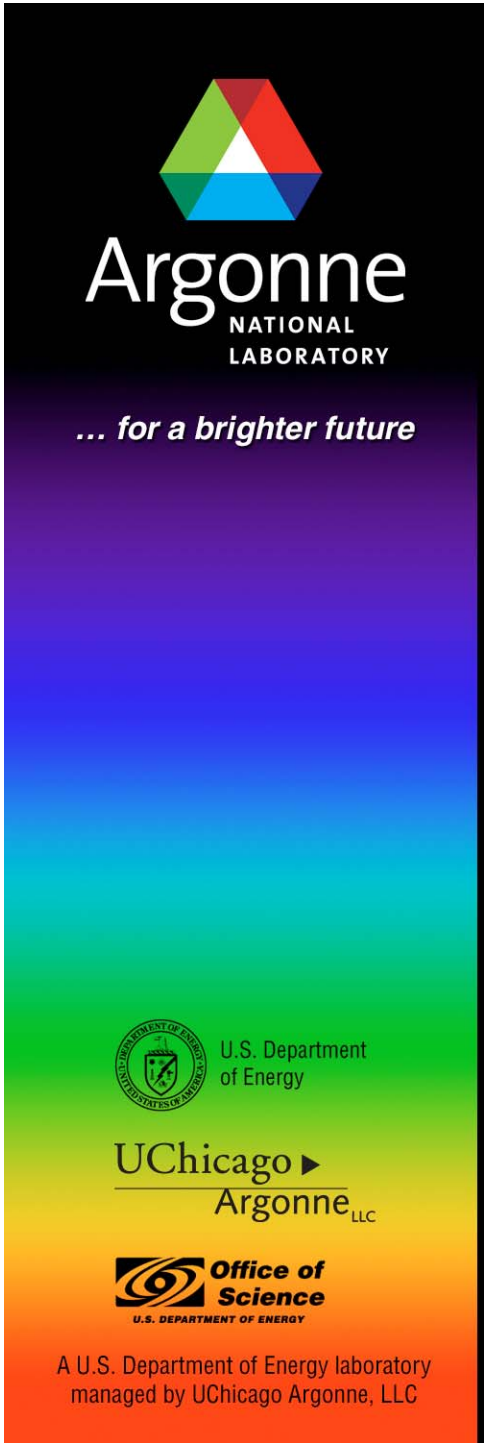


News from ATLAS

Robert V. F. Janssens

NSAC Meeting, 8/21/07

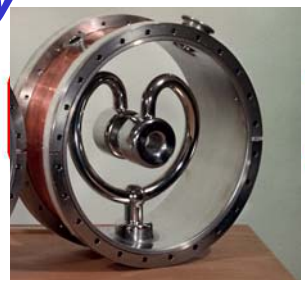
The ATLAS Facility Today

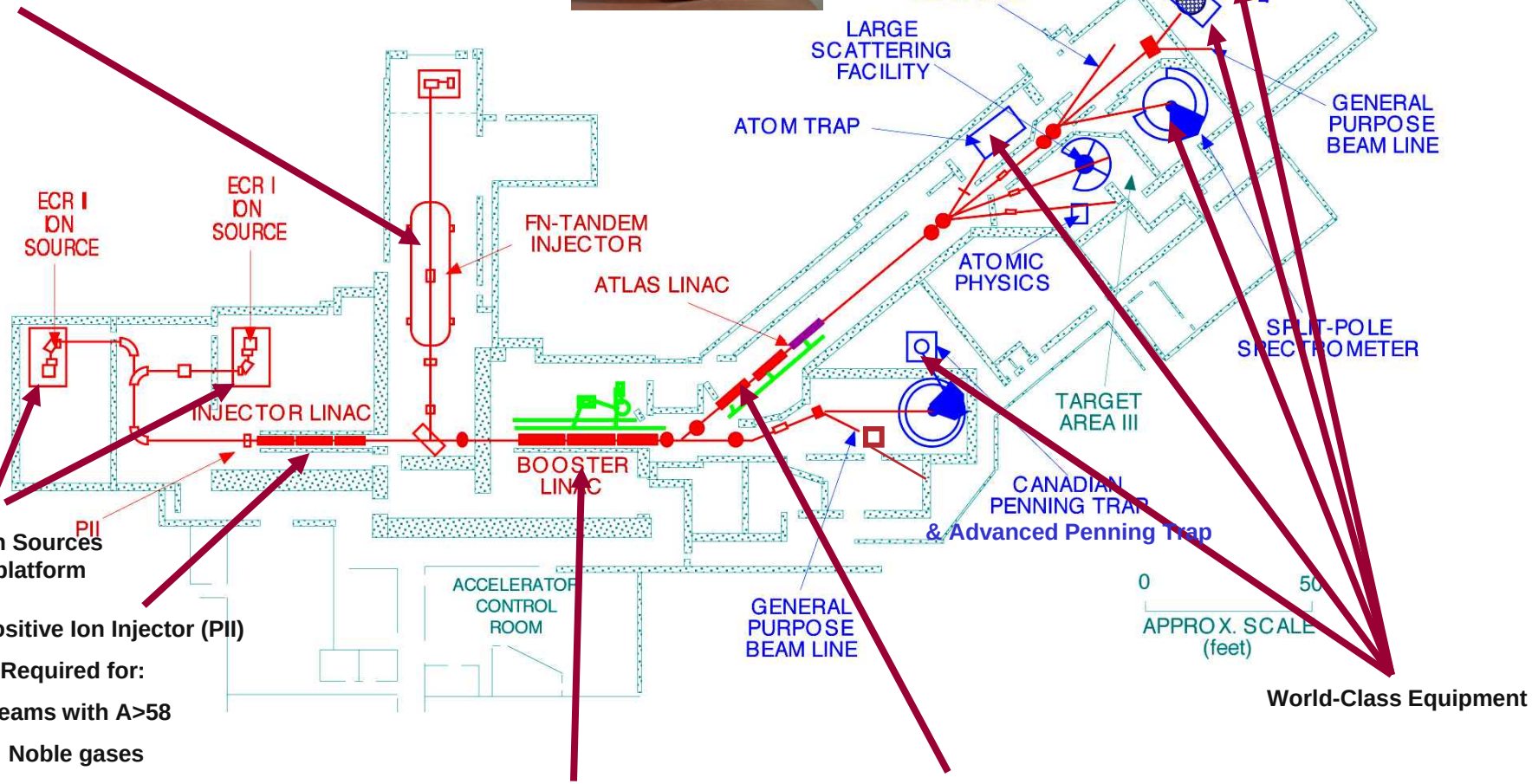
8.5-MV Tandem Injector

Important for:

Beams of A<58

Long-lived RIB's





2 ECR Ion Sources on HV platform

12-MV Positive Ion Injector (PII)

