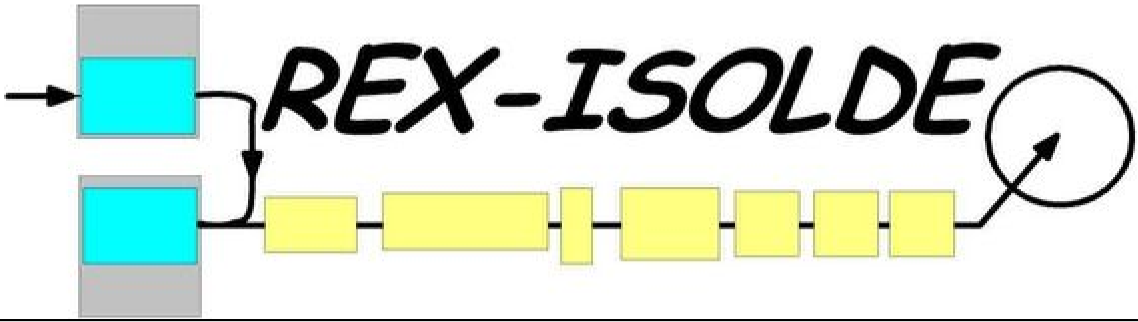
Radioactive Beam EXperiment at ISOLDE



Today, research on nuclear structure far from stability is one of the most exciting frontiers in nuclear physics since such nuclei allow to amplify and isolate particular aspects of nuclear interaction and dynamics. The **R**adioactive beam **EX**periment at ISOLDE (REX-ISOLDE) [1,2,3,4,5] accelerates radioactive ion beams and thus the full variety of beams available at ISOLDE become accessible as accelerated beams for experiments.

REX-ISOLDE uses the method of charge-state breeding to enhance the charge state of the ions before injection into a linear accelerator. The charge multiplication of the radioactive ions allows access to the heavier mass region of the nuclear chart, which cannot be reached by accelerating monocharged ions.

Fig 1. Schematics of the ISOLDE and the post accelerating REX-ISOLDE.

REX makes use of the large variety of radionuclides that have been extracted from the on-line mass separator ISOLDE. The radioactive singly-charged ions from the separators are first accumulated, bunched and cooled in a Penning trap, REXTRAP. The trap stores the ions during the breeding in the subsequent charge breeder. Bunches of ions are then transferred to an electron beam ion source, REXEBIS where the ions are charge bred to a mass-to-charge ratio below 4.5. Finally, the ions are injected into a compact linear accelerator via a mass separator.

The linear accelerator has a total length of about 10 m. It consists of a Radio Frequency Quadrupole (RFQ) accelerator which accelerates ions from 5 to 300 keV/u, a rebunch section, an interdigital H-type (IH) structure that boosts the energy to 1.2 MeV/u, three seven-gap resonators which allow the variation of the final energy, and a 9-gap resonator. The final energy is variable between 0.8 and 3.0 MeV/u.

