Towards a Nuclear Charge Radius Determination of the One-Neutron Halo Nucleus ^{11}Be

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Using very accurate isotope shift measurements combined with mass shift calculations at the highest level of accuracy that is nowadays available for two- and three-electron systems, nuclear charge radii of the lightest elements can be extracted in a nuclear-model independent way [1]. Such measurements are challenging because in light nuclei, the nuclear volume effect of the isotope shift is a tiny fraction (10^6 Hz) of the total isotope shift (3×10^{10} Hz) in an optical transition (10^{15} Hz). Particular interesting is the application of this method for exotic short-lived isotopes of helium and lithium, namely the two-neutron halo nuclei ^{6}He [2], ^{11}Li [3], and the four-neutron halo nucleus ^{8}He [4]. In extension of these studies on light nuclides close to the neutron-dripline, a first calculation of the mass shift in Be^+ has been completed [5], and will be used to determine the charge radius of the one-neutron halo nucleus ^{11}Be. High-accuracy isotope shift measurements of ^{7,9,10,11}Be are currently being prepared at the ISOLDE facility at CERN, based on high-resolution fluorescence spectroscopy involving two frequency doubled dye lasers and an optical frequency comb for stabilization and frequency determination. The setup has recently been successfully used on a test beam of the stable isotope ^{9}Be. The technique and the results of this first off-line experiment will be presented.

[1] G.W.F. Drake et al., Lecture Notes in Physics **745** 131 (2008).

[2] L.-B. Wang et al., Phys. Rev. Lett. **93** 142501 (2004).

[3] R. Sánchez et al., Phys. Rev. Lett. **96** 033002 (2006).

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

[5] Z.-C. Yan et al., Phys. Rev. Lett., *in print* (2008).