ION TRAPS: Primary physics motivation - precision mass measurements:

1. Nuclear shell structure
2. The r-process
3. Fundamental interactions - set up for recoil asymmetry measurements (e.g. $ap_e \cdot p_\nu$)
4. The nuclear mass surface
5. The rp-process

Current and future - centered on LEBIT 9.4 T penning ion trap/collaboration

gas cell - beam cooler and buncher - Penning trap

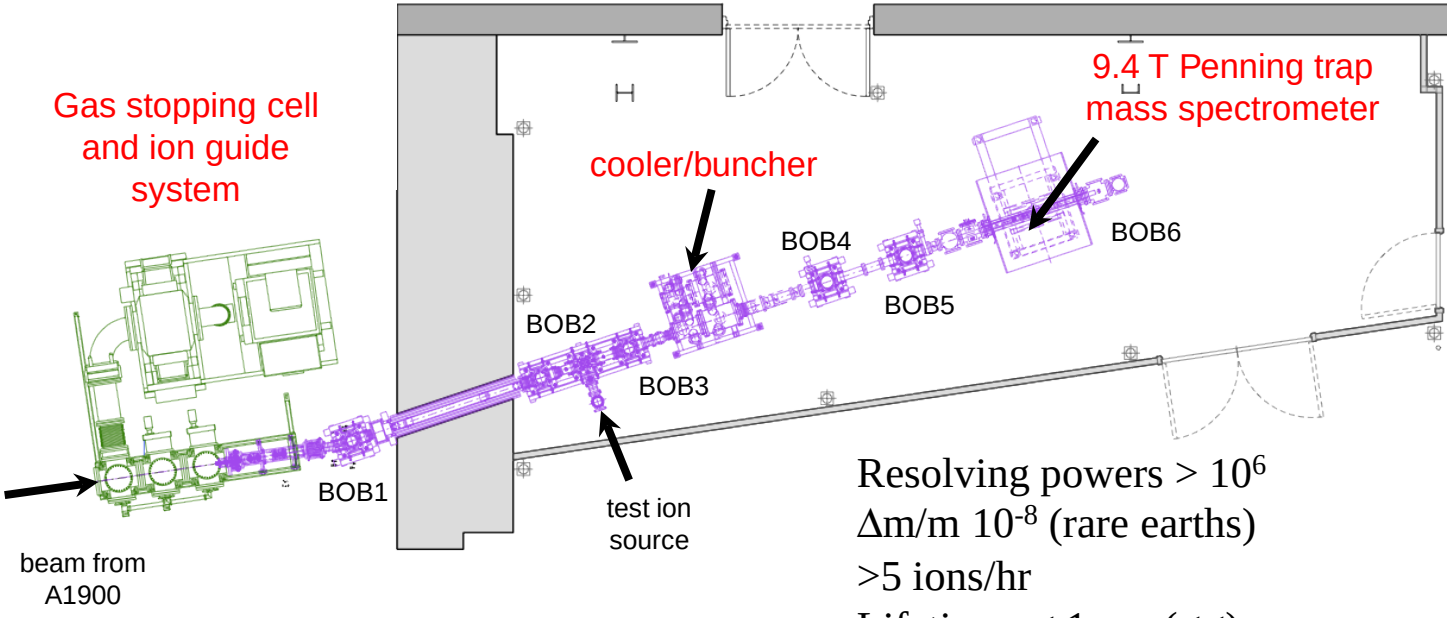
2000: LEBIT project initiated

2004: System complete and functional

2005: First mass measurement of radioactive species - ^{38}Ca

2009: Final mass measurement in current configuration - ^{66}As

40 isotopes stopped and measured: Si, P, Ca, S, Fe, Co, Ge, As, Se, Br



Resolving powers > 10^6

$\Delta m/m$ 10^{-8} (rare earths)

>5 ions/hr

Lifetimes < 1 sec (<<)

LEBIT Collaboration: **Ryan Ringle**, NSCL, ringle@nscl.msu.edu, Michael Block, GSI, Hendrik Schatz, NSCL, Peter Schury, Tsukuba Univ. , Dan Melconian, Texas A&M, Cody Folden III, Texas A&M, Sky Sjue, TRIUMF

Other facilties: CPT (ANL) TITAN (Triumf)

