Rapid Response Time-Domain Science with Gemini

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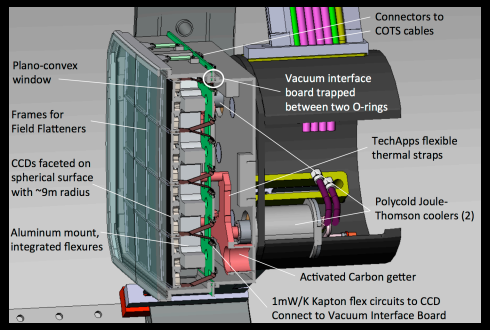
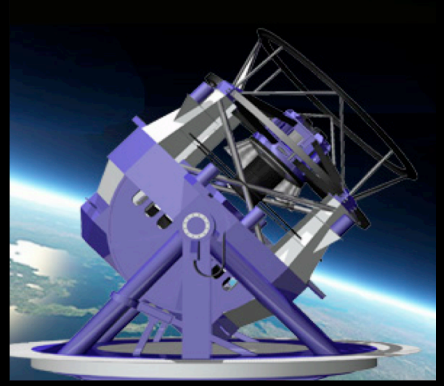
Time-Domain Astronomy

Optical:

Evryscope, ASASSN, HATPI



ZTF, CSS-II, PS2, BG, ATLAS



DECAM, HSC, LSST

Infrared: SPIRITS, Palomar Gattini-IR, Polar Gattini-IR

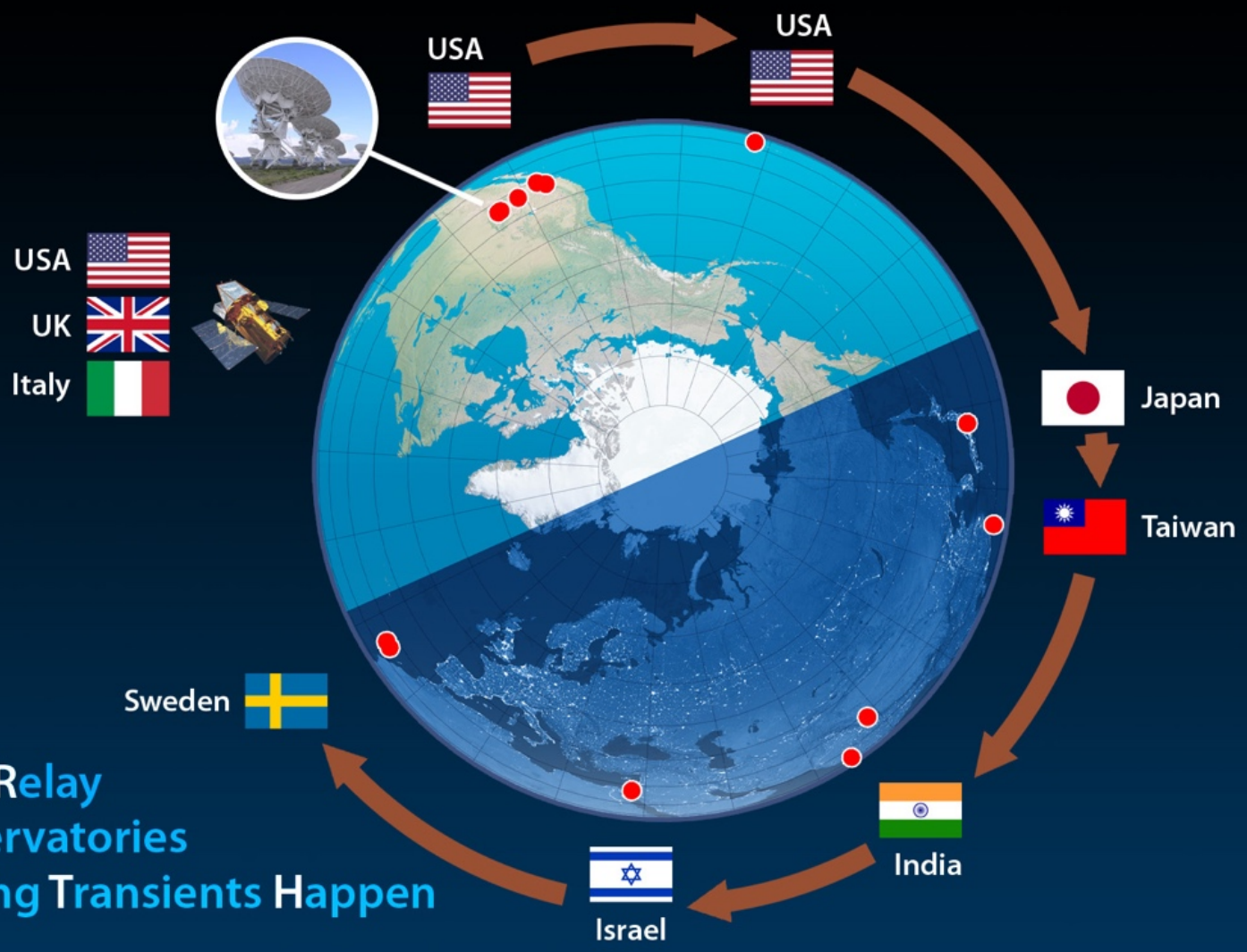
High Energy: Fermi, Swift, Integral

Radio:

LOFAR, MWA and LWA: meter and decameter-mapping

Apertif, Meerkat and Askap: decimetric mapping

Follow-Up is Key



GROWTH

Global Relay of Observatories Watching Transients Happen

NSF

PIRE

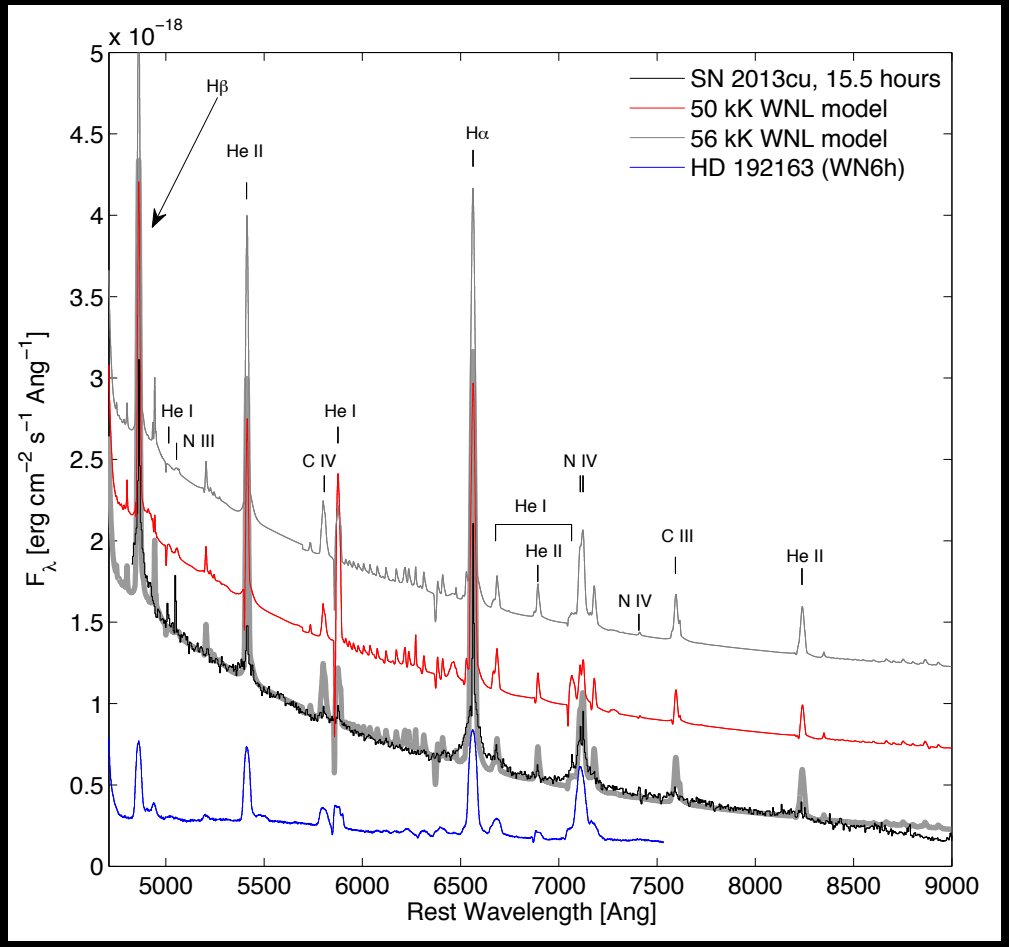
Rapid Response Follow-up with Gemini

- Queue scheduling facilitates rapid response within minutes
- North+South: Anywhere in the Sky, Weather Hedge
- Instrument Availability without Lunation Constraints
- Gen4 Instrument: Octocam

