Observational Opportunities for TEAMS

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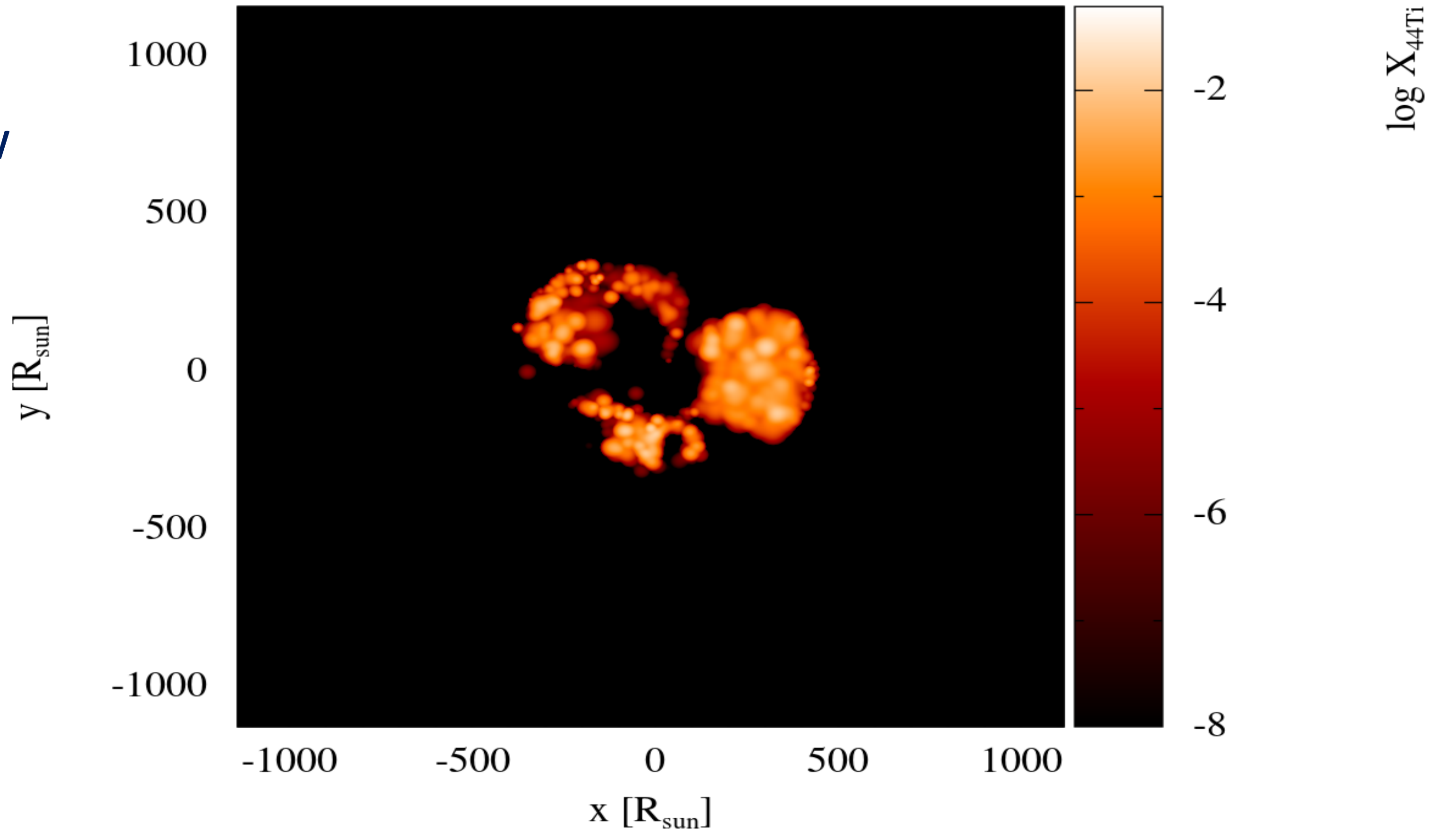
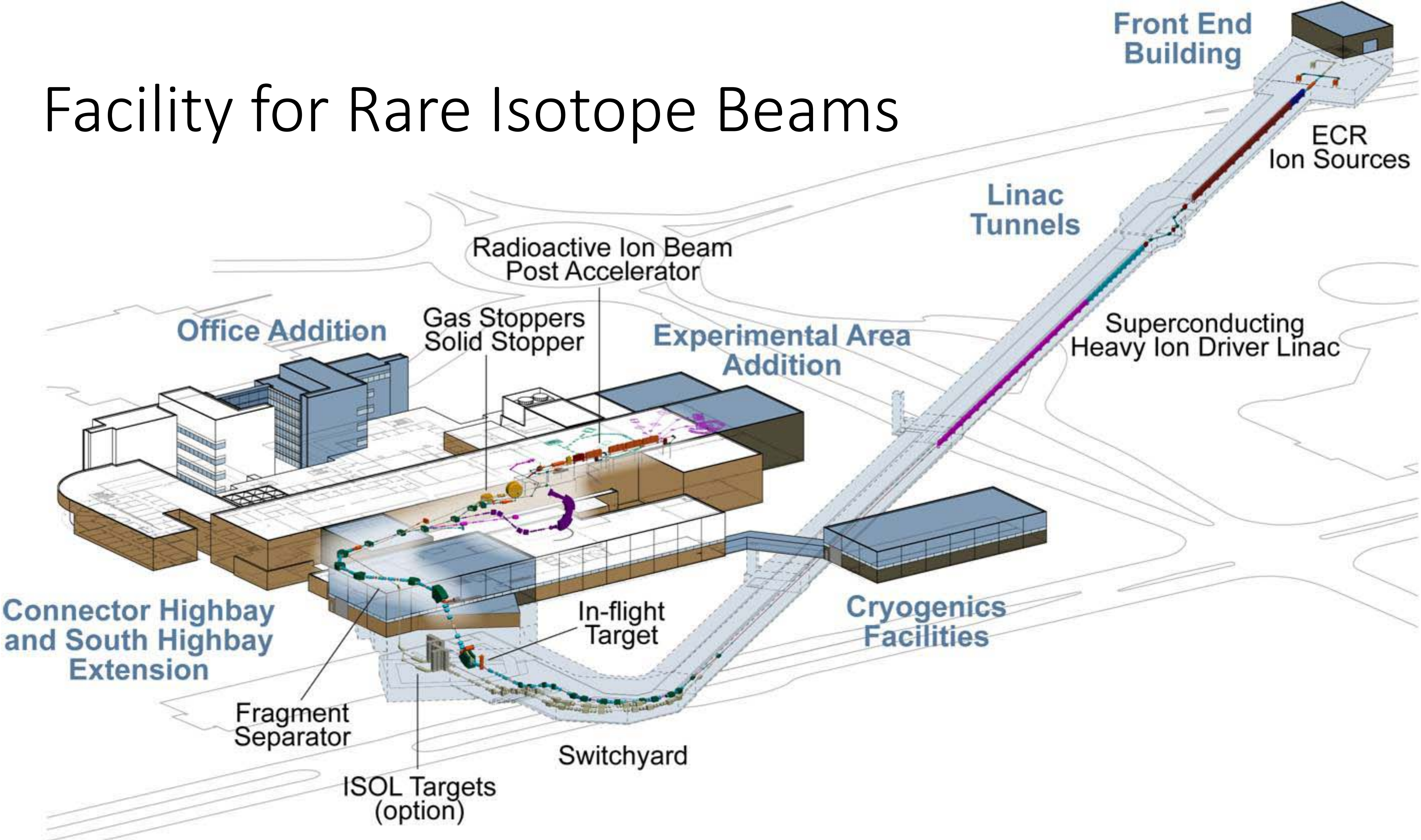
- Our team produces results that are important to a number of upcoming DOE and NASA missions. We are now in a position in TEAMS where we should tie to some of this science.
- Here I discuss a few such possible ties:
  - FRIB
  - Gamma-Ray Satellites
  - Shock Breakout
  - SN Remnants

