Neutron Production Capabilities:
LBNL 88-Inch Cyclotron
UCB High Flux Neutron Generator

Leo Kirsch November 7, 2014

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Who I am

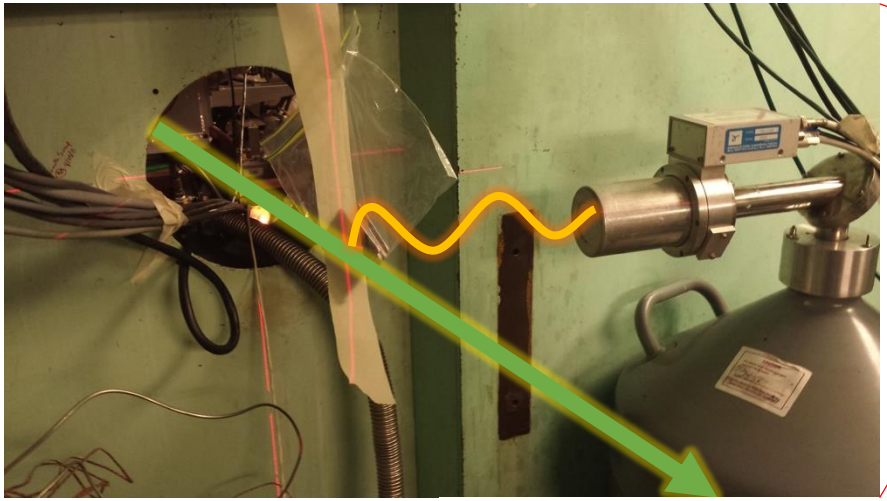
NSSC 7
NUCLEAR SCIENCE and SECURITY CONSORTIUM

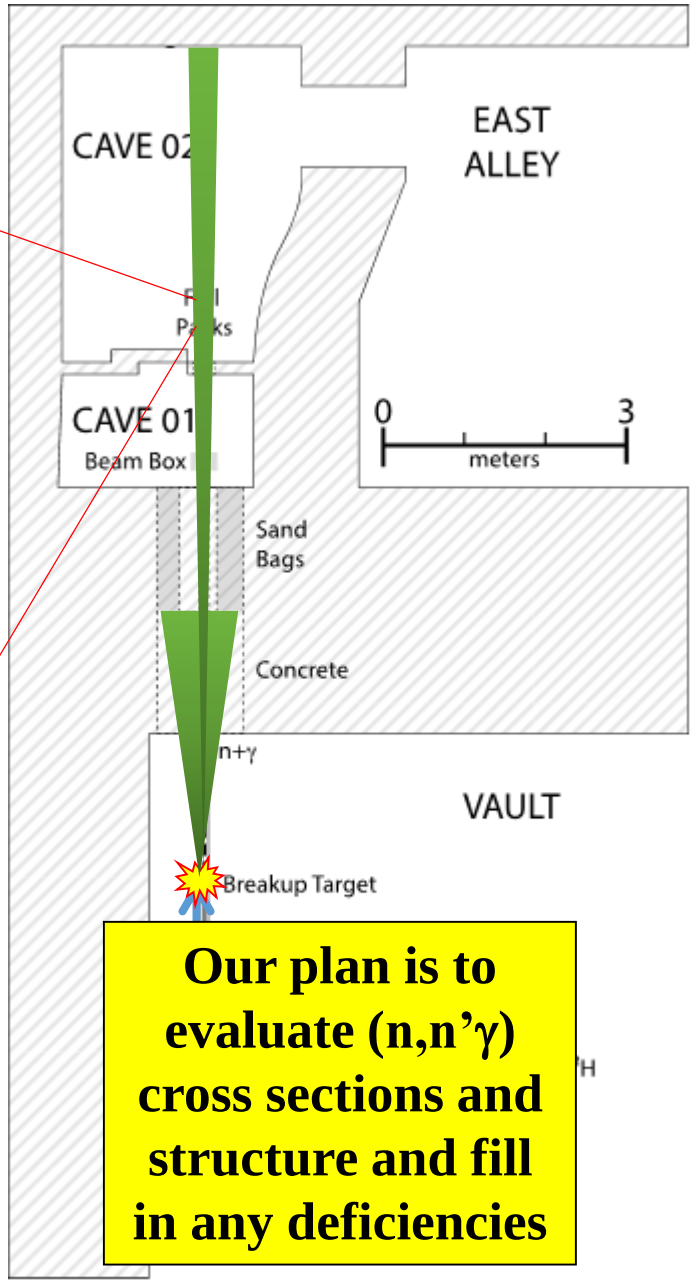
- I'm a 2nd year grad student at UCB, post-prelim, looking to start research
- Working with Lee Bernstein in the Bay Area Nuclear Data Group funded by NA-22 and NSSC
- The NSSC is a NNSA-funded $25 million grant to *Seven Universities Coordinating Coursework and Experience from Student to Scientist in a Partnership for Identifying and Preparing Educated Laboratory-Integrated Nuclear Experts (SUCCESS PIPELINE)*
- I've worked on the development of the HFNG and most recently on measuring (n,n'γ)

