

# 2<sup>nd</sup> IAEA Technical Meeting on Fusion Data Processing, Validation and Analysis

May 30<sup>th</sup> - June 2<sup>nd</sup>, 2017

MIT Samberg Center  
Cambridge, MA, USA



## MEETING NEWS (as of 06/06/17):

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## INTRODUCTION:

The International Atomic Energy Agency (IAEA) will organize the second Technical Meeting on Fusion Data Processing, Validation and Analysis from 30 May to 02 June, 2017, in Cambridge, MA USA. The meeting will be hosted by the [MIT Plasma Science and Fusion Center \(PSFC\)](#).

## OBJECTIVES:

The objective of the meeting is to provide a platform where a set of topics relevant to fusion data processing, validation and analysis are discussed with the view of extrapolation needs to next step fusion devices such as ITER. The validation and analysis of experimental data obtained from diagnostics used to characterize fusion plasmas are crucial for a knowledge based understanding of the physical processes governing the dynamics of these plasmas. The meeting will aim at fostering, in particular, discussions of research and development results that set out or underline trends observed in the current major fusion confinement devices.

General information on the IAEA, including its mission and organization, can be found at the [IAEA website](#).

## TOPICS:

Uncertainty quantification (UQ)  
Model selection, validation, and verification (V&V)  
Probability theory and statistical analysis  
Inverse problems & equilibrium reconstruction  
Integrated data analysis  
Real time data analysis  
Machine learning  
Signal/image processing & pattern recognition  
Experimental design and synthetic diagnostics  
Data management

Click [here](#) for IAEA information on meeting topics for 2017 meeting in Cambridge, MA-USA

Click [here](#) for IAEA information on meeting topics from the 2015 meeting in Nice, France.



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**LOCAL ORGANIZERS:**

Nathan Howard (Chair) - MIT Plasma Science and Fusion Center

Martin Greenwald (Local Coordinator) - MIT Plasma Science and Fusion Center

Jessica Coco (Meeting Administrator) - MIT Plasma Science and Fusion Center

## IAEA-TM Agenda

May 30<sup>th</sup>

### **Morning Session**

#### **Session 1. Inverse Problems and Equilibrium Reconstruction**

8:15 – 8:45 am	Check-in and Registration
8:45 – 8:50 am	Welcome
8:50 – 9:20 am	<u>Cianciosa</u> (Invited): Uncertainty Analysis in 3D Equilibrium Reconstruction
9:20 – 9:45 am	<u>Xiao</u> : 2D magnetic field diagnosed by Laser-driven Ion-beam Trace Probe
9:45 – 10:10 am	<u>Faugeras</u> : Assimilation of polarimetry Stokes vector measurements in tokamak free-boundary equilibrium reconstruction with application to ITER
10:10 – 10:35 am	<u>Howell</u> : Development of a Non-Parametric Gaussian Process Model in V3FIT

**10:35 – 10:55 am      Coffee Break**

10:55 – 11:20 am	<u>Skvara</u> : Robust Bayesian linear regression for Tokamak plasma boundary estimation
11:20 – 11:45 am	<u>Lupelli</u> : Recent updates in Machine-Agnostic EFIT++ Free Boundary Equilibrium Code
11:45 – 12:10 am	<u>Stagner</u> : Determining the Population of Individual Fast-ion Orbits using Generalized Diagnostic Weight Functions

**12:10 pm – 1:00 pm Lunch Break (Provided at site)**

### **Afternoon Session**

#### **Session 2. Inverse Problems and Equilibrium Reconstruction Probability theory and statistical analysis/UQ**

1:00 – 1:30 pm	<u>Chilenski</u> (Invited): Bayesian inference of impurity transport coefficient profiles
1:30 – 1:55 pm	<u>Stankunas</u> : Accurate Determination of Radiated Power Density Profile Using Bolometer Data for DT Baseline Scenario at JET
1:55 – 2:20 pm	<u>Ferreira</u> : Full-pulse tomographic reconstruction with deep neural networks
2:20 – 2:45 pm	<u>Wang</u> : Bayesian soft X-ray Tomography on Tore Supra and WEST
2:45 – 3:15 pm	Discussion for Inverse Problems & Equilibrium Reconstruction