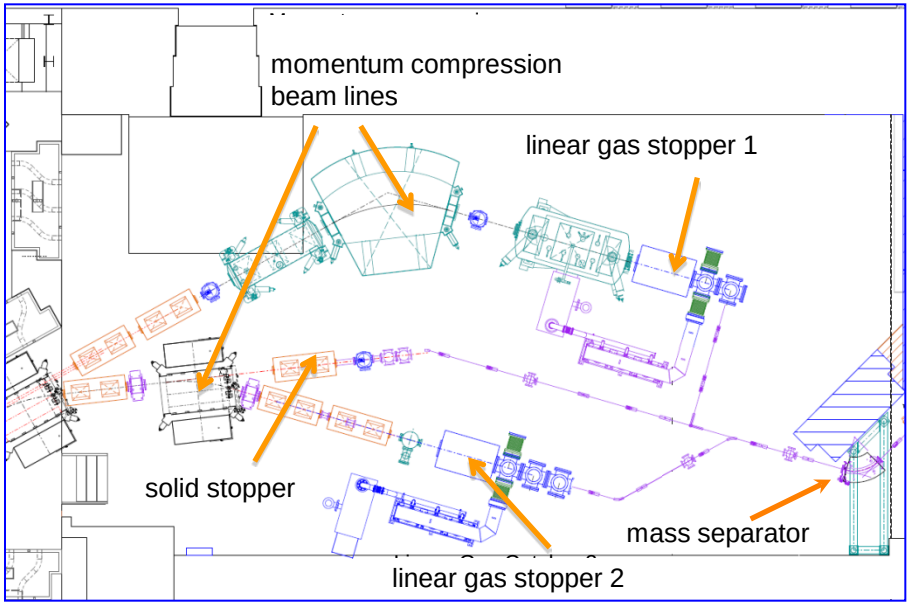
Next generation NSCL gas stopping stations

Goal: Radioactive beam to ReA3 by the end of 2010

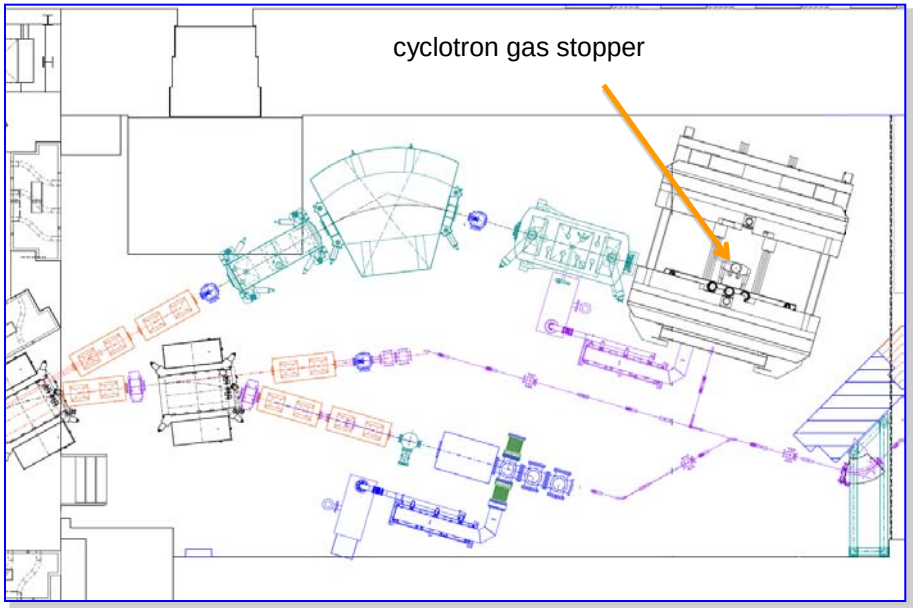
- Vault reconfiguration in 2009
  - 2 new momentum compression beam lines + solid stopper line
  - Opportunity for simultaneous R&D and beam operation for pre-FRIB science (ReA3, stopped beams)
- Phase 1 (before 2012):
  - ANL gas stopper and MSU linear cryogenic gas stopper
- Phase 2 (after 2012):
  - Cyclotron gas stopper and linear gas stopper

Allows the delivery of the best beam from multiple
stoppers in a manner which is transparent to the systems downstream