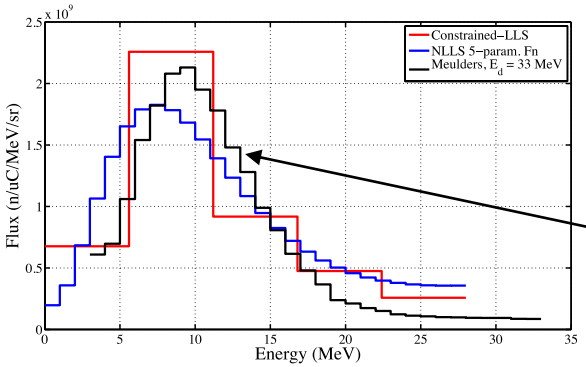
Why we care about (n,n'γ)

- Neutron transport and data for applications
  - Extended-EGAF: partial (n,xγ_i) cross sections)
- Nuclear Structure (ENSDF)
  - Low lying states
- Statistical Models
  - Level densities, Radiative strength functions
  - Highly excited states

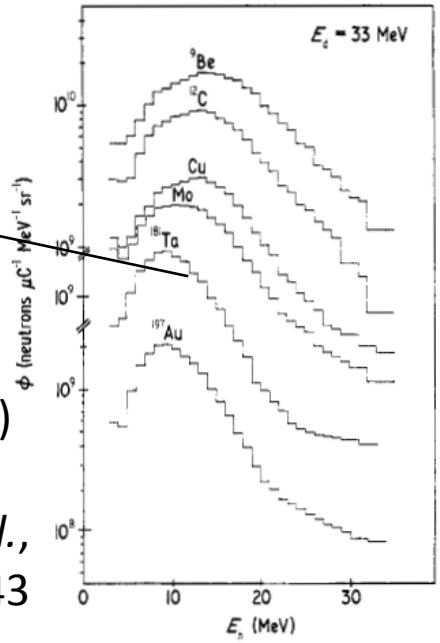
Deuteron Breakup n source at the 88-Inch cyclotron for σ(n,n'γ)







Activated Foils (29MeV D on Ta)

