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First operation of the FAMU experiment at the RIKEN-RAL high intensity muon beam facility

The FAMU experiment targets a high-precision measurement of the ground-state hyperfine splitting (1S-hfs) in muonic hydrogen, aiming for an accuracy of 10^{-5}. This will enable extraction of the proton Zemach radius with <1% uncertainty, offering key insights into proton structure and testing QED contributions.
Being carried out the ISIS RIKEN Port1 beamline at the Rutherford Appleton Laboratory (UK), the experiment uses a 55 MeV/c pulsed negative muon beam injected into an 8-bar hydrogen gas target. After thermalisation, muonic hydrogen atoms are irradiated with tunable mid-infrared laser light (~6788 pm) to induce the 1S-hfs transition.
If the transition happens, the atom is left with a residual kinetic energy, which enhances the probability of ceasing the muon to another atom. For this reason, the gaseous target contains also 1.5% oxygen, and the observable is the laser-enhanced number of muonic oxygen X-rays. This variable is measured as a function of the laser wavelength, looking for a resonance.
The X-ray detector system is based on a set of 34 custom $LaBr_3$:Ce scintillators, optimized for timing and energy resolution. Six of them are read-out by fast PMTs, whereas the remaining 28 have a SiPM readout. A dedicated muon beam monitor ensures accurate beam diagnostics and data normalization. Initial results, systematics, and detector performance are presented, demonstrating the experiment's potential for advancing precision muon physics.

Secondary track

T05 - QCD and Hadronic Physics

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