International Workshop on

# Lasers & Nuclei

## Applications of Ultra-high Intensity Lasers in Nuclear Science

*Gartensaal, Karlsruhe Schloss, Karlsruhe,*

*13th - 15th Sept. 2004*

Organised by the European Commission, Institute for Transuranium Elements, Karlsruhe, and the Institut für Optik und Quantenelektronik, University of Jena, Germany

Editors: J. Galy, T. Žagar, J. Magill, H. Schwoerer

EUROPEAN COMMISSION
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Institute for Transuranium Elements

IOQ Jena
Institute für Optik und Quantenelektronik


The fact that nuclear fission can be induced by laser light was predicted in 1988 (by C. Rhodes et al.) and demonstrated experimentally in 2000 through a collaboration with UK universities, Rutherford Appleton Laboratory, UK , and ITU. Through this development, nuclear reactions can now be induced and studied in the laboratory without recourse to nuclear reactors or particle accelerators. As a result, a new field of Laser Nuclear Physics has been established and is currently undergoing tremendous growth.

This international workshop on lasers and nuclei (IWLN) was the first meeting of its kind in this exciting new area. Forty six experts from as far afield as Japan , South Africa , US, Israel and including representatives from the leading groups in the UK , France and Germany came together for this 2.5 day meeting which was held in the Gartensaal of Karlsruhe Schloss.

Following an introductory session on the laser matter interactions by Drs. F. Amiranoff and C. Rhodes, the "applications" sessions then covered: nuclear and astrophysics, medical applications, transmutation, radiography and addressed the questions of how these lasers could make a direct impact on technology.

First day presentations ended in a poster session in the foyer of the Gartensaal. This gave younger colleagues the opportunity to present their work. In total, fourteen posters were presented on such diverse topics as "*Transmutation and Cross-section Measurements of Iodine-129*" through to "*Synthesis of Heavy Ion Beams with High Intensity lasers*".

The final morning session described future developments in high intensity lasers. At present around $10^{20}$ W/cm$^2$ is currently achievable. With these intensities electron temperatures a thousand times higher than those produced in fusion are attained – and produce conditions similar to those existing approximately 1 s after Big Bang. In the next few years intensities of $10^{23\text{-}24}$ W/cm$^2$ will become reality. Charlie Bowman (ADNA Corp) concluded the meeting by asking us to get back to the experiments as quickly as possible to map out this exciting new area of science!

The proceedings of the meeting containing all the presentations, participants list, photos, etc is published as a European Commission special publication on this CD-ROM. Springer Verlag will publish all manuscripts in a book on "Laser & Nuclei"(eds. J. Magill, H. Schwoerer) to be published in 2005.

International Workshop on Lasers & Nuclei held in the Gartensaal of the Karlsruhe Schloss, 13-15$^{th}$ Sept. 2004.
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## ➲ Programme (powerpoint presentations on CD)

| | | |
|---|---|---|
| **So 12.9.04** | Workshop reception / Registration 18:00 - 20:00 | Ch. Walther, E. Spengler |
| **Mo 13.9.04** | Registration 8:00 - 9:00 | Ch. Walther, E. Spengler |
| 09:00 | Welcome | G. Lander (ITU), R. Sauerbrey (IOQ) |
| | **Laser Matter Interaction:** | |
| 09:15 | Lasers and Nuclei | C. Rhodes (Uni. Chicago) |
| 10:00 | Laser acceleration of particles | F. Amiranoff (LULI, Paris) |
| 10:45 | Coffee | |
| | **Nuclear and Astrophysics** | |
| 11:00 | Nuclear Physics with Laser Compton Gamma rays | T. Shizuma (JAERI, Japan) |
| 11:30 | Nuclear physics with lasers: aims and constraints | F. Hannachi, (CENBG, Bordeaux ) |
| 12:00 | Lunch | |
| 14:00 | Fast ignition of fusion targets | P.A. Norreys (RAL, UK) |
| | **Medical Applications** | |
| 14:30 | Medical isotope production by laser | W. Pilloy (Luxembourg) |
| 15:15 | Coffee | |
| 15:45 | Particle sources produced by compact lasers | V. Malka (LOA, Paris) |
| 16:15 | **Discussion - Poster session/ reception** (list of posters on CD) | All |
| **Tu 14.9.04** | | |
| | **Transmutation** | |
| 09:00 | Transmutation of nuclear waste | Ch. Bowman (ADNA, USA) |
| 09:45 | High brightness gamma sources for nuclear transmutation | K. Imasaki (ILT, Japan) |
| 10:30 | Coffee & Group Photo | |
| 11:00 | Experimental program on laser nuclear physics | H. Schwoerer (IOQ, Jena) |
| 11:30 | Laser transmutation of nuclear materials | J. Magill (ITU, Karlsruhe) |
| 12:00 | ITU's minor actinide laboratory | D. Haas (ITU, Karlsruhe) |
| 12:30 | Lunch | |
| 14:00 | Ion acceleration in petawatt laser-plasma interactions - applications to spallation physics | P. McKenna (Strathclyde, UK) |
| | **Radiography** | |
| 14:30 | Status of neutron imaging | E. Lehmann (PSI) |
| 15:15 | Coffee | |
| 15:30 | Proton radiography with lasers<br>Visit to ITU labs | O. Willi (Düsseldorf) |
| 16:00 | Laser driven radiography | R. D. Edwards (AWE, UK) |
| 19:00 | **Dinner at the Badisches Brauhaus** | |


