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

- **B02: Standard Model precision tests with hadrons and nuclei (Theo)**
  The ambitious precision goal on the weak charge of the proton makes effects from radiative corrections as well as from hadronic and nuclear structure non-negligible and requires the interplay of theory with the high-level analysis of the experimental data. The results will also be analyzed in a global context, where they are complementary to the physics program at the LHC
  Supervisor: Jens Erler

- **B03: Data-driven evaluation of the hadronic vacuum polarization (Exp)**
  This project will significantly improve the accuracy of the data-driven determination of the Hadronic Vacuum Polarization (HVP) contribution to $(g\text{-}2)_\mu$ 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

- **B04: Precision determination of the hadronic vacuum polarization from lattice QCD (Theo)**
  The key objective is to compute the leading Hadronic Vacuum Polarization (HVP) contribution to $(g\text{-}2)_\mu$ with a precision of 0.7% using lattice QCD.
  Supervisors: Harvey Meyer, Hartmut Wittig

- **B05: Dark sector searches at MESA (Theo and Exp)**
  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. The theoretical work aims to set the framework to analyze the dark sector searches in the MESA energy range.
  Supervisors: Dr. Harald Merkel (exp), Marc Vanderhaeghen (Theo)

- **H01: Nucleon form factors for neutrino detection (Theo)**
  The main aim of this project is to provide a precise ab-initio determination of nucleon axial form factors (FFs) using lattice QCD, including both the isovector FF describing quasi-elastic neutrino-nucleon scattering via W-boson exchange, as well as other flavour components of the axial current.
  Supervisors: Harvey Meyer, Georg von Hippel

- **H02: Electrons for neutrinos: nuclei (Theo and Exp)**
  This project is devoted to the theoretical and 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.
  Supervisors: Sonina Bacca (Theo) and Luca Doria (Exp)

- **H03: Muonic atom spectroscopy (Exp)**
  We will perform precision laser and X-ray spectroscopy on muonic hydrogen and the lightest muonic atoms, with as a primary goal improve the Zemach radius of the proton and the charge radius of 6/7Li by an order of magnitude, respectively, thereby providing valuable input for nuclear theory and atomic physics calculations. These measurements will be performed at the high-intensity proton accelerator facility of the Paul Scherrer Institute (PSI). Hydrogen and helium are accessible with laser spectroscopy, for the other light nuclei the energy levels will be measured with magnetic metallic microcalorimeters (MMCs).
  Supervisor: Randolf Pohl

- **H04: Precision nucleon structure in muonic hydrogen versus electron scattering (Theo)**
  This project is devoted to low-energy nucleon structure and provides the theory component for the laser spectroscopy of muonic atoms at PSI, and the electron and Compton scattering ex-periments at MAMI and MESA. A prime goal is to refine the current theoretical predictions for the Lamb shift and hyperfine splitting in muonic hydrogen, deuterium and ^{3}He, with the main focus on nuclear- and nucleon-structure contributions, in particular on two-photon exchange (2PE).
  Supervisor: Franziska Hagelstein, Marc Vanderhaeghen

- **H05: Electron and photon scattering (Exp)**
  A dedicated electron scattering program using the MAGIX spectrometers at MESA is planned to measure the proton form factors to unprecedented small momentum transfers, as well as a Compton scattering program at the Crystal Ball detector at MAMI, with the aim to improve on the extraction of the neutron polarizabilities by a factor of two.
  Supervisor: Michael Ostrick

- **N01: Neutron-skin and surface-thickness of ^{208}Pb (Exp)**
  The parity-violating electron scattering (PVES) program at MESA with the P2 spectrometer will initiate a new era of measurements of the neutron skin of ^{208}Pb (MREX) with unprecedented precision, aiming to improve on previous PVES extractions of the neutron skin by a factor of two. In parallel we will perform, a systematic study of the beam-normal single spin asymmetry A_n which also allows experimental access to the imaginary (absorptive) part of the two-photon exchange amplitude.
  Supervisor: Concettina Sfienti, Michaela Thiel

- **N02: Study of reaction cross-sections of astrophysical interest (Theo/Exp)**
  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 astro-physical interest, such as (γ, α) and (γ, n). These new measurements will challenge nuclear theory calculations. For this purpose, dedicated theoretical efforts will aim at modelling these reactions.
  Supervisors: Pierre Capel (Theo), Concettina Sfienti (Exp), Tanja Heftrich (Exp - Goethe Universität Frankfurt)

- **N03: Few-body systems (Theo/Exp)**
  This project covers an electron scattering program on light nuclei that will serve as a benchmark to constrain state-of-the-art theoretical calculations in a combined theoretical and experimental effort. High-precision inclusive and exclusive electron scattering data in the sector of few-body systems offer a rich insight into the nuclear dynamics. Electron scattering observables measure the matrix element of the electroweak current operators, which should be consistently derived within an Effective Field Theory (EFT).
  Supervisors: Sonia Bacca (Theo), Sören Schlimme (Exp)