Mode structures and dispersion relations of Alfvénic fluctuations in shaped toroidal plasmas

Hydromagnetic Alfvén waves are fundamental low-frequency electromagnetic oscillations in magnetized plasmas, which are found to be prevalent in nature and laboratory plasmas. For example, rapid loss of alpha particles due to Alfvén wave instabilities is a major issue of concern in burning fusion plasmas, such as the International Tokamak Experimental Reactor (ITER).

Computing dispersion relation and mode structures of Alfvén waves in non-uniform plasmas with realistic equilibrium geometries is of crucial importance for the prediction of alpha particle confinement properties in fusion reactor relevant conditions. This must rely on numerical simulations but to large extent, significant information can be obtained by a proper theoretical formulation, which can provide the optimal framework for further numerical analyses. This Doctoral Thesis research will focus of the general formulation of the problem and the solution of the one-dimensional dispersion relation first. Then it will address the construction of the complete two-dimensional structure of Alfvénic fluctuations in toroidal plasmas of fusion interest and the corresponding spectral features.