

PROGRESS TOWARD THE FACILITY UPGRADE FOR ACCELERATED RADIOACTIVE BEAMS AT TEXAS A&M

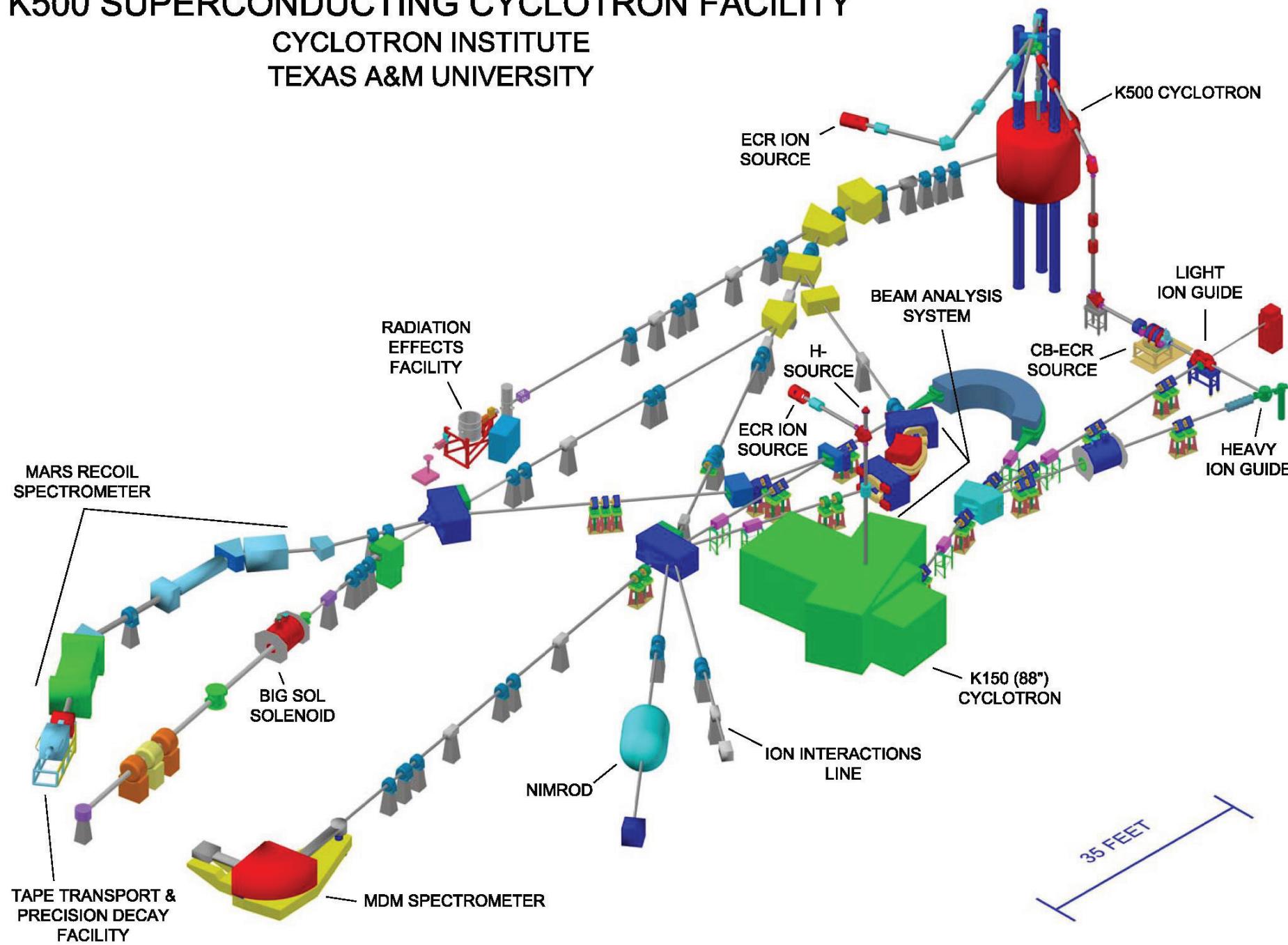
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G. J. Kim, B. T. Roeder, G. Tabacaru, R. E. Tribble - TAMU,
J. Arje - JYFL*

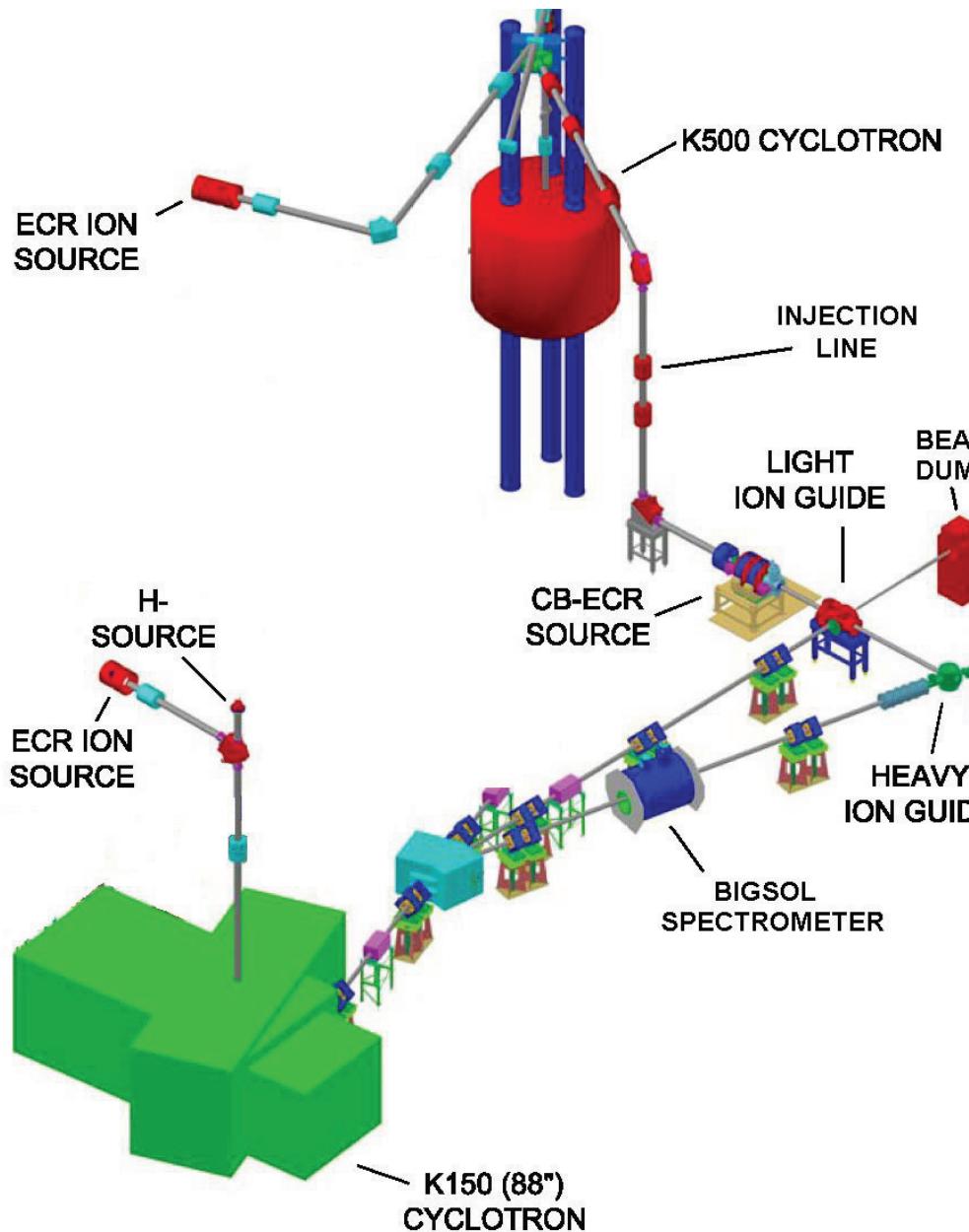
Approved in 2005

**Funded by the US Department of Energy, Texas A&M,
the Welch Foundation and by revenue from our
Radiation Effects Facility**

K500 SUPERCONDUCTING CYCLOTRON FACILITY

CYCLOTRON INSTITUTE
TEXAS A&M UNIVERSITY





Remove experimental beam-lines

- 30 MeV proton beam
- $^{27}\text{Al}(\text{p},\text{n})^{27}\text{Si}$
- 4.2 sec half-life
- 10^4 pps, 30AMeV