Required for:

Beams with A>58

Noble gases

High current

18 Quarter-wave SC resonators

24-Resonator Booster

19-Resonator ATLAS

World-Class Equipment

The ATLAS Facility Today

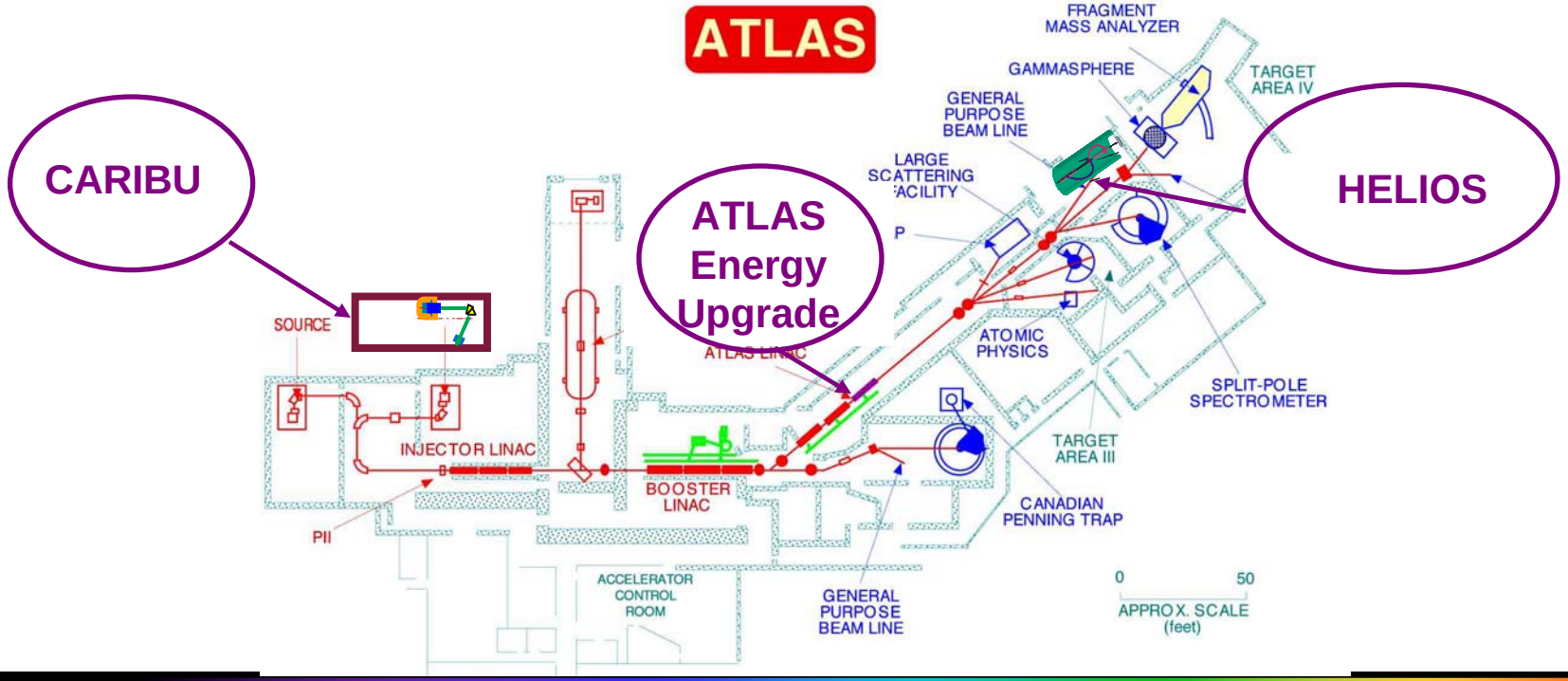
- **6 days/week Operation**
- **Construction of Californium Rare Ion Breeder Upgrade (CARIBU) & Energy Upgrade**
- **Development of new instrumentation capabilities to capitalize on CARIBU & ATLAS**

  Continuous input & ideas from the ATLAS user community

Priorities of the ATLAS strategic plan developed by the ATLAS user community and ANL management.

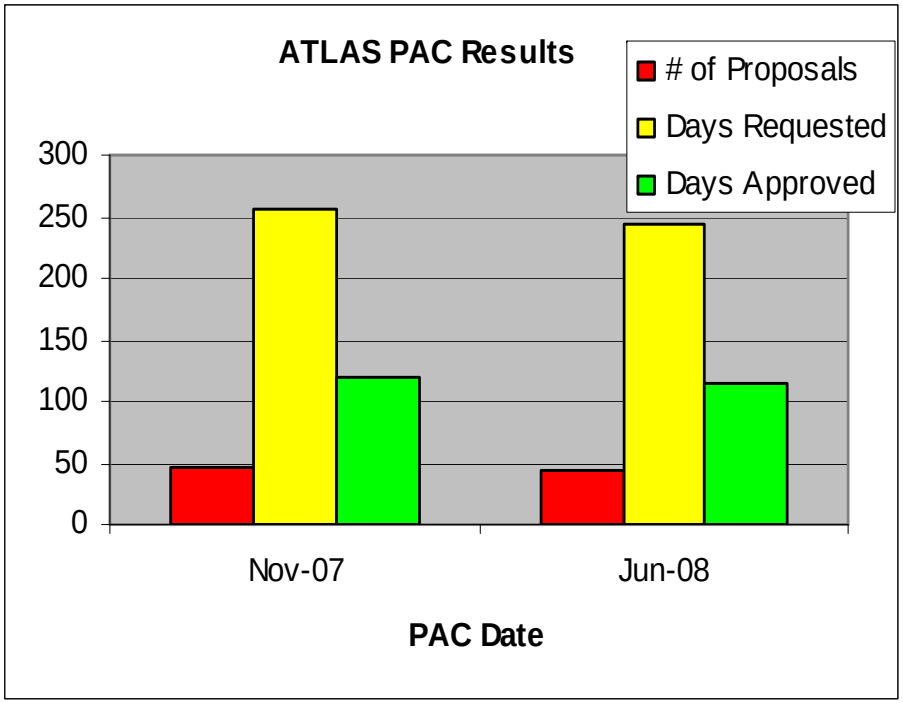
CARIBU & Energy Upgrade & HELIOS: Unique Synergy

- **CARIBU gives access to exotic beams not available elsewhere.**
- **Energy Upgrade provides beams from CARIBU in the energy regime of 12 MeV/u ideal for transfer reaction studies.**
- **HELIOS will greatly expand the effectiveness of both the fission fragment beams and the existing in-flight RIB program at these higher energies.**
- **These three projects form a truly unique facility which complements the capabilities of other world facilities in the era leading to FRIB.**
- **The three projects are funded.**