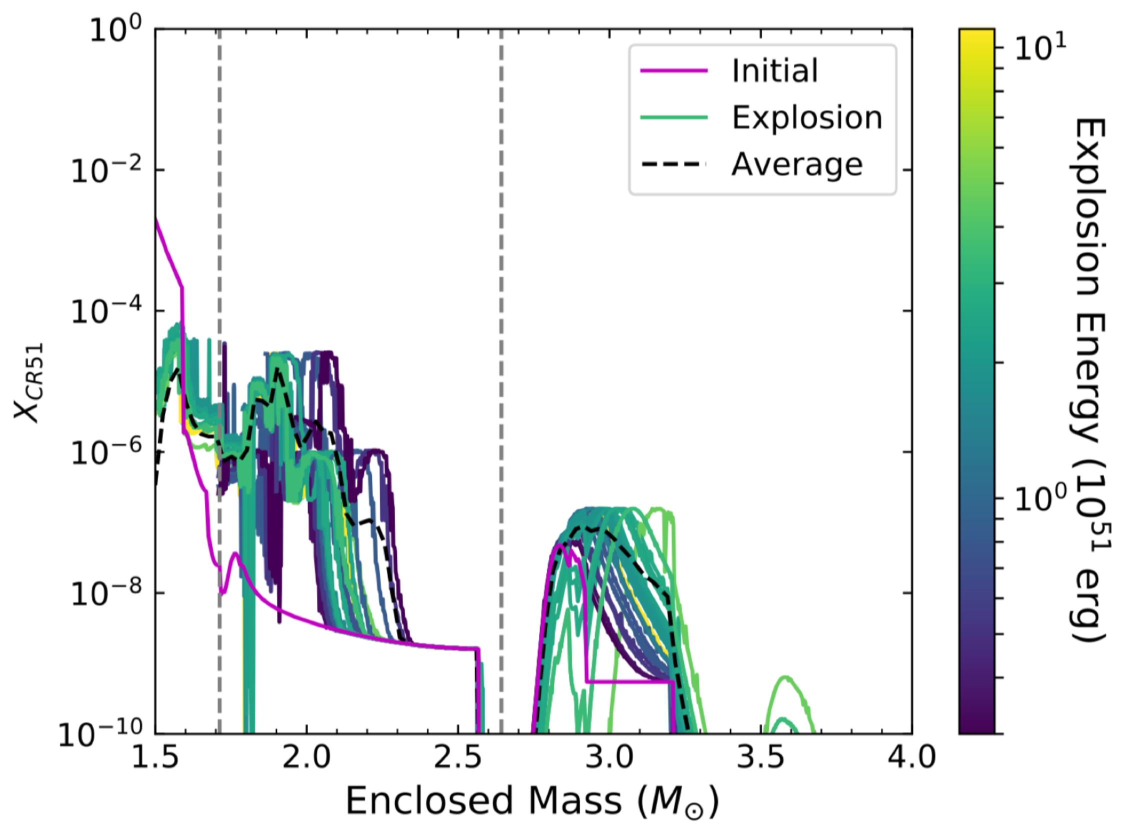


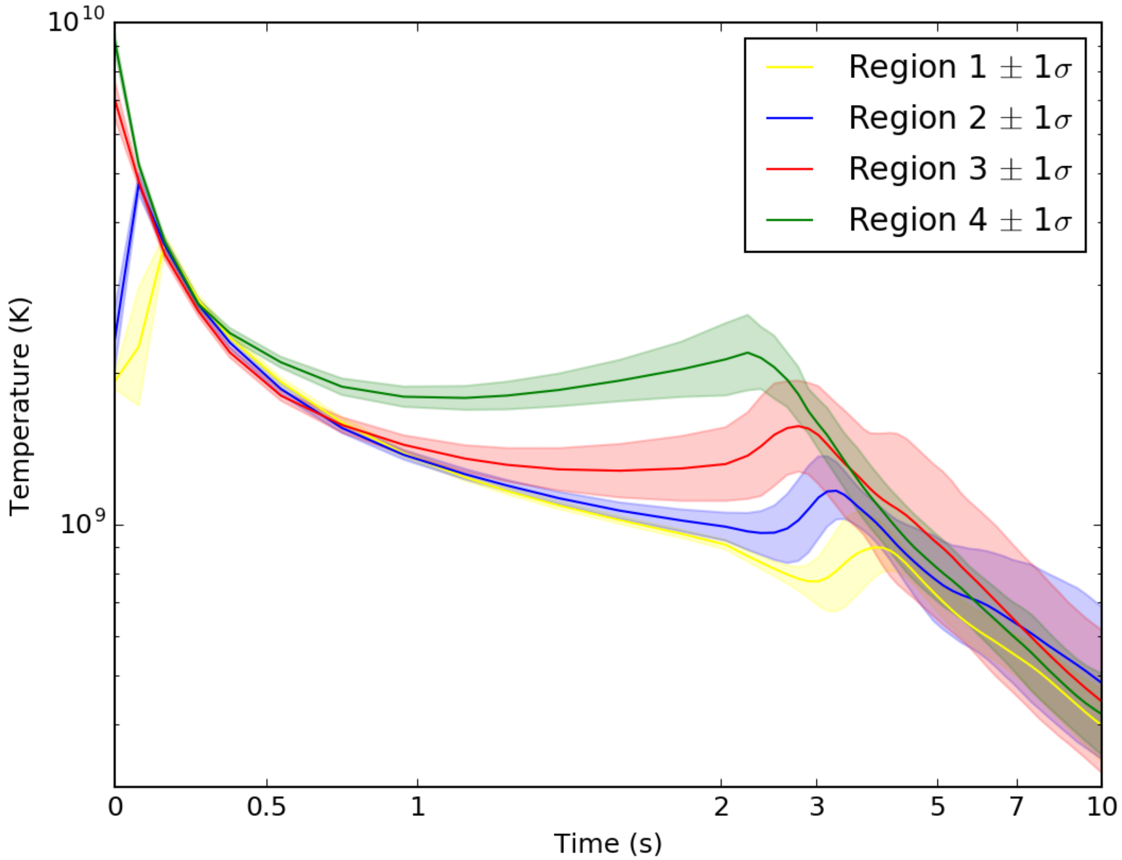
Facility for Rare Isotope Beams



New Studies in Core-Collapse Supernovae

- Lots of work within JINA (perhaps TEAMS can lead a team to help with proposals)
- Wide variation with energy (Andrews et al. 2020)

