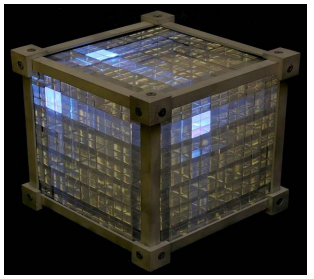
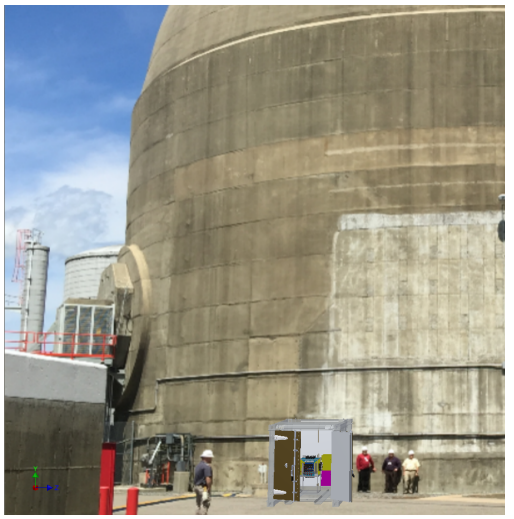
NuLat Motivations

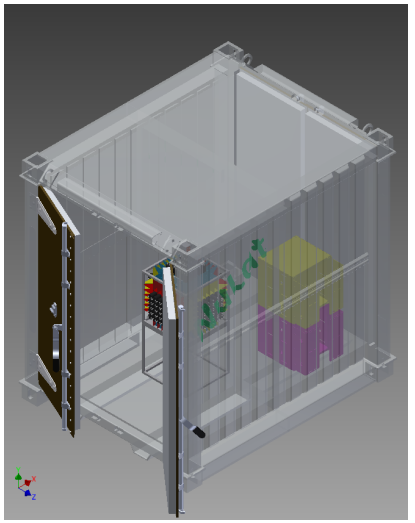
for the NuLat Collaboration – UH Manoa, Virginia Tech, NCCU, NIST, et. al.

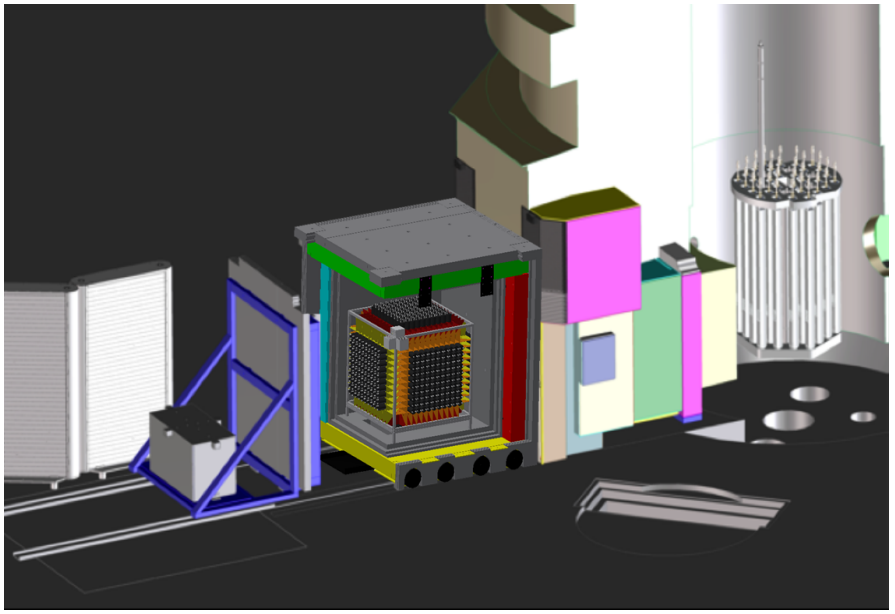


- **Demonstrate reactor monitoring capabilities**
  - Security monitoring
  - Commercial burn-up monitoring
- **Investigate fast neutron directionality capabilities**
  - Detection of special nuclear material
- **Probe reactor anomalies**
  - Sterile neutrino search
  - Precision ν_e energy spectrum measurement
- **Exceptional background rejection**
  - full 3D ***precision*** segmentation (256 cubic centimeters)
  - complete event 'topology' (dE,x,y,z,t)
  - exceptional light collection (600 pe/MeV)
  - sub-nanosecond timing

North Anna Power Station

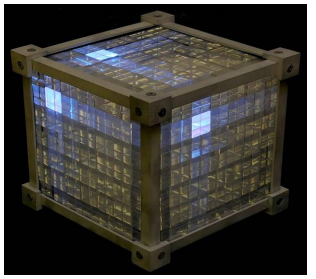






NIST NCNR Reactor

Features and Segmentation



Feature	Rational
Excellent Energy Resolution	Precision Spectral Analysis – Distortions from prediction
Unique Start Signal	separate positrons from gammas, neutrons, and electrons
Unique Stop Signal	separate n-capture from backgrounds
Short Time Delay	improves real/random
Fine Segmentation	smaller improves real/random
E,x,y,x,t complete event topology	best method to remove residual backgrounds
Minimal Wall Material	improves systematics and signal degradation
Fast Timing (Sub Nanosecond)	time-ordering of energy deposits
Minimal Fiducial Cut Required	minimizes shielding size
Strong neutrino source	L/E easier at shorter distances, better S/B
Movable	Vary L without E, multiple sources and uses
Pulse shape discrimination	Aids in background rejection and s/b

Segmentation

- 5x5x5 cubes (NuLat Demonstrator)
  - effectively 125 individual detectors
- 2.5 inch polished plastic scintillator cubes w/ psd
- 0.5% ^{6}Li by wt. loading (Eljen)
- VM2000 reflective film ‘dots’ to maintain air-gap
- ***Total*** light channeling (n=1 and 1.54)
- Scalable to larger mass
- True zero-mass wall – no energy loss