Surrogate Cross Section Experiment

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We have demonstrated the surrogate approach for many important reactions

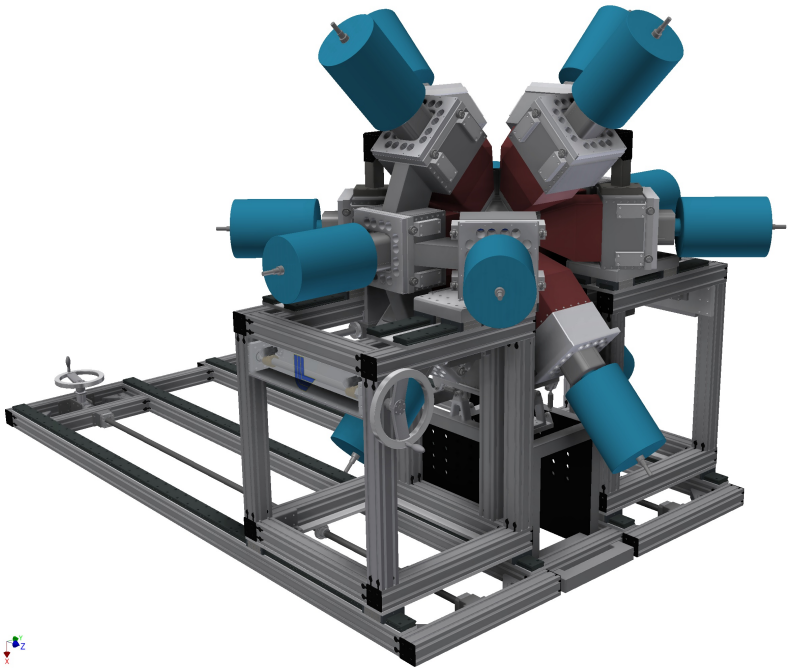
Reaction	Measurement	Nuclear Theory	Complete Methodology
(n,γ)	Hyperion / STARLiTeR	Recently demonstrated	FY 2017 L2 milestone
(n,n')	NeutronSTARS	Need advanced structure + reaction approach	
(n,2n)	NeutronSTARS	Starting in FY 2018	
(n,f)	Hyperion/ NeutronSTARS	Approximations sufficient for most applications	Proven method
(n,fxn)	NeutronSTARS	May be needed at low energies (<0.2 MeV)	Proven method

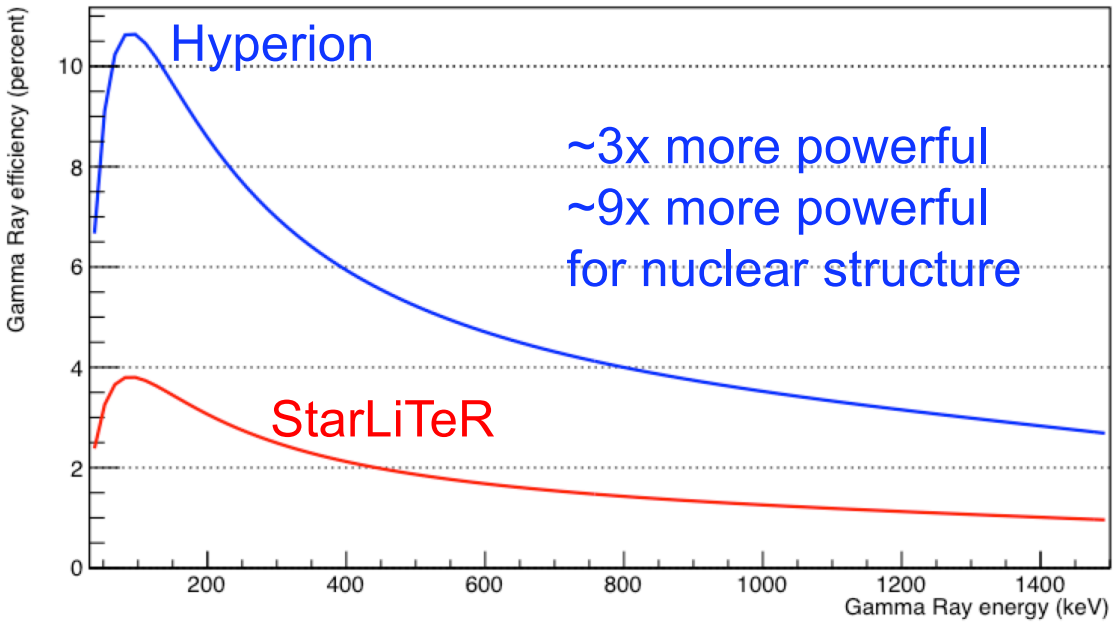
Demonstrated | In Progress | Not Started