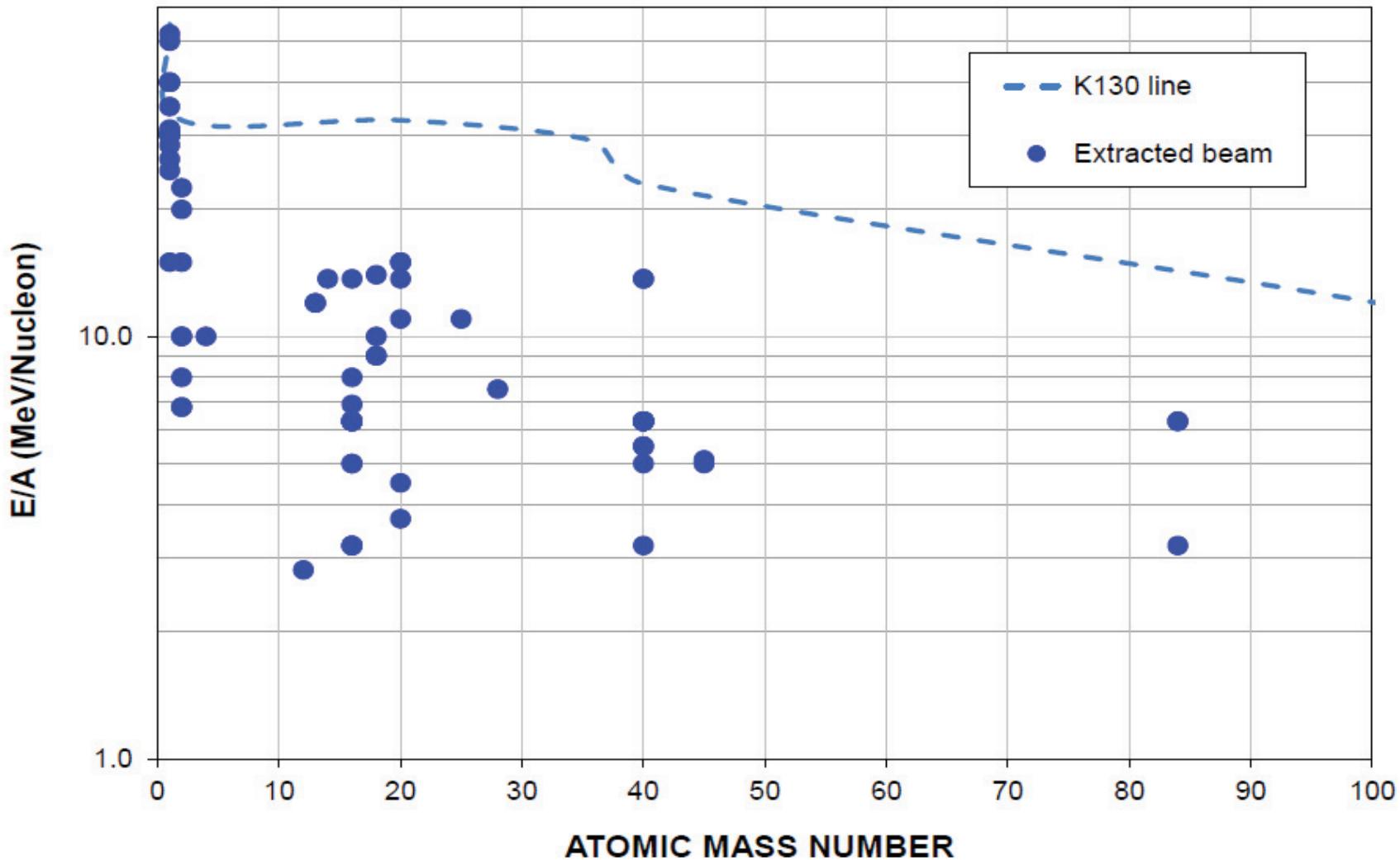
- 13 AMeV ^{40}Ar beam
- $^{40}\text{Ar} + ^{58}\text{Ni} \rightarrow ^{38}\text{S} + \text{X}$
- 11 sec half-life
- 10^5 pps, 20 AMeV

Scheme for Production of RIBs

- The K150 provides either an intense beam of light ions (p , d , α) to a target in the LIG chamber or an intense beam of heavy ions (e. g. argon) to a target in the BIGSOL superconducting-solenoid spectrometer.
- Products from the target directly enter a helium gas flow in the case of LIG, or in the case of HIG the products are focused through an entry foil in the HIG chamber.
- Products in either chamber are stopped by the helium and extracted by the helium flow. They are guided by a multipolar rf structure and formed into a beam.
- This low-charge-state beam of products is focused inside of CB-ECRIS where the products are stopped in the plasma and further ionized by the energetic electrons.
- Extracted beam from CB-ECRIS is analyzed, and a beam of one charge-state is injected into the K500.

Cyclotron Tuning – George Kim and Brian Roeder

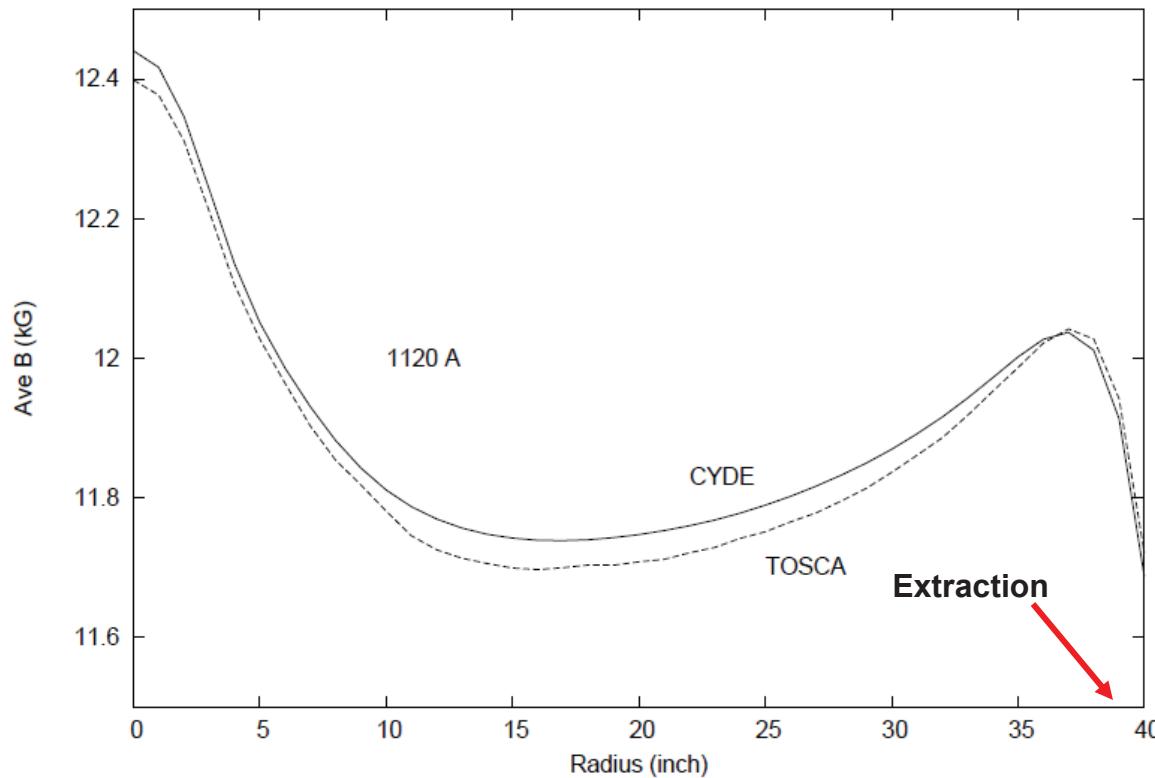
K150 CYCLOTRON + ECR + H⁻



K150 Tuning

- Use CYDE code for setting trim-coils
- Adjust trim-coils (17 of them), valley-coils, rf-voltage and inflector rotation while observing beam intensity at various radii
- Adjust deflector voltage and position for extracted beam
- Problem – both CYDE and the field maps that it uses are from the 1960's and maps come from the LBNL 88"

