Data Processing and Validation

A strategic discussion led by the

IEA Fusion Power Co-ordinating Committee (FPCC)

Wednesday, 12 February 2020

9h30-13h00

International Energy Agency
9 rue de la Fédération
75015 Paris

International Energy Agency (IEA)

The IEA is at the heart of global dialogue on energy, providing authoritative analysis, data, policy recommendations, and real-world solutions to help countries provide secure and sustainable energy for all.

The IEA was created in 1974 to help co-ordinate a collective response to major disruptions in the supply of oil. While oil security remains a key aspect of its work, the IEA has evolved and expanded significantly since its foundation.

Taking an all-fuels, all-technology approach, the IEA advocates policies that enhance the reliability, affordability and sustainability of energy. It examines the full spectrum of issues including renewables, oil, gas and coal supply and demand, energy efficiency, clean energy technologies, electricity systems and markets, access to energy, demand-side management, and much more.

Since 2015, the IEA has opened its doors to major emerging countries to expand its global impact, and deepen co-operation in energy security, data and statistics, energy policy analysis, energy efficiency, and the growing use of clean energy technologies.

Committee on Energy Research and Technology

Comprised of senior experts from IEA member governments, the Committee on Energy Research and Technology (CERT) co-ordinates and promotes the development, demonstration and deployment of technologies to meet challenges in the energy sector. The CERT also provides guidance to its working parties and experts' groups to examine topics that address current energy technology, or technology policy, issues. Four topical working parties support the work of the CERT, including the Fusion Power Co-ordinating Committee (FPCC).

Fusion Power Co-ordinating Committee (FPCC)

Created by the IEA Governing Board in 1975, the objective of the FPCC is to enhance fusion research, development, demonstration and deployment (RDD&D) activities with a strategic approach to realising fusion energy in both IEA member countries and partner countries. The FPCC accomplishes this objective by promoting, initiating and co-ordinating international co-operation on fusion carried out under the eight specialised fusion technology collaborations.

Technology Collaboration Programme

The Technology Collaboration Programme (TCP), a multilateral mechanism established by the IEA 45 years ago, was created with a belief that the future of energy security and sustainability starts with global collaboration. The programme is made up of thousands of experts across government, academia and industry in 55 countries dedicated to advancing common research and the application of specific energy technologies.

Currently there are 38 individual technology collaborations working across several technology or sector categories: energy efficiency end-use technologies (buildings, transport, industry and electricity), renewable energy and hydrogen, fossil energies, fusion power, and cross-cutting issues. These technology collaborations are a critical, member-driven part of the IEA family, but they are functionally and legally autonomous from the IEA Secretariat. The breadth of the analytical expertise in the Technology Collaboration Programme is a unique asset in the global transition to a cleaner energy future.

Strategic Discussion on Data Processing and Validation

Rationale

The science of taking, processing and validating data has become the key for modern science in many areas. This is very apparent for instance in high energy physics and fusion research. A fusion plasma has inherent complexity and extremely large data sets have to be recorded, stored and analysed in order to make progress in its understanding. Also the access to large validated data sets in collaborative schemes is of utmost importance. New approaches, like Bayesian statistics in big data, machine learning algorithms, automated scientific discovery and others, have opened exciting perspectives for experimental and computational plasma physics. The IEA FPCC strategic session "data processing and validation" is devoted to recent developments in this rapidly developing domain.

Aims

The goal of the IEA FPCC strategic session "data processing and validation" is to gather leading experts from fusion research, high energy physics and other fields of complex science in order to share experiences and discuss new trends and perspectives. It will address the experience drawn from existing facilities and discuss the development foreseen in large devices such as W7X, ITER and the LHC.

