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Precision Laser Spectroscopy for Antiprotonic Helium

The ASACUSA collaboration at CERN aims to measure the antiproton-to-electron mass ratio with high precision using sub Doppler two-photon laser spectroscopy of metastable antiprotonic helium. Any deviation from the proton value would indicate a broken fundamental symmetry of nature. The new ELENA storage ring is used to synthesize samples of antiprotonic helium and the experiment relies on lasers with a very low frequency uncertainty to perform proper spectroscopy during the microsecond lifetime of the atom. This presents a very stringent requirement due to time fluctuations of just a few tens of attoseconds. The authors of this work demonstrate how to approach this problem, analyze the frequency chain, and provide a noise budget for different scenarios to identify which is best for present and future needs.

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