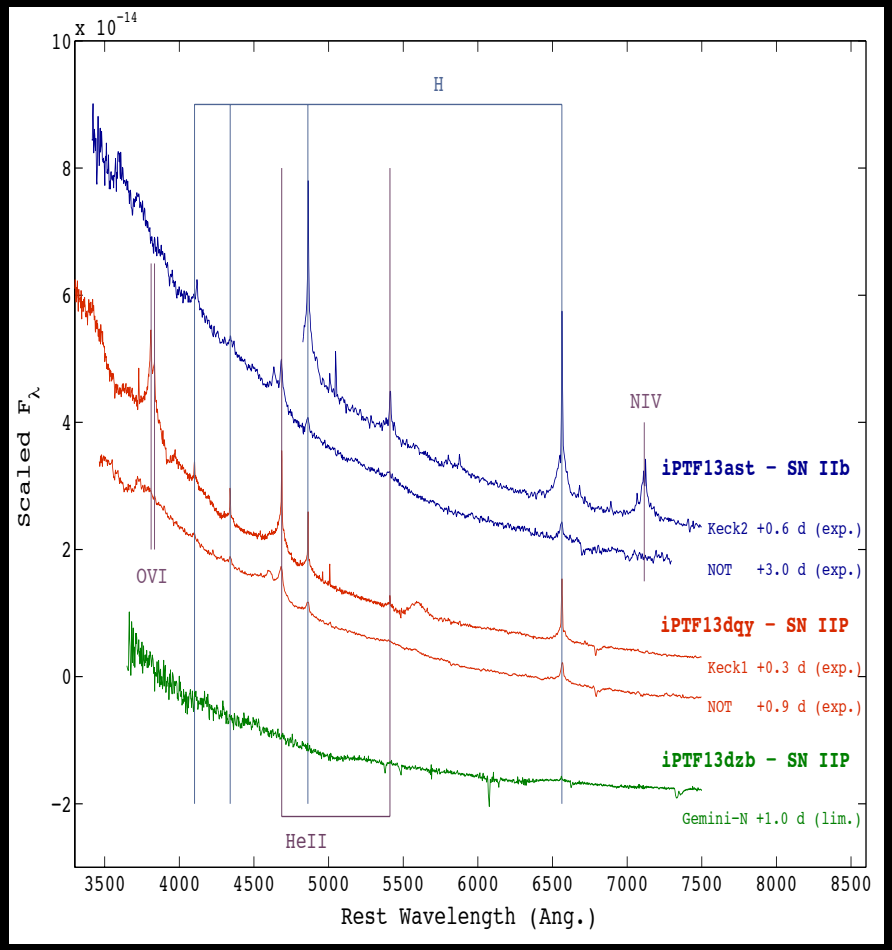
I. Young Supernovae

Infant Type II Supernovae

Connecting the type of progenitor star to the type of core-collapse

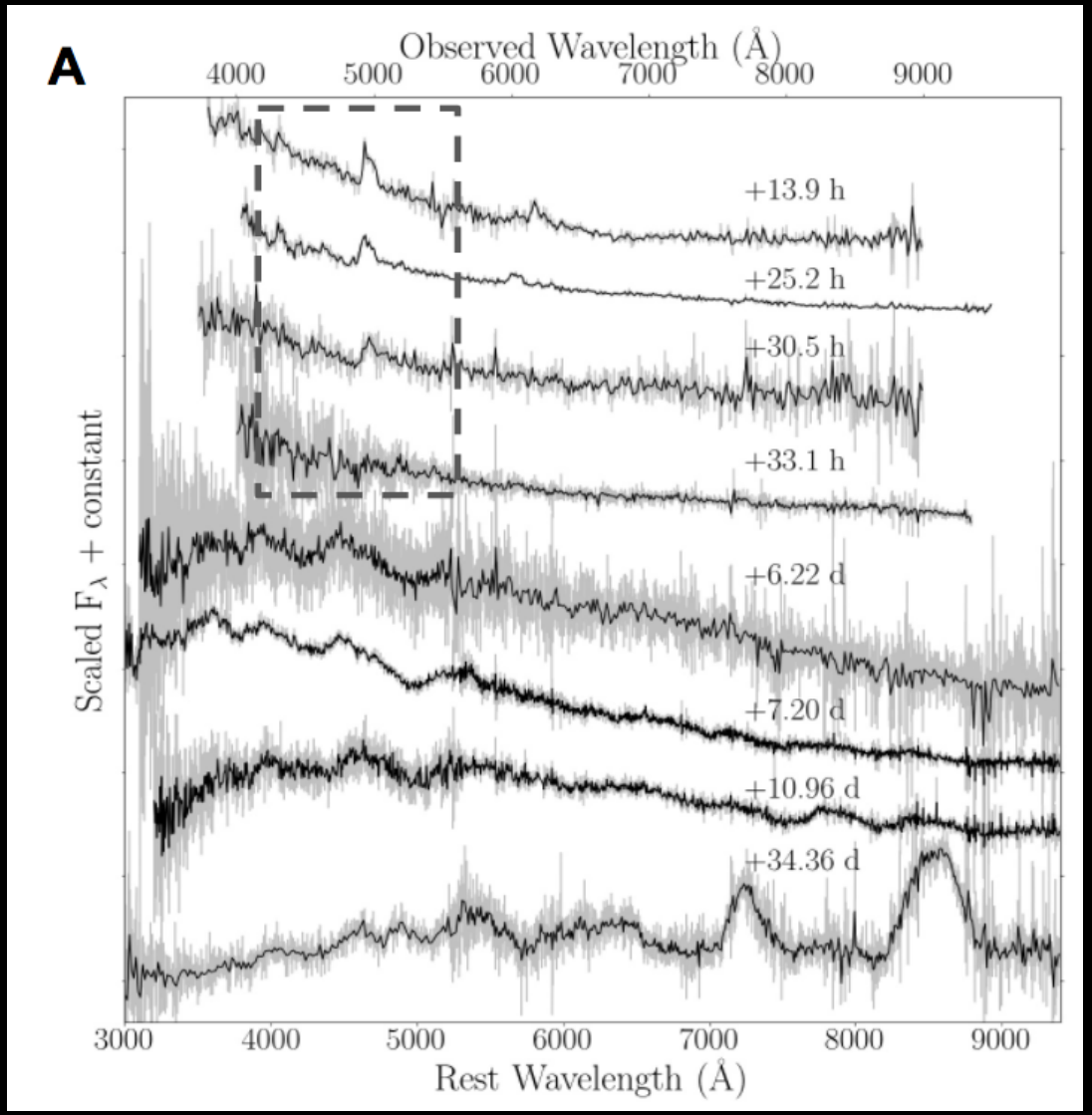


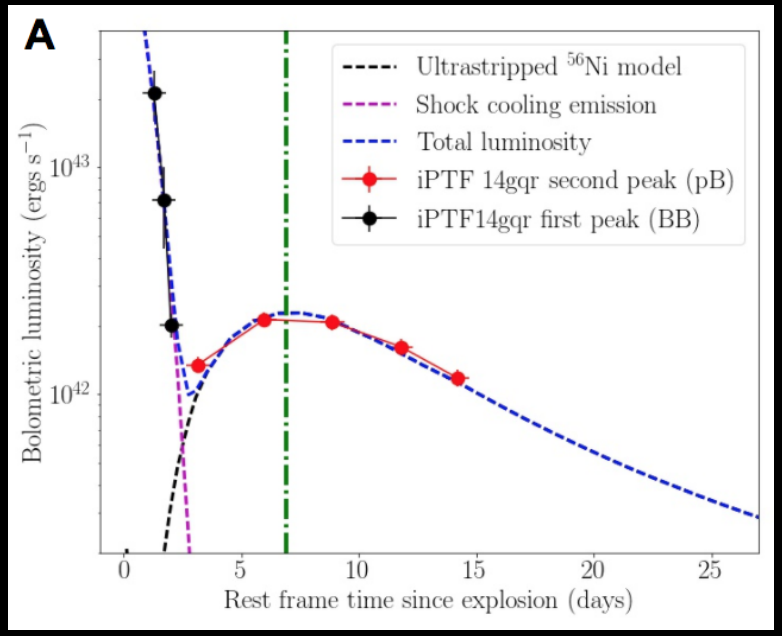
Gal-Yam et al. 2014, Nature



Khazov et al. 2016, Rubin et al. 2016
See also Hosseinzadeh et al. 2018

Infant Type Ic Supernova



