Status of the double Penning trap mass spectrometer MLLTRAP

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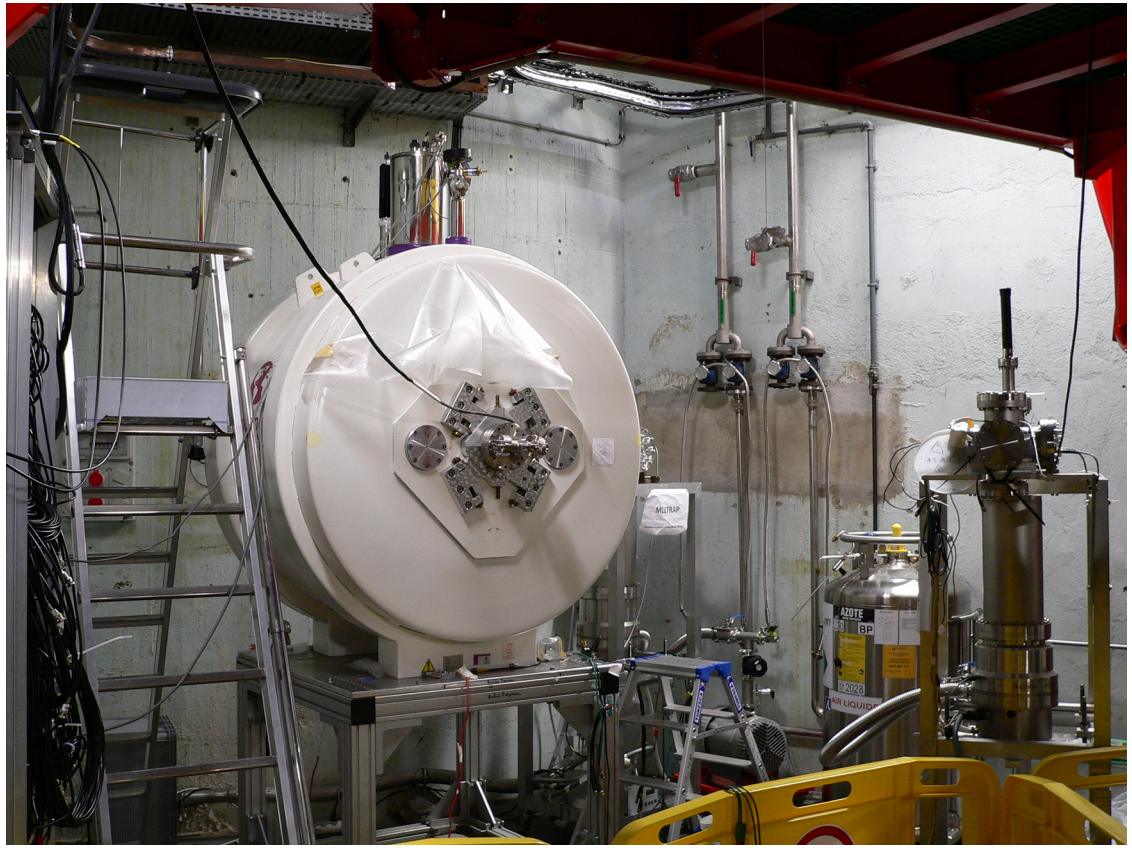
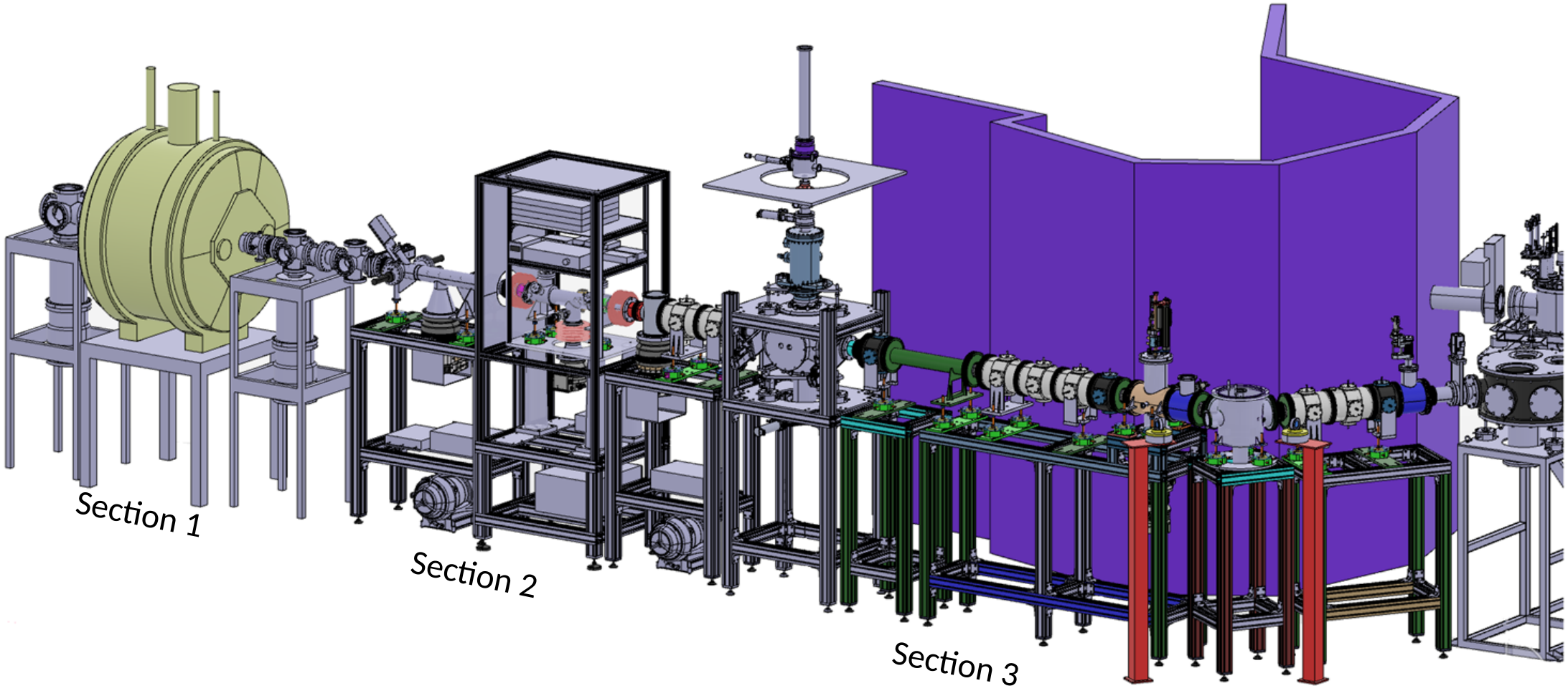


