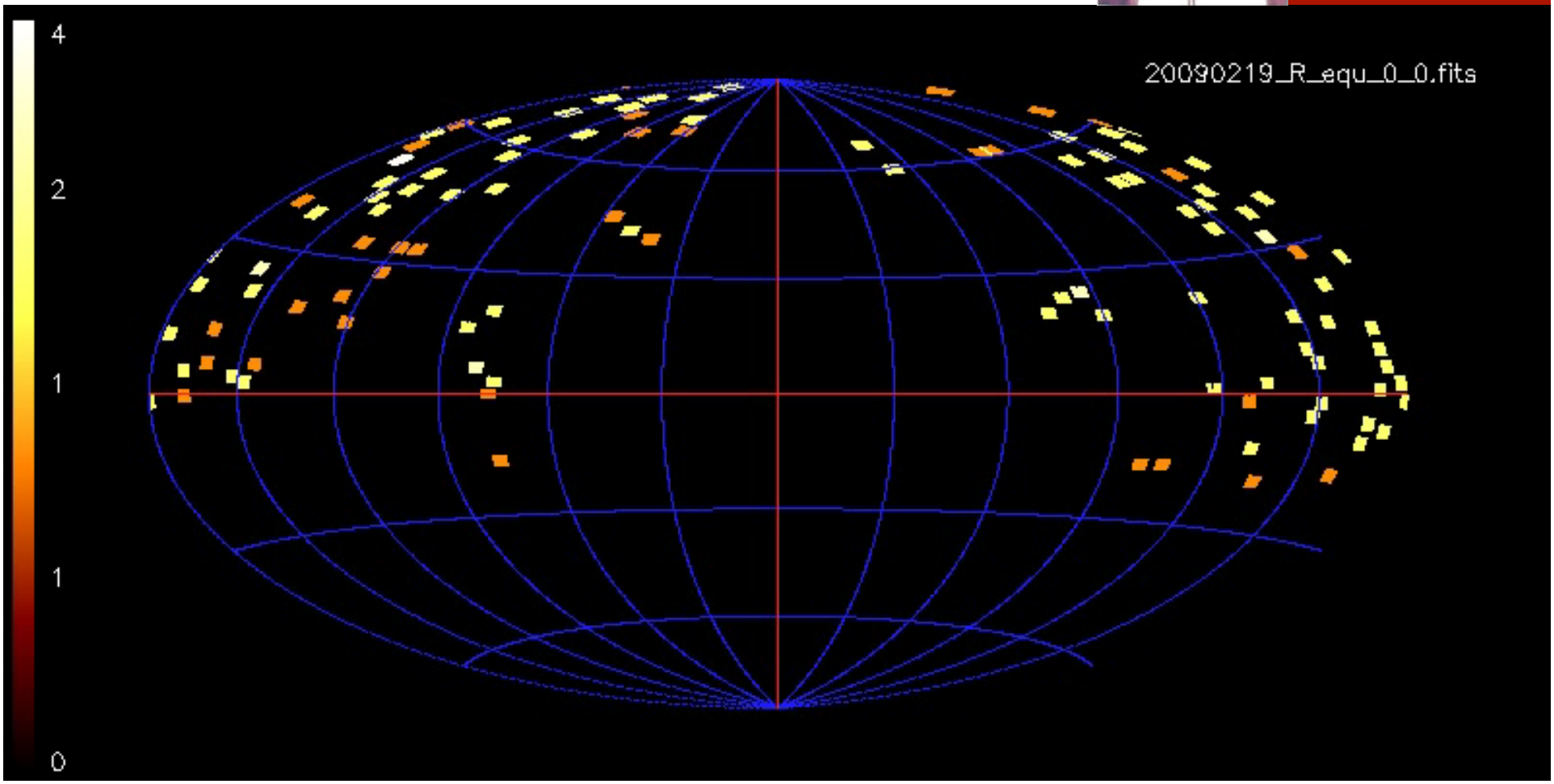
The Dynamic Universe

Eric Bellm & Mansi M. Kasliwal

Celestial Cinematography pioneered at Palomar



Imagine: ZTF will be 12x Faster!

Palomar Transient Factory

A wide-angle, high cadence survey dedicated to systematically chart the transient sky.

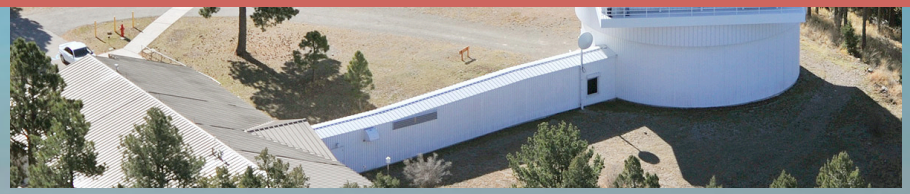
Discovery Machine + Classification Engine