Hyperion provides a significant improvement in gamma ray efficiency

- We have tested and deployed 6 modules in Hyperion
  - One module = HPGe clover detector + BGO shield
- Hyperion can support 14 modules
  - Better efficiency for counting statistics
  - Provide nuclear structure information requested by nuclear theory

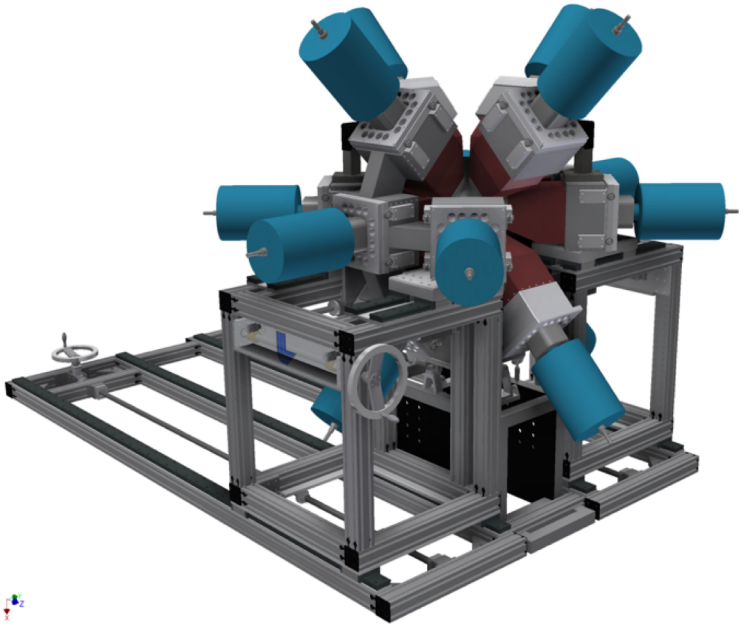
$$P_{(p,d\gamma)}(E) = \frac{N_{(p,d\gamma)}(E)}{\varepsilon_\gamma N_{(p,d)(}E)}$$