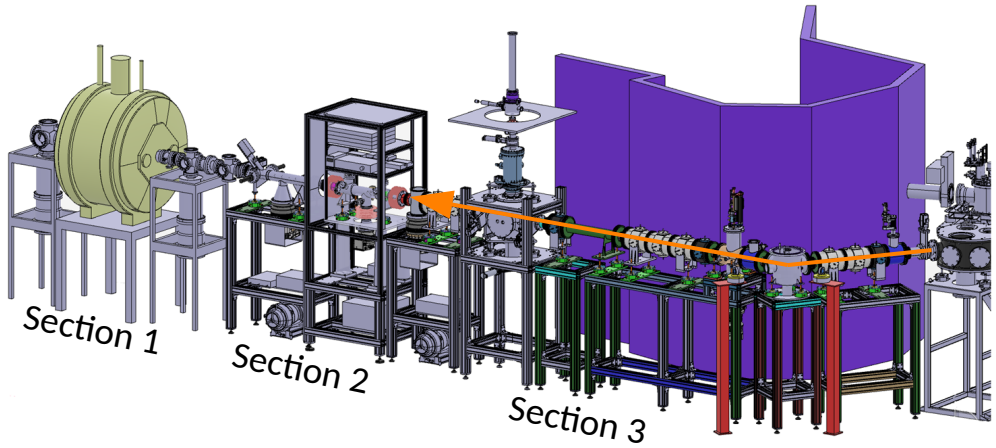
October 13th, 2021

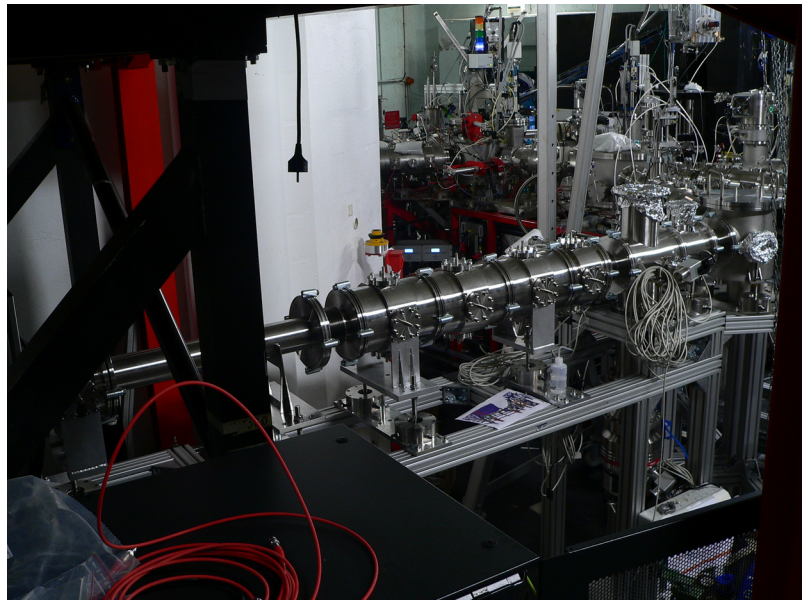
MLLTRAP experiment at ALTO



Beam transport line (section 3)

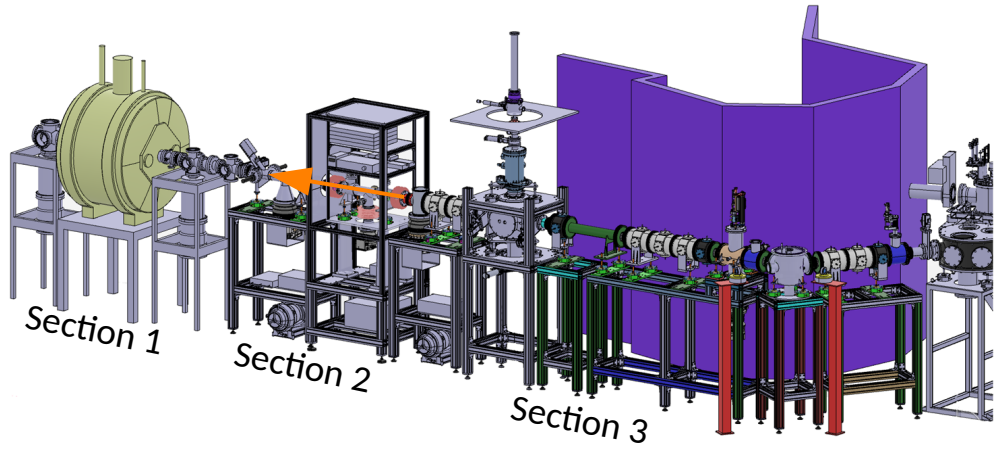
- Transports at 30-60 keV the radioactive ion beam created by photophission with steerers and quadrupoles
- Construction and alignment almost finished
- A 50 kV ion source developed for off-line commissionning and calibration during experimental campaigns