Cover page graphic: *https://commons.wikimedia.org/wiki/File:BigData_2267x1146_white.png*

AGENDA

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All talks should allow 10 minutes for discussion

09:30	1	**Welcome and opening remarks** *Jean Jacquinot, FPCC Chair*
09:35		**Format and aim of the session** *Dr Thomas Klinger, Chair of the session*
09:45	2	**A Collaborative Data Model** *Dr. Simon Pinches, ITER Organization*
10:20	3	**W7-X Large scale Bayesian Modelling and Automated Discovery** *Dr. Jakob Svensson, MPI for Plasma Physics*
10:55		*Coffee break*
11:25	4	**Machine learning and disruption prevention** *Dr. Robert Granetz, MIT*
12:00	5	**Dealing with big data** *Dr. Giuseppe Lo Presti, CERN IT department*
12:35	6	**Discussion** *Speakers and chairs*
13:00		**Session close**
13:00		*Lunch (self-catering)*

Delegates are advised that remote participation via Go To Meeting will be offered for this meeting. Kindly advise the FPCC secretary (diana.louis@iea.org) if you wish to take advantage of this facility.

Guest speakers

Dr. Simon Pinches is the Section Leader for the Plasma Modelling and Analysis Section at the ITER Organization. He is responsible for the Integrated Modelling Programme at ITER which entails developing a modelling infrastructure that can support a high-performance, high-fidelity plasma simulator as well as experimental data interpretation and analysis. He studied Mathematical Physics in Manchester, UK before obtaining a PhD modelling and studying the interaction of energetic particles with Alfvén waves whilst based at Culham Laboratory in the UK, home of the UK's domestic fusion programme and host to the European JET tokamak. He subsequently worked for nearly 10 years at the Max Planck Institute for Plasma Physics, Garching, in Germany.

Dr. Jakob Svensson did his PhD at KTH, Stockholm in the 1990s on artificial neural network modelling of fusion plasmas, 20 years before the big data revolution and is since 2001 employed as a senior scientist at the Max Planck Institute for Plasma Physics in Greifswald, Germany. He has developed a number of methods for scientific data analysis, and is author or co-author of over 100 publications on Bayesian modelling. He is also the author of the Minerva Bayesian modelling framework, the main data analysis framework at the Wendelstein 7-X stellarator, also used at a number of other nuclear fusion experiments. He is also director of Seed eScience Research Ltd, a non-profit organisation created to further the development of the Minerva framework.

Dr. Robert Granetz is a principal research scientist at the MIT Plasma Science and Fusion Center. His PhD thesis research was on MHD instabilities in the early Alcator A and C tokamaks. He was the head of the MHD group on the Alcator C-Mod tokamak, focusing his studies on disruptions and disruption mitigation, magnetics instrumentation, x-ray tomographic imaging, diagnostic neutral beam operation, and plasma control. Early in his career, Dr. Granetz spent 2.5 years at JET, developing x-ray tomography to analyze sawtooth crash physics. Dr. Granetz has taught graduate student courses in plasma physics and fusion at MIT, and supervised many PhD graduate students and post-docs. In recent years he has been leading a group that is applying machine learning methods to the real-time prediction of impending disruptions on multiple tokamaks, with the ultimate goal of developing a real-time disruption warning algorithm for ITER.

Dr. Giuseppe Lo Presti is a senior Software Engineer at the CERN IT Storage group, where he works on the design, development and operation of large data storage services for the High Energy Physics community. He has over 15 years' experience in storage software, in particular as the main contributor of CASTOR, the CERN storage system used to archive all Physics data on tape (340 PB by December 2019), and as a contributor of CERNBox, the cloud storage solution being proposed to the CERN users community. In addition, Giuseppe regularly contributes to several CERN outreach activities, ranging from visits to the CERN facilities, to seminars and trainings for University students and high-school teachers, to workshops and conferences. Before joining CERN IT, Giuseppe obtained a PhD in Computer Engineering at the University of Palermo in 2005, in collaboration with the Data Acquisition group of the CMS experiment at CERN, and a Master Degree in Computer Engineering at the University of Palermo in 2000, with a thesis on Computer Networking.