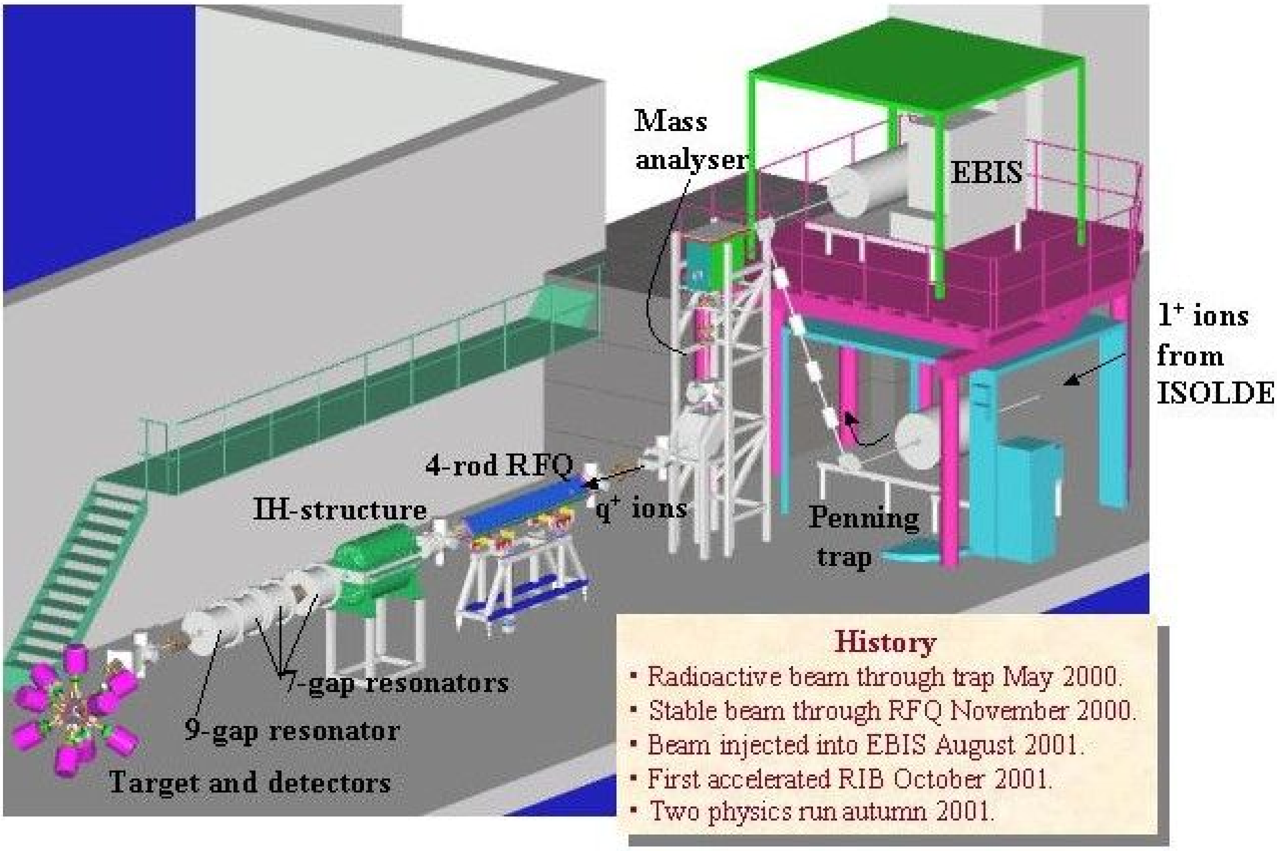


Fig 2. The REX-ISOLDE post accelerator with the Miniball

The first aim of REX-ISOLDE was to demonstrate a new concept to bunch, charge-breed and post-accelerate singly-charged, low energetic ions in an efficient way. Second, to study the structure of neutron-rich Na, Mg, K and Ca isotopes in the vicinity of the closed neutron shells N = 20 and N = 28 by Coulomb excitation and neutron transfer reactions with a highly efficient γ- and particle-detector array MINIBALL. The experiment dwells on established techniques, but represents a new way of combining these structures. Since, 2003, the machine is fully operational and used for accelerating isotopes with masses up to A=150 for experiments in nuclear physics, astrophysics and solid state physics.

