NSCL Operations Overview

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NSCL heading toward FRIB era

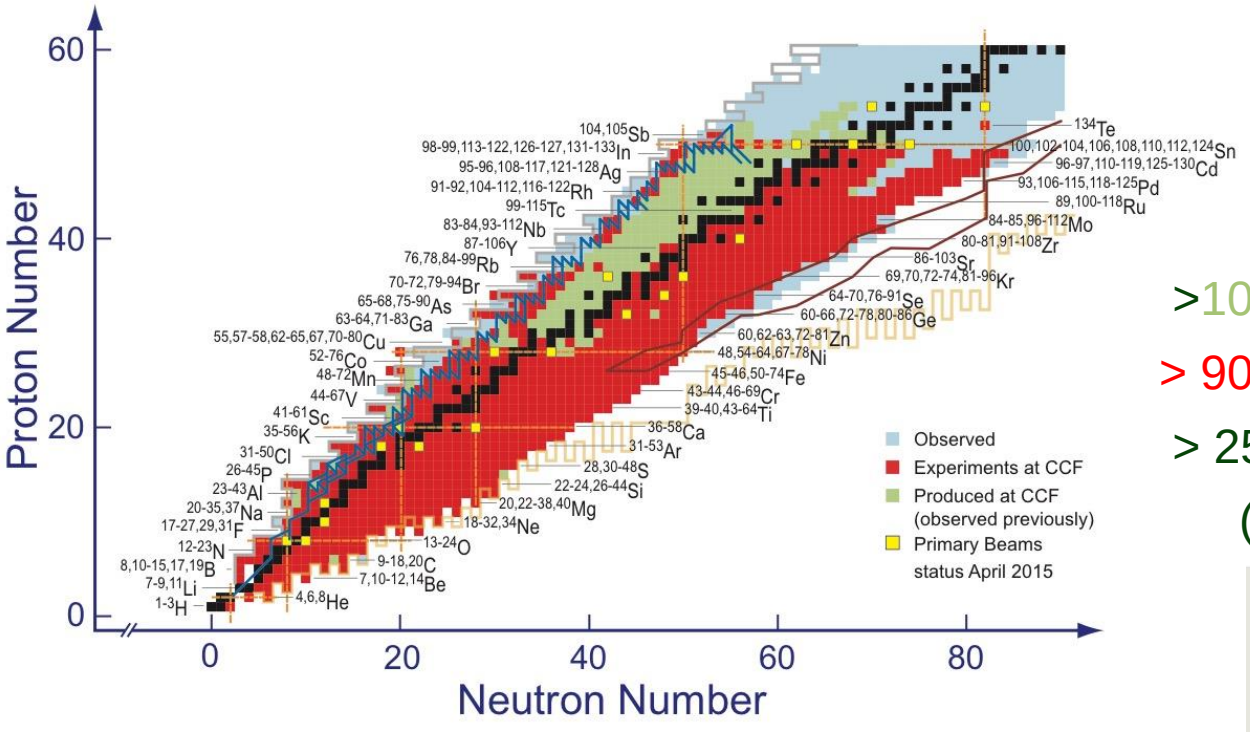
- NSCL is close to finalizing a new cooperative agreement with NSF to cover the period Oct 2016 to Oct 2021. Operating hours are the priority with a seamless transition to FRIB operations.
- The NSCL is part of FRIB Laboratory at MSU. Thomas Glasmacher is Laboratory Director with two major components:
  - DOE sponsored FRIB construction project, Paul Mantica Project Manager
  - NSF sponsored NSCL Operations and Research, Brad Sherrill Director
- NSCL Leadership Team:
  - Alexandra Gade (NSCL Chief Scientist),
  - Richard Jacobson (Executive Director),
  - David Morrissey (AD for Operations),
  - Artemis Spyrou (AD for Education and Outreach),
  - Remco Zegers (AD Experimental Research)
  - Scott Bogner (Theory Head, separately funded)
  - Hendrik Schatz (JINA-CEE Director, separately funded NSF Frontier Center)

NSCL Operations: Goals

- **Operate the NSCL with high user satisfaction and enable world-class research**
  - Meet high user-demand for fast, thermalized and reaccelerated beams
  - Carry out a complex schedule with many short experiments, each with different RIBs while maintaining a beam availability of approximately 90%
  - Treat users as valued customers and enable them to be successful
  - Train next generation of accelerator physicists and engineering staff
- **Develop new capabilities requested by users to maintain world leadership in nuclear science**
  - Support development, fabrication, installation, commissioning and in many cases operation of the newest experimental apparatus
  - Explore new capabilities with existing resources:
    - » Reacceleration of projectile fragments – large demand from users
    - » 100% pure, thermalized beams – higher ReA3 intensities and new decay studies become possible
    - » Prototype harvesting of longer-lived isotopes – new opportunities
  - Upgrade ReA3 energy as desired by users with new resources

NSCL Operational Overview

- During the previous 10 year period up to present, the CCF operated ≈ 4500 hours/year with ≈ 90% availability as required to support the scientific program defined by the Program Advisory Committee. [ISO-9001 certified annually]
- The FY16 scientific program continued at this level:
  - (second) GRETINA program with fast-beams and S800 spectrometer underway
  - ReA3 program started with RIB experiments on all three beam lines with a few stable beams for reference rxn's and calibration.



