

*GRETINA/GRETA/  
Digital Gammasphere*

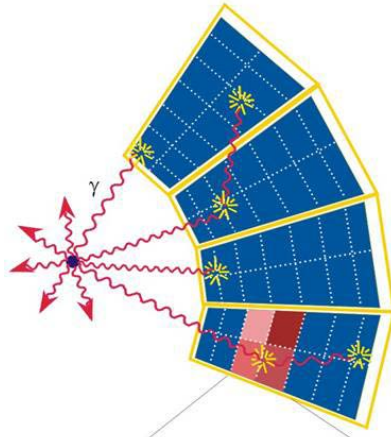
*I-Yang Lee*

LBL

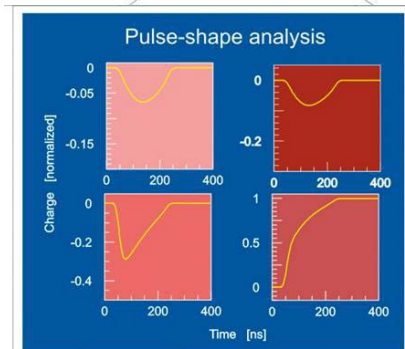
*FRIB Equipment Workshop  
February 20-22, 2010  
FRIB, MSU, East Lansing, MI*

# Principle and advantages of $\gamma$ -ray tracking

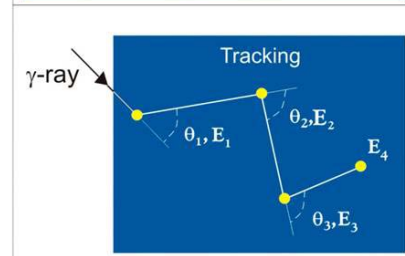
3D position sensitive  
Ge detector shell



Resolve position and energy of interaction points

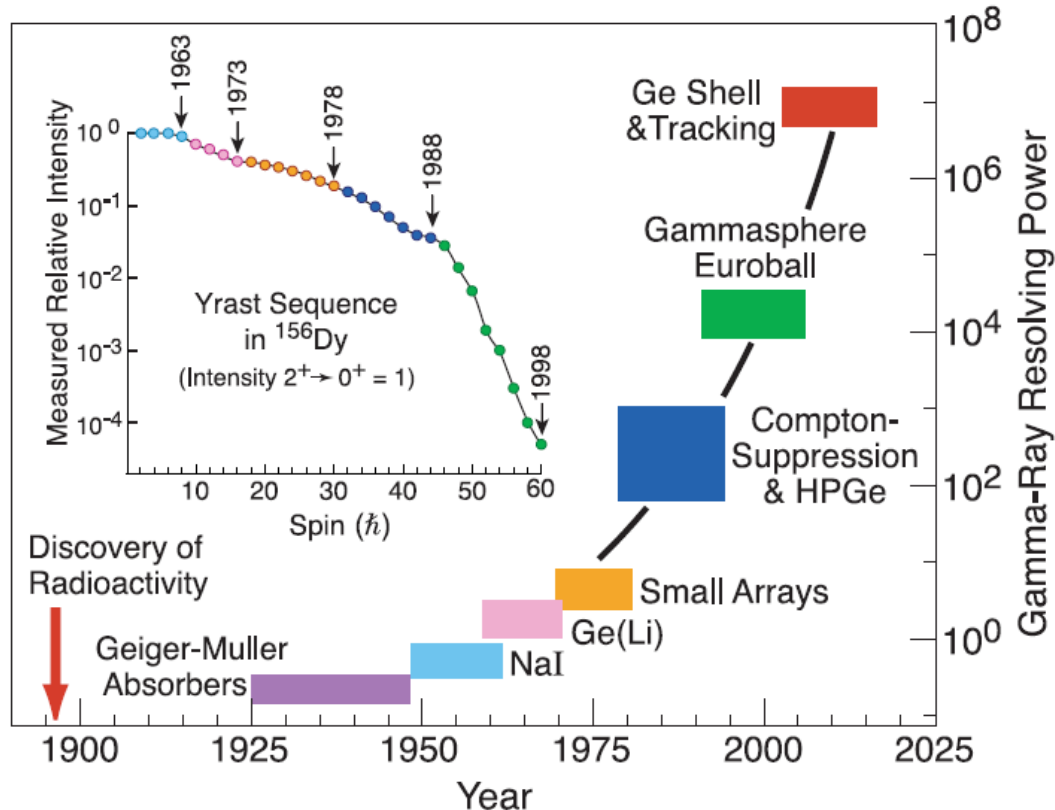


Determine scattering sequence



- **Efficiency (50%  $\Omega$ )**  
Proper summing of scattered gamma rays, no solid angle lost to suppressors
- **Peak-to-background (60%)**  
Reject Compton events
- **Position resolution (1-2 mm)**  
Position of 1<sup>st</sup> interaction for Doppler correction
- **Polarization**  
Angular distribution of the 1<sup>st</sup> scattering
- **Counting rate (50 kHz)**  
Many segments