Phase 1



Phase 2



New NSCL stopped beam area

Stopped beam delivered to ReA3 for charge breeding in EBIT and subsequent reacceleration, or into the new stopped beam area

Stopped beam area to include:

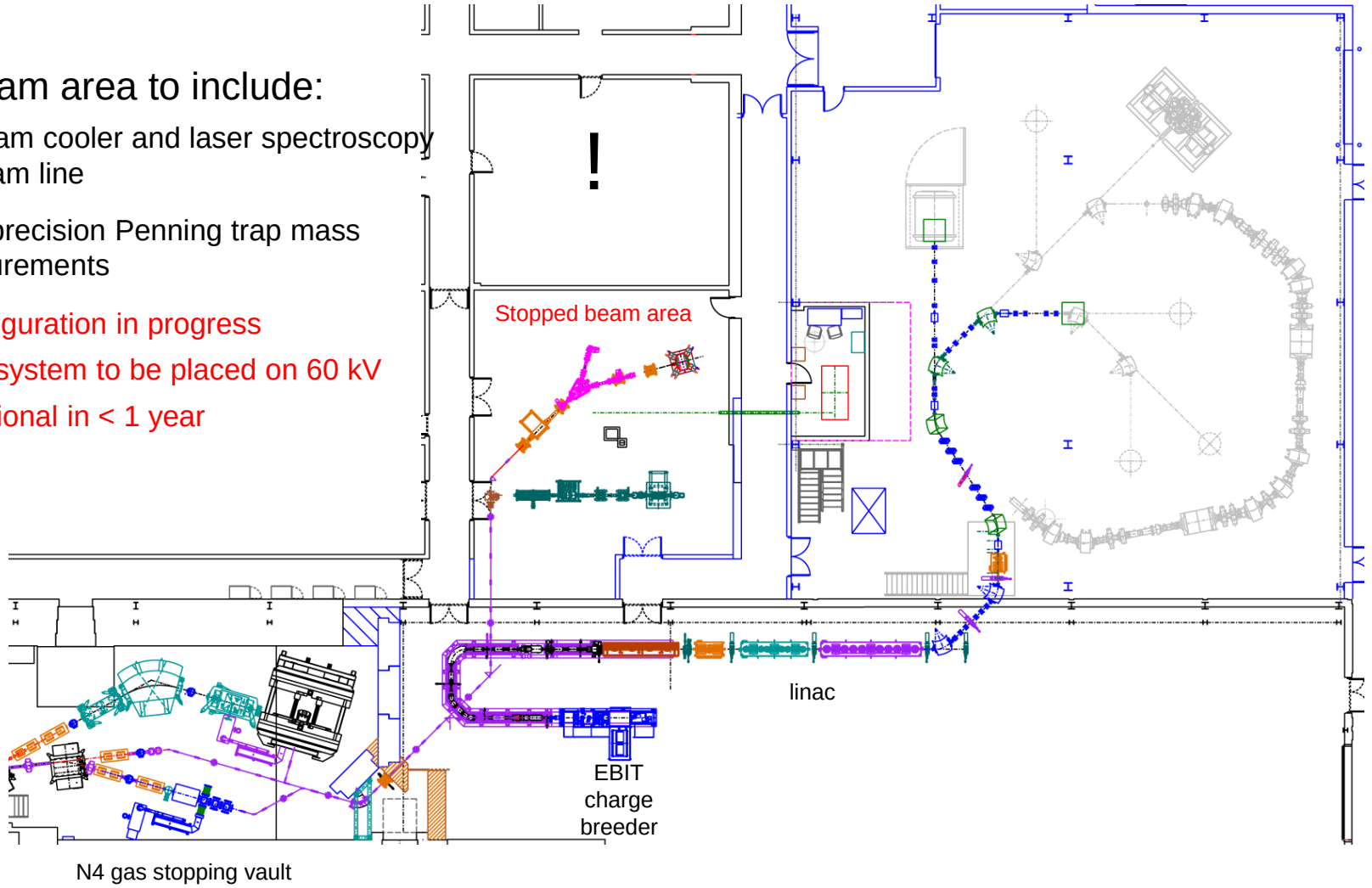
BECOLA - beam cooler and laser spectroscopy beam line

