Beam measurements at the ISOLDE facility

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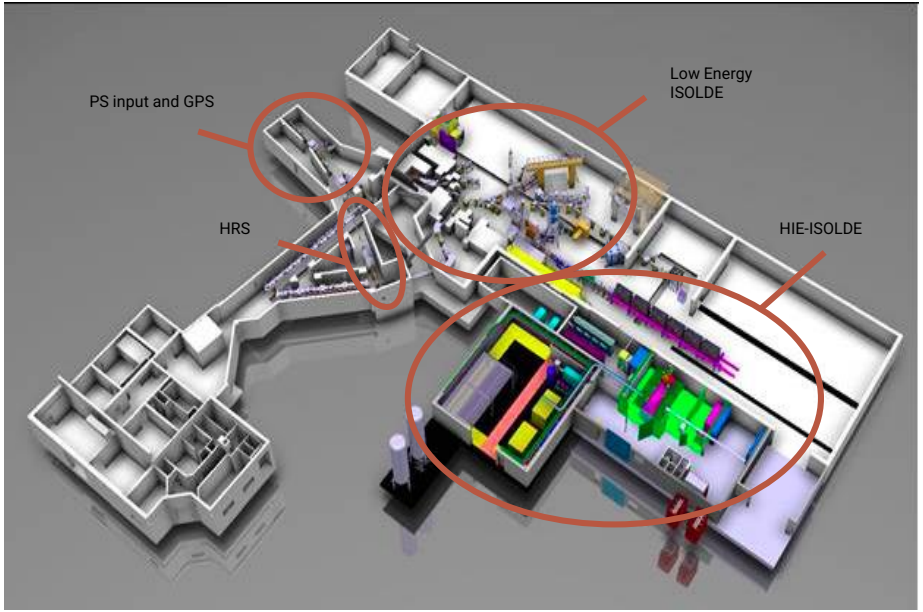
What is the purpose of ISOLDE?

- Radioactive Isotopes Facility
  - Isotope beam generation through proton radiation
- Nuclear and Atomic physics
  - Structure of nuclei
  - Properties of radioactive isotopes
  - Largest facility in the world for study of nuclear physics
- Material science
  - Targets
  - 1300 isotopes from 73 elements
- Medical applications
  - Cancer treatment through radiation therapy
- Astrophysics
  - Nuclear fusion in stars

What is ISOLDE?