>1000 RIBs produced

> 900 RIBs used in experiments

> 25 RIBs thermalized

(of 19 different chemical elements)

NSCL PAC Statistics

Highly Oversubscribed with Dramatic Shift in Experimental Program

Program Advisory Committee reviews proposals, recommends the program:

PAC 37: 19 approved [May/2012, Δt = ~1 yr] 19/31 proposals or 2861 / 4741 hours
- 0 using reaccelerated beams … ReA3 partial commissioning …
- 0 thermalized beams … LEBIT recommissioned, BECOLA commissioned…
- 19 fast beams (11 GRETINA, completion of first campaign)

PAC 38: 30 approved [Apr/2014, Δt = ~2 yr] 30/48 proposals or 4246 / 8119 hours
- 6 using reaccelerated beams … ReA3 complete but EBIT failed …
- 4 thermalized beams
- 20 fast beams (4 SeGA converted to GRETINA, second campaign)

PAC 39: 26 approved [May/2015, Δt = ~1 yr] 26/48 proposals or 3885 / 8277 hours
- 5 using reaccelerated beams … EBIT returned, ReA3 program started …
- 5 thermalized beams
- 16 fast beams (11 GRETINA, second campaign)

PAC 40: 19 approved [April/2016, Δt = ~1 yr] 19/44 proposals or 2744 / 7515 hours
- 2 using reaccelerated beams … ReA3 program underway …
- 3 thermalized beams
- 14 fast beams (8 GRETINA, second campaign)

Backlog at the end of FY16 Operations (now) is 8109 hrs.

FY-16 Scheduled Operation with Two Accelerators

October 1, 2015 – July 23, 2016

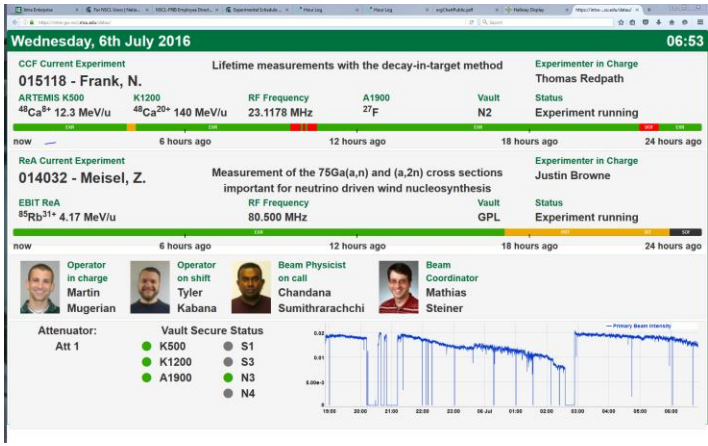
The NSCL carried out a user program with *scheduled* operations of the CCF and ReA3 for the first time.

Total Operating Hours: 4727 hours [8760 hrs in a year, → 54% of the year]

Of which 3900 hrs for 23 PAC approved experiments

15 CCF-only RIB experiments (11 with GRETINA),
3 stable beam experiments (216 hrs total)
5 CCF-ReA3 coupled RIB experiments

Plus 8 ReA3 stable beam experiments, (356 hrs total)
Plus Exotic Beam Summer School run with CCF



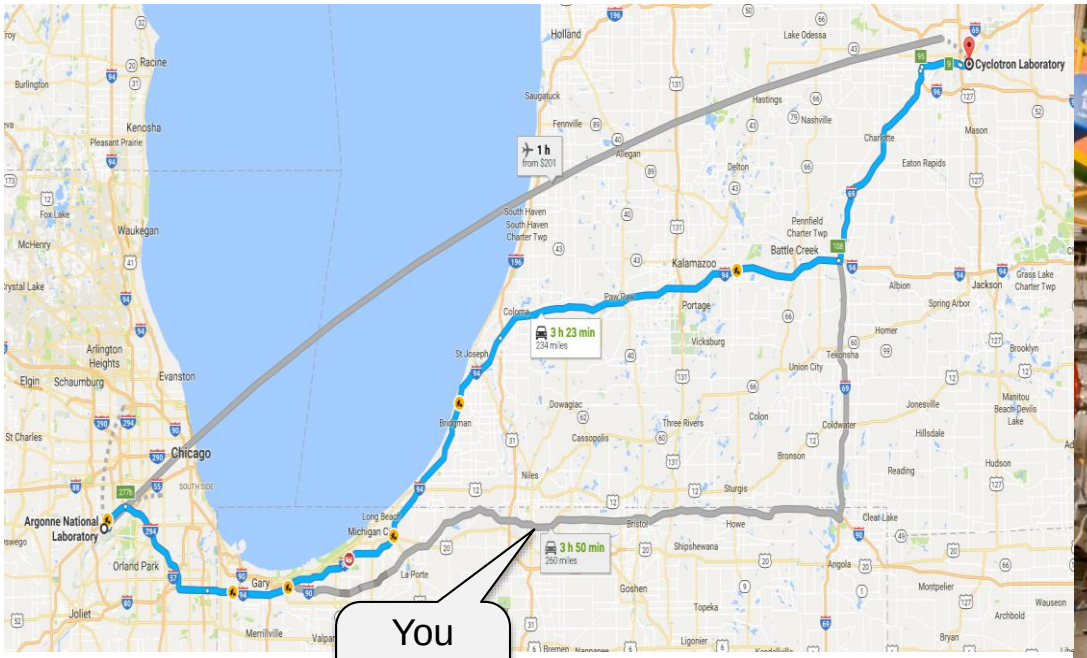
Two significant repairs:

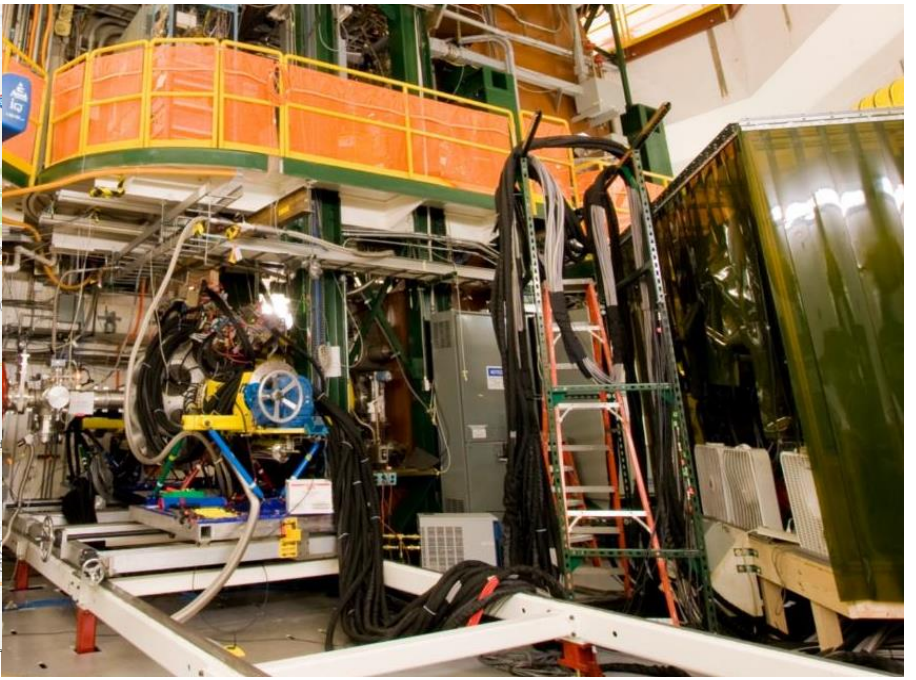
- A dipole magnet power supply problem damaged the coil in one of the large A1900 dipole magnets in November – replaced with space coil-package
- A water leak inside the ReA3 RFQ in May – found, repaired during shutdown