**3:15 – 3:35 pm      Coffee Break**

3:35– 4:00 pm	<u>Verdoolaege</u> : Benchmarking robust regression techniques for global energy confinement scaling in tokamaks
4:00 – 4:25 pm	<u>Trask</u> : Empirical Optimization with the Optometrist Algorithm: Randomization Coupled With Expert Interpretation
4:25 – 4:50 pm	<u>Fujii</u> : Machine Learning of Noise for LHD Thomson Scattering System
4:50 – 5:10 pm	Discussion on Probability Theory & UQ

## May 31<sup>st</sup>

### **Morning Session**

#### **Session 3. Model Selection Validation and Verification**

8:00 – 8:25 am	<u>Ernst</u> : Multichannel Validation of Gyrokinetic Simulations using a Synthetic Diagnostic for Doppler Backscattering based on Full-Wave Simulations
8:25 – 8:50 am	<u>Rodriquez – Fernandez</u> : Validation of Quasilinear Transport Codes Via Machine Learning Strategies
8:50 – 9:15 am	<u>Howard</u> : Validating Simulations of Multi-Scale Plasma Turbulence in ITER-Relevant, Alcator C-Mod Plasmas
9:15 – 9:40 am	<u>Vaezi</u> : An Improved Approach to Uncertainty Quantification for Plasma Turbulence Validation Studies
9:40 – 10:05 am	<u>Michoski</u> : Global Surrogates for the Upshift of the Critical Threshold in the Gradient for ITG Driven Turbulence

#### **10:05 – 10:25am Coffee Break**

10:25 – 10:50 am	<u>Jacobson</u> : Validation of MHD Models using MST RFP Plasmas
10:50 – 11:15 am	<u>Reusch</u> : Model Validation for Quantitative X-ray Measurements
11:15 – 11:40 am	<u>Mazon</u> : GEM tomographic measurements for WEST and validation strategies
11:40 – 12:10 pm	Discussion for Model Selection Validation and Verification

#### **12:10 – 1:00 pm Lunch Break (Provided at site)**

### **Afternoon Session: Session 4. Disruption prediction and pattern recognition**

1:00 – 1:30 pm	<u>Ratta (Invited)</u> : AUG-JET cross-tokamak disruption predictor
1:30 – 1:55 pm	<u>Kates-Harbeck</u> : Disruption Forecasting in Tokamak Fusion Plasmas using Deep Recurrent Neural Networks
1:55 – 2:20 pm	<u>Berkery</u> : Disruption event characterization and forecasting of global and tearing mode stability for tokamaks
2:20 – 2:45 pm	<u>Vega</u> : Increased warning times in JET APODIS disruption predictor by Using confidence qualifiers

**2:45 – 3:05 pm      Coffee Break**

3:05 – 3:30 pm      Granetz: Developing Universal Disruption Warning Algorithms Using Large Databases on Alcator C-Mod, EAST, and DIII-D  
3:30 – 3:55 pm      Rea: Exploratory machine-learning studies for disruption prediction Using large databases on DIII-D  
3:55 – 4:20 pm      Ho: Tokamak profile database construction incorporating Gaussian process regression  
4:20 – 4:45 pm      Churchill: Finding structure in large datasets of particle distribution functions using unsupervised machine learning  
4:45 – 5:10 pm      Smith: Identification of ELM evolution patterns with unsupervised clustering of time-series similarity metrics  
5:10 – 5:40 pm      Discussion for Disruption Prediction and Pattern Recognition

