Quick notes on

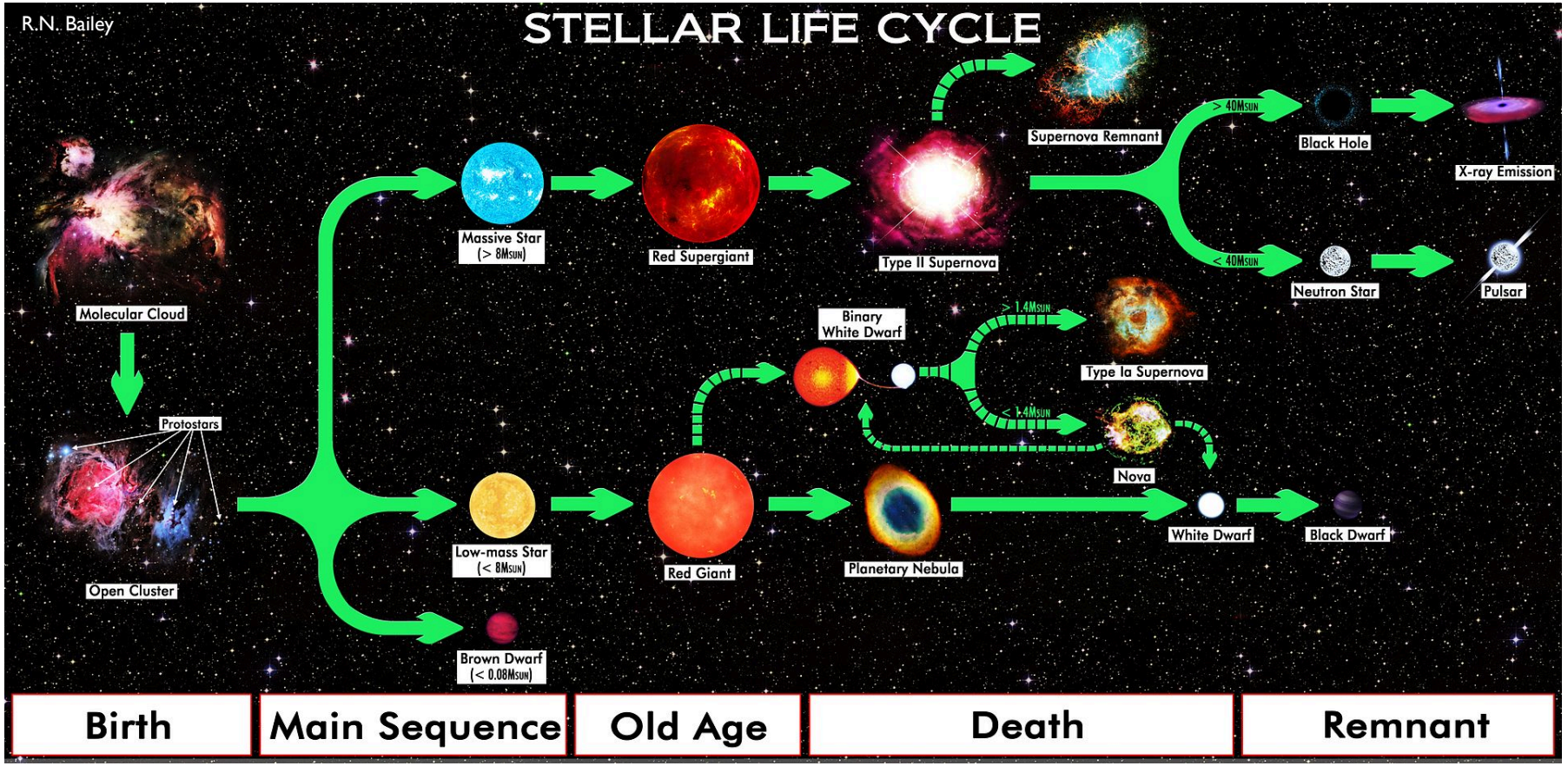
Compact Object Nucleosynthesis

Zach Meisel

Ohio University - ASTR4201 - Fall 2020

Compact Objects: *White Dwarves, Black Holes, and Neutron Stars* (oh my)

