Contribution ID: **319** Type: **Oral**

Strongly non-linear energetic particle dynamics in ASDEX Upgrade scenarios with core impurity accumulation

Tuesday 23 October 2018 10:45 (20 minutes)

In 2017 a new scenario on ASDEX Upgrade for the dedicated investigation of energetic particle (EP) physics has been developed. This scenario is unique in two aspects: firstly, the neutral beam (NB) induced fast-ion beta is comparable to the background plasma β, and secondly, the ratio of the fast ion energy to the thermal background is of the order 100.
At ASDEX Upgrade we reach this previously unexplored regime by NB off-axis heating only and by letting impurities accumulate in the core. Due to strong radiation losses the background tempera- tures and pressures of both ions and electrons stay low, despite 2.5 – 5MW NB heating. In the stable flattopphaseanunprecedentednumberofvariousEP-driveninstabilities(despitevEP/vAlfvén ≈0.4≪ 1) is simultaneously observed: EP-driven geodesic acoustic modes (EGAMs), beta-induced Alfvén eigenmodes (BAEs), reversed shear Alfvén eigenmodes (RSAEs) and toroidal Alfvén eigenmodes (TAEs), that are modulated by transient q = 2 sawtooth-like crashes, NTMs and ELMs. The physics reasons for these strong mode activity are discussed. During the stable flat-top phase meaningful EP distribution function measurements (FIDA) and analysis (TRANSP/FIDASIM) can be performed. First results indicate that the EP profiles differ significantly from neoclassical predictions. Bicoherence analysis using an advanced toolset for non-stationary processes reveals that non-linear coupling processes between different frequency bands exist. In addition, TAE bursts are observed to trigger the onset of EGAMs which indicates coupling of these modes via the velocity space (EP avalanches). Linear and non-linear tools (HAGIS/LIGKA, ORB5, XHMGC) are used for mod- eling mode onset and non-linear phases. These experiments facilitate the experimental study of the interaction of AEs, zonal modes and turbulence and thus serve as an ideal validation opportu- nity for various non-linear analytical and numerical models. In addition, the observed onset of EP avalanches can be quantified. The investigation and understanding of these - so far not accessible - physics elements is a prerequisite for a reliable prediction of the self-organisation of a burning plasma.

Country or International Organization

Germany

Paper Number

EX/1-1

Author: Dr LAUBER, Philipp (IPP Garching)

Co-authors: Dr BOTTINO, Alberto (IPP Garching); Dr BIANCALANI, Alessandro (Max-Planck-Institut für Plasmaphysik); Dr GEIGER, Benedikt (Max-Planck Institut für Plasmaphysik); Dr PALERMO, Francesco (IPP Garching); Dr POR, Gabor (Institute of Nuclear Techniques, Budapest); Dr CONWAY, Garrard (Max-Planck-Institut fuer Plasmaphysik); Dr PAPP, Gergely (Max Planck Institute for Plasma Physics); Dr POKOL, Gergo (NTI, Budapest University of Technology and Economics, Hungary); Mr NOVIKAU, Ivan (IPP Garching); Dr GUIMARAIS, Luis (IST, Lisbon, Portugal); Dr MARASCHEK, Marc (IPP Garching); Mr POLOSKEI, Peter (IPP Garching); Mr HAYWARD-SCHNEIDER, Thomas (IPP Garching); Dr IGOCHINE, Valentin (Max-Planck-Institut für Plasmaphysik); Dr WANG, Xin (Max Planck Institute for plasma physics); LU, Zhixin (School of Physics, Peking University)

Presenter: Dr LAUBER, Philipp (IPP Garching)

Session Classification: EX/1-TH/1 Energetic Particles

Track Classification: EXW - Magnetic Confinement Experiments: Wave–plasma interactions; current drive; heating; energetic particles