ATLAS: Statistics (including September 08 schedule)

Total number of Experiments in FY08 : 47



- **Nuclear Structure: 19**
- **Nuclear Astrophysics: 11**
- **Nuclear Reactions: 4**
- **Fundamental Interactions: 2**
- **Others: 11**

Total number of Beam Hours : 5200 h

Total number of Beams : 40

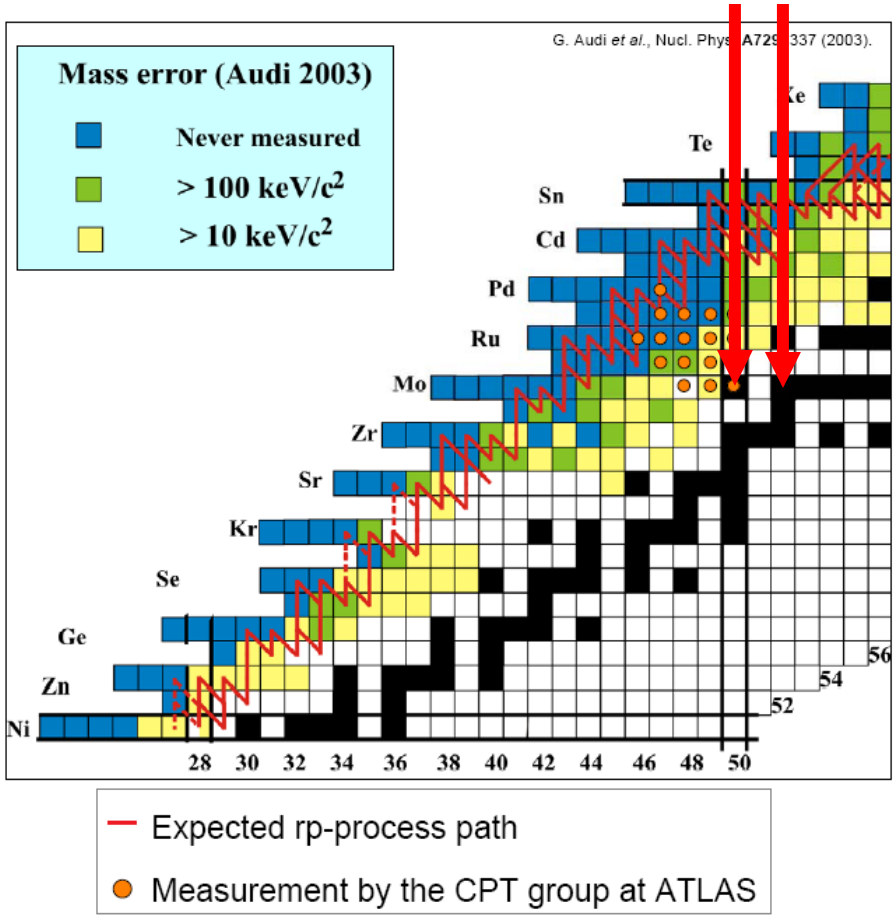
- **Stable Beams: 32**
- **Radioactive Beam: 8**

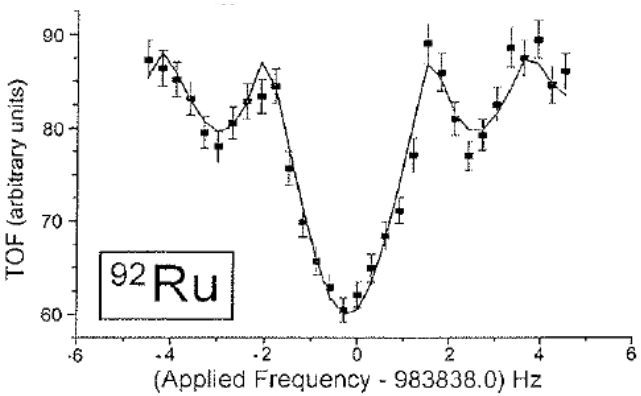
Total number of Users: 459

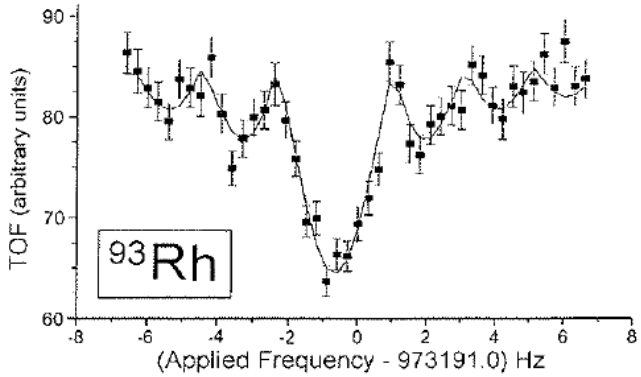
10/01/2007 to 09/30/2008

Number of Users present at ATLAS in FY2008: ~200

Recent Results: The νp-process and the production of ^{92,94}Mo







The S_p values for ^{93}Rh and ^{92}Ru and neighboring nuclei rule out the νp-process as the origin of the anomaly in the relative production abundances of ^{92}Mo & ^{94}Mo.

J. Fallis, PhD thesis U. Manitoba
J. Fallis et al, Phys. Rev. C78 (2008) 022801(R).

Recent Results: New test of ab-initio calculations in A=10 nuclei

- **Development of realistic NN and NNN interactions**
- **Test of Green's function Monte Carlo *ab initio* calculations**

Many opportunities for experimental tests

Binding Energies

Spins and Parities

Wavefunctions: ATLAS program

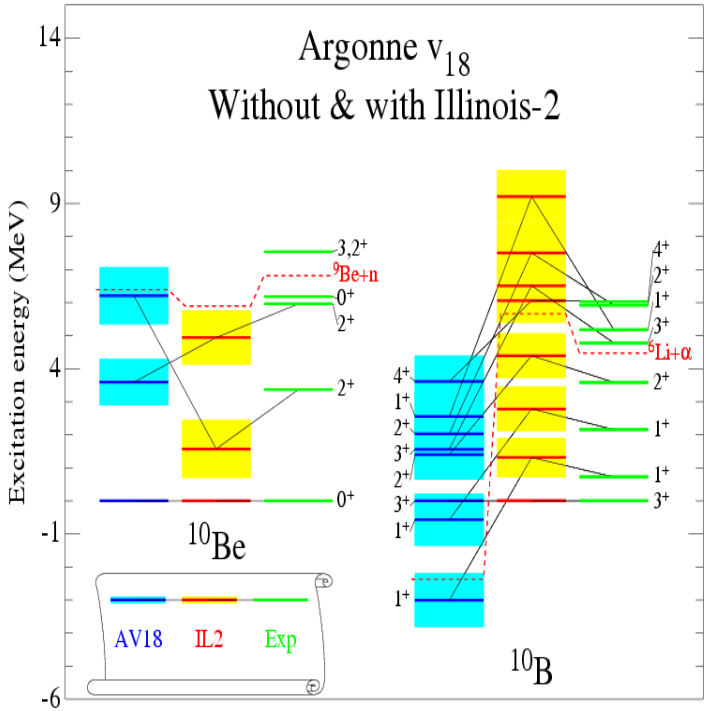
^{6,8}He charge radius

P. Mueller *et al.*, PRL **99**, 252501 (2007).

Unbound states in ^{7}He

A.H. Wuosmaa *et al.*, PRC **72**, 061301(R) (2005).