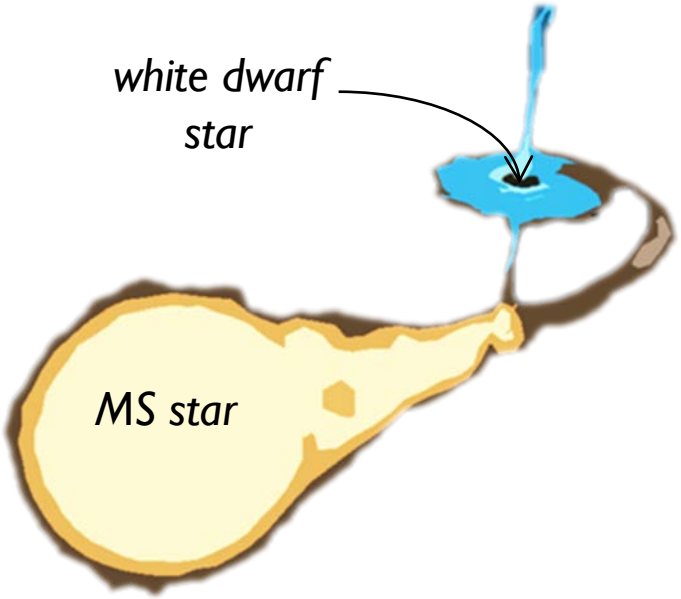
"Dead" stars are prolific nucleosynthesis environments:



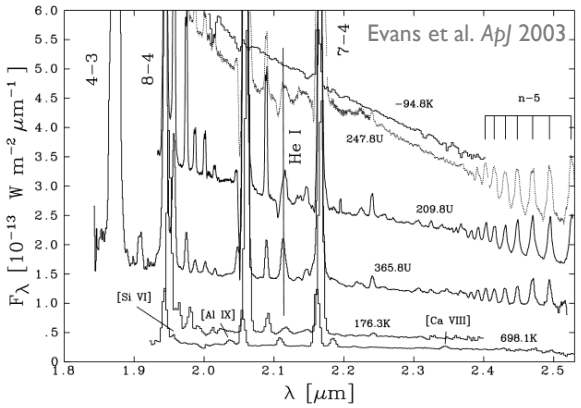
- Black-hole accretion disks
- Neutron star mergers
- Type-Ia supernovae
- Novae

Nova nucleosynthesis: *dumping H onto a white dwarf star*

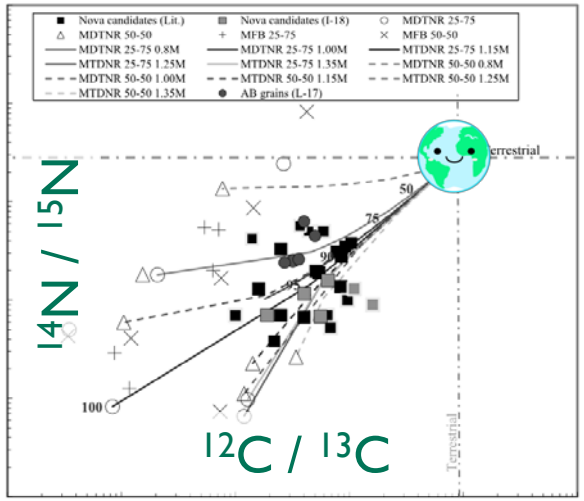
Recurrent explosions synthesize up to ^{40}Ca (and beyond?) with a potentially rich set of observables