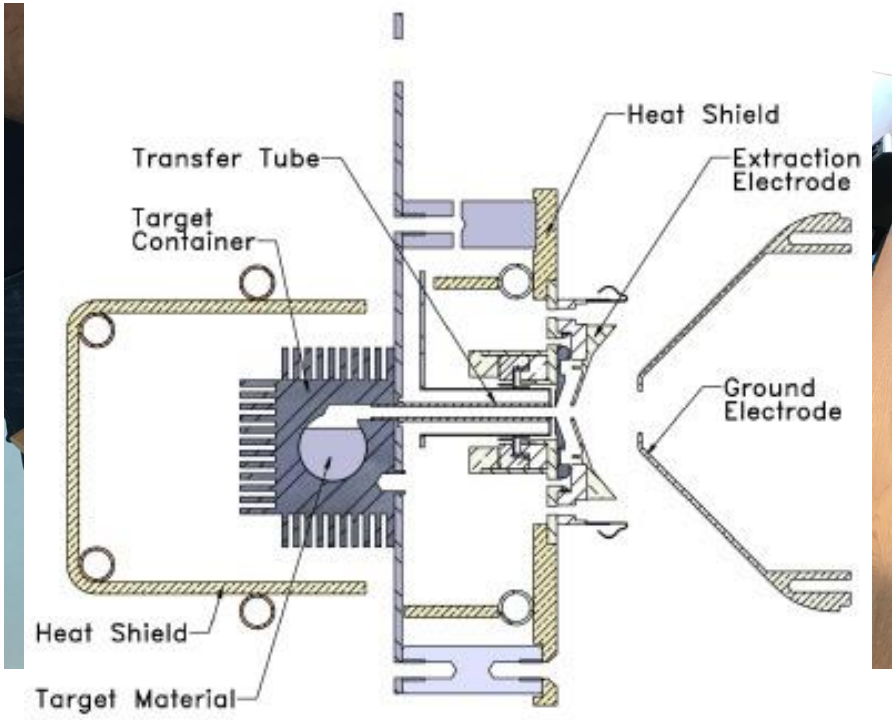


- Proton beam from Booster
- Irradiation of target and beam generation
- Mass separation to select isotopes
- Beamlines to Low Energy ISOLDE experiments
  - COLLAPS (COLlinear LAser SPectroscopy)
  - IDS (ISOLDE Decay Station)
- Delivery of isotopes to MEDICIS
- Post accelerator
  - Penning Trap
  - EBIS (Electron Beam Ion Source)
  - Normal Conducting LINAC
  - Superconducting LINAC
- HIE-ISOLDE experiments
  - ISS (ISOLDE Solenoidal Spectrometer)

Low Energy ISOLDE

Targets & extraction of beam

- Target material is heated
- Proton beam irradiates target
- Extraction electrode extracts beam
- Target material is changed to gain different isotopes
    - UC (Uranium carbide)
- Radioactive targets are placed by robots



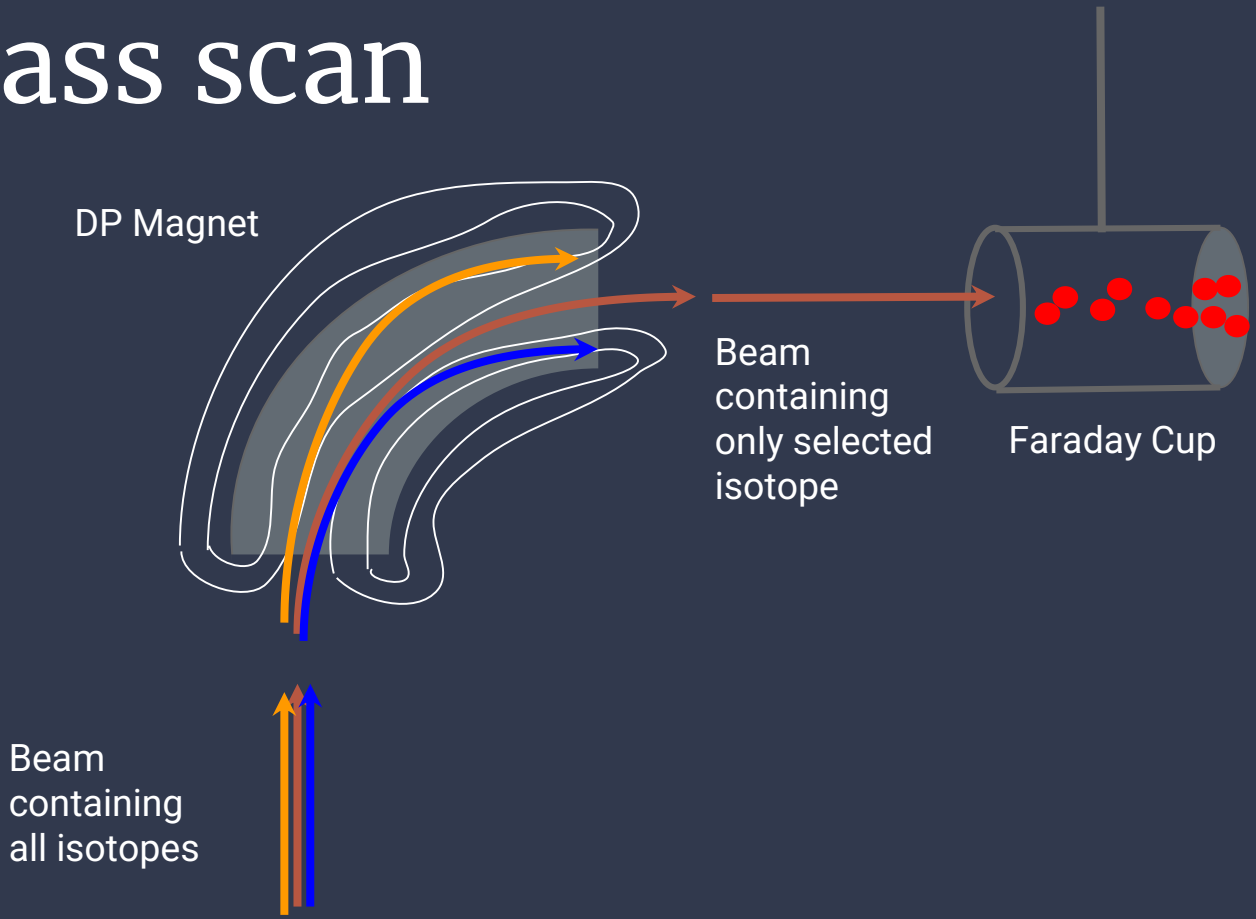
Selecting beam isotope using mass spectroscopy