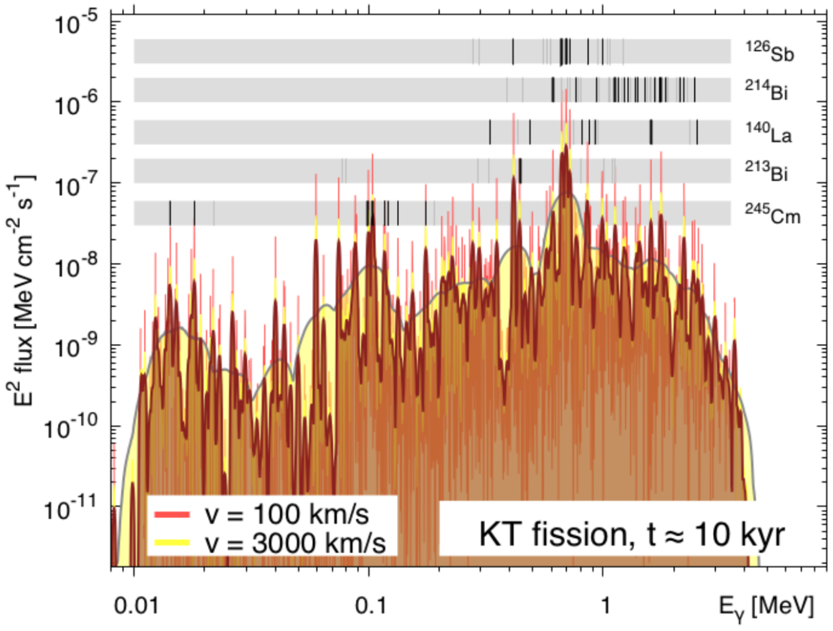




- The trajectories, especially in 3D are not simple – reheat happens that may change the importance of certain cross-sections (Vance et al. 2020).

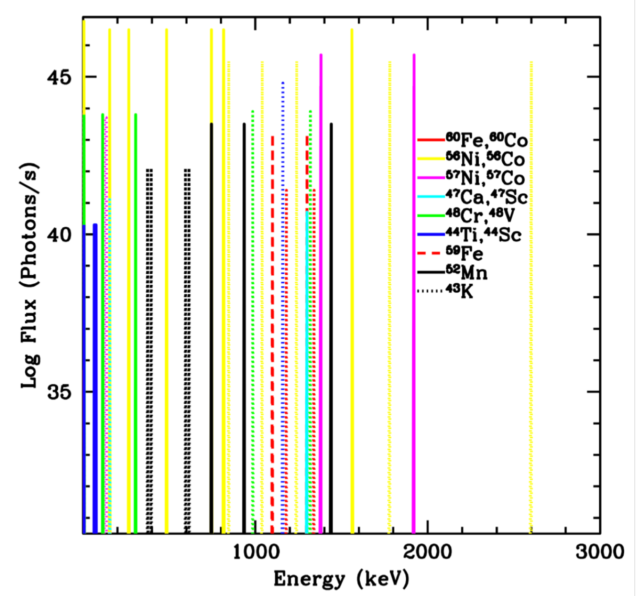
Nuclear Astrophysics and gamma-ray astronomy

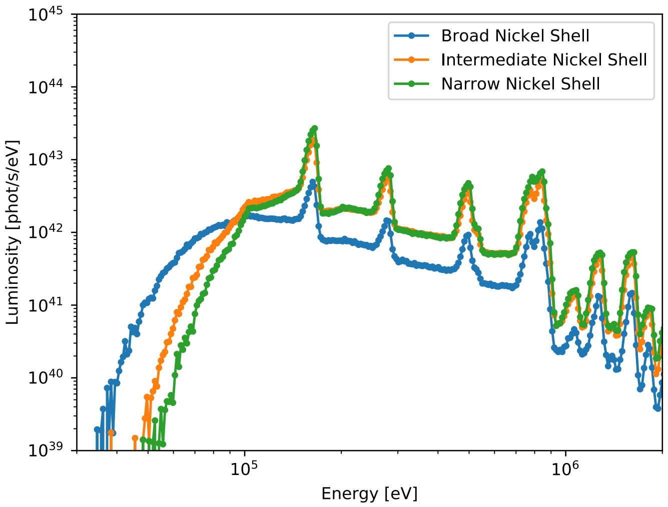
- Nuclear decay lines are important probes of the engines (and the physics behind them) of many transients.
- There are a lot of missions proposed for the next generation gamma-ray satellites (covering a range of funding levels): Lunar Occultation Explorer (LOX), Compton Spectrometer and Imager (COSI, COSI-X has phase I funding), All-Sky Medium Energy Gamma-Ray Observatory (AMEGO), …
- To prepare for these missions, astronomers are calculating a modern set of signals inferred from the yields of a wide range of explosions.



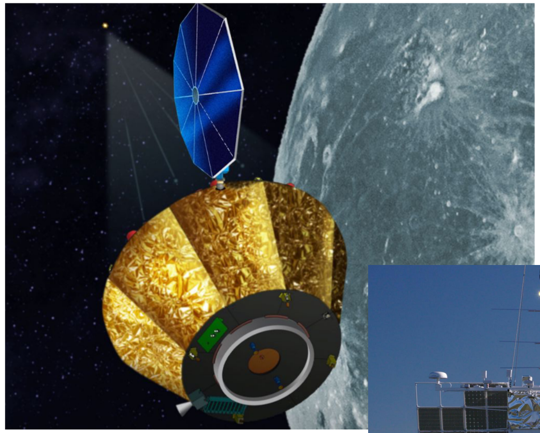
Kilonovae (Korobkin et al. 2019)

Core-Collapse Supernovae (Andrews et al. 2020)





Thermonuclear Supernovae (Hungerford et al.. In prep)