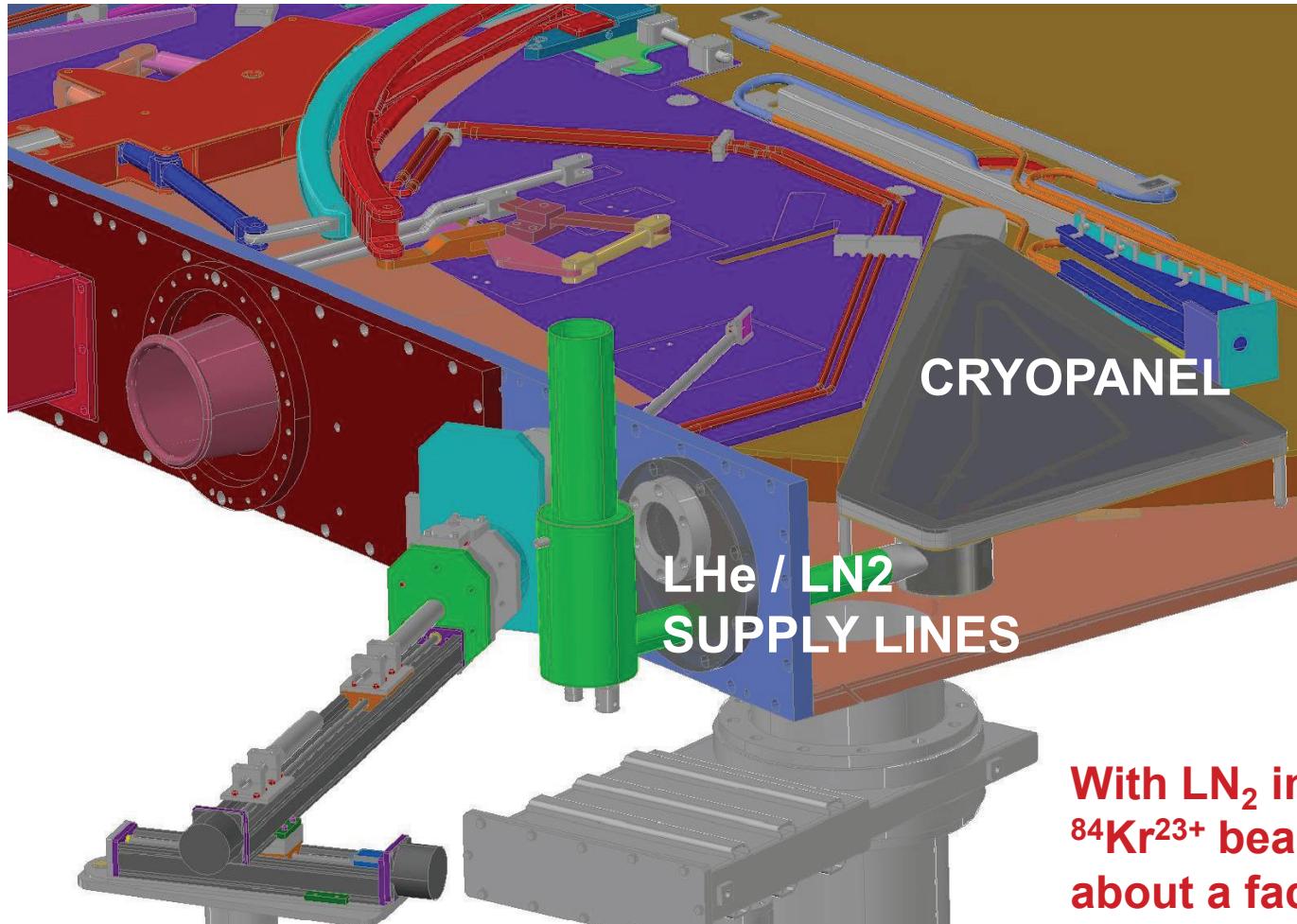
Effort to model field with TOSCA - George Kim



Difference is approximately TC-13 or TC-14 form factor, so CYDE tune can be corrected here by adding ~200 A to trim.

Plan to introduce TOSCA fields into CYDE - probably need to do this to approach K150 (3200A on main coil).

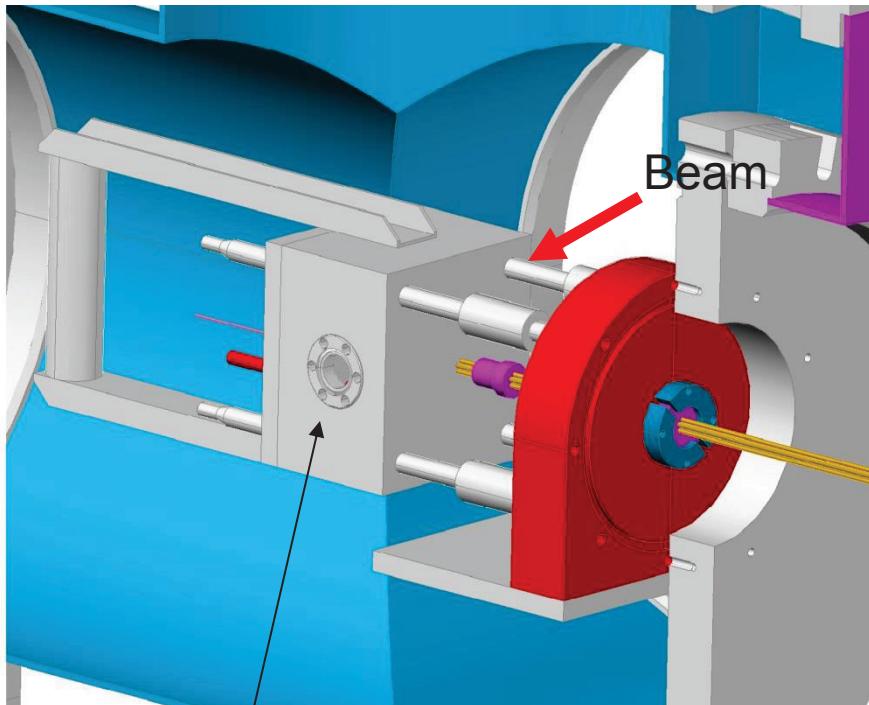
Cryopanel installed in K150



**With LN₂ intensity of 6 AMeV
 $^{84}\text{Kr}^{23+}$ beam increased by
about a factor of 30.**

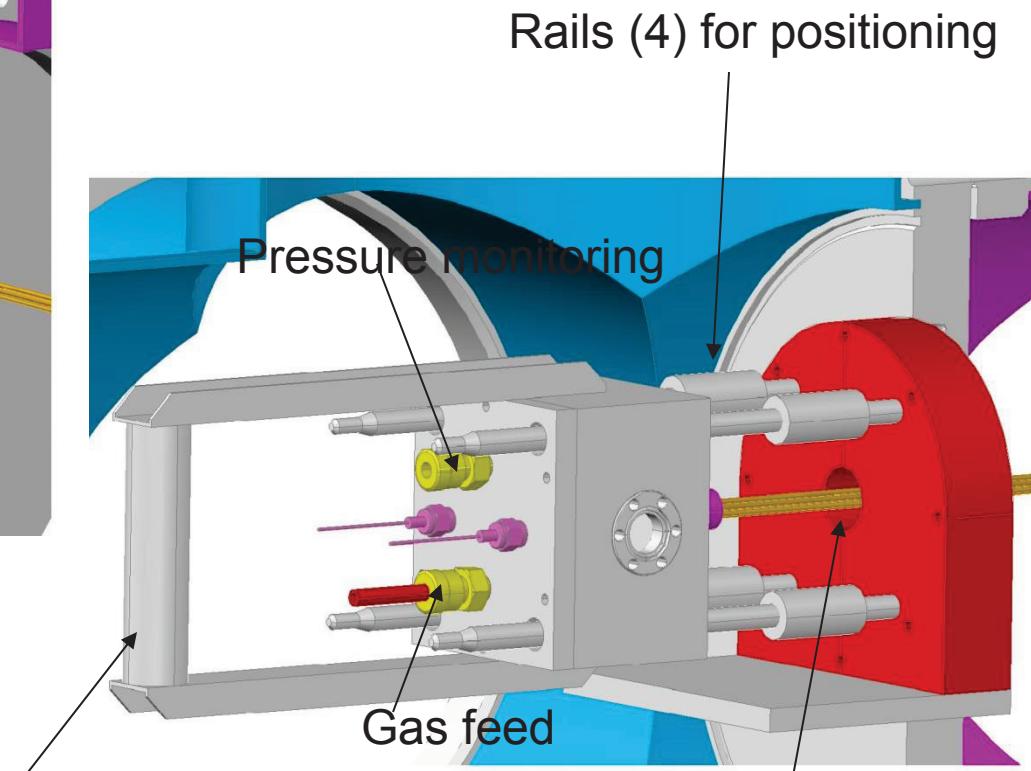
Light-Ion Guide

Juha Arje (JYFL) and Gabriel Tabacaru



Exit foil (Havar)