PTF follow-up telescopes

742 nights of spectroscopy in 6 years

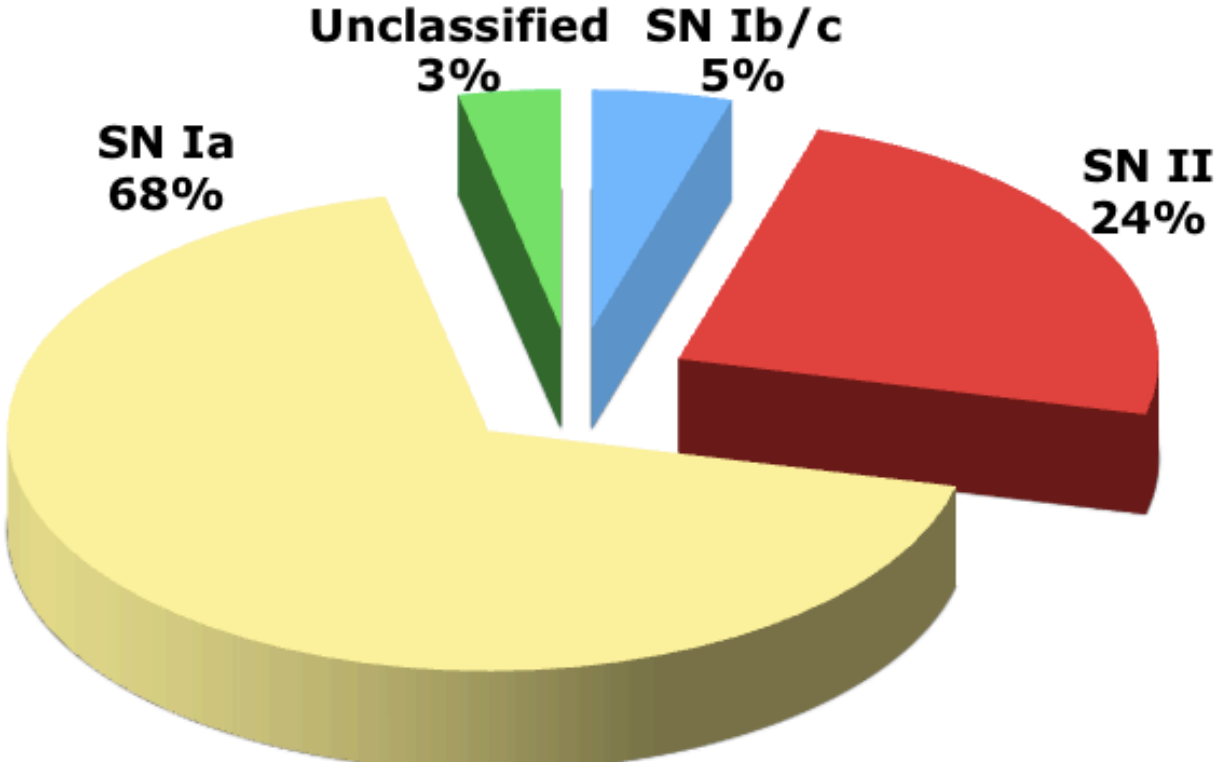
128+ P200 nights

114+ Keck nights



Live (i)PTF Scorecard

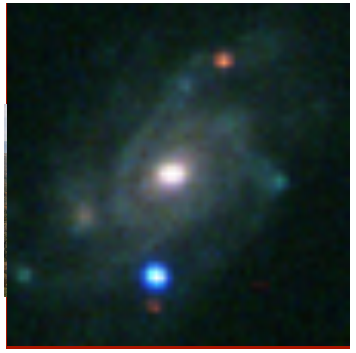