GRETINA with S800 spectrograph

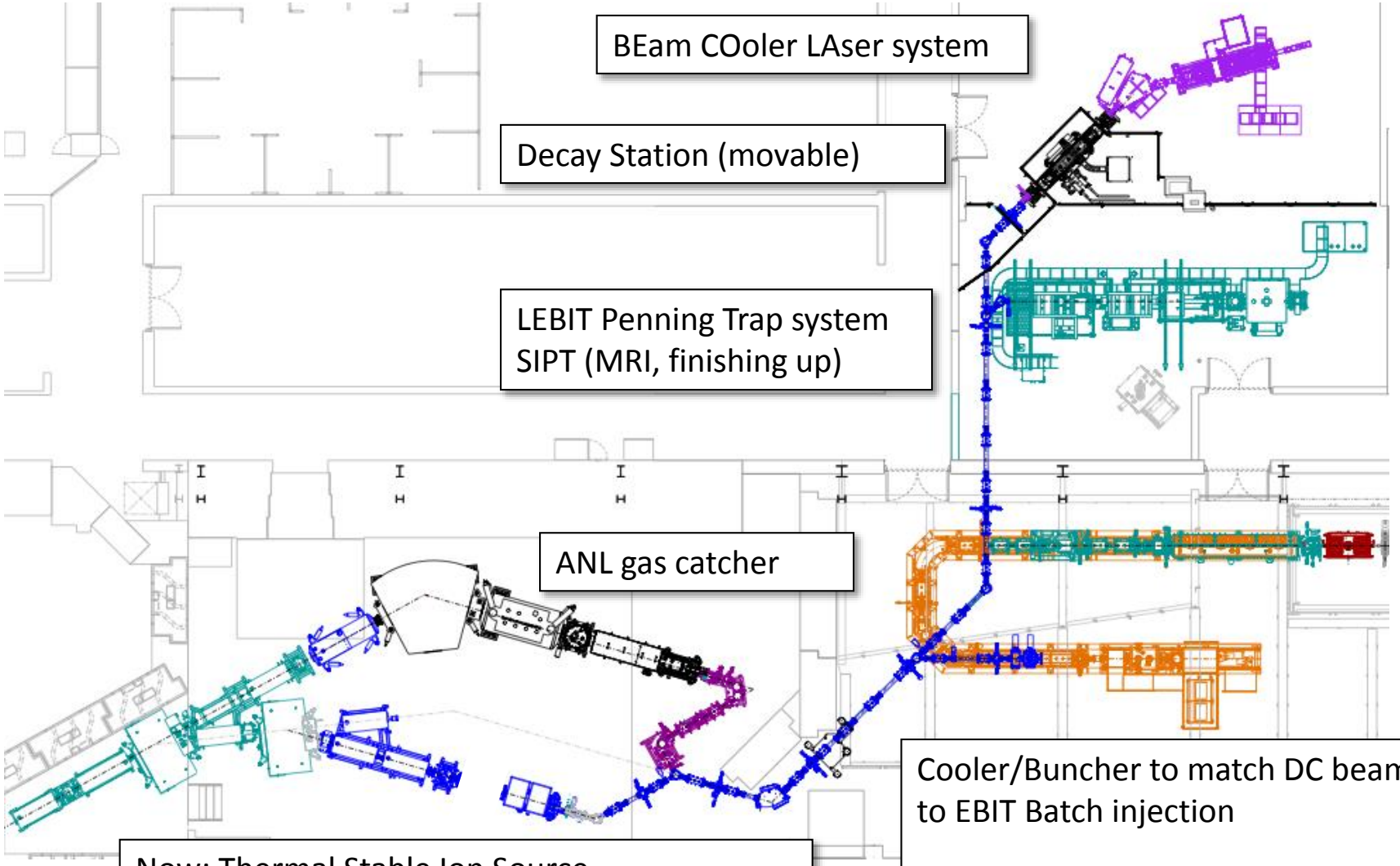
http://gretina.lbl.gov/publications

- June 2012 – July 2013, 24 experiments (20 pubs, 2 in-press, more submitted)
  (followed by sojourn to Argonne National Lab)
- July 2015 – June 2017 for a campaign with 23 PAC-approved experiments
- We plan to complete the second GRETINA NSCL campaign in FY17
- Note: GRETINA is expected to return to the NSCL in 2019