- Particles' trajectories are bent when they pass through a magnetic field

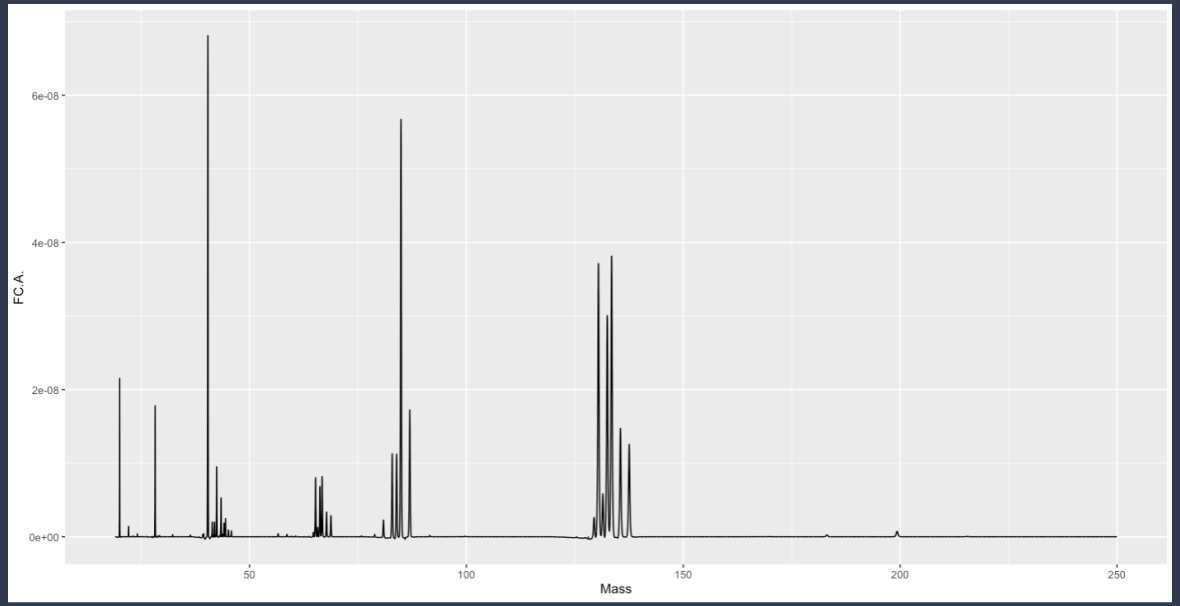
$$F_L = q(E + v \cdot B)$$

- Required magnetic field is dependent on mass
- Dipole magnets
  - Bending the beam
- Quadrupole magnets
  - Focusing the beam
  - Doublets and triplets

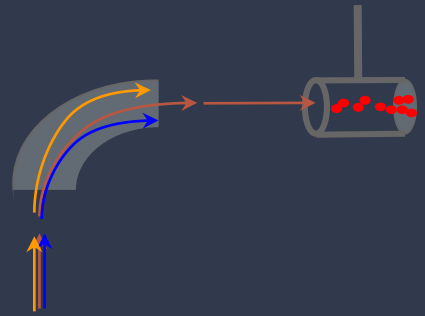
Mass scan


DP Magnet
Beam containing only selected isotope
Faraday Cup
Beam containing all isotopes

