



Exploratory Workshop Scheme

Scientific Review Group for Physical and
Engineering Sciences

ESF Exploratory Workshop on

**MULTI-SCALE METHODS FOR
WAVE AND TRANSPORT
PROCESSES IN FUSION PLASMAS:
THE LEGACY OF
GRIGORY PEREVERZEV**

Garching (Germany), October 13th – 16th, 2013

Convened by:
**Eric Sonnendrücker^①, Clemente Angioni^①, Emiliano Fable^①,
and Omar Maj^①**

① Max Planck Institute for Plasma Physics, Boltzmannstraße 2,
D-85748 Garching



The European Science Foundation (ESF) was established in 1974 to provide a common platform for its Member Organisations to advance European research collaboration and explore new directions for research. Currently it is an independent organisation, owned by 67 Member Organisations, which are research funding organisations, research performing organisations and academies from 29 countries.

ESF is in a period of transition; the ESF Member Organisations (MO's) have indicated that they would like to wind down certain ESF activities, such as EUROCORES, RNP's, ECRP's and Forward Looks by the end of 2015, but ESF will continue to honour its existing commitments until the projects are finalised.

In 2013 the only research instrument that will have a call for proposals is the Exploratory Workshops. The focus of the Exploratory Workshops scheme is on workshops aiming to explore an emerging and/or innovative field of research or research infrastructure, also of interdisciplinary character. Workshops are expected to open up new directions in research or new domains. It is expected that a workshop shall conclude with plans for follow-up research activities and/or collaborative actions or other specific outputs at international level.

ESF is also currently exploring new areas where we could serve the science community. Services we have identified that would leverage our expertise and experience and provide added-value to the science community are: peer review, evaluation, research conferences and career tracking.

Please check our website (www.esf.org) for regular updates regarding ESF and its future developments.

European Science Foundation

1 quai Lezay Marnésia
BP 90015
67080 Strasbourg Cedex
France
Fax: +33 (0)3 88 37 05 32
<http://www.esf.org>

ESF Exploratory Workshops:

Jean-Claude Worms
Head, Science Support Office

Nathalie Geyer-Koehler
Administrative Coordinator
Tel: +33 (0)3 88 76 71 48

Isabelle May
Administrative Coordinator
Tel: +33 (0)3 88 76 71 46

Email: ew-office@esf.org
<http://www.esf.org/workshops>

Convenors:

Prof. Eric Sonnendrücker
Eric.Sonnendruecker@ipp.mpg.de

Max-Planck-Institut für Plasmaphysik
Boltzmannstraße 2
D-85748 Garching, Germany.

Dr. Clemente Angioni
Clemente.Angioni@ipp.mpg.de

Max-Planck-Institut für Plasmaphysik
Boltzmannstraße 2
D-85748 Garching, Germany.

Dr. Emiliano Fable
Emiliano.Fable@ipp.mpg.de

Max-Planck-Institut für Plasmaphysik
Boltzmannstraße 2
D-85748 Garching, Germany

Dr. Omar Maj
Omar.Maj@ipp.mpg.de

Max-Planck-Institut für Plasmaphysik
Boltzmannstraße 2
D-85748 Garching, Germany

Main Objectives of the Workshop:

The goal of the workshop is the exploration of recent mathematical techniques for multi-scale problems and their potential applications to the theory and simulations of wave and transport processes in fusion plasmas, including gyro-kinetic theory which is considered the state-of-the-art theoretical tool for the description of plasma turbulence and its consequences on transport. Both modeling and computational issues are considered, thus covering theoretical aspects of wave and transport processes, as well as the numerical schemes used to solve the relevant model equations and the development of numerical codes for the simulation of such phenomena in realistic tokamak experiments.

The Workshop is dedicated to the memory of **Grigory V. Pereverzev**.

Workshop Agenda

By means of tutorial presentations, Delegates from the field of fusion plasma physics will review the basic theory of high-frequency wave beams and transport modeling in fusion plasmas, with emphasis on open issues and “hot topics” that should be addressed in the workshop. Analogously, Delegates with an expertise in numerical methods and applied mathematics are asked to present their results on new methods that have been identified as potentially applicable to the considered physics problems.

During the time allocated for discussions, the Delegates will be asked for proposal for further collaborations aiming to the application of the strategies identified during the workshop.

Report publication and dissemination

Upon approval by the Delegates, the final version of the presentations will be made available on the web page of the Workshop. If there is enough interest, proceedings can be published in the form of an IPP report.