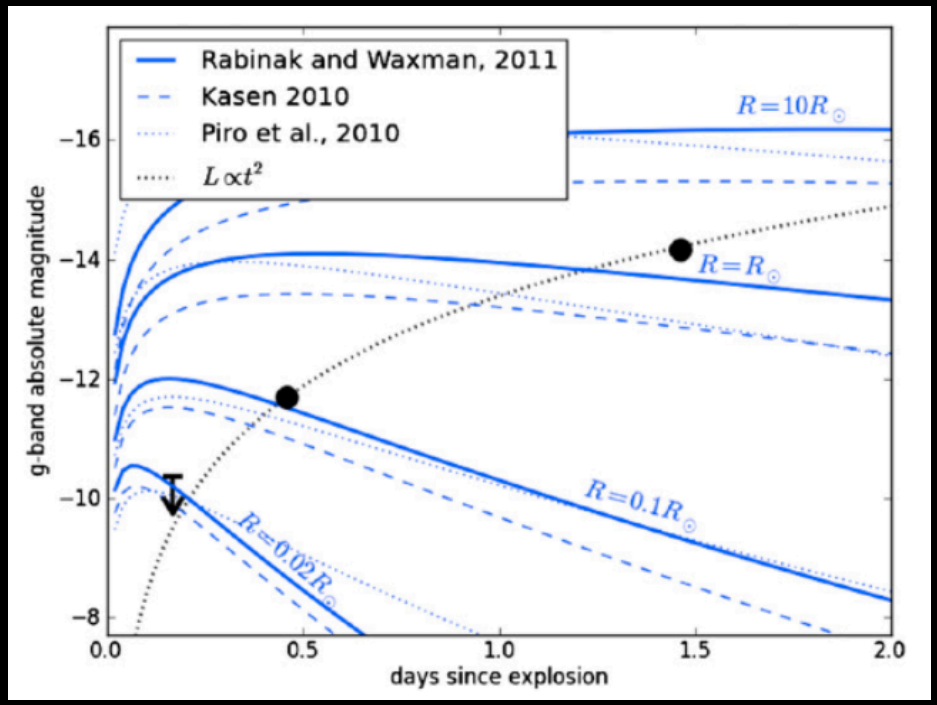


An ultra-stripped supernova that just formed a compact neutron star binary?

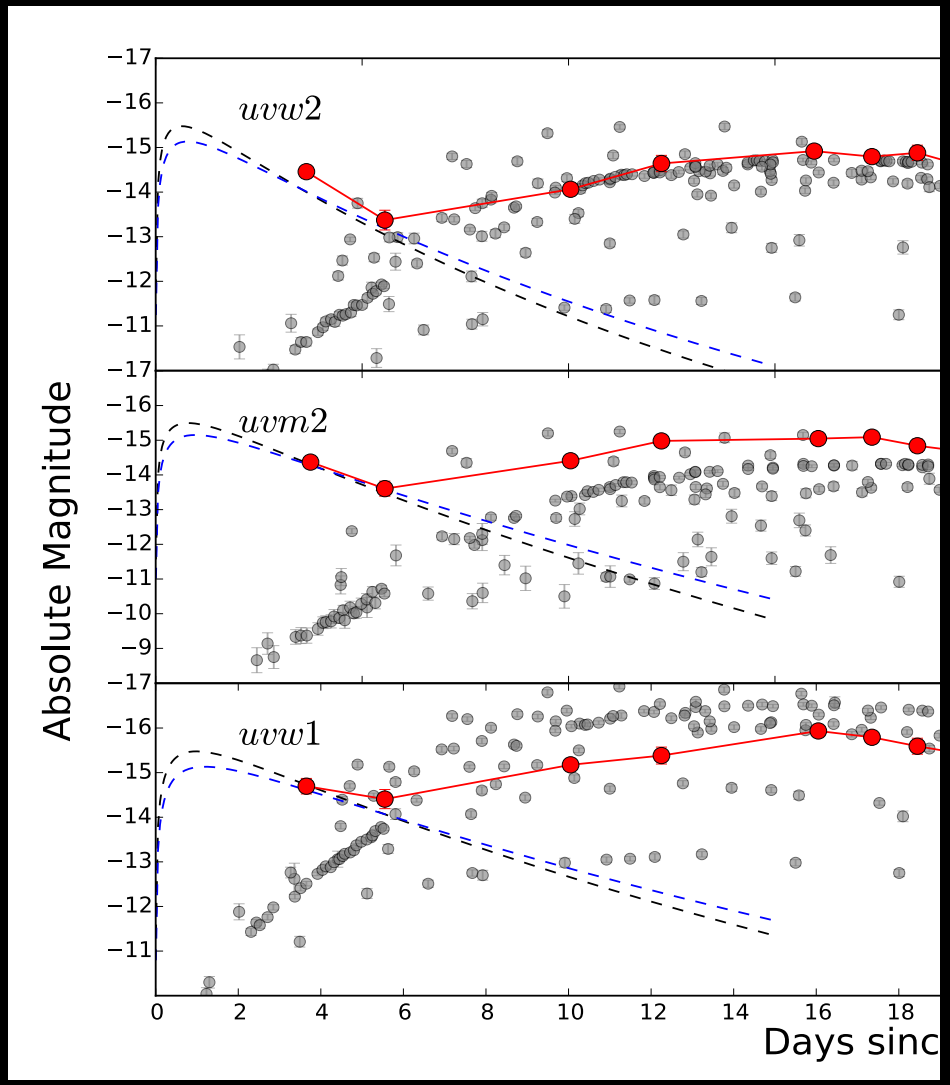
De et al. 2018, Science, submitted

Infant Type Ia Supernova

What is the companion of the exploding white dwarf?



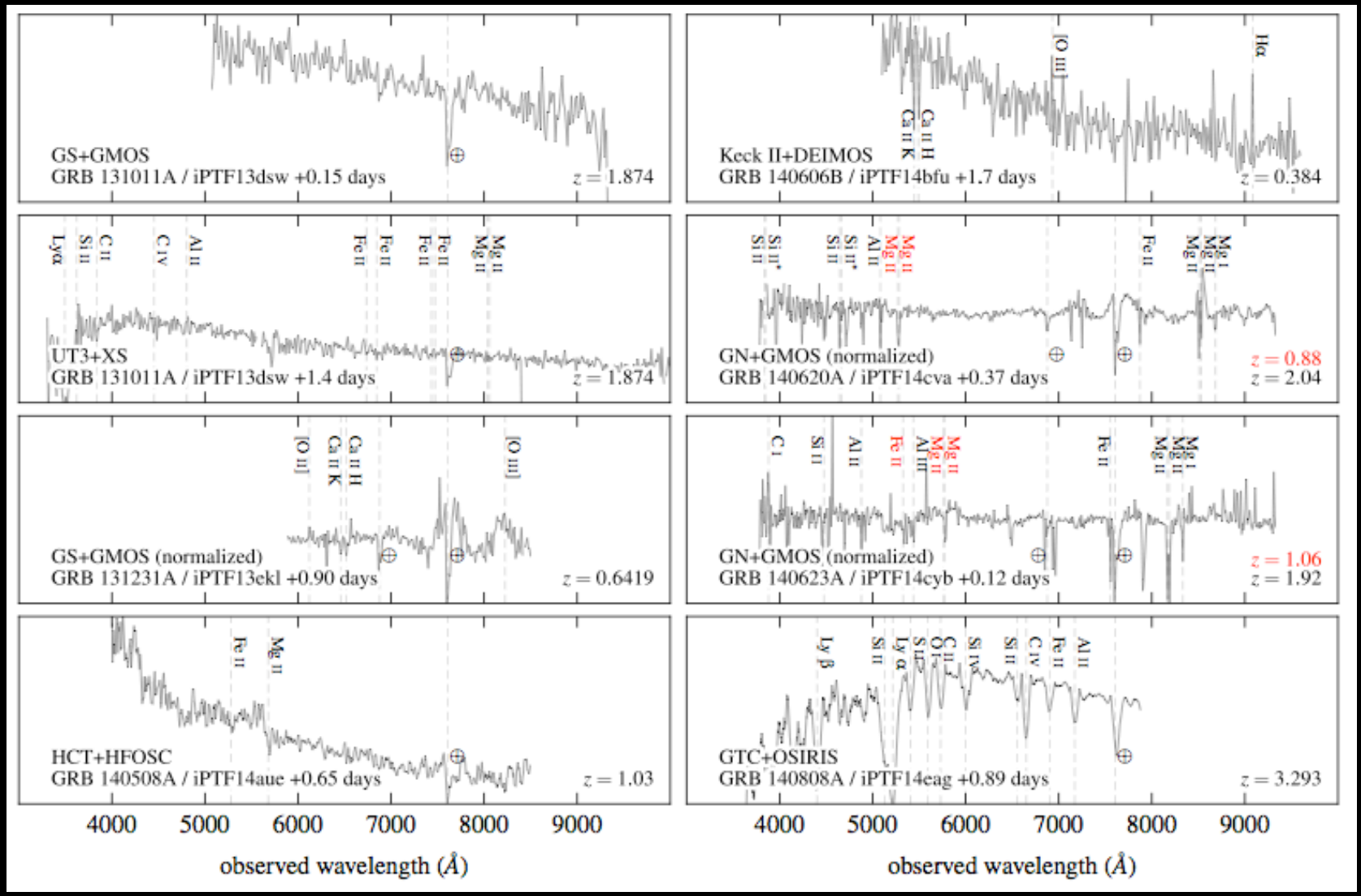
Nugent et al. 2011, Li et al. 2011,
Horesh et al. 2011, Bloom et al. 2011
+ 122 more papers