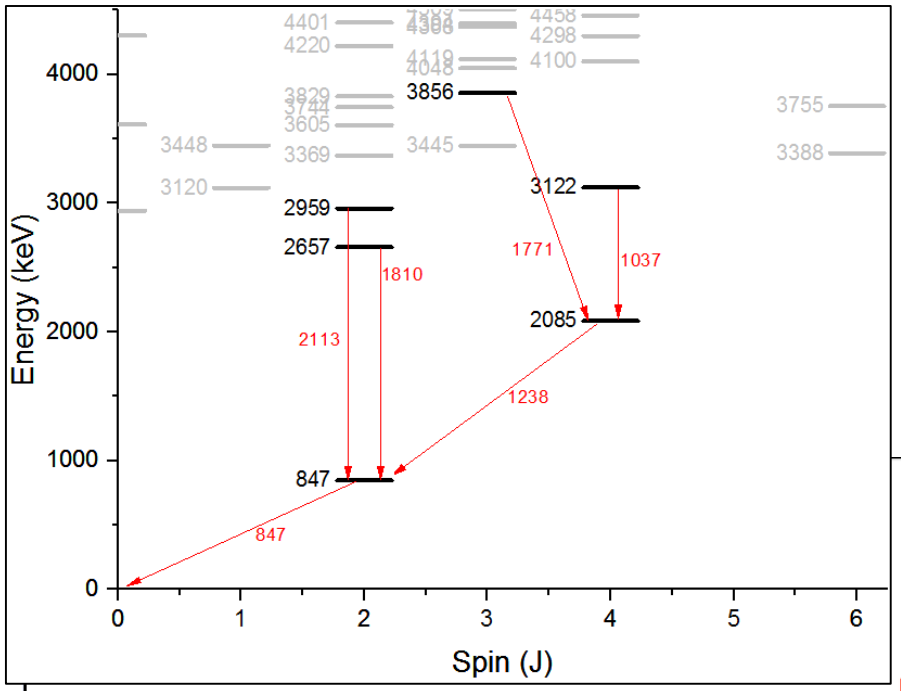


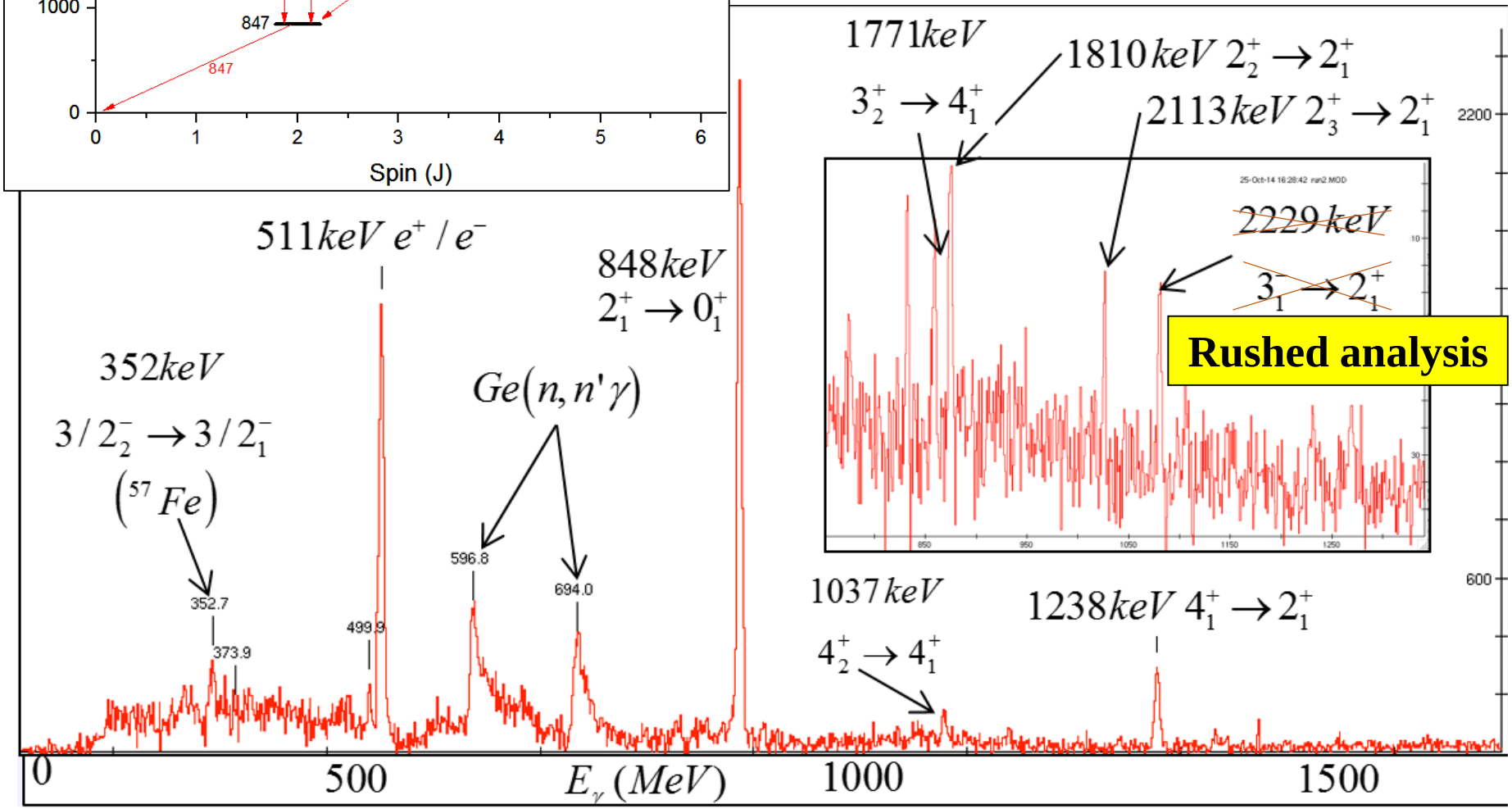
Meulders et al, *Phys. Med. Biol.*, 1975, 20 (2), pp 235-243

