

List and description of the projects

- **B01: A precision determination of the weak mixing angle at low energies**

The parity-violating electron scattering (PVES) program at MESA with the P2 spectrometer aims at determining the weak charge of the proton at an unprecedented level of precision, improving the existing results by factors of 3 to 4. **Supervisors:** *Niklaus Berger, Frank Maas*

- **B03: Data-driven evaluation of the hadronic vacuum polarization**

This project will significantly improve the accuracy of the data-driven determination of the Hadronic Vacuum Polarization (HVP) contribution to $(g-2)_\mu$ and to the determination of the running of the electromagnetic fine structure constant. The improvement will be achieved through the measurement of the most important exclusive contribution, the pion time-like form factor, with world leading precision at the BESIII experiment. **Supervisor:** *Achim Denig*

- **B05: Dark sector searches at MESA**

This project is dedicated to dark sector searches using the high-intensity electron beam of the MESA accelerator. The MAGIX spectrometers will be commissioned using the Extracted Beam (EB) mode. A Dark Photon search in visible decay mode using a tantalum target in EB mode will be performed covering the mass of the hypothetical X17 particle. **Supervisor:** *Harald Merkel*

- **H02: Electrons for neutrinos**

This project is devoted to the experimental study of electron scattering off medium-mass nuclei (^{12}C , ^{16}O , and ^{40}Ca) with the goal of improving our understanding of the nuclear structure dynamics governing lepton-nucleus cross sections. This effort will allow us to quantify and possibly reduce uncertainties stemming from nuclear structure, which presently affect the extraction of neutrino oscillation parameters from long-baseline experiments. **Supervisor:** *Luca Doria*

- **N01: Neutron-skin and surface-thickness of ^{208}Pb**

The PVES program at MESA using the P2 spectrometer will achieve unprecedented precision in measuring the neutron skin of ^{208}Pb (MREX), improving previous results by a factor of two. Additionally, it will systematically study the beam-normal single spin asymmetry, providing experimental access to the absorptive part of the two-photon exchange amplitude. **Supervisors:** *Concettina Sfienti, Michaela Thiel*

- **N02: Study of reaction cross-sections of astrophysical interest**

We aim to infer radiative-capture cross sections at low energy employing an indirect technique by using MESA's high-intensity electron beam to induce photo-dissociation reactions of astrophysical interest, such as (γ, α) and (γ, n) . **Supervisor:** *Concettina Sfienti*

- **N03: Few-body systems**

This project covers an electron scattering program on light nuclei that will serve as a benchmark to constrain state-of-the-art theoretical calculations. High-precision inclusive and exclusive electron scattering data in the sector of few-body systems offer a rich insight into the nuclear dynamics. **Supervisor:** *Sören Schlimme*