

# Holifield Radioactive Ion Beam Facility (HRIBF) Budget Impact

B. Alan Tatum

DOE/NSF Nuclear Science  
Advisory Committee Meeting

North Bethesda, MD

February 26, 2010

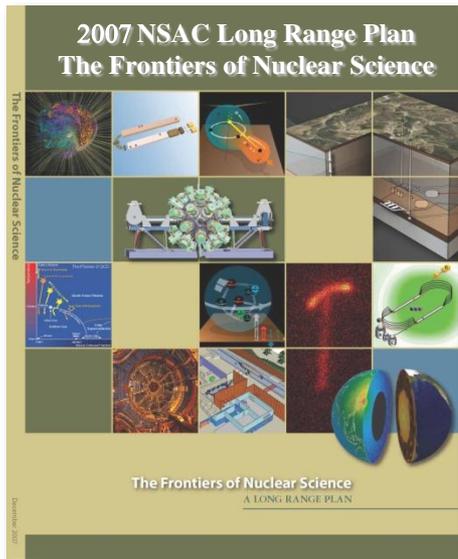
A photograph of the Holifield Radioactive Ion Beam Facility (HRIBF) building, a tall, cylindrical structure with a red brick base, situated on a grassy area near a body of water under a blue sky with clouds.

*HRIBF*

# HRIBF

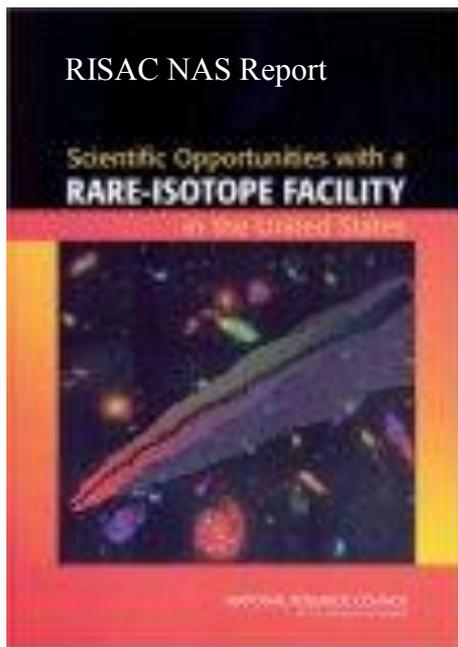
- Produces high-quality post-accelerated beams of unstable nuclei
  - Radioactive ion beams (RIBs)
- We are a DOE-NP funded national user facility for RIB science
  - Developed out of existing accelerator complex [low incremental cost, <\$4M] 1993-1996
  - Users group has 570 members
  - Research programs in two primary areas
    - Nuclear structure & reactions
    - Nuclear astrophysics
  - Operates on a 5 day, 24 hour schedule
    - 4000 to 4500 total hours per year
- Only facility of its type in the U.S.
- Has capabilities that are unique worldwide
- Helping to develop ISOL RIB science
  - Pioneering techniques, developing technology
  - Helping to develop, maintain a user base for a next-generation facility





# Mission / Scientific Direction

- Deliver high-quality RIBs for studies of nuclei far from stability
- Do outstanding, high-impact science aligned with the NSAC Long Range Plan
  - Support and nurture our user community
  - Provide world-class research tools
  - Develop new techniques and tools
- Focal research areas:
  - Nuclear Structure
    - Probing the disappearance of shells
    - Evolution of collective motion
    - Neutron skins
    - Superheavy elements
  - Nuclear Astrophysics
    - Origin of elements
    - Mechanisms of stellar explosions
  - Applications
- Develop new beams and continually improve beam quality
- Develop techniques/technology to advance RIB science in the U.S.
- Operate the facility in a safe, efficient, cost-effective manner