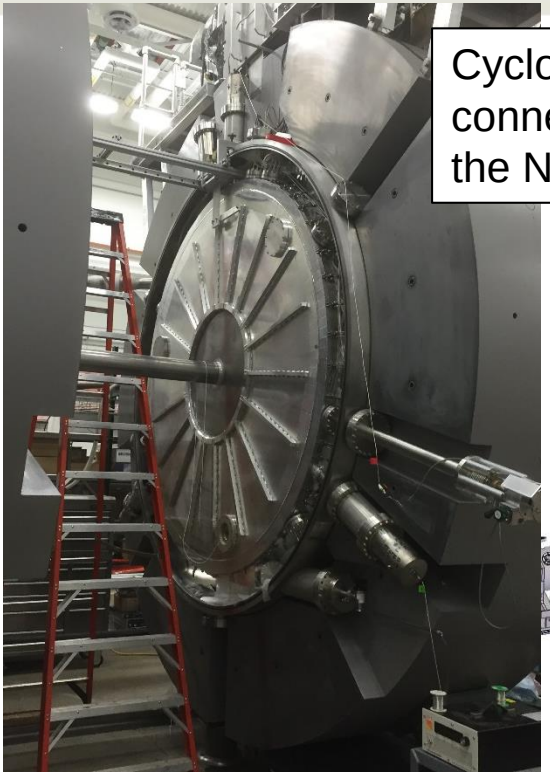




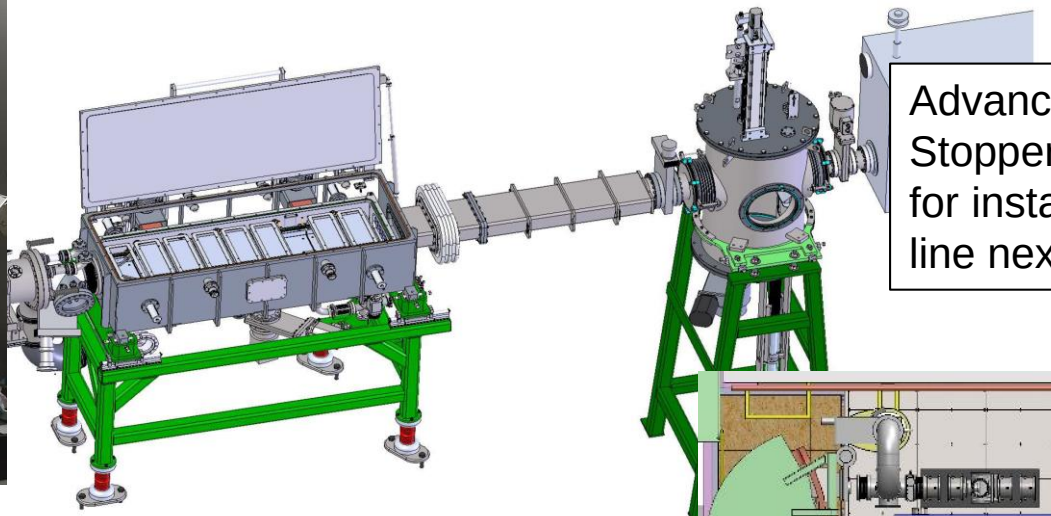
Present Low-energy Beam Area for ReA and Precision Experiments



Devices for More Intense Thermalized Beams with three different MRI's



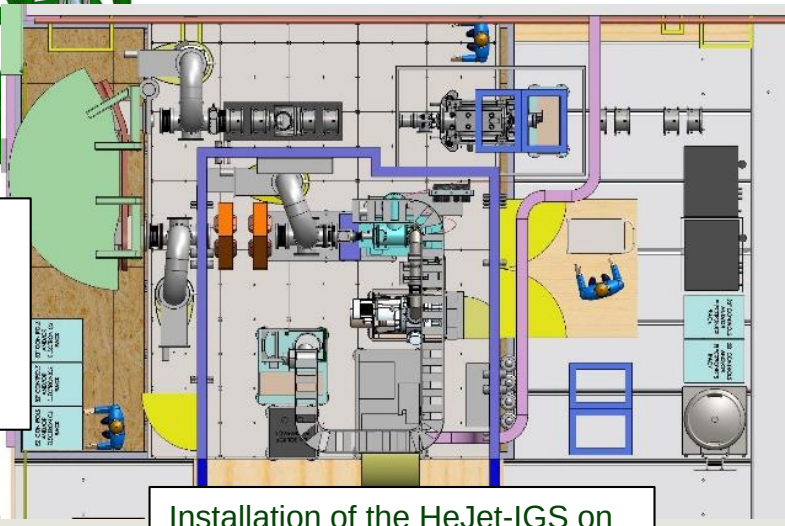
Cyclotron-stopper is essentially complete, being tested but not connected to beam line. We are developing plans for installation in the N2 vault so as not to interrupt the ongoing low-energy program.



Advanced Cryogenic Gas Stopper is being fabricated for installation on a second line next to ANL gas catcher.

Helium-Jet Ion Source was constructed/tested at ORNL by ORNL, UNIRIB, Center for Radioactive Ion Beams for Stewardship Science at Rutgers University, NSCL

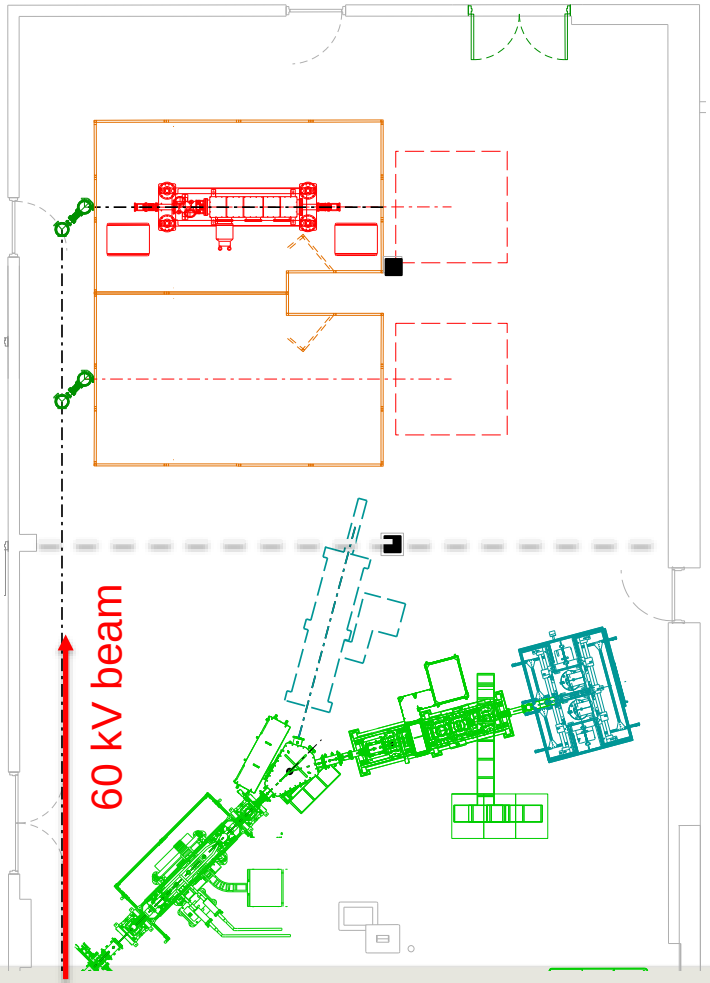
Implementation at NSCL is supported through an NSF-MRI