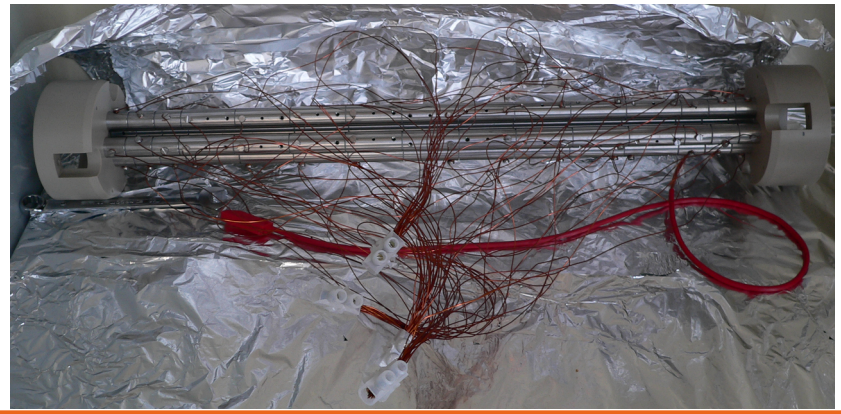


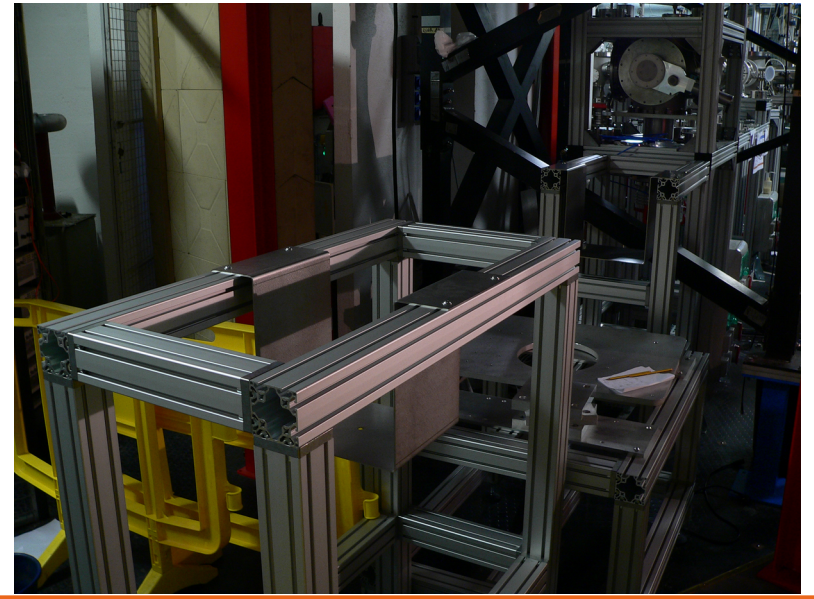


Beam preparation (section 2)

- RFQCB (RadioFrequency Quadrupole Cooler and Buncher) : reduces the beam emittance and bunch it ; this step is required to inject efficiently the ions in the Penning traps
- Pulse Drift Tube : decelerate the bunched beam from 30-60 keV to 3 keV over 30 cm
- RFQCB and Pulse Drift Tube assembly in progress
- Supports installed at ALTO