Handle for rapid removal

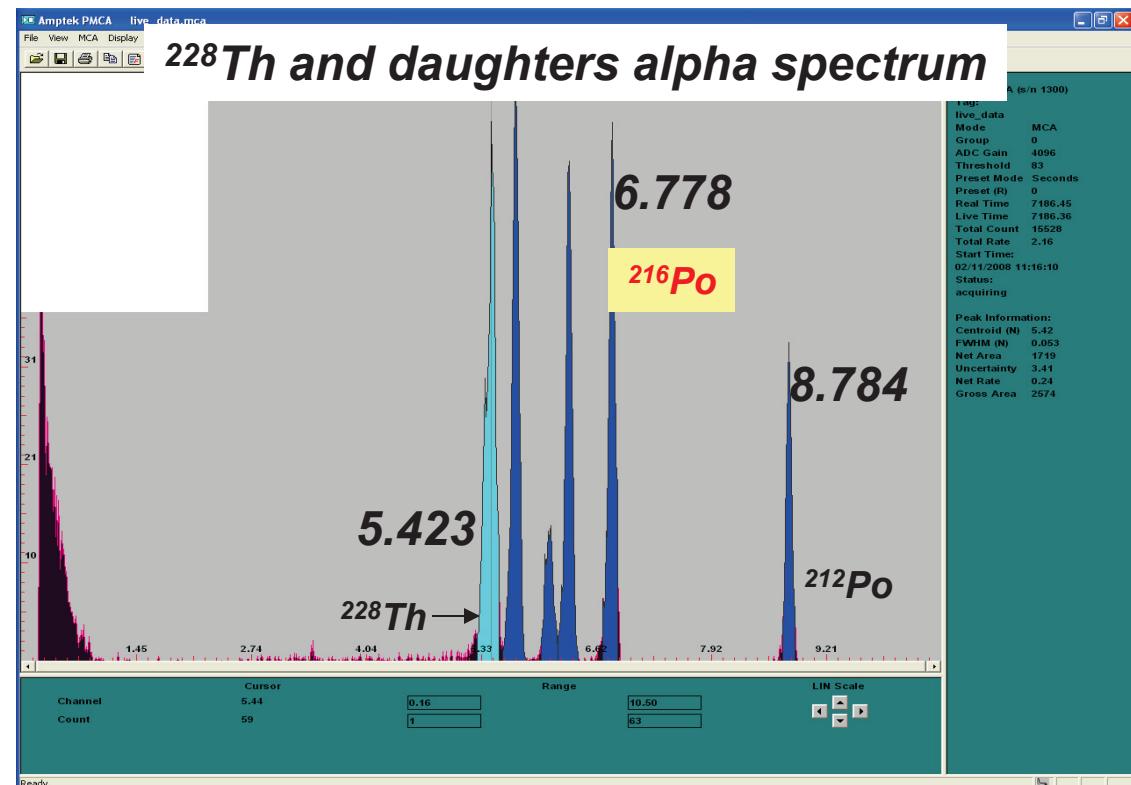
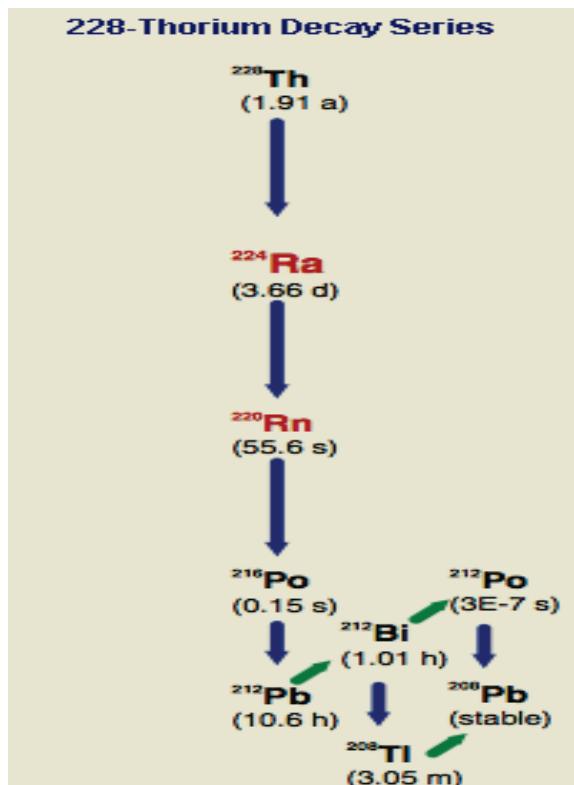


Gas feed

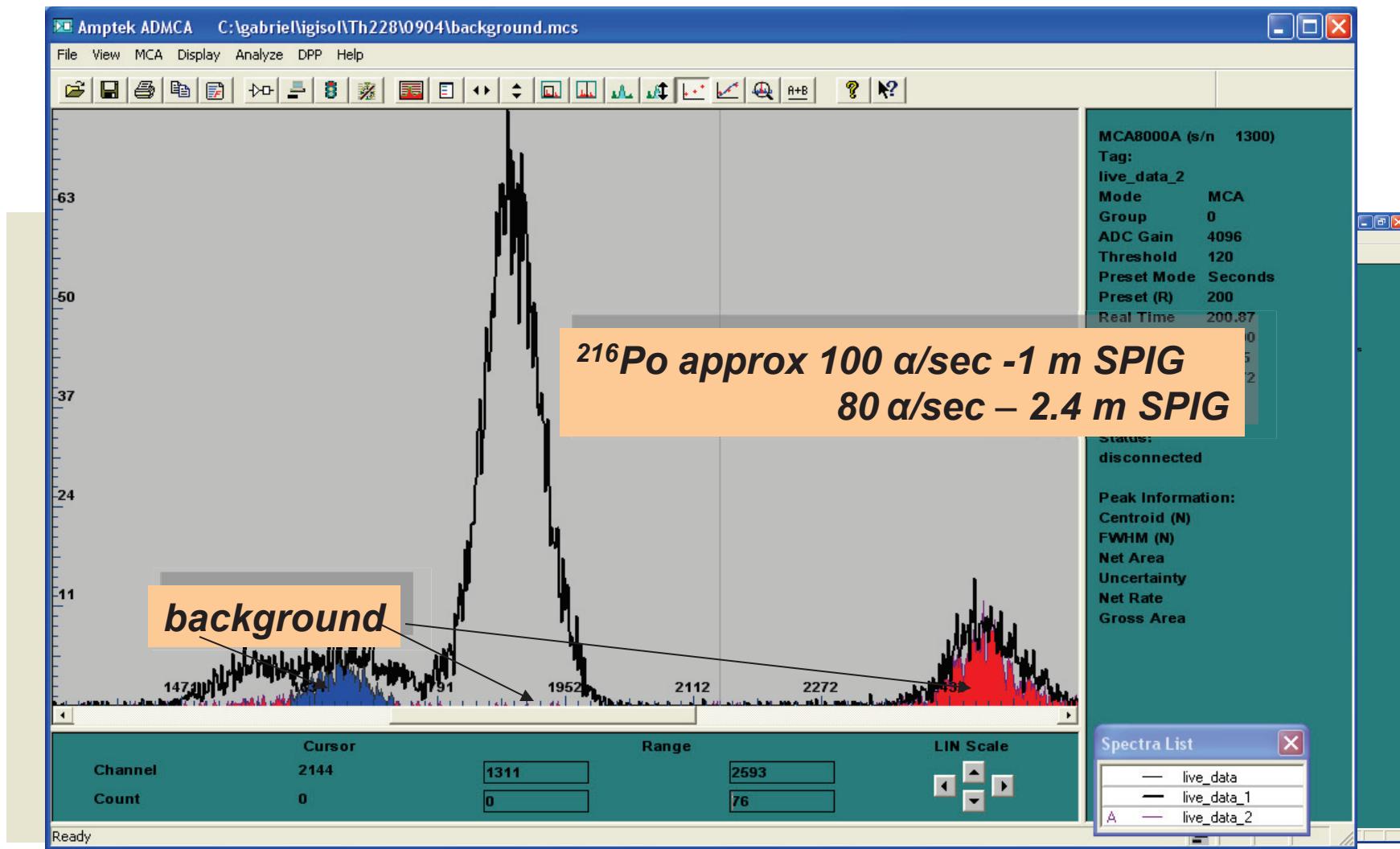
RF only sextupole –
SPIG

Tests – ^{228}Th open source in the chamber

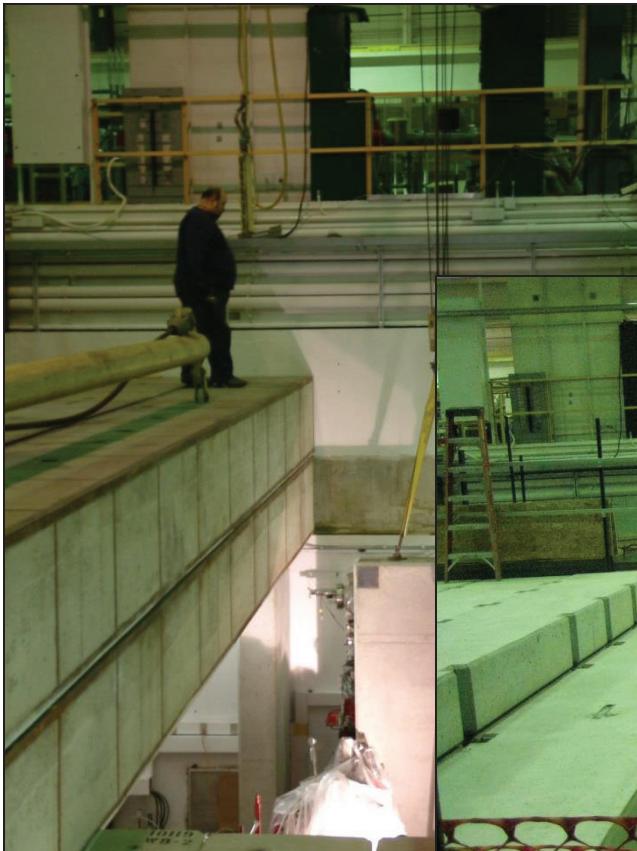
- Partially simulate the online conditions
- Lower final velocity at the injection in the CB-ECRIS
- Alpha particle detection necessary – difficult to fine tune