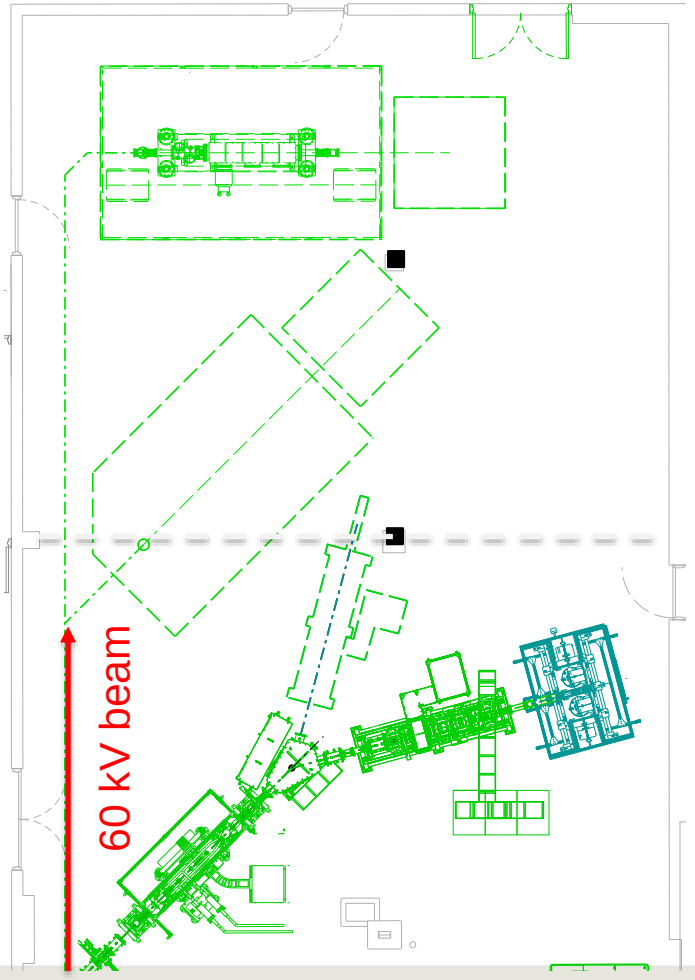


Installation of the HeJet-IGS on N1 vault roof – started (top view)

Expanding Low-energy Beam Area
two options for new beam lines

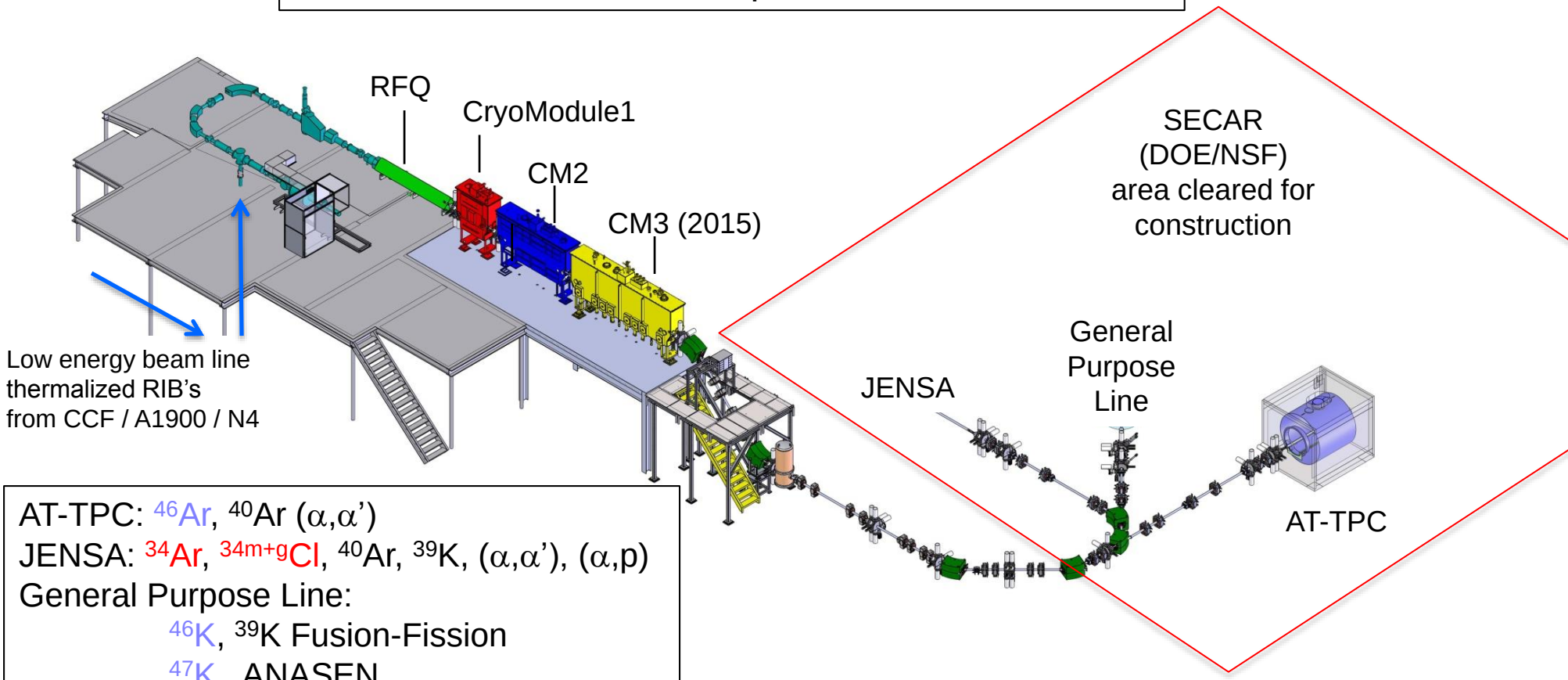
Office space will be vacated to provide space for two new beam lines – asking for input on layout … two possible options