Cao et al. 2015, Marion et al. 2015,
Hosseinzadeh et al. 2017

II. Relativistic Explosions

Gamma-Ray Bursts



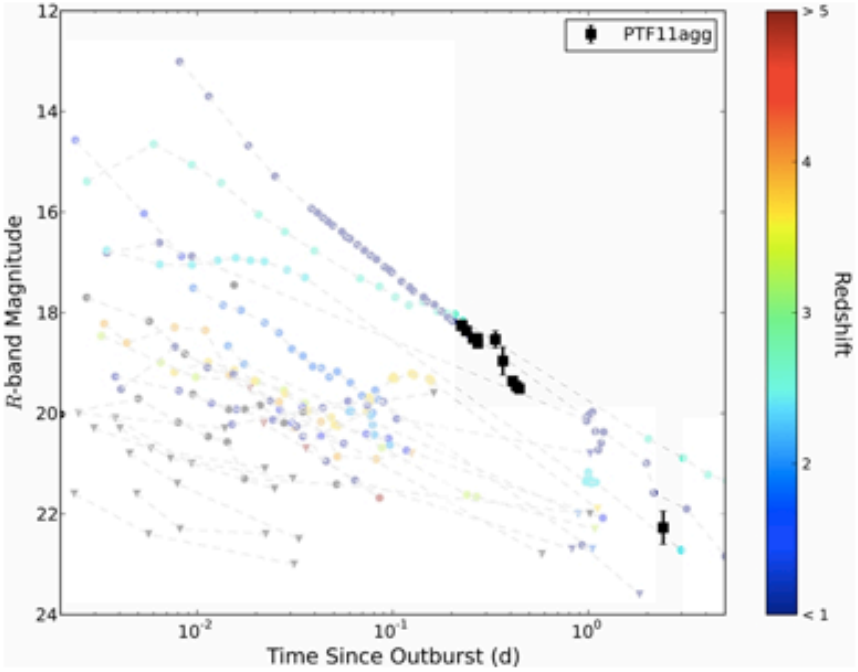
Singer et al. 2015

Many years of GRB science including high-redshift GRBs

Orphan Afterglows

PTF11agg

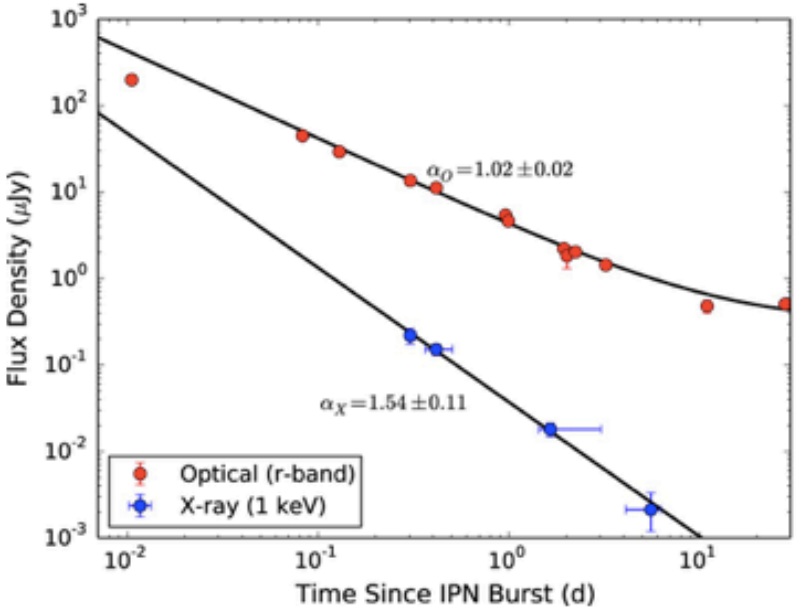
Cenko+ 2013



untriggered GRB afterglow?

iPTF14yb

Cenko+ 2015

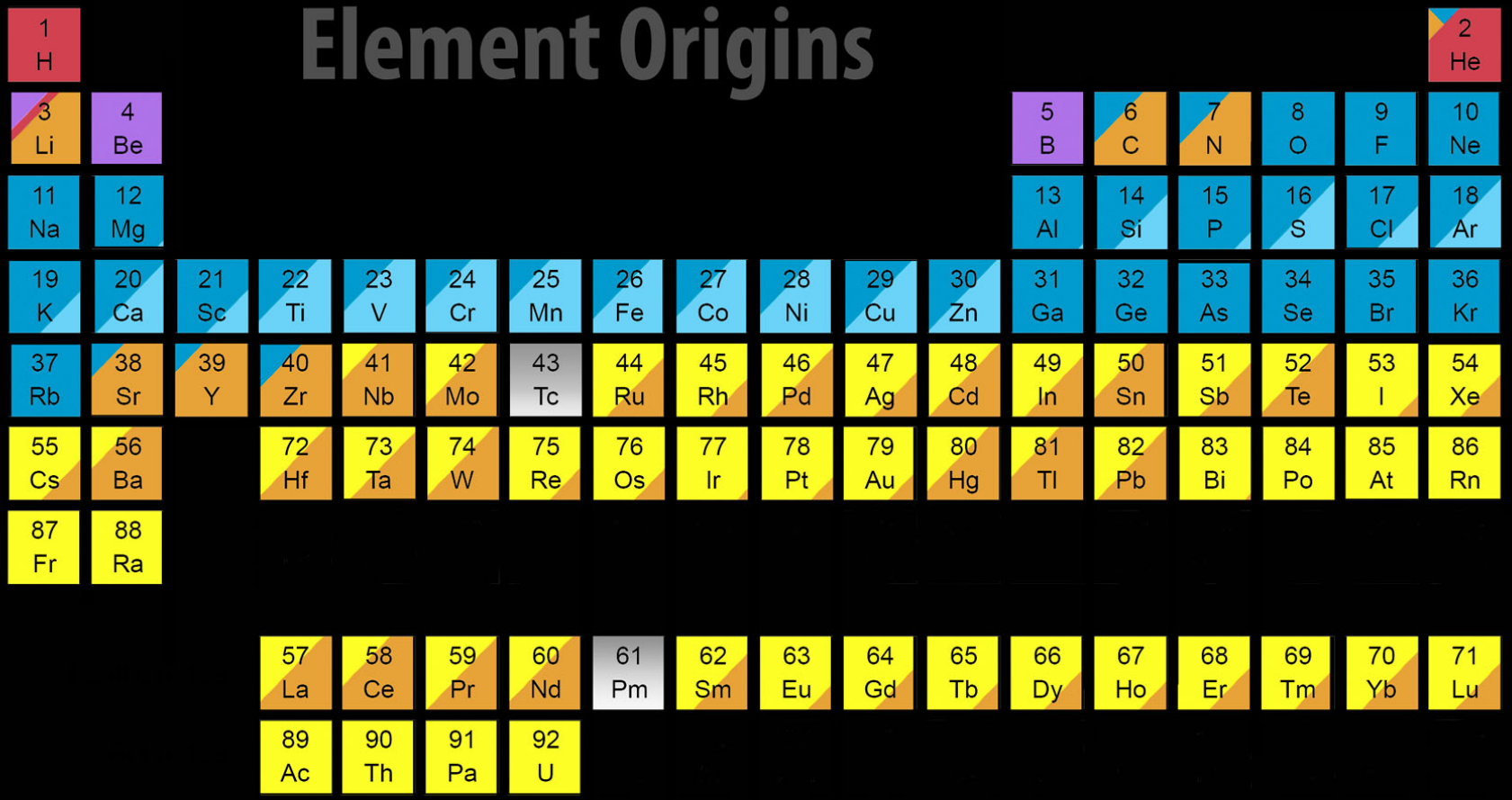


first optically discovered GRB

Also, ATLAS17aeu (Stalder et al. 2017)