→ **Electromagnetic transitions**

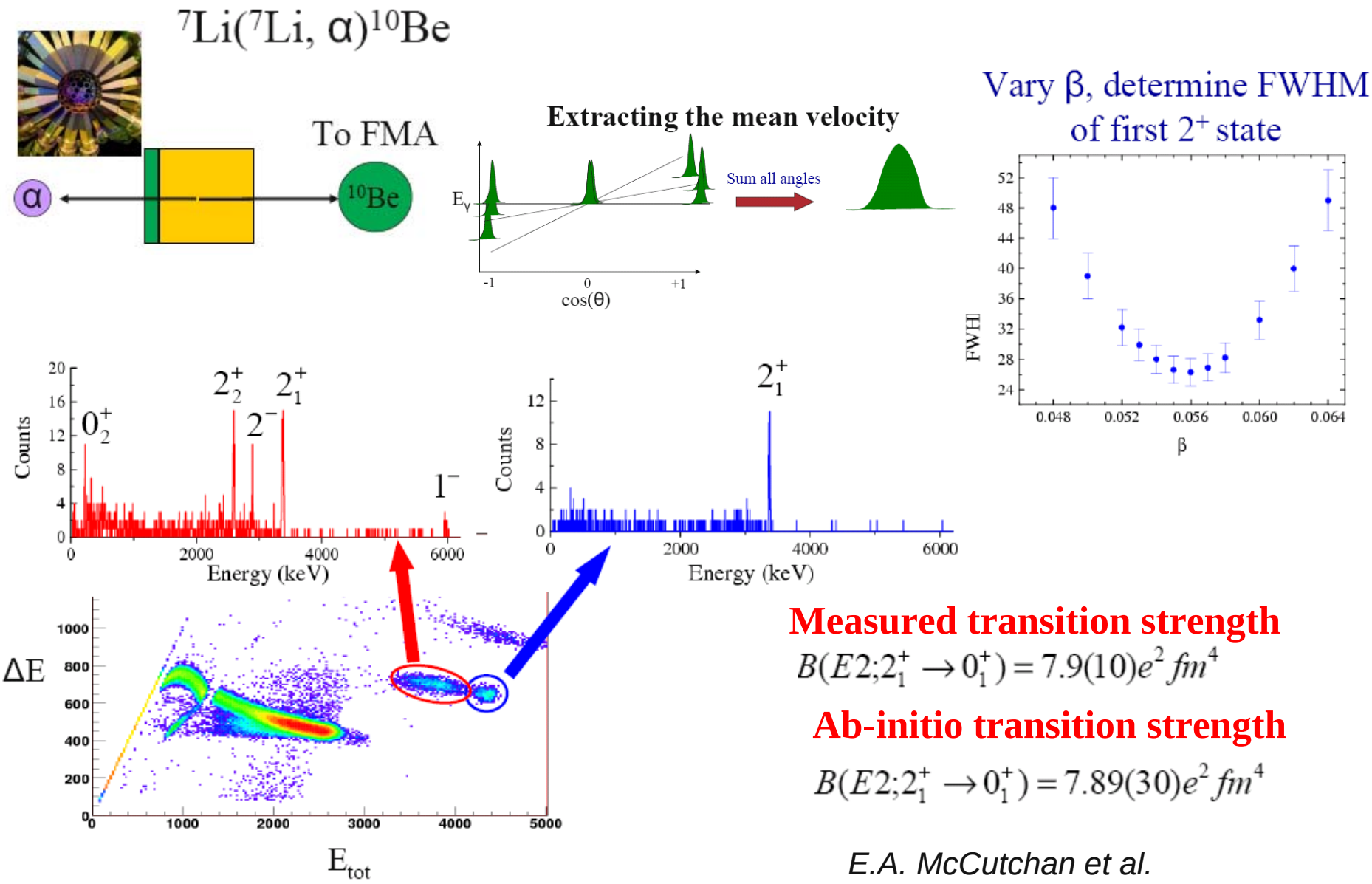


S.C. Pieper, K. Varga and R.B. Wiringa, PRC **66**, 044310 (2002).

High-precision lifetime measurements in ^{10}Be

New experimental approach with Gammasphere and the FMA

New Test of ab-initio calculations in A=10 nuclei



Measured transition strength

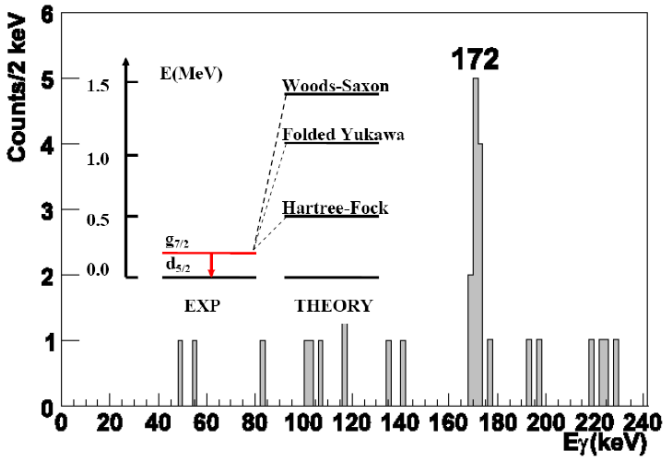
$$B(E2;2_1^+ \rightarrow 0_1^+) = 7.9(10)e^2\,fm^4$$

Ab-initio transition strength

$$B(E2;2_1^+ \rightarrow 0_1^+) = 7.89(30)e^2\,fm^4$$

E.A. McCutchan et al.