Re-Accelerator Facility: State-Of-The-Art RIB Post-Accelerator fully commissioned and running in FY16

ReA3 Accelerator and Experimental Hall – FY16

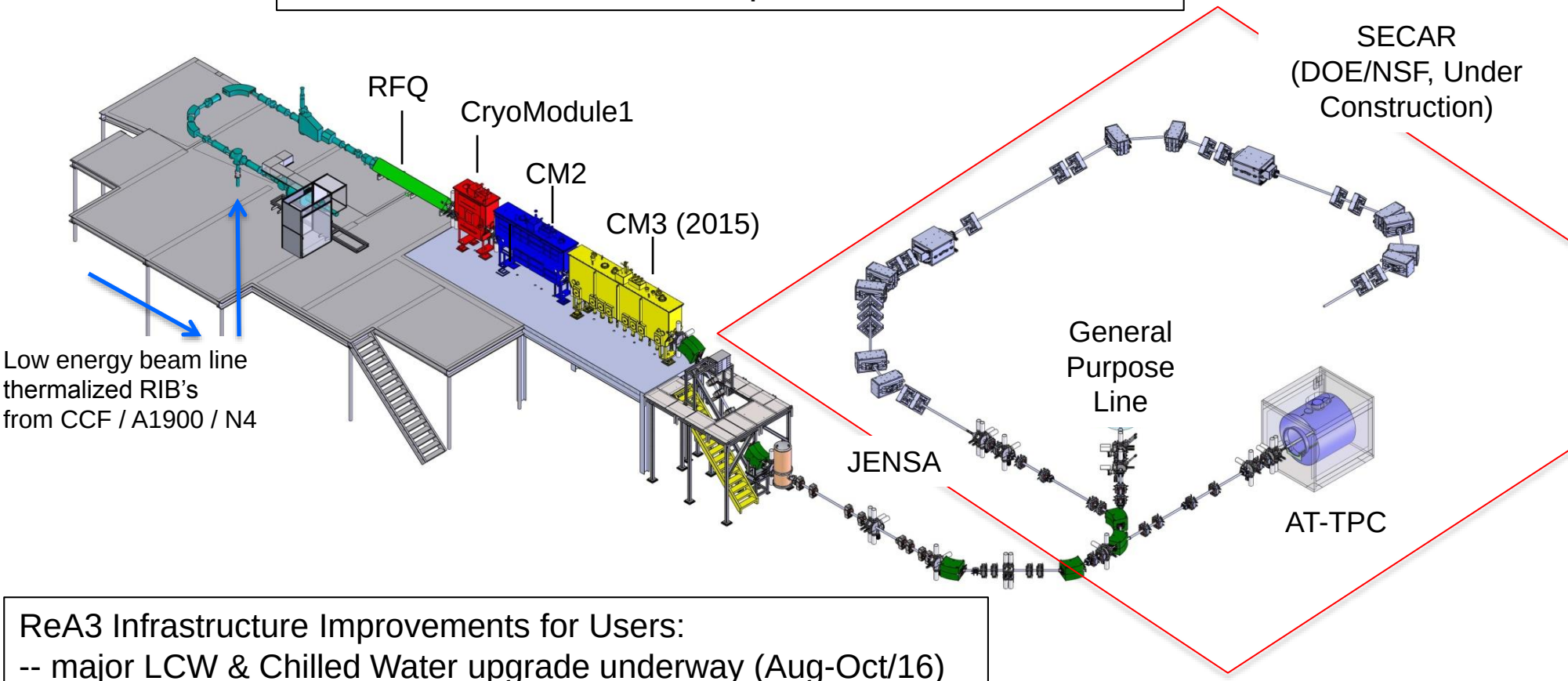


AT-TPC: ^{46}Ar, ^{40}Ar (α,α')
JENSA: ^{34}Ar, $^{34m+g}$Cl, ^{40}Ar, ^{39}K, (α,α'), (α,p)
General Purpose Line:
^{46}K, ^{39}K Fusion-Fission
^{47}K, ANASEN
^{75}Ga, ^{85}Rb, NERO, (α,n)
All with significant effort to stretch the time structure of EBIT extraction pulse

