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Laser wavelength tuning for (Anti) Hydrogen and/or Muonium resonant ionization

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To advance the development of the Lyman-α light source for generating ultra-slow muons at J-PARC, as well as for spectroscopy and experiments involving muonium, hydrogen, and antihydrogen, it is essential to control not only spectral stability but also linewidth. In previous ultraslow muon experiments, the Lyman-α wavelength was tuned to the muonium 1s-2p resonance transition, and the spectral width was optimized to match the Doppler broadening of muonium by adjusting the wavelength-tunable Ti:sapphire laser in the light source system. In preparation for future applications, this study explores two approaches:
(i) designing and installing a solid etalon inside the Ti:sapphire resonator to enable precise wavelength control around 820 and 845 nm, and (ii) developing a feedback system to stabilize the RF power applied to the acousto-optic tunable filter (AOTF). These improvements enhance spectral control of the Lyman-α source, thereby establishing it as a reliable tool for resonant ionization of (anti-) hydrogen and muonium.

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