Contribution ID: **28** Type: **Oral (Plenary Session)**

First investigation of fast-ion-driven modes in Wendelstein 7-X

Thursday, 5 September 2019 17:00 (25 minutes)

The 2018 operation phase (OP 1.2b) of the stellarator Wendelstein 7-X (W7-X) included, for the first time, neutral beam injection (NBI) to heat the plasma. During longer phases of NBI injection, with the primary purpose to study the heating efficiency of this system, Alfvén eigenmodes (AEs) were observed by a number of diagnostics, including the phase contrast imaging (PCI) system, the magnetic pick-up coils (Mirnov and Rogowski coils), and the soft X-ray multi-camera tomography system (XMCTS).

Alfvén eigenmodes are of great interest for future fusion reactors as it has been shown that the resonant interaction of fast ions with self-excited AEs can lead to enhanced transport of fast ions and potentially to energy losses. This is especially true for so-called gap-modes, Alfvén eigenmodes with frequencies in gaps of the continuous spectrum, since they lack continuum damping.

In this contribution we present a first analysis of the observed mode numbers and frequencies from the theoretical side. The calculation of shear Alfvén wave continua for selected cases and the assignment of observed frequencies to the gaps of the continuous spectra are presented. We emphasize the crucial role of the Doppler shift arising as a consequence of the radial electric field in W7-X. Furthermore, the ideal-MHD code CKA [A. Könies et al., *10th IAEA TM on Energetic Particles in Magnetic Confinement Systems* (Kloster Seeon, 2007)] has been used to compute mode structures which are compared to experimental measurements.

The Monte-Carlo particle-following code ASCOT [E. Hirvijoki et al., *Comput. Phys. Commun.* **185** 1310-1321 (2014)] is used to compute the slowing-down distribution function of the fast ions. This information is used by the gyro-kinetic codes CKA-EUTERPE [T. B. Fehér, Ph.D. thesis, *University of Greifswald* (2013)] and EUTERPE to assess the fast-ion drive and to answer the question whether the fast-ion drive is sufficient to destabilize the modes. This question is of particular importance since mode activity has also been observed in other experimental programs without NBI heating. These findings indicate the existence of other destabilizing mechanisms, e.g. associated with the electron pressure gradient [T. Windisch et al., *Plasma Phys. Control. Fusion* **59** 105002 (2017)].

Country or International Organization

Germany

Primary author: SLABY, Christoph (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald)

Co-authors: ÄKÄSLOMPOLO, Simppa (Max Planck Institute for Plasma Physics); BORCHARDT, Matthias (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); BOZHENKOV, Sergey (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); BRANDT, Christian (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); DINKLAGE, Andreas (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); DREVAL, Mykola (Kharkov Institute of Physics and Technology); FUCHERT, Golo (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); HARTMANN, Dirk (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); HIRSCH, Matthias (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); HÖFEL, Udo (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); KLEIBER, Ralf (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); KÖNIES, Axel (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); MCNEELY, Paul (Max--Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); PABLANT, Novimir (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); RAHBARNIA, Kian (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); RUST, Norbert (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); SCHILLING, Jonathan (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); VON STECHOW, Adrian (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald); THOMSEN, Henning (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald)

Presenter: SLABY, Christoph (Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald)

Session Classification: Plenary

Track Classification: Collective Phenomena