Recent Results: New Information on Shell Structure



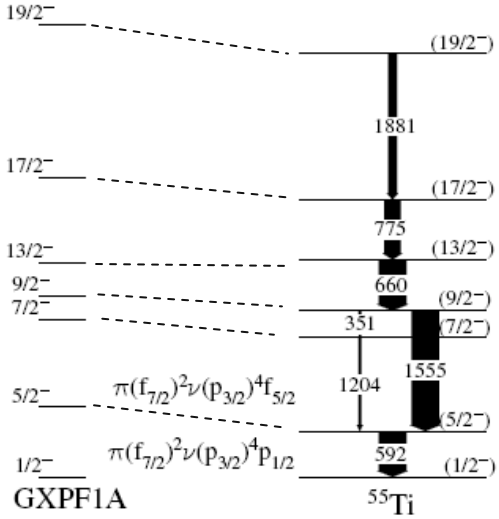
D. Seweryniak et al. Phys. Rev. Lett. **99**, 022504 (2007)

First observation of single neutron states in ^{101}Sn

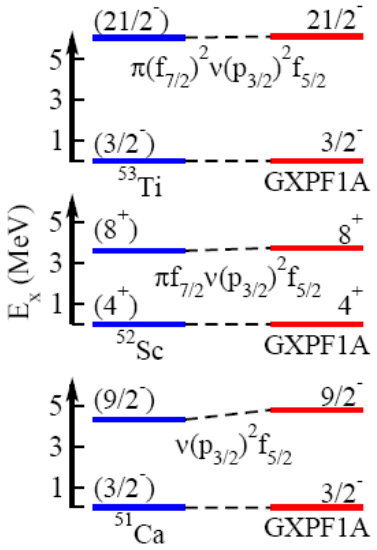
$g_{7/2}$-$d_{5/2}$ splitting is very small....172 keV

→ challenge for theory

Shell Structure around the New Shell Gap at N=32



S. Zhu *et al.*, Phys. Lett. **B 650**, 135 (2007)



B. Fornal *et al.*, Phys. Rev. C **77**, 014304 (2008)

Ordering of the orbitals in n-rich N=31 isotones and in one-proton and one-neutron nuclei outside semi-magic ^{54}Ti established.

Strength of monopole tensor interaction probed & modern effective interactions tested.

CARIBU - CAlifornium Rare Ion Breeder Upgrade

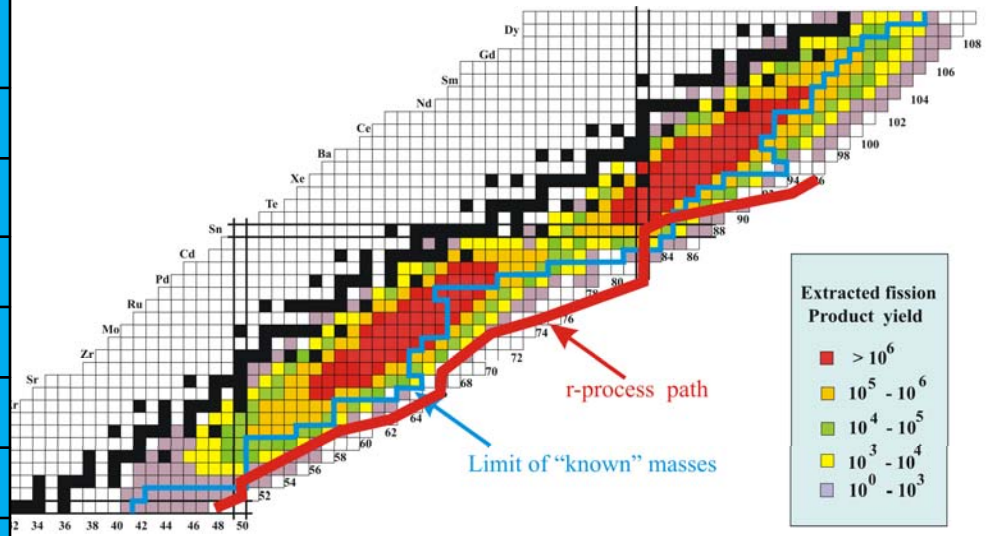
- ^{252}Cf fission yield is complementary to uranium fission
- Provides access to unique, important areas of the N/Z plane
- Significant yield extends into r-process region
- Available energy exceeds that from HRIBF and ISAC (10 MeV/u)
- Builds on extensive ATLAS weak beam experience
- Technology and experience useful for FRIB

1 Ci ^{252}Cf fission Yields

Isotope	Half-life (s)	Low-Energy Beam Yield (s^{-1})	Accelerated Beam Yield (s^{-1})
^{104}Zr	1.2	6.0×10^5	2.1×10^4
^{143}Ba	14.3	1.2×10^7	4.3×10^5
^{145}Ba	4.0	5.5×10^6	2.0×10^5
^{130}Sn	222.	9.8×10^5	3.6×10^4
^{132}Sn	40.	3.7×10^5	1.4×10^4
^{110}Mo	2.8	6.2×10^4	2.3×10^3
^{111}Mo	0.5	3.3×10^3	1.2×10^2

