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Helicon mysteries: fitting a plane wave into a cylinder

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Since the first reports in the 1960s, the dispersion of helicon waves in a plasma cylinder has been difficult to describe theoretically for axial wavelengths that are greater than the plasma radius. About 10 years ago, Breizman and Arefiev showed how radial density gradients make the plasma column similar to a coaxial cable, allowing the helicon waves to propagate below the cut-off frequency. The resulting dispersion relation is similar to that of a plane wave propagating parallel to the magnetic field. A few years later, Degeling et. al. presented experimental evidence demonstrating such a plane wave dispersion for a broad range of axial wave numbers. The reason lies in the decoupling of the Hall and electron inertial terms in the dispersion, the former describing the electromagnetic propagation and the latter the electrostatic propagation. Combining the experimental and theoretical results has recently thrown further light on this phenomenon that is applicable to both space and laboratory situations. Radially Localized Helicon Modes in Nonuniform Plasma, Boris N. Breizman and Alexey V. Arefiev, Phys. Rev. Letts. 84, 3863 (2000). Transitions from electrostatic to electromagnetic whistler wave excitation, A. W. Degeling, G. G. Borg and R. W. Boswell, Phys. Plasmas, **11**, 2144, (2004)