EDITORIAL

Editorial: 15th IAEA Technical Meeting on Energetic Particles in Magnetically Confined Systems

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Editorial

Editorial: 15th IAEA Technical Meeting on Energetic Particles in Magnetically Confined Systems

Guest Editors

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This Special Issue of Nuclear Fusion contains a collection of papers addressing critical issues for the understanding of confinement and transport properties of energetic particles in magnetically confined plasmas, which is required for reliable operations of fusion reactors such as ITER and DEMO.

Energetic particles represent an essential source of heating to the plasma, can affect global plasma stability, and—in the event of enhanced and localized losses—can threaten plasma facing components and imperil their structural integrity.

This collection represents a summary of the remarkable progress made over the last two years towards understanding those phenomena, in order to achieve quantitative, reliable and validated predictions for future fusion devices.

Magnetically confined thermonuclear fusion plasmas inherently contain significant supra-thermal populations of energetic particles. These may include, for example, the fusion-generated alphas from the D-T reaction needed for self-sustainment (heating) of the plasma, energetic ions from neutral beam injection to heat the plasma and control the current profile, non-thermal ion or electron populations created by a variety of radio-frequency wave heating and current drive methods, and 'runaway' electrons generated e.g. during disruptions.

Energetic particles play a critical role for the good performance of thermonuclear fusion reactors. However, they also provide a source of free energy to drive instabilities. Redistribution or loss of fast ions interacting with instabilities can reduce reactor performance and reduce plasma stability. Moreover, the potentially concentrated losses of energetic particles can threaten plasma-facing components.

Future devices such as ITER and DEMO will operate in parameter regimes for energetic particle physics that cannot be comprehensively duplicated in present devices. Therefore, the development and validation of theoretical and numerical models that can be used to predict the behavior of energetic particles in ITER and future thermonuclear fusion reactor plasmas is critical to provide guidance for the design of such machines, as well as help identify operational scenarios. Present experiments provide the required test-bed to improve our understanding of energetic particle physics and to validate predictive tools.

Papers in this Special Issue cover topics ranging from modeling the response of diagnostics proposed for energetic particle physics research on ITER, to theoretical and experimental studies on energetic particle driven instabilities and losses, interaction of turbulence with fast ion confinement and fast ion driven instabilities and runaway electrons.

The papers are based on presentations made at the 15th IAEA Technical Meeting on Energetic Particle Physics in Magnetically Confined Systems, hosted by the Princeton Plasma Physics laboratory in Princeton, New Jersey (USA). A total of 84 participants from 20 countries made presentations on the most recent advances in research on energetic particle physics, with 13 Invited presentations, 24 Oral presentations and 47 Poster presentations. Two Summary presentations concluded the meeting with an overview of the main developments in the areas of experimental and theoretical/numerical energetic particle research in magnetically confined plasmas.

The full Agenda of the meeting can be found from https://iaea-ep-tcm-2017.pppl.gov/

Most presenters kindly agreed to make their meeting presentation available through the IAEA website at https://nucleus.iaea.org/sites/fusionportal/Pages/Energetic%20Particles%2017/General-Info.aspx

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The International Programme Advisory Committee for the meeting included as members E. Fredrickson (chair), H. Berk, A. Fasoli, T. Fulop, W. Heidbrink, Y. Kolesnichenko, P. Lauber, S. Pinches, S. Sharapov, K. Shinoara, Y. Todo, G. Vlad, W. Chen and M. Podestà (representative for the Local Organizing Committee).

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