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Indication of Bulk-Ion Heating by Energetic Particle Driven Geodesic Acoustic Modes on LHD

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Heating of bulk-ions by waves excited by energetic particles, such as fusion born alphas, was theoretically pointed out in the past [1], but none of the experimental results related on this phenomena was reported. This is the first report of experimental results indicating the increases of ion temperatures with Energetic-particle driven Geodesic Acoustic Mode (EGAM) excitation.
On the Large Helical Device (LHD), ion temperature increase, which was evaluated from the low energy neutral spectra, was observed with excitation of the EGAM for the first time. This phenomenon was observed when the high energy Neutral Beam (NB) of ˜170keV was injected into very low density plasmas below ˜1x1018m-3 sustained by Electron Cyclotron Heating (ECH). In IAEA-FEC 2012, the excitation of the instability and its identification as GAM were reported. In this report several possible mechanisms to explain this phenomenon were discussed, i.e., (1) change of measured ion spectra due to the orbit topology change, (2)increase of classical ion heating power by energetic particles, (3) enhancement of energy confinement properties and (4) enhanced ion heating by the EGAM. Among them, it was found that the enhanced ion heating by the mode activity was the most probable mechanism for this phenomenon. In addition to the analyses, increase of effective ion temperatures was correlated with the time integrated power of the mode amplitude. These analysis suggests the existence of a new energy channel of bulk-ion heating by energetic particles through the EGAM [2].

[1] N. J. Fisch and M. C. Herrmann: Nucl. Fusion 34 (1994) 1541.
[2] M. Sasaki, K. Itoh and S. Itoh: Plasma Phys. and Control. Fusion 53 (2011) 085017.

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