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Study of nuclear properties with muonic atoms

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Muonic atoms as laboratories for fundamental physics provide crucial input to quantum electrodynamics, the weak interaction and the strong interaction.
Muonic atoms spectroscopy, i.e. the detection of the muonic X-rays emitted subsequently to the atomic capture of a negative muon, has been a very extensively used technique to determine the extent of the nuclear charge distribution. This method for determining nuclear charge radii complements the knowledge from electron scattering experiments and laser spectroscopy. Other properties such as its quadrupole moment can be extracted as well.
In addition to the muonic X-rays it is also possible to study the gamma rays emitted following the capture of the muon by the nucleus. This gives access to nuclear matrix elements and is especially relevant for neutrinoless double beta decay as the the momentum transfer in muon capture is high and thus very similar states can be probed.

This lecture will describe the basic techniques of muonic atom spectroscopy and its application. It will conclude with a description of the muX experiment where we aim to perform muonic atom spectroscopy with targets available only in microgram quantities such as the highly radioactive Ra-226 isotope.

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