

# Annual report of the ITPA Topical Group on Energetic Particle Physics

For the period June 2008 to July 2009

The EP Topical Group held two meetings (its 1<sup>st</sup> and 2<sup>nd</sup>) during the reporting period – at CRPP Lausanne, from 20<sup>th</sup>-22<sup>nd</sup> October 2008, and at Daejeon from 21<sup>st</sup> -24<sup>th</sup> April 2009. Both meetings were held in conjunction with the MHD TG, the Lausanne meeting also with the IOS TG. A full summary of these meetings and viewgraphs presented are available at the ITPA website, therefore only a summary of the main results is given here.

## Summary of the results of the 1<sup>st</sup> meeting of the Energetic particle Topical Group, CRat loads to the walls induced by the

various code results have been presented. Agreement between recent designs for ferritic inserts in ITER to reduce the CRat loads has been found however for the MHD code results have been found however for the MHD code. As a possible reason, a problem with the input data for the electromagnetic response of the TBMs was considered for the coils only. A correct treatment should include, the plasma currents as well. The difference between the angle of the magnetic field lines in front of the TBMs. Calculations based on a correct background magnetic field (induced by the FEMAG code).

The ripple field at high plasma beta was reported (Spong) and compared with the MHD reconstructions. It was decided to repeat these calculations for the ripple field and perform correct free boundary calculations.

Calculations of fast ion losses for full orbit simulations with the MHD code (including the cyclotron resonance in the ripple field). Strong interest for the ITER scenario 4, if the full particle orbits are calculated. It has been decided to perform benchmark simulations with the MHD code (~5) shall be used. The group as well decided to perform a benchmark simulation of the redistribution of particles. For this complex physics problem as a first step a simple benchmark case should be chosen (Gorelenkov).

In a joint session with the IOS-TG the recent experiments on **NBI current drive** at MAST have been discussed. It has been proposed to repeat the DIII-D

experiments for higher heating power and to investigate the evolut

- MAST: antenna excitation successful, but overlapping modes, no damping rates yet
- ASDEX Upgrade: beat-wave excitation of TAEs on ASDEX Upgrade experiments demonstrated

**EP-2: Fast ion losses and redistribution (Pinches)**

- JET: no losses caused by fishbones observed, but strong losses caused by TAEs and tornado modes
- ASDEX Upgrade: good agreement between measured and simulated fast ion losses induced by BAEs/TAEs
- DIII-D: interesting new fast ion diagnostics: FIDA

The **effect of background turbulence on fast ions** has so far been considered very small. Recent experiments on NBI current drive on ASDEX Upgrade put a question mark to this “belief”. New results based on turbulence simu

## First answers to the ITER high priority research tasks (Stambaugh October 2010)

### Requests by ITER-IO

### main results

<ul style="list-style-type: none"> <li>▪ TF Ripple: timescale: 2 years               <ul style="list-style-type: none"> <li>• require an improved predictive basis for fast particle confinement effects of TF ripple - in particular localized ripple such as that associated with TBMs</li> </ul> </li>   <li>• Localized ripple due TBMs: timescale : 2 years               <ul style="list-style-type: none"> <li>• ferromagnetic structural material used in TBMs will produce an additional component of at 3 locations</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• TF ripple with design for FIs as presented by ITER-IO so far reduce fast ion losses significantly</li> <li>• Heat loads to the walls well below the limits according to OFMC and ASCOT simulations (further codes to be included)</li> <li>• No full orbit simulations required (good agreement with drift orbit simulations)</li> <li>• <i>New design of FIs needed for definitive answer</i></li>   <li>• Effect of TBMs on fast ion losses demonstrated to be small</li> <li>• No 3d equilibria needed to describe the effect of TBMs</li> <li>• TBMs create n=1 magnetic field perturbation (magnetic islands, error field for RWM locking)</li> </ul>
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### Next meeting(s)

The next meeting will be held in conjunction with the IAEA-TCM in Kiev (Ukraine), September 24/25. The spring meeting 2010 is planned to be together with the MHD-TG.