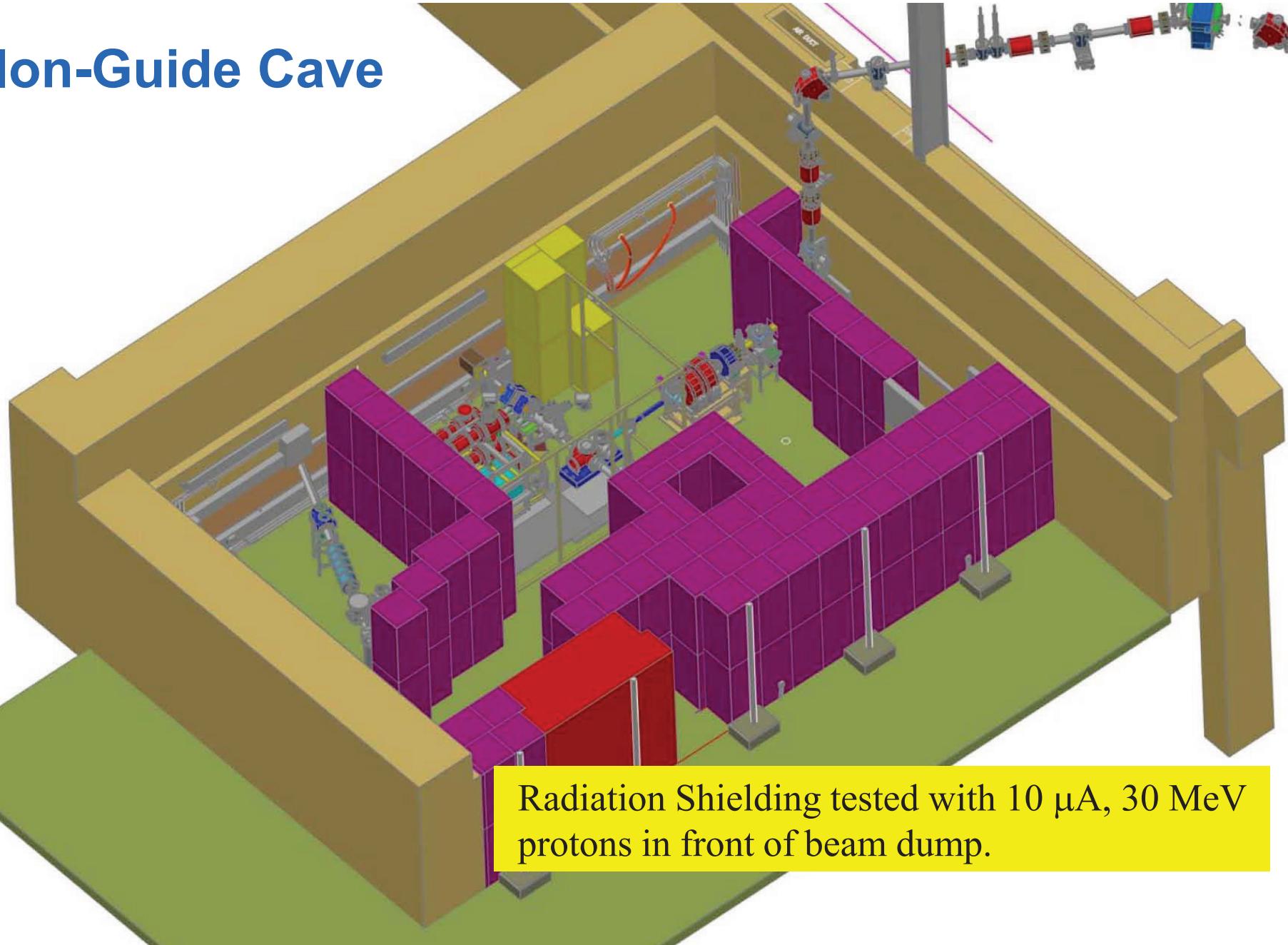
Tests – ^{228}Th open source in the chamber



Shielding the Ion-guide Cave



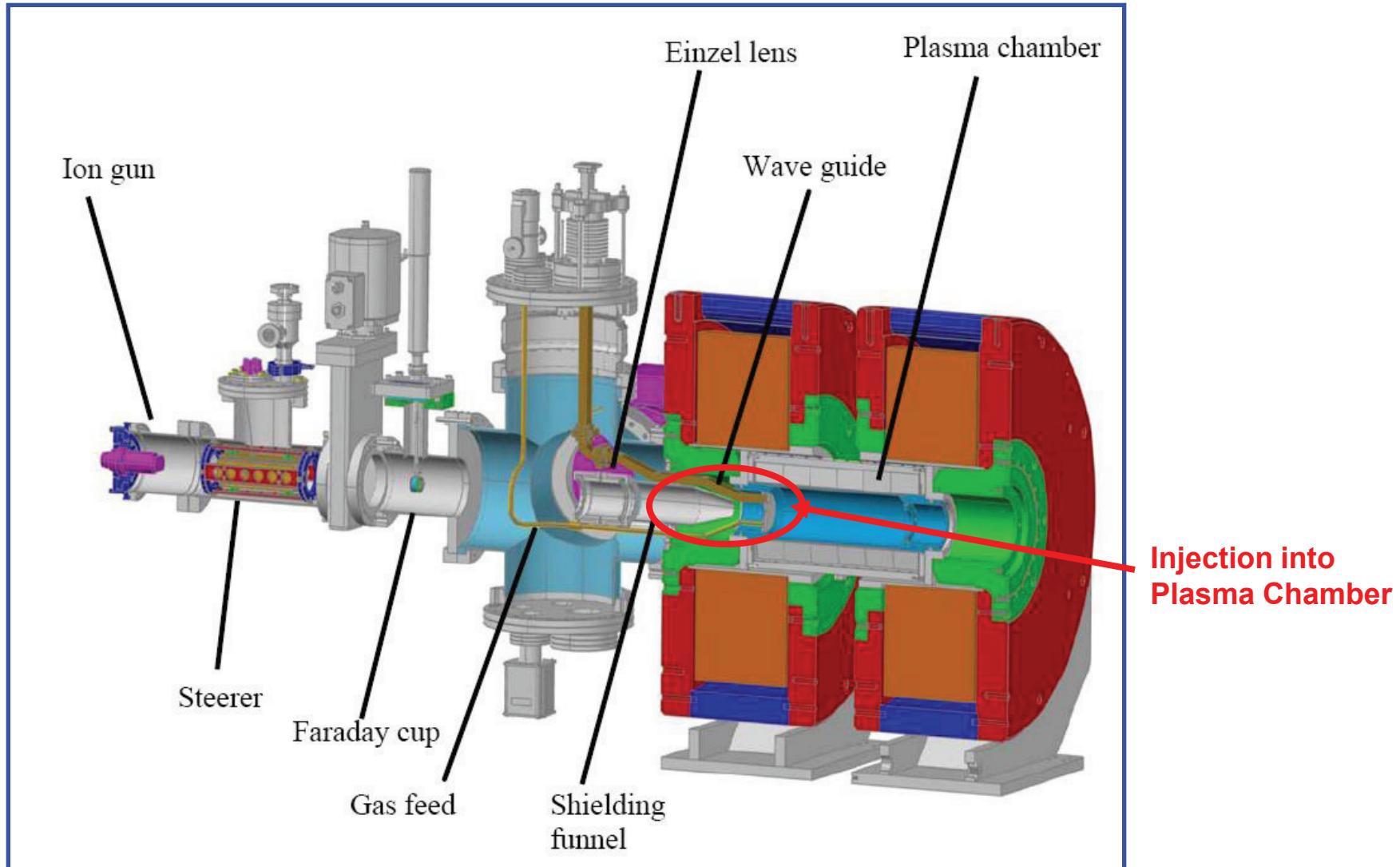
Ion-Guide Cave



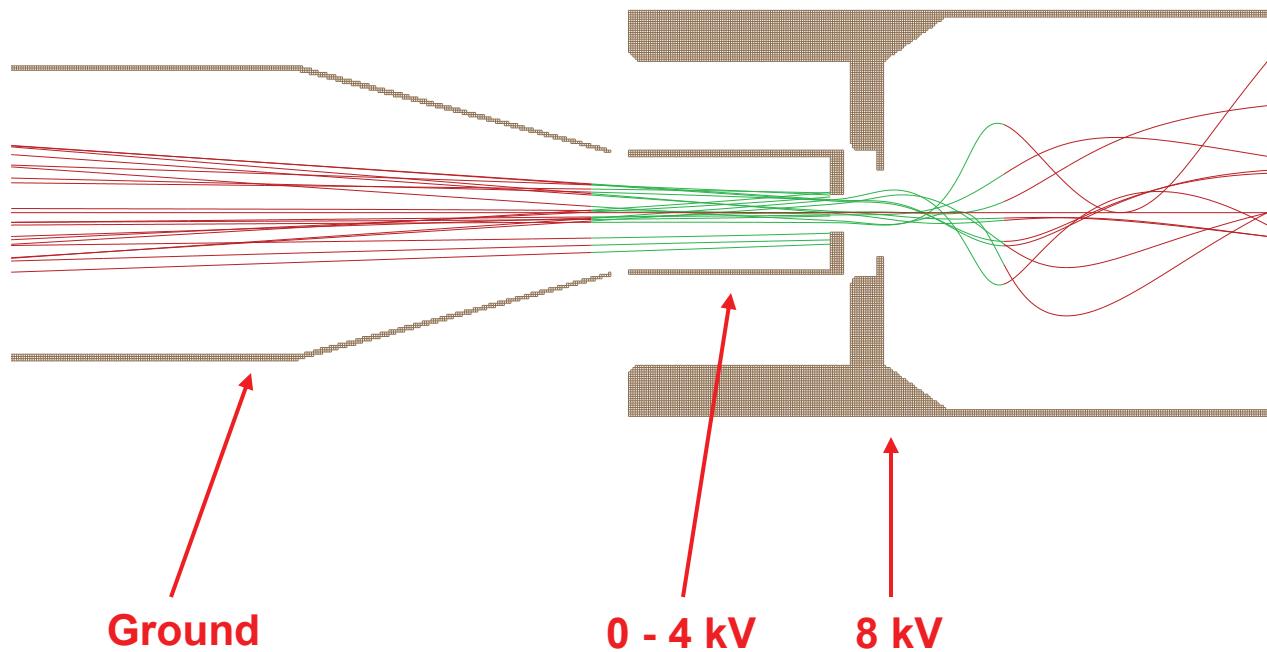
Radiation Shielding tested with 10 μA , 30 MeV
protons in front of beam dump.

