Project 8: A frequency-based approach to measure the absolute neutrino mass scale

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Neutrino flavour oscillation experiments have proven that at least two neutrinos have finite masses but they cannot reveal their absolute masses. Various extensions to the Standard Model of Particle Physics have been developed to explain the non-zero masses and can be directly tested by a measurement of the absolute neutrino mass scale. This scale can be determined from the highest precision spectroscopy of the β^--decay of tritium around its endpoint region (Q = 18.6 keV). The current state-of-the-art experiment, KATRIN, stretches all technological limits to probe the mass range down to 200 meV/c^2 while cosmological results suggest that the absolute mass scale might be even lower. A completely new technological path has to be envisioned to test the mass range down to 40 meV/c^2, allowed under an inverted neutrino mass ordering scenario. The Project 8 collaboration has recently demonstrated the novel technique of Cyclotron Radiation Emission Spectroscopy (CRES) to pursue a frequency-based measurement approach. I will present this new approach and results obtained with mono-energetic conversion electrons from ^{83m}Kr as well as preliminary results from measurements using molecular tritium. The phased program towards a measurement using atomic tritium with a mass sensitivity potentially below 40 meV/c^2 will be discussed. This work has been supported by the Cluster of Excellence "Precision Physics, Fundamental Interactions, and Structure of Matter" (PRISMA+ EXC 2118/1) funded by the German Research Foundation (DFG) within the German Excellence Strategy (Project ID 39083149).