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INT

FRAUNHOFER INSTITUTE FOR TECHNOLOGICAL TREND ANALYSIS INT

ANNUAL REPORT 2011

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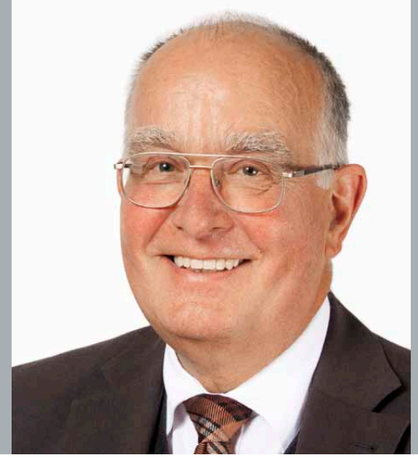

First of all, a personal comment: at the beginning of last year, I said in the Foreword to the report for 2010 that I presumed that this Foreword for 2011 would be written by my successor (I turned 65 in September, 2010). That was wishful thinking, but I think I can be confident that the statement will be correct this time.

But back to the Institute: 2011 was another year in the run of continuous development. The Institute's role in national and international civilian networks was strengthened – as made clearly apparent in the number of cooperation partners – evidence of the continued positive trend. This was reflected in the healthy state of contract research, with continued good growth potential. In terms of international acquisition, INT was successful both as consortium leader and as a partner. It was possible to win EU-level projects across the whole business unit spectrum (EU Security Research Programme, EU Commission, European Space Agency ESA, European Defence Agency EDA, CERN). As well as continually satisfying growth in work not directly connected with security and defense, INT achieved a slight increase in the volume of contract research (outside BMVg) that qualifies for funds under the Federal and State Basic Funding Program. On the one hand this concerned the vulnerability analysis of electronic and optoelectronic systems and components for ionizing radiation and their analysis for industry, and cooperation with CERN on the radiation sensitivity of optical fibers, and on the other hand it concerned support for public and private sector clients in long-term planning and decision-making. In the view of the Fraunhofer-Gesellschaft, the proportion of contracts from industry was also gratifying.

This continuity is crucial for an institution that largely lives on developing and maintaining its ability to assess the planning implications of long-term technology developments for the safety of the state, not only, but primarily in defence and security. Against this background, a short-term perspective in human resources development is dangerous – a topic affecting all publicly-financed research bodies in view of the problem of short-term contracts.

Strategically, the Federal Ministry of Defence BMVg remains of paramount importance for INT. Through its basic funding, BMVg guarantees the continuity of the Institute's work, even if the tight budgetary situation has not failed to have its effect on us as well.

INT support for national civilian protective bodies (including the Federal Ministry of Interior Commission on Civil Protection, the Federal Office for Radiation Protection BfS, the Federal Office of Civil Protection and Disaster Assistance BBK, the Federal Criminal Police Office BKK) again increased, and International cooperation on integrating long-term technological developments in EU and NATO defense planning was also intensified.

The strategic further development of INT's specialist research in nuclear and electromagnetic threats was also positive. There was again an increase in the volume of SME company projects analyzing the suitability of components for use in radiation environments (space). Noteworthy here was the additional € 1.24 m secured under the second Economy Stimulus Package, allocated to procurement in 2010 and available for use in 2011. This considerably widened INT's experiment scope in the major field "the vulnerability of space systems through ionizing radiation".

Implementation of the master plan for adding to INT's building complex – launched in 2008 in cooperation with the Fraunhofer-Gesellschaft's Central Administration and the Federal Ministry of Defence – began with the completion of a new office complex in December 2011. Funds were granted for a larger seminar room and library, and construction is planned for mid-2012. Planning began for a comprehensive reconstruction of the laboratory complex (INT-financed) and we are confident of being able to carry out all construction work in the coming years without interruption. If all goes well, the master plan including the newly-organized laboratory complex will be completed by the end of 2013.

The most important framework development for INT was the restructuring of the Federal Ministry of Defence, begun in 2011 and taking on more concrete shape in 2012. This will especially be felt in the new organization of the armaments sector. It means that Federal Office for Defence Technology and Procurement (BWB), or the new Federal Office of Bundeswehr Materiel, Information Technology and Equipment Management (BAAINBw) will be playing an increasing role in strategic and conceptual R&T planning. The new structures for the Planning Division and the Planning Office will also have a considerable effect on INT. In the coming year, it will thus be a major challenge for us to adapt our offers package on planning support to the new reality.

At this point, I would like to thank the Federal Ministry of Defence personally for their fruitful and friendly cooperation, in spite of the increasingly difficult situation. I also wish to thank all other friends of the Institute, especially the members of the Advisory Board, for their support.

Prof. Dr. Uwe Wiemken

ANNUAL REPORT 2011

BUSINESS UNITS

FRAUNHOFER INT IN PROFILE

The Fraunhofer Institute for Technological Trend Analysis INT creates and continuously updates a comprehensive overview of the general research and technology landscape and of the entire spectrum of national and international technological developments. In addition to this general overview, we generate our own specialized analyses and forecasts in selected technological areas.

For more than 35 years, the institute has advised the German Federal Ministry of Defense on questions of technology and on how to plan and realize new research and technology projects. In recent years, there has been an increase in the volume of research carried out for other public institutions involved in security precautions and long-term changes in society. In addition to this, the INT performs its own experimental and theoretical research on the effects of ionizing and electromagnetic radiation on electronic components and systems.

The Institute is equipped with state-of-the-art measurement technology. The major laboratory and large-scale devices are radiation sources and electromagnetic simulation facilities which cannot be found in this combination in any other civilian institution in Germany. Our main clients include authorities and organizations concerned with security affairs and precautions, as well as aerospace companies and their suppliers.

THE INSTITUTE'S SERVICES ARE STRUCTURED IN FIVE BUSINESS UNITS:

BUSINESS UNIT

TRENDS IN RESEARCH AND TECHNOLOGY

BUSINESS UNIT

PLANNING, PROGRAMS AND STRUCTURES IN RESEARCH AND TECHNOLOGY

BUSINESS UNIT

NUCLEAR SECURITY POLICY AND DETECTION TECHNIQUES

BUSINESS UNIT

ELECTROMAGNETIC EFFECTS AND THREATS

BUSINESS UNIT

NUCLEAR EFFECTS IN ELECTRONICS AND OPTICS

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FRAUNHOFER INT FACTS AND FIGURES

Personal

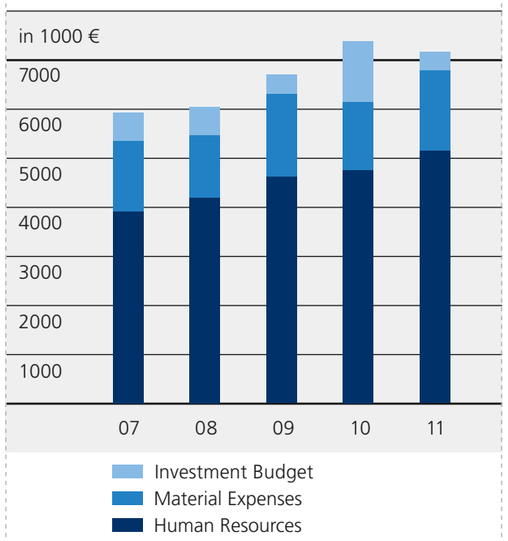
The growth trend seen in recent years continued again in 2011, with INT staff numbers passing the 100 mark for the first time. Following the earlier increases in scientist numbers, 2011 also saw a larger requirement for staff in support functions. This requirement was covered by qualified reinforcements across the board. In addition, INT draws on a network of freelance researchers who are regularly involved in the Institute's work.

Budget

The Fraunhofer-Gesellschaft distinguishes between operating an investment budgets. The operating budget covers staffing and administrative expenditure, the investment budget concerns the procurement of capital goods such as scientific apparatus and the Institute's technical equipment. Owing to the growth in staff numbers, our operating budget was greater than in the previous year. After considerable expenditure in the previous year, financed by the Economic Stimulus Package, the investment budget was wound back again for the year under review. In addition, there was investment in the construction of a new office complex. This is not shown in the Institute budget, but in the central construction budget of the Fraunhofer-Gesellschaft.

To date, approx. 44 % of the budget is financed by external projects. The remainder is covered by basic funding from federal (Bund) and state (Länder) sources. As well as for the public sector, contract work is for various industries, associations and international organizations. Income from EU projects saw a marked increase over the previous year. Our major client in the public sector remains the Federal Ministry of Defence (BMVg), which we have provided with comprehensive advice in research and technology planning for more than 30 years.

Budget from 2007 to 2011



Financial Development from 2007 to 2011

Human Resources

	2009		2010		2011	
	Manned Positions	People	Manned Positions	People	Manned Positions	People
Scientists	42.5	45	44	47	46.3	49
Graduates	15.5	16	15.5	16	16.7	18
Technicians / Others	11.5	14	11.5	14	13	14
Assistants / Trainees	3.9	15	4.2	15	5.5	21
Total	**73.4**	**90**	**75.2**	**92**	**81.5**	**102**

Budget

in 1000 €	2007	2008	2009	2010	2011
Expenses					
Operating Budget	5356.8	5453.6	6297.3	6111.0	6787.0
of which Human Resources	3931.1	4177.8	4606.5	47180	51500
of which Material Expenses	1425.7	1275.8	1690.8	1393.0	1637.0
Investment Budget	560.2	569.2	391.1	1230.0	362.0
Total	**5917.0**	**6022.8**	**6688.4**	**7341.0**	**7149.0**
Funding					
Basic Funding	3881.0	3881.0	4071.0	4047.0	4032.0
Contract Research Projects	2037.0	1951.8	2646.4	3295.0	3117.0

ADVISORY BOARD

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The Institute is advised by an Advisory Board which is composed of people from industry, science, politics and administration.

Chairman:

Prof. Dr. Horst Geschka; Geschka & Partner

Members:

- Herr Manfred Braitinger;
  IABG -Industrieanlagen-Betriebsgesellschaft GmbH
- Prof. Dr. Roland Dierstein; Wehrwissenschaftliches Institut für Schutztechnologien – ABC Schutz
- Prof. Dr. Wolfgang Fahrner; Fernuniversität Hagen
- Dr. Rainer Kroth Diehl; BGT Defence GmbH & Co. KG
- Dr. Walter Kroy; THARSOS
- MinR Rainer Krug; Bundesministerium der Verteidigung (BMVg)
- Dr. Heinz-Josef Kruse; Rheinmetall
- Dr. Stefan Mengel; Bundesministerium für Bildung und Forschung (BMBF)
- Prof. Dr. Eckard Minx; Daimler AG
- Dr. Ulrich Wiese; früher: Fraunhofer Gesellschaft
- Dr. Dr. Axel Zweck; VDI-Technologiezentrum

1 *Adivsory Board meeting on June 15. 2011.*
Representative of the Executive Board:
Dr. Hans-Otto Feldhütter

THE FRAUNHOFER-GESELLSCHAFT

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft. Founded in 1949, the research organization undertakes applied research that drives economic development and serves the wider benefit of society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains more than 80 research units in Germany, including 60 Fraunhofer Institutes. The majority of the more than 20,000 staff are qualified scientists and engineers, who work with an annual research budget of € 1.8 billion. Of this sum, more than € 1.5 billion is generated through contract research. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 percent is contributed by the German federal and Länder governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

Affiliated international research centers and representative offices provide contact with the regions of greatest importance to present and future scientific progress and economic development.

With its clearly defined mission of application-oriented research and its focus on key technologies of relevance to the future, the Fraunhofer-Gesellschaft plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers.

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the professional and personal skills that will allow them to take up positions of responsibility within their institute, at universities, in industry and in society. Students who choose to work on projects at the Fraunhofer Institutes have excellent prospects of starting and developing a career in industry by virtue of the practical training and experience they have acquired.

The Fraunhofer-Gesellschaft is a recognized non-profit organization that takes its name from Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur.

FRAUNHOFER VVS – GROUP FOR DEFENSE AND SECURITY

Fraunhofer Group for Defense and Security VVS

The Fraunhofer Group for Defense and Security (Fraunhofer-Verbund Verteidigungs- und Sicherheitsforschung VVS) is the national organ in defence and security research.

The successful "Future Security" conference was staged in the Office of North Rhine-Westphalia's Representation in Berlin.

Anchoring Security and Defense Research in the Fraunhofer-Gesellschaft Identity

Since its foundation, the Fraunhofer-Gesellschaft has been tied to both the Federal Ministry of Education and Research BMBF and the Federal Ministry of Defence BMVg. Fraunhofer's research service by far provides most of BMVg's institutional research.

Prosperity and growth in our industrial societies depends on globally networked critical structures, the disruption or destruction of which can have incalculable economic and social consequences. Diminishing boundaries between internal and external, between public and private security are placing hitherto unknown challenges before the government institutions responsible for our security. International terrorism, trans-national organized crime and the global effects of local natural disasters and major accidents are examples. To be able to recognize potential dangers in good time, to avoid them where possible and to limit follow-on damage after the event, comprehensive technological security solutions and parallel concepts for methodology, processes and tactics are developed within the VVS Group.

"Future Security" Conference in Office of North Rhine-Westphalia's Representation in Berlin

For the second time, VVS held its annual "Future Security" conference in the Federal Capital in 2011. At the attractive address of North Rhine-Westphalia's Berlin Representation, experts from 20 nations made use of the three-day event to present the latest projects and results in security and defense research. The Conference opened with keynotes from Prof. Jürgen Stock, Vice-President of the Federal Criminal Police Office, and from Dr. Christian Ehler, Member of the European Parliament. Particular attention was given to the realignment of content and structure of civil security research within the new national civilian security research program, as well as to the form of security research within "Horizon 2020", the new European framework program for research and innovation.

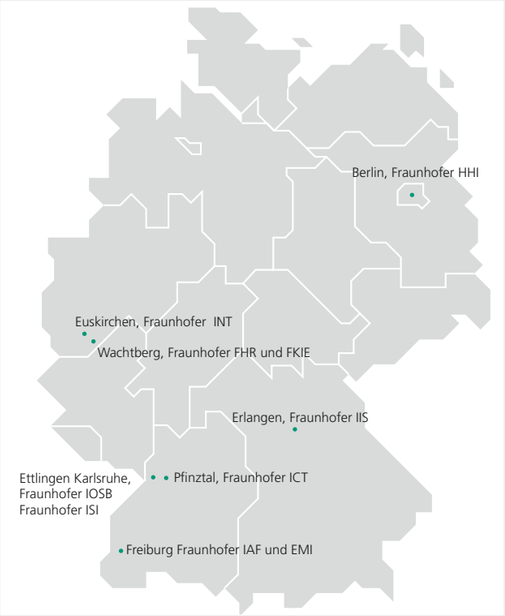
Apart from the technology-oriented sessions, the Conference gave scientists from the Humanities and Social Sciences the opportunity to present research results in Societal Security. These technically-challenging contributions were rounded off by a pleasant social agenda, including an evening event 200 meters above Berlin in the famous TV tower. In 2012, "Future Security" is being staged in the former chamber of the Bundestag, the Federal Parliament, in Bonn.

Prof. Klaus Thoma heads VVS for three more years, Fraunhofer ISI joins the VVS Group

With the office of VVS Group Chairman coming up for election in 2011, the incumbent Professor Klaus Thoma again achieved unanimous support as Chairman for the next three years, his 4th term of office. Professor Jürgen Beyerer, Director of Fraunhofer IOSB, was also unanimously re-elected Vice-Chairman.

During the year, the Fraunhofer Institut für System- und Innovationsforschung ISI joined the ranks of the Group as a guest, strengthening the Group's civilian research spectrum with its expertise.

Fraunhofer VVS overview



- Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI
- Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR
- Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE
- Fraunhofer Institute for Applied Solid State Physics IAF
- Fraunhofer Institute for Chemical Technology ICT
- Fraunhofer Institute for Integrated Circuits IIS
- Fraunhofer Institute for Optronics, System Technologies and Image Exploitation IOSB
- Fraunhofer Institute for Technological Trend Analysis INT
- Fraunhofer Institute for Systems and Innovation Research ISI
- Fraunhofer Institute for Telecommunications HHI

BUSINESS UNIT “TRENDS IN RESEARCH AND TECHNOLOGY”

Dr. Matthias Grüne

In this Business Unit, Fraunhofer INT offers the achievements and results of its research into the future of technology, thus providing planners and decision-makers with a future-oriented approach in an ever more complex environment. Work in the Unit focuses primarily on the substantive discussion of research and technology issues, and on creating a dialog platform for scientists on the one hand and clients (technology planners) on the other. The services are provided by the Department Technology Analysis and Foresight – TAV. This consists of scientists and engineers with comprehensive specialist expertise, which is in turn augmented by all-round expertise in methodology and processing. Using our own specialist insights when analyzing technological subjects – something rare in futures research – allows us high-grade forecasting for both the whole picture and the analysis of single developments. Our internal peer-review process serves to ensure this.

The growth and differentiation of the Business Unit in recent years made structural professionalization urgently necessary. The response in 2011 was to set up coordinators for the markets Corporate Foresight, Public Foresight and Defense Foresight. Unit staff was again increased, especially in the high-demand area of materials expertise, but also for programming our own software tools for bibliometrics.

After setting up and implementing the concept in 2010, the year under review saw the first regular operation of the new “Wehrtechnische Vorausschau” (Defense Technologies Forecast – WTV), which Fraunhofer INT produces to support planning in the Federal Ministry of Defense (BMVg, see following article). In addition, a procedure was developed and implemented for analyzing long-term system concepts. The first results of this were published in the 4th quarterly number. The response from the users was large and gratifying, confirming the accuracy and usefulness of the path chosen.

The “Netzwerk Zukunftsforschung e. V.”, a German-language association of science-based futures researchers, voted a Unit staff member on to its steering committee in 2011. Fraunhofer INT’s views on futures research have been built into various higher education and training courses. Our own methodological expertise was used to advise e.g. the Federal Ministry of Education and Research (BMBF) and the Bundeswehr Transformation Center (ZTransfBw). Several contributions to seminars in industry were concerned with the importance of science-based futures research for technology and innovation management.

Security research is also important for the Business Unit. In this context, a monitoring project for the Federal Ministry of Defense was concluded, technology foresight projects were launched for the Federal Criminal Police Office (BKA) and the European Commission, and our own invention of a population warning system was introduced in a demonstration to the public, together with numerous media reports.

Work in the Business Unit subdivides into the following four fields:

Technology Foresight: Overview of Future Themes

Technology Foresight serves to create the most comprehensive overview of future scientific and technological progress and its application potential. This calls for the continuous assessment of all relevant sources (scientific papers, conferences, etc.). The most important result of this work is the so-called “core topics”, highly dynamic research and high-tech development themes that show great application potential. These themes provide the basis for further investigation. Results from technology foresight are usually published, e.g. in the form of the monthly INT column “Neue Technologien” (New Technologies) in the professional journal “Strategie und Technik” (Strategy and Technology). As of 2012, this will be the journal “Europäische Sicherheit & Technik” (European Security & Technology).

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THE DEFENSE TECHNOLOGIES FORECAST 2011+ (WTV 2011+)

Dr. Ulrik Neupert, Dr. Matthias Grüne

Advancement in Methodological Tools

The critical examination of one's own methodological basis and its further development is a self-evident part of the work of a scientific institute. In 2011, the spotlight was again on our own bibliometric processes and tools, which were formed into a practical toolbox that constantly undergoes improvement. Together with the Business Unit Planning, Programs and Structures in R&T, work began on a technology roadmap on "Intelligente mobile Systeme für SAR-Aufgaben in geschlossenen Räumen" (Intelligent Mobile Systems for Search-and-Rescue Tasks in Confined Spaces) that should also lead to further developments in this methodology. Within the framework of NATO RTO, Fraunhofer INT took part in the development of a new methodology for assessing the military relevance of new technologies (Disruptive Technology Assessment Game). This work was concluded in 2011 and is to be professionalized later.

In-depth Technology Analyses

In Technology Analyses, a series of technological questions undergoes long-term, in-depth examination with regard to their future potential and/or defense relevance. The focus is currently on materials, energy technologies, unmanned systems/robotics, information and communications technology, biological technologies/life science and optical technologies. The results are in part made available to the Ministry of Defense and its subordinate agencies through the new series "Analysen und Expertisen zur Technologievorausschau" (Analyses and Expertises in Technology Foresight) supplementing a series edited since 1991. In 2011, ten in-depth studies were thus issued.

The Unit's comprehensive, in-depth competence in all material types illustrates its unique selling position regarding materials. This competence is regularly documented in our own series "Werkstofftrends" (Materials Trends) in the specialist journal "Werkstoffe in der Fertigung" (Materials in the Production Process), as well as in presentations at materials conferences. A large proportion of the industrial projects was acquired in this area of competence.