Mass scan

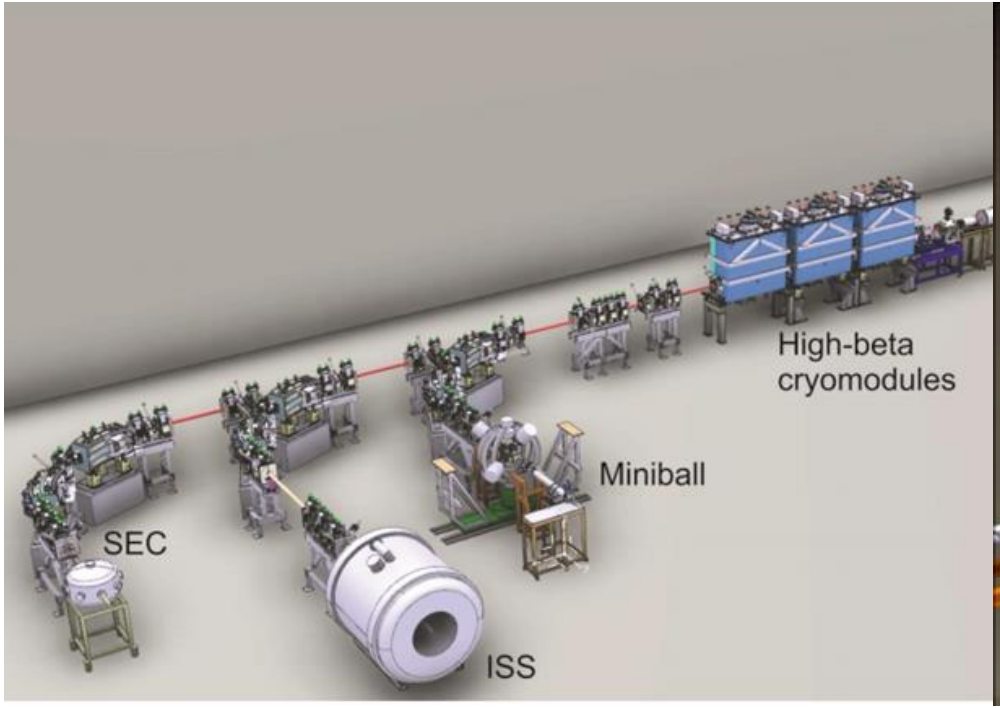


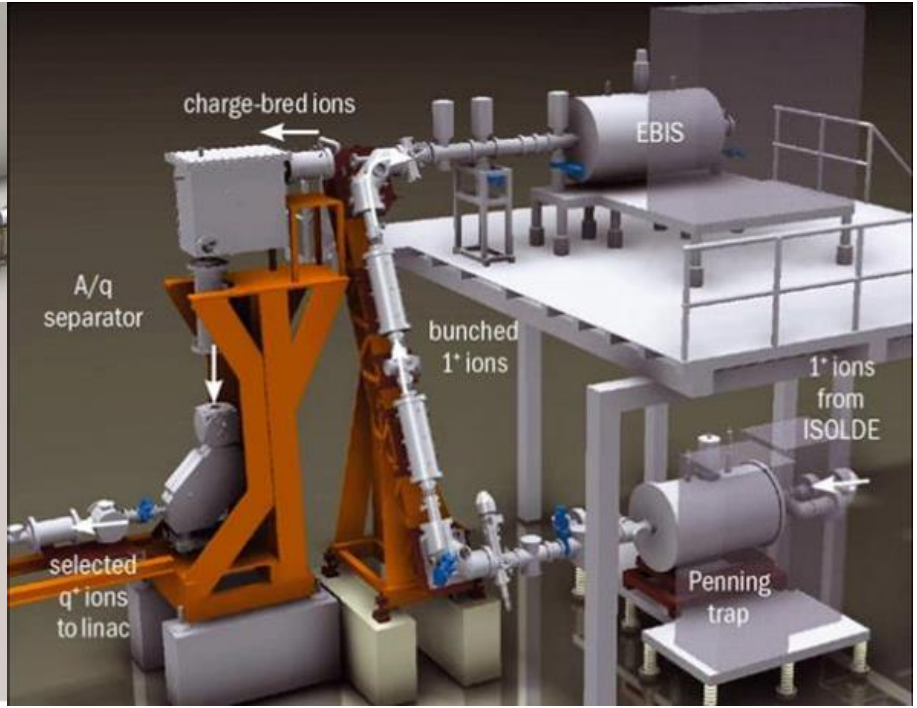
- Stable beam mass scan
- Peaks indicate a charge measured by the Faraday Cup
- Stable isotopes corresponding to the masses are found on the nuclei chart



