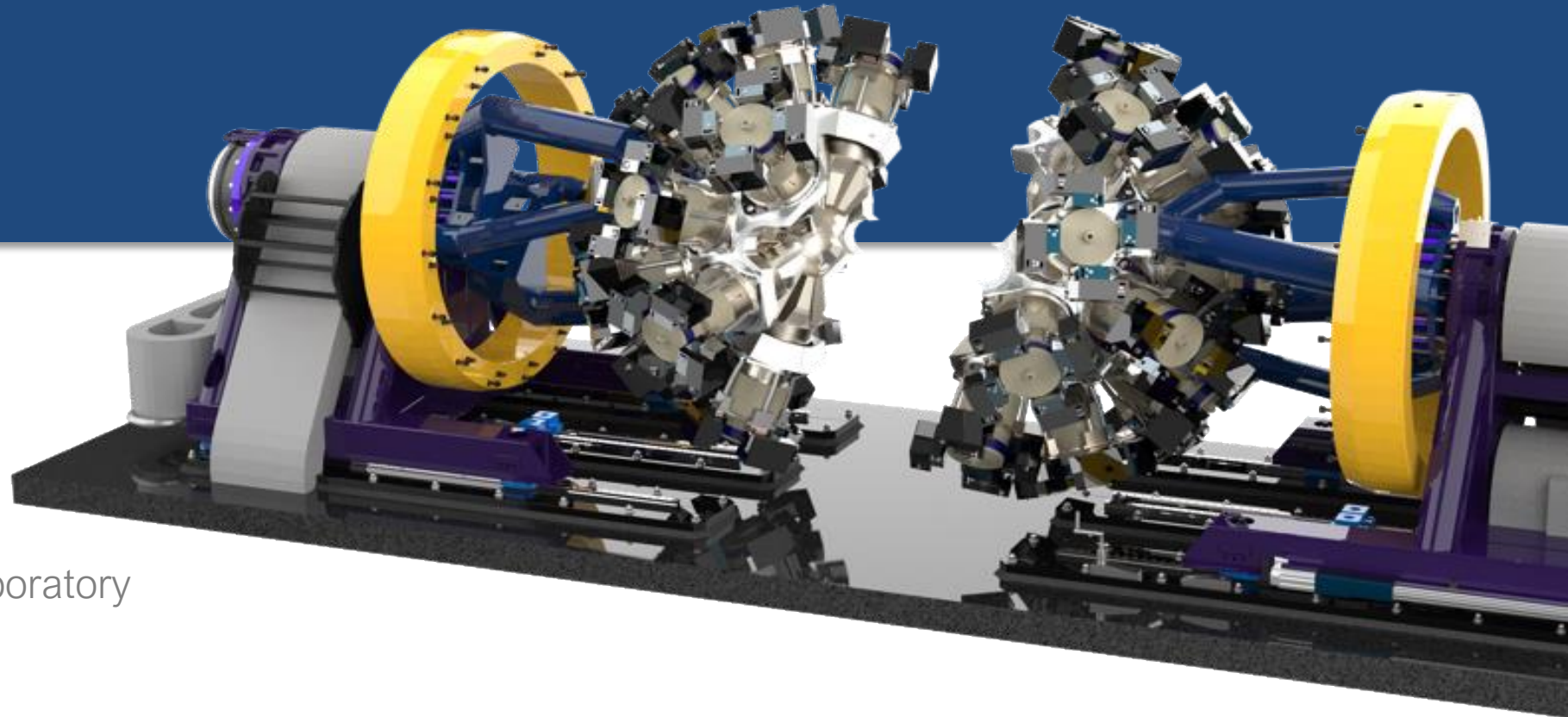


GRETA



Paul Fallon

Project Director

Nuclear Science Division

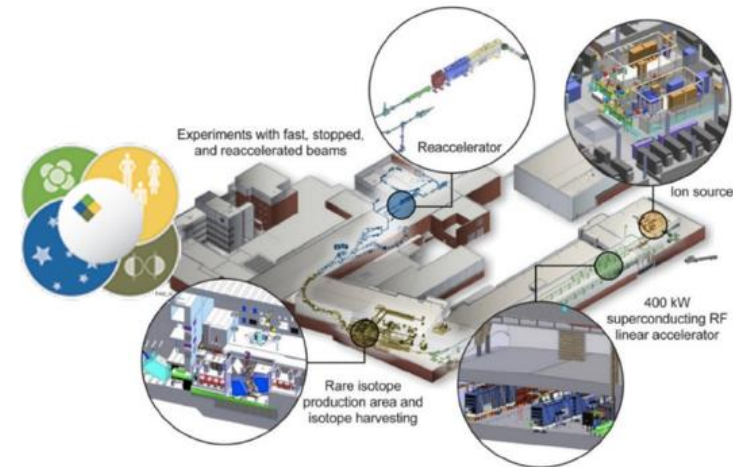
Lawrence Berkeley National Laboratory

GRETA: A premier γ -ray tracking detector for FRIB

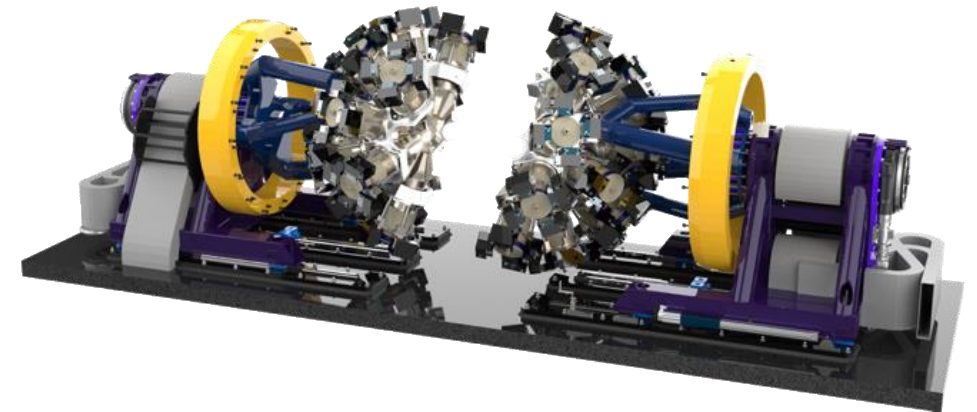
The Facility for Rare Isotope Beams (FRIB) is a world leading accelerator facility to understand the properties of exotic nuclei and how the elements are synthesized.

GRETA will be a key instrument at FRIB capable of reconstructing the energy and three-dimensional position of γ -ray interactions.

Its design provides the performance (combination of full solid angle coverage and high efficiency, excellent energy and position resolution, and good background rejection) needed to carry out a large fraction of the nuclear science programs at FRIB.