Analysis of Future Defense Technology – the Technology Radar for the Federal Ministry of Defense

The task of Future Defense Technology Analysis is to assess and describe the (especially long-term) relevance of future technology progress for the Federal Armed Forces (Bundeswehr) in the light of foreseeable threats and the capabilities required. The main result is the document "Wehrtechnische Vorausschau – WTV" (Defense Technologies Forecast). Participation in various committees dealing with international cooperation on defense-related expectations for the future serves the constant improvement and updating of defense technology assessment criteria. Results from the Future Defense Technology Analysis are also taken into account in the technology evaluation process of the Round Table of institutions funded by the Federal Ministry of Defense.

For the years 2011–2013, Fraunhofer INT was given the task of producing a study on the "Post-Fossil Bundeswehr", for which this Business Unit is acting as the coordinator. The in-depth expertise in energy technology and the outcomes of the Defense Technologies Forecast serve as a valuable basis for the design of the workshop-based discussion (see separate article). The Defense Technologies Forecast was also the basis on which the Unit was given the task of technology analyses for "Teknisk Prognos", an organ of the Swedish defense procurement office (FMV). Overall, these orders meant that for this Business Unit, the market segment of Defense Foresight has the largest share of contract research.

1 *Dr. Matthias Grüne*

In its 40-year history, the "Defense Technologies Forecast" (Wehrtechnische Vorausschau – WTV) has experienced several transformations in consequence of condition changes. Since the end of the Cold War, it has had the character of a planning support document with the task of presenting an unbiased explorative picture of the situation and of foreseeable technological trends. In the broadest sense, its addressees have been planners in defense technology, as well as in military and security politics. When published in 2005–2007 the WTV had grown to a four-volume edition. Additions came in the form of in-depth analyses and expert reports that were published on an irregular basis. Purely explorative and impartial, this WTV considered all areas important to defense technology, as well as fields with potential defense technology relevance. The advantage of this approach was the comprehensive overview. However, since the prognosis component was not particularly marked, direct planning decisions could not be derived from such a round-up.

As a result of the changed situation, the Forecast has meanwhile seen further development. Increasing military tasks are facing ever smaller budgets, which results in the need to prioritize all research and procurement projects. The effect is a need for faster, more direct and more detailed planning support, which has to be brought closer to the daily needs of the decision-makers. At the end of the last decade, the WTV brief was therefore changed. The main task is no longer a lexical overview, but rather the identification, analysis, forecast and evaluation of individual outstanding technology topics of potential relevance for defense. The concept is greater emphasis on the prognosis aspect, with forecasting reaching as far into the future as reasonably feasible for each topic.

The new "WTV 2011+" is compiled under the leadership of INT Business Unit 1 "Trends in Research and Technology". It has been published quarterly in CD format since the beginning of 2011, which allows timely access to the state of the art. It is classified "restricted" and is only available to official users.

Analysis of Individual Core Issues

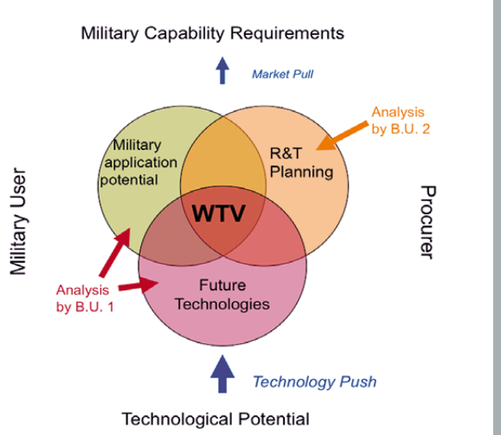
The new WTV discusses individual technology issues for which considerable research dynamics, a significant defense-related role and/or acute planning and consulting needs have been identified. For each technology under review, analysis takes account of the defense-technological applicability, threat potential and the planning situation. What is explicitly required now is a course of action to be recommended to the addressees in defense research planning (procurer) and capability analysis (user). This recommended course of action is not coordinated with or between government departments and other stakeholders; it should rather reflect the unbiased opinion of Fraunhofer INT. Nevertheless, the Defense Ministry view is taken into account, i. e. known ministry structures, processes and targets are also considered. It follows that an analysis of the national and international defense technology planning landscape is now essential (see Fig. 1), which is why the Business Unit 2 „Planning, Programs and Structures in Research and Technology" is also involved in the process.

In the first three quarterly editions of a year, three technology fields at a time are examined using this bottom-up approach. In spite of focusing on particularly dynamic topics, the use of a wide topic spread is intended to generate a (cumulative) overall picture within just a few years. A comparison with a WTV taxonomy serves to ensure this.

Analysis of Long-Term System Concepts

Once a year, the Defense Technologies Forecast is supplemented by a top-down approach starting at the systems level. In this, the fourth quarterly edition, the technical feasibility of visionary long-term system concepts is analyzed using a time horizon of 30 years.

The first step for a topic is researching visionary long-term system concepts (e. g. a "Future Combat Ship") in defense



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TECHNOLOGICAL IMPLICATIONS FOR A "POST-FOSSIL BUNDESWEHR"

Dipl.-Phys. Jürgen Kohlhoff

technological literature such as that published by (often American) military-academic institutions. The first analysis identifies technologies relevant to the achieving of the future concepts. A second analysis studies the technologies with regard to their applicability or maturity at a presumed point of time in the future (e. g. 2040). As with the bottom-up approach described above, what happens is an analysis of the technical state of the art and of developments observed, together with a subsequent prognosis.

This is followed by a synthesis of the single forecasts, from whose summary the technological feasibility of the system concepts under review can be derived. The result is a picture of the future showing the most probable characteristics that can be expected of the system under review at a given time. Additionally, there is a description of the effects on military equipment as a whole, on system applications, military capabilities and operational options, as well as on possible new threats.

With the time horizon selected here and the cross-technology character of the analysis, a recommended course of action for the defense technological and military planners is not a useful option. The picture of the future thus described – at the level of prerequisites for technological feasibility – can nonetheless present a reliable basis for setting a long-term goal.

Conclusion

The production of the new Defense Technologies Forecast, with all the steps that serve quality assurance (specialist conferences, technology comparison workshops, conferences on recommendations, final editing on a "ten eyes" principle), has proved to be a very complex project. It has been achieved in spite of a very ambitious time schedule and publication deadline.

Within a year, the new Defense Technologies Forecast has established itself as an impartial technology radar for the Ministry of Defense that focuses on the long-term and on the needs of the user. Confirmation for this comes especially from users in the military.

1 *Analysis Scope of the Defense Technologies Forecast 2011+ (WTV 2011+). Driving forces are the development of technological options and the military capability requirements. In this context, future technologies, their defense application potential and the related research and technology planning are examined and evaluated. From the overall picture, recommended courses of action are derived that ideally give equal attention to the needs of both procurer and user.*

Together with international environment legislation aimed at combating the climate change, the increased cost and scarcity of fossil energy sources will lead to drastic changes in society's mobility and general energy supply. These changes will also affect the Armed Forces, but individual technological implications for the Bundeswehr are complex, and they cannot be predicted off the cuff. Accessing the necessary knowledge and deducing from it the right recommendations for the Armaments Directorate in the Federal Ministry of Defence are the target for a joint activity of INT's departments for Technology Analysis and Foresight (TAV) and Meta-Analyses and Planning Support (AP), which took up work in 2011.

The project's method basis is conducting workshops calling on external experts, as well as from the Armaments Directorate sector. The first workshop, held in September 2011, examined the subject in its entirety, placing the focus on civilian research in the field. In January 2012, a further event looked into the strategies and perspectives of civilian industry. After examining the situation thus far, the project will go on to place the emphasis on the actual needs of the Bundeswehr. Planned for 2013 are a comprehensive study, deriving recommended action, and supporting implementation.

The workshop in September 2011 was titled "Future Energy Sources and Drive Concepts from the Research Perspective". Participation was of the highest calibre (as was the case for the second event in 2012), regarding both presenters and attendees from the Armaments Directorate. Results-oriented and staged by INT's own specialists, the workshop has already undergone an initial evaluation. A major part of INT's work was also selecting the subjects for consideration and finding and securing competent presenters.

The workshop went beyond just looking at aspects of an actually "post-fossil" Bundeswehr; it looked also at the way towards such a Bundeswehr. Subjects under consideration were:

- Energy concepts (energy markets) of the future
- Energy efficiency technologies
- Regenerative power supply
- Electrochemical energy storage/batteries
- Electrochemical converters/fuel cells
- Alternative fuels
- Drives land/air/sea
- Field supplies
- Micro energy generation/mobile power supply

The event served as an introduction to this highly-complex field and produced an initial situation report. In the end, the question is what the Bundeswehr needs to do in R&T today, in order to be able to use technologies required in the mid and long term, but which cannot simply be "bought". After the first workshop, this question still needs answers.

A final, comprehensive opinion on the subject will only be possible and meaningful upon the project's completion. At first sight, it appears that "fuel cells", "batteries" and "alternative fuels" will be important for the future of the Bundeswehr. New energy supply concepts are being pragmatically put to use wherever economical or (for example because of legal prescription) where there is no alternative. In future, energy-saving will be of great importance for the Bundeswehr, for logistics reasons alone in the case of out-of-area missions.

HIGH-ENERGY LASER WEAPONS

Dr. David Offenberg

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Since the foundation of the Fraunhofer INT in the 1970s, the assessment and prognosis of the potential of laser weapons (at that time a rather visionary idea) has been an important subject. Monitoring their technological progress, these analyses have been updated continuously. Meanwhile, with the significant advances in the development of solid-state lasers, a new technical design of high-energy laser weapons has become feasible, which gave rise to a new investigation of this topic in the reporting year 2011.

High-energy laser weapons work by using the energy of the laser beam to damage or destroy targeted objects. The main objective of decades of research and development is laser weapon systems for defence against rockets, artillery and mortars (Counter-RAM), ballistic missiles, or unmanned aerial vehicles (Counter-UAV). Such systems could be deployed, for example, for base protection or ship self-defence (see Fig. 1). Especially in these application areas, laser weapons offer unique capability advantages compared to conventional air defence systems. Their fast optical pointing and tracking systems, for example, allow extremely precise, highly agile and rapid targeting. Unlike conventional weapon systems that must be resupplied with ammunition, laser weapons based on modern solid-state lasers only need electricity to be powered. Therefore, such systems come with “deep magazines” and the costs per shot are comparatively low.

The main problem of laser weapon development has always been the construction of a laser source with a high output power, in order to destroy targets in the shortest dwell time possible. In the 1980s it was possible for the first time to produce a continuous power output of more than one megawatt using chemical lasers. However, this type of laser has the major logistical disadvantage that it depends on a permanent supply with very specific fuels. Today, chemical lasers have been almost entirely replaced by electrically powered solid-state lasers, whose development has been intensified in the last few years.

In solid-state lasers the laser light is generated in gain media made from crystals or glasses, which are excited with a suitable light source. Current solid-state lasers achieve electro-optical efficiencies of up to 30 %. This means that about one third of the electrical supply power is converted to laser light, whereas the residual two thirds are released as heat. In order to prevent damage to the gain medium, this waste heat needs to be dissipated. Due to the high power needed for weapon use, this cooling is the core problem in the development of high-energy solid-state lasers. Today, different cooling concepts are pursued, using gain media shaped as thin disks, flat slabs, or fibers. Currently it is not possible to predict which of these concepts will be used in future weapon lasers. The most powerful solid-state laser so far emits a continuous power of slightly more than 100 kW by combining the beams of several slab laser modules to a single output beam.

Beam combining techniques are important for almost all current solid-state laser weapons under development, and essential for all future systems with output powers above 100 kW. This is due to the fact that the output power of a single gain medium is limited, in part by the technical constraints of waste heat removal. Therefore, the use of ceramic gain media is increasingly spreading, since they allow more efficient cooling due to their high heat conductivity. Another subject of current research and development is adaptive optics used to correct thermal perturbations of the laser beam profile inside the laser source. With adaptive optics, the full capacity of the gain medium can be exploited, leading to higher output powers.

There is a number of additional technical challenges to be solved in the development of high-energy laser weapon systems, before they are ready for operational use. Systems for target detection and tracking, as well as systems for beam shaping and guidance are very complex components, which require thorough and optimal integration. Especially for a deployment on mobile platforms, such as combat vehicles or fighter jets, compact and powerful energy supplies need to be developed. Essential for a permanent operational capability of laser weapons, beyond test mode periods, is the development of durable optical coatings that can resist the high laser intensities and the harsh environmental conditions, e.g. during marine deployment. In general, the transformation of a laboratory system into a fieldable device can be more difficult than expected.

Most of the technical problems will be solved in the foreseeable future, and first laser weapon systems based on high-energy solid-state lasers will be routinely deployed in ten years at the latest. However, besides the advantageous capabilities of laser weapons, there are several special characteristics that limit their military application. For example, laser weapons need a certain dwell time from a few seconds up to a minute, until the targeted object is destroyed or sufficiently damaged by the laser irradiation. This can be a problem with fast approaching targets and in cases in which a direct line-of-sight cannot be maintained for long enough. Furthermore, the required dwell time can be prolonged to some extent by comparatively simple measures, so that an approaching target may not be destroyed in due time. These countermeasures include an intentional rotation of rockets and mortar rounds, reflective coatings on the targets and more stable and less vulnerable structures.

However, the most significant down side of laser weapons is their weather-dependent deployability. Laser weapons are no all-weather weapons. The laser light is scattered and absorbed by rain, snow, fog, clouds and dust, reducing the range of laser weapons, and therefore limiting or even preventing their use. For reliable protection, even under adverse weather conditions, a laser weapon can never be operated alone, but always needs a conventional weapon as a backup.

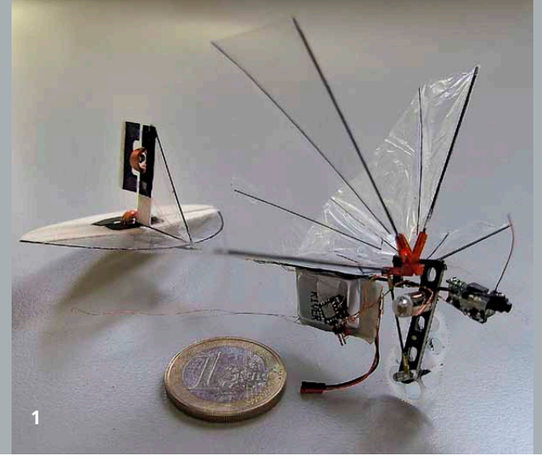
In the past few years, research and development activities mainly in the USA, but also in Germany (see Fig. 2) brought out high-energy laser weapon systems whose operational potential has been successfully demonstrated even under realistic conditions. However, any critical assessment of high-energy laser weapons will reveal their specific limitations and disadvantages. These principle problems always have to be considered in decisions on the future deployment of laser weapon systems.

1 *Illustration of the Laser Weapon System LaWS. Raytheon and the US Navy are developing a solid-state laser weapon based on the Phalanx Close-in Weapon System to defeat aerial targets. Source: Raytheon*

2 *Laser weapon demonstrator by Rheinmetall Defence. In autumn 2011, the operational capabilities of the 10 kW laser weapon were demonstrated destroying an unmanned aerial vehicle in flight and mortar rounds. Source: Rheinmetall Defence*

NANO AIR VEHICLES

Dr.-Ing. Guido Huppertz



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Thanks to repeated press reports on the military use of unmanned aircraft, or drones, the public is used to pictures of aircraft ranging in size from sports planes to 200-seater passenger jets. At the bottom end of the size scale, the development of a new category of miniaturized aircraft has been going on more or less unnoticed. Compared with aircraft already existing, this new miniature technology shows significant differences. For the German Federal Ministry of Defence (BMVg), INT's Business Unit "Trends and Developments in Research and Technology" is monitoring and documenting developments, in this case the development of "Nano Air Vehicles" or "NAVs" for short.

What are NAVs?

So far, there is no standard definition for "Nano Air Vehicles". Generally speaking, they are aircraft with a maximum wingspan of 15 cm, weighing less than 20 grams. Development is still in its infancy; there are currently only a few NAV prototypes worldwide.

The challenge is that NAVs as small as songbirds, hummingbirds or large insects can hardly be realized using classical aero-technology. Because of scaling effects through miniaturization, air resistance increases disproportionately. Solely because of their size, NAVs are aerodynamically inefficient according to current standards. Their low mass causes very low intrinsic stability, so that they are extremely sensitive to external disturbances such as wind gusts. The efficiency of miniaturized engines drops, which in combination with decreasing volume for energy storage, means a drastic reduction in range. These adverse scaling effects have caused a paradigm shift in the development of flight systems: for the first time, flapping-wing platforms are being studied intensively. This means a departure from the principle, valid for a century, which says that aerodynamic lift is generated by a bound vortex that has to be constantly maintained on the wing or rotor throughout the flight. In comparison, up and down wing strokes create a constantly changing or unsteady flow field, which is itself in part the subject of basic university research.

The effort of following a completely new path is worth it if one considers what flight performance is in principle possible with flapping wings. Over millions of years, insects and songbirds have developed flight capabilities that are way beyond the reach of technical systems to date. Flies, for example, can perform complex body turns along complex trajectories within just a few wing beats. And, in relation to body length, hummingbirds are by far the fastest creatures on Earth – measured against aircraft length, much faster than jet fighters or a space shuttle re-entering the Earth's atmosphere. And one litre of fuel (nectar) is all they need to circumnavigate our planet several times. Scientific experiments have shown in recent years that at NAV dimensions, even with technical systems the aerodynamic and energy performance of flapping wings can be more efficient than that of aircraft with conventional fixed wings.

Achieving flight with flapping wings is nonetheless a challenge. In flapping wing flight, lift is largely generated by unsteady or flapping-wing specific effects, for which customary calculation procedures are unsuited. Exactly how insects or birds generate these effects and what uses they get from them has only been understood for a few years. There are still unanswered questions, however. In the case of insects, for example, lift largely depends on the stabilization of the Leading Edge Vortex (LEV). Recent findings show that this LEV stabilization depends on the rotary motion of the wing at the shoulder joint, the wing's aspect ratio and a characteristic number of the flight (the Reynolds number). A number of criteria for the construction of a NAV wing is thus known, but what remains is the difficulty of constructing such a flapping wing mechanism that takes account of size, weight and the required number of degrees of freedom, and that technically implements the kinematics of, for example, an insect wing. Current prototypes normally have simplified actuating, with just one degree of freedom of wing movement. However, at least two degrees of freedom are needed to achieve both the transition from hovering to forward flight, and trajectory control. Otherwise, the NAV has to be fitted with extra control surfaces, which negatively affects weight and flight performance.

Where can NAVs be used?

The motive for taking up the technical challenge of developing flapping wing platforms arises from the new and varied applications that NAVs could make possible. For the first time, they would allow use in confined spaces such as buildings, alleys or caves, for the purpose of situation awareness, hazard detection or searching for buried persons. The police could use them for criminal surveillance or to search buildings unobtrusively in hostage cases. Also possible could be inspecting construction sites with difficult access, or new concepts for major entertainment events. And apart from the application possibilities, the biggest argument for the soldier in action is that NAVs will be so small and light that they can be tucked away in a small pocket.

The use of NAVs in buildings calls for special requirements, however. Since walls reduce signal strength, remote control by the operator will not be possible on its own. The systems will therefore need to be able to control their flight and carry out the mission independently. Intended to navigate in confined, three-dimensional spaces, the platform needs to be able to hover, with real-time flight control. To capture the environment, an optical sensor is required, as this is the only way to avoid collisions. Inertial sensors can also provide data, especially for navigation. As with an insect's eye, data from the optical sensor – for example through analyzing the optical flow – can provide information on attitude, height above ground, approaching obstacles, and more. In addition, photo or video material is required for most missions.

There are currently flyable prototypes of the size of a hummingbird. However, several years will pass before they reach operational readiness, or before even insect-size aircraft can carry out missions independently.

1 *Project DelFly micro of the University Delft.*
Source: MAV-lab Team, TU Delft, Netherlands

BUSINESS UNIT “PLANNING, PROGRAMS AND STRUCTURES IN RESEARCH AND TECHNOLOGY”

Dr. Joachim Schulze

This Business Unit is specialized on planning, monitoring and evaluating research programs, and also manages and conducts major research projects. Highly important for this task is our comprehensive knowledge of the research landscape, and an excellent network.

Work is done by a team of scientists from a variety of disciplines, including biology, biotechnology, chemistry, geophysics, history, computer science, mathematics, pharmacy, physics, economics and business informatics.