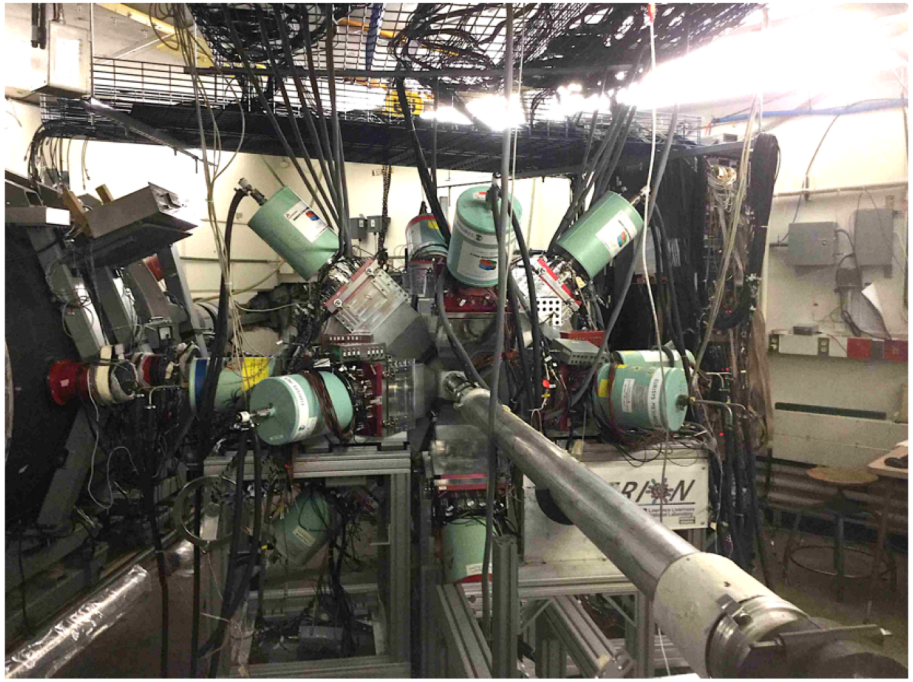




Hyperion provides a significant improvement in gamma ray efficiency

Hyperion is the largest and most efficient gamma ray array in the NNSA complex. It will used for nuclear structure, (n,g) surrogate reactions, measurements of nuclear life times, gamma ray strength function measurements, etc…