Our plan is to evaluate (n,n'γ) cross sections and structure and fill in any deficiencies

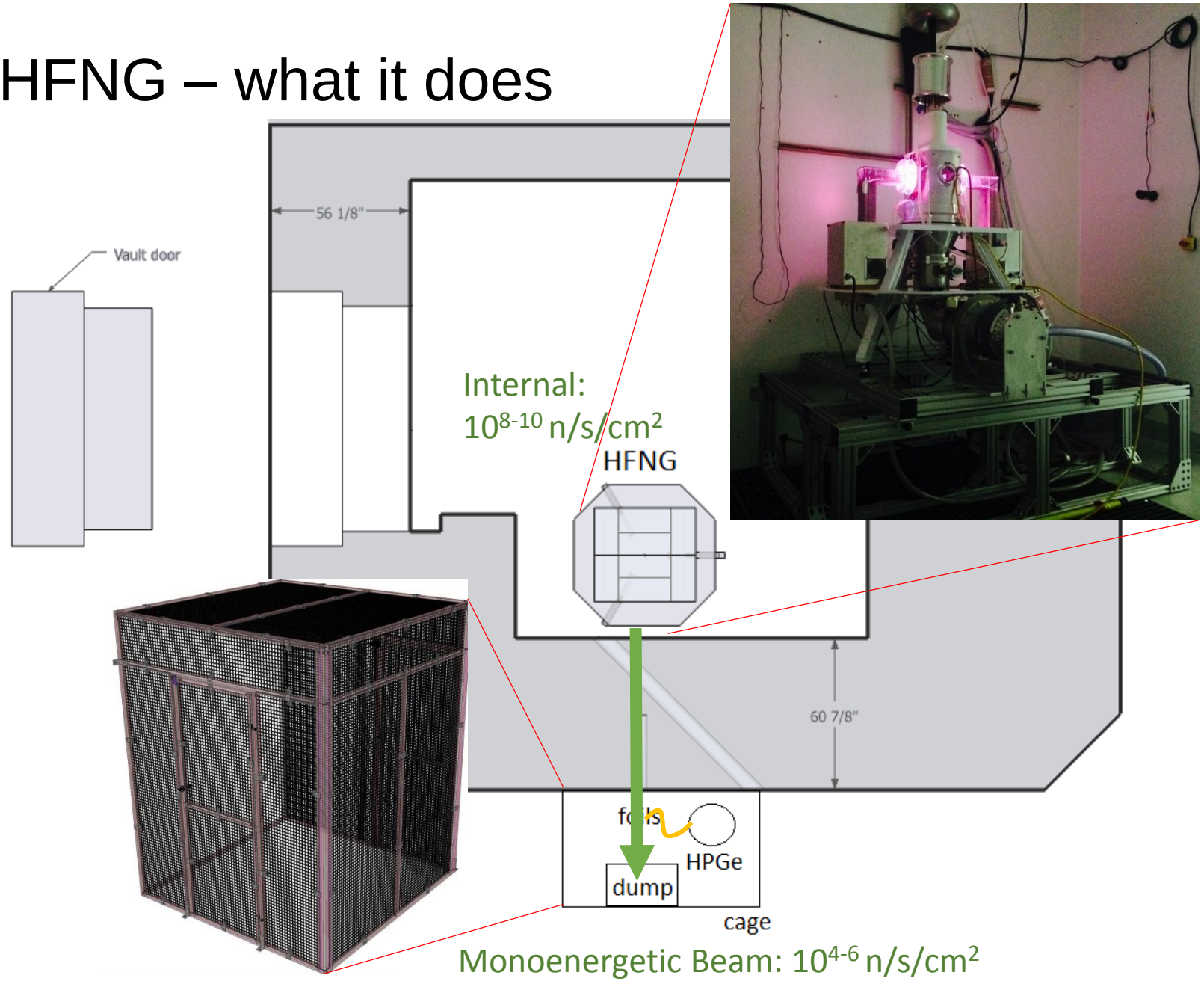
Iron spectrum

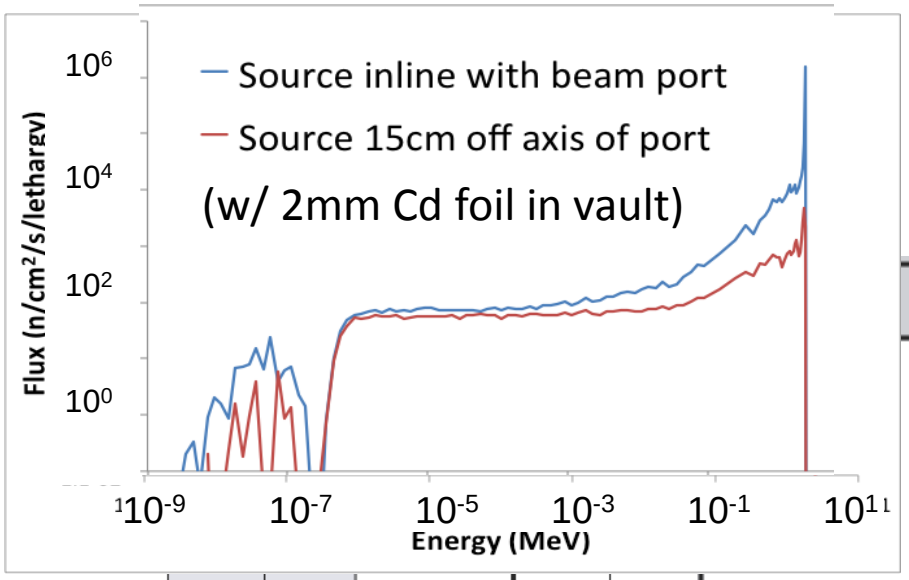
- 1 hour of data, 2uA
- natural iron: 92% Fe^{56}; 2% Fe^{57}
- Four clovers, up current to 20uA
- 64 “clean”γ/s /barn /1%N_a/cm^2