http://ptf.caltech.edu

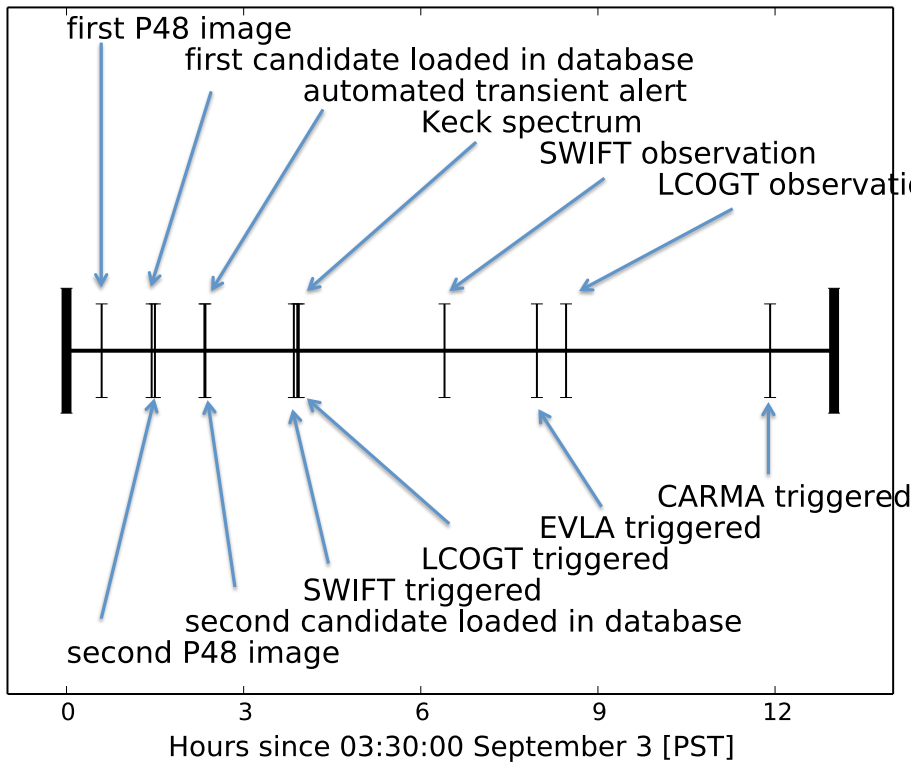


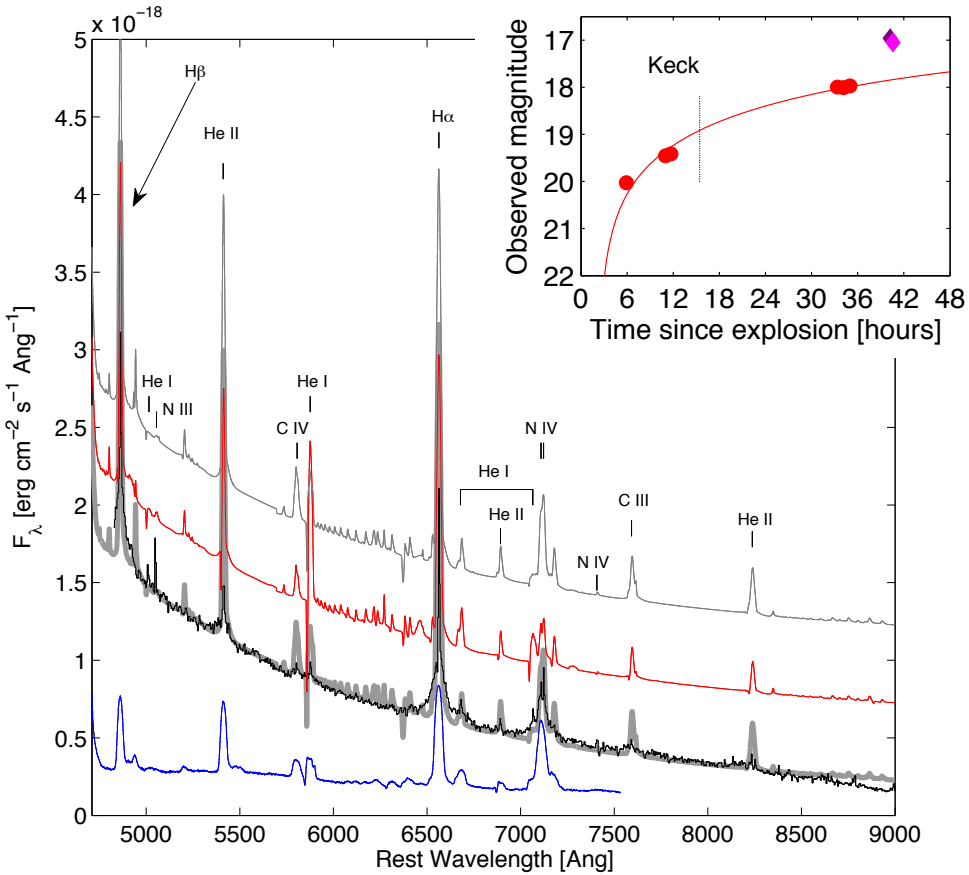
2383+ Spectroscopically Classified Transients
101+ Refereed Papers, 3199+ Citations

End-to-End Planning:

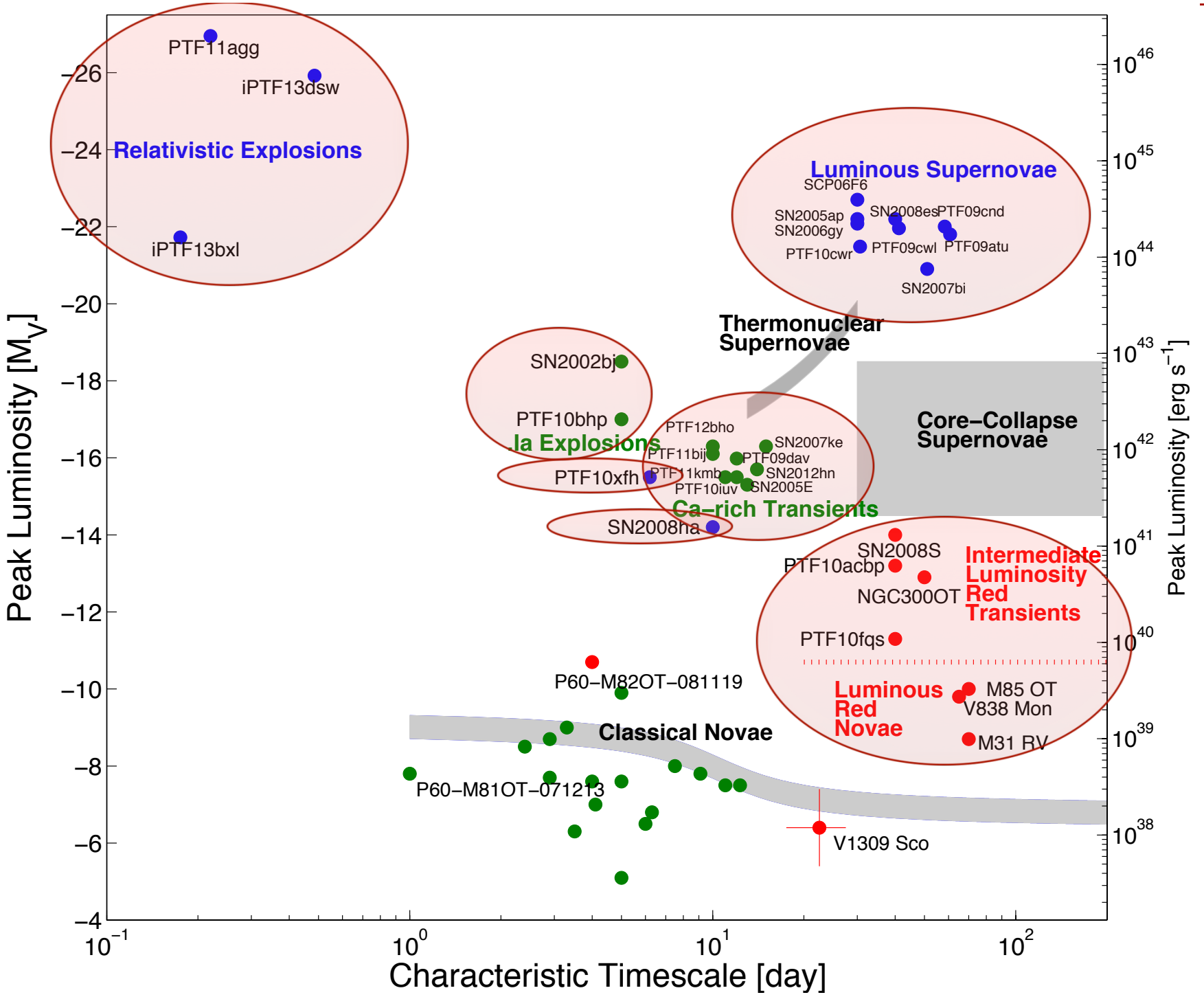
Rapid response follow-up of newborn supernovae