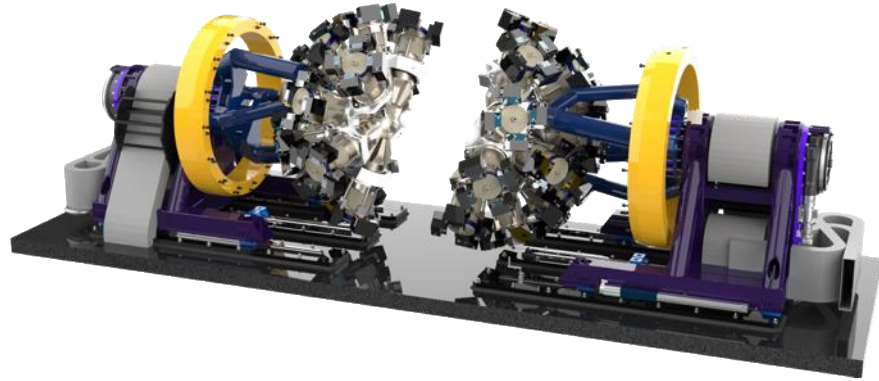


FRIB at Michigan State University



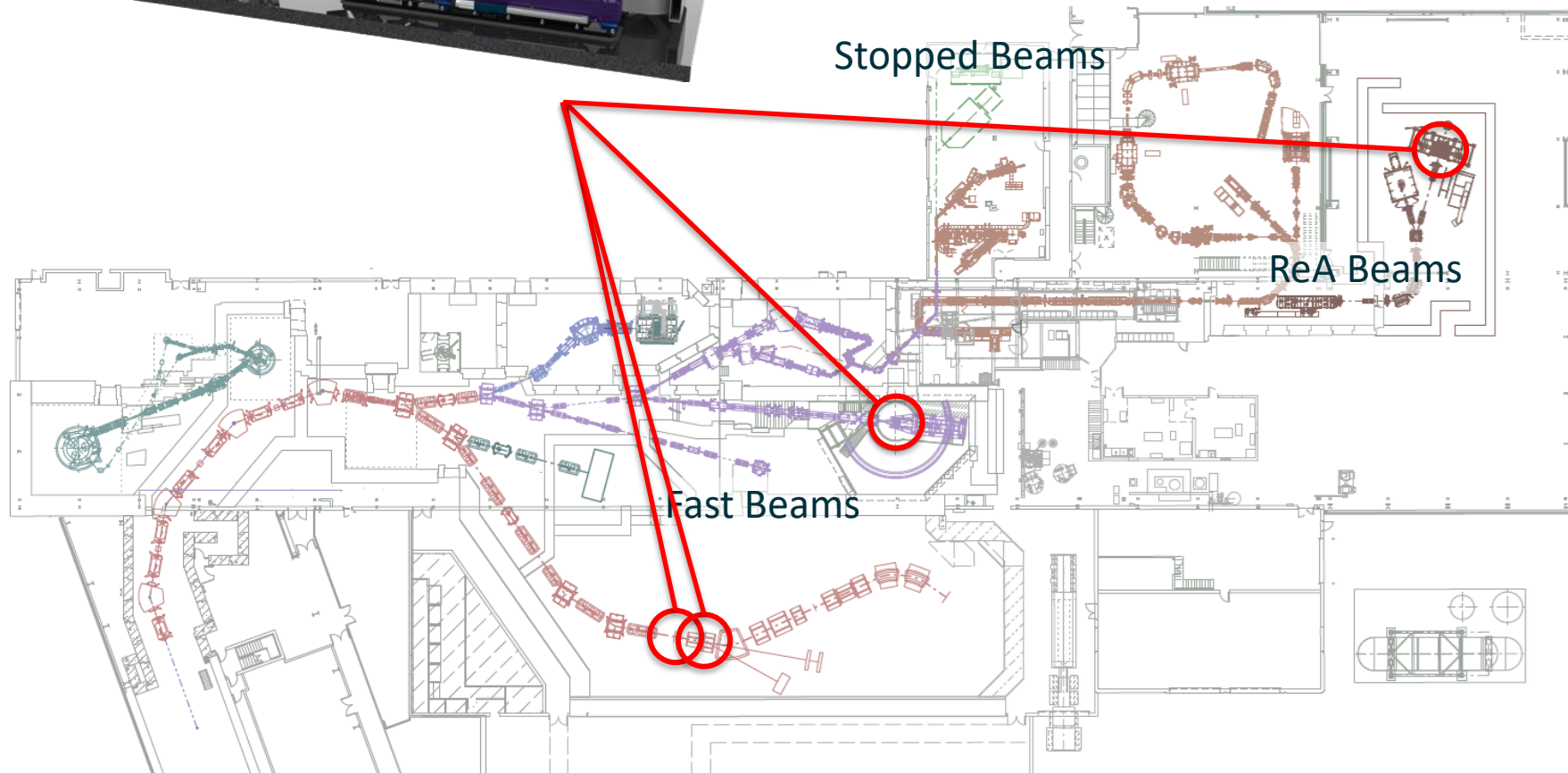
GRETA

Measurements use Fast, Stopped, and Reaccelerated Beams

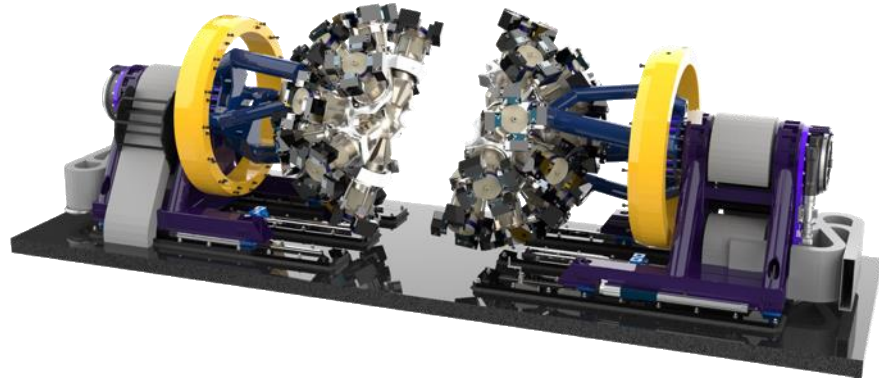


GRETA will be a key instrument at FRIB and provides the sensitivity to enable a broad range of physics with both fast-fragmentation and reaccelerated beams