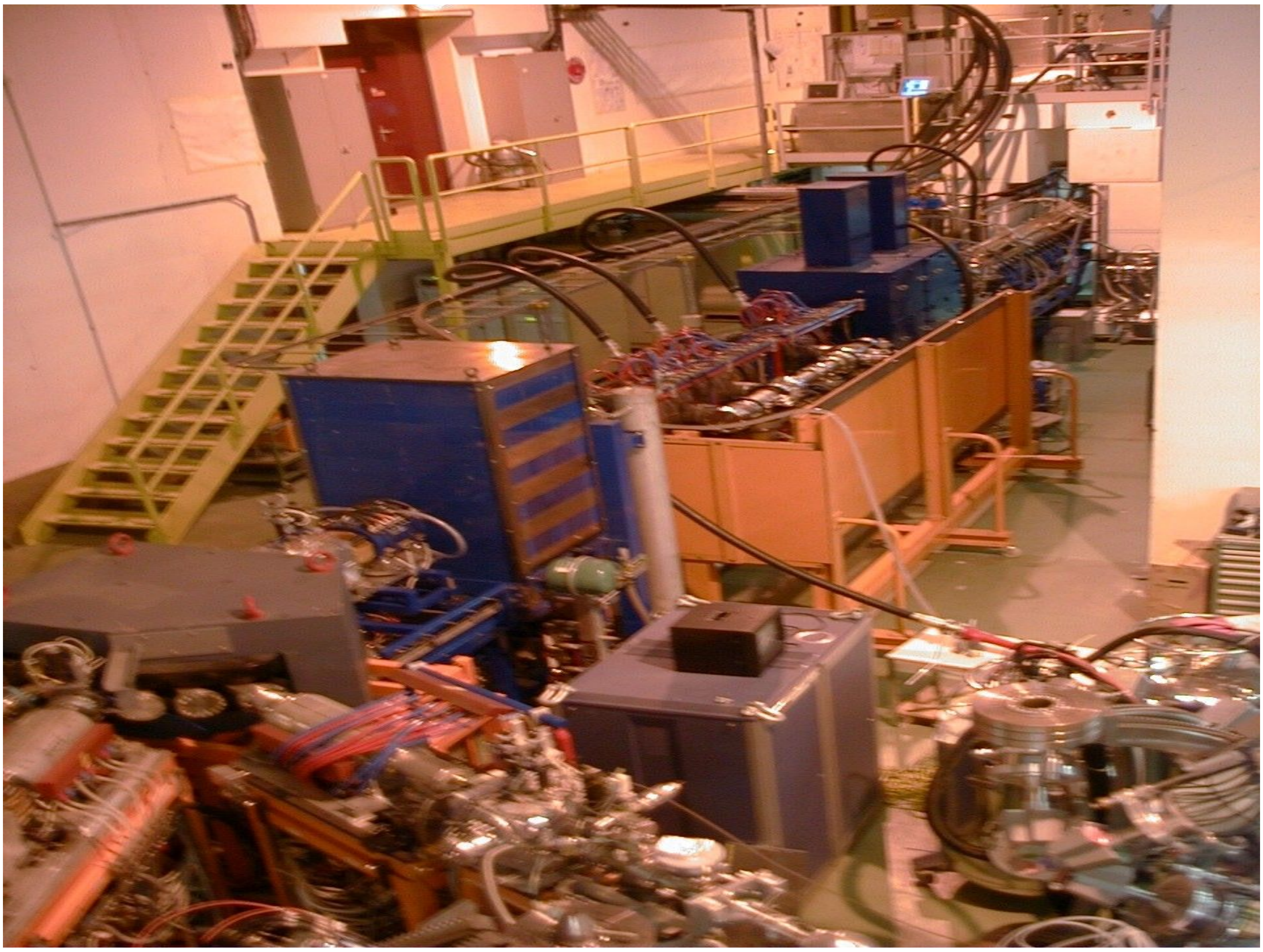


Fig 3. The REX-ISOLDE facility seen from above the experimental stations

Radioactive elements run in REX so far
(click on the mass for machine summary of the run):

$^{8}Li^{3+}$ (2006), $^{9,11}Li^{2+}$ (2004), $^{9}Li^{2+}$ (2005), $^{10,11}Be^{3+,4+}$ (2006), $^{11,12}Be^{3+,4+}$ (2005),

$^{10}C^{3+}$ (2008), $^{17}F^{5+}$ (2004), $^{17}F^{5+}$ (2007), $^{24-29}Na^{7+}$, $^{29,31}Mg^{9+}$ (2006), $^{30}Mg^{9+}$ (2007)

$^{30,31}Mg^{9+}$ (2007), $^{28,30,32}Mg^{8+}$, $^{61,62}Mn^{15+}$ (2008), $^{61,62}Fe^{15+}$ (2008), $^{68}Ni^{19+}$ (2005), $^{70}Cu^{19+}$ (2008)

$^{67,69,71,73}Cu^{19+,20+,20+,19+}$ (2006), $^{68,69,70}Cu^{19+,20+,19+}$ (2005), $^{74,76,78}Zn^{18+}$ (2004),

$^{80}Zn^{21+}$ (2006), $^{70}Se^{19+}$ (2005), $^{88,92}Kr^{21+,22+}$, $^{96}Sr^{23+}$ (test), $^{96}Sr^{27+}$ (2007),

$^{108}In^{30+}$ (2005), $^{106,108}Sn^{26+}$ (2006), $^{108}Sn^{27+}$ (2005), $^{110}Sn^{30+}$ (2004), $^{100,102,104}Cd^{24+,25+,25+}$ (2008)

$^{122,124,126}Cd^{30-31+}$ (2004), $^{124,126}Cd^{30,31+}$ (2006), $^{138,138,140,142,144}Xe^{34+}$, $^{140,142,148}Ba^{33+,33+,35+}$ (2007),

$^{148}Pm^{30+}$, $^{153}Sm^{28+}$, $^{156}Eu^{28+}$, $^{184,186,188}Hg^{43+,43+,44+}$ (2007), $^{202,204}Rn^{47+}$ (2008)