# Recent Science Highlights

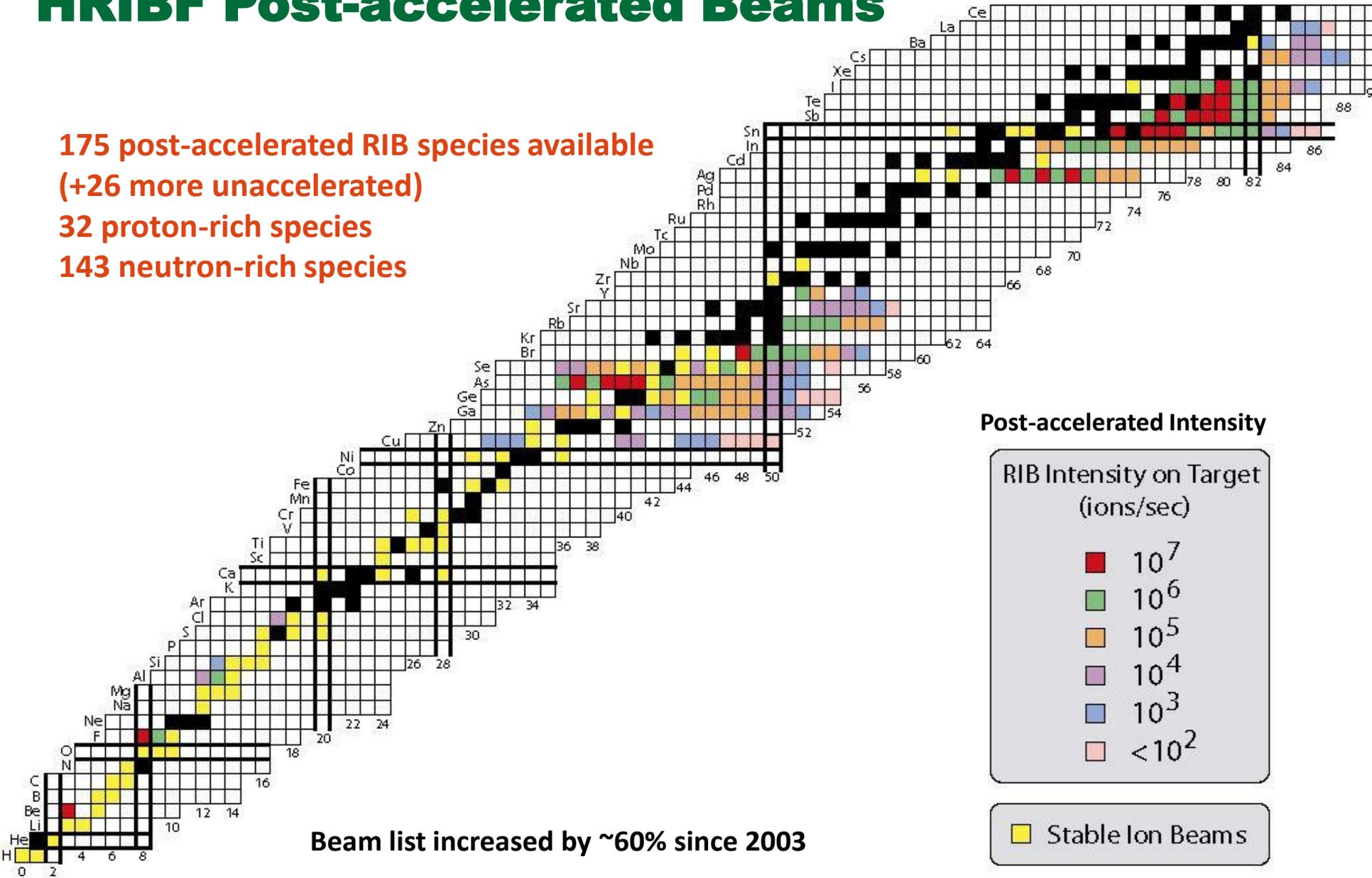
- First constraint on very low temperature  $^{18}\text{F}(p,\alpha)^{15}\text{O}$  reaction rate in Novae
- First  $^{17}\text{F}(p,\gamma)$  measurement for Novae
- Measurements of  $^{26}\text{Al}(p,p)$  and  $^{26}\text{Al}(d,p)$  to help make sense of “ $^{26}\text{Al}$  maps” of the galaxy
- Structural surprises above  $^{100}\text{Sn}$ 
  - Spectroscopy of  $^{101}\text{Sn}$  via  $^{109}\text{Xe}$  sequential double  $\alpha$  decay
- Structure of  $^{133}\text{Sn}$  from  $^{132}\text{Sn}(d,p)$ : magic nature of  $^{132}\text{Sn}$
- Decay spectroscopy of fission fragments near  $N=50$ 
  - Example: beta delayed neutron emission from  $^{77,77,78}\text{Cu}$ ,  $^{83}\text{Ga}$
- $^{10}\text{Be}(d,p)$ : transfer to halo states.
- Resonant scattering of  $^{10}\text{Be}+^4\text{He}$ : study of cluster structure

# HRIBF Post-accelerated Beams

175 post-accelerated RIB species available  
(+26 more unaccelerated)