Designed (expected) to be used on multiple beam lines

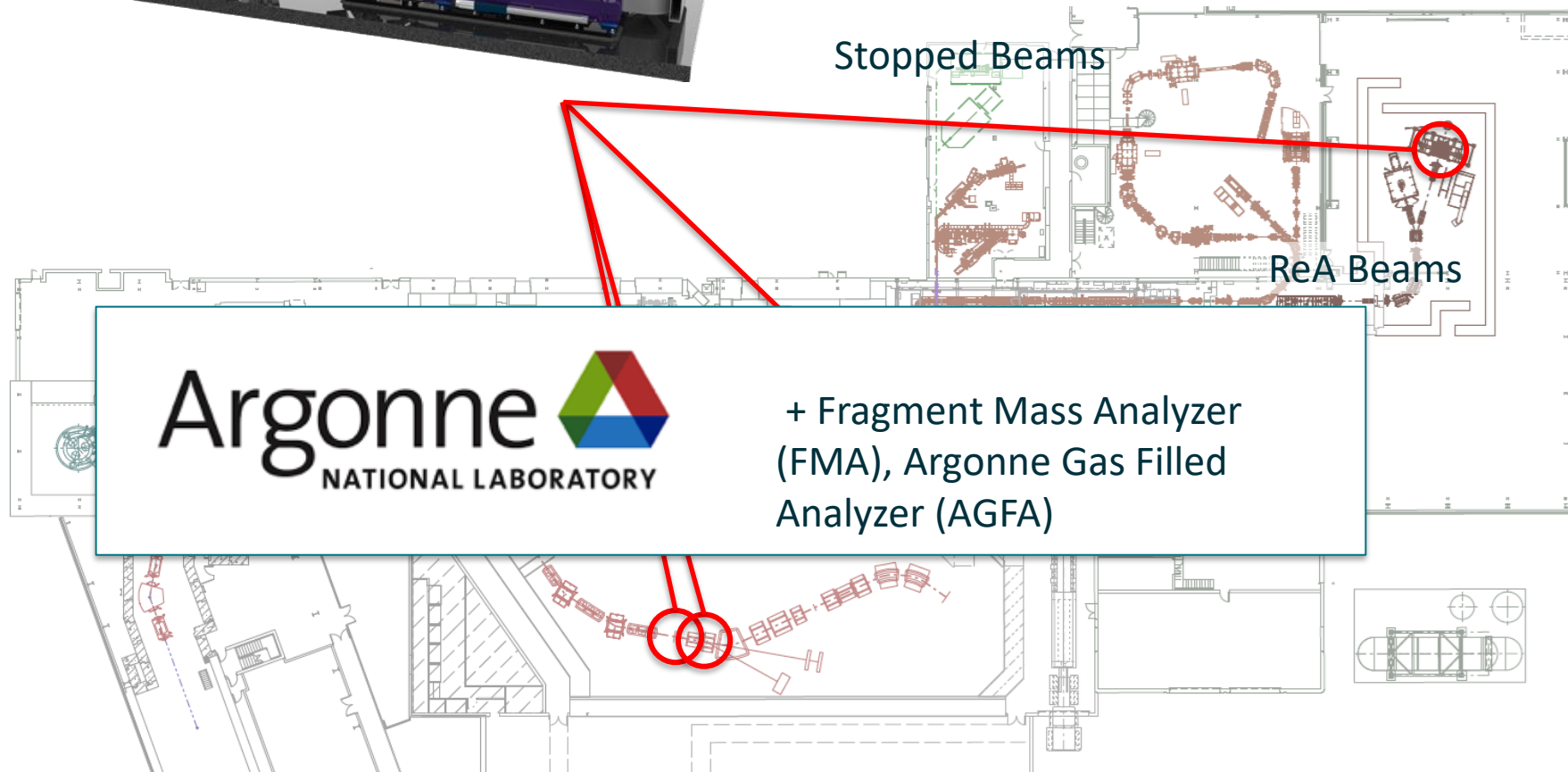


Measurements use Fast, Stopped, and Reaccelerated Beams



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GRETA Builds on Past Success: GRETINA

Between 2003 and 2011, the US low-energy nuclear physics community constructed GRETINA, a 1π tracking detector employing the same segmented detector and signal decomposition technology as GRETA.

- GRETINA a \$20M project funded by US DOE-Nuclear Physics Office
 - LBNL led the construction (NSD: I-Y. Lee)
 - Covered $\sim 1/4$ of a sphere with 7 Quad Detector Modules
- GRETINA science operations at NSCL and ANL have demonstrated the technology and scientific impact of a γ -ray tracking array
- Added Quad Detector Modules – total of 13
- Flagship Instrument for Nuclear Physics

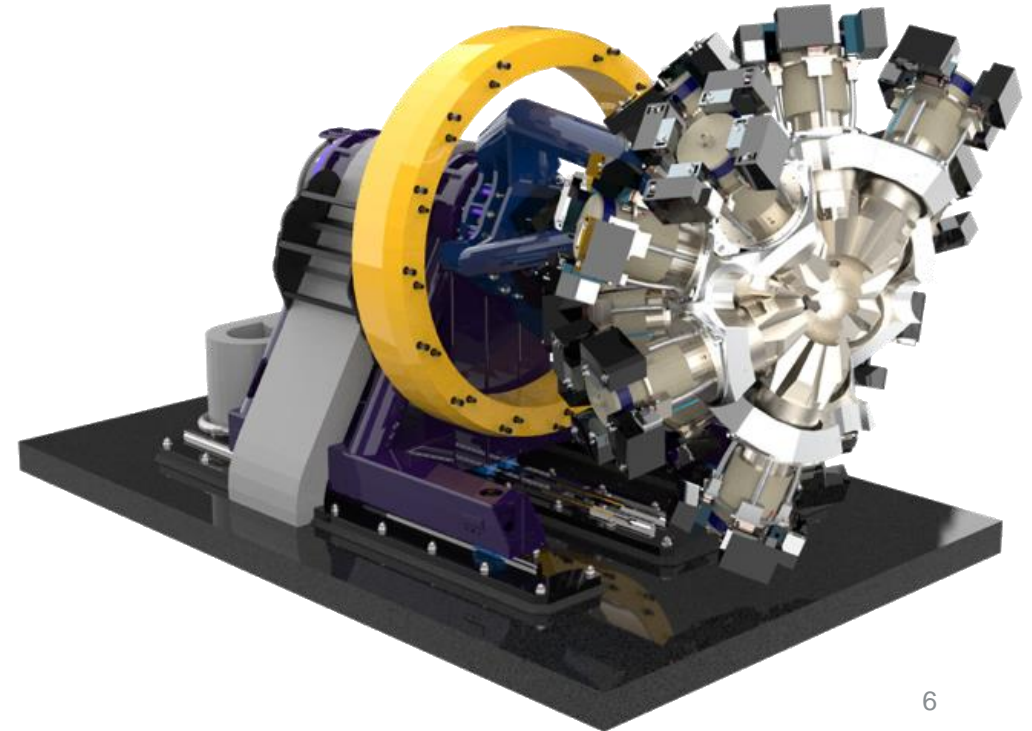


10 Quad Detector Module at NSCL

The GRETA Project

GRETA builds on the existing GRETINA array to subtend the full 4π coverage of γ -ray tracking detectors.