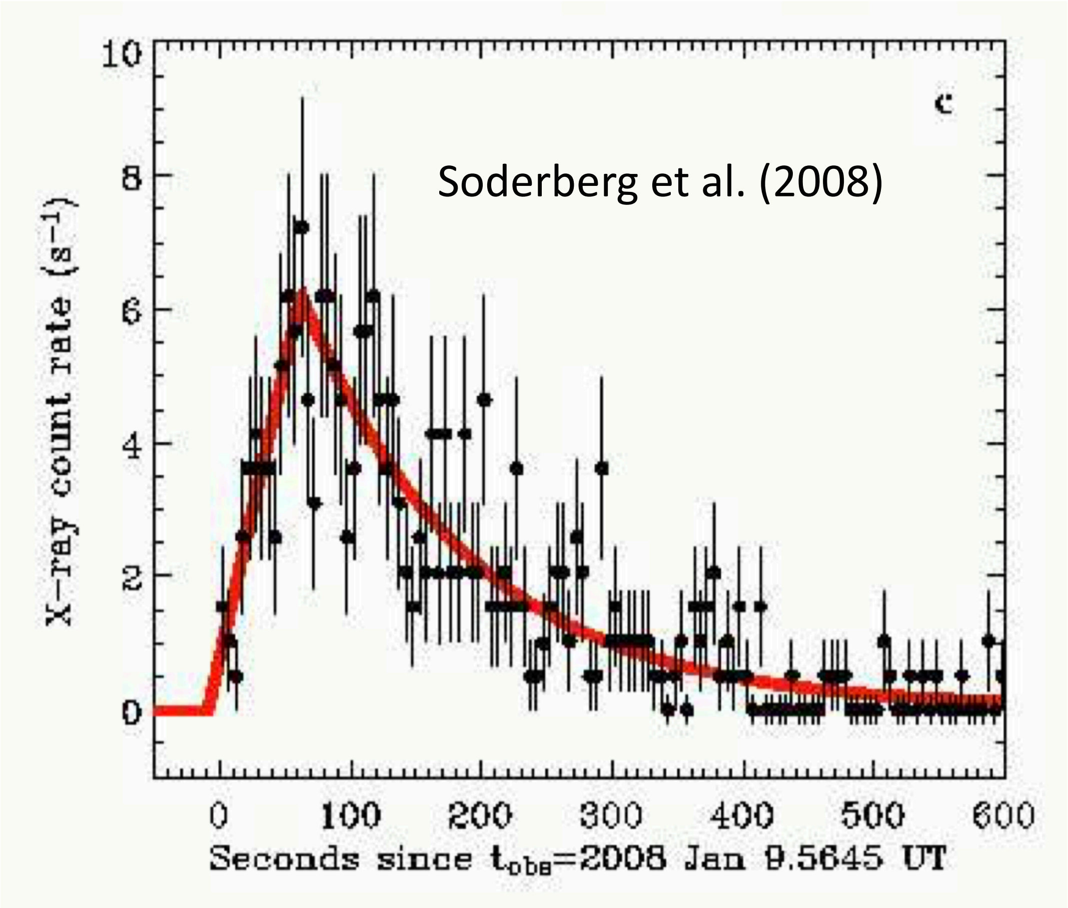


LOX

COSI

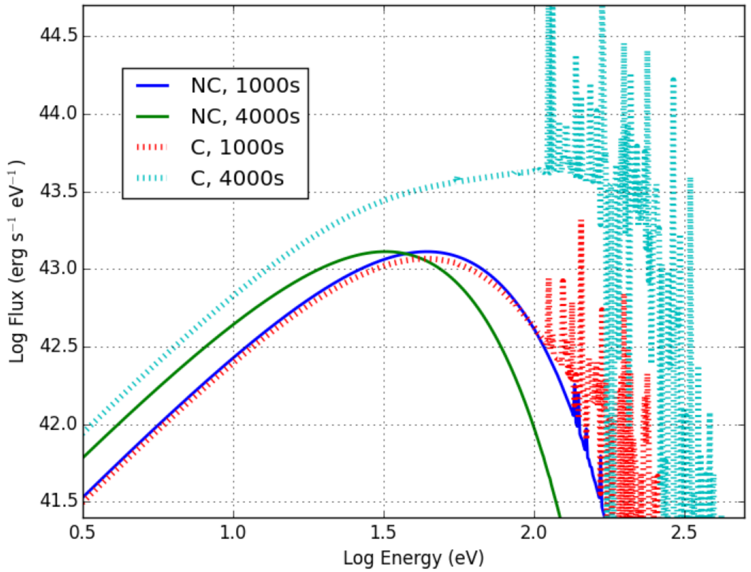
Supernova Shock Breakout

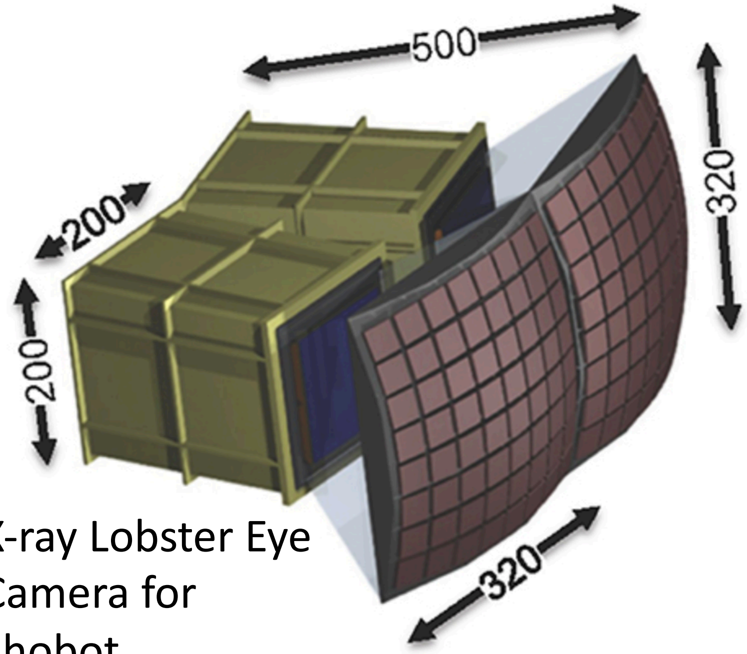
- Shock Breakout in supernovae refers to the condition when the radiatively-driven supernova shock emerges ("breaks out") of a star. This is the first electromagnetic emission of the explosion. A few serendipitous observations of shock breakout exist (Soderberg et al. 2008, Schawinski et al. 2008)
- Models of the emission have shown that scientists can probe properties of the star and its supernova explosion (e.g. stellar radius and density profile, shock velocity, etc.) from the time-dependent breakout emission.