A. Villari, ReA3 Dept. Head

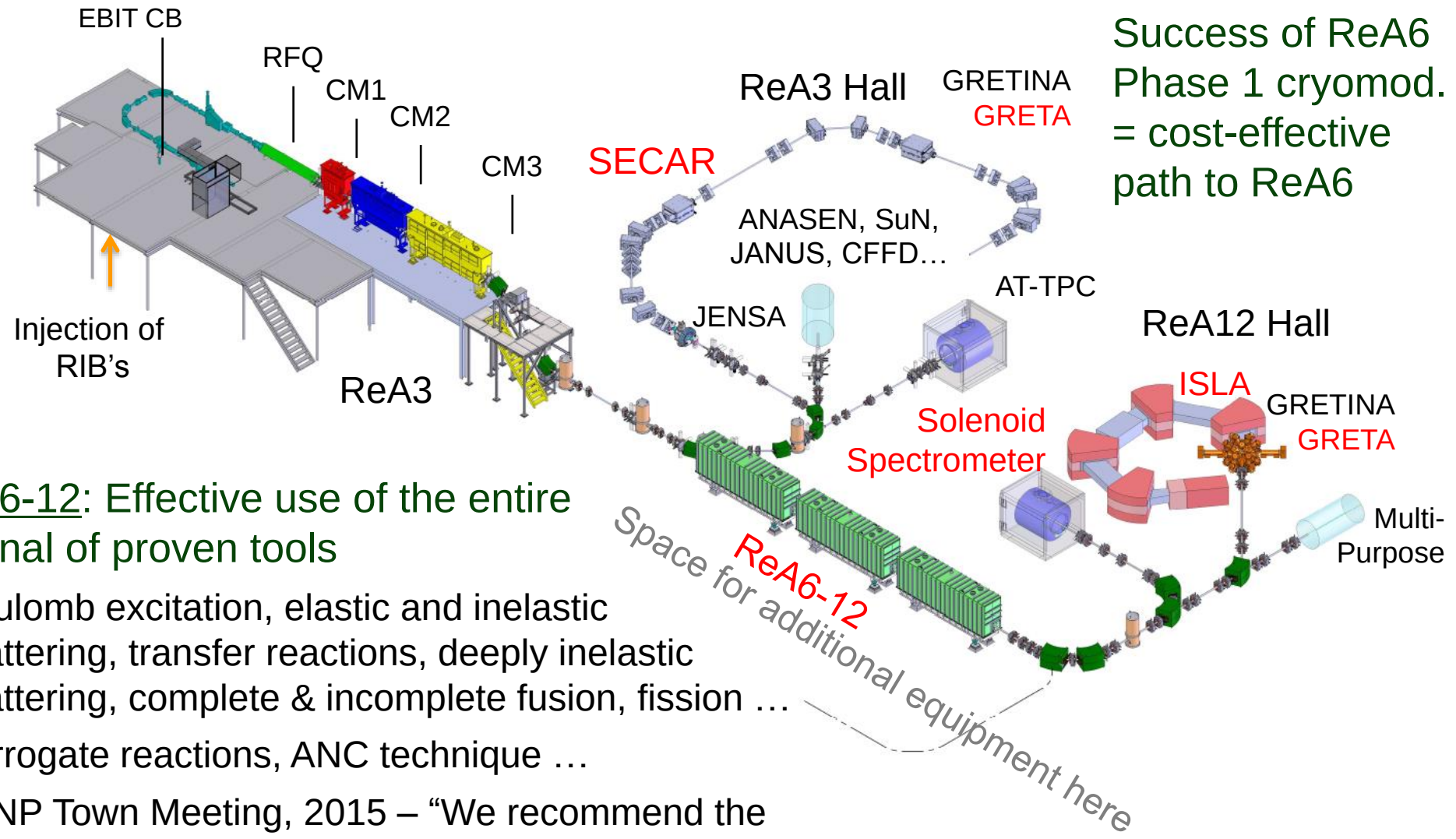
ReA3 Hall Construction

ReA3 Accelerator and Experimental Hall – FY18



ReA3 Infrastructure Improvements for Users:
-- major LCW & Chilled Water upgrade underway (Aug-Oct/16)
-- installed second-story deck (May/16)
-- cleared ReA3 of temporary experimental setups

ReA6-12: Significant Scientific Opportunity Whitepaper Finished !



Success of ReA6 Phase 1 cryomod. = cost-effective path to ReA6

ReA6-12: Effective use of the entire arsenal of proven tools

- Coulomb excitation, elastic and inelastic scattering, transfer reactions, deeply inelastic scattering, complete & incomplete fusion, fission …
- Surrogate reactions, ANC technique …
- LENP Town Meeting, 2015 – "We recommend the construction of ReA12 in a timely manner"

Major Facility Developments

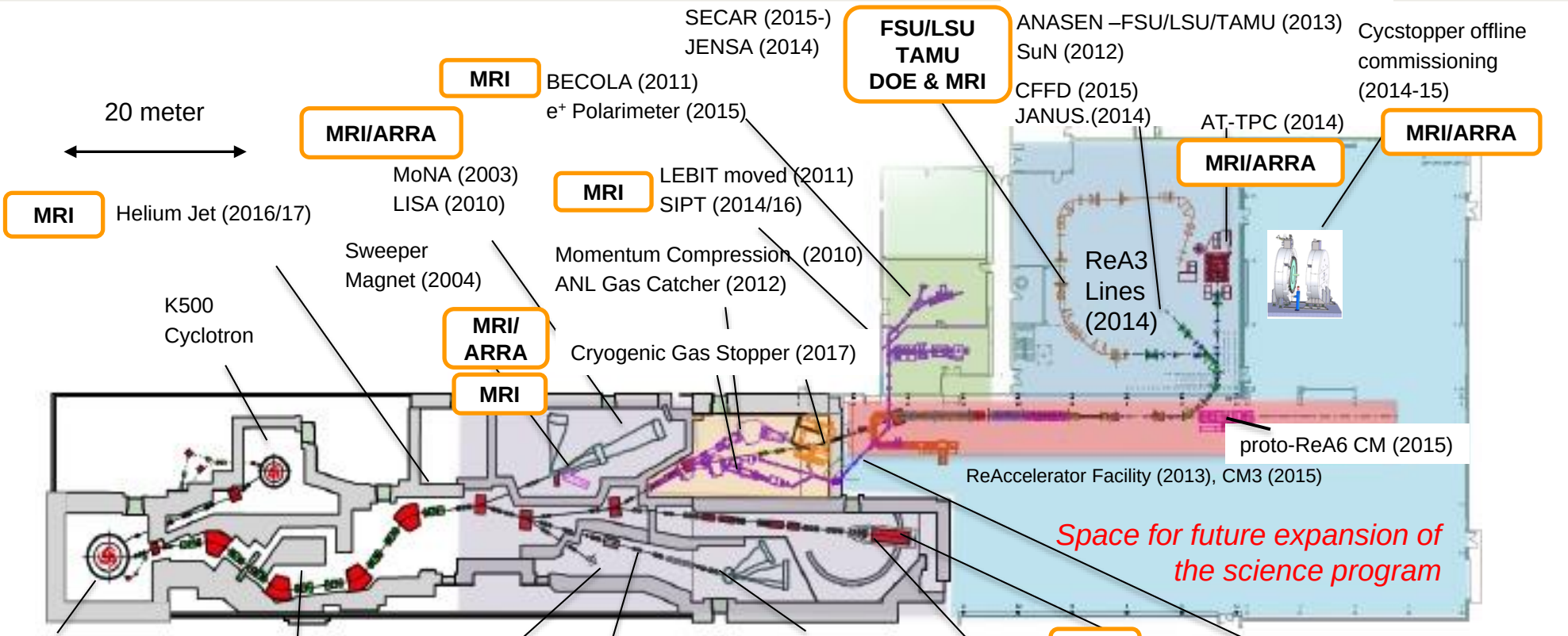
- Facility Improvements:
  - Expanded low-energy beam area
    - » Requesting input on layout (djm)
  - High Energy Beamlines, near future
    - » Replace problematic magnets in beamline (I184, G147 quadrupole doublets)
    - » Repair coil for A1900 dipoles to create new spare
  - Heavy-ion ion source for ReA3 calibration beams
    - » Small EBIT under consideration for calibration, etc., input from users on beams and intensities desired (Villari)
- MRI Projects:
  - SIPT single-ion Penning Trap (testing phase)
  - ACGS next generation beam thermalization device (fabrication phase)
  - Cyclotron Stopper (off-line testing), developing plan for N2 installation
  - He-jet on-line harvesting system (installation)
- Input from the user community on these initiatives and other priorities are welcome and needed (Sherrill, Berryman)