32 proton-rich species

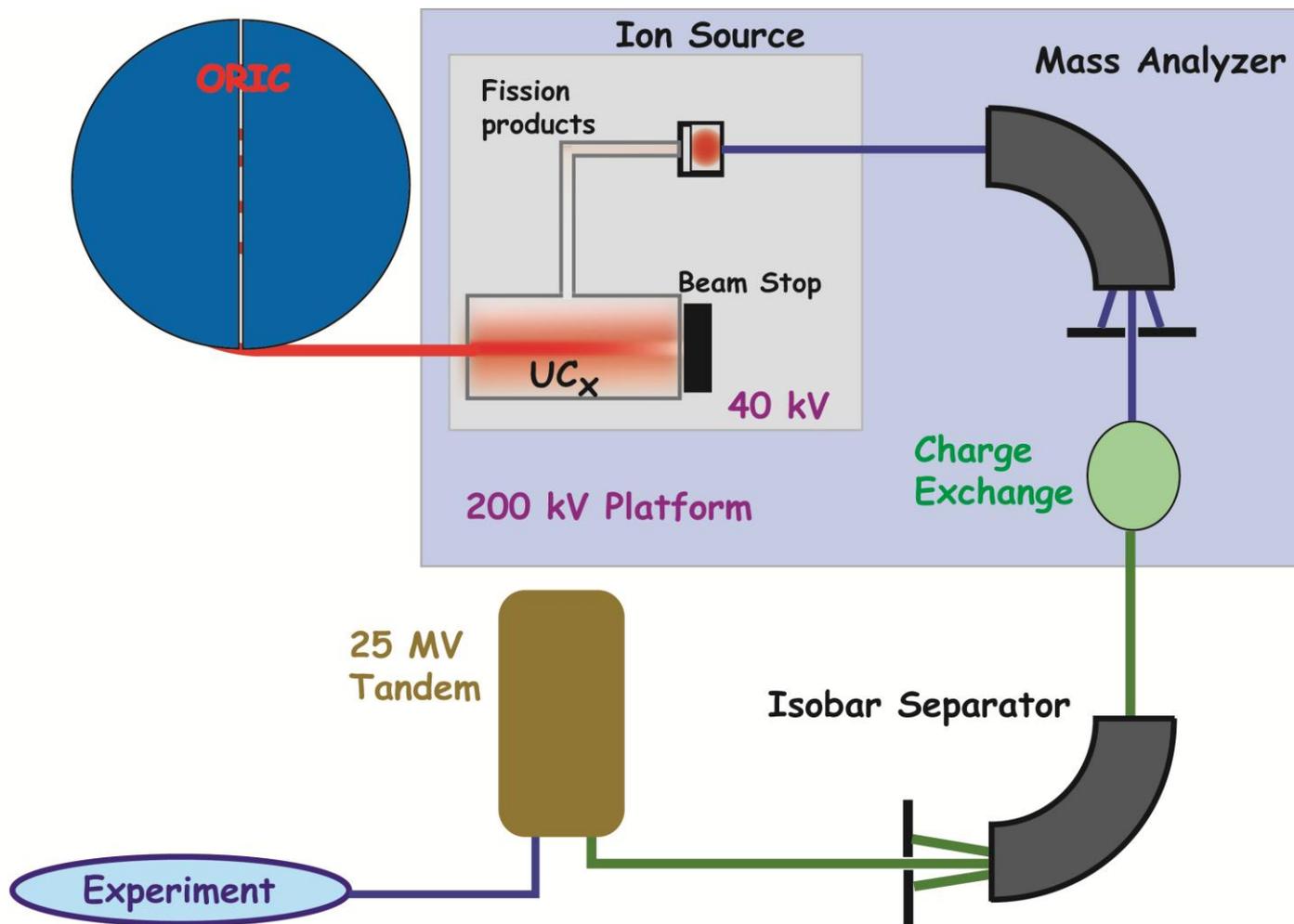
143 neutron-rich species



Beam list increased by ~60% since 2003

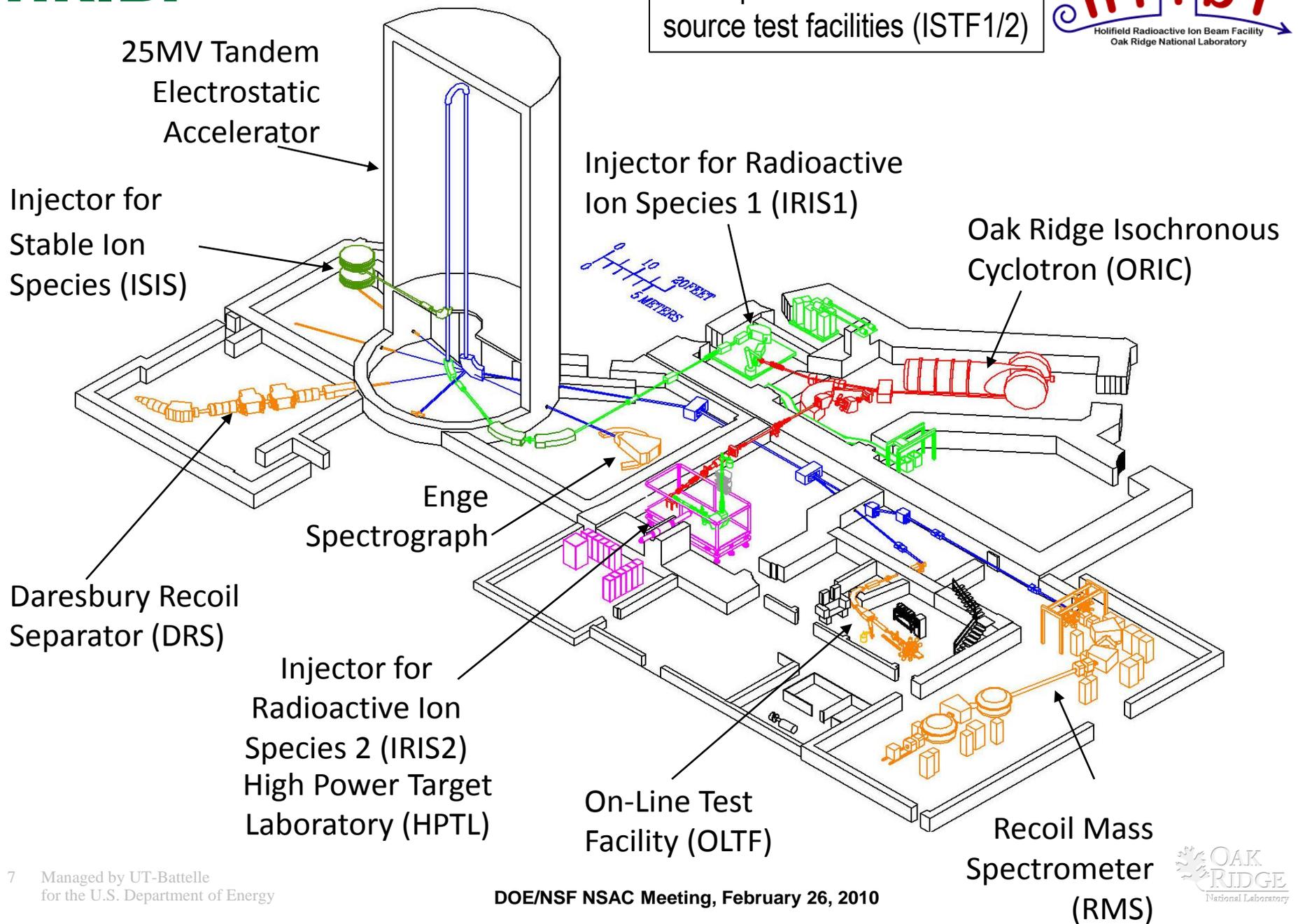
# ISOL RIB Production

## Schematic of ISOL implementation at HRIBF



# HRIBF

Also operate two off-line ion source test facilities (ISTF1/2)



# HRIBF Budget in Recent Years



- **FY06-08 were lean years for the HRIBF operations budget**
  - **FY06 budget down 7.5% from FY05 ( -11% COL adjusted)**
  - **Ops budget did not exceed COL adjusted FY05 budget until FY09**
  - **To offset this decline we had to eliminate temporary staff positions, drastically reduce M&S expenditure, and reduce operation hours**
- **The FY09 budget provided a much-needed 13% increase, but an extended Continuing Resolution (CR) delayed some of the positive impact until FY10**

# FY 2010 and FY 2011 Budgets

- **Increases in FY10 (+8.9%) & FY11 (+4% proposed) build on the positive FY09 budget**
  - **New hires**
    - Two accelerator operators in FY10 → 7 day operation enabled
    - A badly needed control-system software engineer to be hired late FY10
    - Addition of an ISOL postdoc in FY10
    - A mechanical engineer to be hired in early FY11
  - **Alleviate spare parts shortage**
  - **Increase operating hours**
- **Current operation is “campaign mode” with a nominal 5-day, 24 hour schedule, although we can run for ~10-12 days straight to avoid interrupting a working experiment.**
- **These budgets help us to achieve an important facility goal: transition to 7-day operation**
  - **Improve efficiency**
  - **Improve reliability**
  - **Increase hours**