Charge-breeding using aluminosilicate ion-gun

Gabriel Tabacaru and Juha Arje

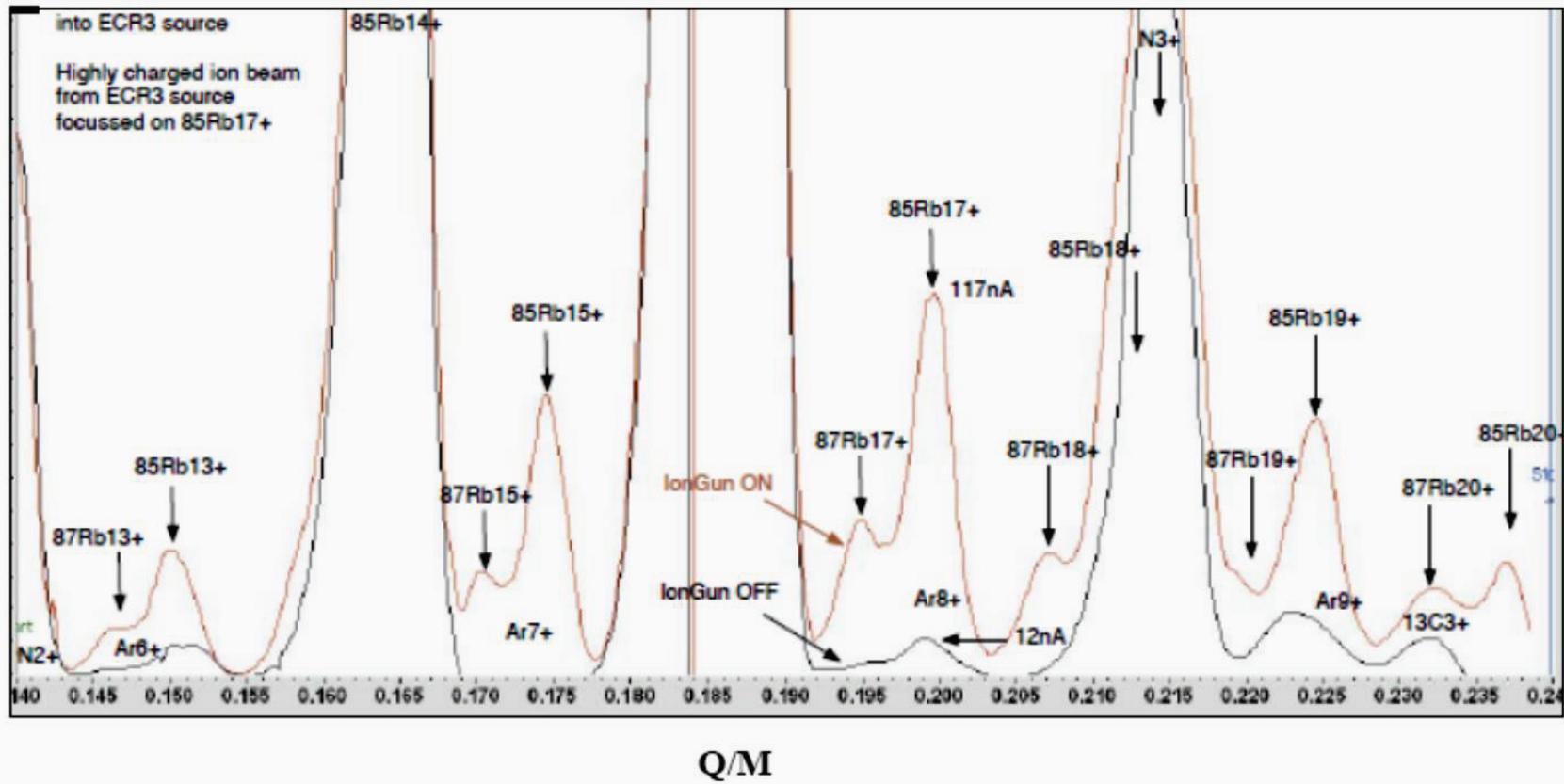


Simulation of Ion Trajectories into CB-ECRIS Plasma Chamber (SIMION)