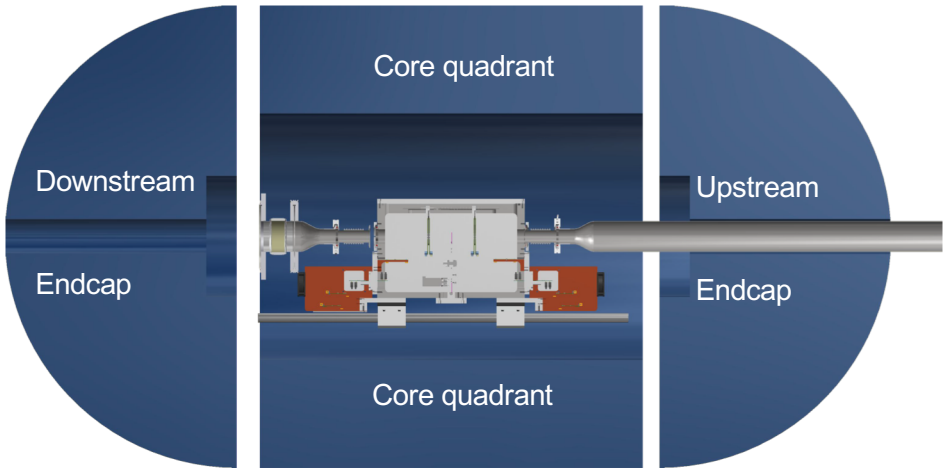


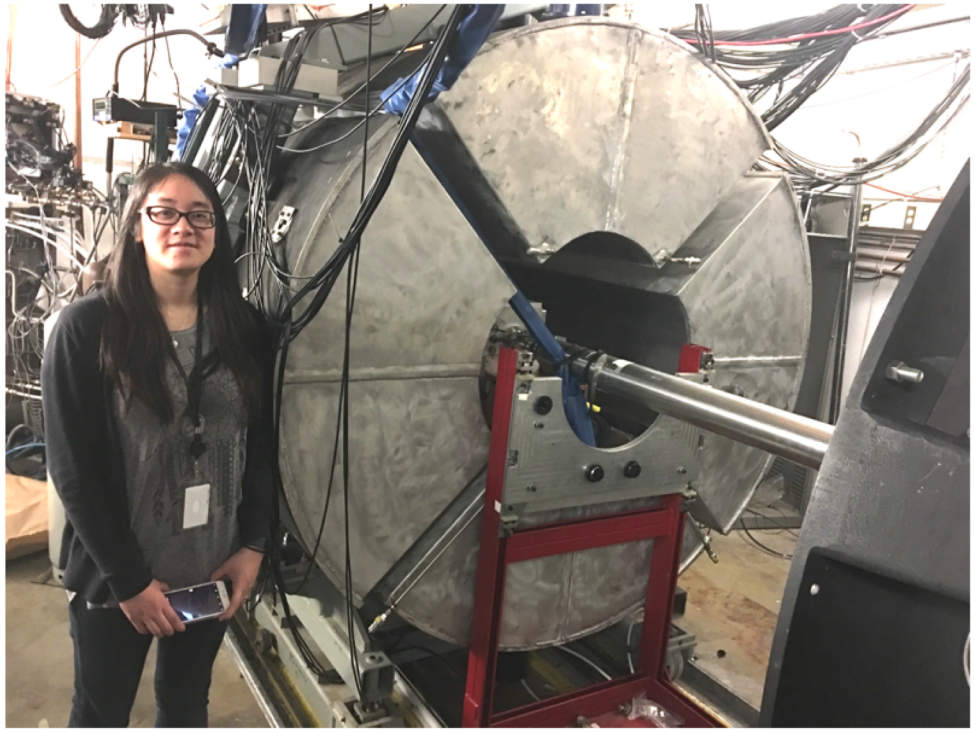


Hyperion currently consists of 8 HPGe detectors and shields. We borrow clovers from the CloverShare Collaboration if they are available to complete the array. Still seeking funding to fully instrument Hyperion.

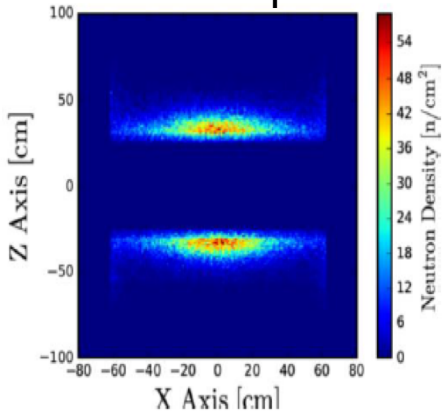
NeutronSTARS: 3.7-ton EJ-335 liquid scintillator + Gd 0.25% doping

Measure: Fission neutron multiplicity (nu-bar), fission neutron distribution, surrogate (n,n') and (n,2n).

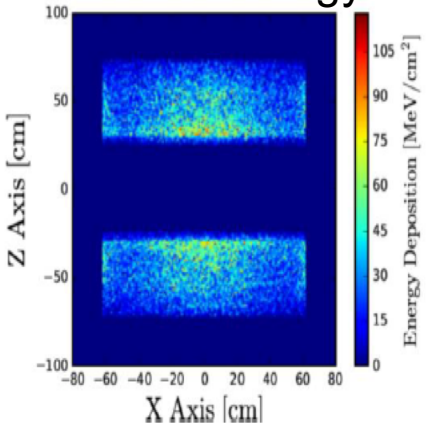




Neutron capture



Gamma energy dep.