- 18 Quad modules, to be combined with 12 GRETINA modules for a total of 30
- Full mechanical structure for a 30 module, close-packed array, covering 80% of solid angle
 - Removable forward and rear detector rings
 - Rotation and translation capabilities
- Electronics to instrument all 30 Quad modules
 - Detector-mounted digitizer modules with continuous streaming of waveforms to FPGA-based signal filter boards
 - New trigger, timing and controls systems
- Computing cluster to support full array
 - Real-time signal decomposition up to total through-put of 480k decompositions/s
 - High-speed local network
 - Large local RAID storage



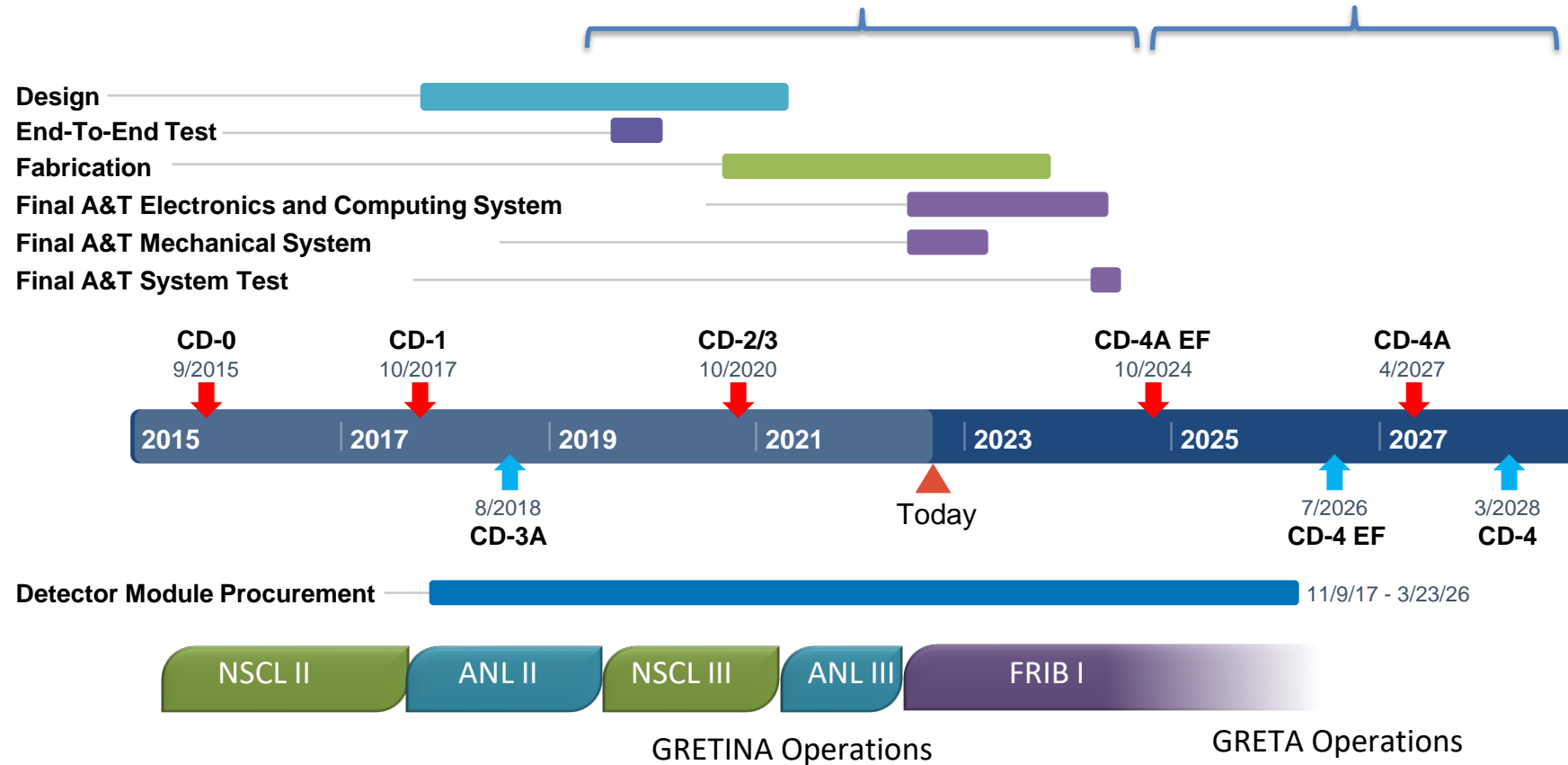
GRETA Project Phased for Early Science Operation at FRIB

CD-4A Scope

- Electronics, Computing and Mechanical systems for 30 Quad Detector Modules
- Subset of Detector Modules (6)
- Delivered to FRIB for Science Operation

