12th IAEA Technical Meeting on Energetic Particles in Magnetic Confinement Systems (7–11 September 2011) and 5th IAEA Technical Meeting on Theory of Plasma Instabilities (5–7 September 2011)

The behavior of energetic alpha particles in magnetically confined plasmas is perhaps the ultimate plasma physics issue that needs to be understood in the quest to achieve controlled nuclear fusion. The partial pressure of alpha particles in a burning plasma will be ∼5–10% of the total pressure and under these conditions the alpha particles may be prone to develop instability through Alfv´enic interaction. This may lead, even with moderate alpha particle loss, to a burn quench or severe wall damage. Alternatively, benign Alfv´enic signals may provide the vital information to control fusion burn. The significance of this issue has led to extensive international investigations and a biannual meeting that began in Kyiv in 1989, followed by subsequent meetings in Aspen¨as (1991), Trieste (1993), Princeton (1995), JET/Abingdon (1997), Naka (1999), Gothenburg (2001), San Diego (2003), Takayama (2005), Kloster Seeon (2007) and Kyiv (2009). The meeting was initially entitled 'Alpha Particles in Fusion Research' and then was changed during the 1997 meeting to 'Energetic Particles in Magnetic Confinement Systems' in appreciation of the need to study the significance of the electron runaway, which can lead to the production of energetic electrons with relativistic energies.
The 12th IAEA Technical Meeting on Energetic Particles in Magnetic Confinement Systems took place in Austin, Texas (7–11 September 2011). This meeting was organized jointly with the 5th IAEA Technical Meeting on Theory of Plasma Instabilities (5–7 September 2011). The two meetings shared one day (7 September 2011) with presentations relevant to both groups. Some of the work reported at these meetings was then published in a special issue of Nuclear Fusion [Nucl. Fusion **52** (2012)]. The presentations from most of the participants, as well as some preliminary versions of papers, are available at the websites [1, 2]. To view a presentation or paper, go to the link 'program', view the list or speakers and poster presenters and press 'talk' or 'paper' under the appropriate name. Summaries of the Energetic Particle Conference presentations were given by Kazuo Toi and Boris Breizman. They respectively discussed the experimental and theoretical progress presented at the meeting. Their presentations can be viewed on the 'iaeaep' website [1], by pressing 'Summary–I (or II)' by each of their names.

Highlights of this meeting include the tremendous progress that has been achieved in the development of diagnostics that enables the 'viewing' of internal fluctuations and allows comparison with theoretical predictions, as demonstrated, for example, in the talks of P. Lauber and M. Osakabe. The need and development of hardened diagnostics in the severe radiation environment, such as those that will exist in ITER, was discussed in the talks of V. Kiptily and V.A. Kazakhov.
In theoretical studies, much of the effort is focused on nonlinear phenomena. For example, detailed comparison of theory and experiment on D-III-D on the n = 0 geodesic mode was reported in separate papers by R. Nazikian and G. Fu. A large

number of theoretical papers were presented on wave chirping including a paper by B.N. Breizman, which notes that wave chirping from a single frequency may emanate continuously once marginal stability conditions have been established. Another area of wide interest was the detailed study of alpha orbits in a burning plasma, where losses can come from symmetry breaking due to finite coil number or magnetic field imperfections introduced by diagnostic or test modules. An important area of development, covered by M.A. Hole and D.A. Spong, is concerned with the self-consistent treatment of the induced fields that accounts for toroidally asymmetric MHD response. In addition, a significant number of studies focused on understanding nonlinear behavior by means of computer simulation of energetic particle driven instability. An under-represented area of investigation was the study of electron runaway formation during major tokamak disruptions. It was noted in an overview by S. Putvinski that electron energies in the 10–20 MeV range is to be expected during projected major disruptions in ITER and that reliable methods for mitigation of the runaway process needs to be developed. Significant recent work in the field of the disruption induced electron runaway, which was reported by J. Riemann, had been submitted to *Physics of Plasmas* [3]. Overall it is clear that reliable mitigation of electron runaway is an extremely important topic that is in need of better understanding and solutions.

References

[1] Program 2011 *12th IAEA Technical Meeting on Energetic Particles in Magnetic Confinement Systems (Austin, Texas, USA, 7–11 September 2011)* http://w3fusion.ph.utexas.edu/ifs/iaeaep/program.html
[2] Program 2011 *5th IAEA Technical Meeting on Theory of Plasma Wave Instabilities (Austin, Texas, USA, 5–7 September 2011)* http://w3fusion.ph.utexas.edu/ifs/iaeapi/program.html
[3] Riemann J., Smith H.M. and Helander P. 2012 *Phys. Plasmas* **19** 012507