In the year under review, there were new developments in instruments for planning support and the method spectrum was expanded. With the help of various partners, different forms of good practice were evaluated. The methods used include comparative analyses, qualified expert interviews, scenarios, technology roadmaps, text mining, Delphi, bibliometrics and wikis. Existing methods of early innovation management (like new creativity methods, open innovation and weighted assessment methods) for strategic research planning are currently being examined for our methods portfolio. The websites on text mining and European Security Research, and the individual research project websites show high visitor numbers.

With these methods and many years of experience, we provide support for planning and research for Federal Ministries (Defence, Education and Research, Environment, Interior, External Affairs, Economics), public offices (Federal Office for Defence Technology and Procurement – BWB, Federal Office of Civil Protection and Disaster Assistance – BBK), research institutes (Robert Koch Institut), national organizations (the Commission on Civil Protection of the Federal Ministry of the Interior) and international organizations (EU Commission, European Organization for Security, European Defence Agency – EDA, Comprehensive Test Ban Treaty Organization – CTBTO, NATO), as well as for industry. Assisting the Federal Ministry of Defence is a major factor, directly supporting research planning by participating in the planning process and in committees (F&T Advisory Board, departmental research). We contribute to the Defence Technologies Forecast – WTV, which is produced under the Technology Analysis and Foresight Department – TAV, as well as to the project “Post-Fossil Bundeswehr”. Our Business Unit supports and coordinates the content of the Defence Ministry’s annual report on defence science research.

In security research (FP 7), we are consortium leaders for two large projects (ACRIMAS and ETCETERA, see pages 29 to 31). The different facets of scientific management and problem-solving at administration level call for great versatility on the part of the scientists concerned. Meeting deadlines is very important in the European theater, since the principle of equal opportunities does not allow the EU Commission to make exceptions or permit postponements. We are consortium partners in a further nine EU projects.

A working group is supporting the Federal Government in the scientific/technical assessment of measures in nuclear security and disarmament. This group is cooperating with Department NE.

Part of the work is organizing and managing the science agendas of conferences, symposia and workshops. A lot of foundation work is needed to attract the top people in a science field and take an event to a successful outcome. An attractive scientific program is essential, as is error-free organization and follow-up assessment. So far, all events have resulted in a call for continuation. A particular highlight was the European Defence Conference (EDC, see also page 32), held in Warsaw, which drew the attention and interest of several international organizations (EDA, NATO, European Organisation for Security – EOS).

A major prerequisite for work in this Business Unit is Europe-wide networking and participation in various committees (Commission on Civil Protection of the Federal Ministry of the Interior, Ad Hoc Group on the Hazard of Biological Substances, EU Security Advisory Group, Scientific Committee of CTBTO Science & Technology Conference, National Experts of CTBTO,

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Eurotech Security Research Group, EOS, Aviation Security Working Group, Nuclear Proliferation Working Group of the German Institute for International and Security Affairs – SWP).

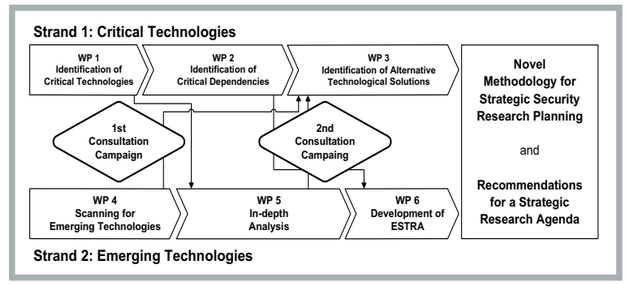
Following the aim of staying abreast with specialist work within the team's various fields, a bit map system for assessing the hazard of chemical weapons and toxic industrial chemicals has been developed several years ago. In addition, the first stage of a bit map system for the hazard of biological substances is also complete, and in the field of biology, a databank structure for biological substances has been developed. Also, a scenario study on "The Effects of an Influenza Pandemic" is currently being produced.

1 *Dr. Joachim Schulze*

ETCETERA – CRITICAL AND EMERGING TECHNOLOGIES WITH SECURITY IMPLICATIONS

Dr. Joachim Burbiel, Stefanie Goymann, Dr. Ruth Schietke

"Evaluation of critical and emerging technologies for the elaboration of a security research agenda" (ETCETERA) is the name of a collaborative project within the security theme of the 7th Framework Programme. It started on October 1, 2011 and will end in September 2013. The project volume is approx. two million euros.



This international project, coordinated by Fraunhofer INT, brings together 14 partners from seven European nations: Germany (Fraunhofer INT/ISI, UDE, Comsec, VDI TZ), Schweden (FOI, SSFB), Spain (Tecnalia, ISDEFE), Austria (AIT), France (CEA, Morpho), the Netherlands (TNO), and Italy (Ansaldo STS, CSSC),

ETCETERA's aim is threefold:

- to develop novel methodologies for future strategic research planning,
- to identify risks and potential benefits associated with Critical Dependencies and Emerging Technologies with security implications,

and

- to recommend research plans to deal with these risks and potential benefits.

The ETCETERA project deals with the issues "Critical Technologies" and "Emerging Technologies" in two separate but interrelated research strands. Each strand is further divided into three work packages that will be carried through in a sequential manner. A further work package deals with project management. Two Consultation Campaigns will generate input from technical experts, end-users, and public authorities for both strands.

In 2011 work started in the three work packages "Identification of Critical Technologies" (WP 1), "Scanning for Emerging Technologies" (WP 4), and "Project Management" (WP 7).

WP 1 started with the identification of all technologies indispensible for European security now and in the near future, through extensive consultations within the consortium and with external experts. The list thus obtained will be validated through a feedback mechanism.

In WP 4 Emerging Technologies are being scanned for their security implications in 10 to 20 years time. Three scanning methods will be performed in parallel. A comparative analysis of the results of these three methods will then be performed, leading to the explorative task of developing a novel method for this kind of technology scanning.

Fraunhofer INT as coordinator is managing the project and playing a major part in the consultation campaign. We are contributing with the Weighted Bit Assessment Method to the first strand. In the second strand, Fraunhofer INT is leading all Work Packages, scanning Emerging Technologies and providing in depth-analyses. At the end of the project the overall conclusions and recommendations will be developed. Scientists of Business Units 1 and 2 are contributing to the project, with Business Unit 2 acting as the coordinator.

Further information at:
www.etcetera-project.eu

FP7 PROJECT ACRIMAS: AFTERMATH CRISIS MANAGEMENT SYSTEM-OF-SYSTEMS DEMONSTRATION, PHASE I

Dr. Merle Missoweit, Dipl.-Volksw. Hans-Martin Pastuszka

Since February 2011, the Department for Meta-Analysis and Planning Support has coordinated the FP7 project ACRIMAS, a 15-month Support Action with 15 partners from 10 European countries. As Phase I, ACRIMAS is developing a roadmap for an upcoming Demonstration Project (Phase II) within Crisis Management, that is part of the 6th call of the European Commission's European Framework Programme dealing with Security Work themes.

The project's roadmap will elaborate a systematic development process for Crisis Management systems, procedures and technologies in Europe, to be implemented within the Demonstration Project.

The process aims at the gradual evolvement of CM capabilities through demonstration and experimentation (Concept Development & Experimentation, CD&E approach), the transfer of related knowledge between stakeholders, and by promoting an environment for co-developing Crisis Management technology and methodology where users, providers and researchers work together.

ACRIMAS further emphasizes community-building, which will be supported considerably by the execution of Phase II, bringing together the key stakeholders and the available demonstration infrastructures in case-by-case demonstration or experimentation activities.

ACRIMAS work approach

Large-scale incidents (manmade and natural) inside and outside the EU require a coordinated response from crisis managers and first responders across Europe, with resources from all levels of government. Currently, Crisis Management in the EU can be regarded as a highly diversified "system-of-systems" integrating organisations and components with different cultures, policies and assets, and various stakeholders and procurement schemes.

To identify the current critical CM system-of-systems topics which need to be addressed by the Phase II demonstration programme, ACRIMAS follows a scenario-based and user-centric work approach.

ACRIMAS is scenario-based in the sense that it identifies, selects and develops characteristic CM scenarios to constitute a sound basis for ensuring the work of posing user needs and requirements, recognizing current CM gaps and weaknesses in Europe, looking at potential solutions and documenting corresponding demonstration topics and R&D needs for integration in a roadmap for Phase II. The scenario approach embraces an all-hazard view, including the EU external dimension in terms of humanitarian operations.

ACRIMAS is user-driven in the sense that users and other stakeholders such as first responders, authorities and government bodies as well as the supply side, are actively involved throughout the project process, some of them as full partners, most of them linked to the project through a supporting Expert Group and project workshops. The users play a central role in complementing and validating the scenario analysis by expressing their needs regarding both the identification of relevant CM topics which should be addressed by CD&E activities in Phase II, and the demonstration concept to be elaborated. ACRIMAS will prepare a roadmap setting out the main areas and relevant topics of Crisis Management to be addressed by Phase II. In addition, ACRIMAS will deliver a demonstration concept for Phase II, describing how and where the CD&E activities in Phase II should be conducted.

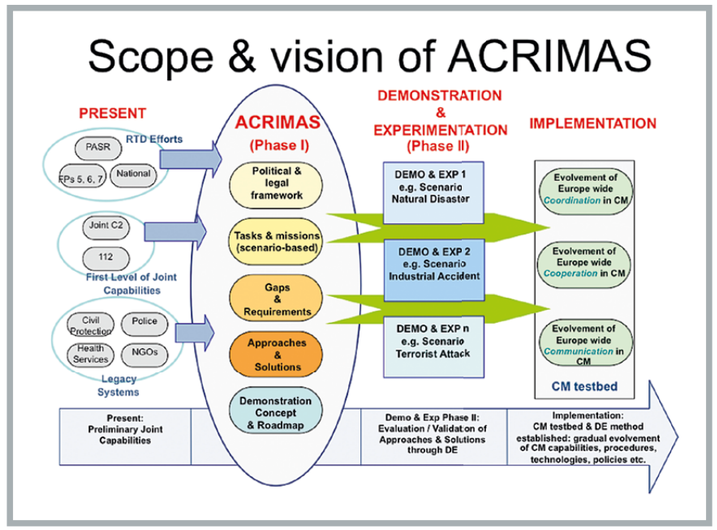
ACRIMAS results

An analysis of the improvement needs in EU CM was conducted on the basis of a comprehensive analysis and description of the organizational and legal aspects of the EU internal and external CM system and on the elaboration of a range of hazard scenarios following an all-hazard approach.

After extensive consultation (workshops, questionnaires and interviews) with 150 crisis management experts, 120 of whom with an operational background, ACRIMAS has currently identified 26 improvement needs for an EU CM system where development is important and where research, development and demonstration activities could provide benefit.

The next step for ACRIMAS will be to conduct comprehensive screening of the national, European and global R&D landscape in order to identify technological and conceptual solutions for the needs to be addressed. In order to differentiate between solutions ready for demonstration within the proposed CD&E approach in Phase II and solutions that need further R&D within the next European Framework Programme (Horizon 2020), an assessment of the maturity or technological readiness level of the solutions available will be conducted.

During the final phase of ACRIMAS, these results will be incorporated into the demonstration roadmap providing different demonstration strands that cluster the improvement needs and available solutions in an appropriate way and a proposal for the required demonstration infrastructure.



SCENARIO-ORIENTED ASSESSMENT OF HAZARDOUS BIOLOGICAL AGENTS

Dr. Britta Pinzger, Dr. Ruth Schietke, Dr. Silke Römer

The aim of this study was to test the feasibility of a system that will enable easy, yet sound, communication between people of different background on the topic of dangers and risks associated with the liberation of potentially hazardous biological agents.

The starting point for research conducted in this project was to find out if and to what extent new insights on biological hazardous agents could be gained through a scenario-oriented assessment tool, and whether this approach can help to improve civil protection and disaster management.

The study scenarios are focussed on the intentional and unintentional liberation of an agent and its primary effect. For practical reasons, this deliberately excluded aspects of agent acquisition (in case of an intentional release) taking place prior to the release of an agent, as well as secondary effects such as epidemiological and socio-economic aspects. Nevertheless, the tool developed allows the later inclusion of such factors.

Sample agents were chosen to fulfil the following criteria:

- One toxin, one bacterium, one virus should be included
- At least one agent should include human to human spreading
- Data for the sample agents should be available
- The agents should generally be considered to represent a hazard

This led to the choice of three sample agents, data for which was provided by the Robert Koch Institute.

Scenarios were chosen to cover as many different extremes of the following aspects:

- Closed/open space
- Overall number of persons present
- Fluctuation of persons during short time periods
- Point in time
- Circumstances (private/business, every-day/special event; possible symbolic value, political denotation)
- Propagation pathway for the liberation of the biological agent

Based on these deliberations, three initial scenarios were chosen, refined and generically described (large-scale catering establishment/canteen kitchen & propagation via food; metro station & airborne propagation, open air event & propagation via air and/or food). The workshop focus was on the first two scenarios, and prospective divergences from the third were considered. The characteristics of the sample agents were also reviewed.

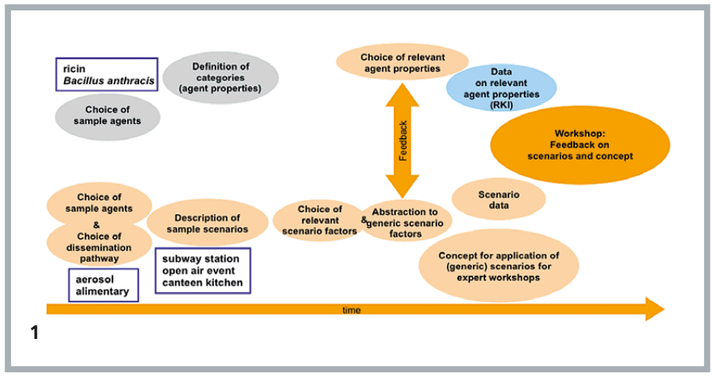
Following detailed elaboration, subsequent abstraction, and clustering of the influencing factors, various similarities and overlaps were observed. The result opens the possibility to create a toolbox of factors of influence. After comprehensively collecting such influencing factors, it would be possible to choose and combine the appropriate factors for each specific scenario. With the assistance of this toolbox, the time needed to create a new scenario could be reduced considerably.

Moreover, such a toolbox-system could provide a common basis for discussion for all experts in civil protection and crisis management. This would easily enhance communication as well as the exchange of information. Thus, deficiencies could be identified faster and strategic planning of procurement and necessary research could be improved.

Parts of the toolbox of influencing factors could also be integrated and deployed in other projects or in studies analyzing potentially hazardous biological agents.

This study was funded by the Federal Office of Civil Protection and Disaster Assistance (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe, BBK).

We wish to thank the members of the current working group on developing an assessment system for potential biological dangers (“Entwicklung eines Systems zur Einschätzung potentieller biologischer Gefahrenlagen”) of the Commission on Civil Protection of the Federal Ministry of the Interior, Germany, for their expertise and advice.



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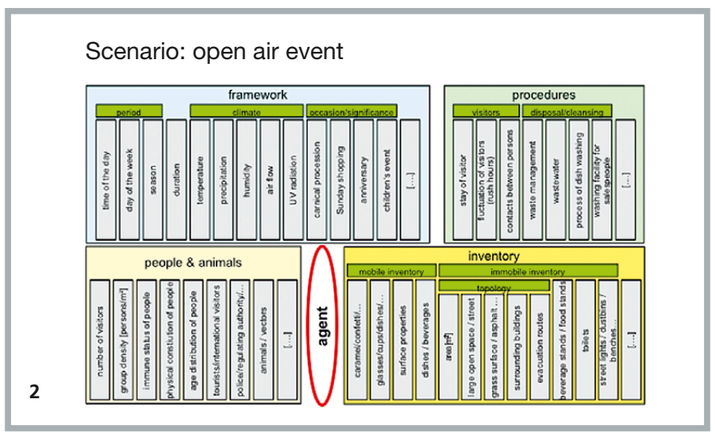

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1 *Schematic overview of the tasks of the feasibility study*

2 *Toolbox – Abstract of the factors of influence for the scenario “open air event”*

EDC 2011 – A DEFENCE CONFERENCE FOR EUROPE

Dr. Miloš Jovanović, Dr. Merle Missoweit

Prior to 2011, an independent European conference on defence R&T, bringing together key players from government, industry and science to consider a wide-based agenda, had never taken place. For this reason, Fraunhofer INT, in collaboration with the WISER Consultancy (Netherlands), and event.lab, the Leipzig conference organizers, staged the first European Defence Conference (EDC, 20 – 21 October, 2011) in Warsaw, Poland. The idea for this conference arose in 2009 as a result of an INT study prepared for the German Federal Ministry of Defence (BMVg). This study emphasized the need for greater information exchange between actors in European defence, aimed at improving international cooperation.

The 130 participants were welcomed by Zbigniew Wlosowicz, Poland's Undersecretary of State for Defence. Among the key speakers were LtGen Ton van Osch (Director General of the EU Military Staff), Jelle Keuning (R&T Director, Netherlands Ministry of Defence), Dr. Hilmar Linnenkamp (former Deputy Chief Executive of the European Defence Agency, EDA) and Christian-Peter Prinz zu Waldeck (Director, Association of German Security and Defence Industry, BDSV)

The conference mainly centred on debate sessions on current issues concerning European defence technology cooperation, and on pinpointing new approaches for the improvement of EU defence cooperation. Additionally, research results and ideas for research cooperation were presented in "snapshot sessions".

Among the discussed ideas and possibilities for improving both European and transatlantic cooperation in developing military capacity capabilities were the following:

- national specialization on individual military capabilities and corresponding mutual exchange (NATO SMART Defence Concept)
- multinational solutions for armaments requirements instead of individual national solutions
- the need for greater participation at the highest political level in enhancing cooperation
- industry's view of promoting strategic competition development in the defence market
- the possibility of EDA using the Disruptive Technology Assessment Game, as developed by NATO with Fraunhofer INT participation.

Practical recommendations that came out of the debates include the following:

- setting up workshops at various EU locations, in order to reach a wider public and to explain more clearly the opportunities in cooperating with the EDA community
- simplifying EDA rules for awarding R&T contracts
- for setting agendas, a greater inclusion of Member States at the highest level

The first EDC produced a very positive echo. Adam Sowa, Deputy Chief Executive of EDA, expressed his satisfaction with the conference management, and with a NATO representative scheduled to attend a further conference, NATO participation already looks to be stronger in future. The second EDC is scheduled for the end of 2012. For updates on the conference, go to: www.defenceconference.eu

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DEVELOPMENTS IN THE DEPARTMENT NUCLEAR AND ELECTROMAGNETIC EFFECTS – A NEW BUSINESS UNIT

Dr. Wolfgang Rosenstock

The strategic alignment of our Institute and consequently of our Department is regularly monitored to take account of market shifts, and adapted to bring it up to date with current developments. Our R&D marketing in particular is oriented to Business Units that serve the Institute's image and reflect our main research operations. Until mid-2011, the Department Nuclear and Electromagnetic Effects (NE) operated in disciplines under the two Business Units "Nuclear Effects, Threats and Detection Systems", and "Electromagnetic Effects and Threats".

A strategic analysis showed that the field Nuclear Effects in Electronics and Optics (NEO had recorded a marked increase in project income and that future prospects were positive. To sustain this state of affairs in the long term and promote competitiveness, a clear external presence is called for.

In NEO, the Institute falls back on years of experience regarding the effect of ionizing radiation on electronic, optoelectronic and optical components and systems. Irradiation tests on these components are conducted in accordance with recognized standards. In addition, industry is advised on radiation qualification and hardening in aerospace components. The behavior of such components in other irradiation environments, for example in accelerators (CERN), is also investigated. Lessons learned from irradiation tests are also used for developing radiation sensors. The irradiation facilities needed for these tests are either directly available at INT or are exclusively at INT's disposal when located externally.

In addition to projects for industry, INT also succeeded in acquiring projects for the European Space Agency ESA. The satellite market in particular is generally based on long-term projects where sometimes substantial public funds are also available, both in the form of research funds and as investments in own capacities, such as for national, also military satellites. This area thus shows more growth potential, and it is to be expected that more, new orders can be won, especially from industry. To attract greater notice from outside and to address project inquiries more clearly, it was decided to consolidate the presentation of these activities in an independent Business Unit.

This new Business Unit goes by the name "Nuclear Effects in Electronics and Optics". More information is to be found on page 51.

The remainder of the former Business Unit was accordingly renamed "Nuclear Security Policy and Detection Methods". The two Business Units are currently about the same size. On the whole, NE's technical and experimental infrastructure is commonly used by all three Business Units, which results in numerous synergies that are also reflected in mutually conducted projects.

