

ANNUAL REPORT 2013



Institute of Plasma
Physics and Laser
Microfusion

Warsaw, Poland

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Preface

The year 2013 was a very fruitful one for the Institute of Plasma Physics and Laser Microfusion abounding with numerous scientific achievements and important events.

The Institute was granted “A” category in the classification of the Ministry of Science and Higher Education (3rd place among 10 research institutes under evaluation dealing with energetics and mining).

As far as the laboratories operating in the Institute are concerned, one must stress the successful completion of the project “Development and modernization of the High Power Laser Laboratory” co-financed by the Regional Operational Program of the Mazovia Province. The project dealt with the construction of modern diagnostic systems designed at IPPLM for experimental stand which includes also high power laser (10TW).

Also that year in was fully launched PLANS laboratory for testing plasma thrusters for microsatellites in IPPLM. Scientists involved in this laboratory activities can boast about the successful installation of cryogenic vacuum pump as well as testing of the first Polish space thruster in conditions similar to those in space which took place in the laboratory of the European Space Agency (ESA-ESTEC), Noordwijk (the Netherlands). The thruster designed at IPPLM will be cheaper in operation in comparison with the existing devices thanks to the introduction of a specific innovation, namely xenon was replaced with krypton.

In 2013 the modernization of PF-1000U from the financial sources of the National Centre of Research and Development (NCBiR) took place. The device focuses mainly on the experimental research of physical processes occurring in hot plasma, namely the emission of products of the fusion reaction of hydrogen isotopes (the program of the International Centre for Dense Magnetised Plasmas). NCBiR’s project assumed the research of plasma-wall interaction in PF-1000U, elaboration and application of numerical codes for the modelling of plasma-wall interaction, development of techniques of plasma imaging in the range of X-radiation as well as the construction and application of the system of the plasma generator.

The international cooperation in 2013 was extended with signing the Cooperation Agreement in the field of plasma physics and controlled fusion between Commissariat à l’énergie atomique et aux énergies alternatives (CEA) and IPPLM. The management of IPPLM had an honour to welcome the representatives of CEA, namely Mr. Gabriele Fioni, Directeur des sciences de la matière du Commissariat à l’énergie atomique et aux énergies alternatives, Dr. Alain Becoulet, Chef de l’IRFM / Head of IRFM; CEA/DSM/Institut de Recherche sur la Fusion par confinement Magnétique and Dr. Tuong Hoang, Institut de Recherche sur la Fusion par confinement Magnétique, CEA Cadarache. The French delegation was accompanied by Ms Camille Baudoin (Adjointe du Conseiller Nucleaire, Ambassade de France en Pologne). Poland is the first European partner to sign such Cooperation Agreement.

On the 6th and 7th of September 2013 the Annual Meeting of the International Scientific Committee of the International Centre for Dense Magnetised Plasmas (ICDMP) took place in Warsaw, at the IPPLM premises. The participants included distinguished scientists from different countries and IPPLM. The Foundation Council presented its report and the election of a new ICDMP director followed. Dr. Marek Scholz was replaced by Dr. Marian Paduch, and Dr. Ryszard Miklaszewski became the deputy director of ICDMP. The workshop participants discussed the accomplished goals within the activities at PF-1000U

and laboratories in frame of ICDMP and defined the scope of works for the future. Mr. Pavel Kubes announced that the grant of Ministry of Education, Youth and Sports of the Czech Republic, supporting activities of ICDMP, would continue up to the year 2015.

The scientific and achievements of IPPLM in 2013 include among others the completion of works over X-ray diagnostics for W7-X, completion of works focused on GEM detector for JET, and the calibration of neutron diagnostics for JET.

As far as the first achievement is concerned, two spectroscopic systems: pulse height analysis (PHA) and multi-foil system (MFS) were designed for Wendelstein 7-X stellarator for long pulse operation. The proposed PHA diagnostic will provide the spectral energy distribution with high energy resolution along a central line of sight. The system consisting of 3 single silicon detectors operating with different filters will be installed on the stellarator W7-X in 2014. In the MFS system the recorded spectrum is estimated by measurement of the total X-ray emission in different ranges of energy, which are determined by the type and thickness of the filters and the thickness of the detectors. These two spectroscopic systems, namely PHA and MFS designed in IPPLM, will be used for measurement of soft X-ray emission from W7-X stellarator in 2015.

