Universität Rostock Traditio et Innovatio

Master's thesis or research assistantship (30h/month)

Radio-frequency resonators for Muon Collider

In this master thesis or scientific assistantship in the field of accelerator technology, a literature study on radio-frequency (RF) resonators on the one hand and electromagnetic field simulations for selected resonators, on the other hand, are to be carried out.
The international "Muon Collider" is a proposed particle accelerator facility in the design phase. The European Strategy for Particle Physics recommended an international design study for a Muon Collider with centre-of-mass energies close to 10 TeV (tera electron Volts, i.e., 10^{12} electron Volts). This design study is part of an international collaboration led by CERN. The accelerator facility shall produce muon beams for precision studies of the properties of the Higgs particle. In addition, it shall serve for collider studies for the direct search for new physics. The greatest challenge in such a collider is the extremely short lifetime of the muons: it is only 2.2 µs in their rest system. This short lifetime implies challenges for the accelerator complex: first, the muons require acceleration to high energy before they decay, and second, the accelerator needs a continuous source of new muons.
The Chair of Theoretical Electrical Engineering received an invitation to participate in the international Muon Collider consortium for the fundamental design study to conceptualise the radio-frequency accelerator. Central questions include the technology of the RF resonators, the type, the material, the frequency, the number of cells and the number of resonators. In the master thesis, a literature study shall provide a comprehensive overview of the state of research. The main focus is on fundamental considerations of the RF requirements of the first acceleration stages, such as a linear accelerator, while the most demanding accelerator, the Rapid-Cycling Synchrotron (RCS), is excluded. The resonators required in the pre-accelerators are to be analysed. The most critical resonators will need further investigations.
The research will happen in close cooperation with CERN, with whom research stays are also part of the master thesis. Possibilities for a subsequent doctorate exist if there is sufficient aptitude.

Students who would like to work on this project should have

- Good knowledge of electromagnetic field theory

- Ideally also knowledge of radio-frequency engineering

- Basic knowledge of programmes such as CST STUDIO SUITE® or COMSOL Multiphysics®.

- The ability to solve problems independently.

You will gain insights into an exciting, international field of research. In addition, this knowledge is also relevant for other areas of radio-frequency technology or the simulation of electromagnetic fields and thus also for industry.

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