1 *Dr. Wolfgang Rosenstock*

BUSINESS UNIT “NUCLEAR SECURITY POLICY AND DETECTION TECHNIQUES“

Dr. Theo Köble

This Business Unit “Nuclear Security Policy and Detection Techniques” (Nukleare Sicherheitspolitik und Detektionsverfahren – NSD) carries out theoretical and experimental research and development in the fields of nuclear security policy and nuclear detection systems. In addition to basic studies, research projects are conducted for industrial clients (nuclear research and technology) and public bodies (mainly for offices and organizations concerned with security, and major research centers). With basic funding from the Federal Ministry of Defence (BMVg), GF 3 also deepens and expands the national ability to discern threats in the field of nuclear and radiological weapons and associated asymmetric areas. Several neutron generators (14 MeV and 2.5 MeV) and an isotope laboratory are used in research work. For the safe operation of these irradiation facilities and for handling the many radioactive substances, INT has the appropriate radiation protection infrastructure and a permit to operate in third-party nuclear facilities (such as research reactors, nuclear power stations). All experimental work is supported by precision mechanics and electronics laboratories.

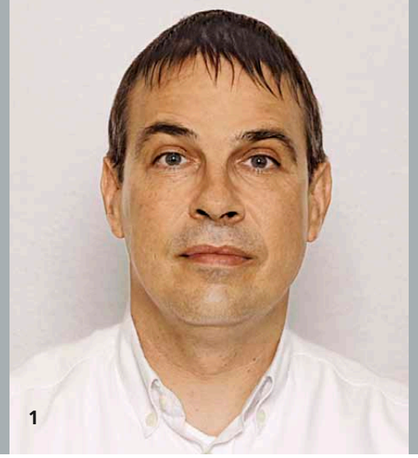
The Business Unit was also present at the Deutschlandtag event, staged from 1 – 3 October, 2011 in Bonn, where detection methods for the early discovery of smuggled radioactive material were demonstrated with the help of a model. For ANSTO, the Australian Nuclear Science and Technology Organisation, a neutron generator was used in the spring of 2011 to irradiate simulated soil samples. This research is intended to develop a mobile system for measuring the CO_2 content of soil on location, without having to resort to taking samples and laboratory tests.

In the field of nuclear disarmament and proliferation, potential developments, both political and, primarily, technical, were pursued continuously. These were analyzed with particular emphasis on physical and technical aspects. Nuclear developments in Iran were specifically observed, analyzed and evaluated, taking account of the fact that uranium has been enriched in Iran, for use as fuel for the Tehran Research Reactor.

As part of the work in the ESARDA Working Group on Verification Technologies and Methodologies (VTM) – organized by the Non Proliferation and Nuclear Safeguards Unit at the Joint Research Centre in Ispra, Italy – BU 3 reviewed developments in international disarmament treaties, including export controls and new safeguard technologies for the IAEA.

For the prevention and early detection of terrorist activity involving nuclear or radioactive material, state-of-the-art detection and measurement systems for the non-destructive identification of such substances were studied with a view to their suitability for use on location. In realistic tests under difficult conditions, the systems were tested to verify capability and limitations. To this end, radioactive and nuclear substances in particular were measured behind various shields. It was demonstrated that the automatic analysis programs of many measuring systems fail to deliver the reliable results that are certainly possible under ideal laboratory conditions. There were also further developments in neutron measuring systems well suited to gauging hidden fission material.

The many years of support for the CTBTO (Comprehensive Test Ban Organisation) were continued. At the international CTBTO conference “Science and Technology”, this included the presentation of examination results of a measuring system with software for suppressing the natural substrate for gamma measurements. At EU level, the issue of CBRN threats and their countermeasures was further pursued, with Business Unit 3 participating in the radiological (R) and nuclear (N) sectors. INT was cooperating in the project DECOTESSC1 (Demonstration of Counter Terrorism System-of-Systems against CBRNE Phase 1). Successfully concluded, this was part of the 7th EU Research Framework Program. It concerned the analysis of the CBRNE threat and suitable countermeasures (including R&T), as well drafting invitations for tender for a Phase 2 Project focusing on the demonstration of a consistent countermeasure system of in the event of CBRNE attack. The corresponding call for tenders is currently open, and Business Unit 3 is involved as part of a bidding consortium. In the project “Ukrainian Border



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Crossing Station", which aims to improve the battle against smuggling radiological and nuclear material past Ukrainian border stations, BU 3 supported evaluation work on tenders submitted for detectors. This project is part of TACIS, the European Commission's program for Technical Assistance to the Commonwealth of Independent States. The European Joint Research Centre (JRC) in Ispra serves as promoter for the TACIS program.

1 *Dr. Theo Köble*

CARBON CONTENT DETERMINATION BY NUCLEAR IRRADIATION OF SOIL SAMPLES

Dr. Olaf Schumann

The impact of greenhouse gas emission, especially that of carbon dioxide, on global warming led to several attempts for its reduction. One initiative is the implementation of emission rights. Here a certain amount of emission rights or "carbon credits" are granted to potential emitters that must outweigh the actual emissions. If more carbon dioxide is produced, additional emission rights have to be purchased while surplus rights can be traded. Thus a financial incentive to reduce carbon dioxide emissions is generated.

The carbon dioxide does not simply accumulate in the atmosphere. Moreover, large quantities of carbon dioxide are stored in the oceans as dissolved gas or biomass in the soil. The form of agricultural cultivation affects the storage capacity of the soil. Therefore, in addition to power generation and traffic, the cultivation practice could be included in the emission rights trading market.

This requires the measurement of the soil carbon content. At the moment, this requires soil sample taking and time consuming laboratory work which renders long term monitoring and the creation of high resolution maps expensive.

ANSTO and the proposed measurement instrument

The Australian Nuclear Science and Technology Organisation (ANSTO) is therefore planning on designing an instrument which enables the determination of carbon and other elements in the soil on-site without the need of sample-taking and preparation with a short measurement time. The instrument will be based on the interactions of fast neutrons penetrating the soil and producing characteristic high energy gamma radiation that is detected in turn and allows the quantification of the chemical composition.

Neutrons can interact with matter in different ways. They lose energy by repeated elastic scattering events and thus slow down. Owing to the high neutron energy it is also possible to excite a nucleus (inelastic scattering). The excited nucleus decays into the ground state and emits the transferred energy as characteristic gamma radiation. Finally, the neutrons could be captured by a nucleus, where characteristic gamma radiation is emitted as well.

The contribution of inelastic scattering and capture to the gamma spectrum can be separated, because the moderation of the neutrons requires a time in the order of some milliseconds. While inelastic scattering could only occur at high neutron energies, the low energy neutrons primarily participate in the capture reactions. If the neutrons are created in a very short pulse, these two processes happen before and after the deceleration, respectively. A time resolved gamma measurement allows the separation of these processes and simplifies the evaluation of the gamma spectra. As neutron source, a deuterium-tritium neutron generator is suitable because it could deliver an appropriate neutron pulse. It is also compact and robust.

Measurements at the INT

IIn the course of preliminary investigation and the selection of an appropriate neutron generator, ANSTO had carried out measurements with a German manufacturer whose generator turned out to be unsuitable. When searching for an alternative, ANSTO contracted the Fraunhofer INT to perform test measurements with the Genie 16 neutron generator. These measurements were performed in cooperation with ANSTO and with the use of their equipment. The major focus was on questions regarding the design of a field instrument, such as what type of detector (HPGe, $LaBr_3$, NaI) is suitable, the impact of the pulsing on the quality of the resulting spectrum, whether the pulsing has an influence on the detector electronics and whether the beam parameters of the Genie 16 are suitable for these kinds of measurements. Moreover, a characterization

of a diamond detector as sensor for the neutron flux and pulse duration and shape was to be performed.

Special challenges of this measurement campaign were the weight and the size of the experimental setup. The detectors were protected from the neutron radiation by means of a heavy iron shielding and the soil sample volume was about 1 m^3. To be able to conduct these measurements, the mesh flooring had to be reinforced, and the procedure for the transport of the soil sample containers through the narrow entrance of the irradiation laboratory had to be carefully planned.

In early April 2011 the equipment of ANSTO was delivered. In addition to the mechanical test set-up with the shielding and the detectors, including the measuring electronics, there were also several containers with artificial soil samples consisting of different mixtures of terracotta, sand and polyethylene, the latter as the carbon containing component. After the first irradiation experiments it was found that the resolution of the NaI detector was not sufficiently high to resolve the individual peaks and that the high-resolution germanium detector was not compatible with the ANSTO system for time-resolved measurements. Hence the $LaBr_3$ detector had to be used for these. For use in a field instrument, it would probably provide the best trade off between resolution and robustness in any case. With this setup, a number of different soil samples were measured, with varying neutron intensity and pulse duration including continuous neutron beam.

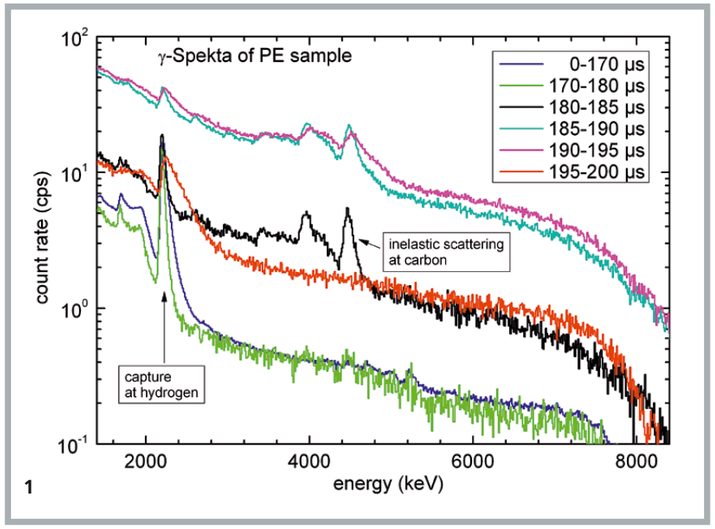
Results

During the measurements it could be demonstrated that the setup of ANSTO was capable of resolving the carbon in the sample. Furthermore, it could also be shown that the time-resolved measurements with pulsed neutrons reduce the background underneath the carbon signal and can lead to an increase in accuracy and a reduction in the detection limits.

Figure 1 shows an example of multiple gamma spectra in different phases of the neutron pulse. The inelastic scattering of neutrons on carbon shows up in the signal at about 4.4 MeV, the other clearly visible signal at 2.2 MeV is due to the capture of neutrons by hydrogen. The neutron pulse starts at about 180 µs and lasts for approximately 15 µs. The black curve shows the signal in the first phase of the pulse, where the background is still modest; the carbon signal can clearly be seen. During the pulse (magenta and cyan curve) the background increases strongly, the signal from inelastic scattering from carbon as well as from capture by hydrogen is easily visible. This changes in the red curve, that shows the situation immediately after the end of the neutron pulse. The hydrogen peak is still visible, but broadened, the carbon signal has disappeared, however. In the pulse pause (blue and green curves) only the hydrogen peak is seen at its usual width. As can be seen from this example, the signal to background ratio could be improved significantly by carefully choosing the spectrum acquisition time with respect to the neutron pulse. The obtained results are a first step for ANSTO towards optimizing the proposed system to high sensitivity. Moreover, some questions arise from the experiments, like that of the origin of peak broadening and the question of whether and how the increased background during the neutron pulse could be further reduced by an optimized shielding.

Conclusion

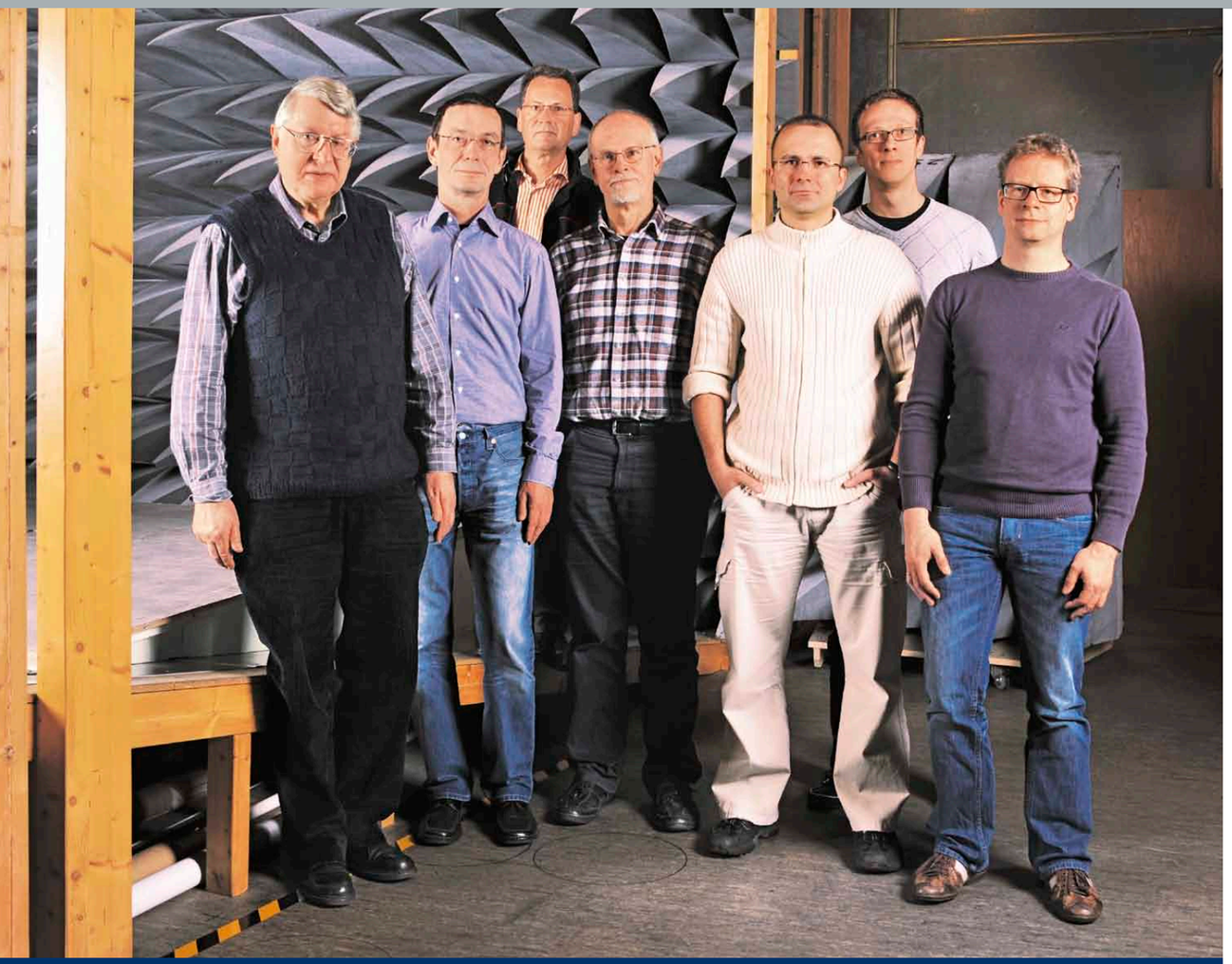
The radiation measurements on behalf of ANSTO could be completed within the designated time and without incident, thanks to careful preparation on both sides. In particular, the scientific and technical infrastructure of the Fraunhofer INT, especially Mr. Clemens and Mr. Lennartz, made a valuable contribution. As the primary goal, the measurement program for ANSTO has been completely processed. At the same time, the pulse shape of the neutron generator was precisely determined and valuable experience was obtained in operating the generator with less-commonly used parameters. ANSTO currently evaluates the obtained data in detail and will decide on that basis how the project will be continued.



1 *Gamma spectra in different phases of the pulsed neutron signal*

BUSINESS UNIT “ELECTROMAGNETIC EFFECTS AND THREATS”

Dr. Michael Suhrke



With basic funding from the Federal Ministry of Defence (BMVg), this Business Unit’s task is to contribute to developments in the ability to assess electromagnetic effects regarding military threats. Since this task is only addressed to a limited extent in the military sector, the Business Unit conducts its own theoretical and experimental research, including the development of measurement technology. In addition to basic funding, project research for clients outside the defense area (civilian security research, space flight) is becoming increasingly important.

The Unit’s experimental work on electromagnetic threats, in particular from high power microwaves (HPM), is coordinated with BMVg and is also carried out in cooperation with companies from the defense field. Research is conducted on coupling electromagnetic fields into structures and specific systems, as well as on the vulnerability of electronics to high intensity electromagnetic fields. Current studies are concentrating on EME vulnerability of IT devices and systems using state-of-the-art technology, and in particular of wired and wireless data transmission technology (network technology). Basic studies and experiments are also conducted on detection techniques for electromagnetic threats, especially HPM threats.

The Business Unit has developed and operates its own TEM (Transverse Electromagnetic Mode) waveguide field simulation facility, housed in a shielded hall and suitable for frequencies from 1 MHz to 8 GHz. The facility allows linear coupling measurements to determine transfer functions, investigations on electromagnetic compatibility (EMC), and susceptibility measurements with constant and pulsed fields with field strengths of up to several kV/m on objects with volumes up to several m^3. For on-site measurements, the Business Unit has developed its own mobile HPM irradiation facility. Using horn antennas, it generates field strengths of up to 5 kV/m within frequencies ranging from 450 MHz to 3.4 GHz. The Business Unit also owns a reverberation chamber, a small fully anechoic chamber for frequencies up to 40 GHz, and extensive high-frequency and microwave measuring equipment.

In order to account for the growing number of applications for modern sensor and communications technology in the higher GHz range, the necessary extension to frequencies up to 18 GHz was completed in 2011, enhancing the capability of HPM sources and measurement equipment in the Business Unit. For this purpose, two pulse amplifiers were acquired: a 5 kW unit for frequencies from 4 to 8 GHz, and a 2 kW unit for frequencies from 8 to 18 GHz. These are being integrated into the Business Unit’s measurement environment, for operating the TEM waveguide and reverberation chamber. With the new pulse amplifiers, maximum field strengths of about 10 kV/m can be generated in the reverberation chamber for frequencies between 4 and 18 GHz. In 2011, the chamber was successfully validated in accordance with IEC standards and was used in HPM susceptibility tests of electronic devices for external customers.

Among the studies on detection techniques for electromagnetic threats, a contribution on the development of an HPM detector at the Business Unit received the Best Paper Award at the EMC Europe 2011 conference in York. In addition, studies were completed on the susceptibility and robustness of different HPM detector prototypes in the TEM waveguide and, using very high field strengths, in the Business Unit’s reverberation chamber. The topic was presented at the 6th Future Security Conference 2011 in Berlin. The threat by high power microwaves and by High Altitude Electromagnetic Pulse (HEMP) was illustrated in external presentations, e. g. at TU Darmstadt and at the Directed Energy Weapons 2011 conference in London.

The subject of further work was the numerical characterization of the TEM waveguide. To this end, the electrical parameters of the waveguide absorbers were determined by measuring the properties of the absorber material in coaxial cells owned by the Business Unit. On this basis, numerical simulations of the absorber wall were carried out, using different theoretical models which were presented at EMC Europe 2011. The objective of this work is a comparison of the numerical simulation of field distributions in the TEM waveguide with measurements of the field strength taken during an internship semester at

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the Business Unit in 2011. A bachelor thesis dealt with the directional dependence of coupling of electromagnetic interferences into IT network devices as a precondition for a comparison of interference thresholds in the TEM waveguide and reverberation chamber.

In addition, investigations were finished on the HPM susceptibility of military IT network technology within the NATO RTO SCI-198 Task Group "Protection of Military Networks Against High Power Microwave Attacks". The results were presented in three contributions at the NATO RTO SCI-232 Symposium "High Power Microwaves and Directed Energy Weapons" in Norfolk. The follow-on NATO RTO SCI-250 Task Group, scheduled for 2012 – 2014, has the topic "Radio Frequency Directed Energy Weapons in Tactical Scenarios". The experience gained by the Business Unit in coordinating the international test campaign in the NATO RTO SCI-198 Task Group was included in the BMVg 2011 Annual Military Scientific Report. An assessment of NATO capabilities in the field of laser and HPM weapons for the next 15 years was completed in NATO RTO SCI-227 ST "Directed Energy Weapons (DEW) Related Capabilities: Near, Mid, Long Term Prospects".

In civilian security research within the 7th Framework Program on Security Research of the European Commission, the Business Unit EME is a partner in the consortium HIPOW on the "Protection of Critical Infrastructures against High Power Microwave Threats" under the leadership of FFI Norway, for which contract negotiations were conducted in 2011. In Germany's national program "Research for Civilian Security", part of the high-tech strategy of the Federal Ministry of Education and Research BMBF, the Business Unit is contributing to a cooperation in civilian security research between Germany and France, with studies of electromagnetic compatibility in the joint project "UAV-Assisted Ad Hoc Networks for Crisis Management and Hostile Environment Sensing (ANCHORS)".