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# List of participants

| Name | Institution |
|---|---|
| Amiranoff, François | Ecole Polytechnique Laboratoire pour l'Utilisation des asers Intenses |
| Amthor, Kay-Uwe | Friedrich-Schiller-Universität Jena, Institut für Optik und Quantenelektronik |
| Ascheron, Claus | Springer Verlag |
| Bernhardt, Jens | Friedrich-Schiller-Universität Jena, Institut für Optik und Quantenelektronik |
| Berthou, Veronique | |
| Besnard, Didier | CEA Ile de France, DAM/DAN |
| Bowman, Charles | ADNA Corporation |
| Brandenburg, Sytze | Kernfysisch Versneller Instituut |
| Collier, J. | Rutherford Appleton Laboratory, Central Laser Facility |
| D'Humieres, Emmanuel | CEA, CEA/DAM, Ile de France |
| Drska, Ladislav | Czech Technical University, Faculty of Nuclear Sciences and Physical Engineering |
| Edwards, Ray | AWE plc Aldermaston, Plasma Physics Department |
| Ewald, Friederike | Friedrich-Schiller-Universität Jena, Institut für Optik und Quantenelektronik |
| Fazzia, Hannachi | Centre d'Etudes Nucléaires de Bordeaux-Gradignan |
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| Gobet, Frank | Centre d'Etudes Nucléaires de Bordeaux-Gradignan |
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| Hutchinson, M H R | Rutherford Appleton Laboratory, Central Laser Facility |
| Imasaki, Kazuo | Institute for Laser Technology |
| Klein, Horst | Phys.-Technische Bundesanstalt |
| Kühl, Thomas | GSI |

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|---|---|
| Lander, Gerry | Institute for Transuranium Elements, Joint Research Centre |
| Ledingham, Ken W. D. | University of Strathclyde, Department of Physics |
| Lehmann, Eberhard | Paul Scherrer Institute |
| Liesfeld, Ben | Friedrich-Schiller-Universität Jena, Institut für Optik und Quantenelektronik |
| Magill, Joseph | Institute for Transuranium Elements, Joint Research Centre |
| Malka, Victor | Université d'Orsay, ENSTA / CNRS, Ecole Polytechnique |
| May-Tal Beck, Sharon | NRCN |
| McKenna, Paul | Royal Society of Edinburgh Research Fellow, Department of Physics (John Anderson Bld.), University of Strathclyde |
| Nolte, Ralf | Phys.-Technische Bundesanstalt |
| Norreys, Peter A. | Rutherford Appleton Laboratory, Central Laser Facility |
| Pilloy, Wilfried | Centre Hospitalier de Luxembourg |
| Reiss, Howard R. | Max-Born-Institut, Abteilung B2 |
| Rhodes, Charles | University of Illinois |
| Sauerbrey, Roland | Institut für Optik und Quantenelektronik der Universität Jena |
| Schwoerer, Heinrich | Friedrich-Schiller-Universität Jena, Institut für Optik und Quantenelektronik |
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| Thompson, Peter C. | Aldermaston AWE, Atomic Weapons Establishment |
| Toshiyuki, Shizuma | Japan Atomic Energy Research Institute |
| von Bergmann, Hubertus | University of Stellenbosch, Laser Research Institute |
| von Zweidorf | Institute for Transuranium Elements, Joint Research Centre |
| Wahlström, Claes-Göran | Department of Physics, Lund Institute of Technology |
| Walther, Christine | Institute for Transuranium Elements, Joint Research Centre |
| Willi, Oswald | Heinrich-Heine-Universität, Institut für Laser- und Plasmaphysik |
| Witte, Klaus | Max-Planck-Insititut für Quantenoptik |
| Zagar, Tomaz | Institute for Transuranium Elements, Joint Research Centre |
| Zimmerman, Colin | British Nuclear Fuels |