Beam- wave interaction at High-Frequency in High-Power devices. Theory and code development

Development of new mm and sub-mm-wave sources for additional plasma heating is an important research and technological issue that could boost the design and realization of new generation tokamak machines. Currently the gyrotrons are the unique sources fulfilling this duty. However they reached the natural frequency limits due to the mode complexity and the use of high magnetic field. An alternative of the Gyrotrons are the Cyclotron Autoresonnace Masers (CARM). Those generators operate at much higher beam energy and lower beam current (in comparison to gyrotrons) which helps to overcome the problems related to the beam transport and quality (longitudinal velocity spread). However the electrodynamical system is extremely oversized in longitudinal direction (1000 λ) and has very complicate fine structure in radial direction (40 μm). Those features combined with the short wavelength makes the simulation of the beam-wave interaction very slow which makes the optimization of the device inefficient. The proposed Ph.D. thesis aims the theoretical investigation of the this phenomena and development of new software code capable to design the CARM oscillator overcoming the above mentioned problems.