Work on the ESA project "Metamaterials for Optical and Photonic Applications in Space" was successfully completed in 2011. The results were presented at the SPIE conference "UV/Optical/IR Space Telescopes and Instruments: Innovative Technologies and Concepts" 2011 in San Diego. On this basis, experimental and theoretical studies were started on the influence of ionizing radiation on reflection properties of vertically aligned structures from carbon nanotubes. First results were presented at the Conference on "Radiation Effects on Components and Systems – RADECS" 2011 in Seville.

1 *Dr. Michael Suhrke*

ANALYSIS OF THE SUSCEPTIBILITY OF MEDIA CONVERTERS BY HIGH POWER MICROWAVES

Dipl.-Ing. Christian Adami

In the past, many test campaigns have shown high vulnerability against High Power Microwaves (HPM) for computer and IT network components. For example, an upset of a network switch has an impact on the whole local area network and data transfer. In the test campaigns, the network cable was identified as one of the main coupling paths. These problems cannot be overcome by using a wireless network, because the antennas are open gates for the electromagnetic waves (front-door coupling). Fiber optic cables are another data transmission method that is used in many networks. Many test campaigns with computer network components and also military C4I networks (C4I: Command, Control, Communications, Computers, and Intelligence) have shown that one of the most susceptible components was the media converters which transform electrical signals from a network cable into optical signals for a fiber optic cable. This special part of these computer networks was tested in a campaign.

Tests of six models at Fraunhofer INT provide the comparative assessment of the susceptibility of different types of media converters. Five media converters were commercial and industrial equipment, so the MCs were not especially hardened against HPM or HEMP (high altitude electromagnetic pulse). In comparison to the commercial versions, tests were conducted on a military media converter designed for IT networks in electromagnetic harsh environment conditions. For these environments, the military MC uses tactical shielded SFTP cable with special EMC connectors (EMC: electromagnetic compatibility) and tactical fiber optic cable. For EMC hardening measures, the device also has an EMC gasket between cap and case. In addition, a shielded enclosure for a commercial media converter was tested to compare different hardening measures. The box consists of a metallic body with a metallic cover plate and a metallic adhesive tape that functions as a gasket. Connectors for power and network all have filters. The apertures for the cabling are as small as possible and were sealed additionally with metallic adhesive tape.

The tests took place at the Fraunhofer INT test facility, which consists of a waveguide built as an open pyramidal asymmetric three-plate TEM transmission line located within a shielded hall. Inside the waveguide, homogeneous microwave fields can be realized in a maximum test volume of approximately 2 x 2 x 3 m^3. Transfer function measurements can be carried out by continuous wave (CW) illumination of the EUT using digital tunable sweep generators together with power amplifiers for frequencies between 1 and 8000 MHz and vector network analyzers as receivers. Susceptibility tests can be done with a pulse modulated generator in the frequency range from 150 to 3425 MHz for different pulse widths and repetition rates. The generator permits electric field strengths at the EUT up to some kV/m.

The tests have been carried out in different test configurations to determine the influences of the coupling of high power microwaves into the MC case apertures, both directly and via network and power cables. Figures 2 and 3 show a network cable loop between the two test MCs, with a cable length of two meters between the MCs. The network cable and the media converters were fixed on a wooden frame. The effective length of the loop measured 400 mm (horizontal) and 750 mm (vertical). Two PCs were connected by fiber optical cable to the test MCs via additional MCs outside the shielded hall in order to generate data traffic from the one PC to the other. To determine the different coupling paths, especially on the network cable and power cable, we used three different test configurations with two kinds of network cables, in particular UTP (unshielded) and SFTP.

The results of the tests showed that it is possible to disrupt the traffic between the PCs in broad frequency ranges for the most MC types. In most cases the traffic continued after the end of the HPM-exposure. However in some cases a restart of the data transfer was necessary. In the lower frequency range, coupling via the network cable was responsible, while in the higher frequency range, coupling was through the case apertures. Figure 4 shows the transfer function of the current on the SFTP cable for two media converters. Figure 5 shows an

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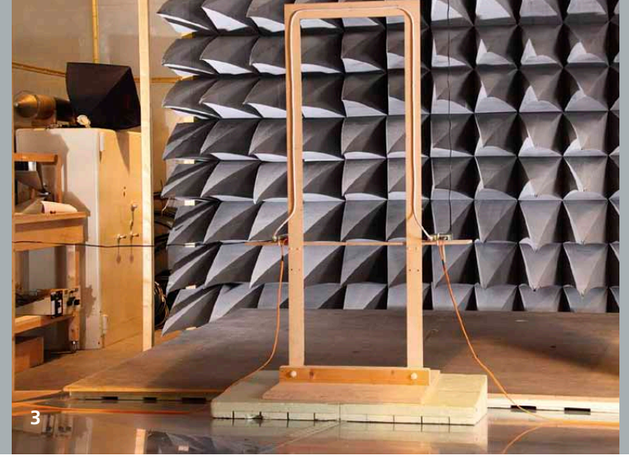

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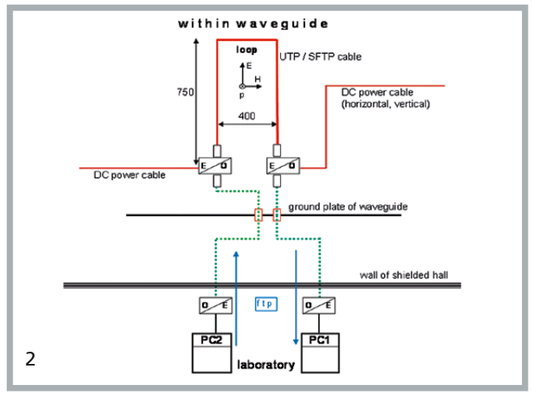
RADIATION EFFECTS IN VERTICALLY ALIGNED CARBON NANOTUBES

Dr. Grzegorz Lubkowski, Dr. Jochen Kuhnhenn

HPM-pulse, measured on the network cable which causes inter-ference. The MCs in the setup with the shielded SFTP-cable were as susceptible as in the setup with the unshielded UTP cable. The influence of the power cable was marginal. The military MC, which only available with SFTP cable, showed susceptibility similar to that of the commercial MCs with SFTP cable. The shielded enclosure in connection with the SFTP network cable reduces the failures to a minimum.



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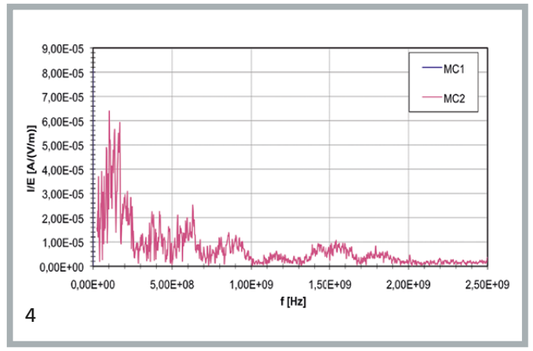

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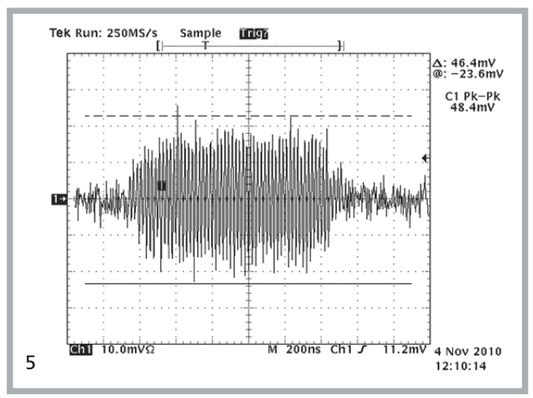

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1 *Media converter*

2 *Test setup*

3 *Test setup within the TEM-waveguide at INT*

4 *Transfer functions current to electrical field I/E in comparison of two models, setup with 2 m-loop SFTP-cable*

5 *HPM-pulse with 1 µs pulse width, measured on the SFTP cable*

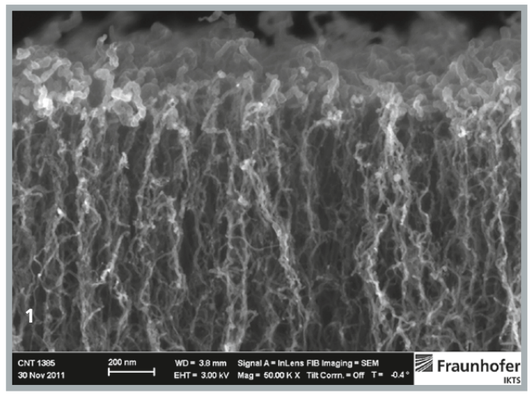
Optical sensors on satellites face increasing demands regarding sensitivity and resolution. Not only are the detectors used in such sensors constantly optimized, the reduction of unwanted stray light, produced by scattering at surrounding components, also plays an important role. Currently special black paintings are used that absorb more than 90 % of that light. Reducing the reflectivity of such surfaces automatically increases the sensitivity of detector devices.

In 2008 new types of surfaces were investigated for the first time with respect to their optical properties. These extremely dark coatings were not based on paintings but consisted of vertically aligned carbon nanotubes (VA-CNTs). This material is a nearly perfect black body and absorbs almost all light at all angles for all visible and infrared wavelengths, potentially increasing the sensitivity by orders of magnitude. In a study conducted at Fraunhofer INT for the European Space Agency this material was identified as one of the most promising metamaterials for a multitude of applications in space.

However, using new technologies in space always comes with a lot of challenges, especially if the material is to be used on the surface of a satellite, directly exposed to space. Huge temperature variations, vacuum and electrostatic discharges might degrade the performance of the anti-reflective layer, but also cosmic radiation threats the integrity of the VA-CNTs.

To assess the suitability of VA-CNTs for space applications, Fraunhofer INT investigates the radiation hardness in cooperation with Fraunhofer IKTS and the Leibniz-Institut für Festkörper- und Werkstoffforschung in Dresden. In contrast to previous research conducted in this field, the optical properties of VA-CNTs under irradiation are in the focus of the current research at Fraunhofer INT.

VA-CNT samples manufactured by Fraunhofer IKTS were exposed to high dose levels of Co-60 gamma radiation at Fraunhofer INT. Figure 1 (top) shows the tip region of the VA-CNTs before irradiation, obtained in a scanning electron



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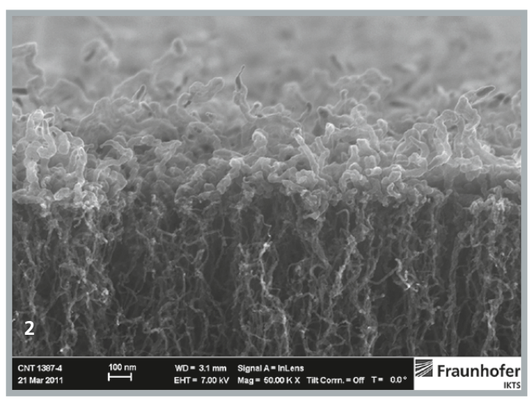

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microscope (SEM). After irradiation with 500 kGy the CNTs in the tip region appear thicker and slightly degraded.

This small change is in agreement with earlier observations – however, the optical reflectivity remains unchanged. The total reflectivity before and after irradiation was below one percent and compares favorably to the values of conventional black coatings characterized by reflectivity of several percent.

Additional measurements with Raman spectrometers did not reveal any detectable changes in the structure of the VA-CNTs.

Hence, regarding the irradiation effects no indications have been found to date that would disqualify this nanotechnology for space applications.

Since the space radiation environment is not fully simulated by gamma radiation, especially for surface effects, another irradiation was conducted with high energy protons. Again, no detectable changes or damages have been observed.

Following these promising results several companies involved in optical space technologies expressed their interest in applying VA-CNTs in future satellite projects.

The research team at Fraunhofer INT continues this work in two directions. First of all, additional tests will be done with low-energy protons in order to simulate the effects in the first layers of the VA-CNTs when they are directly exposed to space without any shielding. Secondly, new samples will be selected for the upcoming tests that are optimized for maximum absorption. For such samples the total reflectivity could be as low as 0.1 %, demanding a dedicated measurement setup.

BUSINESS UNIT “NUCLEAR EFFECTS IN ELECTRONICS AND OPTICS”

Dr. Stefan Metzger

Since the 1980s, the staff in this Business Unit has been working on the effects of ionizing radiation on electronic, optoelectronic and optical components and systems. The unit performs radiation testing to recognized standards and advises industry on radiation qualification and hardening, components and systems for use in space or in other radiation environments. Lessons learned from radiation testing are also used in the development of radiation sensors.

The Unit’s work scope covers the following:

- The study of effects of different types of radiation in products intended for use in radiation environments
- Conducting, evaluating and assessing radiation tests, using the various radiation facilities at Fraunhofer INT
- Ensuring the operability of components and systems in typical radiation environments such as space, nuclear engineering, medicine and high-energy accelerators
- Advising manufacturers and users regarding selection, optimization and hardening for systems in radiation environments
- Measuring the effect of radiation on ionising optical fibres
- Developing radiation sensors with optical fibres, crystal oscillators, UV EPROMs and SRAMs
- Developing test procedures for IEC, IEEE, NATO and IAEA.

The following radiation facilities necessary for these tasks are either installed at Fraunhofer INT or are available at other locations:

- 3 cobalt 60 gamma irradiation facilities with different activities
- An exclusive proton irradiation location at the Forschungszentrum Jülich
- Access to high-energy heavy ions at the Helmholtz Center for Heavy Ion Research in Darmstadt (GSI)
- A picoseconds laser for investigating the effects of single particles
- An industrial 450 kV X-ray facility and a flash X-ray system
- 2 neutron generators
- An UV solar simulator

A wide range of modern equipment for measuring electrical and optical parameters is also available, as well as a mechanical workshop and an electronics laboratory. Most tests can thus be carried out without the need for customer staff or equipment.

Tasks in 2011

In its first year as an independent Business Unit, NEO was busy with funded projects for a variety of German companies, mainly for aerospace suppliers and for nuclear technology applications (Areva, Astro- und Feinwerktechnik, Berliner Glas, Honeywell, Jena-Optronik, Tesat Spacecom, and others). There was also a remarkable increase in demand for our skills from the European market (CERN, CEA, ESA, Draka, Hirex, Swiss Optic, and others). For these competences, investigation and qualification work was carried out on components, circuits and assemblies, as well as on optical and optoelectronic components. Crucial for the winning of these orders was INT expertise and its immediate access to dedicated irradiation facilities – unique in Europe. In the period under review, the construction and commissioning of additional facilities and measurement equipment acquired through grants from the second German Economic Stimulus Package was finalized: With the third cobalt 60 facility, we are now able to carry out more irradiation projects under significantly improved conditions. The 450 kV X-ray system or the picoseconds laser open up further areas of scientific and commercial interest.

In addition, further investigations widened knowledge of the influence of space weather (solar wind and galactic cosmic radiation) on satellites in general, as well as its impact on onboard electronics in particular. The biggest threat in a satellite’s natural environment comes from solar events (coronal mass ejection or solar flares), for which their strength, frequency and time of occurrence cannot be predicted. An undesirable effect of these events is the impact of single particles on modern electronic circuits. The competence, especially the ability, to be able to measure this was acquired as part of a project funded

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by the European Space Agency (ESA). The project was concluded in the report period and the results were presented at RADECS, the annual conference on radiation effects on components.

Alongside studying the effects of space weather, the Business Unit is building up a new pillar in the field of satellite-based radiation measurement. To this end, a radiation sensor payload is being developed as a contribution to Fraunhofer's share of the national geostationary communication satellite "Heinrich Hertz". The total accumulated radiation dose over the whole 15-year operation will be measured with an UV EPROM. Exposure to high-energy solar protons or heavy ions will be identified and quantified with the use of a static memory chip. The radiation sensor will provide not only a contribution to the measurement of the Earth's radiation environment, but in case of a satellite anomaly will also point to whether elevated radiation levels could be the cause of malfunction or failure. This work is being carried out in close collaboration with Fraunhofer IIS (Fraunhofer Institute for Integrated Circuits), using the communication facilities and the computers there. We also support IIS in the selection of suitable electronic components.

In November, the "Herausforderung Weltraum" workshop was held. Increased participation proves that the event has become well-established over the years. More than 30 guests came from both the user and producer sides, and considering the extremely positive echo, we intend to stage another workshop in 2013. More on this subject is on page 53. As part of the event, the film "Irradiation Tests at Fraunhofer INT" was presented for the first time. The film shows the effect of high energy solar particles, to the extent that e.g. semiconductor elements suffer radiation damage or can even lose their ability to function owing to the effect of radiation. With the possibility of irradiation tests at INT, particularly sensitive semiconductor elements can already be excluded on Earth, thus preventing malfunction in orbit.

The Unit also mounted an exhibition stand at the third "Forum Weltraum", the space forum staged by the Deutsche Gesellschaft für Wehrtechnik (German Association for Defence Technology – DWT) in Bonn Bad-Godesberg. In addition, the Unit presented its work with two exhibits at the "Deutschlandfest" in Bonn. One exhibit was a demonstrator for the supervision of a flat glazing element by means of fiber Bragg grating. Patent application for this idea has been filed, and it was also presented at the Fraunhof symposium "Netzwert".

To examine Vertically Aligned Carbon Nanotubes (VA-CNT) with regard to their suitability for use in space, INT is cooperating with Fraunhofer IKTS (Fraunhofer Institute for Ceramic Technologies and Systems) and the Leibnitz Institut für Festkörper- und Werkstoffforschung (Leibnitz Institute for Solid State and Materials Research) in Dresden. The subject of research is the radiation resistance of such layers. In contrast to previous work in this field, the optical properties are at the center of the experiments.

Certification of the Unit in accordance with ISO 9001 has been brought forward, and is now scheduled for 2012. For this it was necessary to set up a measuring laboratory that conforms to the accepted rules for ESD protection (against electrostatic discharge).

1 *Dr. Stefan Metzger*

WORKSHOP "HERAUSFORDERUNG WELTRAUM"

Dr. Stefan K. Höffgen

The third workshop "**Herausforderung Weltraum**" (The Space Challenge) took place at Fraunhofer INT in November, 2011, with 32 participants from the German aerospace industry, research centers and the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt, DLR). On the agenda were the effects of radiation in space.

In his talk titled "**Radiation in Space**", Dr. Stefan Höffgen (Fraunhofer INT) opened the workshop by looking at the nature and origin of ionizing radiation in space. He presented concrete calculations with simulation programs (SPENVIS, OMERE) for several sample orbits.

The next two talks considered the basic effects of ionizing radiation in electronic components. First, Dr. Stefan Metzger (Fraunhofer INT), reported on the "**Single Event Effects in Electronic**s". He introduced the various types of single event effects and gave details on the practical aspects of the tests on accelerators. His talk rounded off with a discussion on single event tests using short-pulsed high-power lasers, as has recently become possible at Fraunhofer INT. Second, Dr. Höffgen described the two remaining effects, "**Dose and Displacement Effects**". Apart from the basic effects in MOSFET and bipolar technologies, mechanical and electrical effects on materials, especially polymers, were also discussed. This lecture also dealt comprehensively with the practical issues when testing these effects.

Industry's view of component selection was given by Dr. Daniela Staerk (Tesat Spacecom) in her talk on "**Quality Levels for EEE Components**". She went through the bewildering variety of quality levels and their relevance in selection for space projects. Special mention was made of the use of commercial components without quality specifications (Commercial off-the-shelf – COTS – components).

After this detailed consideration of "**Radiation Effects in Photonics**", Dr. Jochen Kuhnhenn (Fraunhofer INT) spoke on radiation effects in photonics. Both active and passive components were considered, especially focusing on optical fibers and fiber Bragg gratings, the subject of intensive research at Fraunhofer INT.

Two final talks widened the workshop's horizons. Mr. Ronny Käso (Astro und Feinwerktechnik) spoke on the "**Qualification and Acceptance of Space Equipment**", describing all necessary tests for space missions that are not concerned with ionizing radiation. He was followed by Prof. Dr. Marco Durante (GSI), who spoke in English on the hazards of space irradiation to astronauts on interplanetary missions in his talk "**Cosmic Radiation and Human Spaceflight**".