HIE-ISOLDE & REX

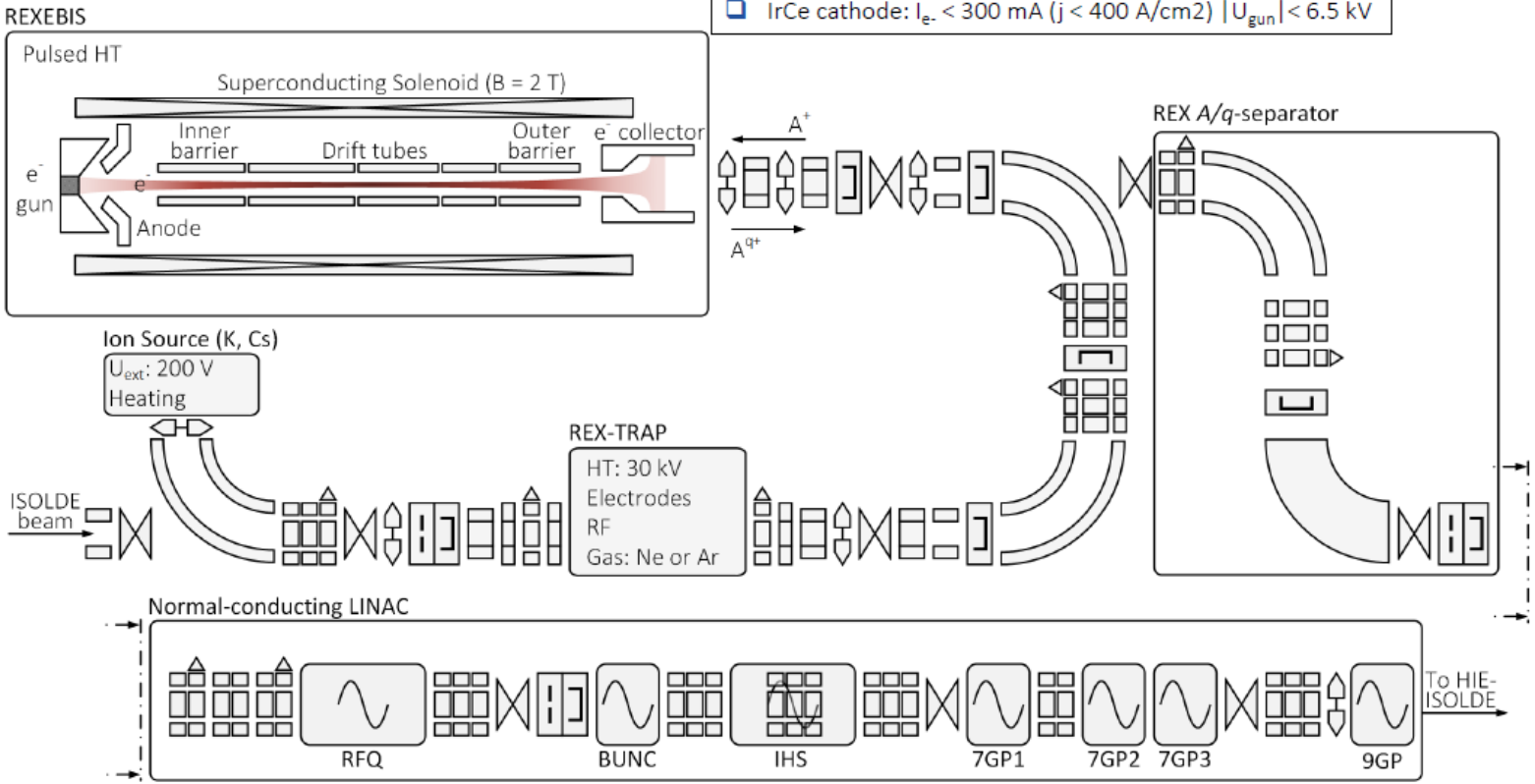
Where does the beam go after LEI?





