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Mass and radius measurements of exotic nuclei

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The understanding of the strong force and the nuclear interaction is on the forefront of today's physics research. More and more detailed theories are successfully used to describe an every increasing set of nuclei on the Segre chart. To further refine the theoretical approaches, such as ab-initio or density functional theories, to name two, one needs accurate and precise measurements to compare predictions to. Two of the key quantities of an atom are mass and size (or radius). The mass of an atom is a basic and fundamental quantity, and provides information of the binding of the many-body quantum mechanical system, and is as such well suited to probe nuclear theory. To overcome the obstacles given by the nature of rare isotopes, we have developed very sensitive and fast methods using ion trap techniques at TITAN (TRIUMF's Ion Trap of Atomic and Nuclear science). Ion traps are typically used in analytical chemistry and atomic physics for stable molecules or isotopes. At TITAN we are able to measure masses, using one single ion in as short as 8ms with 10ppb precision, breaking a new world-record for precision mass spectroscopy. Using this, we are able to probe, in particular, nuclear halos. Moreover, laser spectroscopy, allows one to probe, amongst other quantities, the size of the nucleus. These are very sensitive tests of our understanding and the theoretical approaches, and present state-of-the art in atomic physics techniques applied to nuclear physics. In this talk I will report on such measurements and show how and where they are applied, and what we have learnt so far, as well as where we want to go with these tests and techniques.