Precision Laser Spectroscopy of Exotic Helium Isotopes

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We have succeeded in laser trapping and cooling of the exotic helium isotopes ^{6}He ($t_{1/2}$ = 0.8 sec) and ^{8}He ($t_{1/2}$ = 0.1 sec), and have performed precision laser spectroscopy on individual trapped atoms. Based on the atomic isotope shifts measured along the isotope chain ^{3}He - ^{4}He - ^{6}He - ^{8}He, and on the precise theory of the atomic structure of helium, the nuclear charge radii of ^{6}He and ^{8}He are determined for the first time in a method independent of nuclear models [1, 2]. The results are compared with the values predicted by a number of nuclear structure calculations and test their ability to characterize these neutron rich, loosely bound halo nuclei. The ^{6}He measurement was performed at ATLAS of Argonne, and the ^{8}He measurement at GANIL, France. This work was supported by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357.

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[2] P. Mueller *et al.*, Phys. Rev. Lett. **99** (2007) 252501.