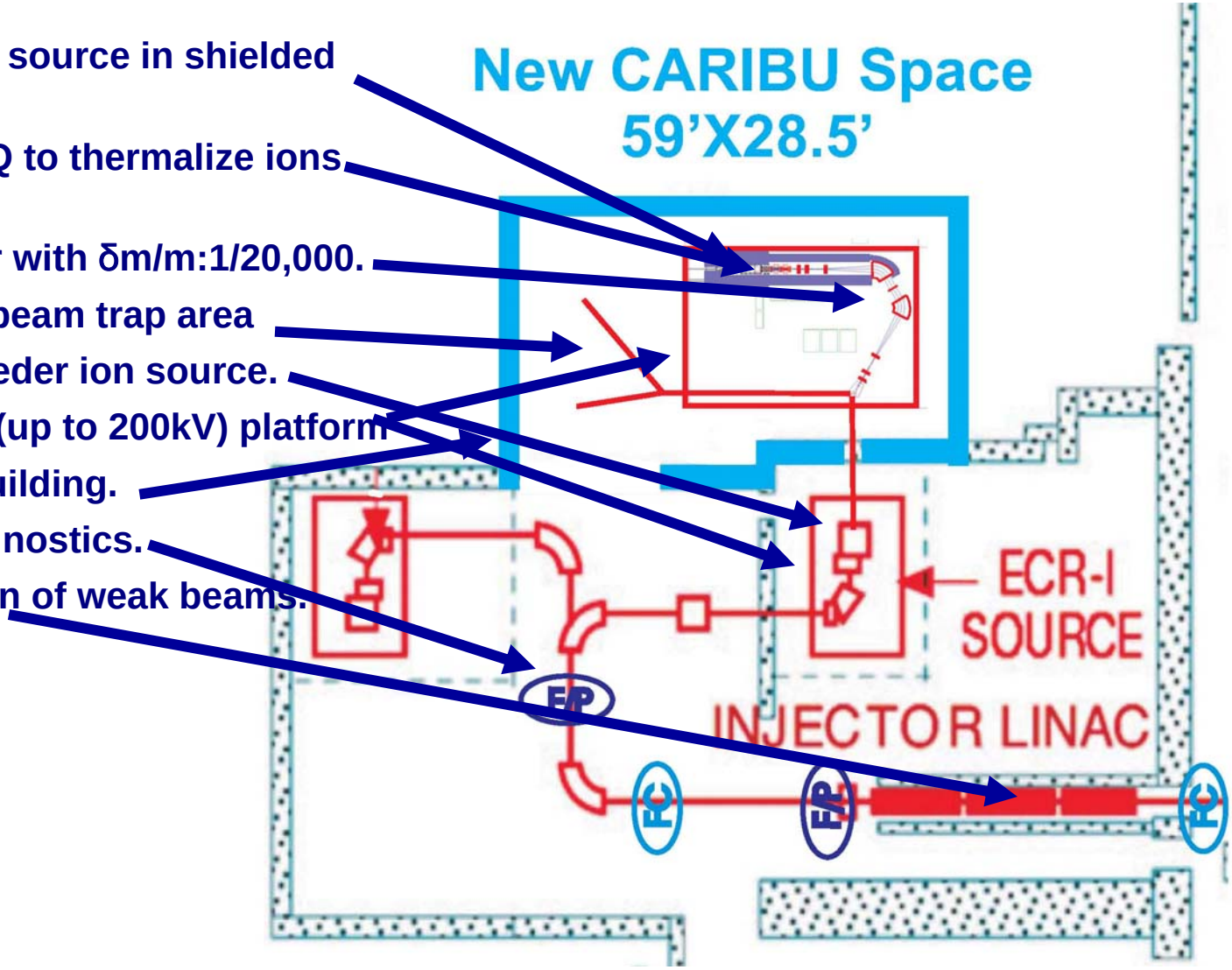
^{252}Cf spontaneous fission yield

$T_{1/2}$=2.6 a 3+% fission branch



CARIBU: Integrating Concepts & Gaining Experience for FRIB

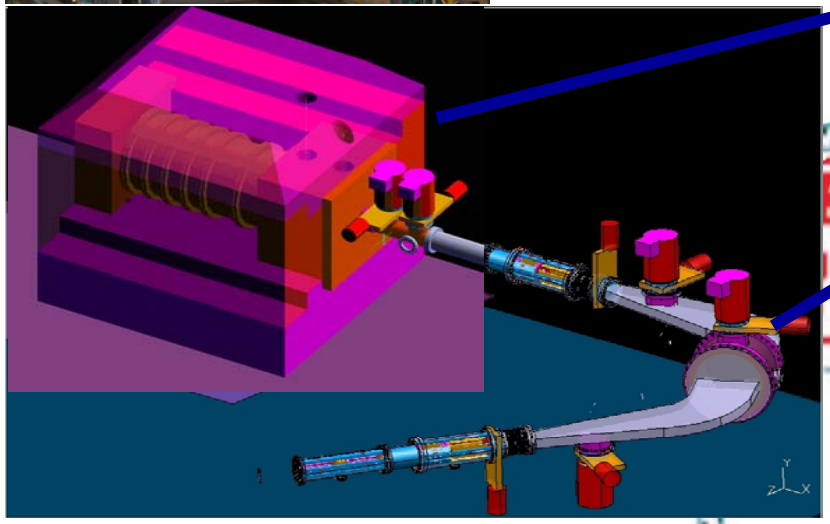
- 1 Ci ^{252}Cf fission source in shielded cask.
- Gas catcher/RFQ to thermalize ions and create beam.
- Isobar separator with δm/m:1/20,000.
- Un-accelerated beam trap area
- ECR charge breeder ion source.
- Mounted on HV (up to 200kV) platform
- New ~1600 ft^2 building.
- Weak beam diagnostics.
- Post-acceleration of weak beams.