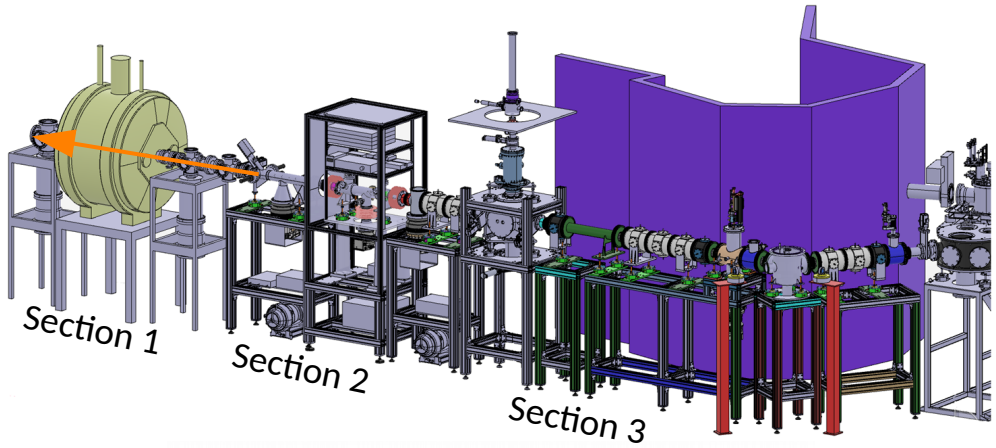




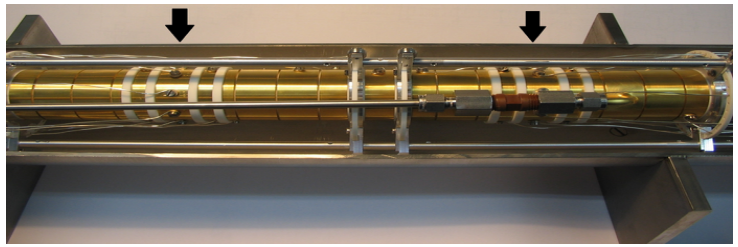


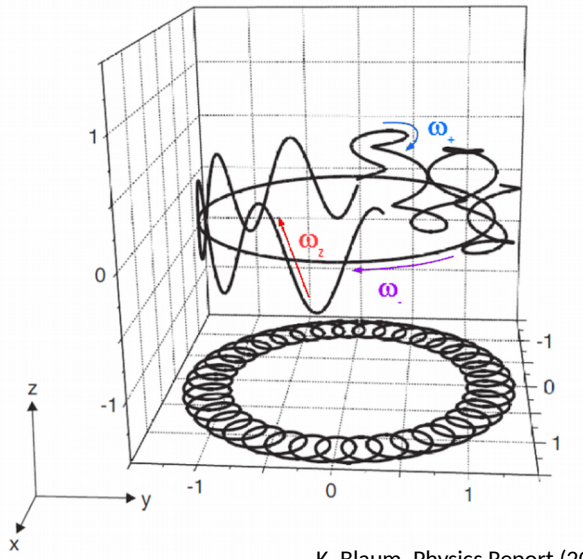
Beam manipulation (section 1)

- Penning trap mass spectrometer : manipulation of ions to separate isobaric contaminants and measure cyclotron frequencies $\nu_c = qB/2\pi m = \omega_c/2\pi$
- Two destructive techniques (rf excitations) to measure ν_c
- Preparation work around the 7T superconducting magnet :