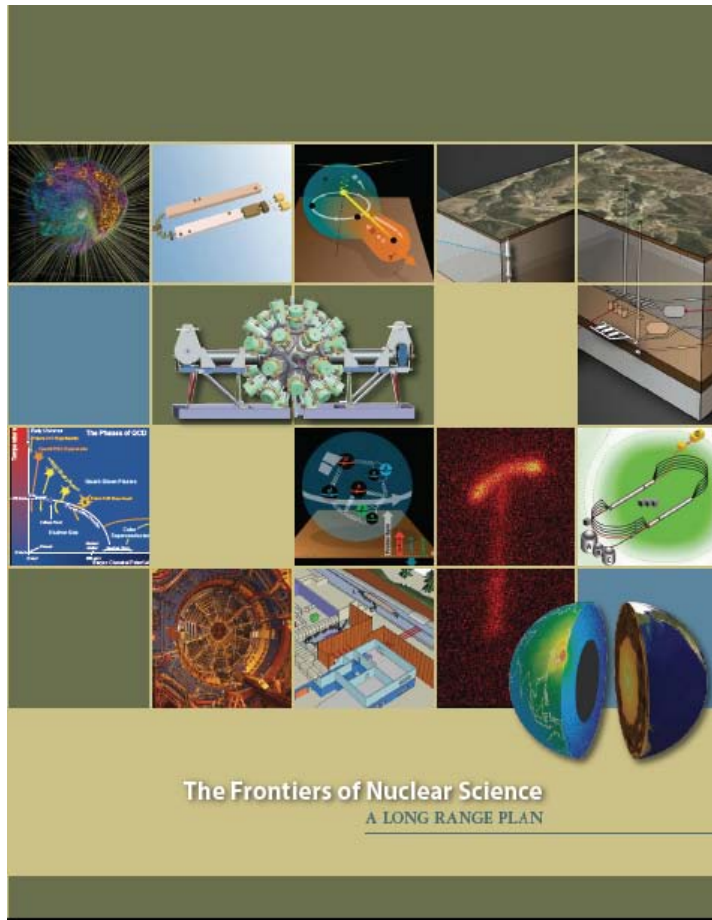
# *Evolution of $\gamma$ -ray detector technology*



**The calculated resolving power is a measure of the ability to observe faint emissions from rare and exotic nuclear states. (from 2002 LRP)**

# 2007 Long Range Plan

Supports the construction of the  $4\pi$  array GRETA



..... Thus the construction of **GRETA** should begin upon successful completion of **GRETINA**. This gamma-ray energy tracking array will enable full exploitation of compelling science opportunities in nuclear structure, nuclear astrophysics, and weak interactions.

# Map to FRIB examples

Example:	GRETINA/GRETA
1. Shell Structure	X
2. Superheavies	X
3. Skins	X
4. Pairing	X
5. Symmetries	X
6. EOS	
7. r-process	X
8. $^{15}\text{O}(\alpha, \gamma)$	X
9. $^{59}\text{Fe}(n, \gamma)$	X
10. Medical	
11. Stewardship	X
12. Dipole Moment	
13. Limits of Stability	
14. Weakly bound	X
15. Mass Surface	
16. rp-process	X
17. Weak interactions	

# *GRETINA scope and schedule*

Collaboration Institutions : LBNL, ANL, MSU, ORNL, Wash. U.