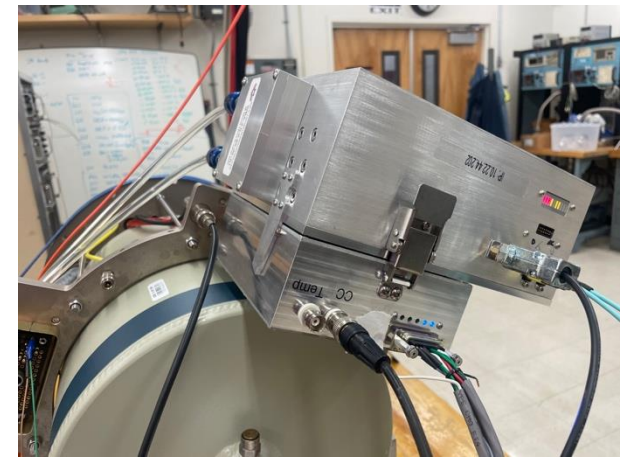
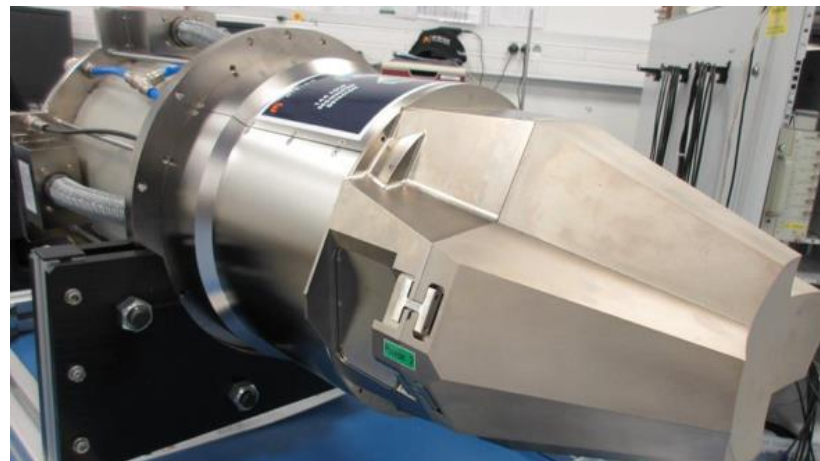
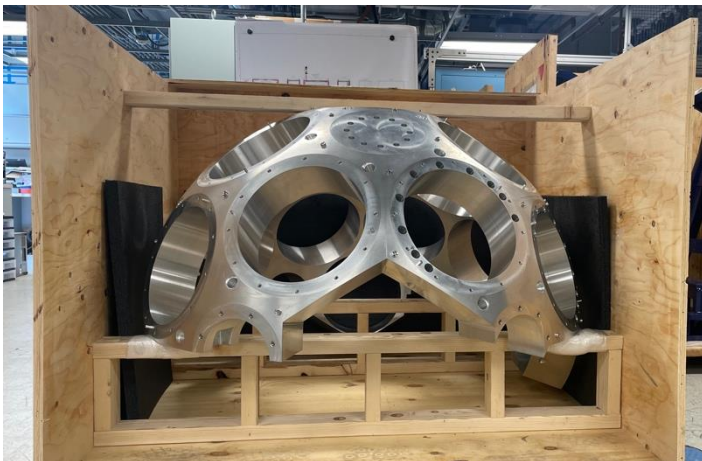
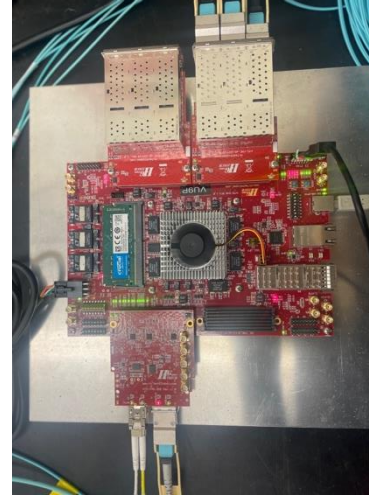
CD-4 Scope

- Accept the remaining Quad Detector Modules (For a total of 18)