To describe the second achievement in greater detail one must note that two Triple Gas Electron Multiplier (Triple-GEM) detectors were developed for high-resolution X-ray spectroscopy measurements for tokamak plasma to serve as plasma evolution monitoring in soft X-ray region (SXR). They provide energy resolved fast dynamic plasma radiation imaging in the SXR with a high kHz frequency. Detectors were designed and constructed for continuous data-flow precise energy and position measurement of plasma radiation emitted by metal impurities in the JET tokamak. The studies of capabilities of Triple-GEM detecting units developed and constructed in IPPLM within collaboration with other institutions have been performed to fulfil the requirements for soft X-ray monitoring in JET tokamak.

And finally, the JET neutron activation diagnostics calibration was performed in 2013 by the IPPLM team in cooperation with groups of researchers from other institutions. The neutron diagnostics need to be calibrated very carefully, because they are essential to properly determine fusion power and estimate dose rate from activated structure materials. In case of JET calibration, the spontaneously-fissile californium source was used instead of deuterium plasma source of 2.5 MeV neutrons. Therefore, neutron transport calculations strongly supported the calibration. The experimental data collected in such way allow determination of the activation coefficients for recorded reactions. The measured coefficients will be compared with the coefficients calculated by the MCNP code.

The year 2013 witnessed two international conferences organized by IPPLM: International Conference PLASMA-2013 Research and Applications of Plasmas (2-6.09.2013) and the 14th International Workshop on Plasma Edge Theory in Fusion Devices (23-25.09.2013).

Scientists could also share their knowledge and experience with the visiting public during the XVII Science Festival held in Warsaw on the 20-29 of September.

More details describing the above-mentioned events can be found in the section called Public Information.

In 2013 the Central Commission for Scientific Degrees and Titles finished its evaluation of two applications regarding the full professor title to be granted to Assoc. Prof. Tadeusz Pisarczyk and Assoc. Prof. Jerzy Wołowski.

IPPLM researcher, Rafał Prokopowicz, defended his doctor's thesis entitled "Neutron diagnostics in nuclear and thermonuclear reactors using activation method" (Scientific Council of the Institute of Nuclear Physics PAS, the 8th of July 2013, Cracow).

In 2013 IPPLM director awarded the prize of the first degree and two prizes of the second degree to IPPLM scientists. The first degree prize went to Assoc. Prof. Tadeusz Pisarczyk and Dr. Andrzej Kasperczuk for their research of laser plasma with the application of multiframe interferometry in the framework of the international experiment in PALS (Prague, Czech Republic).

Second degree prizes were awarded to Irena Ivanova-Stanik for the results of computer simulations of plasma parameters in devices like tokamaks (in the framework of EURATOM programme) and to the team of Leszek Ryć, Dr. Sławomir Jabłoński, Jacek Kaczmarczyk and Waldemar Figacz for the completion of elaboration of X-ray diagnostics prepared for W7-X stellarator built in Greifswald (Germany).

All those achievements would not have been possible without the active involvement, professionalism and passion of the personnel of IPPLM. I would like to congratulate the staff and thank them for their hard work.



Andrzej Gałkowski
Director

1 General Information

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- **Associate Director for Research**
 Prof. Jerzy Wołowski
- **Associate Director for EUROFUSION**
 Assoc. Prof. Roman Zagórski
- **Chief Accountant**
 Ewa Sieczkowska MA
- **Director Plenipotentiary for Administration**
 Paweł Nadrowski, MBA

Departments of the Institute

- **Division of Laser Plasma**
 - Department of Laser Fusion
Head of Department: Prof. Jan Badziak
 - Department of Plasma Hydrodynamics
Head of Department: Prof. Tadeusz Pisarczyk

- **Division of Magnetised Plasma**
 - Department of Nuclear Fusion and Plasma Spectroscopy
Head of Department: Dr. Monika Kubkowska
 - Department of Plasma Diagnostics and Technology
Head of Department: Dr. Marian Paduch

Scientific Staff of the Institute

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T. Pisarczyk
J. Wołowski

Visiting professors

V. Gribkov
Z. Peradzyński
M.J. Sadowski

IPPLM Professors

A. Gałkowski
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S. Barral
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T. Czarski
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E. Kowalska-Strzęciwilk
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M. Paduch
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R. Stankiewicz
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Researchers (MSc)

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D. Daniłko
J. Domański
I. Ivanova-Stanik
J. Kaczmarczyk
Z. Kalinowska
E. Łaszyńska
J. Miedzik
P. Parys
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L. Ryć
W. Stępniewski
A. Szelecka
A. Zaraś-Szydłowska
E. Zielińska

The following part of the Annual Report contains information of a preliminary and/or tentative nature and must not be quoted in publications nor listed in abstract journals.
It is the executive summary of the full annual report, summarizing activities performed by the Institute of Plasma Physics and Laser Microfusion in 2013