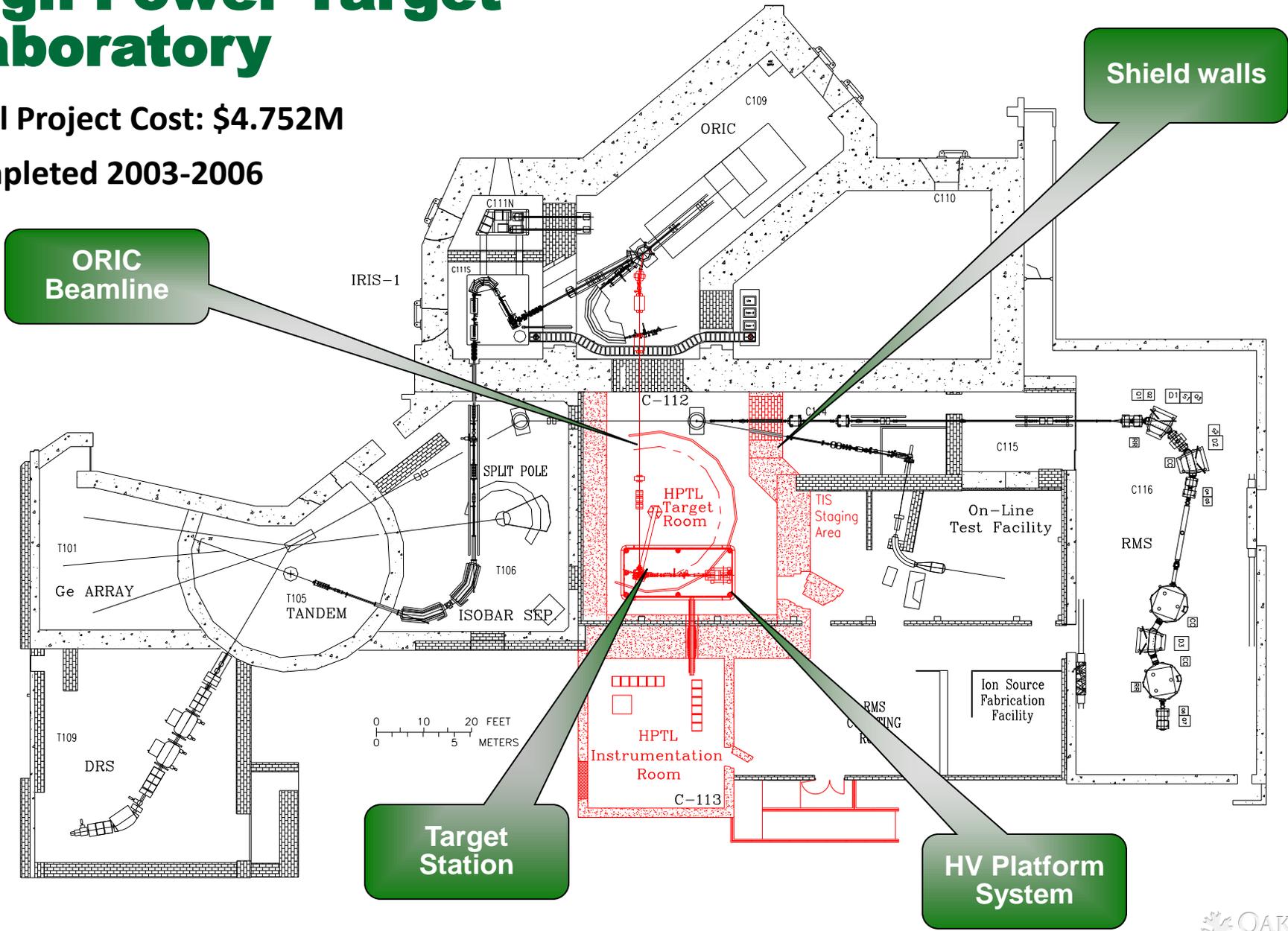
# HRIBF Project Funding

- Because HRIBF was developed at low cost with existing accelerators and research infrastructure, weaknesses were evident, and an upgrade plan was established early-on.
- In spite of some difficult budget years, DOE-NP funded the first two major upgrade projects in that plan, significantly expanding the capabilities of our facility.
- These projects, funded with AIP above base allocation are:
  - High Power Target Laboratory (HPTL): a venue for testing ISOL targets, ion sources, and beam production and purification techniques using high power ORIC beams
  - Injector for Radioactive Ion Species2 (IRIS2): a second RIB production station, co-located with HPTL, which provides much-needed redundancy and the ability to rapidly switch between RIB campaigns