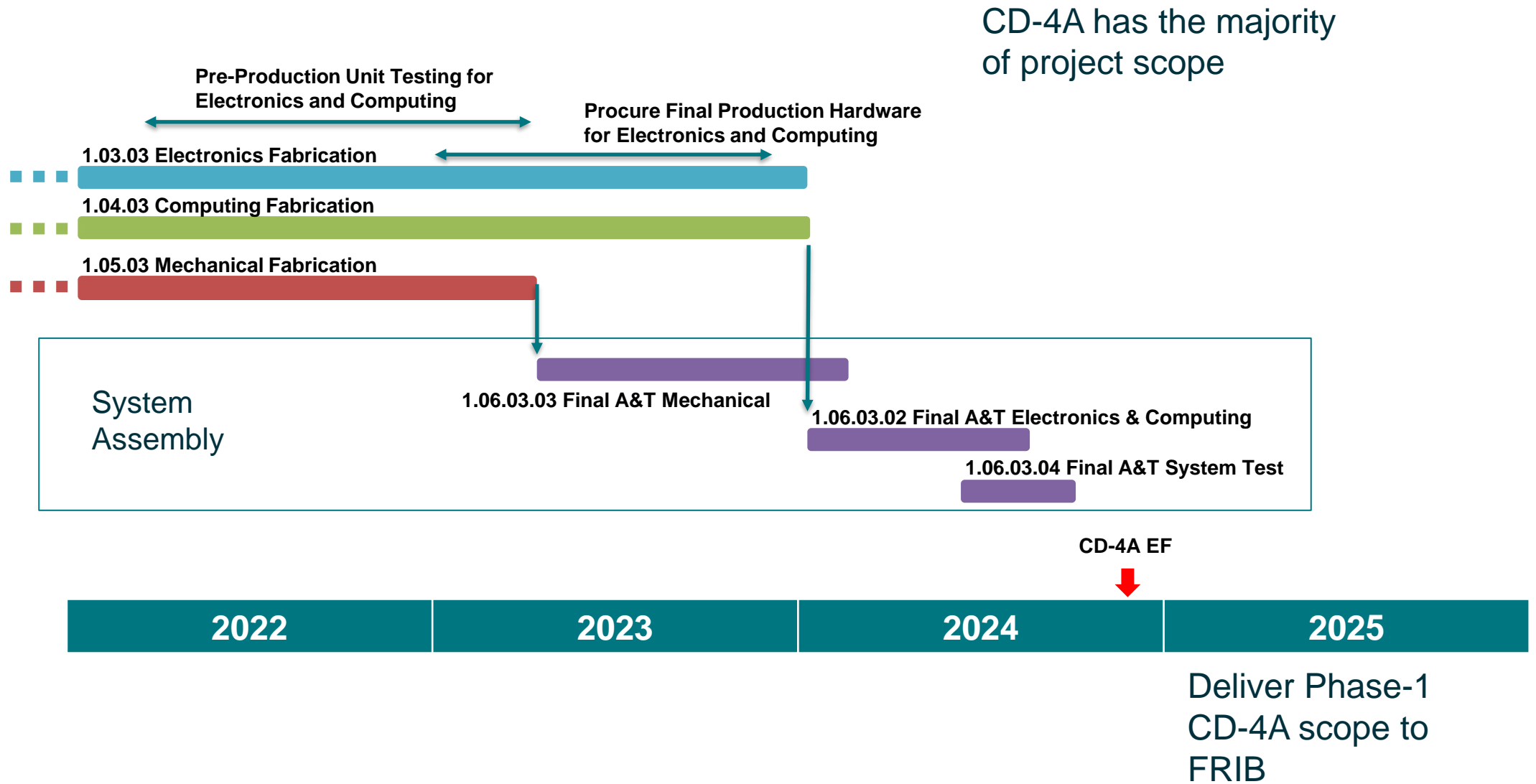


Technical Progress

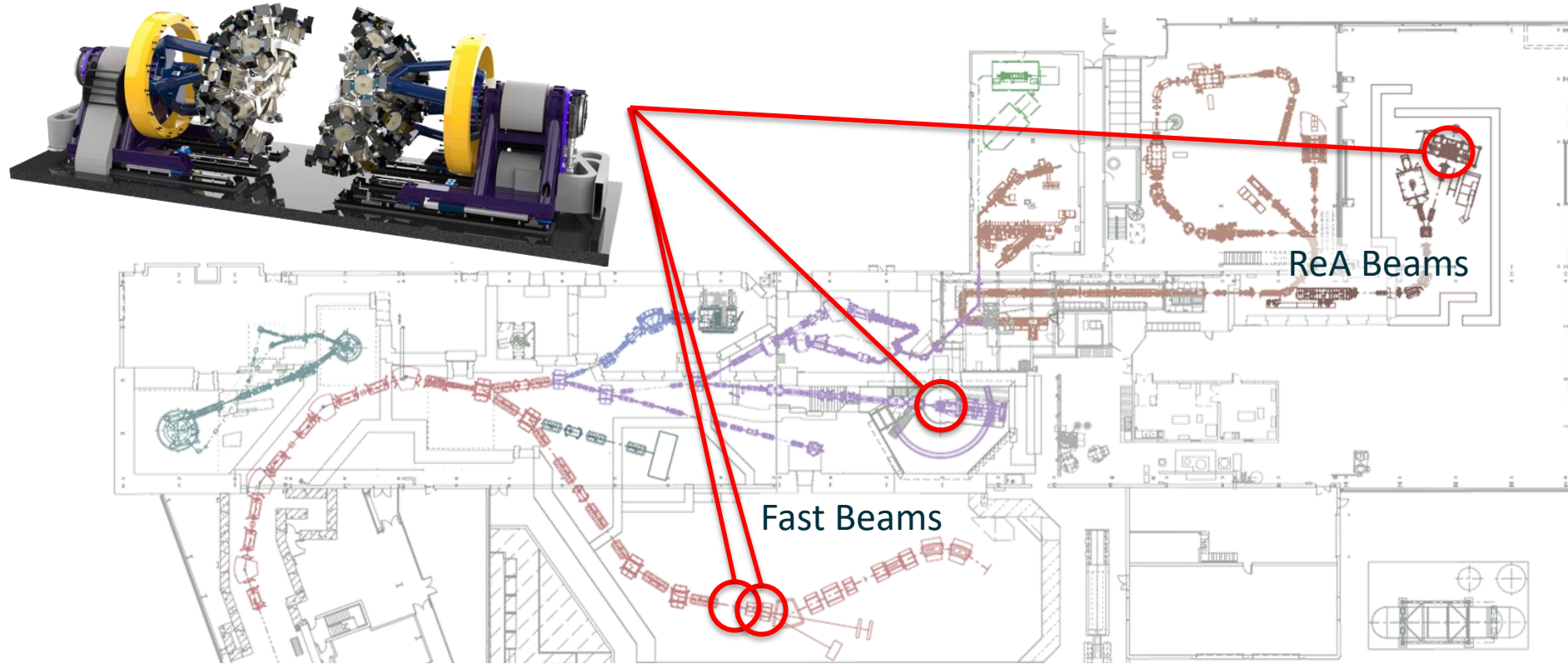
- Mechanical Systems major procurement ongoing and being delivered
- Procured/fabricated pre-production hardware in Computing and Electronics to enable testing and software integration
- Detector Systems - 12 ordered, 8 delivered and 7 accepted
 - CD-4A KPP detector scope complete`