CARIBU: Present Status

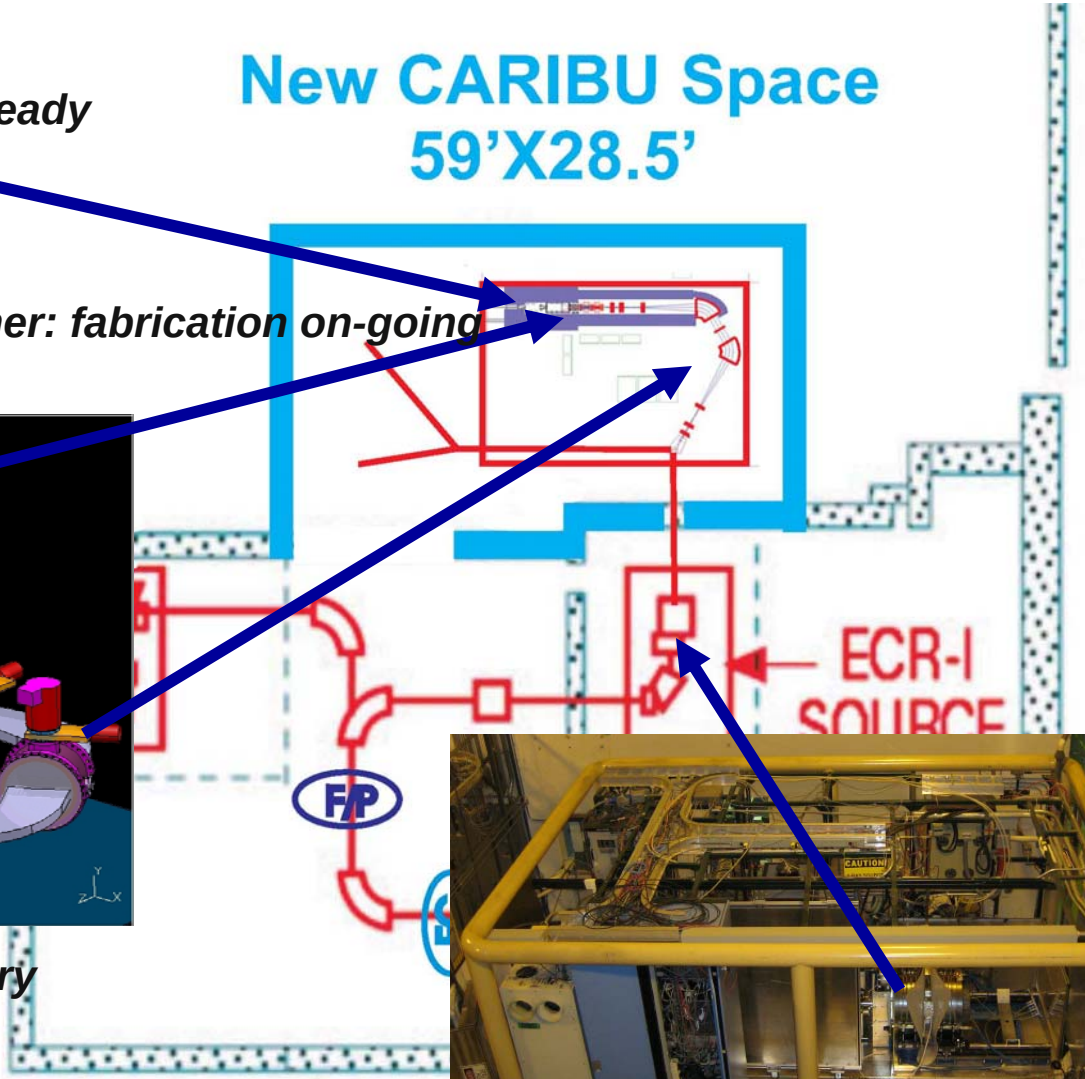
Completion March 2009

Cask ready



Gas catcher: fabrication on-going

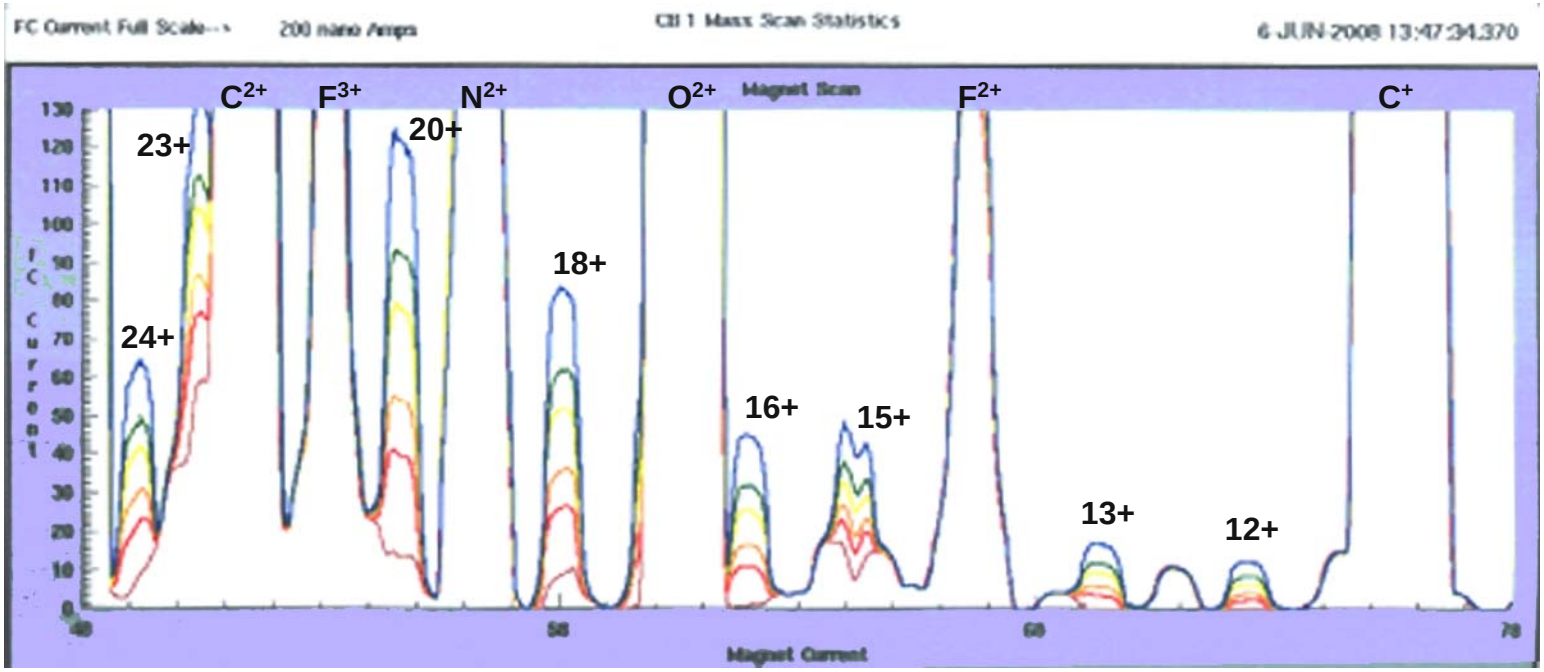
Isobar separator: 09/08 delivery



Charge breeding: started

Charge breeding of Cs

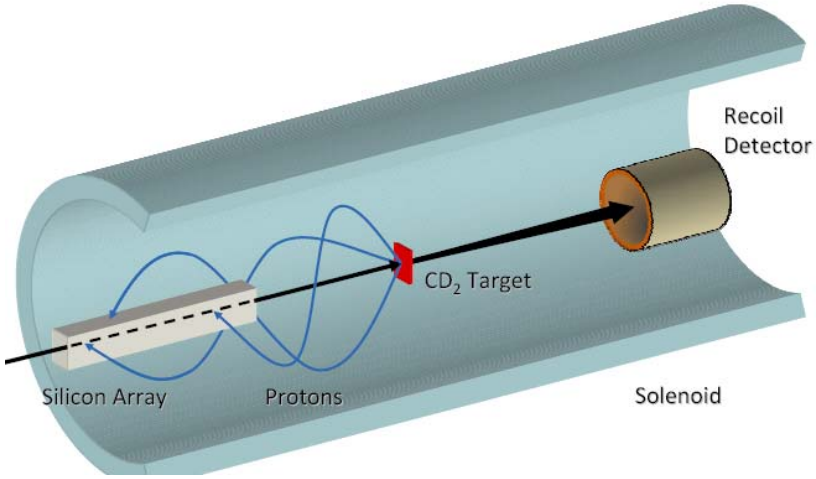
- Mass spectrum of ECR ion source output with and without Cs^{+} injection
  - Background beam, without Cs^{+} injection, is shown in brown
  - Other traces represent varying levels of charge bred Cs as a function of Cs^{+} input intensity
- Maximum efficiency thus far 2.93 % for Cs^{20+}



HELIOS (Helical Orbit Spectrometer)

Western Michigan U, Manchester U, ANL collab.