# High Power Target Laboratory

Total Project Cost: \$4.752M

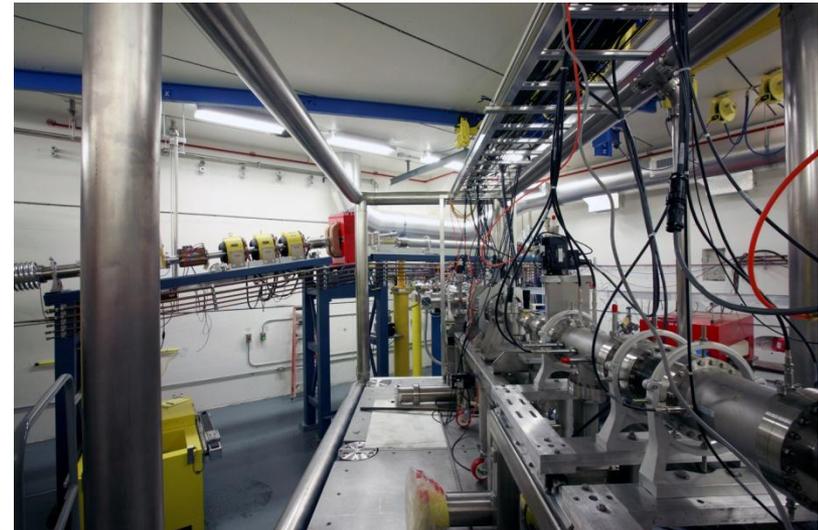
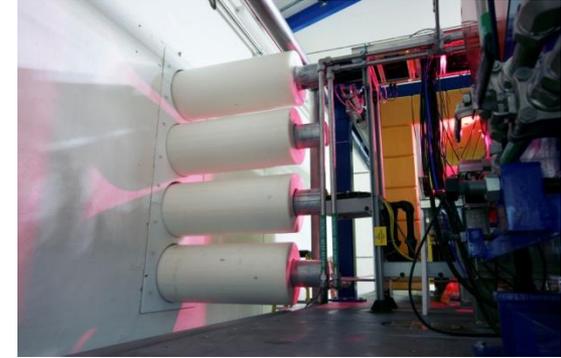
Completed 2003-2006



# Injector for Radioactive Ion Species 2 (IRIS2)

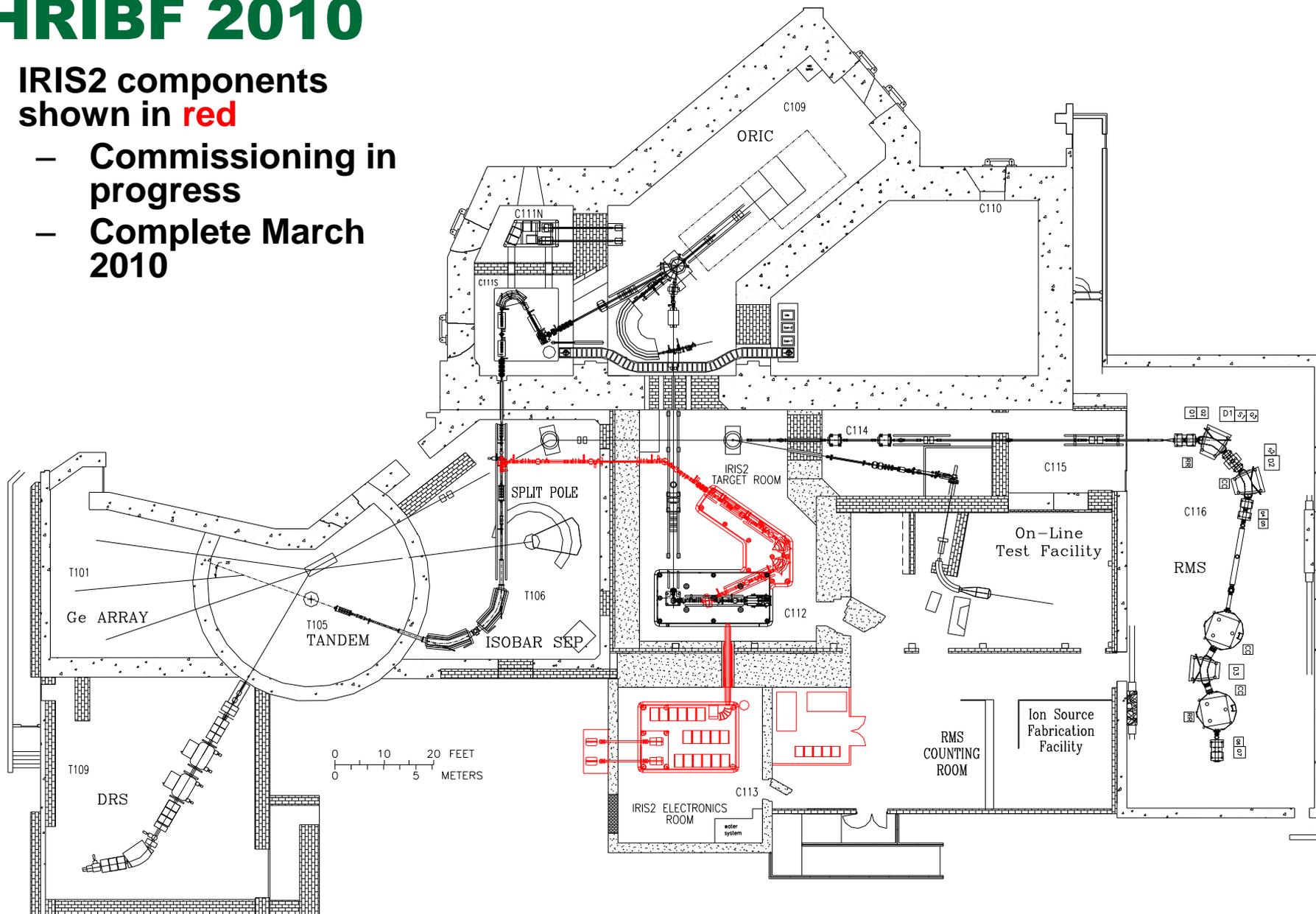
Total Project Cost: \$4.735M. Will be completed in March 2010.