Delivery to System Assembly and Path to CD-4A



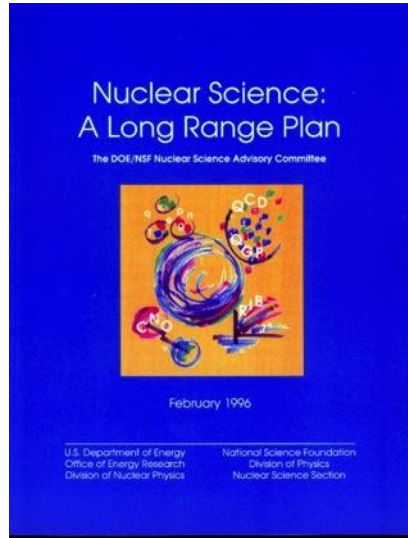
GRETA Initial Operations (starting 2025)



- Reaccelerated beams
 - GRETA at ReA beam Line
- Fast Beams
 - GRETA frame is not designed for S3 vault (S800) and HRS is under construction
 - Plan to modify GRETA frame to be able to have up to ~20 QUADS in front of the S800, with the new GRETA electronics and computing and cooling (to maximize HPGe coverage and science opportunities)

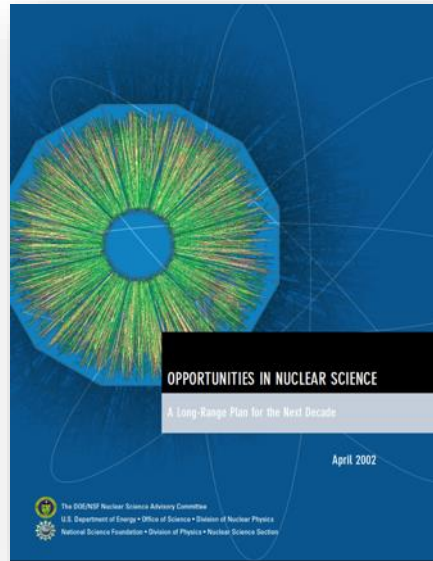
LRP key to initiating new Major Instruments – science based

'96



GRETA first discussed in the 1996 NSAC LRP

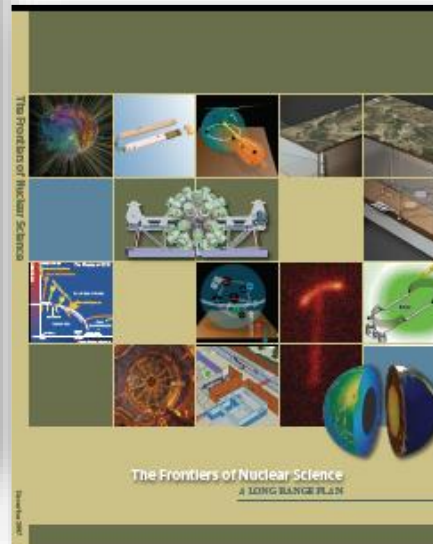
'02



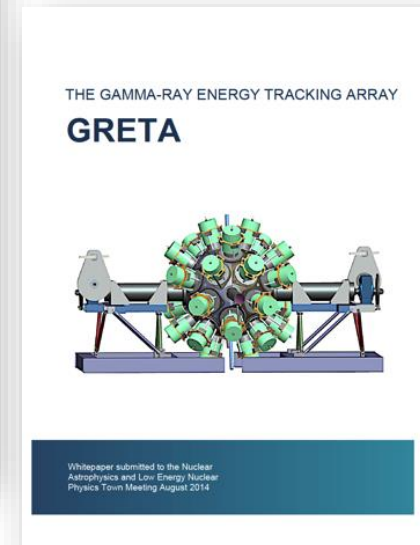
2002 NSAC LRP “The detection of γ -ray emissions from excited nuclei plays a vital and ubiquitous role in nuclear science ..”

2007 NSAC LRP “Construction of GRETA should begin immediately upon successful completion of the GREINA array”

'07

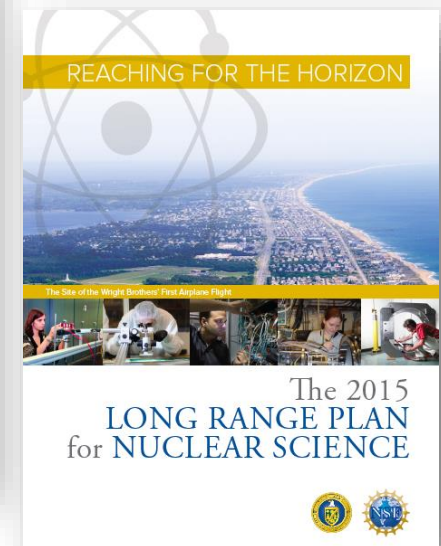


'14



Concept endorsed – GRETA identified as a key instrument for FRIB

'15



Summary

- Well into the project fabrication phase
- All major procurements for Mechanical Systems have been awarded and most delivered
- Completed fabrication/purchase of pre-production hardware in Computing and Electronics and this is being used to for testing and software integration
- Detector Systems - 12 (out of 18) ordered, 8 delivered, and 7 accepted
 - CD-4A KPP detector scope complete

Working to deliver GRETA (phase-1) early in calendar 2025 and complete everything by summer 2026

Acknowledge the GRETA project team, GRETINA project and operations team, community (GUEC) and agency's (DOE/NP) support – and I-Yang Lee