- **4π solid angle**
- **Particle I.D. from TOF**
- **Simple detector and electronics - few channels**
- **Excellent center-of-mass energy and angle resolution**
- **Suppression of backgrounds**



A. Wuosmaa et al.,
Nucl. Instr. and Meth. A **580** (2007) 1290.

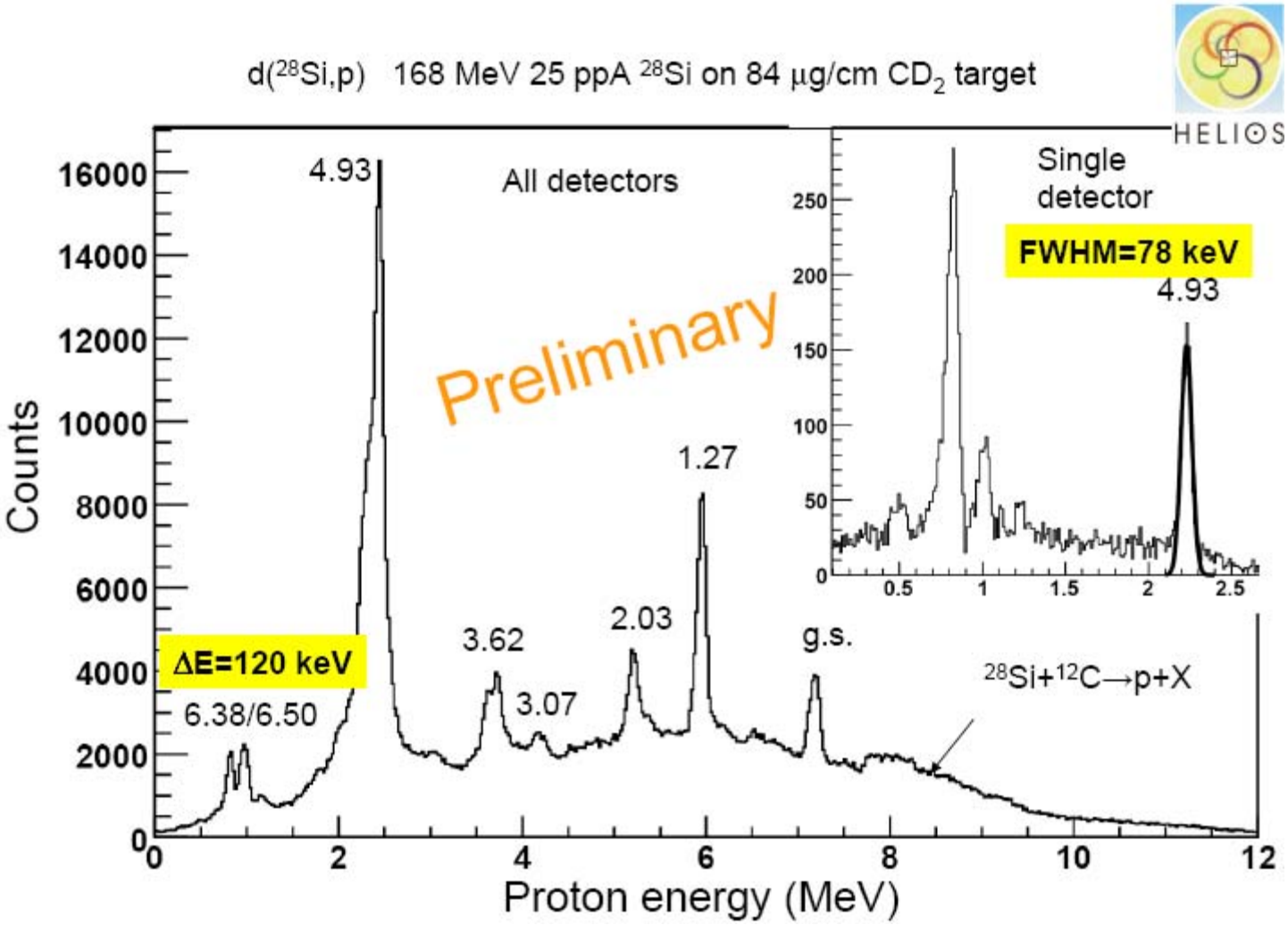
Ideal tool for reactions in inverse kinematics (also with Radioactive Ion Beams)

First experiment last week

HELIOS

HELIOS (Helical Orbit Spectrometer)

First Spectrum from HELIOS



Upstream Si array assembled at Western Michigan Univ. from old detectors
Project is main FY2008 equipment priority, but lack of CE funds delays procurement of "real" upstream and downstream arrays and associated, dedicated electronics.

ATLAS Operations and Low Energy Research: impact of the FY2008 budget?

- Operations at 6 days/week

  Because of uncertainty in funding, ATLAS personnel leaving early in FY2007 were replaced late and ATLAS ran only 5 days/week until Feb. 2008 as a result. ATLAS is now operating 6 days/week and will deliver 5200 h in FY 2008 (original plan called for delivery of 5800 h).

- Construct and operate the Californium Rare Ion Breeder Upgrade (CARIBU) & ATLAS Energy Upgrade

  Project is on track, BUT there is a ~$100k shortfall in funding and a worry about ^{252}Cf availability. CARIBU was given priority over the ATLAS Energy Upgrade which is not yet complete due to lack of manpower.

- Develop the new instrumentation capabilities to capitalize on CARIBU and ATLAS

  Shortfall in Capital Equipment funding in FY08, in line with the DOE priority of retaining manpower in the face of the FY2008 budget situation, has resulted in limited instrumentation development (focus on HELIOS and X-array). Specifically, the planned laser lab and upgrades of the FMA and Gammasphere are on hold.

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ATLAS Operations in FY2009: Impact of a Six Months Continuing Resolution (followed by President's Budget)

Guiding Principle: Protect Scientific & Technical workforce

Because of FY2008 savings and assistance from ANL, U. Chicago and ONP this is feasible BUT for 6 months at most (this stretches resources to the very limits!).

Further impact: anticipated hires postponed (CARIBU technical & scientific support)

→ CARIBU start may be delayed

Redirection of effort: - to CARIBU (installation and move of CPT to stopped-beam area)

- to ATLAS Energy Upgrade

→ This will result is a decrease in available beam time (ATLAS is supposed to run 5900 h in FY2009, will be reduced to ~ 5300 h *at most*)

→ The next PAC meeting (originally scheduled for 12/08) will be postponed by 1-2 months

The lack of Capital Equipment funding puts ATLAS Operations and the experimental equipment at risk in the event of a major equipment failure (delayed upgrades of vacuum & cryo. systems, magnet power supply replacements, delayed equipment repairs & upgrades on Gammasphere, FMA and CPT).

ATLAS Long-Term Future

- **Present ATLAS program with rare isotope beams uses ~ 20% of available time.**
- **Once CARIBU turns on, the rare isotope program is anticipated to represent ~ 50 % of the available time. ATLAS remains fully committed to its responsibilities as the U.S. stable beam User facility.**
- **The present program with exotic beams and the potential offered by the CARIBU upgrade demonstrate the value of ATLAS as an accelerator for research with rare isotope beams.**
- **ANL has responded to the FOA for FRIB and the proposal incorporates ATLAS as the post-accelerator. We are looking forward to the next steps in the FOA process.**
- **ANL is fully committed to participate in the national FRIB effort, independent of its site.**