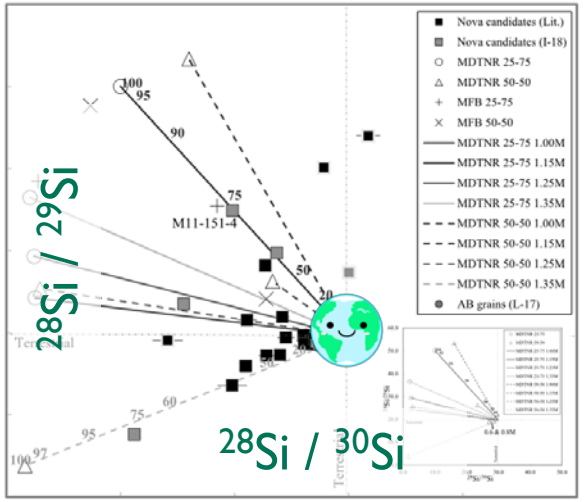


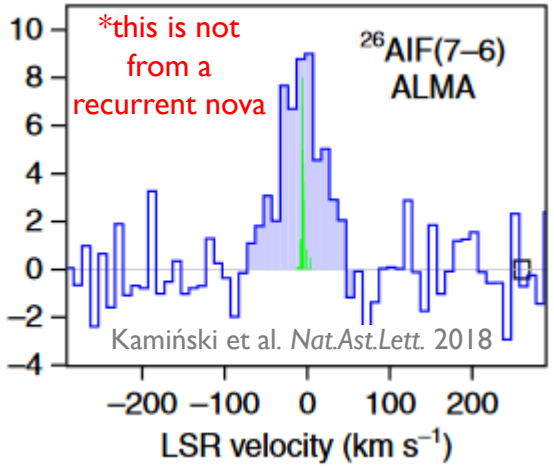
Atomic spectra:



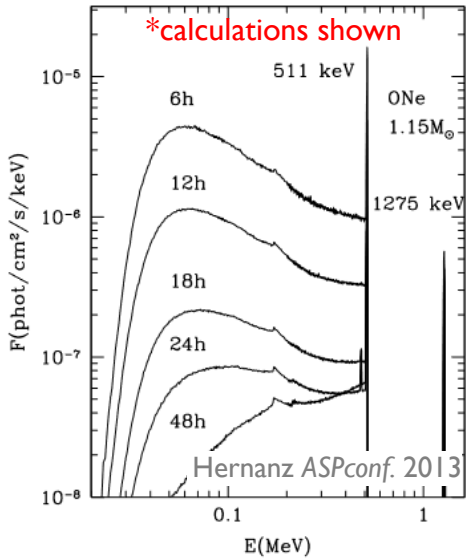
Pre-solar grains:

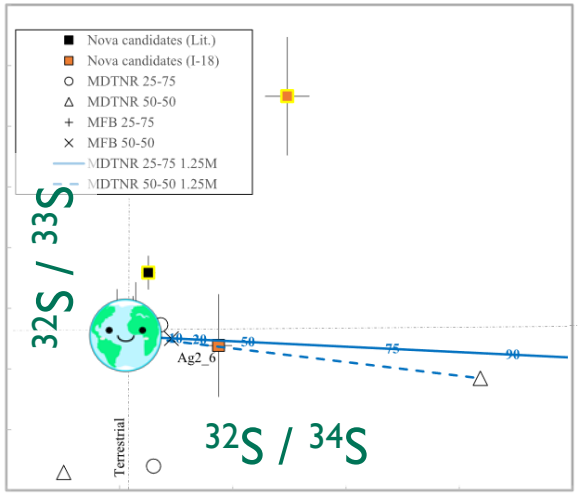


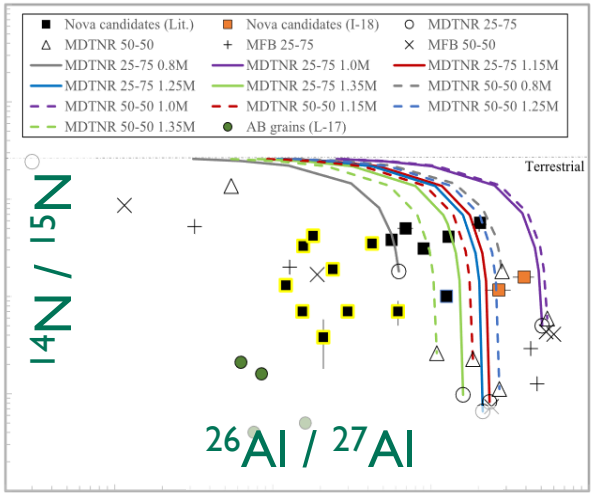




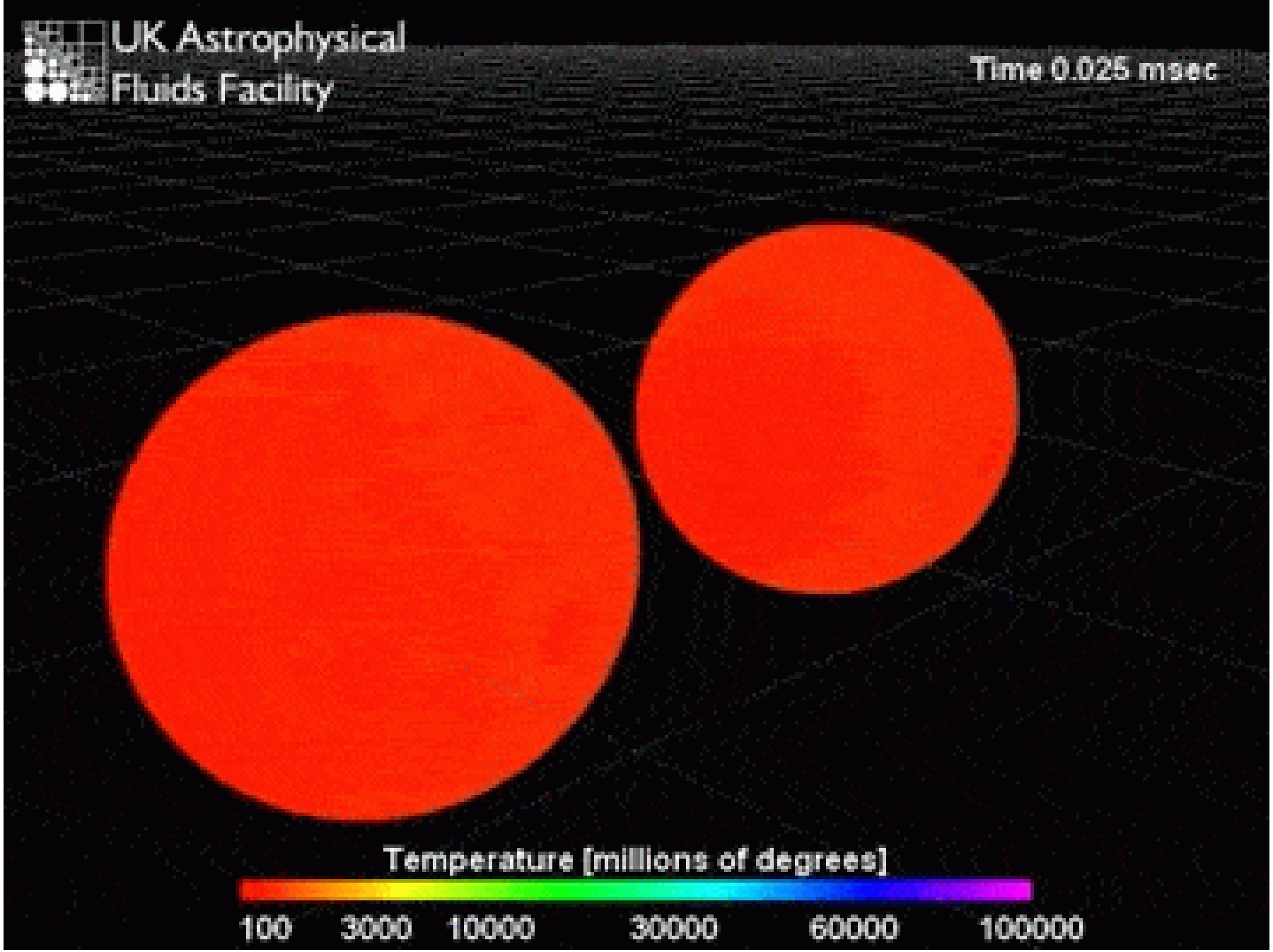
Maybe* γ-rays:

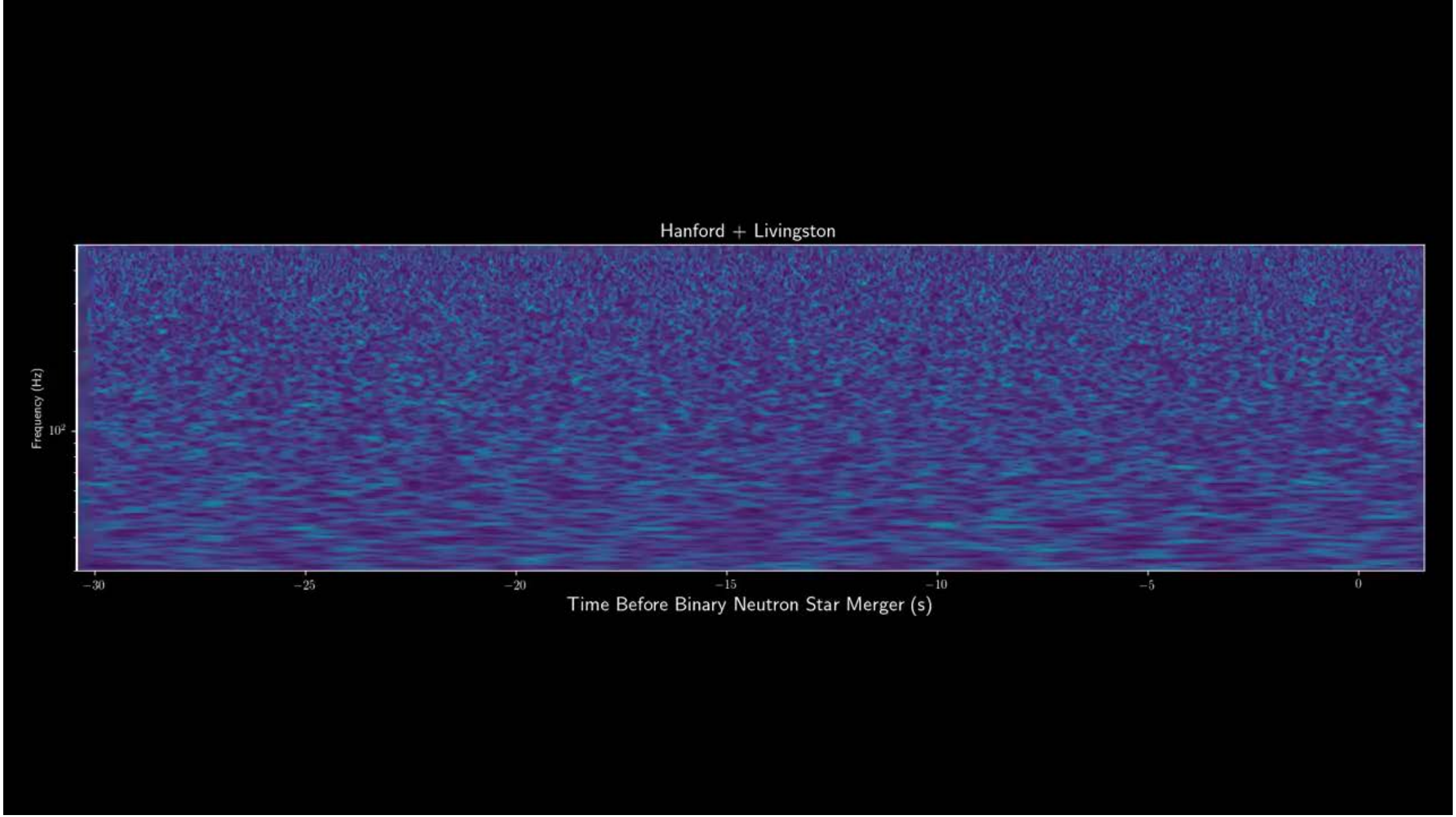




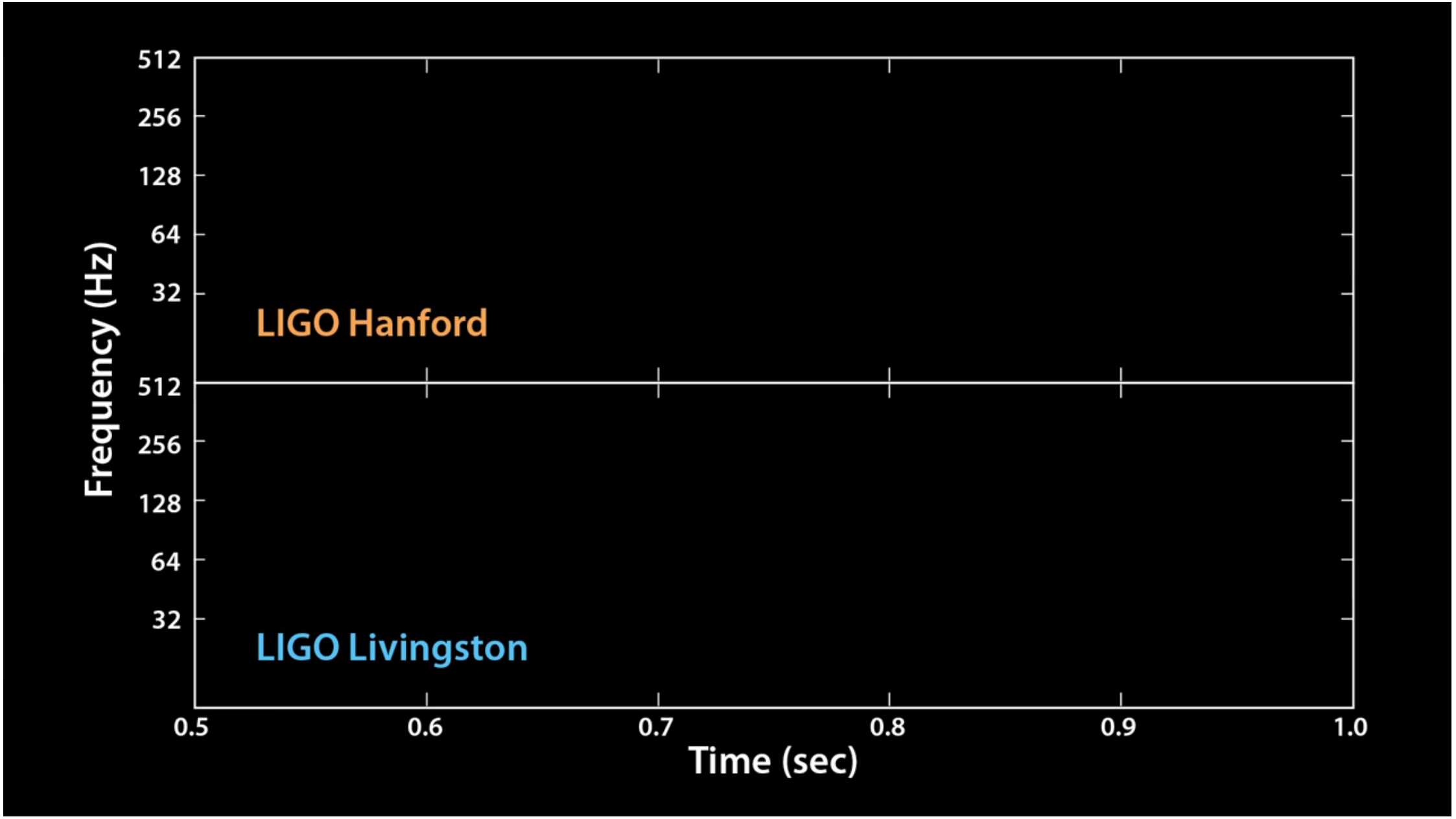


Bose & Starrfield *ApJ* 2019


UK Astrophysical
Fluids Facility