LEBIT - high precision Penning trap mass measurements

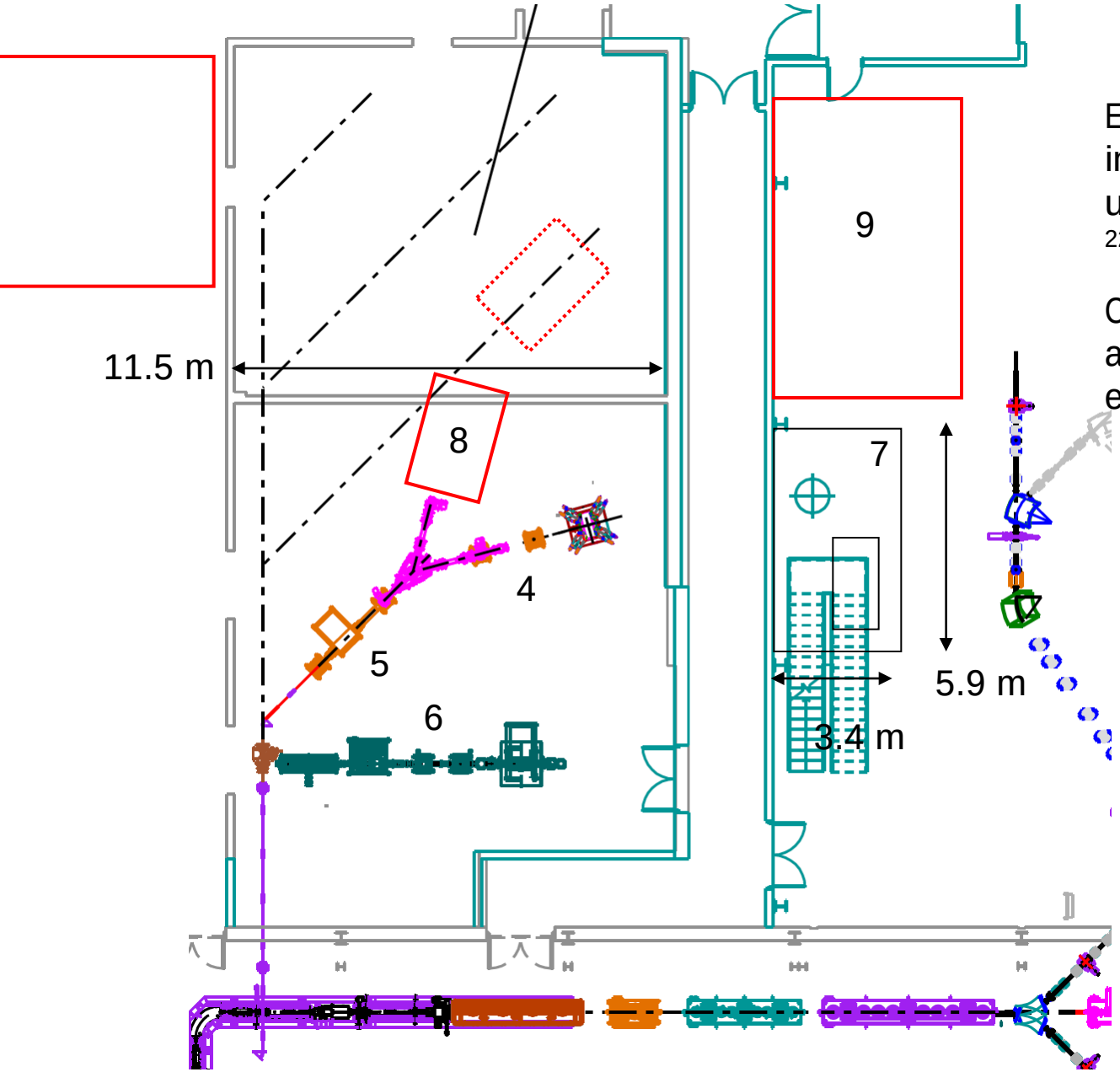
reconfiguration in progress

entire system to be placed on 60 kV

operational in < 1 year



Fundamental symmetries lab/beams (MOT/EDM/Parity/Fr)



Experiment may be developed in another lab - take beam or use harvested isotopes (e.g. ^{225}Ra)

Consider upgrading space to be a lab suitable for such experiments