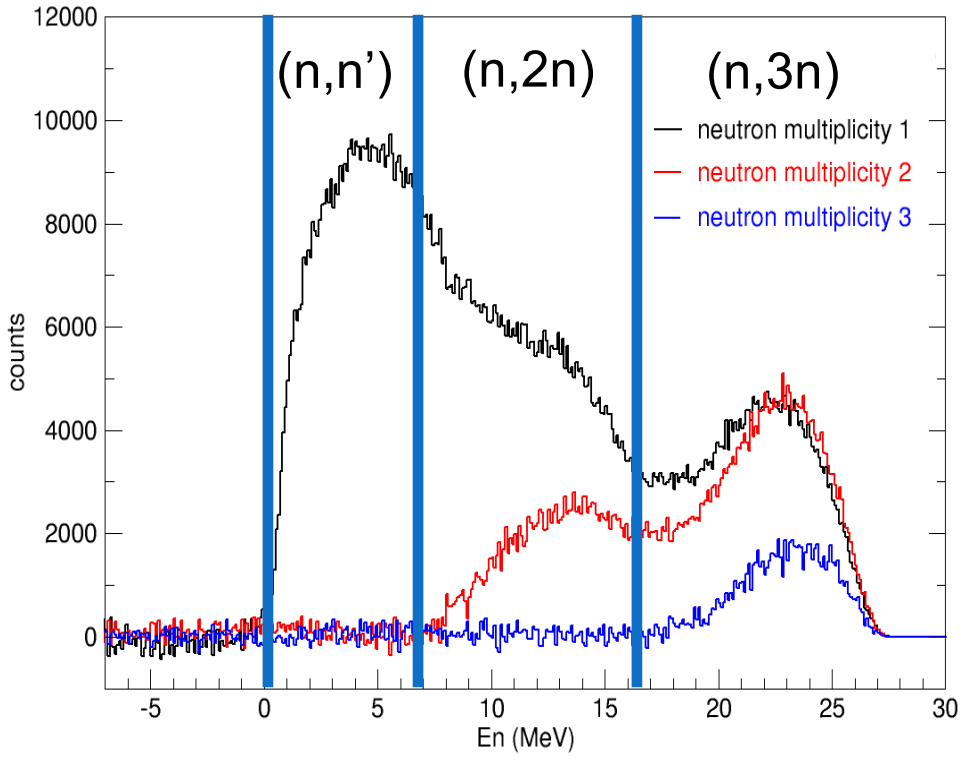
Commissioned January-April 2017

R.J. Casperson, J.T.Burke, R.O.Hughes, B.S.Alan, S.Fisher, O.Akindele, A.Tamashiro, A. Padilla

NeutronSTARS:
surrogate (n,2n) cross section measurements for ^{155}Gd and ^{168}Tm

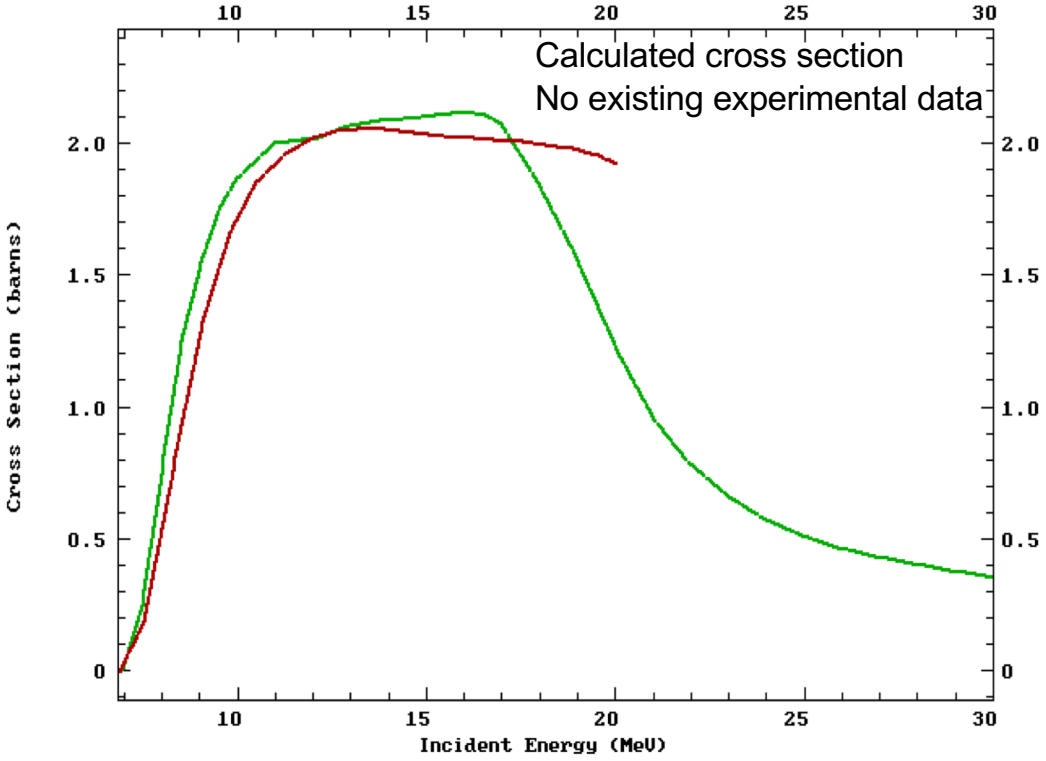
- Two week experiment using 55 MeV a beam on ^{156}Gd and ^{169}Tm targets. Completed run September 2017
- Analysis for efficiency deconvolution to isolate the 1n, 2n, 3n channels for extraction of cross sections

^{156}Gd(α,α'xn) surrogate for ^{155}Gd(n,2n)