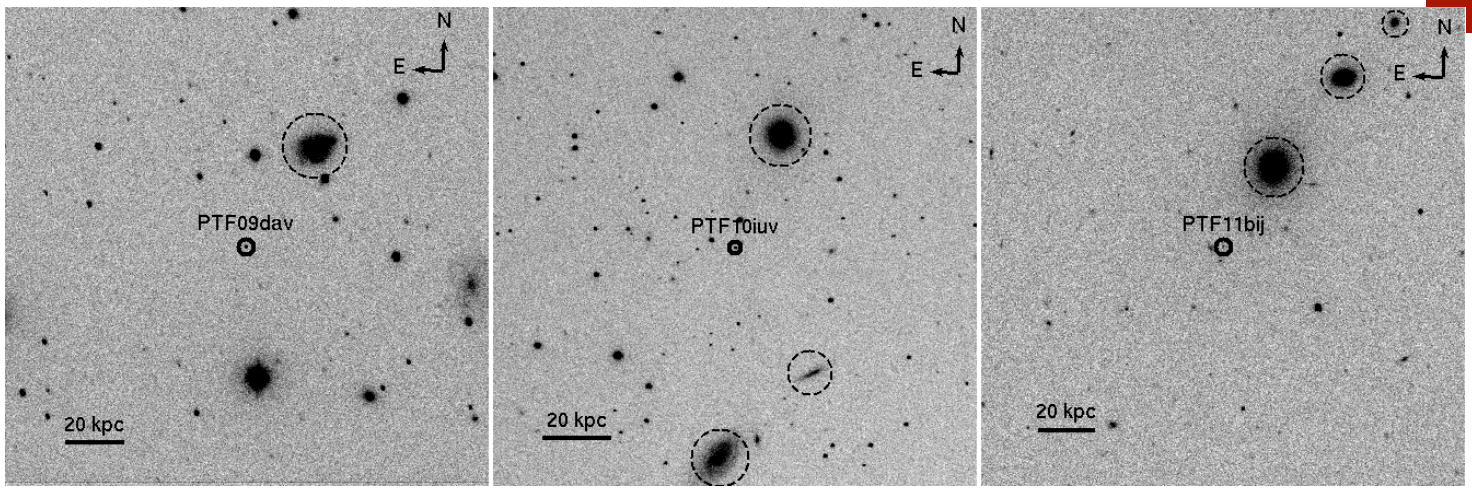


Gal-Yam et al. 2014, Nature

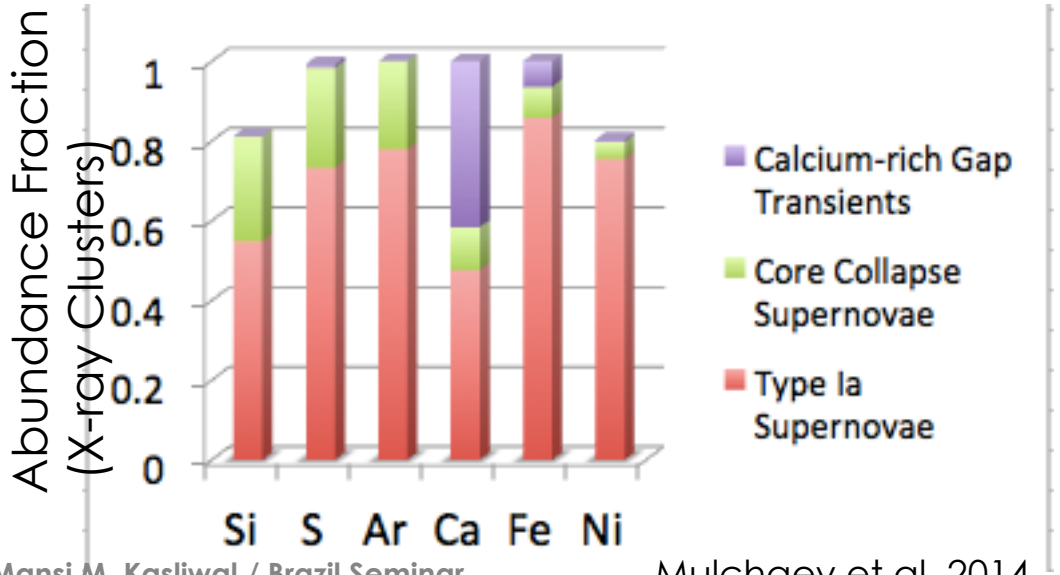


Updated from Kasliwal 2011 (PhDT)

II. Rare Calcium-rich gap transients



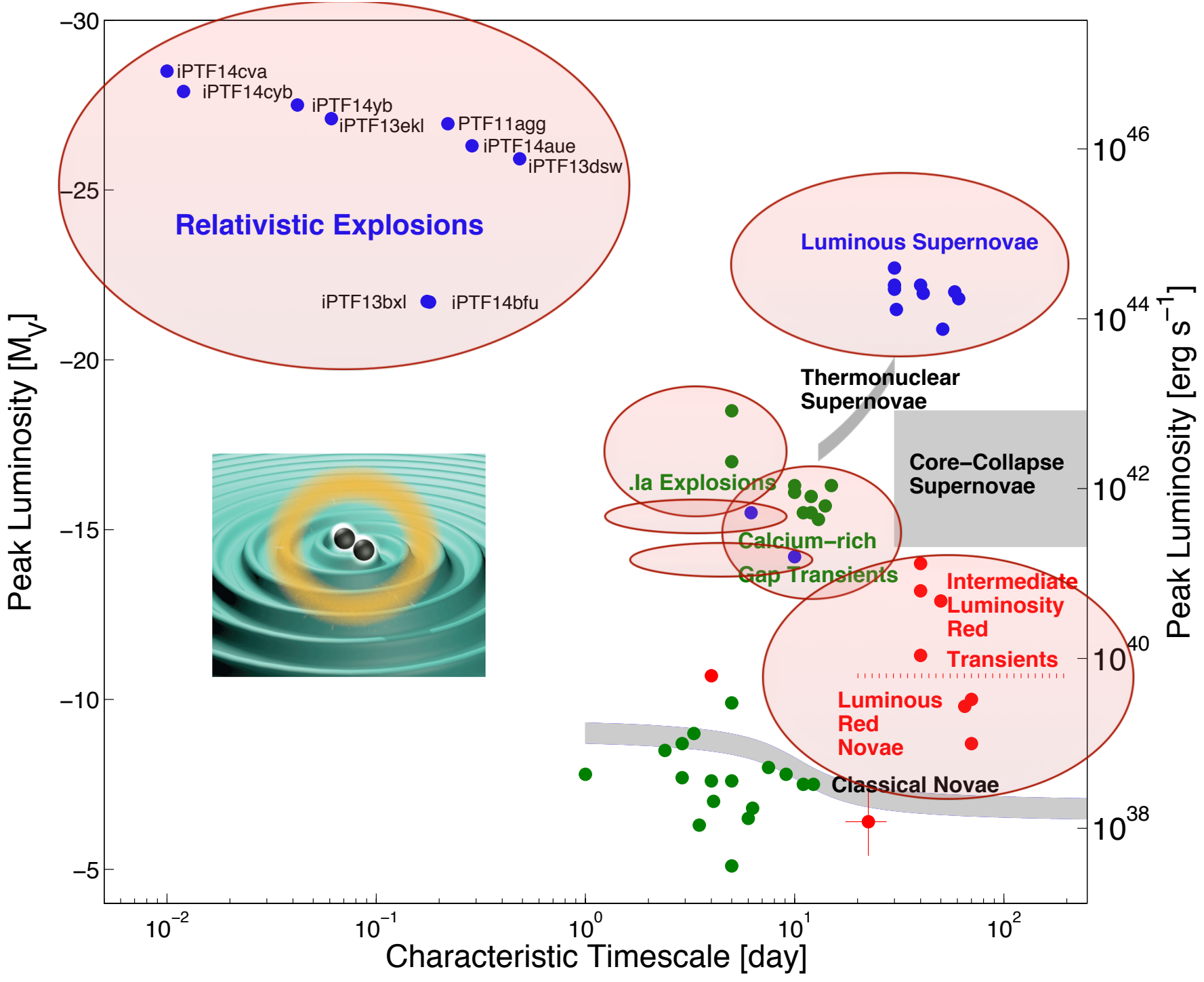
Kasliwal et al. 2012



Mulchaey et al. 2014

Are these White-Dwarf + Neutron-Star Mergers?