- But the shocks produced as the blastwave hits the interstellar medium make this signal both more difficult to interpret and a more powerful probe of the stellar properties.



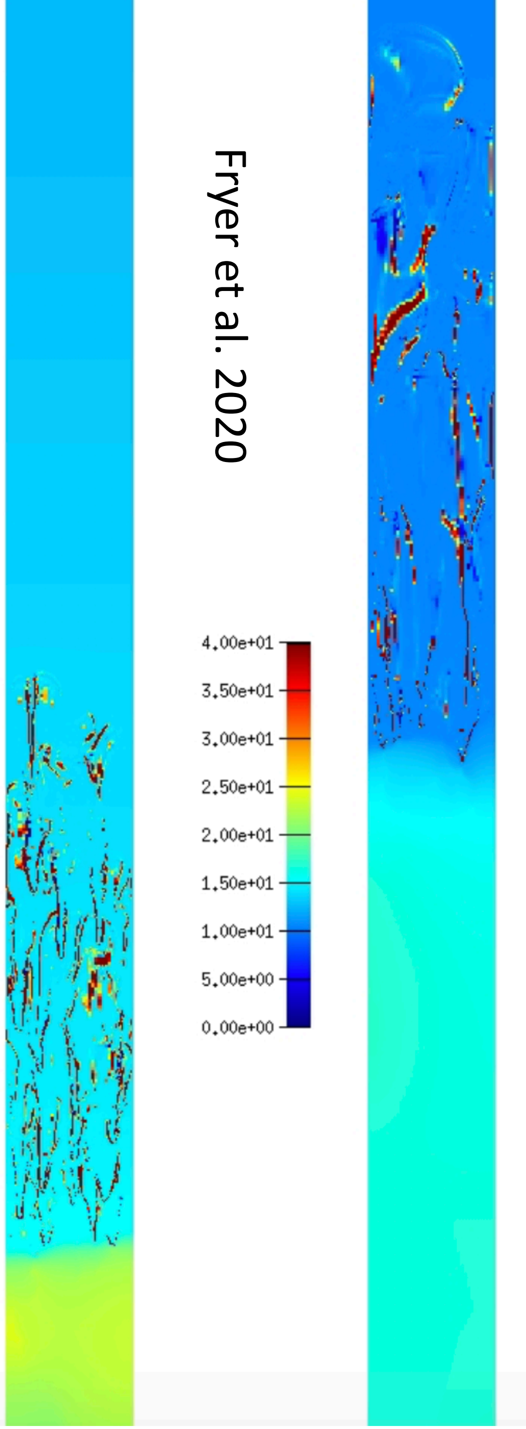
Shock Interactions and UV/X-ray Observations

- With our models, we can study the dependence of the UV and X-ray signal on the shock interactions.
- Scientists are planning missions for ISA and NASA to detect these UV and X-ray signals. LANL scientists are involved in the science case and mission design for the NASA Shobot mission.
- Laboratory Experiments at LANL are designed to test the physics of shock interactions: Radishock