  - Alignment of the vacuum tube with magnetic field lines almost finished
  - Implementation of a magnetic probe for real time monitoring



Measurement trap Preparation trap





K. Blaum, Physics Report (2006)

Scientific context - Motivations

Study of N = 82 shell closure with high precision mass measurements of silver isotopes (A = 124-129)

- Nuclear structure :
  - Binding Energies :

$$B(N,Z)=[N M_n+Z M_p-M(N,Z)]c^2$$

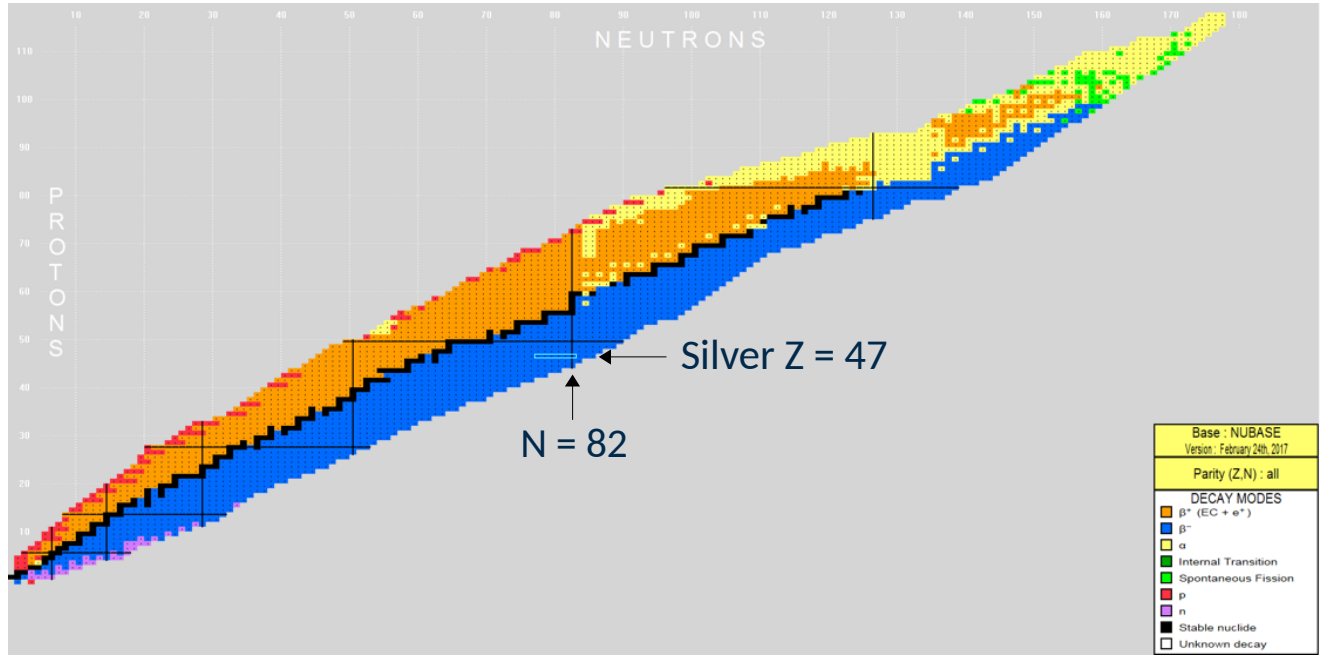
  - Two neutron separation energies :