Cover  $\frac{1}{4}$  of  $4\pi$  solid angle  
Seven 4-crystal detector modules  
All the required software



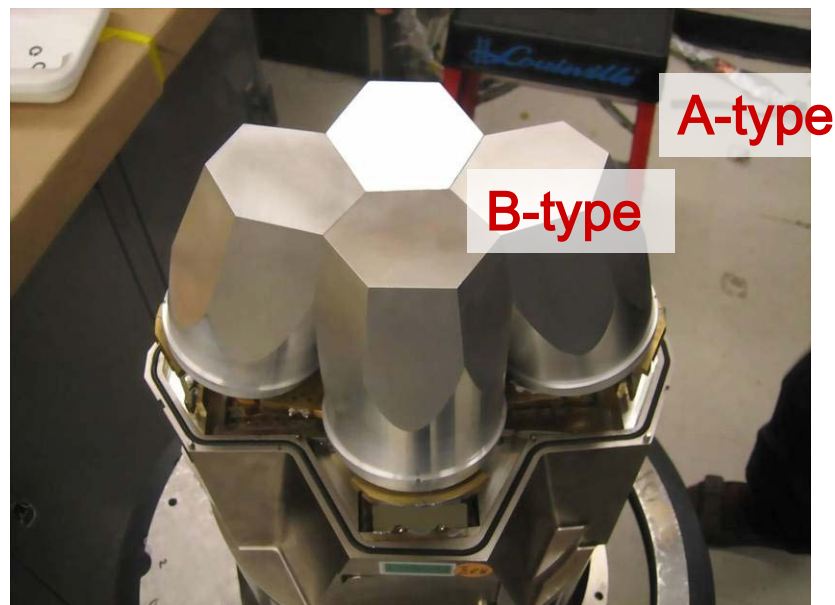
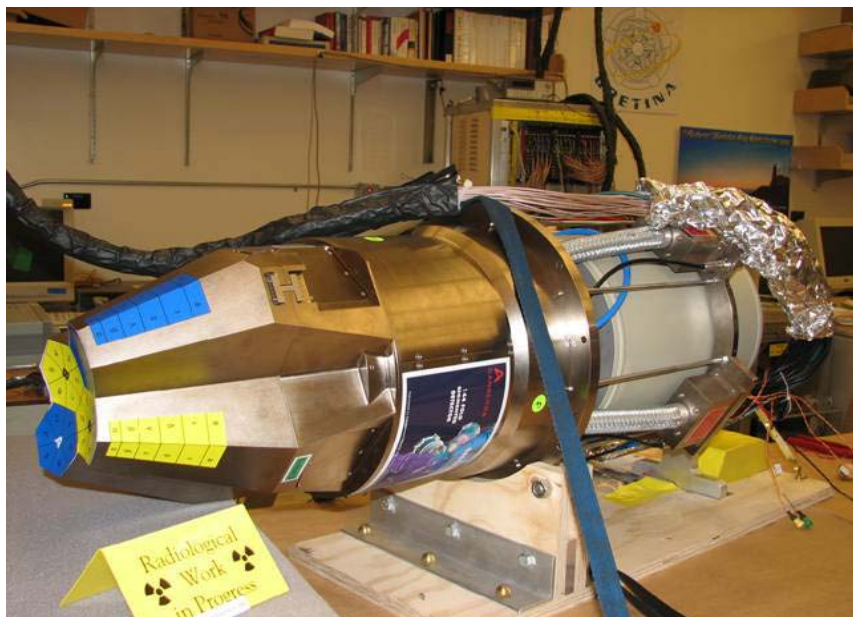
- Start Construction June 2005
- Start of Operation February 2011
- Engineering and commissioning runs at LBNL 2011
- Operation at: 2012 -2013
  - NSCL MSU
  - HRIBF ORNL
  - ATLAS ANL

# *GRETINA Status*

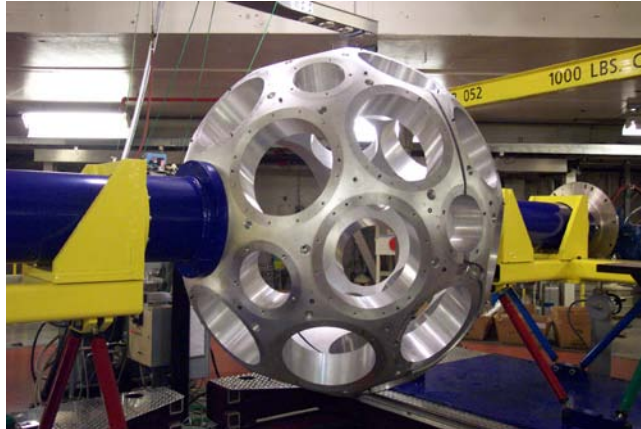
- Ordered all 7 detector modules and 2 spare crystals. Received 6 modules.
- Support structure installed in Cave4C 88-Inch cyclotron.
- Produced and installed all digitizer and trigger modules.
- Installed 30 CPU nodes, 40 are on order.
- Achieved 2 mm(rms) position resolution.