Metzger et al. 2014

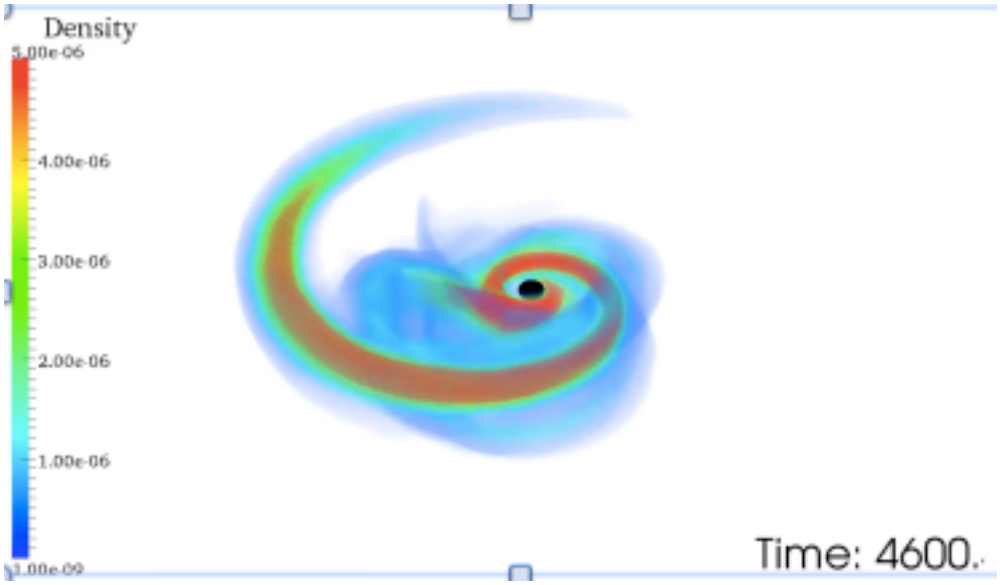


Updated from Kasliwal 2011 (PhDT)

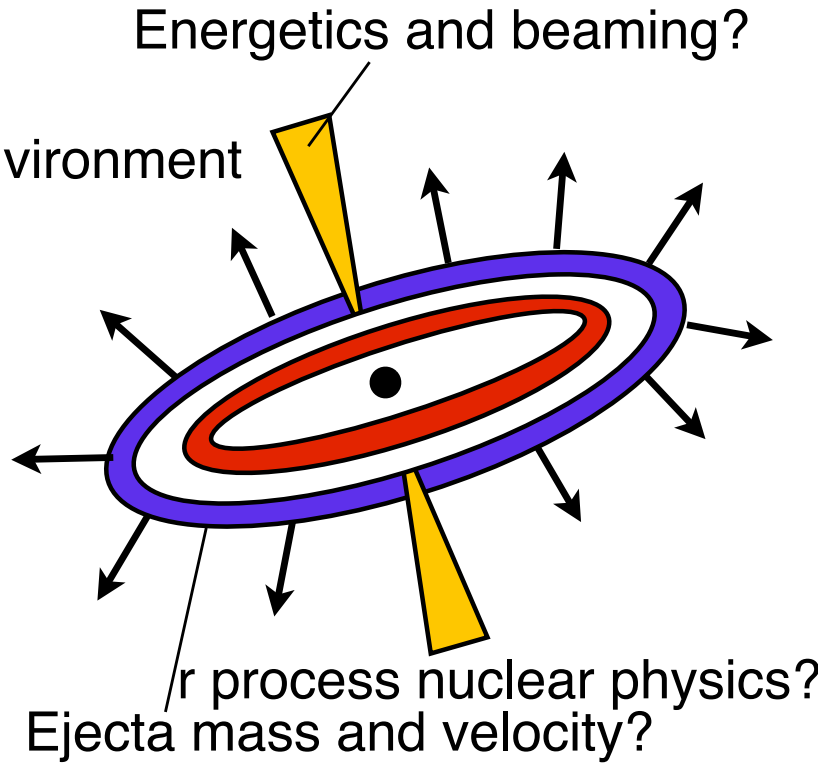
III. Seeing the Sound:

Bridging Gravitational Wave Physics & Electromagnetic Astronomy

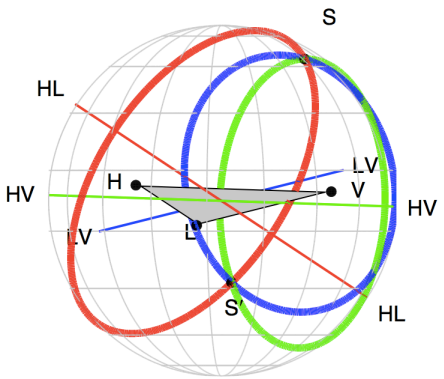
Strong Field Gravity: Masses, Spins, Inclination