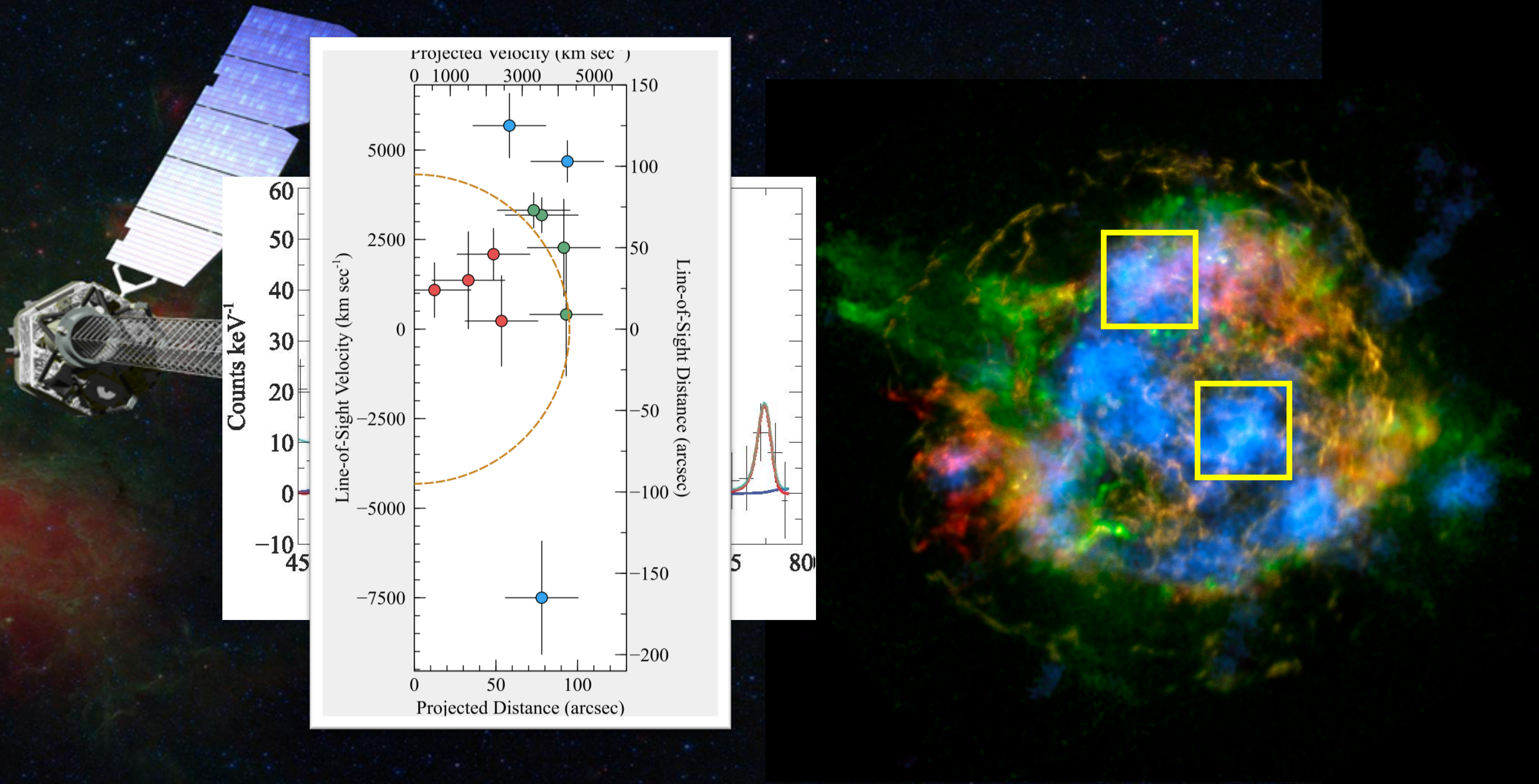




X-ray Lobster Eye Camera for Shobot



Supernova Remnants: NuSTAR and Cassiopeia A



SuperConducting TiTanium Imager (SCOTTI)