Time 0.025 msec
Temperature [millions of degrees]
100
3000
10000
30000
60000
100000



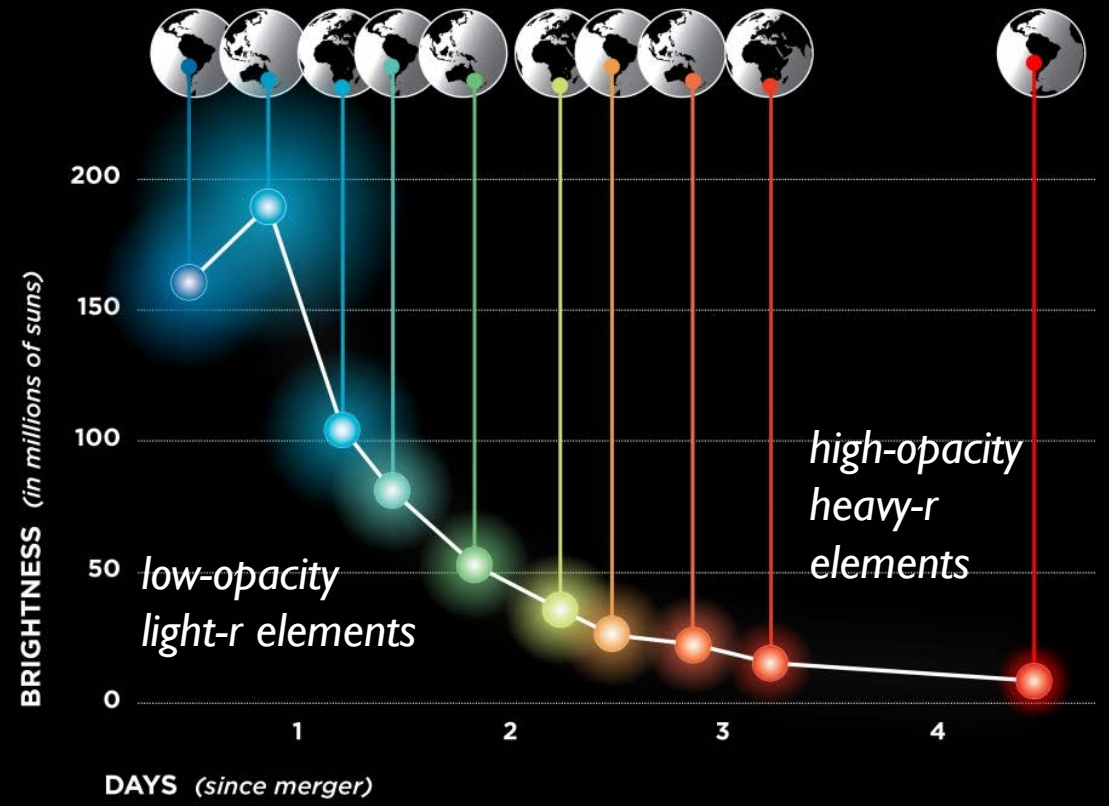
https://www.youtube.com/watch?v=_SQbaILipjY



https://www.youtube.com/watch?v=QyDcTbR-kEA

Kilanova: *a signature of gold production (many other elements too!)*

NASA, ESA, ESO, Tanvir et al.