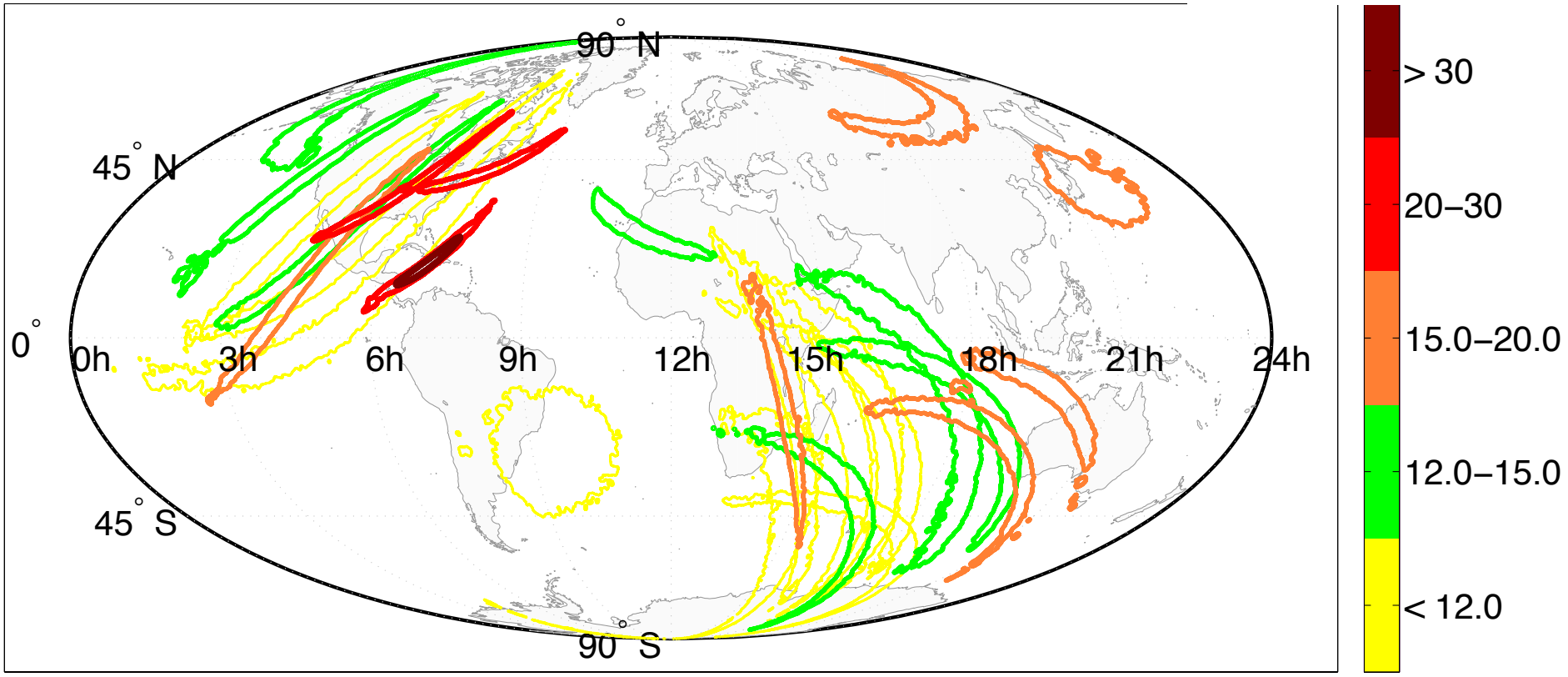


Simulation: M. Duez



The Challenge: Coarse LIGO Localizations





Kasliwal & Nissanke 2014

(See also Singer et al. submitted)