# *Ge detectors*

- Ordered all 7 modules and 2 spare crystals
- Received 6 detector modules
- Accepted 3, returned 1
- Measurements at LBNL and NSCL
- Characterization of 1 and 2 completed



# *GRETINA Status*



Mechanical support



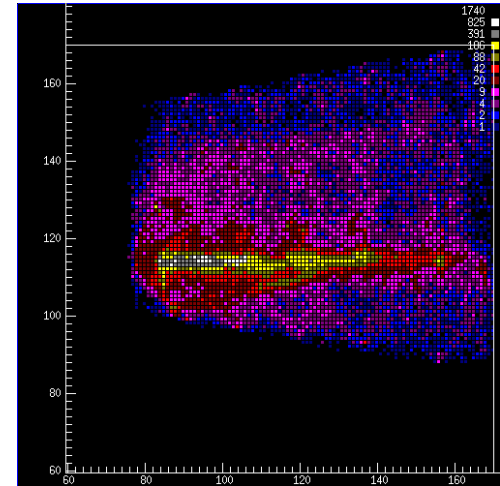
Digitizer and power supply



30 computer nodes and 30TB disk storage



Pencil beam result (2mm resolution)



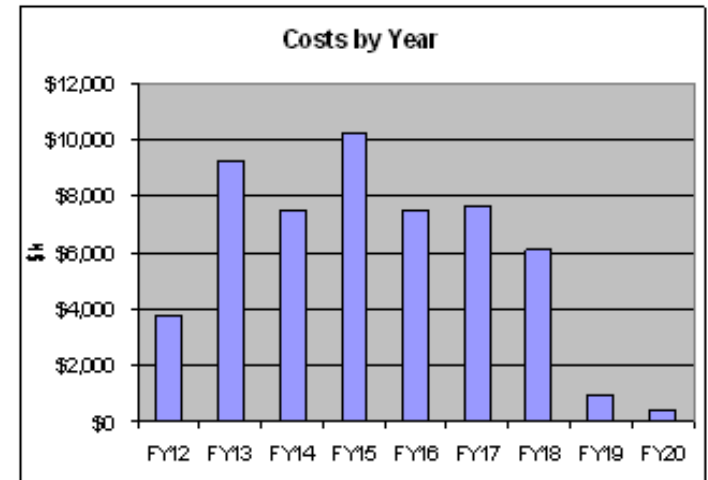
# *GRETA scope*

- Complete  $4\pi$  coverage, base on established GRETINA technology and experienced staff
- Purchase 23 detector modules
  - Vendor can delivery 4 module per year during 6 year period. This is the critical path.
- Design and fabricate mechanical support for 30 detector modules.
- Fabricate electronics to instrument added detectors.
- Purchase computers to meet the higher data processing needs.
- Consider possible upgrades to take advantage of technology advances

# Pathway to GRETA

- Starts (CD-0) FY12
  - Upon successful completion of GRETINA
- Completes (CD-4) in FY20
  - Detector delivery starts in FY14 + 6 years
- 23 detectors at end of FY17 for FRIB experiments

Critical Decision	Date in FY quarter
CD-0	Q1 FY12
CD-1	Q4 FY12
CD-2	A: Q4 FY12, B:Q4 FY13
CD-3	A: Q4 FY12, B:Q4 FY13
CD-4	Q2 FY20



# *Digital Gammasphere*

- Replace electronics with GREINA digital electronics.
  - Increase data rate by a factor 5
  - Improve reliability
  - New capability – e.g. resolve pileup events
- Extended Gammasphere physics reach – e.g.  $^{100}\text{Sn}$  region, hyperdeformation
- At FRIB
  - Reaccelerated beams- e.g. Coulomb Excitation, Transfer
  - Decay studies – e.g. gamma/beta coincidence
- Phase I, digitize Ge signal only, started with \$125k in FY09 and \$150k in FY10.
- Phase II, full digital including BGO, needs funding

# *Summary*

- Physics case remains strong and new opportunities are being proposed.
- GRETINA is within budget and on schedule.
- Expect to complete on Monday 2/14/2011.
- Physics campaign schedule proposed which extends through 2013.
- GRETINA will be ready for FRIB in 2017.
- Auxiliary detectors planned; waiting for funding
- Plan for GRETA is in place; waiting for funding.