PRELIMINARY PROGRAMME

Sunday, 13th October 2013

Afternoon *Arrival*

Monday, 14th October 2013

- 08.30-08.40 **Welcome**
Eric Sonnendrücker (IPP, Garching, Germany)
- 08.40-09.00 **Presentation of the European Science Foundation (ESF)**
Roland Diehl (Scientific Review Group for Physical and Engineering Sciences)
- 09.00-09.30 **Grigory V. Pereverzev Lecture**
Arthur Peeters (Universität Bayreuth, Bayreuth, Germany)
- 09.30-12.00 Morning Session: Transport modeling I**
- 09.30-10.00 **Presentation 1 "Transport theory agenda"**
Clemente Angioni (IPP, Garching, Germany)
- 10.00-10.30 *Coffee Break*
- 10.30-11.15 **Presentation 2 "Asymptotic-Preserving schemes for an efficient resolution of anisotropic elliptic and parabolic equations"**
Claudia Negulescu (Toulouse Institute of Mathematics, Toulouse, France)
- 11.15-12.00 **Presentation 3 "Asymptotic preserving methods for the BGK-Vlasov-Poisson system in the quasi-neutral and fluid limits"**
Marie-Hélène Vignal (Toulouse Institute of Mathematics, Toulouse, France)
- 12.00-13.30 *Lunch*
- 13.30-15.00 Afternoon Session I: Transport modeling II**
- 13.30-14.00 **Presentation 1 "Transport codes for magnetic fusion: ASTRA (overview of applications)"**
Irina Voitsekhovitch (EURATOM/UKAEA association, Culham, UK)
- 14.00-14.30 **Presentation 2 "Numerical treatment of stiff transport in the ASTRA code"**
Emiliano Fable (IPP, Garching, Germany)
- 14.30-15.00 **Discussion on numerical schemes for transport equations and applications**
- 15.00-15.30 *Coffee break and group photo*
- 15.30-17.45 Afternoon Session II: High-frequency waves I**
- 15.30-16.15 **Presentation 1 "Pereverzev paraxial WKB method and semi-classical asymptotics - Wave theory agenda"**
Omar Maj (IPP, Garching, Germany)
- 16.15-17.00 **Presentation 2 "Gaussian beam approximations for high frequency waves"**
Olof Runborg (KTH, Stockholm, Sweden)
- 17.00-17.45 **Presentation 3 "Modeling of Electron Cyclotron Current Drive applied for the suppression of magnetic islands in tokamaks"**
Egbert Westerhof (FOM Institute DIFFER, Nieuwegein, The Netherlands)
- 19.30 *Conference dinner*

Tuesday, 15th October 2013

- 08.30-12.00** **Morning Session: High-frequency waves II**
- 08.30-09.15 **Presentation 1 "What is the semiclassical limit of non-Hermitian time evolution?"**
Roman Schubert (University of Bristol, Bristol, UK)
- 09.15-10.00 **Presentation 2 "Discrete Flow Mapping - a mesh based simulation tool for high-frequency vibro-acoustics of complex engineering structures "**
Gregor Tanner (University of Nottingham, Nottingham, UK)
- 10.00-10.30 *Coffee break*
- 10.30-11.15 **Presentation 3 "Development of a stable coupling of the Yee scheme with a linear current"**
Bruno Després (University Paris VI, Paris, France)
- 11.15-12.00 **Presentation 4 "Generalized model solutions for electromagnetic waves in overdense plasmas with electron collisions"**
Olivier Lafitte (University Paris 13, Paris, France)
- 12.00-13.00 *Lunch*
- 13.00-15.00** **Afternoon Session I: High-frequency waves III**
- 13.00-13.30 **Presentation 1 "Asymptotic analysis of the whistler waves propagation in space plasma thrusters"**
Alessandro Cardinali (ENEA, Rome, Italy)
- 13.30-14.45 **Presentation 2 "Weak turbulence in two-dimensional magnetohydrodynamics."**
Natalia Tronko (York Plasma Institute, York, UK)
- 14.45-16.00 **Discussion on wave theory and applications**
- 16.00-16.30 *Coffee break*
- 16.30-18.30** **Afternoon Session II: Transport modeling III**
- 16.30-17.15 **Presentation 1 "Exact conservation laws for full and truncated gyrokinetic Vlasov-Poisson equations"**
Natalia Tronko (York Plasma Institute, York, UK)
- 17.15-18.00 **Presentation 2 "Modern challenges in the gyrokinetic modeling of turbulent transport in tokamak plasmas"**
Yann Camenen (PIIM Aix-Marseille University and CNRS, Marseille, France)
- 18.00-18.30 **Discussion on gyro-kinetic models for transport**

Wednesday, 16th October 2013

- 08.30-11.45** **Morning Session: Transport modeling IV**
- 08.30-09.15 **Presentation 1 "Kinetic instabilities driven by runaway electrons"**
Tünde Fülöp (Chalmers University of Technology, Göteborg, Sweden)
- 09.15-10.00 **Presentation 2 "The role of global gyrokinetic simulations in multi-scale transport modeling"**
Susan Leerink (Alto University, Helsinki, Finland)
- 10.00-10.30 *Coffee Break*
- 10.30-11.00 **Discussion on kinetic description and applications**
- 11.00-12.00** **Closing Session**
- 11.00-12.00 **Discussion on follow-up activities/networking/collaboration**
- 12:00 *End of the Workshop*

European Science Foundation

Objectives of the ESF Scientific Review Group for the Physical and Engineering Sciences

The **ESF Scientific Review Group for Physical and Engineering Sciences** covers a broad number of fields from physics, chemistry, mathematics, informatics and computer sciences, to engineering, material and technical sciences. The ESF Scientific Review Group for Physical and Engineering Sciences has the following responsibilities and tasks:

- to develop scientific initiatives within the ESF operational framework;
- to undertake studies on large research facilities and assist in the evaluations and assessments and other special reviews requested by Member Organisations;
- to provide specialist advice and input on a wide range of ESF actions, and
- where appropriate, to work with other Scientific Review Groups and groups in promoting multidisciplinary and interdisciplinary activities.

ESF Physical and Engineering Sciences Staff:

Thibaut Léry
Senior Science Officer

Catherine Lobstein
Senior Administrator
Tel: +33 (0)3 88 76 71 30
Email: pen@esf.org
Website : *under construction*