中科院等离子体所研究员讲堂

特邀报告

报告名称： Axisymmetric Electrostatic Magnetohydrodynamic Oscillations in Tokamaks with General Cross-sections and Toroidal Flow

主讲： Dr. Ming Sheng Chu

时间：2016 年 5 月 23 日下午 14:00

地点：601 会议室

授课内容摘要：

The frequency spectrum and mode structure of axi-symmetric electrostatic oscillations [the zonal flow(ZF), sound waves(SW), geodesic acoustic modes(GAM) and electrostatic mean flows (EMF)] in tokamaks with general cross-sections and toroidal flow are studied analytically using the electrostatic approximation for MHD modes. These modes constitute the "electrostatic continua". Starting from the energy principle for a tokamak plasma with toroidal rotation, we showed that these modes are completely stable. The ZF, the SW, and the EMF could all be viewed as special cases of the general GAM. The equations determining the frequency spectrum and mode structure are solved analytically for both the low and high range of Mach numbers. The solution consists of the usual countable infinite set of eigen-modes with discrete eigen-frequencies, and two modes with lower frequencies. The countable infinite set is identified as the usual GAM. Mode with the lower frequency and divergence free displacement at no flow is identified as the ZF. Another low frequency mode is a pure geodesic ExB flow, and not divergence is identified as the EMF, which is also shown to always have exactly 0 frequency. In general, sound waves with no geodesic components are (almost) completely lost in tokamaks with a general cross-sectional shape. The exception is the special case of strict up-down symmetry. Then half of the GAMs would have no geodesic displacements and are identified as the SW. Present day tokamaks are slightly up-down asymmetric. It is expected that half of the GAM would be sound wave-like, i.e. have much smaller coupling to the geodesic components than the other half of non-sound-wave like with stronger coupling . Based on the general notion that the geodesic component of the GAM is more effective in tearing up the eddies in the electrostatic turbulence, it is important to preferentially excite the GAMs which are not sound-wave like to maximize efficiency on turbulence suppression through external means.

授课人简介：

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Current Area of Research: General MHD Topics; NTV; Control of Electrostatic Modes; RWM

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