The CANREB Project for Charge State Breeding at TRIUMF

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**CANREB (CANadian Rare isotope facility with Electron Beam ion source)**

- high resolution mass separator
- \(M/\Delta M = 20,000\) for beams from ARIEL
- charge state breeder for radioactive ion beams from ISAC and ARIEL,
  - \(A/q = 5 - 7, E = 10 - 14\) q\(^*\)kev
  - RFQ cooler/buncher
  - EBIS charge state breeder
  - Nier spectrometer for highly charged ions
  - pulsed operation at 100 Hz

**Charge state breeding**

- RFQ buncher

- gas filled radio frequency quadrupole (3-36 MHz, 1 kV\(_p\))
- capturing of singly charged ions at 60 keV
- accumulating section
- release as ion bunches
- pulsed drift tube for energy matching to accelerator

- EBIS parameters
  - electron beam: \(I_e \sim 0.5\) A, \(E_e \sim 0.5 - 8\) keV up to 20 000 A/cm\(^2\)
  - magnet but T
  - beam acceptance:
    - singly charged ions
    - \(<1\)\(^0\) ions per bunch
    - \(E = 10 - 14\) keV
    - transversal emittance 5 \(\mu\)m
    - bunch length 1 \(\mu\)s
- highly charged ion beam properties
  - \(E = 10 - 14\) keV \(Q\)
  - 6\(^0\) \(< 100\) eV \(Q\)
  - transversal emittance \(< 20\) \(\mu\)m

**High resolution mass separator**

- two 90\(^\circ\) dipoles
- and electrostatic multipole (44 poles)

- incoming beam:
  - mass range up to \(A = 238\)
  - beam energy 60 keV
  - can be floated up to -60 kV to increase energy
  - resolving power 20000 (energy spread < 1 eV, 3 \(\mu\)m emittance)
  - 10000 (6 \(\mu\)m emittance)

- other design requirements:
  - stable operation over extended time (weeks)
  - fast set-up
  - low intensity beam diagnostics

- status:
  - magnets tested and received
  - multipole manufacturing in progress

**Outlook**

- complete installation at TRIUMF in August 2018
- Commissioning with stable ion beam from test ion source
- First charge breeding test with radioactive ions from ISAC 2019