- Fully functional second RIB production station for HRIBF.
- Duplicates all capabilities of IRIS1, thus providing needed redundancy that will substantially improve facility reliability and efficiency.
- Will increase the number, intensity, and quality of RIB beams and increase the number of beam hours on target.
- Provides new capabilities unavailable at IRIS1 (laser ion sources, laser ion beam purification, beam cooling, etc...).



# HRIBF 2010

- IRIS2 components shown in red
  - Commissioning in progress
  - Complete March 2010



# ORNL-Funded Utilities Infrastructure Improvements

During the same time period, ORNL has also provided funding to modernize the utilities infrastructure.

ORNL-funded projects (~\$5M total investment):

- Replacement of the HRIBF wooden cooling tower (circa 1960) with a higher capacity unit (completed 12/09)
- Replacement of substation breakers to improve reliability, ensure safety, and increase maintainability (90% complete)
- Variable frequency drives (VFDs) have been purchased for cooling water pumps to improve energy efficiency (received, install in FY10)

These enhancements will improve safety and reliability, reduce maintenance costs, and increase capacity for future expansion (cooling tower).



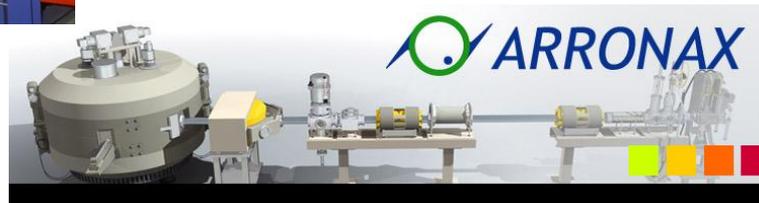
# Driver Accelerator Upgrade Proposal

- Replace the 50-year-old ORIC with a commercial cyclotron such as the IBA Cyclone 70 (C70), the first of which is being commissioned at ARRONAX in Nantes, FR
  - Results in much better facility performance than any ORIC improvement.
    - Large increase in RIB production rates - greater physics reach
    - Much improved reliability
    - Significantly lower operating cost
  - Offers isotope R&D / production option that is compatible with experimental NP program.
- HRIBF Users Workshop (Nov. 2009, 150 attendees) developed the science case