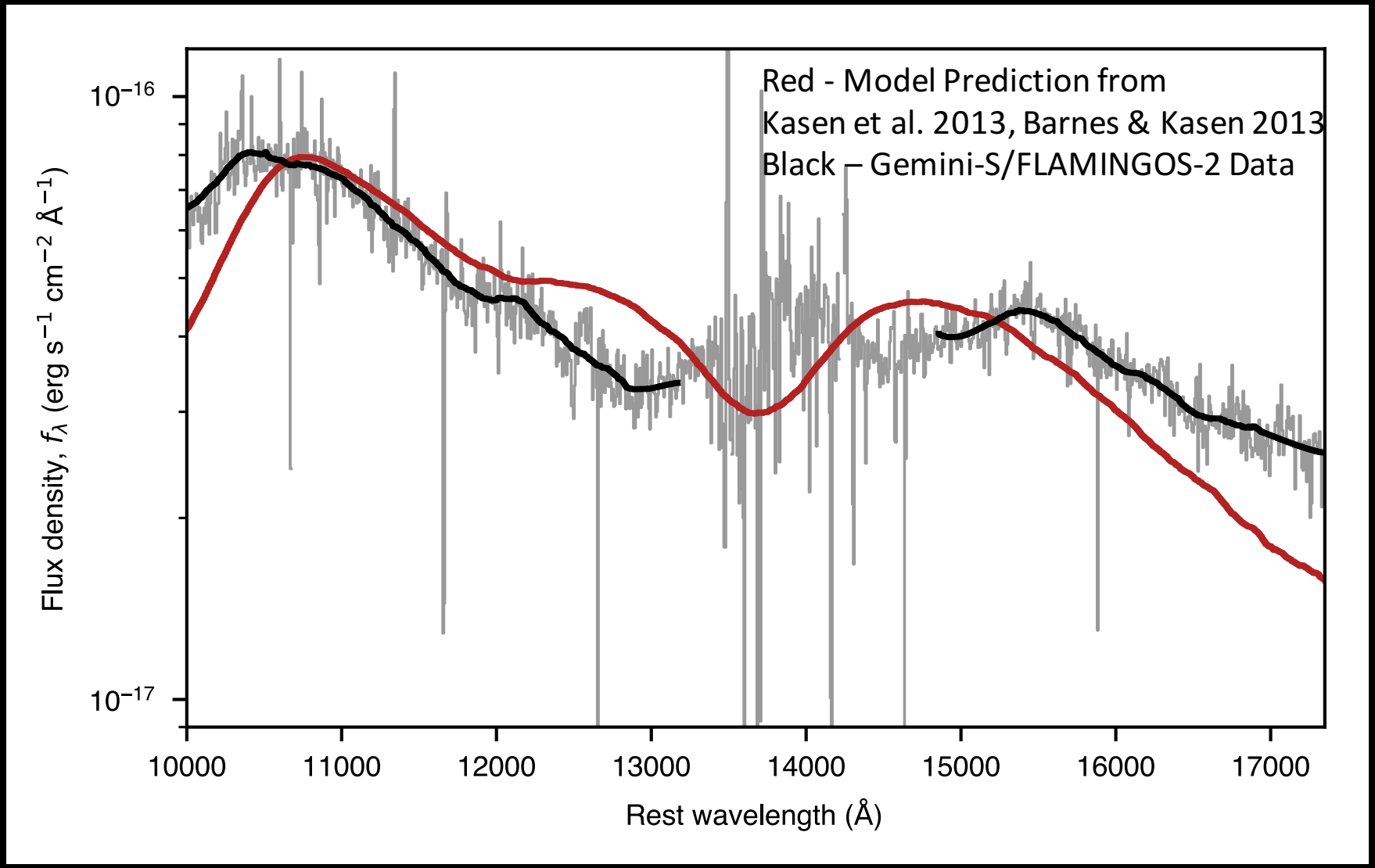
III. Neutron Star Mergers

Cosmic Mines



Credit: J. Johnson

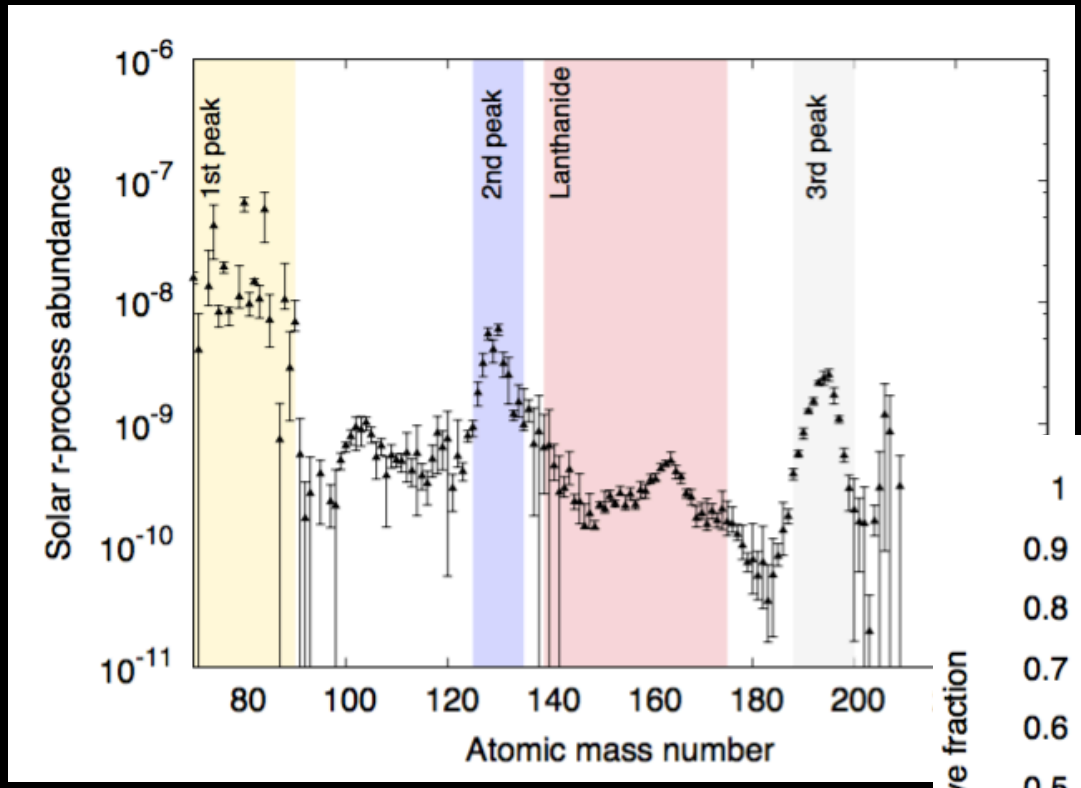
Kilonovae: Heavy Element Thumbprint



Kasliwal et al. 2017c

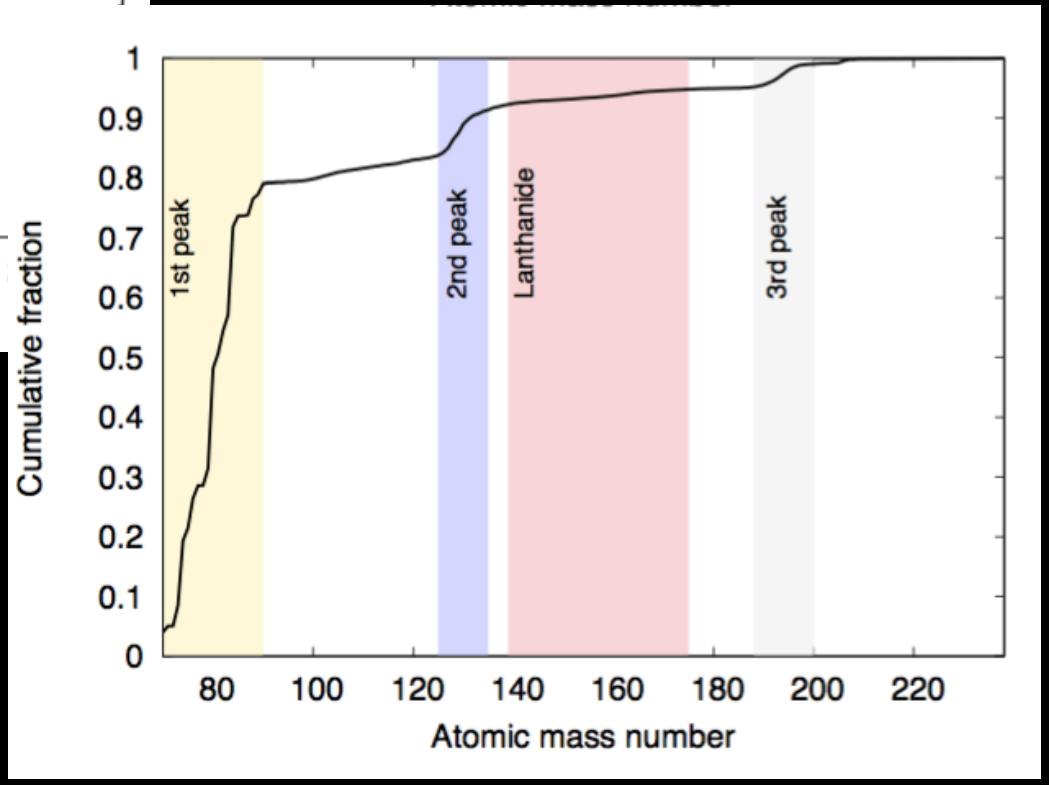