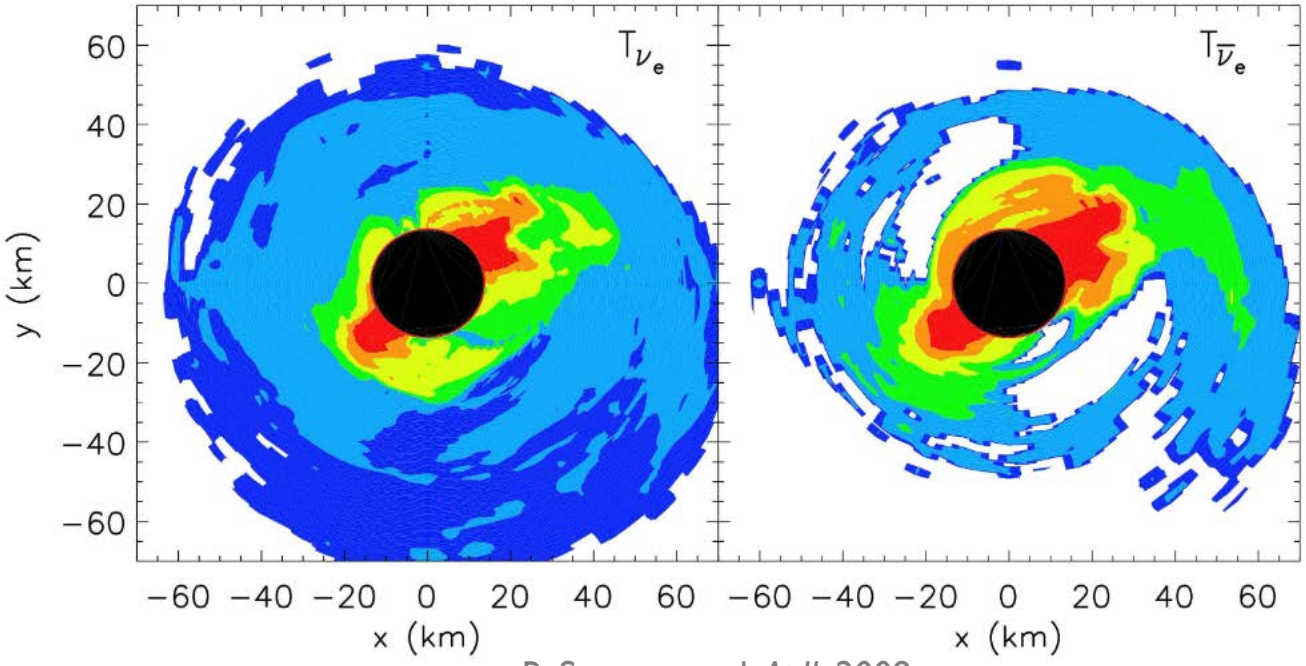


Las Cumbres Observatory LCO

Adapted from data in Arcavi et al. 2017, Nature: 10.1038/nature24291

Nucleosynthesis in Black Hole Accretion Disks

- Nothing escapes a black hole, right? Wrong, as long as things don't get too close!
- Consider a merging neutron star & black hole.
  Material will form an accretion disk around the black hole, which will be hot.
- Outflowing material from a few Schwarzchild radii has undergone nucleosynthesis
  and could in-principle contribute to the cosmic *r*-process abundances



R. Surman et al. *ApJL* 2008