REX-ISOLDE

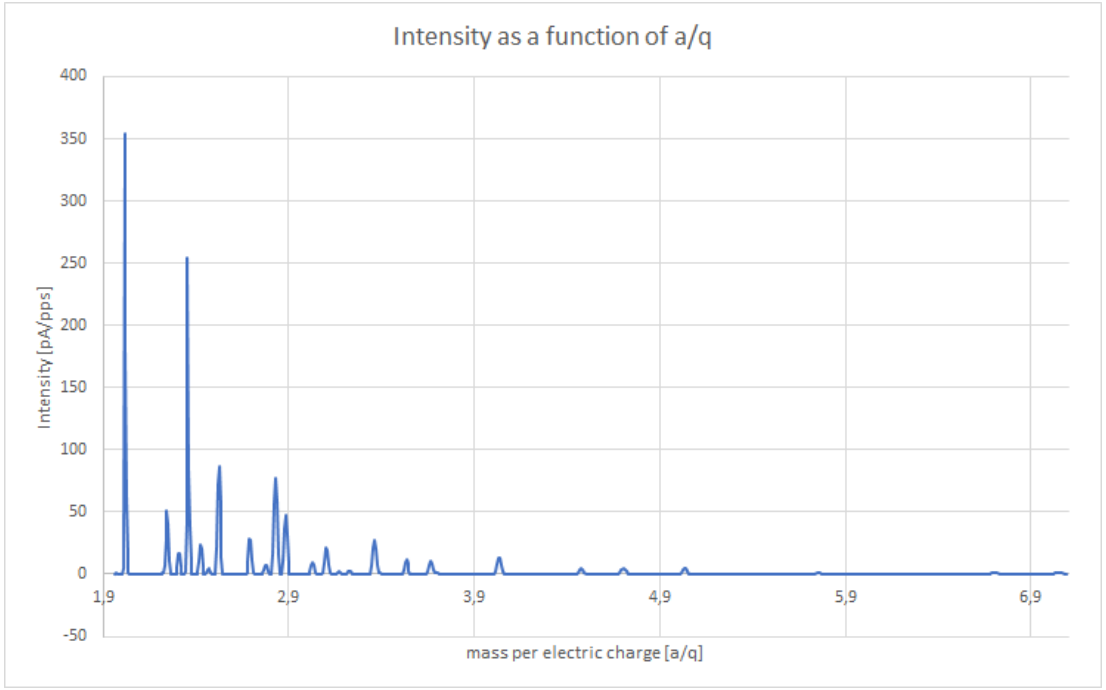
- LaB6 cathode : $I_{e^-} < 250$ mA ($j < 100$ A/cm2) $|U_{gun}| < 5$ kV
- IrCe cathode: $I_{e^-} < 300$ mA ($j < 400$ A/cm2) $|U_{gun}| < 6.5$ kV