See also Chornock et al. 2017, Troja et al. 2017

Abundance of Heavy Elements

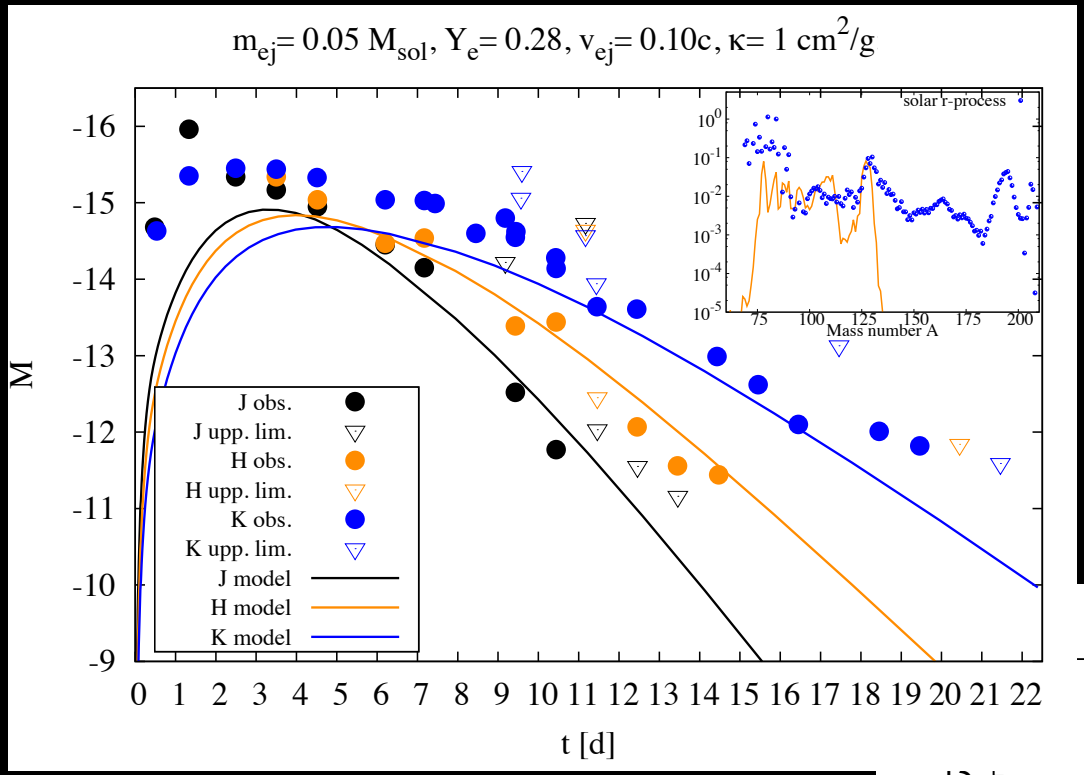


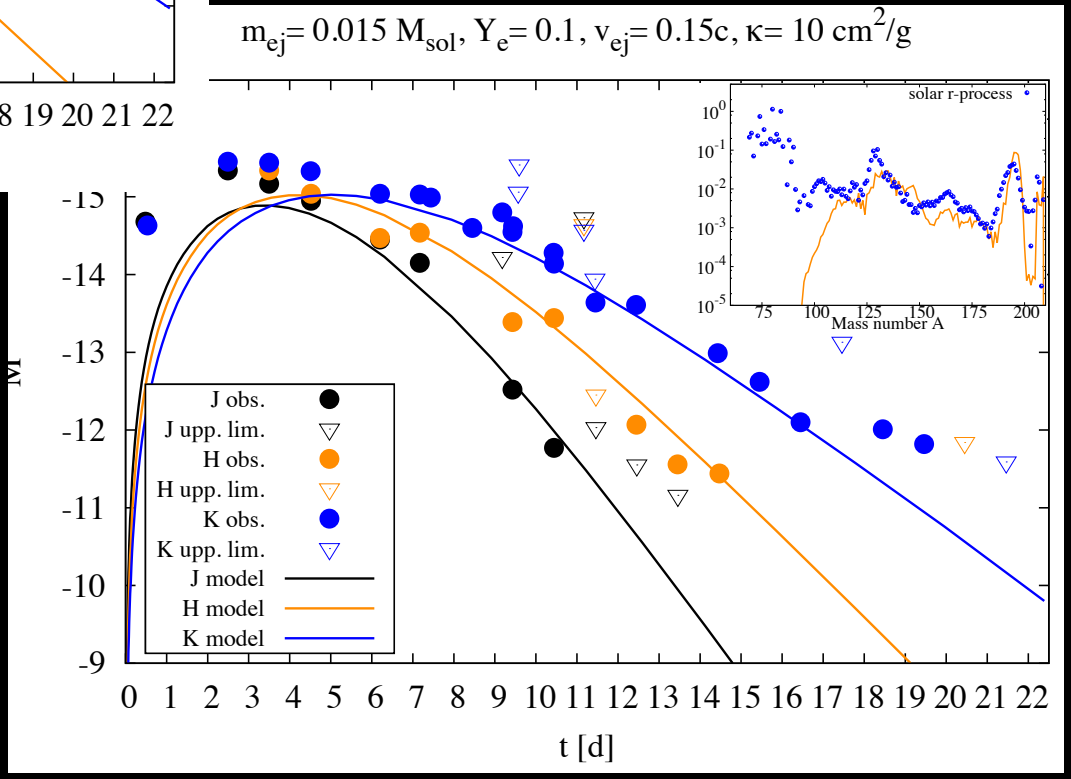
Rate / 500 Gpc^-3 yr^-1
X Ejecta / 0.05 Msun
= Observed Solar Abundance

