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Mass measurements at ISOLDE

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The ISOLDE/CERN mass measurement programme is presently carried out with the ISOLTRAP setup [1], which has provided high-precision masses of almost 600 atomic nuclei [2] with production yields down to a few 10 ions/s and half-lives below 100 ms. The obtained binding energies are relevant to the nuclear structure studies, nuclear astrophysics, or studies of fundamental interactions. Since the last INPC conference numerous nuclei have been investigated with ISOLTRAP, some of which could be addressed only thanks to technical upgrades, both on the ISOLDE and ISOLTRAP [3] sides.

The recent mass measurements at ISOLTRAP cover the whole nuclear chart. In the light-mass region calcium isotopes have been investigated up to ^{54}Ca [4], relevant for the nuclear-structure studies, especially in the context of three-body forces. In the medium-mass range the long-sought mass of ^{82}Zn has been determined [5], which is important for the N=50 shell closure and for astrophysics studies, e.g. in determining the structure of neutron stars. Above Z=50, neutron-rich caesium isotopes up to ^{149}Cs have been investigated. Finally, several experimental campaigns have been devoted to Au, Tl, At, Fr, and Ra isotopes, interesting among others because of their proximity to the double shell closure at ^{208}Pb. The results include masses of very neutron-rich francium and radium isotopes, up to ^{234}Ra and ^{233}Fr, where the latter isotope has been identified for the first time.

Among the recent technical upgrades at ISOLTRAP, the major addition is an electrostatic mirror trap [6]. The device acts as a multi-reflection time-of-flight mass separator (MR-TOF MS) and has been already used to clean away isobaric contaminants (e.g. for ^{82}Zn) or even to determine atomic masses (e.g. ^{54}Ca). Because the ions spend in this trap only a dozen of ms, it has given ISOLTRAP access to shorter-lived and less produced nuclides. MR-TOF MS has also found a novel application - that of investigating the hyperfine structure of laser-ionised nuclides, used for the first time for neutron-deficient gold isotopes. On the ISOLDE side, several developments in targets and ion sources, leading to increased yields and lowered contaminants, have been crucial in the studies of, e.g. ^{82}Zn, as well Ca and At isotopes.

This contribution will give a short introduction to the measurement method and experimental setup, followed by an overview of several of the above scientific and technical achievements.

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