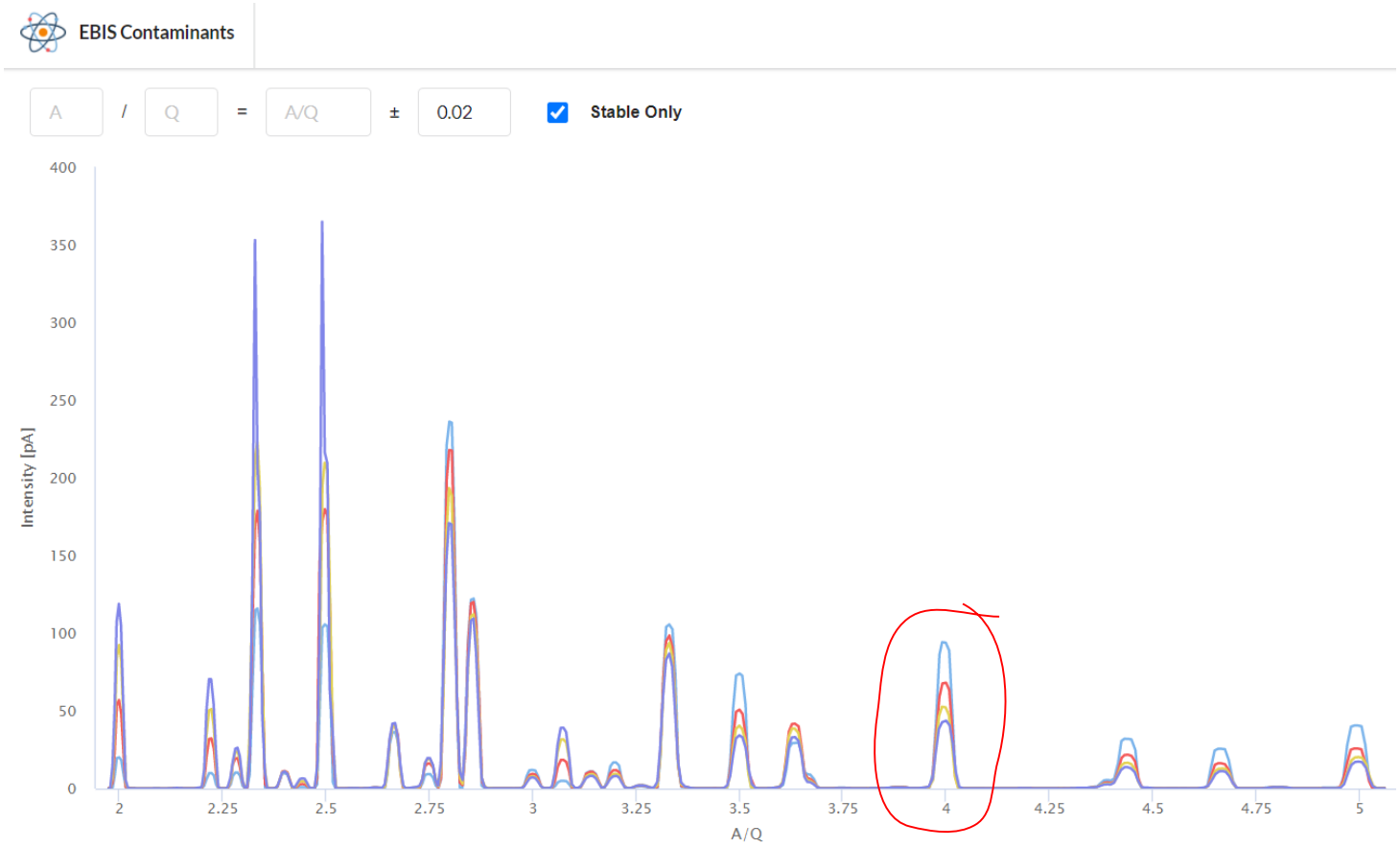


How do we select the ions we want after the Rex-EBIS?