LIGO lower limit: > 320 / Gpc^3 / yr
PTF upper limit: < 800 / Gpc^3 / yr



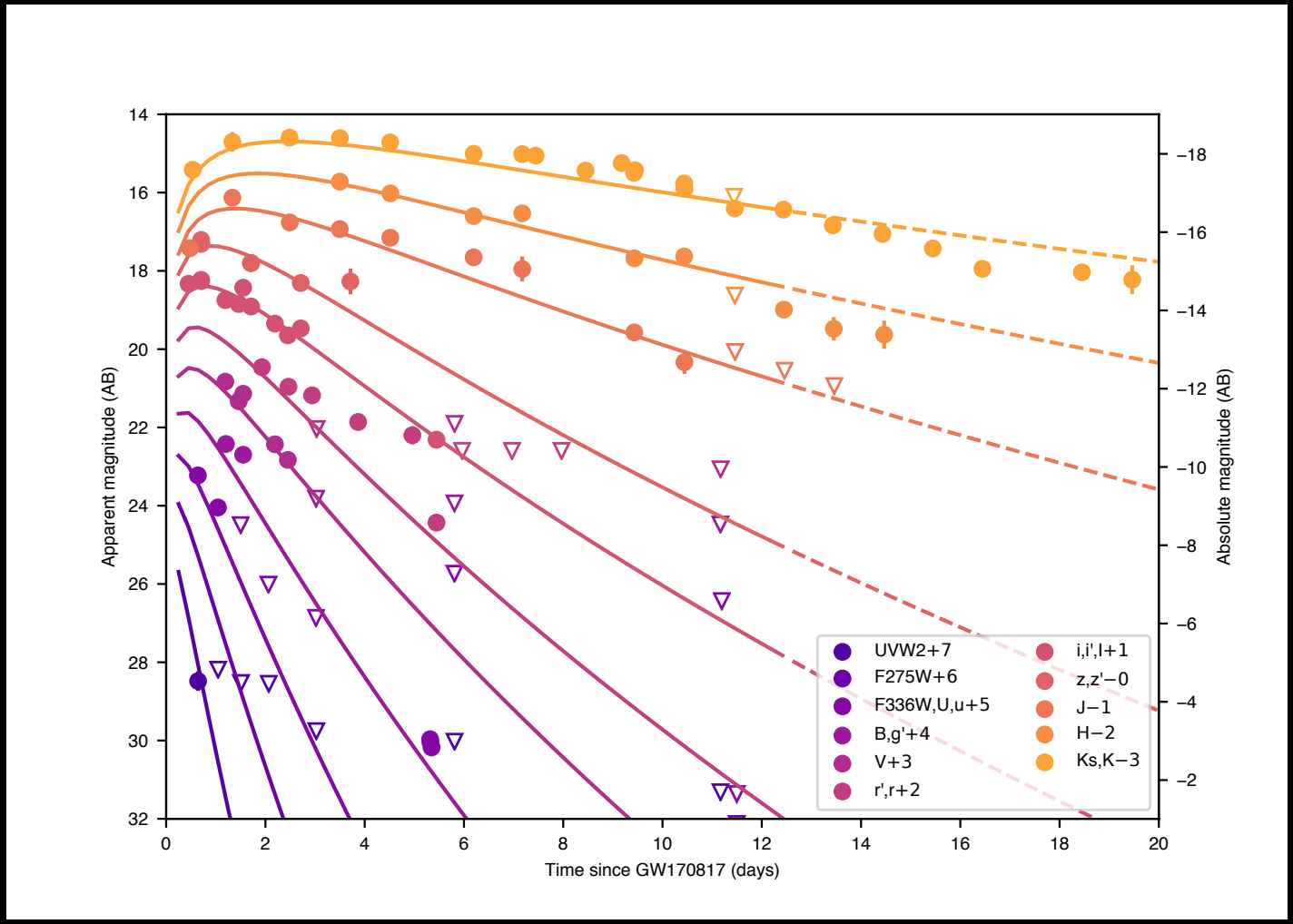
See Kenta's talk





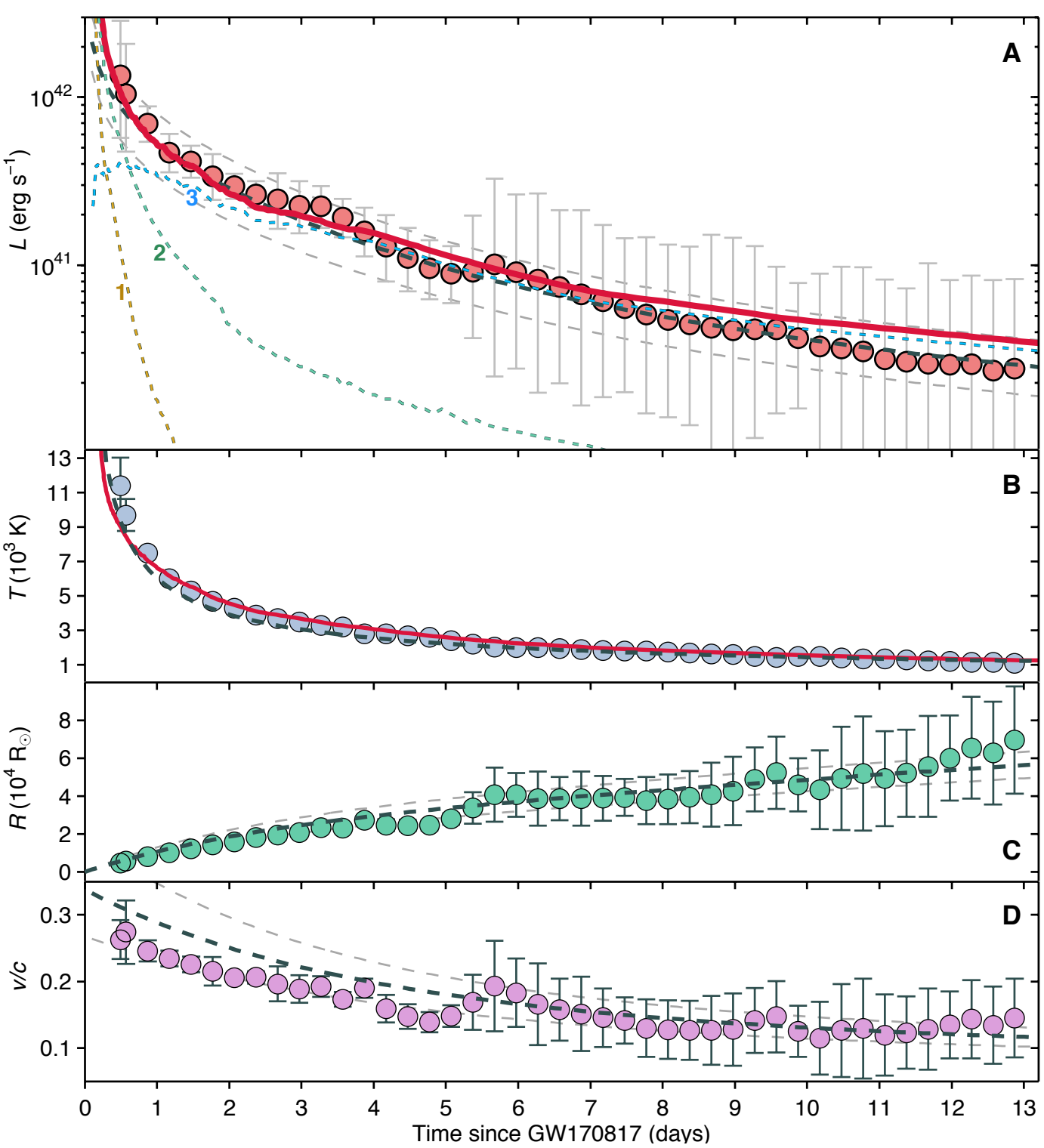
Just the first two peaks can explain the ground-based IR light curve?
Rosswog et al. 2017

UVOIR Light Curve



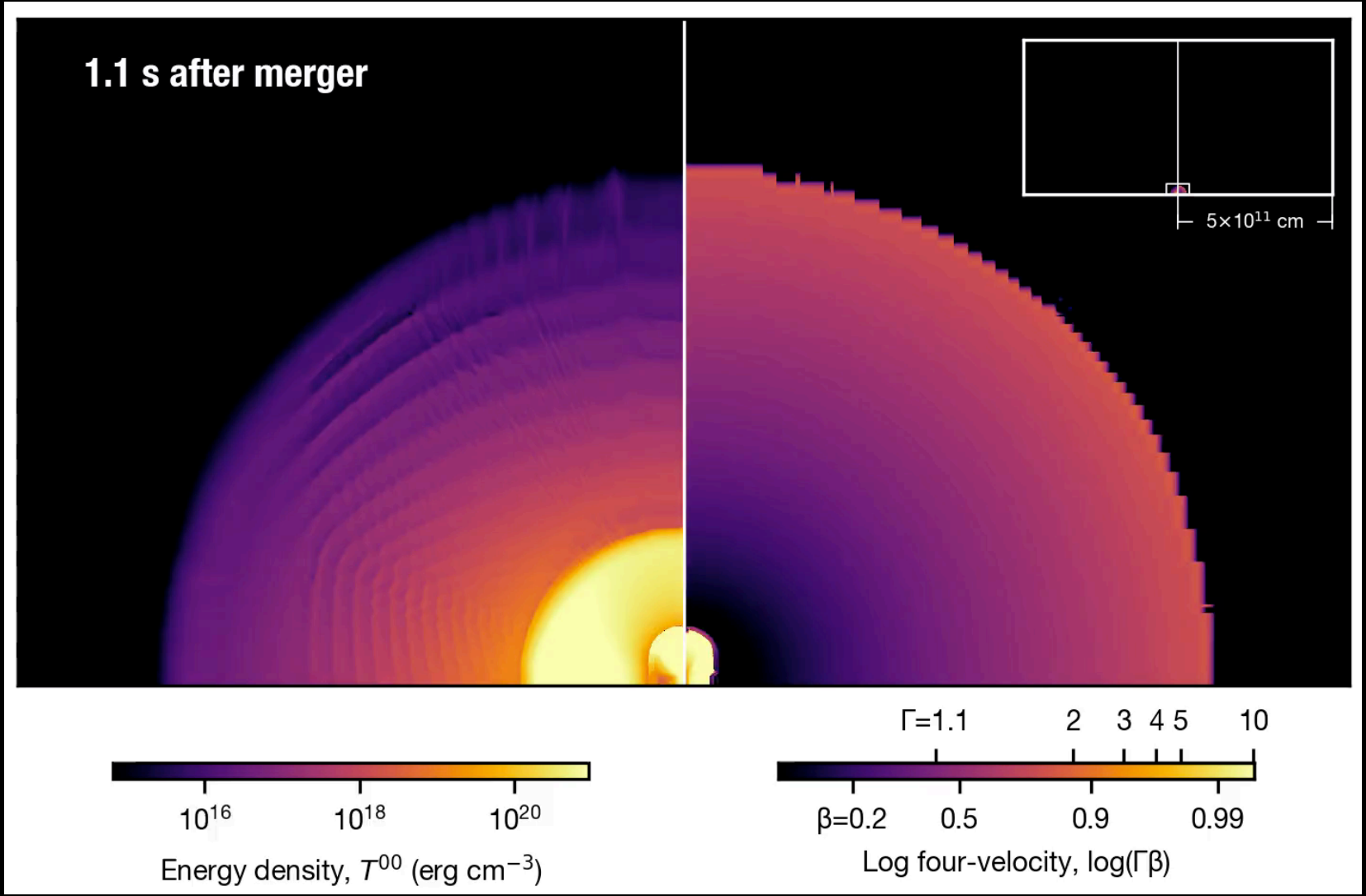
Evans et al. 2017, Kasliwal et al. 2017c