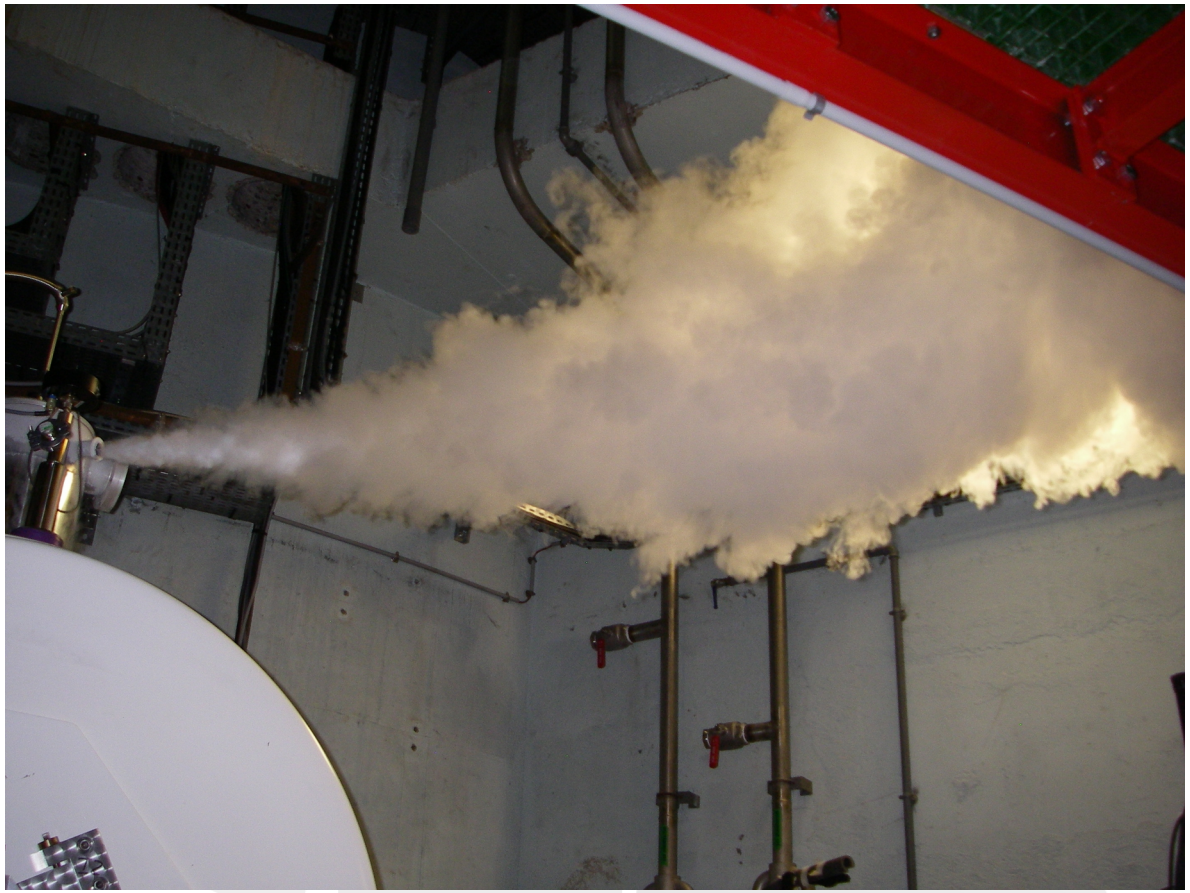
$$S_{2n}(N,Z)=B(N,Z)-B(N-2,Z)$$

  - Shell gaps :

$$\Delta_{2n}(N,Z)=S_{2n}(N,Z)-S_{2n}(N+2,Z)$$

- Nuclear astrophysics
  - Nuclear informations including nuclear masses are important inputs for r-process path evolution models
  - N = 82 could be linked to A = 130 r-process solar abundance peak





Thank you for your attention !