

Observation of suprathermal ions with Neutral Particle Analyzers during electron cyclotron heating in the TJ-II stellarator.

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The plasmas in the TJ-II stellarator are created and maintained using two gyrotrons tuned to the second harmonic of the electron gyrofrequency. Additional heating can be applied using neutral beam injection or the plasma can be maintained with microwave power to produce a pure ECRH discharge. In the case of pure ECRH plasmas the majority ions are not directly heated by external sources rather by collisions with the hot electrons, hence their population distribution function is considered Maxwellian. The bulk ion temperature is clearly detached from the electron temperature, the usual value for the ion temperature is around 80 eV whereas the electron temperature is about 1 keV. Under such conditions the count rates in the high energy channels (> 1 keV) of the TJ-II neutral particle analyzers (NPA) are at the background level, indicating the absence of ions in the high energy tail. However, suprathermal ions have been found in TJ-II ECRH plasmas using spectroscopic methods [1]. Thus it is necessary to confirm their presence with the NPA diagnostics.

In a recent experiment, we modulated the full power of one of the two gyrotrons to produce two clearly separate phases of the ECRH plasmas, one with full power, the other with half power. Also the radial position, where the microwaves heat the plasma, was varied during the experiment. During the experiments the NPA was tuned to scan high energy ions. As a result, in some configurations, signal levels above the normal background levels were detected in the high energy channels when full power was applied. This can be an indication of the presence of suprathermal ions in the plasma.

One possible explanation for the generation of suprathermal ions is a parametric decay instability of the heating wave in a local maximum of the density [2]. We have designed an experiment to inject pellets in the ECRH plasma to modify the density profile while scanning the high energy ion tail with the NPA diagnostics in different positions to investigate the influence of the density profile on the suprathermal ion population.

References

- [1] D. Rapisarda, B. Zurro, V. Tribaldos, A. Baciero and TJ-II Team, *Plasma Physics and Controlled Fusion* **10**, 309 (2007).
- [2] E.Z. Gusakov and A.Yu. Popov, *Plasma Physics and Controlled Fusion* **60**, 025001 (2018).