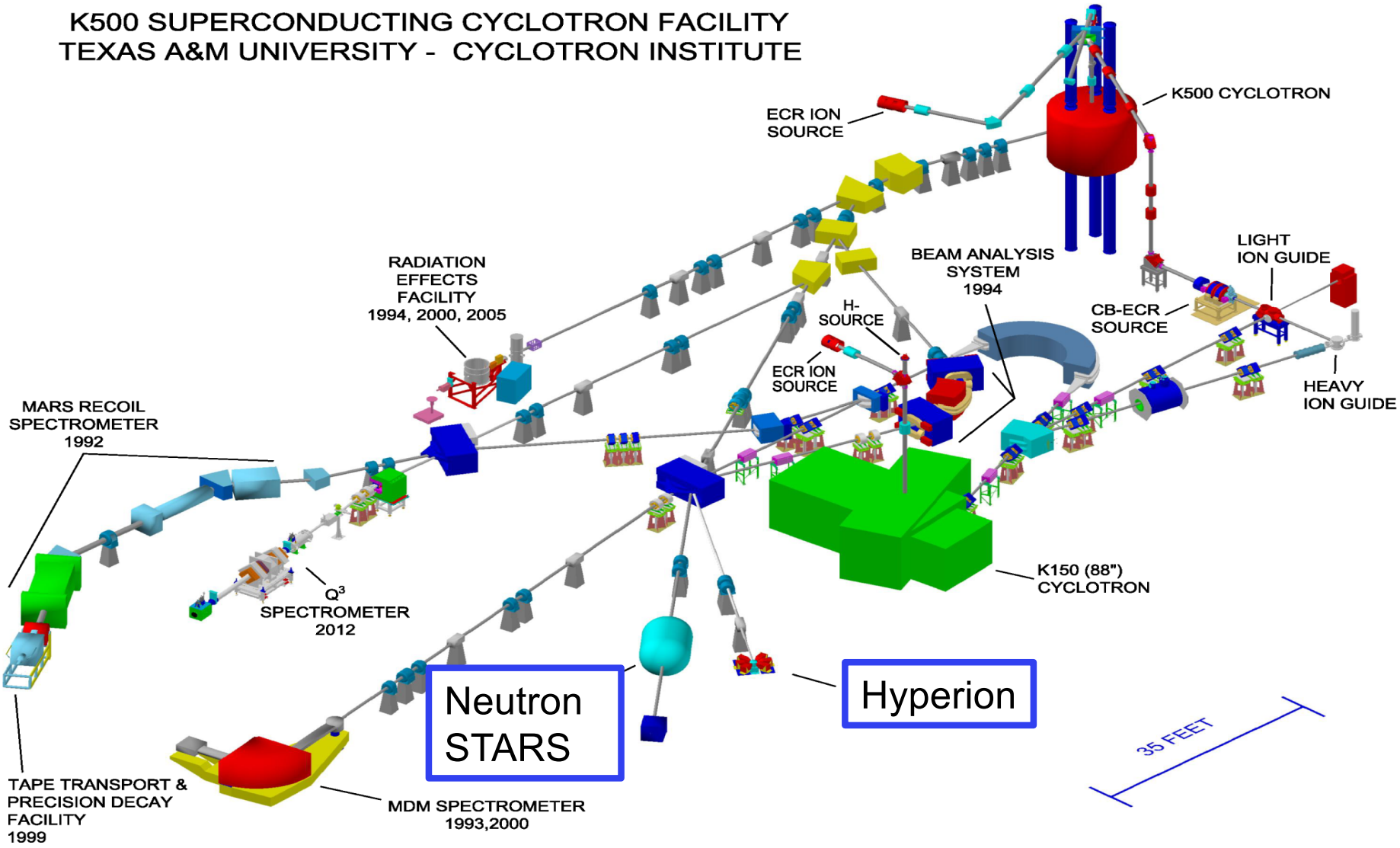


Courtesy of Richard Hughes

^{168}Tm(n,2n)



LLNL leverages existing Texas A&M University Cyclotron Institute facility



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