**June 1<sup>st</sup>**

**Morning Session**

**Session 5. Real time and Integrated Data Analysis**

8:00 – 8:30 am      Citrin (Invited): Realtime capable first principle transport modelling for tokamak prediction and control  
8:30 – 8:55 am      Meneghini: Integrated infrastructure for the development of machine-learning models aimed at fusion applications  
8:55 – 9:20 am      Grierson: Interpretive Analysis and Predictive Discharge Modeling with TRANSP  
9:20 – 9:45 am      Jakubowski: Thermographic measurements of power loads to plasma facing components at Wendelstein 7-X  
9:45 – 10:10 am      Puig: Wendelstein 7-X near real-time image diagnostic system for plasma facing components protection

**10:10 – 10:30 am      Coffee Break**

10:30 – 10:55 am      Logan: OMFIT Tokamak Profile Data Fitting and Physics Analysis  
10:55 – 11:20 am      Kostuk: Automatic between-pulse analysis of DIII-D experimental data performed remotely on a supercomputer at Argonne National Laboratory  
11:20 – 11:45 am      Kocan: ITER Wide Angle Viewing System: Synthetic Measurements and Challenges of the Real-time Data Processing  
11:45 – 12:10 pm      Xu: Data processing on application of real-time systems and validation of diagnostics in HL-2A

**12:10 – 1:00pm      Lunch Break (Provided at site)**

**Afternoon Session:**

**Session 6. Real time and Integrated Data Analysis Experimental Data Analysis and Synthetic Diagnostics**

1:00 – 1:30 pm	<u>Salewski</u> (Invited): Integrated data analysis of fast-ion measurements by velocity-space tomography
1:30 – 1:55 pm	<u>Wojenski</u> : Advanced real-time data quality monitoring concept for GEM detector based SXR plasma diagnostics
1:55 – 2:20 pm	<u>Nornberg</u> - Incorporating beam attenuation calculations into an Integrated Data Analysis model of plasma impurity content
2:20 – 2:50 pm	Discussion for Real Time and Integrated Data Analysis
<b>2:50 – 3:10 pm</b>	<b>Coffee Break</b>
3:10 – 3:40 pm	<u>Kajita</u> (Invited): Assessment and mitigation of wall light reflection in ITER by ray tracing
3:40 – 4:05 pm	<u>Yu</u> : Data analysis and effect corrections of Phase Contrast Imaging diagnostic on HL-2A tokamak
4:05 – 4:30 pm	<u>Liu, Y.</u> : Synthetic diagnostic for interpreting the ECE spectrum in LHW-heated plasmas on EAST
4:30 – 4:55 pm	<u>Liu, C.</u> : Explanation of prompt growth of ECE signal in tokamak runaway electron experiments using ECE synthetic diagnostic
4:55 – 5:15 pm	Discussion for Experimental Data Analysis and Synthetic Diagnostics
6:30 - 9:30pm	<b>Banquet Dinner at Top of the Hub – Boston, MA</b>

**June 2<sup>nd</sup>**

**Morning Session**

**Session 7. Data Management/handling**

8:00 – 8:30 am	<u>Marzouk</u> (Invited): Computational advances for Bayesian inference and optimal experimental design
8:30 – 8:55 am	<u>Pinches</u> : IMAS Updates
8:55 – 9:20 am	<u>Lupelli</u> : The SAGE Project: A paradigm shift in the Storage Systems for Data Centric Computing
9:20 – 9:45 am	<u>Smith, S.</u> : OMFIT (One Modeling Framework for Integrated Tasks): An Efficient Community Driven Integrated Modeling Framework
9:45 – 10:10 am	<u>Greenwald</u> : Navigational Data Management

**10:10 – 10:30 am    Coffee Break**

10:30 – 10:55 am    Zabeo: Diagnostic Data Handling in the PCS  
10:55 – 11:20 am    Emoto: Improvement of Automatic Physics Data Analysis Environment for the LHD Experiment  
11:20 – 11:45 am    Kim: Development of unified data analysis in KSTAR  
11:45 – 12:10 pm    de Witt: A Comparison of Data Management Techniques Across Different Science Disciplines  
12:10 – 12:40 pm    Discussion for Data Management & Meeting Closing