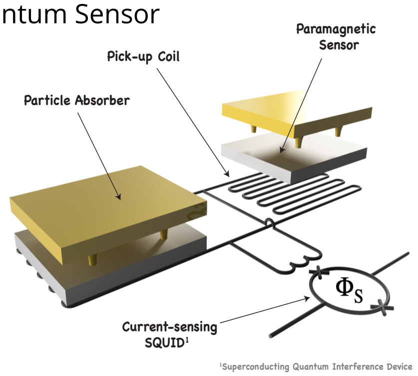
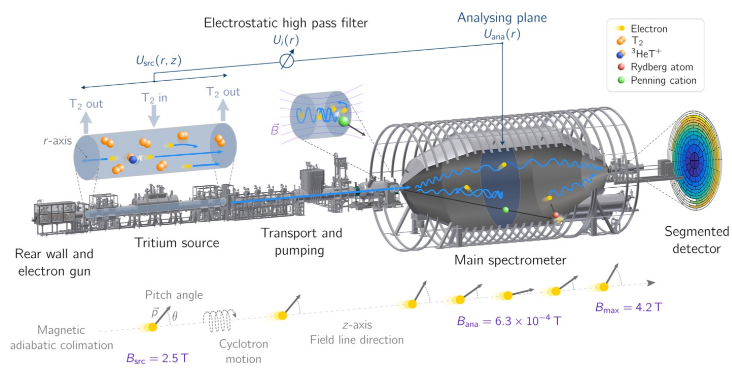
# Bachelorarbeit
# am Institut für Astroteilchenphysik

Quantum Sensor




KATRIN Experiment




## Characterisation of the electrostatic bender using the Kr-83m source, for the ELECTRON project

### General Introduction

First proposed in 1930 by Wolfgang Pauli in order to preserve the energy-momentum conservation in the measured beta decay spectrum, neutrino has ever since remained as one of the most mysterious and most interesting particles in the Standard Model of Particle Physics.

Contrary to the original beliefs, discovery of the neutrino oscillations by the Super-Kamiokande and SNO experiments, provided irrefutable evidence that neutrinos are in fact massive particles. As neutrino mass is an important parameter in cosmological models and in the searches for new physics beyond the Standard Model, neutrino mass determination has become one of the main priorities of the modern particle and astroparticle physics.

The current best limit on the neutrino mass comes from the KATRIN (**KA**rlsruhe **N**eutrino **TRI**tium) experiment, putting the neutrino mass below 0.8 eV/c$^2$.

However, hints from cosmology suggest that the mass of neutrinos lies well below the current sensitivity of the KATRIN experiment ($m_\upsilon$ < 0.2 eV), fuelling the research of new detector technologies for future neutrino mass experiments.

### The ELECTRON Project

The ELECTRON project was initiated with the aim of developing new detector technology for the next generation neutrino experiments with tritium, aiming at sensitivity to neutrino mass well below the current best sensitivity of the KATRIN experiment (i.e. below 0.2 eV).

Current world leading energy resolution is achieved by detectors belonging to cryogenic quantum sensor family, which are operated at temperatures on the order of 10 millikelvin. In order to properly characterise these new detectors, several electron sources are required (e.g. electron-gun). However, interfacing the „hot" source at room temperature with the cryogenic detector sitting on the cold platform of the dilution refrigerator is not a simple task.

To mitigate the thermal radiation emitted by the source, we designed a 90 degree electrostatic bender. In order to fully understand the transmission of the electrons through the bender, we need to characterise it with a well known electron source.

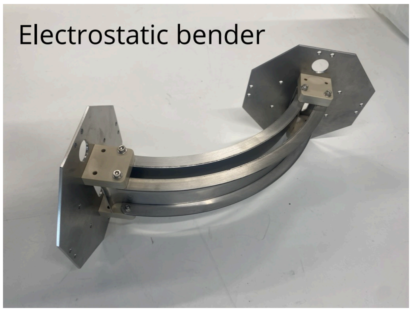
Krypton-83m stands out as an optimal candidate for these measurements due to its well defined electron conversion lines, allowing us to properly study the properties of the electrostatic bender.

**Goal of the Bachelor's Thesis:**

The goal of this thesis is to investigate the transmission of electrons through a 90 degree electrostatic bender, using the Krypton-83m radioactive source and a state of the art Silicon Drift Detector (SDD).

**Work tasks:**

- Performing the measurements of the Krypton-83m spectrum with an SDD detector, installed at the small vacuum system at KIT Campus Nord.
- Spectrum measurements are to be performed for different values of the voltage applied at the bender electrodes, resulting in a transmission function for electrons of specific energy.
- As Krypton-83m features electron lines of different energies in the range of up to 32 keV, measurements should be repeated with several different electron energies in order to investigate energy dependent effects.
- Acquired data will be analysed using simple python code
- Reconstructed spectra will be compared to the Krypton spectra measured previously in a set-up without the electrostatic bender.





**Supervision of the Bachelor's thesis:**

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- **Dr. Magnus Schlösser**
- **Dr. Rudolf Sack**
- **M.Sc. Neven Kovac**

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**Starting date: April or May 2024**

**Location: The work will be carried out at Institute for Astroparticle Physics, KIT Campus Nord**