Summary of NSCL Report

- Operation of about 4,500 hours per year with 90% availability
- 5 more years of operation
- ReA3 now operational and various experiments completed
- A number of facility improvements are underway
- Upgrade of ReA energy is an important goal

NSCL Facility Layout

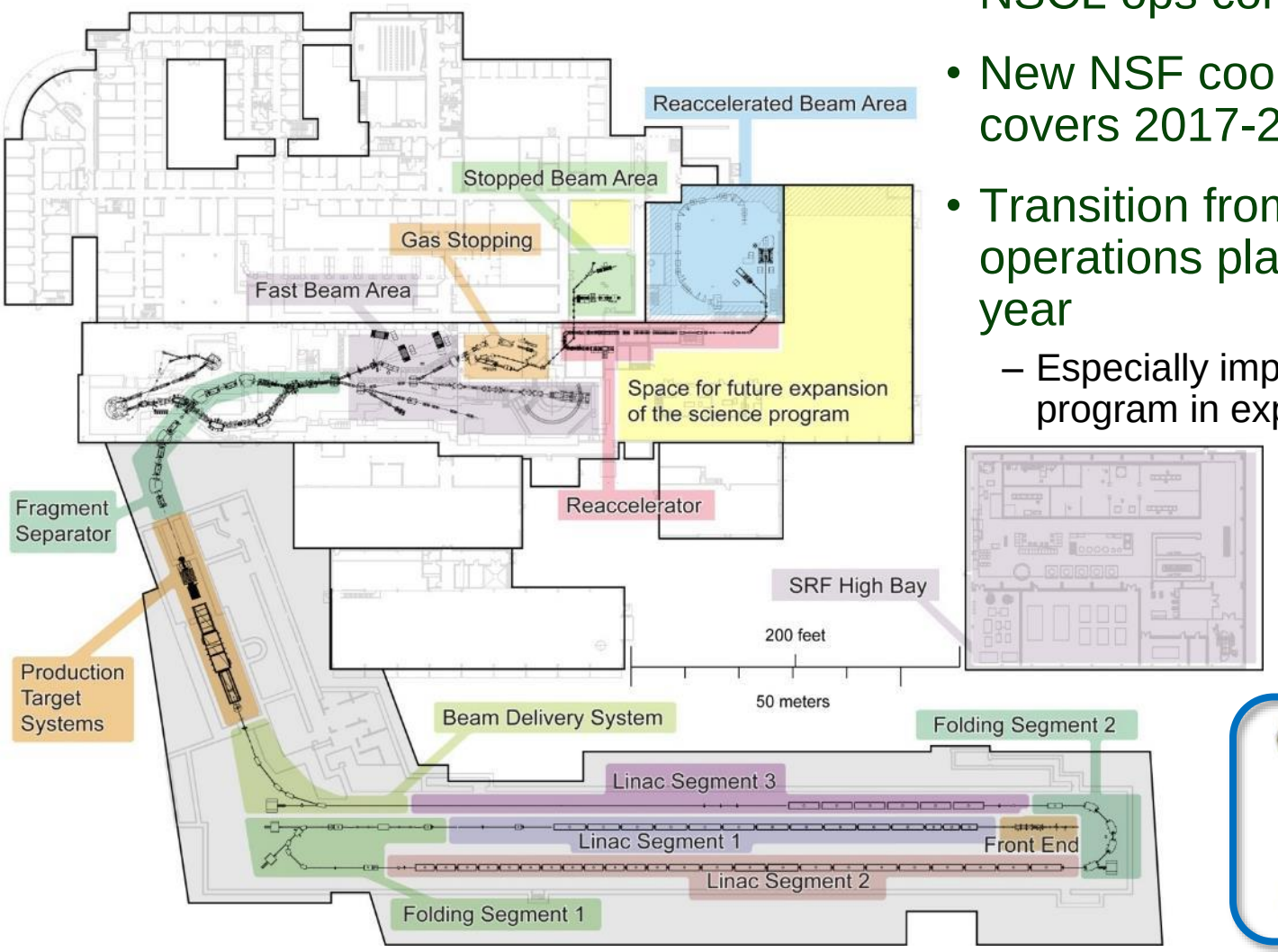
Developments and equipment enable forefront science now
Investments have long-term value for FRIB



Development of multi-user capability – NSF MRI for He-Jet

NSCL-FRIB Integration Plan

Minimal disruption of world-leading science and education program



- NSCL ops complete by end of 2021
- New NSF cooperative agreement covers 2017-2021
- Transition from CCF to FRIB operations planned for less than a year
  - Especially important for graduate program in experimental nuclear science

Plan enables continued world-class science continues for LE Community