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Towards precision beta-decay measurements with laser-cooled argon-35

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Laser cooling and trapping techniques enjoy a solid reputation as powerful and elegant providers of well-localized, backing-free sources. Not only does this hold true within the atomic physics and quantum optics communities, but also beyond. Most notably, these techniques have recently joined the toolbox of low-energy, high-precision tests of the Standard Model. Our work with argon falls within the subset of nuclear beta decay studies, which have historically played a key role in establishing and testing our understanding of weak-interaction physics. In this framework, precision measurements of the beta asymmetry correlation parameter in the beta decay of Ar-35 have been identified as one promising probe for physics beyond the Standard Model.

Our current work focuses on the development of a test magneto-optical trap (MOT) setup for Ar-40 as a preliminary step towards cooling and trapping Ar-35 atoms. In particular, much effort is being put into optimizing the efficiency of our source apparatus, which is crucial to achieving high enough statistics in the final trap. We present the current status of the experimental realization of our setup.

Measuring the beta asymmetry correlation parameter requires highly spin-polarized samples. Therefore, in parallel to our experimental work, we are numerically investigating methods for generating, controlling and precisely measuring the degree of spin polarization of a sample of Ar-35 atoms. We also aim at being able to quickly switch between a polarized and a non-polarized sample so as to better understand systematic effects. We report on the progress of our theoretical modeling.

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