

Priority topics in energetic ion physics research

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Objectives

Review the current status and identify the most important topics in the physics of energetic ions in (a) preparations for burning plasmas and (b) optimizations of future tokamak research.

Accomplishments

Based on recent Nuclear Fusion review we identified a few most important topics encompassing main areas of energetic ions research.

Energetic ion confinement in toroidal devices is prone to multiple Alfvénic instabilities which are among the main problems for the near term fusion research by redistributing fast ions.

- Two approaches exist to address this problem by the community: developing initial value numerical codes and reduced models such as the quasilinear model.

Another identified topic is the effect of the fast ion driven modes on the background plasma transport. One example is the coupling of the compressional Alfvénic modes and the kinetic Alfvén waves in ST devices such as NSTX. This coupling is shown by the HYM code to be ubiquitous for tokamaks.

The less studied Ion Cyclotron Emission (ICE) observed earlier in JET and TFTR experiments and expected in ITER. It is proposed as a method to diagnose the fusion products in the conditions of strong neutron and gamma emissions when other diagnostics may not work.

Impact

- Identifying priority topics is important for the whole fusion program where the research needs to focus on a few important topics.
- Some of the identified problems are more developed than others and the focus should be on the most promising important ones.
- In the example of ICE studies a new discovery of compressional Alfvénic mode (CAE) coupling to the kinetic Alfvén waves emerged which provides strong damping of CAEs. This requires to revisit earlier theories of ICE. It also promises a highly efficient way to diagnose the fast ions.