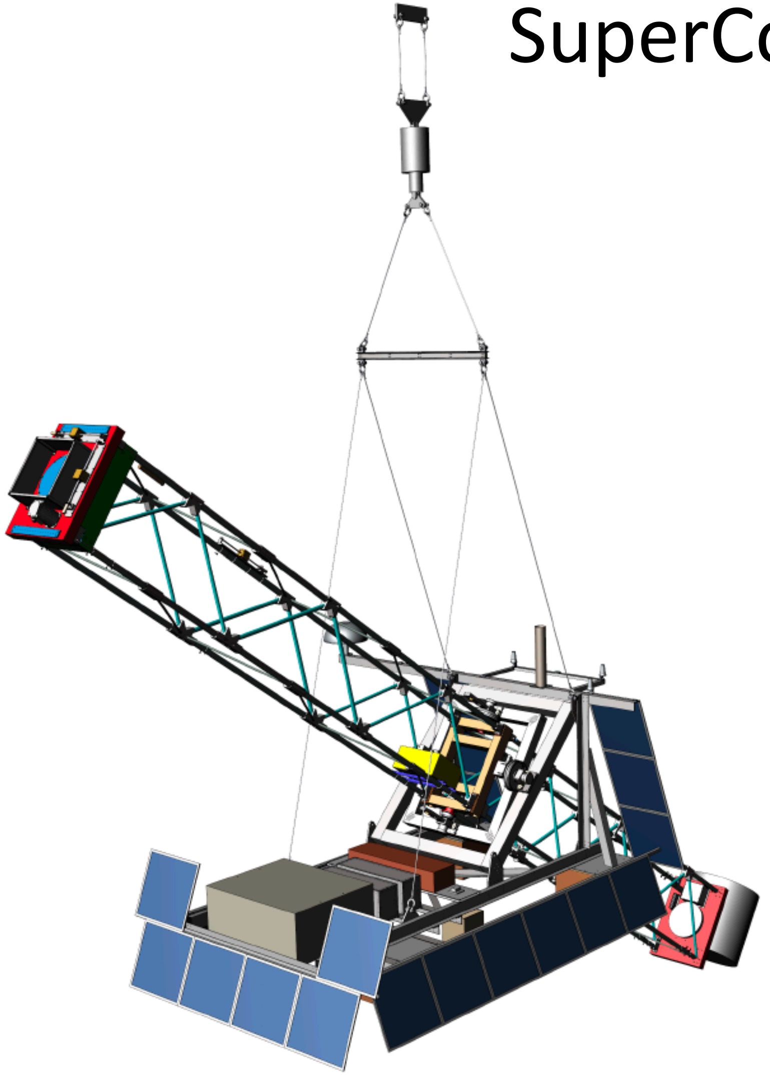
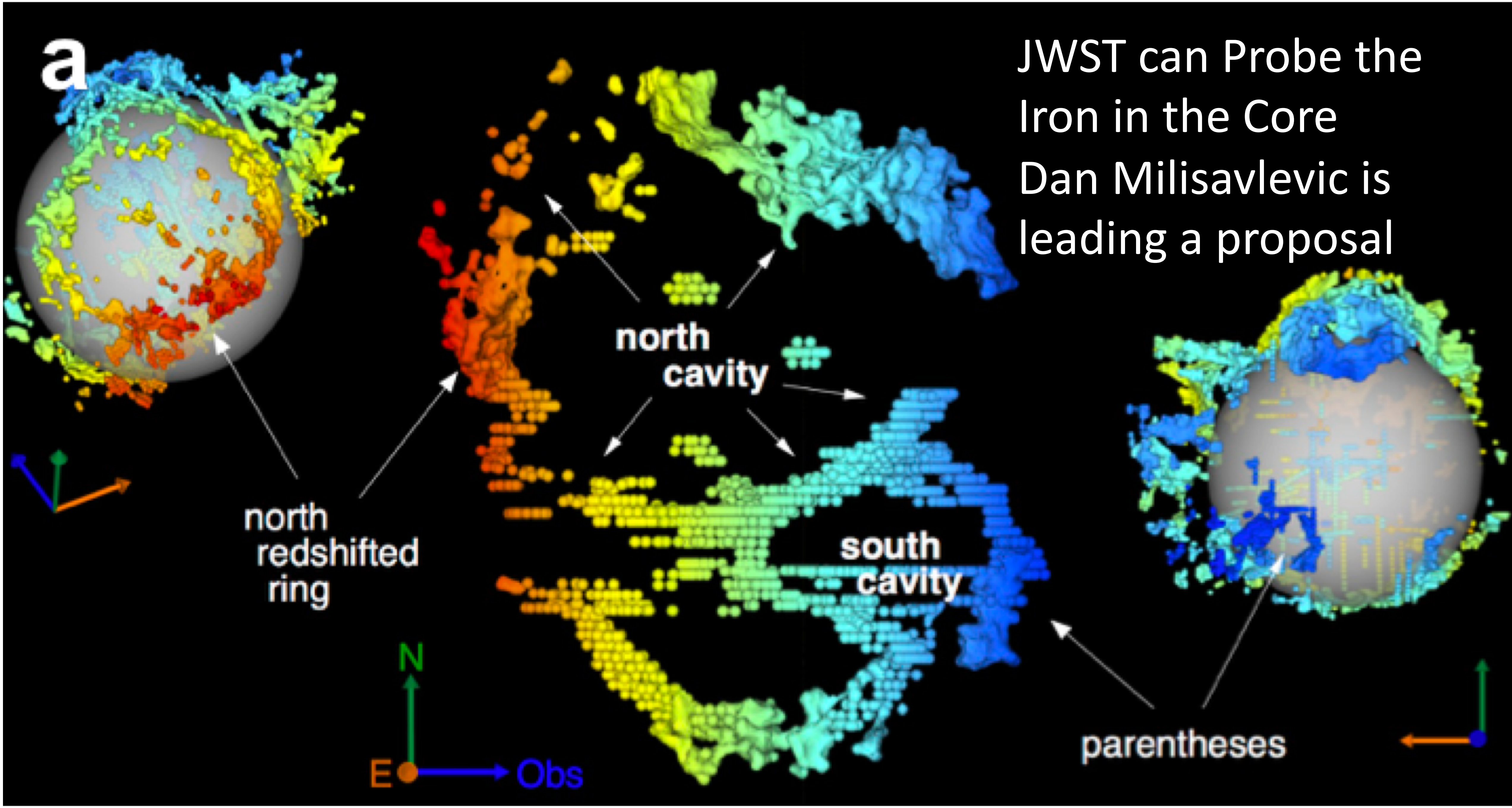


Figure 6: CAD rendering of the *SCOTTI* telescope.

Table 2: Specifications of *SCOTTI* components.

Focal length	12 m
Effective area	>80 cm^2 (60–75 keV)
Angular resolution	1′ HPD
Energy resolution	50 eV at 80 keV
Detector size	$3 \times 3\ cm^2$
Pixel pitch	1.75 mm
Pixel count	256
Base temperature	70 mK
Cryogen	65 L liquid He
Pointing stability	<1″ RMS

JWST can Probe the Iron in the Core
Dan Milisavlevic is leading a proposal



Where next?

- What other opportunities are there? Let’s make a list.
- Trajectories for yields? Do we want a joint effort here?