

Prize Talk

PV I Mon 10:30 AudiMax

Exotic atoms: from fundamental tests of strong field quantum electrodynamics to nuclear and astrophysical applications —

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Atoms where an electron is replaced by a heavier particle like the muon or an antinucleus like antiprotons are called exotic atoms. Because of the large mass of the particle, they allow to test bound state quantum electrodynamics (BSQED) in very strong fields. One can then study transitions between circular Rydberg states of such atoms to test BSQED without influence from the nucleus. Lower levels allow to do nuclear physics or strong interaction physics. A new kind of detec-

tors, microcalorimeters have resolutions ≈ 200 times better than the Ge detectors used in the past, which allows for high precision x-ray energy measurements. They have been used on muonic atoms to test BSQED and to measure light nuclei charge radius. Test of BSQED in antiprotonic atoms are performed at the ELENA ring at CERN. It may be possible in the future that antideuterium atoms may also be observed at ELENA. Atoms with heavier antinuclei could be present in cosmic rays, following decay of dark matter. Their x-rays could be detected using detectors flying on balloons in the atmosphere like GAPS (General AntiParticle Spectrometer).

In my talk I will present results of advanced calculation, using all-order vacuum polarization for several kind of exotic atoms and exact finite size corrected self-energy for muonic atoms. I will then compare to recent measurements and possible future observations.