

# *Experiments for Nuclear Data: Symbiotic Opportunities in Low-energy Decay Studies*

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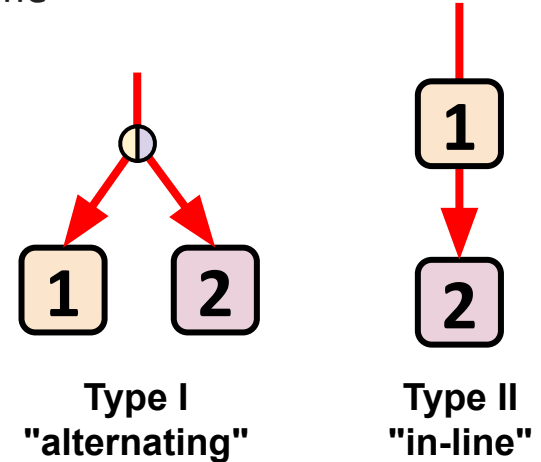
*NSAC LRP Town Hall Meeting on  
Nuclear Structure, Reactions, and Astrophysics  
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# Symbiotic Opportunities in Experiments

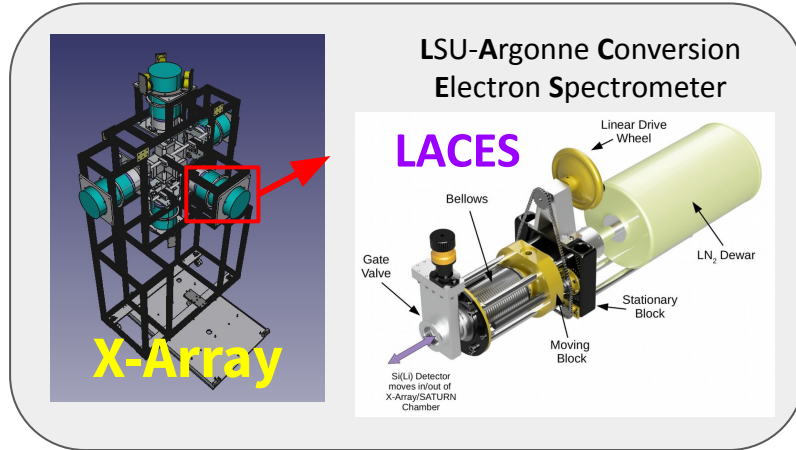
*How do we construct our experiments to maximize nuclear data collected from what will likely be the only use of that beam many years?*

- Symbiotic Experiments!
  - Multiple experiments taking place with the same beam time
  - Analogy works (mutual, commensal, parasitic...)
- Higher-Energy Beams
  - FSDi @ FRIB
  - ATLAS Multi-User Upgrade
- Low-Energy Beams
  - Mass Measurements & Decay Spectroscopy
    - ATLAS: nuCARIBU & N=126 Factory
      - Isotopically separated!
    - FRIB Stopped Beam Hall



# Type-I Example: Symbiotic Decay Stations (at ANL)

Decay Station #1  
( $\beta$ - $\gamma$ - $\gamma$  &  $\beta$ - $\gamma$ -CE)



Decay Station #2  
Choose you nuclear data...

Compact array for fast-timing  
(Fast plastic+LaBr<sub>3</sub>+HPGe)

OR

High Efficiency  $\beta$ - $\gamma$  for beta-spectroscopy  
Spectroscopy

Using the same beam...

- Operate decay stations out of phase with one another ( implant+count vs count-implant)
- Tune decay station duty cycles to optimize how "parasitic" experiments are to one another

# GAMMASPHERE TO AREA 1: BETA DECAY FACTORY

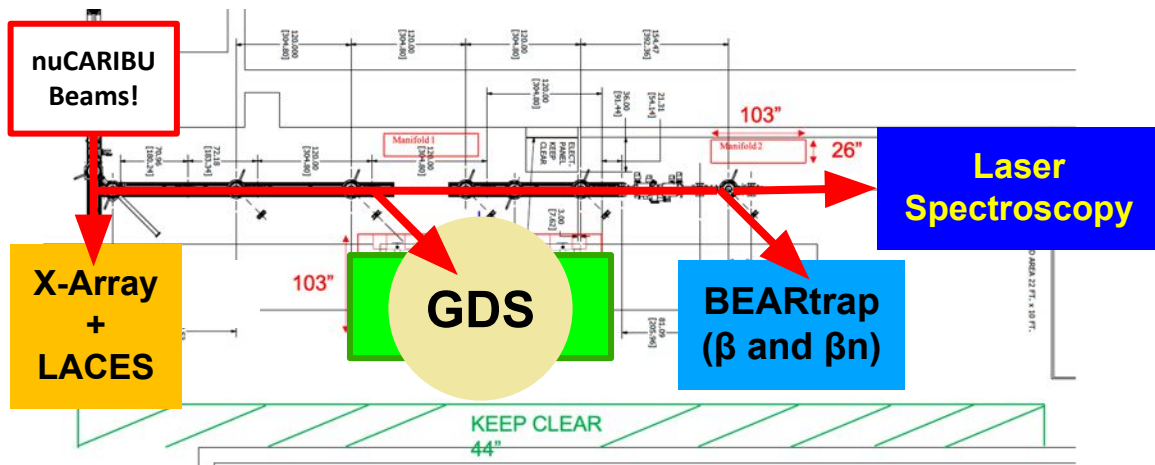
- **Gammasphere is an excellent  $\gamma$ -ray spectrometer for  $\beta$ -decay studies providing:**
  - $\beta$ - $\gamma$  coincidences for proper feeding intensities
  - $\gamma$ - $\gamma$ ,  $\gamma$ - $\gamma$ - $\gamma$  for level structure determination and spin assignments from angular correlations
  - Reduced summing and crystal to crystal scattering (in contrast to close back config)
  - Calorimetry provides information on excitation energy on event-by-event basis (Ge + BGO)
  - Gammasphere electronics upgrade provides 3 copies of Ge central contact @ 4, 8 and 20 MeV full range

- **Move to Area I**

- Provide larger physics reach due to increased intensity (x10) of beam on target (tape)
- Decay measurements do not directly compete with ATLAS beams (beta-decay factory!)

- **When could this happen?**

- Requires Gammasphere upgrade to be completed (Ease of operation)
- GRETINA to move out of Area IV
- **Expected in 2024**



**The Gammasphere Decay Station (GDS), X-Array+LACES, and the BEtA Recoil-ion trap (BEARtrap) all in one experimental hall!!!**

Slide courtesy of  
Mike Carpenter (ANL)

# Summary/Acknowledgements

- Many opportunities exist to make efficient use of low-energy beams by constructing symbiotic experiments
  - Make use of beam that would otherwise be discarded in "normal" decay experiments
- Beams from nuCARIBU and N=126 Factory will be available isotopically separated
  - Beta Decay Factory presents immense opportunity to collect **generational** data sets
- Instrumentation needs: commitment to build new decays stations suited to expanded need (depending on facility)
  - Including new moving tape systems
- Things to Consider:
  - How such experiments are proposed & executed (Many Variations)
  - Dedicated Decay Stations that could be used for diagnostics as well as for ND?
  - Opportunity to expand collaborations

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