The participants were given a practical insight with demonstrations of the experimental facilities at Fraunhofer INT. Presentations were on:

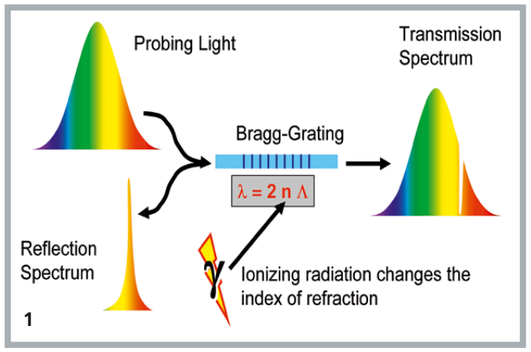
- Single event upsets of an SRAM at the neutron generator
- Light absorption in an optical fiber at one of the gamma sources
- Single event transients in an SRAM at the laser facility
- Displacement of the input characteristic of a MOSFET on the X-ray facility.

Participant feedback was very positive. Special praise was given for the high competence levels of the expert speakers, the practical demonstrations and the opportunity to exchange ideas at the evening event. INT will be continuing the series, with the next workshop being planned for November, 2013.

NEW-TYPE FIBER BRAGG GRATING AND IONIZING RADIATION

Dr. Stefan K. Höffgen

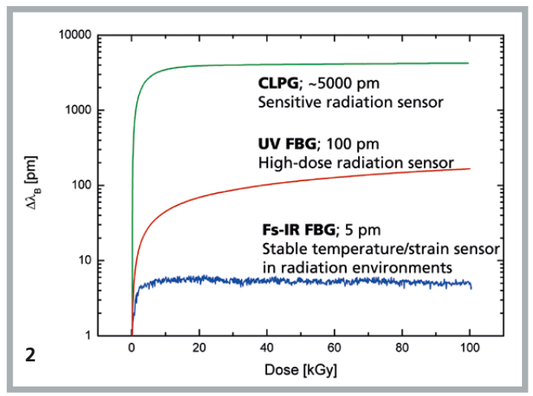
The Fiber Bragg Grating (FBG) is meanwhile a widespread sensor technology. FBGs are produced by irradiating an optical fiber with ultraviolet (UV) light from the side, which changes the refractive index locally. The result is a one-dimensional periodic structure that is inscribed into the fiber by the light (Fig. 1). If light of a specific wavelength along the fiber now strikes the FBG, interference at the FBG causes it to be reflected back. In transmission, there is a corresponding gap at this wavelenght. The formula for this Bragg wavelength is: $\lambda = 2\ n\ \Lambda$, whereby Λ describes the grating element gap, and n is the refractive index. If the refractive index at the grating is changed by the influence of ionizing radiation, then λ changes as well. This change can be measured by a precise spectrometer.



Fraunhofer INT has been intensively studying the influence of ionizing radiation on FBGs for several years (see also Annual Report 2008). The goal is to identify radiation-sensitive FBGs as sensors in high radiation dose environments, as well as FBGs that are resistant to radiation while sensing of other parameters in radiation environments. Extensive studies of the variation of standard FBG production parameters have shown strict limits to adjusting sensitivity.

A great disadvantage in the production of FBGs with UV light is that only optical fibers can be used that have been made photosensitive by adding certain elements. A new method uses femtosecond (fs) pulses of infrared (IR) light. With this method, it is possible to inscribe FBGs into any glass fiber. FBGs can thus be written into fluorine doped fibers that were shown to be particularly radiation resistant in a recent joint INT / CERN project. In fact, the fs-IR FBGs in these fibers are very radiation resistant and show shifts of a few picometers at a dose of 100 kGy (Fig. 2).

Another production method is used for chiral long-period gratings (CLPG). Here, the periodic structure is generated mechanically, by heating and twisting the fibers. Since the core is always somewhat eccentric, the result is a spiral-shaped periodic structure. This has similar transmission properties to the conventional FBGs. With the mechanical stress, one would expect a significantly higher sensitivity to ionizing radiation. Irradiation tests at Fraunhofer INT have confirmed this, showing an increase in the wavelength shift of these CLPGs of 1 to 2 orders of magnitude compared to standard FBGs (Fig. 2).



SCIENTIFIC-TECHNICAL SUPPORT

The Department Nuclear and Electromagnetic Effects Department (NE), has an extensive scientific-technical infrastructure that supports all experimental work in its three Business Units. Belonging to this infrastructure is a precision engineering laboratory which makes special mechanical parts for experimental apparatus, and an electronics laboratory which produces specific electronics for experimental work and carries out servicing and repairs. The Department also has its own secretariat. The following is a selective overview of the tasks performed:

- Cooperating on the installation of new irradiation facilities
- Electronics for safety systems (radiation protection interlock)
- Monitoring technical work: interlock system for TK 1000A irradiation facility
- Work safety, fire protection and office technology
- Hosting 3 scientific assistants
- Hosting 5 school-age trainees (from 1 to 3 weeks).

Precision-engineering laboratory:

- Constructing and adjusting special apparatus for experiments
- Special mountings and fastenings for irradiation work (including sample boxes for CERN)
- Constructing special antennas and casings
- Supporting the installation of new irradiation facilities, in particular for the new gamma irradiation facility TK 1000B (e. g. lead door (2.55 t), source support)
- Coax-DC switches, directional couplers
- Preparing platforms for presentations (incl. Deutschlandtag).

Electronics laboratory:

- Providing extensive support for all fields in preparing and conducting experimental work
- Consulting in the planning of INT's new buildings
- Developing irradiation and measuring boards
- Servicing and operating the neutron generators for irradiation projects
- Preparing and supporting measurements of CO_2 soil content (ANSTO Project)
- Operating the measuring computer network and converting to HTB 10

Secretariat:

- Formatting and producing posters
- Providing organizational support for projects
- Formatting study reports, radiation protection documentation
- Preparing and drafting EU project applications (e. g. Framework Programme 7)
- Preparing and hosting workshops.

BUSINESS ADMINISTRATION AND CENTRAL SERVICES

Prof. Dr. Harald Wirtz

Business Administration and Central Services is the department responsible for all commercial and administrative tasks in the Institute. As well as providing the central infrastructure, department staff also carries out employer duties such as workplace safety and security.

Triggered by the sharp increase in staff, the department was split into single sub-groups in 2011. For the future, there are to be two sub-groups, one for Finance and Human Resources, and one for Infrastructure. The three sub-sections Security, Marketing and Public Relations will continue to operate independent of this.

Department tasks cover the following:

Finance and Accounting, Purchasing

This area performs the Institute's book-keeping in accordance with German commercial and tax law. Current transactions are simultaneously entered in finance and cost accounts to make costs available for both internal accounting and controlling. The area also handles the purchase of all consumer items and investment goods, in compliance with purchase guidelines and the official German terms for awarding service and construction contracts (VOL/VOB). In cooperation with the Fraunhofer Gesellschaft HQ in Munich, tenders for major procurements are invited throughout Europe. The department also manages the INT cash office, handling all cash and non-cash payments.

Controlling and Project Administration, Auditing

Controlling's task covers all monetary processes within Fraunhofer INT, which includes the continuous supervision and control of the Institute's entire budget. To this end, the department evaluates cost and performance accounts as well as the finance accounts, and produces monthly control data showing projections on a cost and payment basis.

There is also administrative support for project budgets in other departments, involving help in drafting quotations and applications, calculating, concluding contracts and budget supervision. Since sponsors continuously conduct internal and external audits of the Institute, the department also deals with all audit inquiries.

Human Resources

Human Resources supports the Institute's management in personnel planning, and processes all personnel tasks such as job advertising, hiring, job evaluations and resultant income-group classification, as well as contract extenuation. In addition to general administrative duties such as personnel file and data management, HR supports INT departments in selection procedures, providing references and other services. Staff members are also given advice on all questions of labor and pay law.

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Travel Management

Travel Management assists staff on every aspect of official travel, from planning and preparation, to transport and hotel booking and, finally, travel expense accounting in accordance with Federal Law.

Facility Management / Internal Services

Tasks for this section include registering and organizing necessary repairs, coordinating user interests in construction work, equipment administration, managing and maintaining the vehicle fleet, procuring and managing furniture and office material, organizing office cleaning and operating the INT printing office. Another important activity was advising and supporting the heads of both administration and Institute, in advance of the construction work on INT's premises.

Marketing and Public Relations

This section does all the necessary communications and marketing work for results produced by INT's various business units. All activities are closely coordinated with the scientists concerned.

Two key projects for the section were the "Deutschlandtag" festival from October 1 to October 3 in Bonn, in celebration of German Unification Day (see p. 63), and the relaunch of the Institute's Internet website.

Library and Specialized Information Services

Key element of this work is procuring and managing the media required by the Institute, and supporting the scientists in research work and accessing information. The section continues its comprehensive support of the Institute's publication work.

The special skills available are also in demand beyond the Institute: as part of her work in the Steering Committee, Ms Siegrid Hecht-Veenhuis is co-managing all substantive and specialist questions concerning the Fraunhofer Gesellschaft project "eLib – enhanced library", representing user interests in INT. The future eLib system will serve to find and make available specialist information sources to the Fraunhofer Gesellschaft, especially to the scientists.

The Bezirksregierung in Cologne, the regional government office, has also recognized the value of Ms Hecht-Veenhuis's expertise, co-opting her on to the experts' sub-committee of North Rhine-Westphalia's vocational training committee. The task is to develop an education program leading to a qualification as certified expert in media and information services.

The library also trains specialist media and information services staff in the fields of information and documentation.

Central IT Services

This section is responsible for the whole of the Institute's IT infrastructure, providing top level support for the users.

Information Security

Information is a critical resource in an organization. Protecting information from unauthorized access, change or loss is more important than ever – especially in a facility concerned with security and defence research. This section supports information security management and the implementation and maintenance of secrecy regulations.

1 *Prof. Dr. Harald Wirtz*

NAMES, DATES, EVENTS

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DEUTSCHLANDFEST 2011

"Fraunhofer is the most important research organization in the Bonn area" – to put this message across to the public at large, the Fraunhofer Institutes in and around Bonn made use of the German Day platform "Deutschlandfest 2011". The event, celebrating the re-unification of Germany, was held in the Federal City of Bonn, in recognition of North Rhine-Westphalia's Presidency of the Bundesrat, the legislative body that represents Germany's 16 federal states. Visits by leading politicians, high media interest and the large number of interested visitors made an ideal setting for an information stage.

The premises of the Bonn Aachen International Center for Information Technology (B-IT) were kindly made available for the presentation of current Fraunhofer research projects. As well as INT, participating Fraunhofer institutes were FHR and FKIE in Wachtberg, and IAIS, FIT and SCAI in St. Augustin. The concept was to stage the exhibits in the most interactive way possible, presenting the public with "hands-on research".

Younger visitors were especially attracted to INT's model railway, which demonstrated how radioactivity can be detected in freight transports. Also popular was a pane of glass that can register the location and intensity of shocks (for demonstration purposes, visitors were able to strike the glass with a padded hammer). The model of a Co-60 irradiation facility also caught the attention of interested visitors.

Other highlights were the Roberta Project, which gave youngsters the opportunity to assemble and program simple robots, and a gesture control system that uses a camera to track hand and finger movements exactly.

B-IT is ideally situated in the center of Bonn's former federal government quarter, very close to the Bundestag, the former parliament building, and to Palais Schaumburg, the Bonn residence of Federal President Christian Wulff, who had opened doors to the public for the day. To attract even more visitors to the exhibition, a mobile information stand was set up on the Rhine Promenade. There was also an optical design concept by the Wuppertal agency Panroyal, which gave visitors a network of white lines to guide them in and around the exhibition.

More than 4000 visitors in three days, plenty of interested inquiries and a generally positive echo showed that the effort had paid off. The event lastingly strengthened Fraunhofer's profile in general and INT's presence in the Bonn area in particular.

1 *Window pane with Smart Security Glass detects changes in temperature and concussions*

2 *Model train demonstrates detection of radioactive material*

FUTURE SECURITY 2011

Presenting scientific projects, exchanging experience and discussing new developments – the 6th Future Security Conference again attracted many important people from German and European security research to its venue in Berlin. The large number of participants from politics, science and industry is a clear sign that this conference is firmly established in the Community's appointments diary. The conference is organized every year by the Fraunhofer Verbund Verteidigungs- und Sicherheitsforschung (Fraunhofer Group for Defence and Security – VVS), whose members include Fraunhofer EMI, FHR, FKIE and IOSB as well as Fraunhofer INT. Conference organization was in the hands of the Fraunhofer Institut für Hochfrequenzphysik und Radartechnik in Wachtberg bei Bonn (Fraunhofer Institute for High Frequency Physics and Radar Techniques – FHR). Again in 2011, the role of conference patron was taken by the Bundesministerium für Bildung und Forschung (the Federal Ministry of Education and Research – BMBF).

A wide range of security research was as usual on the agenda. There were two sessions on food and supply chain security – themes that took on new dynamics, not least because of the EHEC outbreak in northern Germany. Other conference topics dealt with cyber defence, CBRNE and maritime security.

Participating scientists came from the Fraunhofer Gesellschaft and other research centers, including the Deutsches Zentrum für Luft- und Raumfahrt (German National Research Center for Aeronautics and Space – DLR), the Bundesinstitut für Risikobewertung (German Institute for Risk Analysis – BfR), and TNO from the Netherlands. Representatives from politics and industry included Dr. Christian Ehler from the European Parliament; Prof. Dr. Jürgen Stock, Vice President of the Bundeskriminalamt (Federal Criminal Police Office – BKA); and Martin Borett, Head of the IBM Institute for Advanced Security, Europe. The conference plenary was addressed by Prof. Dr. Joachim Ender, Head of Fraunhofer FHR and Conference Chairman; Dr. Wolf Junker, Head of Security Research at BMBF; and Rainer Krug, Head of R&T Strategy in the Bundesverteidigungsministerium (Federal Ministry of Defence – BMVg).

INT contributed to the conference with the following talks:

- Dr. Michael Suhrke, Christian Adami: Detection of High Power Microwaves
- Dr. Merle Missoweit: FP7 Project Acrimas
- Dr. Sebastian Chmel: Enhancing Nuclear Security at Ukrainian Border Stations to prevent illicit Trafficking

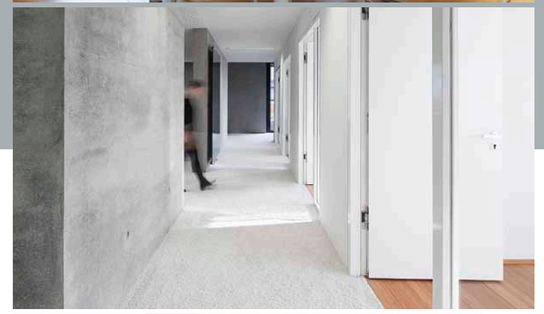
As part of the poster session that accompanied the conference, there were contributions on the EU projects ESFO and ETCETERA, and on "Scenario Oriented Assessment of Hazardous Biological Agents". Three sessions were also conducted by INT chairmen: Hans-Martin Pastuszka on "Crisis Management II", Dr. Wolfgang Rosenstock on "Response to CBRNE Threats", and Dr. Joachim Schulze on "Social Dimensions of Security".

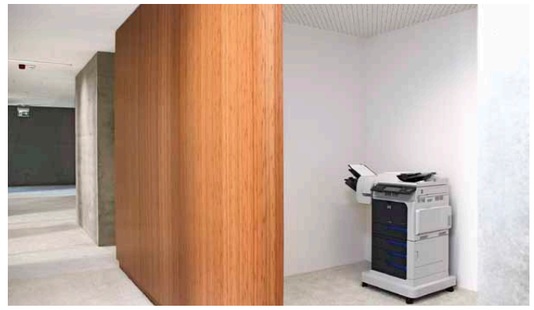
Conference venue was the Federal Representation of North Rhine-Westphalia in Berlin Tiergarten. The 2012 conference will be in the former Federal Government quarter in Bonn. Information on the event is at: www.future-security.eu

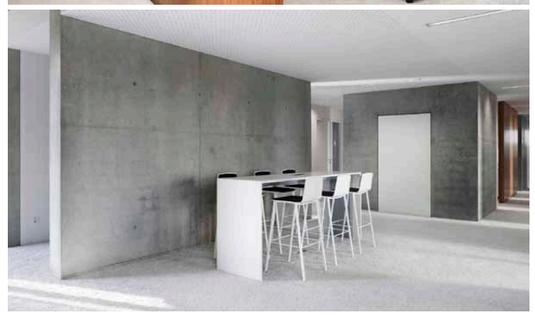
NEW CONSTRUCTION OFFICE BUILDING

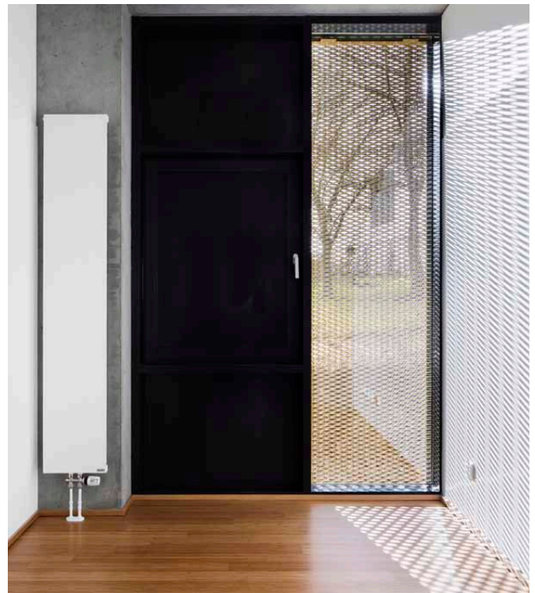
INT has not only seen an increase in staff numbers, the building complex is also expanding, Construction is following a three-stage master plan, as described in last year's report. At the end of 2010, work began on the first stage, a new office building with capacity for 16 single work places. On completion in December 2011, the offices were equipped and the staff moved in.

Stage two, scheduled to begin in 2012, foresees a new seminar room, including a connecting corridor to the existing buildings. Work is expected to begin in summer and should be completed in the first half of 2013.









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SHORT NOTES

System Demonstrator CHORUS – Technical Feasibility Proven

On 22 June, 2011, a lab-based demonstrator for a new warning system with wake-up-effect was presented to the public as part of Fraunhofer INT's lecture program. Under the title "CHORUS – Car Horns used as Sirens", Dr.-Ing. Guido Huppertz and Udo Weinand explained their alarm signal process. With the use of a standard car horn, they also demonstrated how to generate a rising and falling note that resembles a typical siren. The project had already been shown on WDR Television on 6 June, 2011.
Find more information at: www.int.fraunhofer.de

21st Practical IT Security Conference

The 21st Practical IT Security Conference, formerly titled "Rheinlandtreffen", was held on 14 and 15 September, 2011, on the premises of Fiducia IT AG in Karlsruhe. As in past years, the conference addressed a broad spectrum of technical and non-technical IT security themes. This time, the emphasis was on the chances and risks arising from cloud computing. The focus was also on specific problems of today's complex IT landscape that result from the common use of local or widespread systems – many of which are solely designed and used with a view to functionality, regardless of security.

3rd Space Forum – The European Approach

Fraunhofer INT's Business Unit NEO and the Fraunhofer EMI Business Segment Space shared a joint stand at the 3rd DWT Space Forum in Bonn Bad Godesberg. Staged on 20 and 21 September, 2011, by the German Association for Defence Technology (Deutsche Gesellschaft für Wehrtechnik DWT), the event focused on the progress of German and European institutions in space policy.

Visitors to the INT stand were able to find out about NEO's expertise and range of offers in the aerospace sector. In discussions with our experts, many representatives from industry and defense made use of the opportunity to learn about the effects of space weather and irradiation effects on electronics and optics in general, as well as about irradiation and test possibilities at INT in particular.

Best Paper Award – EMC Europe 2011 in York, UK

Europe's leading forum on Electromagnetic Compatibility, the conference EMC Europe 2011 was held from 26 to 30 September in York, UK. At the conference, Fraunhofer INT's Business Unit "Electromagnetic Effects and Threats" won the Best Paper Award for its publication "HPM detection system for mobile and stationary use". The paper describes the basic requirements for a detection system for high-power microwaves (HPM), possible detector circuits, and a demonstrator developed at Fraunhofer INT.

