Direct mass measurements of exotic nuclei at GANIL *

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Atomic masses provide an important test of the reliability of nuclear models, as they reveal information about nuclear structure, such as deformations or shell-closures. They also play a role in nuclear astrophysics for the understanding of the abundances of nuclides and of the paths of the stellar nucleosynthesis processes, such as the r-process on the neutron-rich side of the nuclear chart, or the rp-process on the neutron-deficient side, which proceeds along the N=Z line. Two direct mass-measurement methods for very exotic nuclei have been developed at GANIL, which are based on the measurement of the time-of-flight of heavy ions, either with the SPEG magnetic spectrometer [1,2] or with the CSS2 cyclotron [3,4]. The SPEG technique is well suited to relatively light exotic nuclei produced via the fragmentation of heavy-ion beams. The mass-measurement programme with SPEG focuses on the investigation of the quenching of shell-gaps and the appearance of new magic numbers around N = 16, 20, 28, 34 and 40. The CSS2 method is an original technique, which uses the second GANIL cyclotron as a high-resolution spectrometer. The exotic nuclei are produced by fusion-evaporation from a primary beam delivered by the first GANIL cyclotron, CSS1, impinging on a target located between the two cyclotrons. The mass-measurement programme with CSS2 focuses on the masses of nuclei close to the N=Z line with A≈70-100. A new direct mass-measurement method was recently commissioned [5], using the CIME cyclotron as a high-resolution spectrometer, which offers the possibility to accelerate a wider range of exotic and reference masses than the CSS2 cyclotron. The basis of this new technique is the sweeping of the radio frequency of the cyclotron. A review of recent results obtained with these three techniques will be presented.

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