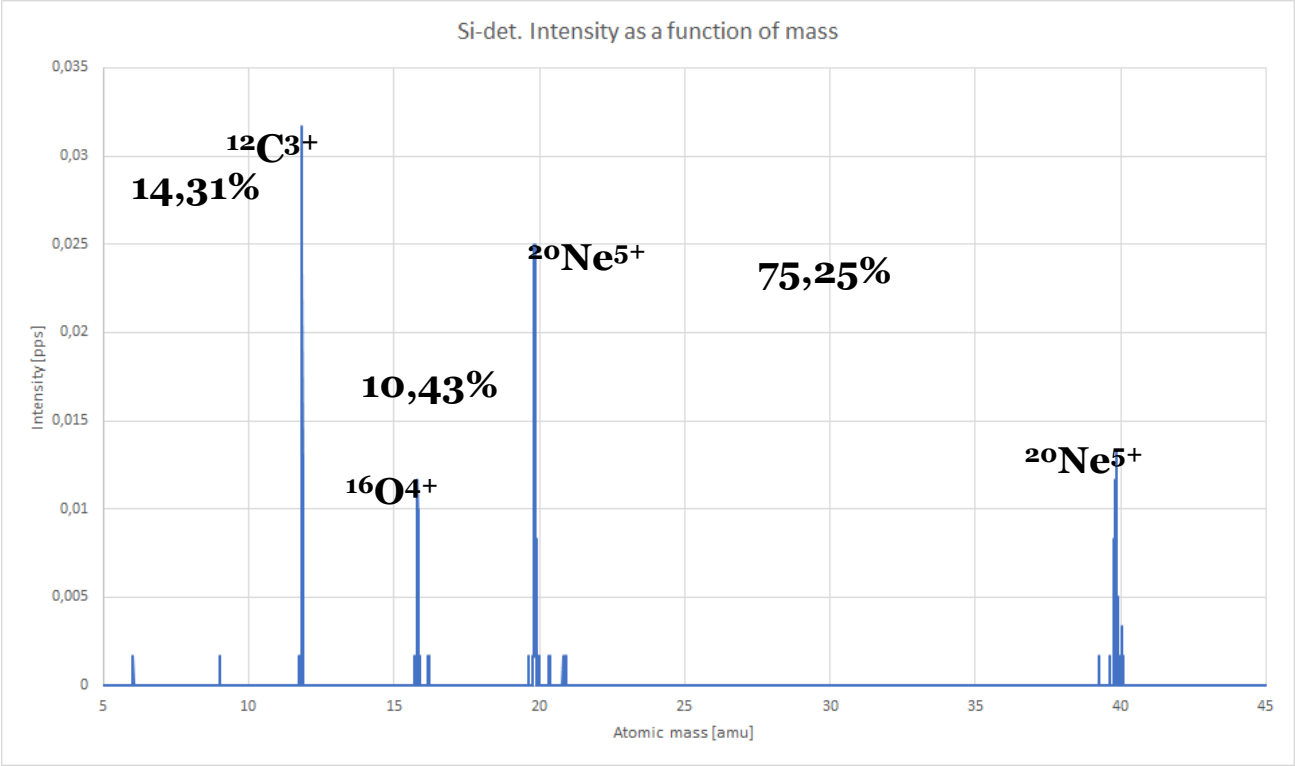
- mass-charge ratio & breeding time

$$B = \frac{1}{R} \cdot \sqrt{\frac{2\,mU_{ext}}{q}}$$



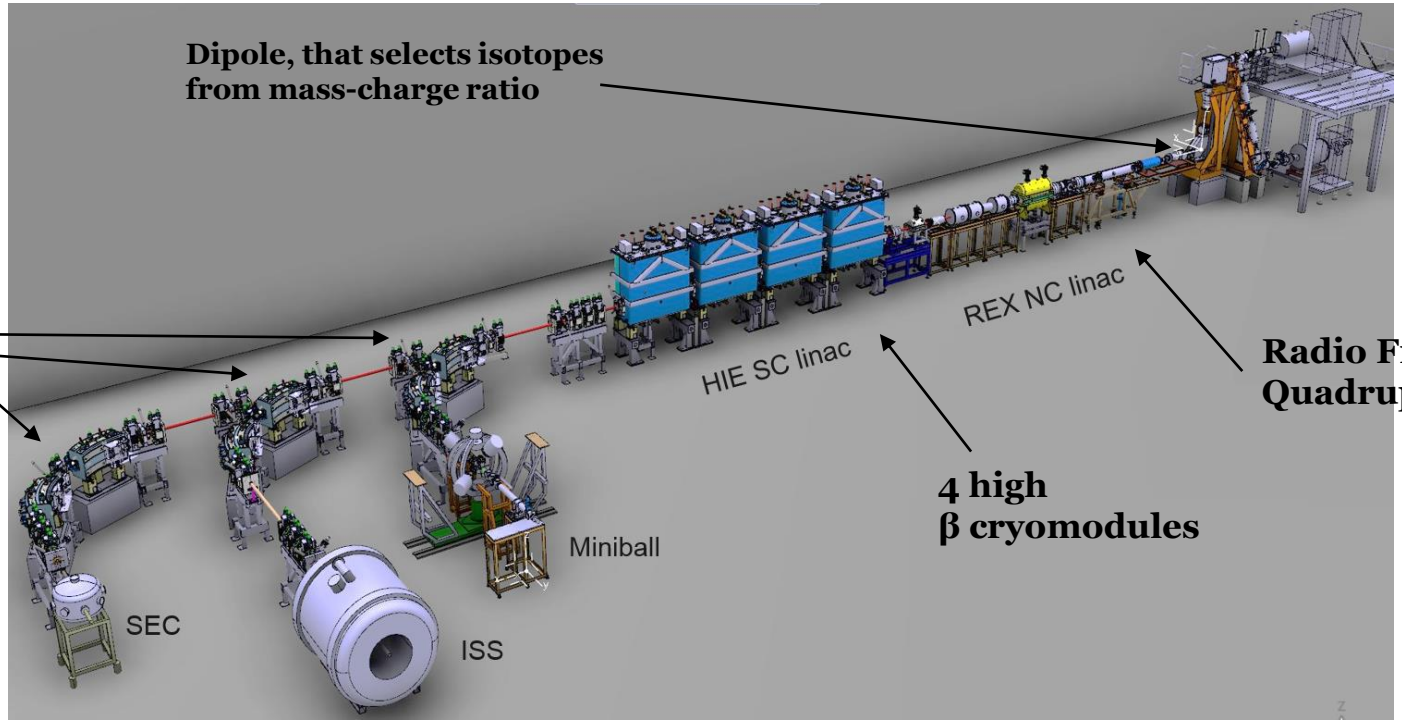


What are EBIS contaminants and why does the EBIS get contaminated?



Now, what contaminants are in the beam?

Where does the selected beam go after HIE ISOLDE?



THANK YOU to…

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for making it possible for us to come!

…any questions?