Future Research Network

On 28 September, 2011, Dr. Birgit Weimert from Fraunhofer INT was appointed to a two-year term on the seven-strong executive board (Vorstand) of the associated network on future research (Netzwerk Zukunftsforschung e.v). Founded in 2007, the network promotes science and research, professional exchange and cooperation in scientific future research in the German language region. The network's scope includes quality standards and criteria for scientific future research. Its specialist working groups discuss wide-ranging aspects and current challenges relevant to research on the future.
More information is available at:
www.netzwerk-zukunftsforschung.eu

1 *Workshop „Energieträger und Antriebskonzepte der Zukunft aus Sicht der Forschung" (cf. p. 19)*

2 *Workshop „Herausforderung Weltraum" (cf. p. 53)*

APPENDIX

University Courses

Chmel, S.: Lecture Physics, Study programme (Bachelor's degree) "Naturwissenschaftliche Forensik" (2. Semester), Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, SS 2011

Chmel, S.: Lecture and exercises "Measuring Techniques", Study programme (Bachelor's degree), "Naturwissenschaftliche Forensik" (2. Semester), Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, WS 2011

Chmel, S.: Lecture and seminar "Atomic and Molecular Physics", Study programme (Master's degree) "Applied Physics", University of Applied Sciences Koblenz, Rhein-Ahr-Campus, WS 2011

Grüne, M.: Zukunftsforschung und Technologieprognosen, Seminar (Module CA1) "Technik und Gesellschaft", Study programme (Master's Degree) "Technik- und Innovationskommunikation", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, Summer Semester 2011, June 9 2011

Huppertz, G.: Nano Air Vehicles, Contribution to the lecture (Module C6 I) "Technik und Gesellschaft", Study programme (Bachelor's degree) "Technikjournalismus/PR", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, May 23 2011

John, M.: Über Cochlea Implantate und Cyborgs – Eine Innovation im Spannungsfeld von Kultur und Technik, Contribution to the lecture (Module C6 I) "Technik und Gesellschaft", Study programme (Bachelor's degree) "Technikjournalismus/PR", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, May 2 2011

John, M.: Das Cochlea Implantat: Funktionsweise, Entwicklung, Chancen, Risiken und Erfahrungen im Hinblick auf die logopädische Praxis, IB-Medizinische Akademie, Schule für Logopädie, Berlin, May 30 2011

Jovanović, M.: Bibliometrie - Die Wissenschaft der Wissenschaft, (Module CA1) "Technik und Gesellschaft", Study Programme (Master's Degree) "Technik- und Innovationskommunikation", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, April 14 2011

Jovanović, M.: Bibliometrie - Die Wissenschaft der Wissenschaft – Beispiel Drahtlose Energieübertragung, Contribution to the lecture (Module C6 I) "Technik und Gesellschaft", Study programme (Bachelor's degree) "Technikjournalismus/PR", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, June 6 2011

Jovanović, M.: Projektmanagement im Studium, Winter Semester 2010/2011, University Düsseldorf

Jovanović, M.: Projektmanagement im Studium, Summer Semester 2011, University Düsseldorf

Neupert, U.: Drahtlose Energieübertragung, Contribution to the lecture (Module C6 I) "Technik und Gesellschaft", Study programme (Bachelor's degree) "Technikjournalismus/PR", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, June 6 2011

Reschke, S.: Neurale & Biologische Ergonomie: Optimierung menschlicher Leistungsfähigkeit, Contribution to the lecture (Module C6 I) "Technik und Gesellschaft", Study programme (Bachelor's degree) "Technikjournalismus/PR", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, May 30 2011

Thorleuchter, D.: Textmining, Contribution to the lecture (Module CA1) "Technik und Gesellschaft", Study programme (Master's Degree) "Technik- und Innovationskommunikation", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, April 14 2011

Wiemken, U. (with contributions by John, M.; Huppertz, G.; Jovanović, M.; Reschke, S.; Neupert, U.): Lecture (Module C6 I) "Technik und Gesellschaft", Study programme (Bachelor's degree) "Technikjournalismus/PR", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, SS 2011

Wiemken, U. (with contributions by Grüne, M.): Seminar (Module CA1) "Technik und Gesellschaft", Study programme (Master's Degree) "Technik- und Innovationskommunikation", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, SS 2011

Wirtz, H.: Prozessmanagement – Change/ Innovation, Fresenius University of Applied Sciences, Cologne, Study programme (Master's degree) Media-Management & Entrepreneurship, SS 2011

Wirtz, H.: Investition, Finanzierung, Steuern, Fresenius University of Applied Sciences, Cologne, berufsbegleitender Diplomstudiengang BWL, WS 2010/2011, SS 2011, WS 2011/2012

Wirtz, H.: Finanzierung, Fresenius University of Applied Sciences, Cologne, Study programme (Bachelor's degree) Business Administration, 2010/2011, SS 2011

International Cooperation

Berky, W., Friedrich, H., Köble, T., Risse, M., Rosenstock, W.: JRC, Institute for the Protection and Security of the Citizen (IPSC), Nuclear Security Unit, G08, European Commission – Joint Research Centre, 21027 Ispra, Italy, cooperation in active neutron interrogation techniques and in situ methods of identification of fission material

Berky, W., Friedrich, H., Köble, T., Risse, M., Rosenstock, W.: ANSTO, Institute for Environmental Research, Australian Nuclear Science and Technology Organisation, joint measurements using the INT neutron generator GENIE16c to determine the carbon content in soil samples

Berky, W., Friedrich, H., Köble, T., Risse, M., Rosenstock, W.: CTBTO, Comprehensive Test Ban Treaty Organization, Vienna, Austria, collaboration on the CTBTO technology foresight process (with AP)

Römer, S., Burbiel, J.: Letter of Intent 6 – Disruptive Technology Group, April and December 2011

Burbiel, J., Goymann, S., Schietke, R.: Coordination of the FP7 Security Research Project ETCETERA (Evaluation of critical and emerging technologies for the elaboration of a security research agenda, www.etcetera-project.eu); 14 project partners, funding period October 2011 – September 2013

Huppertz, G.; Neupert, U.: FP7 Security Research Project ETCETERA: Management Work Packages 4

Köble, T., Rosenstock, W.: Discussion on methods for detecting fissile materials and explosives in suitcases at airports, together with Prof. Vadim L. Romodanov, Experimental Reactor Physics Institute, MEPhI, 115409, Moscow, Kashirskoe Shosse 31, Russian Federation, and his team; conducted in connection with the Canadian – European Project ISTC 2978 "Digital technology for the control of fissile materials in devices with pulsed sources" (Kö, Ro). Further cooperation partners are Università Degli Studi di Bari/Dipartimento Interateneo di Fisica (Italy) and Bubble Technology Industries Inc., Canada

Neupert, U.; Römer, S.: NATO Research and Technology Organisation (RTO), Panel "Studies, Analyses and Simulation (SAS)", Task Group 082 "Disruptive Technology Assessment Game (DTAG), Extension and Applications": Technology Chair und German PoC (U. Neupert), 2011: Organisation and analysis of a DTAG including the preparation of the final report

Neupert, U.: NATO-RTO, Panel SAS: Contributions to a concept paper regarding the professionalization of the DTAG methodology

Pastuszka, H.-M.: Participation in FP7 security research project CRESCENDO (Coordination Action on Risks, Evolution of Threats and Context Assessment by an enlarged Network for an R&D Roadmap, cf. www.crescendo-project.org); 22 project partners, funding period July 2009 – June 2011

Pastuszka, H.-M., Missoweit, M.: Coordination of the FP7 Security Research Project ACRIMAS (Aftermath Crisis Management System-of-Systems, Demo phase I, cf. www.acrimas.eu); 15 project partners, duration: February 2011 – April 2012

Römer, S.: Member of the expert reference group for the study "Tools for evaluating and measuring progress in the establishment of a Level Playing Field (LPF) in the European Defence, Equipment Market (EDEM) – Key indicators for LPF" (prepared by RAND Europe for the European Defence Agency)

Römer, S.; Pinzger, B.; Pastuszka, H.-M.: Contribution to the study on Civil Military Synergies in the Field of Security (subproject within the European Commission framework contract ENTR/09/50); 7 project partners, duration September 2011 – February 2012

Römer, S.: Collaboration in the trilateral cooperation with the Netherlands and Sweden (information exchange on technologies; workshop 2011 on "Team Situation Awareness in Small Unit Operations")

Rosenstock, W.: Working Group on Verification Technologies and Methodologies (VTM), organized by the Non Proliferation and Nuclear Safeguards Unit in the Joint Research Centre in Ispra, Italy, where verification (in general, not exclusively nuclear) is in permanent process for ESARDA (European Safeguards Research and Development Association)

Ruhlig, K.: LoI6 Disruptive Technologies Group: Preparation of the LoI6-Checklists "Quantum Computers" and "Metamaterial Cloaking"

Suhrke, M.: Collaboration in the NATO RTO SCI-198 Task Group Protection of Military Networks against High Power Microwave Attacks: Meeting 2011: Gramat, France, March 14 – 16 2011, Norfolk, USA, May 12 2011, Paris, France, November 8 – 10 2011

Suhrke, M.: NATO RTO SCI-227-ST on Directed Energy Weapons (DEW) Related Capabilities: Near, Mid, Long Term Prospects, Brussels, Belgium, Meeting 2011: Paris, January 25 – 27 2011, Gramat, March 16 – 17 2011

International Reviews

Höffgen, S., Kuhnhenn, J.: IEEE Transactions on Nuclear Science, ISSN: 0018-9499

Höffgen, S., Kuhnhenn, J., Metzger, S.: Conference on Radiations Effects on Components and Systems (Radecs) 2011, September 19 – 23 2011, Sevilla

Jovanović, M.: Scientometrics , E-ISSN: 1588-2861

Kuhnhenn, J.: Optics Communications, Elsevier, ISSN: 0030-4018

Lubkowski, G.: Progress in Electromagnetic Research, EMW-Publishing, E-ISSN: 1070-4698

Rosenstock, W.: Methodology of the CBRNE Guidebook Template (for the EU Directorate of Home Affairs), European Commission, Directorate-General "Justice, Freedom and Security"

Suhrke, M.: IEEE Transactions on Electromagnetic Compatibility, E-ISSN: 1558-187X

Suhrke, M.: Mitglied des Programmkomitees für das NATO SCI-232 Symposium on High Power Microwaves and Directed Energy Weapons, Norfolk, Virginia, USA, May 9 – 11 2011

Thorleuchter, D.: Technological Forecasting and Social Change, Elsevier, E-ISSN: 1873-5509

Thorleuchter, D.: Electronic Commerce Research and Applications, Elsevier, E-ISSN: 1873-7846

Thorleuchter, D.: International Journal of Information Science, E-ISSN: 2763-193X

Collaboration in Committees

Köble, T.; Rosenstock,W.: National workgroup radiological bomb (NAG RB), organized by BMVg, Rü IV

Köble, T.: UAG 2: Physikalische Wirkung

Missoweit, M.: R&T national Points of Contact Group of the European Defence Agency

Missoweit, M.: Points of Contact/Group of Research Directors of the Letter of Intent 6 Framework Agreement/European Defence Industry Restructuring

Missoweit, M.: Working Group "Strategic Aspects" of the Fraunhofer EU network, coordination

Missoweit, M.: FP7 Societal Impact Advisory Group of the EU Commission, DG ENTR

Missoweit, M.; Pinzger, B.; Römer, S.; Schietke, R.; Schulze, J. (Chair): Ad hoc working group of the Commission on Civil Protection of the Federal Ministry of the Interior "Entwicklung eines Punktesystems zur Einschätzung potentieller biologischer Gefahrenlagen", hosting and cooperation

Pastuszka, H.-M.: FP7 Security Advisory Group der EU-Kommission, Generaldirektion Unternehmen und Industrie (DG ENTR)

Pastuszka, H.-M.: Abstimmungsgespräche BMVg-Ressortforschung

Römer, S., Burbiel, J.: Disruptive Technology Group, Letter of Intent 6 Framework Agreement/European Defence Industry Restructuring

Rosenstock, W.: Chair of UAG: UAG1: Bedrohungsanalyse

Schulze, J.; Schietke, R.; Pastuszka, H.-M.: Fraunhofer Representative at ERATO's EUROTECH Security Research Group (European Association of Research and Technology Organisations)

Thorleuchter, D.: Chairman of the Special Interest Group "Information- and Communication Systems" of the German Computer Society (Gesellschaft für Informatik e.V. (GI))

Thorleuchter, D.: Program Committee 2nd International Conference on Advancements in Computing Technology (ICACT 2011), November 29 – December 1 2011, Jeju Island, Republic of Korea

Thorleuchter, D.: Program Committee 6th International Conference on Computer Sciences and Convergence Information Technology (ICCIT 2011), November 29 – December 1 2011, Jeju Island, Republic of Korea

Thorleuchter, D.: Program Committee International Conference on Engineering and Industries (ICEI 2011), November 29 – December 1 2011, Jeju Island, Republic of Korea

Thorleuchter, D.: Program Committee 7th International Conference on Advanced Information Management and Service (ICIPM 2011), November 29 – December 1 2011, Jeju Island, Republic of Korea

Thorleuchter, D.: Program Committee International Conference on Interaction Sciences; Information Technology, Culture and Human (ICIS 2011), August 16 – 18 2011, Busan, Republic of Korea

Thorleuchter, D.: Program Committee 2nd International Conference on Next Generation Information Technology, (ICNIT 2011), June 21 – 23 2011, Gyeongju City, Republic of Korea

Thorleuchter, D.: Program Committee 3rd International Conference on Data Mining and Intelligent Information Technology Applications (ICMIA 2011), October 24 – 26 2011, Macao

Thorleuchter, D.: Program Committee International Conference on Mobile IT Convergence (ICMIC 2011), September 26 – 28 2011, Gumi, Republic of Korea

Thorleuchter, D.: Program Committee 7th International Conference on Digital Content, Multimedia Technology and its Application (IDCTA 2011), August 16 – 18 2011, Busan, Republic of Korea

Thorleuchter, D.: Program Committee 7th International Conference on Networked Computing, (INC 2011), September 26 – 28 2011, Gumi, Republic of Korea

Thorleuchter, D.: Program Committee 16th North-East Asia Symposium on Nano, Information Technology and Reliability (NASNIT 2011), October 24 – 26 2011, Macao

Thorleuchter, D.: Program Committee 7th International Conference on Networked Computing and Advanced Information Management (NCM 2011), June 21 – 23 2011, Gyeongju, Republic of Korea

Thorleuchter, D.: Program Committee 5th International Conference on New Trends in Information Science and Service Science (NISS 2011), October 24 – 26 2011, Macao

Thorleuchter, D.: Editorial Board of the International Journal of Information Science

Weimert, B.: Election to the board of the Netzwerk Zukunftsforschung e.V., September 28 2011

Participation in Norming Processes

Adami, Ch.: NA 140-00-19 AA
Writing VG standards VG96900-96907, NEMP and Lightning Protection, Creation of the VG-standards on Equipment Limits

Adami, Ch.: NA 140-00-20-02UA
Creation of the VG-standards VG95370 ff, Electromagnetic Compatibility

Suhrke, M.: GAK 767.3/4.4
"TEM-Wellenleiter und Reverb-Chamber" (TEM waveguide and Reverb Chamber), DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (DKE German Commission for Electrical, Electronic & Information Technologies within DIN and VDE)

Lectures and Presentations

Thorleuchter, D.:
Finding new technological ideas and inventions with text mining and technique philosophy, Ghent University, Belgium, January 4 2011

Thorleuchter, D.:
Mining ideas from textual information, Ghent University, Belgium, January 4 2011

Thorleuchter, D.:
A compared R&D-based and patent-based cross impact analysis for identifying relationships between technologies, Ghent University, Belgium, January 4 2011

Thorleuchter, D.:
Extracting Consumers Needs for New Products – a Web Mining Approach, Ghent University, Belgium, January 4 2011

Thorleuchter, D.:
Mining innovative ideas to support new product research and development, Faculty of Economics and Business Administration, Ghent University, Belgium, January 4 2011

Thorleuchter, D.:
Predicting e-commerce company success by mining the text of its publicly-accessible website, Ghent University, Belgium, January 4 2011

Thorleuchter, D.:
Analyzing existing customers' websites to improve the customer acquisition process as well as the profitability prediction in B-to-B marketing, Ghent University, Belgium, January 4 2011

Kuhnhenn, J.:
Effects of radiation on electronic components in satellites: risks and assessment, at invitation of SwissRe, Zurich, January 15, 2011

Pastuszka, H.-M.:
Europäische Sicherheitsforschung – Möglichkeiten und Herausforderungen, Presentation for BBK and THW, Bonn, January 19 2011

Pastuszka, H.-M.:
Sicherheitsforschung der EU am Beispiel der Schaffung eines einheitlichen Werkzeuges für die humanitäre Minenräumung, 9. Fachtagung Kampfmittelbeseitigung Dresdner Sprengschule, Dresden, January 27 2011

Thorleuchter, D.:
Textmining for improved decision making, Faculty of Economics and Business Administration, Ghent University, Belgium, February 3 2011

Suhrke, M.:
The nuclear electromagnetic pulse, Interdisciplinary working group "Naturwissenschaft, Technik und Sicherheit (IANUS)", Technische Universität Darmstadt, February 9 2011

Müller, S:
Technologie-Roadmap Intelligente Mobile Systeme, Forum Unmanned Vehicles III der Studiengesellschaft der Deutschen Gesellschaft für Wehrtechnik, Bonn-Bad Godes-berg, February 15 2011

Metzger, S.:
Forschungs- und Technologiesymposium "Technologien für Intelligenten Schutz", BAkWVT Mannheim: "Weltraumwetter – Eine Gefahr für Satelliten", Mannheim, February 23 – 24 2011

Suhrke, M.:
HPM Susceptibility of Electronic Systems, Directed Energy Weapons 2011, London, February 23 – 24 2011

Pastuszka, H.-M.:
FP7 Security Advisory Group (SecAG), EUROTECH Security Research Group Meeting, Euskirchen, February 24 2011

Thorleuchter, D.:
Text Mining zur Entdeckung von Innovationen, DIFI-Tagung, Darmstadt, Germany, March 15 2011

Rosenstock, W.:
"Technische und politische Faktoren der nuklearen Verifikation", 75. Annual meeting of the "Deutsche Physikalischen Gesellschaft (DPG)", Meeting "Abrüstung und Verifikation", Dresden, March 16 –18 2011

Rosenstock, W.:
Requirements on Neutron Detectors Alternative to He-3. Neutron Detector Technologies Workshop – IAEA short term needs for existing installed SG instrumentation. IAEA, Vienna, Austria, March 22 – 24 2011

Burbiel, J.:
Sicherheitsforschung in Deutschland, der EU und dem Vereinigten Königreich, Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, April 7 2011

Goymann, S.:
F&T Landschaft Indien, Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, April 7 2011

Goymann, S.:
Sicherheitsprogramm BMBF und F&T in NRW, Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, April 7 2011

Thorleuchter, D., Van den Poel, D., Prinzie, A.:
LSI based Profitability Prediction of new Customers, SIAM International Workshop on Data Mining for Marketing (DMM 2011), Mesa, Arizona, USA, April 30 2011

John, M.:
Über Cochlea Implantate und Cyborgs – Eine Innovation im Spannungsfeld von Kultur und Technik, Contribution to the lecture (Module C6 I) "Technik und Gesellschaft", Study programme (Bachelor's degree) "Technikjournalismus/PR", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, May 2 2011

Metzger, S.:
"Neue Testeinrichtungen zur Untersuchung von Strahlungseffekten am Fraunhofer INT", DLR-Industriekonferenz 2011, Backnang, May 3 – 4 2011

Kuhnhenn, J.:
Backnang: "Strahlungseffekte in optischen Komponenten – Effekte und Testprozeduren", Presentation at Tesat-Spacecom, Backnang, May 3 2011

Burbiel, J.:
Psychopharmaka – Chemie für die Seele, Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, May 9 2011

Adami, Ch.:
High Power Microwave Tests of Media Convertrers, Symposium on High Power Microwaves and Directed Energy Weapons, Norfolk, Virginia, USA, May 9 – 11 2011

Braun, Ch.:
High Power Microwave Tests of a Deployable C4I Network, Symposium on High Power Microwaves and Directed Energy Weapons, Norfolk, Virginia, USA, May 9 – 11 2011

Suhrke, M.:
Detection of High Power Microwaves, Symposium on High Power Microwaves and Directed Energy Weapons, Norfolk, Virginia, USA, May 9 – 11 2011

Grüne, M.:
Neue Technologien für neue Herausforderungen in Verteidigung und Sicherheit (Teil 1), Seminar of the Carl-Cranz-Gesellschaft "Sicherheit in einer multipolaren Welt – Die Notwendigkeit zur Änderung von Sicherheitspolitik, Strategie und militärischer Ausrüstung", Oberpfaffenhofen, May 11 2011

Grüne, M.:
Neue Technologien für neue Herausforderungen in Verteidigung und Sicherheit (Teil 2), Seminar of the Carl-Cranz-Gesellschaft "Sicherheit in einer multipolaren Welt – Die Notwendigkeit zur Änderung von Sicherheitspolitik, Strategie und militärischer Ausrüstung", Oberpfaffenhofen, May 11 2011

Metzger, S.:
Final Presentation of the TRP activity ESA-ESTEC Noordwijk: "Investigation and Analysis of Very High Energy Accelerators for Radiation Simulation – Executive Summary", May 20 2011