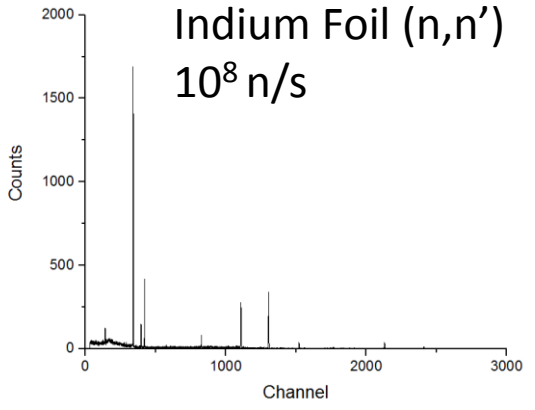
HFNG – what it does



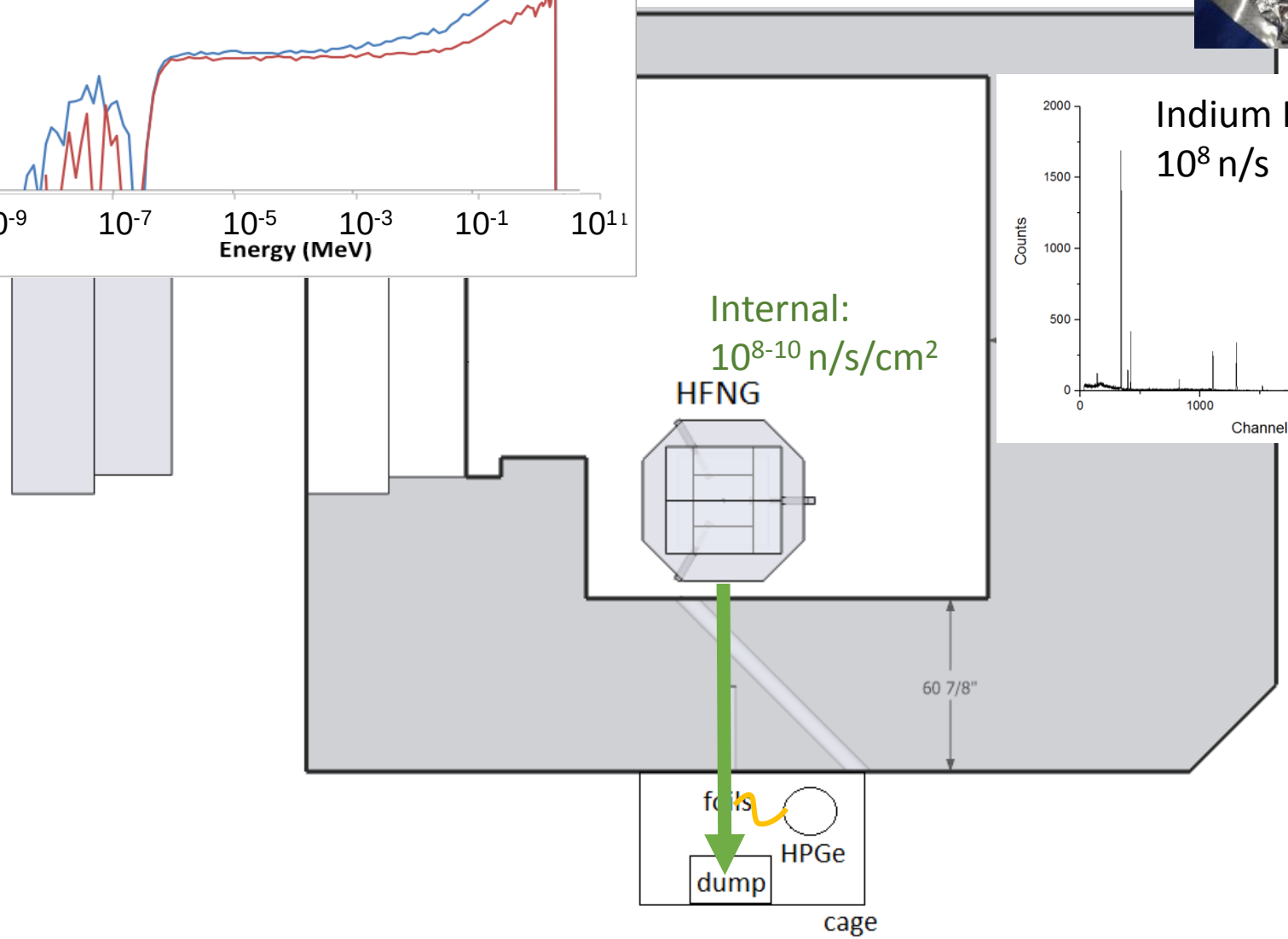


July 25th Commissioning

$$^{115m}In\ \frac{1}{2}^{-} \rightarrow \frac{9}{2}^{+}\ (4.486\ h)$$



Internal:
$10^{8\text{-}10}$ n/s/cm²



Monoenergetic Beam: $10^{4\text{-}6}$ n/s/cm²

Summary/What's Next

- Inelastic scattering capabilities at cyclotron
  I. Deuteron Breakup: 5MeV<E_n<60MeV
  II. 10^{12} n/s/cm^2 in situ; 10^7 n/s/cm^2 beam

- High Flux Neutron Generator at UCB with multiple operation modes
  I. Ion source based DD neutron source E_n=2.45MeV
  II. $10^{8\text{-}10}$ n/s/cm^2 uniform flux in situ; $10^{4\text{-}6}$ n/s/cm^2 beam
  III. Moderation capabilities
  IV. Rabbit system: shuttle time <1s

- What's Next at Cyclotron
  I. Chopper to improve nTOF measurements
  II. 4 clover detectors (Clovershare)
  III. Neutron energy spectrum using scintillators
  IV. Indium and Zirconium foil activation for fast fluence

Collaborators

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