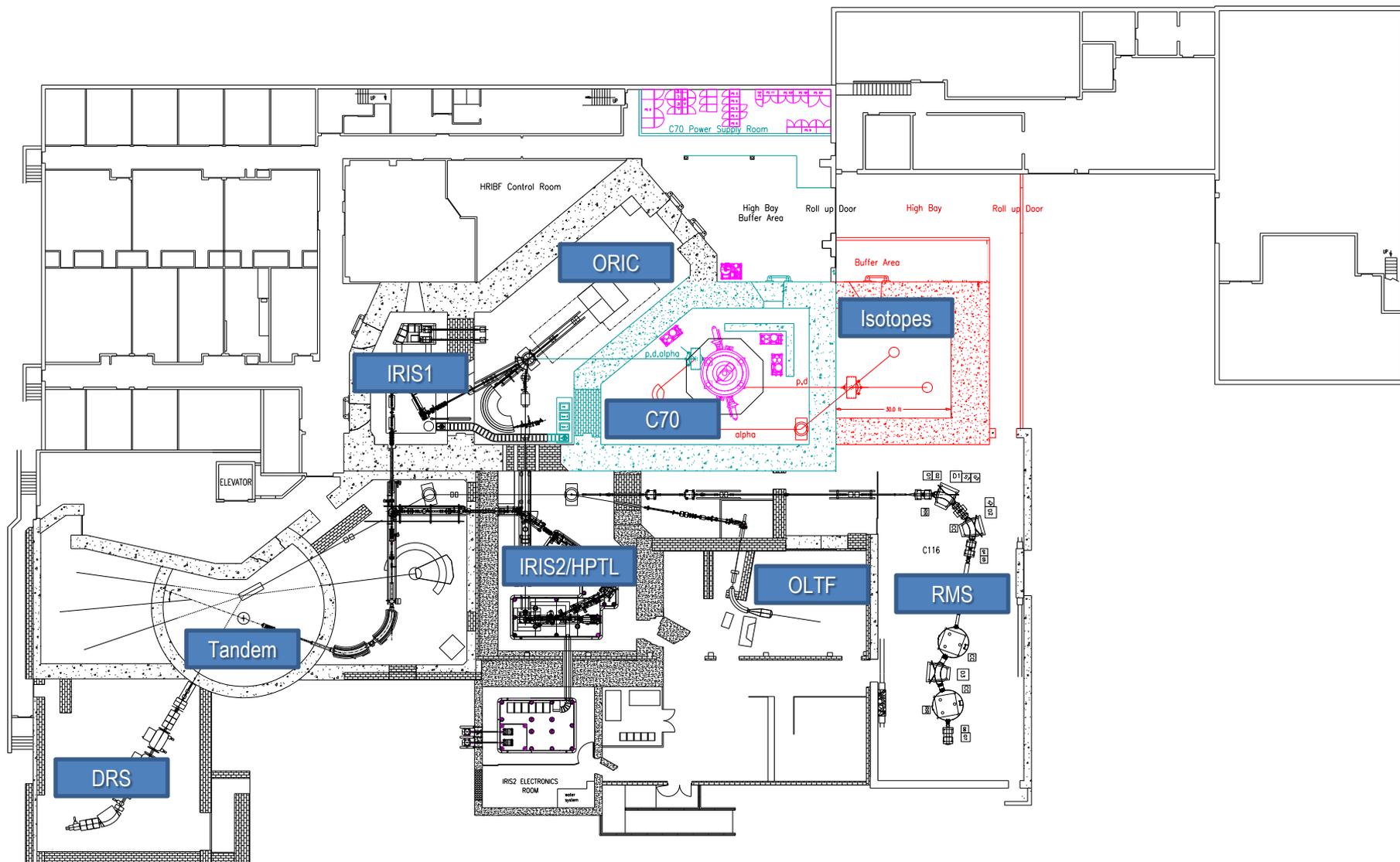


ORIC

iba  
C70



# Integrating the C70 into HRIBF



# Base Capital Equipment and AIP Funds

- Our base Capital Equipment funding is around \$1.5M per year, equally divided between accelerator/beam production systems and experimental apparatus. These funds adequately provide for new capabilities and improvements to reliability and operational efficiency.
- Facility examples include laser systems for beam production and purification, modern power supplies, pumps, etc...
- **New Experimental Systems:**
  - LeRIBSS: Low Energy Radioactive Ion Beam Spectroscopy Station
  - ORRUBA: Oak Ridge Rutgers University Barrel Array
  - GRETINA Prep (for arrival in 2012)
- Our base Accelerator Improvement Project (AIP) funds have been ramped up in recent years from \$400k to greater than \$800k which has been extremely beneficial to making incremental improvements to existing accelerator systems.
- In 2009, we also received American Recovery and Reinvestment Act (ARRA) AIP funding in the amount of \$2.5M to expedite reliability improvements to ORIC.



# Summary

- **Although there have been numerous budgetary challenges in recent years, the HRIBF budget has now increased to a level that should allow us to**
  - Continue to perform outstanding science in the pre-FRIB era
  - Increase staffing levels
  - Increase operating hours
  - Improve reliability and efficiency
  - Add new capabilities
- **We are submitting a proposal for a driver accelerator upgrade**
- **We are appreciative of the on-going support of the Office of Nuclear Physics.**



# Bridging the Future to FRIB