Metzger, S.:
Final Presentation of the TRP activity, ESA-ESTEC Noordwijk: "Investigation and Analysis of Very High Energy Accelerators for Radiation Simulation – Recommendations for Future Research Programs, May 20 2011

Höffgen, S.:
Final Presentation of the TRP activity, ESA-ESTEC Noordwijk: "Investigation and Analysis of Very High Energy Accelerators for Radiation Simulation – Electronic Devices Irradiation, Results and Analysis", May 20 2011

Huppertz, G.:
Nano Air Vehicles, Contribution to the lecture (Module C6 I) "Technik und Gesellschaft", Study programme (Bachelor's degree) "Technikjournalismus/PR", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, May 23 2011

Reschke, S.:
Materialeffizienz durch neue Werkstoffe, Conference "Ressourcenschonung" of the Cluster Sondermaschinen- und Anlagenbau (SMAB) in cooperation with TTI Technologietransfer und Innovationsförderung Magdeburg GmbH, Magdeburg, May 25 2011

Reschke, S.: Neurale & Biologische Ergonomie: Optimierung menschlicher Leistungsfähigkeit, Contribution to the lecture (Module C6 I) "Technik und Gesellschaft", Study programme (Bachelor's degree) "Technikjournalismus/PR", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, May 30 2011

Suhrke, M.:
Elektromagnetische Einkopplungsmessungen am Fraunhofer INT Euskirchen, Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, May 30 2011

Neupert, U., Jovanović, M.: Drahtlose Energieübertragung, Contribution to the lecture (Module C6 I) "Technik und Gesellschaft", Study programme (Bachelor's degree) "Technikjournalismus/PR", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, June 6 2011

Missoweit, M.:
Chair Panel: What do citizens expect – and how can European Security Research meets their expectations? Workshop "Security research and Europe's societal challenges: what do citizens want?", DG ENTR, Oslo, June 7 – 8 2011

Grüne, M.:
Zukunftsforschung und Technologieprognosen, Seminar (Module CA1) "Technik und Gesellschaft", Study Programme (Master's Degree) "Technik- und Innovationskommunikation", Bonn-Rhine-Sieg University of Applied Sciences, Sankt Augustin, Summer Semester 2011, June 9 2011

Pastuszka, H.-M.:
FP7 Project ACRIMAS – Aftermath Crisis Management System-of-systems Demonstration, International Emergency Management Society (TIEMS) 18th Annual Conference, Natural and Technological Risk Reduction through Global Cooperation, 7 – 10 June 2011, Bukarest, Rumänien, June 9 2011

Lubkowski, G.:
Optische und Photonische Anwendungen von Metamaterialien im Weltraum, – Meeting of the Advisory Board, INT, Euskirchen, June 15 2011

Pastuszka, H.-M.:
Aftermath Crisis Management System-of-systems Demonstration Phase I – ACRIMAS, Project overview presentation to FP7 project CRISYS (Critical Response in Security and Safety Emergencies), 1st Workshop, Brussels, June 20 2011

Pastuszka, H.-M.; Missoweit, M.:
Organisation and coordination of the first European Workshop under the FP7 ACRIMAS project "Key Missions and Tasks in Crisis Management in Europe", Bonn, June 30 2011

Jovanovic, M., Fritsche, F.:
There goes another one: Introducing the NUCA-set of indicators, 13th International Conference of the International Society of Scientometrics & Informetrics, Durban, South Africa, July 5 2011

Grüne, M., Neupert, U.:
Die neue Wehrtechnische Vorausschau WTV2011+, Federal Office of Defense Technology and Procurement (BWB), Koblenz, July 15 2011

Metzger, S.:
Joint Space Weather Summer Camp 2011 DLR-Campus Neustrelitz: "The Impact of Space Weather on Satellites", July 17 – August 14 2011

Müller, S.:
Roadmapping als Instrument des Fraunhofer-Strategie-Prozesses, Seminar der Fraunhofer-Gesellschaft zum Fraunhofer-Strategie-Prozess, Munich, July 18 2011

Risse, M.:
Car-borne tracking of fissile material by covert search procedures, INMM Conference, Palm Desert, USA, July 21 2011

Thorleuchter, D., Van den Poel, D.:
Semantic Technology Classification, International Conference on Uncertainty Reasoning and Knowledge Engineering (URKE 2011), Bali, Indonesia, August 4 2011

Thorleuchter, D., Van den Poel, D.:
Companies Website Optimising concerning Consumer's searching for new Products, International Conference on Uncertainty Reasoning and Knowledge Engineering (URKE 2011), Bali, Indonesia, August 4 2011

Missoweit, M., Pastuszka H.-M.:
Aftermath Crisis Management System-of-systems Demonstration Phase I – ACRIMAS, Project overview presentation to FP7 project CRISYS (Critical Response in Security and Safety Emergencies), Future Security Conference 2011, Berlin, September 5 2011

Suhrke, M.:
Detection of High Power Microwaves, Future Security 2011, Fraunhofer VVS, Berlin, September 5 – 7 2011

Pastuszka, H.-M., Missoweit, M.:
Organisation and Coordination of the second European Workshop under the FP7 ACRIMAS project "Current Gaps and Needs in Crisis Management in Europe", Prague, Czech Republic, September 7 2011

APPENDIX

Chmel, S.:
Enhancing Nuclear Security at Ukrainian Border Stations to Prevent Illicit Trafficking, Future Security – 6th Security Research Conference, Berlin, September 7 2011

Reschke, S.:
Technologiefrühaufklärung: Frontend des strategischen Innovationsmanagement, DiFi Conference 3/2011: "Technology-Push Innovation", Geschka & Partner Unternehmensberatung, Bonn, September 13 2011

Gericke W., Thorleuchter, D:
Aktuelle Entwicklungen in der praktischen IT-Sicherheit, Konferenz zur praktischen IT-Sicherheit 2011, Karlsruhe, Germany, September 14 2011

Thorleuchter, D:
Strategien der GI-Fachgruppenleitung BIK ,,Betrieb von Informations- und Kommunikationssystemen", Jahrestagung der Fachgruppe BIK der Gesellschaft für Informatik, Karlsruhe, Germany, September 14 2011

Gericke W., Thorleuchter, D:
Zukunftsperspektiven der Konferenz, Konferenz zur praktischen IT-Sicherheit 2011, Karlsruhe, Germany, September 15 2011

Kunze, S.:
"Laser System for the Simulation of Single-Event-Effects (SEE)", RADLAS, Paris September 16 2011

Höffgen, S.:
"Investigations of Single Event Effects with Heavy Ions of Energies up to 1.5 GeV/n", RADECS 2011, Sevilla, September 19 – 23 2011

Gericke, W.:
Dokumentenverwaltung und Geheimschutz, FhG-ATIS, Fulda, September 20 – 21 2011

Pastuszka, H.-M.:
Building of European Crisis Intervention Capabilities – Challenges from a Researcher's Perspective, 6th European Security Research Conference SRC'11, September 19 – 21 2011 Warsaw, Poland, September 20 2011

Rosenstock, W.:
Hindernisse bei der technischen Verifikation nuklearer Abrüstung. 5. Symposium: Nukleare und radiologische Bedrohungen – Technologische Urteilsfähigkeit und nukleare Sicherheit in Deutschland, Fraunhofer-INT, Euskirchen, September 20 – 22 2011

Metzger, S.:
"Business Unit Nuclear Effects in Electronics and Optics (NEO) – Overview of activities and facilities at Fraunhofer INT", Cicor Microelectronics, Radeberg, September 23 2011

Suhrke, M.:
HPM detection system for mobile and stationary use, EMC Europe 2011, York, GB, September 26 – 30 2011

Kuhnhenn, J.:
"Strahlungseffekte in Carbon-Nano-Tubes: Erste Ergebnisse von Bestrahlungstests des Fraunhofer INT", Lecture at the Leibniz-Institute for Solid State and Materials Research Dresden, Dresden, September 29 2011

Pastuszka, H.-M.:
FP7 security research project ACRIMAS – Presentation to the Friends of the Polish Presidency Group (Crisis Coordination Arrangements Review), FoP CCA, Council of the European Union, Brussels, Belgium, September 23 2011

John, M.:
Das Cochlea Implantat, IB-Medizinische Akademie, Schule für Logopädie, Berlin, September 30 2011

Reschke, S.:
Innovationsmotor Werkstoffe: Evolution, Revolution und Überraschungen, Innovmat Academy: "Innovationsmotor Werkstoffe: Evolution, Revolution und Überraschungen" including the workshop "Nachhaltige Werkstoffauswahl, Materialdaten-Management und ECO-Design", Vienna, October 4 2011

Neupert, U.:
Technological Trends in Photovoltaics – A German Perspective, Presentation at "Renewable Energy Technology Forum", Embassy of the Republic of Korea, Bonn, October 6 2011

Höffgen, S.:
"Onboard Radiation Sensors for the H2SAT", H2Sat SRR-Meeting Fraunhofer – DLR, Erlangen, October 18 2011

Jovanović M.:
Conference Chair, European Defence Conference (EDC), Warsaw, Poland, October 19 – 20 2011

Missoweit, M.:
Conference Chair, European Defence Conference (EDC), Warsaw, Poland, October 19 – 20 2011

Grüne, M.:
Die Wehrtechnische Vorausschau (WTV) – Früherkennung und Bewertung von Zukunftstechnologien für das BMVg, Forum "Früherkennung", 3rd national expert meeting of the network "Früherkennung in Sicherheitsbehörden", Crime Investigation Authority (LKA) North-Rhine Westphalia (NRW), Düsseldorf, October 20 2011

Pastuszka, H.-M.:
European Defence Conference 2011 – Closing session and Wrap-up, EDC October 20 – 21 2011 Warsaw, Poland, October 21 2011

Müller, S.:
Technology Roadmap Self-Healing Materials in Security and Defence Applications, Industrial Partner Event in Microencapsulation Technologies (IPEMTECH), Berlin, October 21 2011

Thorleuchter, D., Van den Poel, D.:
High Granular Multi-Level-Security Model for Improved Usability. 3rd International Conference on system science, engineering design and manufacturing informatization (ICSEM 2011), Chengdu, People's Republic of China, October 23 2011

Weinand, U.:
"Virtuelle Instrumente in der Praxis 2011", "Systemdemonstrator CHORUS", 16. Technologie- und Anwenderkongress, Munich, October 24 – 25 2011

Metzger, S.:
"Single-Event Effects", 3. Workshop "Herausforderung Weltraum", Euskirchen, November 9 – 10 2011

Höffgen, S.:
"Strahlung im Weltraum – Arten, Ursprung, Transport, Effekte", Workshop "Herausforderung Weltraum", Euskirchen, November 9 – 10 2011

Höffgen, S.:
"Dosis- und Struktureffekte", Workshop "Herausforderung Weltraum", Euskirchen, November 9 – 10 2011

Kuhnhenn, J.:
Strahleneffekte in Photonik", Workshop "Herausforderung Weltraum", "Euskirchen, November 9 – 10 2011

Kuhnhenn, J.:
"Demonstration der Bestrahlungsanlagen des INT", Workshop "Herausforderung Weltraum", Euskirchen, November 9 – 10 2011

APPENDIX

Kuhnhenn, J.:
"Strahleneffekte in Photonik", Workshop "Herausforderung Weltraum", Euskirchen, November 9 – 10 2011

Kuhnhenn, J.:
"Demonstration der Bestrahlungsanlagen des INT", Workshop "Herausforderung Weltraum", Euskirchen, November 9 – 10 2011

Höffgen, S.:
"Strahlung im Weltraum – Arten, Ursprung, Transport, Effekte", Workshop "Herausforderung Weltraum", Euskirchen, November 9 – 10 2011

Missoweit, M.:
Irland as a "Female Role Model for Young Girls", Presentation for "Women in Science & Technology", Lycee Francais d'Irland, Dublin, Ireland, November 14 2011

Burbiel, J.:
Motivation & Möglichkeiten, Workshop "One-stop Agency" des Bundesamtes für Bevölkerungsschutz und Katastrophenhilfe (BBK), Internationale Forschungskooperation, Bonn, November 18 2011

Thorleuchter, D., Herberz, S. and Van den Poel, D.:
Mining Social Behavior Ideas of Przewalski Horses. International Conference on Computer, Communication, Control and Automation (3CA 2011), Zhuhai, People's Republic of China, November 20 2011

Pastuszka, H.-M.:
FP7 security research project ACRIMAS – Presentation to the FP7 project IDIRA (Interoperability of data and procedures in large-scale multinational disaster response actions) End User Advisory Board Workshop, Vienna, Austria, November 25 2011

Weinand, U.:
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Personalia

February 2011:
Conferral of the doctoral degree to Mr. Dirk Thorleuchter at the University of Ghent in Belgium. Topic of the PhD-thesis: "Essays on Textmining for Improved Decision Making"

June 2011:
Conferral of the doctoral degree to Mr. Miloš Jovanovic at the University of Düsseldorf. Topic of the PhD-thesis: "Footprints in the publication landscape: On the allocation of scientific topics and technologies into fundamental and applied science using bibliometric methods"

December 2011:
Appointment of Dirk Thorleuchter as Editorial Board Member of the International Journal of Information Science

Other Events

September 5 2011:
Pastuszka, H.-M.: Chairman 6th Future Security Research Conference, Session "Crisis Management II", Berlin

September 20 – 22 2011:
Nuclear-Symposium (in collaboration with Department AP), Fraunhofer INT, Euskirchen

October 6 – 7 2011:
Kickoff-Meeting ETCETERA, FP7 Security Research Project (Evaluation of critical and emerging technologies for the elaboration of a security research agenda, vgl. www.etcetera-project.eu), Euskirchen, responsible: Burbiel, J., Goymann, S., Huppertz, G.

Press Releases

May 23 2011:
Improving Europe-wide cooperation: INT co-hosts European Defence Conference in Warsaw

July 11 2011:
Informationssystem Europäische Sicherheitsforschung esfo Fraunhofer INT startet Webportal

August 1 2011:
Car horns warn against natural disasters

September 27 2011:
Das INT auf dem Deutschlandfest in Bonn

Miscellaneous

Expert in the Expert Chat on "Radioactivity" in the Fraunhofer-Gesellschaft's "myTalent Portal", April 5, 2011: Köble T.
Coordinating and chairing Session 10: Nuclear Security and Border Monitoring II, 33rd ESARDA Conference, Budapest, Hungary, May, 2011

Film: „Bestrahlungstests am INT" created for NEO

Institute Course

Dr. Dangendorf, V. (Physikalisch-Techn. Bundesanstalt Braunschweig):
Cargo- und Containerinspektion mit Neutronen- und Gammastrahlung, Euskirchen, January 26 2011

Dr. Risse, M. (Fraunhofer INT Euskirchen):
Identifikation von Nuklearmaterial mit tragbaren Gamma- und Neutronen-Messgeräten, Ergebnisse aus Messungen am IPSC des JRC in Ispra (Italien), Euskirchen, February 2 2011

Dr. Geisler, J. (Fraunhofer IOSB Karlsruhe):
Sicherheit: Ein systemanalytischer Denkansatz, Euskirchen, February 9 2011

Dr. Offenberg, D. (Fraunhofer INT Euskirchen):
Plasmonik – Elektronik und Photonik vereint in der Nanowelt, Euskirchen, February 16 2011

Prof. Dr. Holl, G. (Institut für Detektionstechnologien an der Hochschule Bonn-Rhein-Sieg, Rheinbach):
Aktuelle Forschungsergebnisse aus dem Bereich der Detektion von Explosivstoffen, Euskirchen, March 2 2011

Nätzker, W. (Fraunhofer INT Euskirchen):
Elektrische Kanonen, Euskirchen, March 16 2011

Dr. Altmann, J. (Exp. Physik III TU Dortmund):
Bewaffnete unbemannte Systeme – Probleme und präventive Rüstungskontrolle, Euskichen, March 30 2011

Dr. Bauer, H. (Neurologische Abteilung Marienhospital Euskirchen):
Netzwerke und Knotenpunkte: Zur Funktion des menschlichen Gehirns, Euskirchen, April 6 2011

Dr. Wehner, M. (Fraunhofer ILT Aachen):
Optische Ferndetektion von Biosensoren zum Nachweis von Gefahrstoffen, Euskirchen, April 13 2011

Faridi, A.; Engels, M. (Engels & Faridi GbR):
Energieprognosen im 19. und 20. Jahrhundert – Szenen aktiver Bedrohung der Versorgungssicherheit in der Energieversorgung, Euskirchen, May 4 2011

Dr. Metzger, S. (Fraunhofer INT Euskirchen):
Untersuchung von Einzelteilcheneffekten mit relativistischen Schwerionen, Euskirchen, June 1 2011

Dr. Huppertz, G.; Dr. Weinand, U.; Müller, P. (Fraunhofer INT Euskirchen):
CHORUS: Entwicklung und Herstellung eines Demonstrators, Euskirchen, June 22 2011

Dr. Höffgen, S. (Fraunhofer INT Euskirchen):
Strahleneffekte in Faser Bragg Gitter, Euskirchen, June 29 2011

Dr. Labs, S. (Fraunhofer INT Euskirchen):
Moderne Methoden aus der Biotechnologie und der Chemie für die Anwendung und die Grundlagenforschung, Euskirchen, September 28 2011

Jöster, M. (Fraunhofer INT Euskirchen):
Elektromagnetische Verträglichkeit in der Automobiltechnik, Euskirchen, October 5 2011

Hülser,T. (Institut für Energie- und Umwelttechnik e.V. (IUTA) Duisburg):
Hochspezifische Nanopartikel: Eine Chance für zukünftige Energieanwendungen, Euskirchen, October 12 2011

Dr. Langner, R. (Fraunhofer INT Euskirchen):
Beitrag von spektroskopischen Untersuchungen zum Verständnis magmatischer Systeme, Euskirchen, October 19 2011

Dr. Kretschmer, T. (Fraunhofer INT Euskirchen):
Strategische Rohstoffe, Euskirchen, November 16 2011

Wansch, R. (Fraunhofer IIS Erlangen):
On-Board-Prozessor für die Heinrich-Hertz-Satellitenmission, Euskirchen, November 23 2011

Prof. Dr. Lechleuthner, A. (Stadt Köln):
Rettungsdienste einer Großstadt – was durch Forschung erreicht werden kann, Euskirchen, November 30 2011

Dr.-Ing. Lubkowski, G. (Fraunhofer INT Euskirchen):
Optische und Photonische Anwendungen von Metamaterialien im Weltraum, Euskirchen, December 7 2011

Prof. Dr. Konschak, K. (Gamma-Consult, Strehla):
Methoden zur Senkung des Proliferationsrisikos bei der Herstellung von Tc-99m, Euskirchen, December 14 2011

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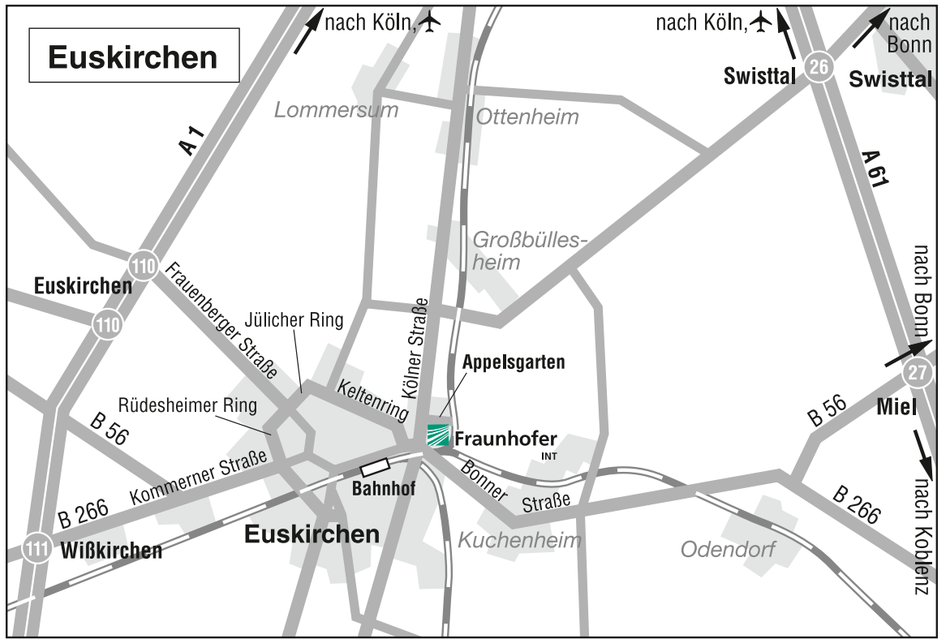

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