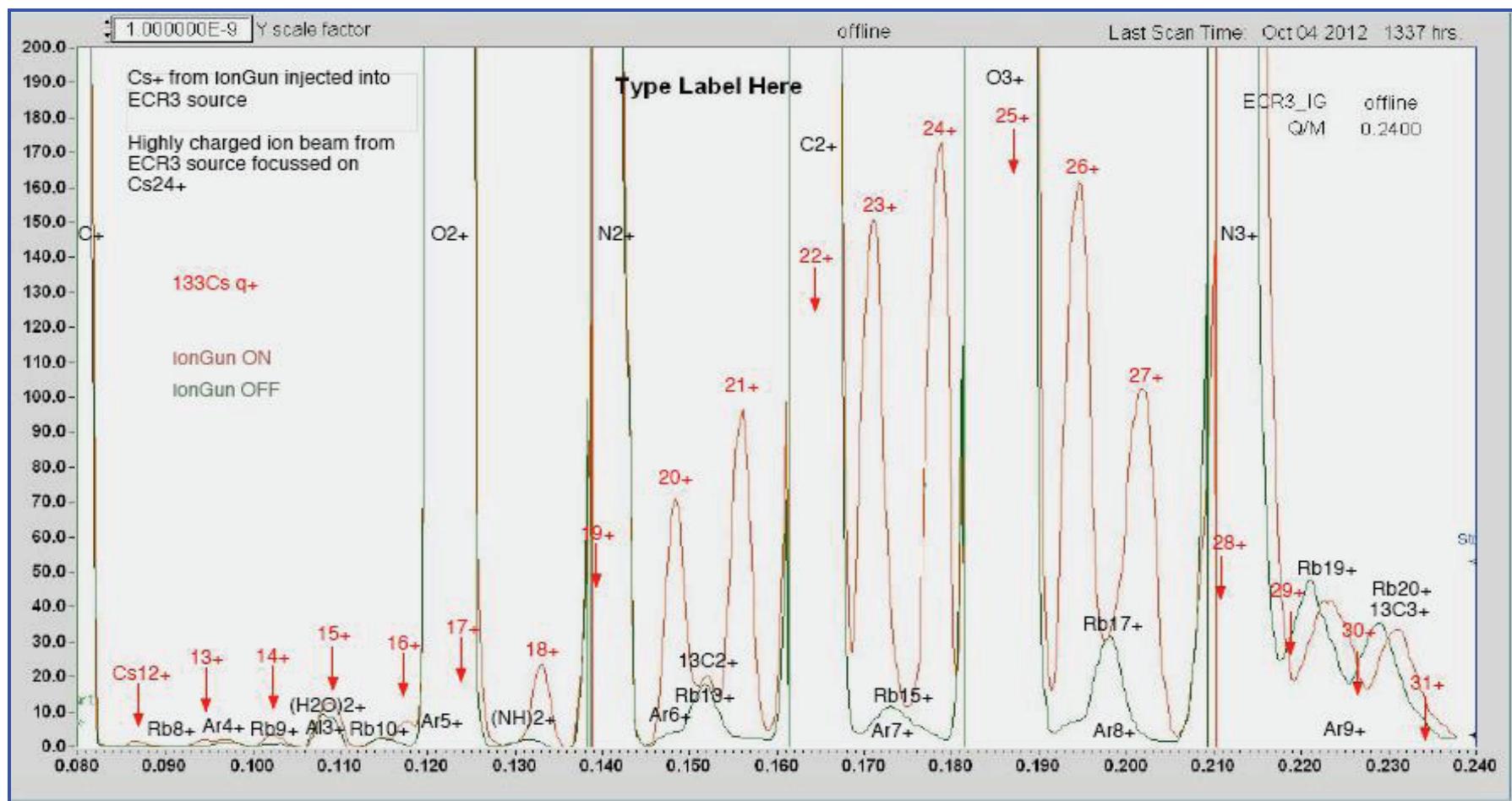


Charge-bred Rubidium

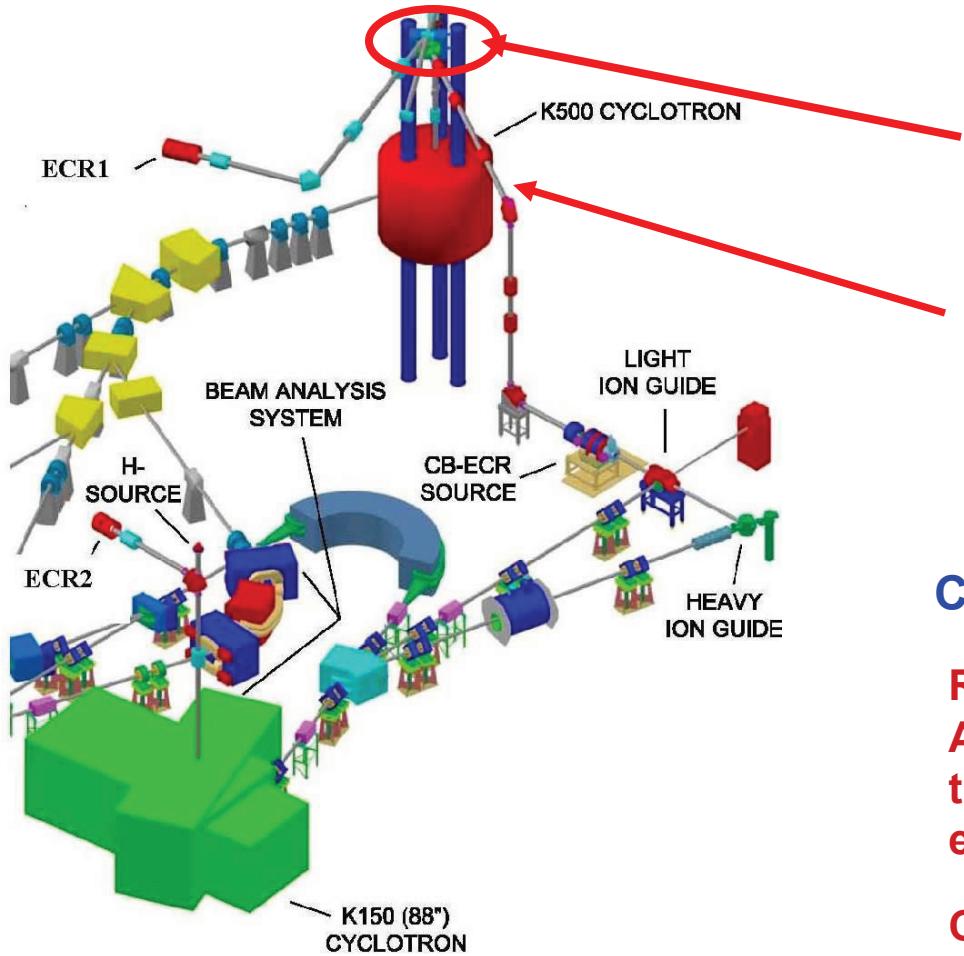
200 nA



Charge-bred Cesium



N⁺ Injection Line into the K500



New switching magnet and
90 deg magnet installed in
Jan. '12

Line completed Aug. '12

*Injection Line Vacuum –
low 10⁻⁸ torr*

Cyclotron Accelerated Beams

Rubidium 15+ and 17+: 10 and 15 AMeV – 14% and 10% transmission (analysis to K500 extr.)

Cesium 24+: 10 AMeV - 13% transmission.

At present the effort is to couple LIG to CB-ECRIS using K150 beam as ionizer.

