Mode Coupling in Two-Dimensional Complex Plasma Crystals

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Wave modes of many physical systems can become coupled to each other. Mode coupling can lead to new interesting effects such as the mode-coupling instability (MCI) which was predicted theoretically [1] and observed experimentally in two-dimensional (2D) complex plasma crystals [2]. MCI occurs when the dispersion relations of the two dust-lattice wave modes, longitudinal in-plane (L) mode and transverse vertical (TV) mode intersect. In the vicinity of their intersection, a new hybrid mode appears which is unstable. If not suppressed by the neutral gas friction, it will grow exponentially with time and can result in the crystal melting. A prominent characteristic feature of MCI is *mixed polarization*, where traces of the L mode can be measured in the transverse vertical spectra and vice versa [2]. It was previously believed that the mixed polarization could only occur when the modes cross.

In this contribution, we report on the experimental observation of mode coupling and mixed polarization of the longitudinal in-plane and transverse vertical wave modes in a 2D complex plasma crystal in the absence of mode crossing [3]. The coupling manifests itself in traces of the TV mode appearing in the measured longitudinal spectra. The observations are corroborated in molecular dynamics simulations. A theoretical analysis of the modes in a plasma crystal with finite temperature predicts the ratio of the trace to the principal mode which is in a good agreement with the experiment and simulations.

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