Surprise: Too Bright and Blue at Early Time



Kasliwal et al. 2017c

A New Model: The Cocoon Breakout



Kasliwal et al. 2017c

Gamma-ray Modeling in Gottlieb et al. 2017b; More analytics in Piro & Kollmeier 2017

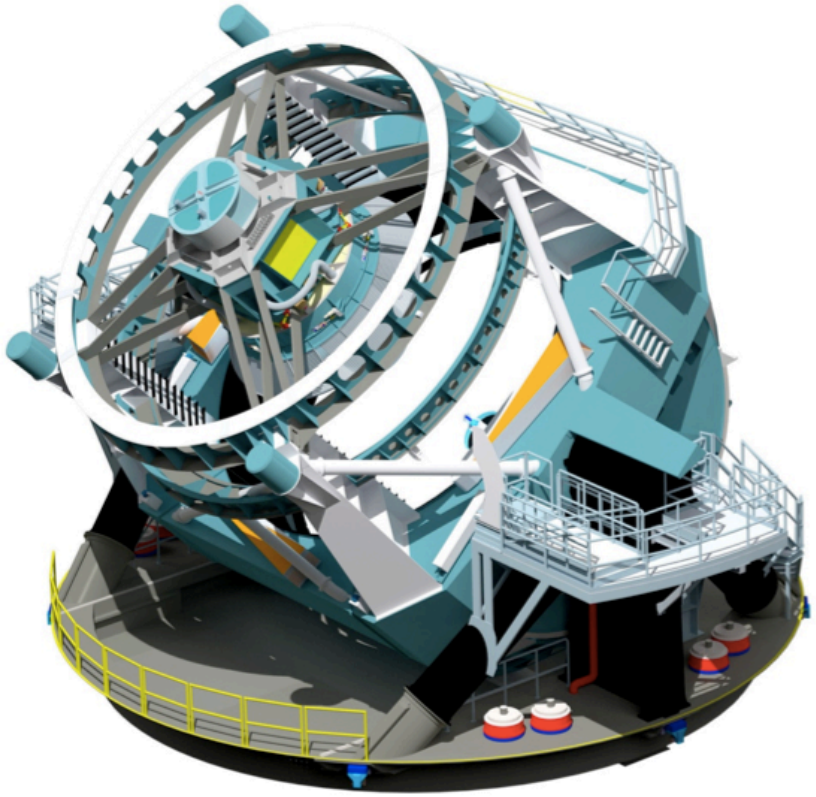
Cocoon for NS mergers: Lazzati et al. 2017a,b, Gottlieb et al. 2017a, Hotokezaka et al. 2015

Simulations: Aloy et al. 2005, Nagakura et al. 2014, Murguia-Berthier et al. 2014 , Duffell et al. 201

TDA in the LSST era

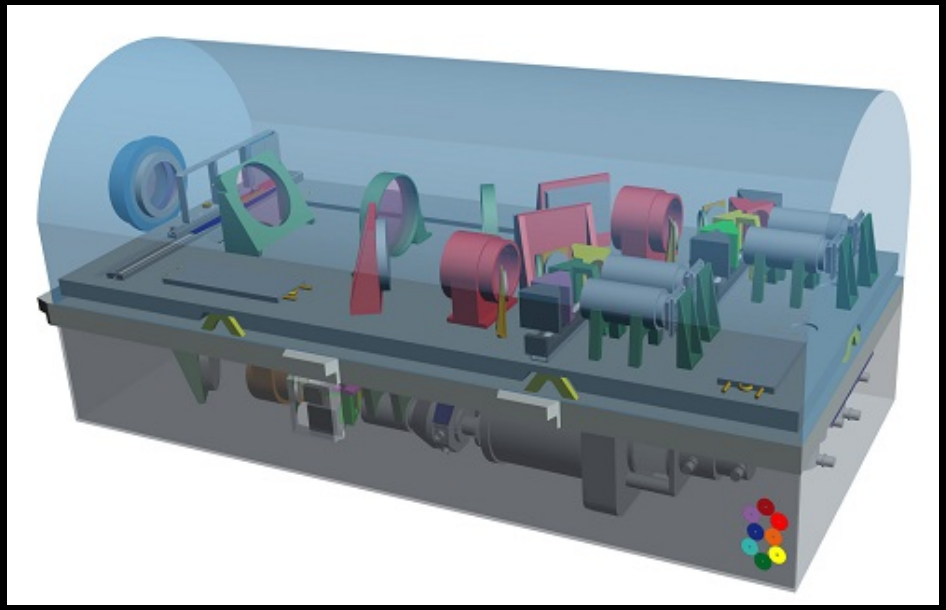
PTF: 4×10^4 events/night
ZTF: 3×10^5 events/night
LSST: 2×10^6 events/night

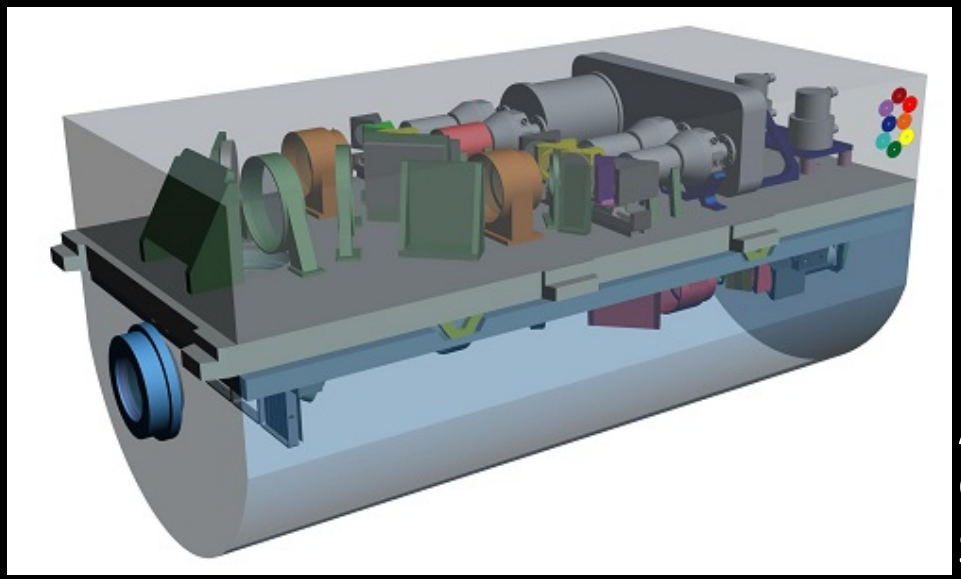
Technical	develop algorithms & software for detection & classification
Scientific	discover new transient & variable phenomena
Organizational	organize collaborations and followup strategies with real data



GROWTH builds a global community ready to contribute LSST time-domain science.

Gen4 Gemini Instrument: OCTOCAM





Interim PI and PS:
Alexander van der Horst
Gemini PM:
Stephen Goodsell

Thank you