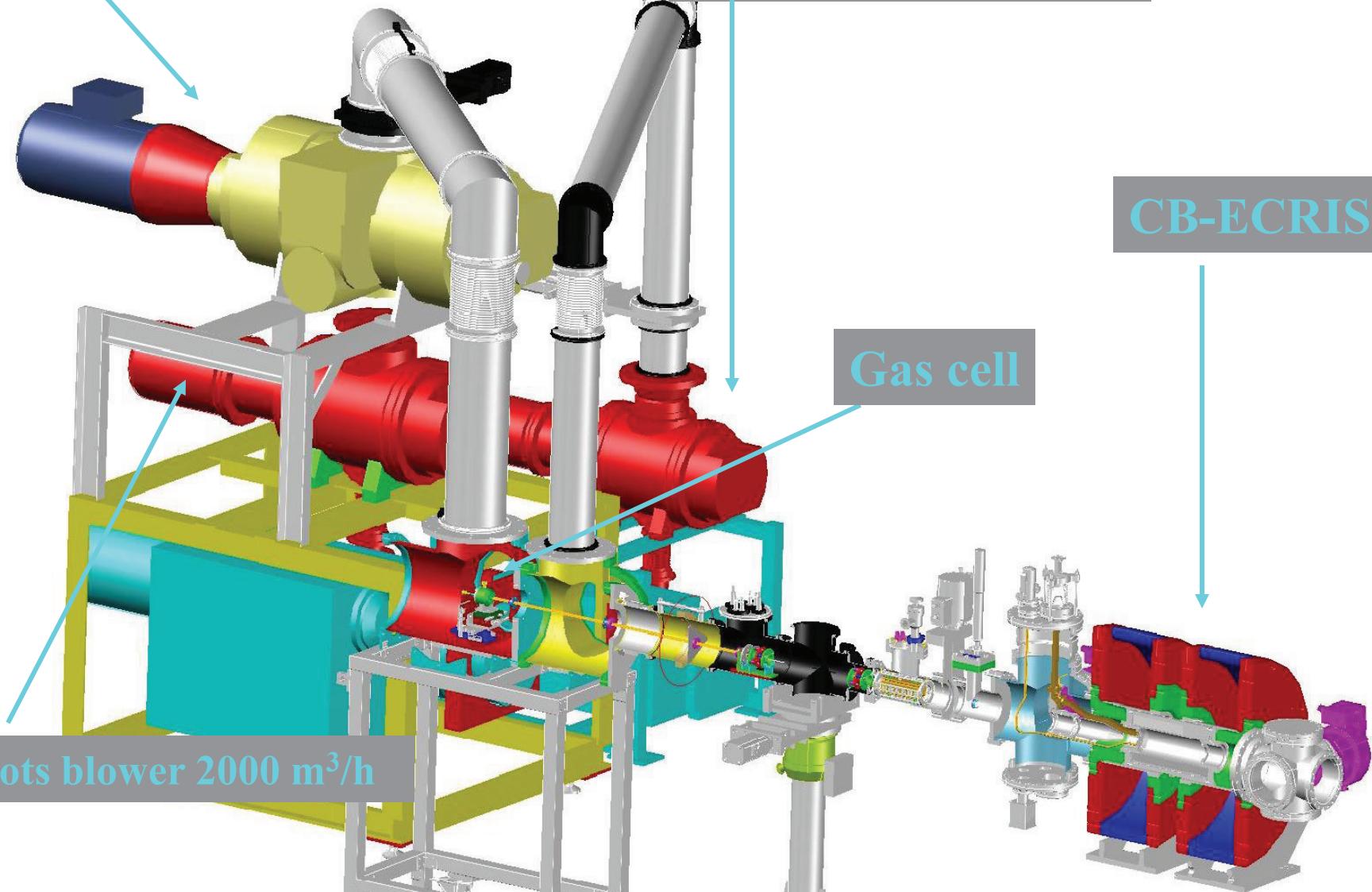
Roots blower 6000 m³/h

Roots blower 1000 m³/h

CB-ECRIS

Gas cell

Roots blower 2000 m³/h



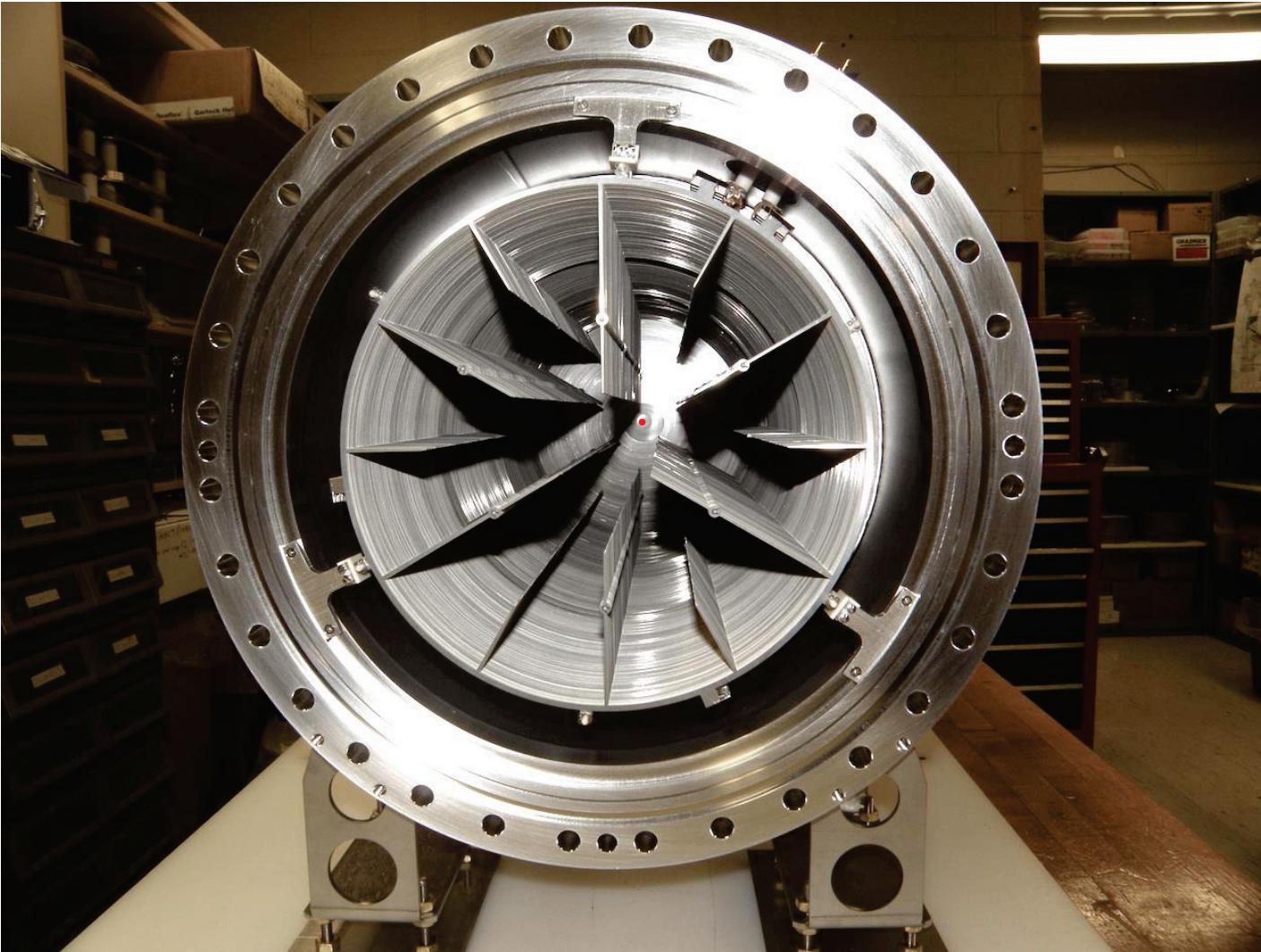
Heavy Ion Line

**Repair of BigSol Spectrometer heat leak
– Fred Abbeglen**



BIGSOL now tested and awaiting installation in the K150 vault

HI Gas Catcher – Greg Chubaryan and ANL (G. Savard)



HI Gas Catcher – Greg Chubaryan and ANL (G. Savard)

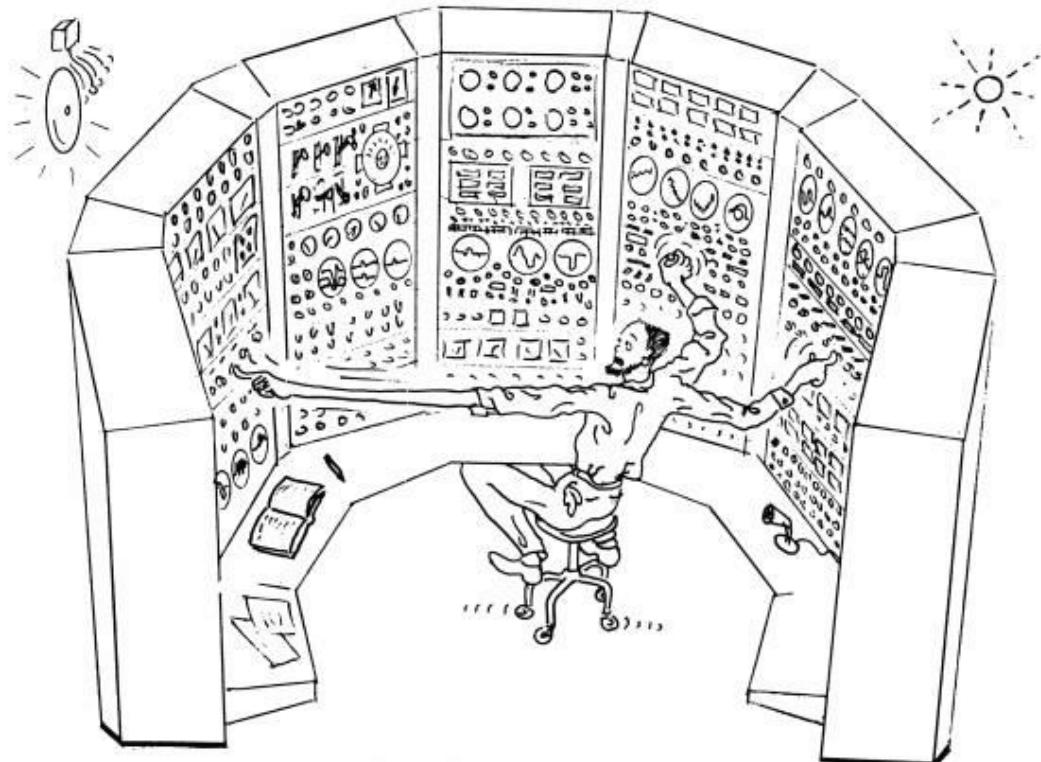


Texas A&M Cyclotron Institute



UPGRADE

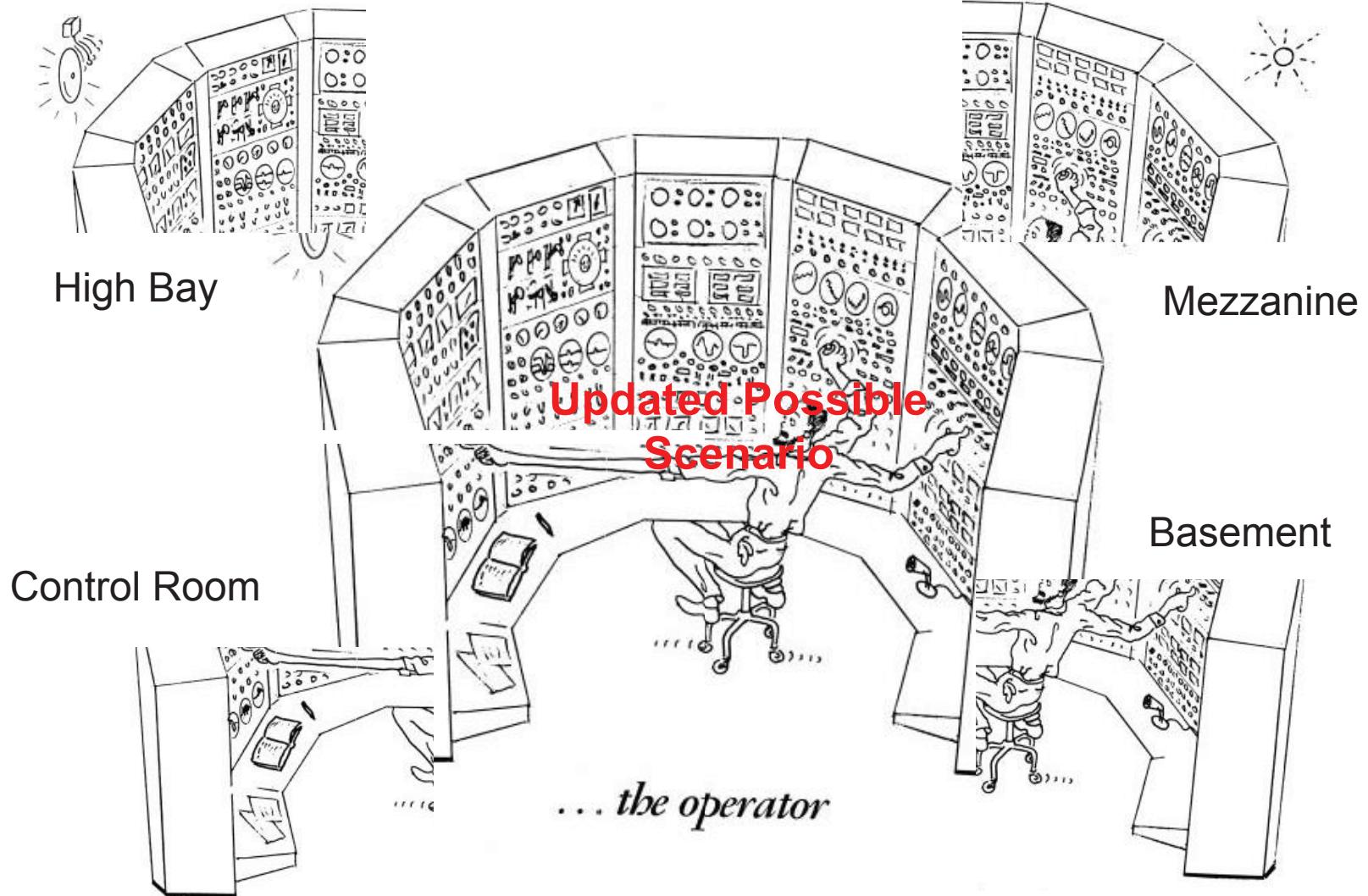
Possible scenario for RIB acceleration(2010)



... the operator

Courtesy Dave Judd and
Ronn MacKenzie

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