Needle in 70 deg^2 haystack

27004 candidates in subtraction images

26960 are NOT known asteroids

4214 are astrophysical with machine learning score > 0.1

2740 do NOT have a quiescent stellar source

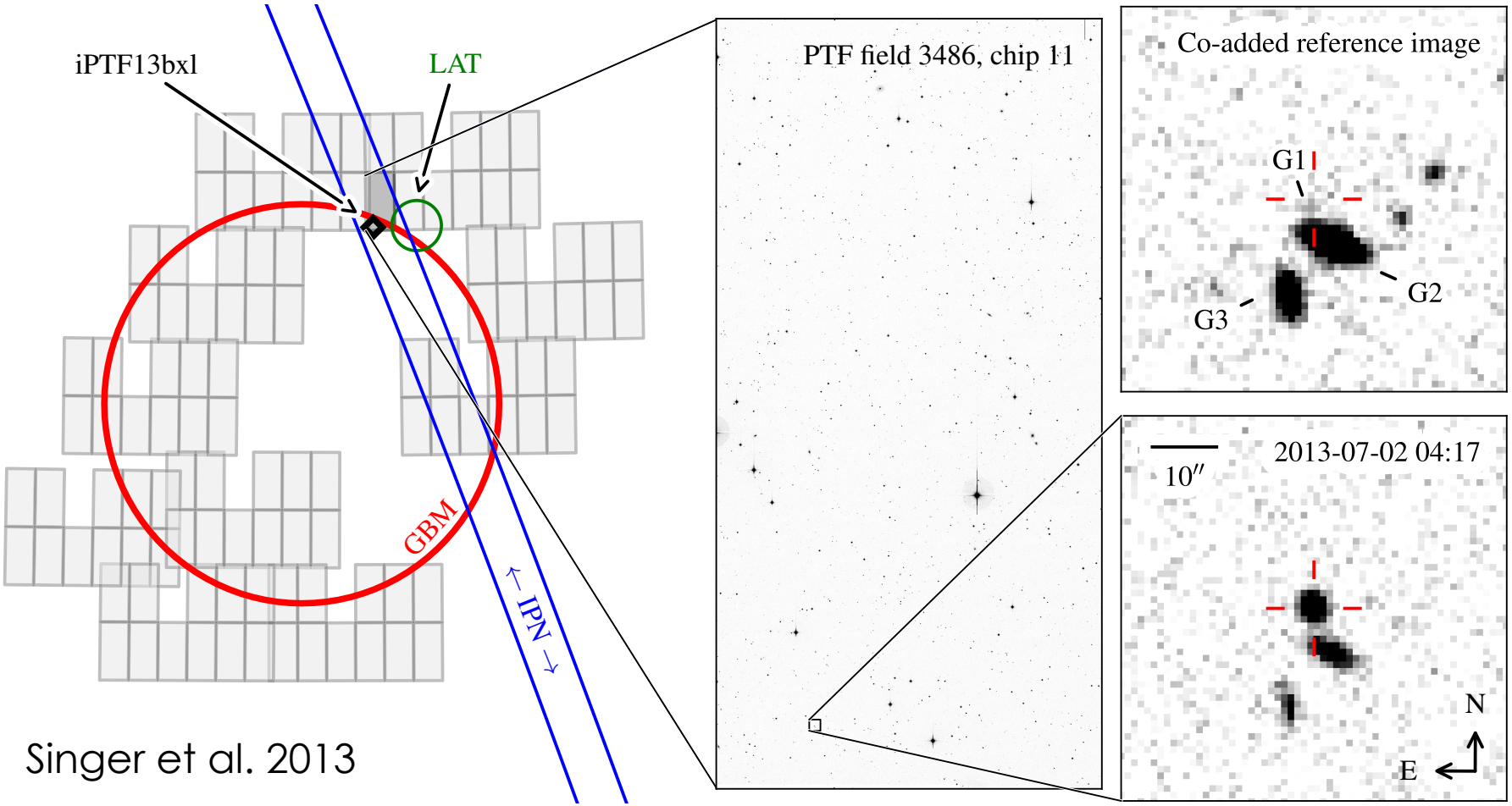
43 are detected in both visits and presented to human scanners

7 are deemed high-value by humans and saved with an iPTF name

3 are scheduled for follow-up spectroscopic observations

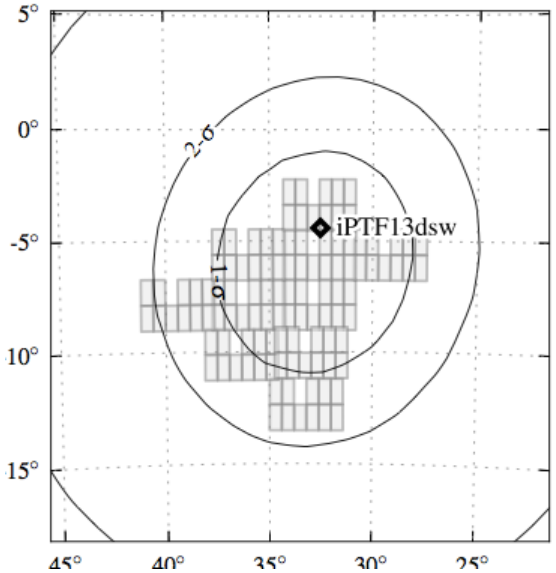
1 is the true afterglow

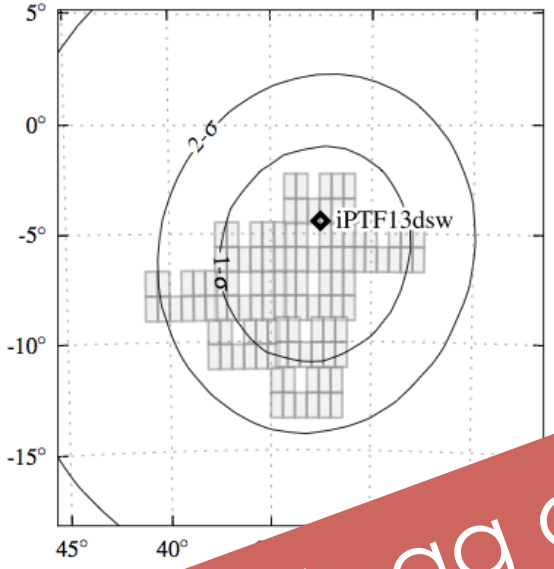
Proof-of-concept: First optical afterglow in 71 deg^2

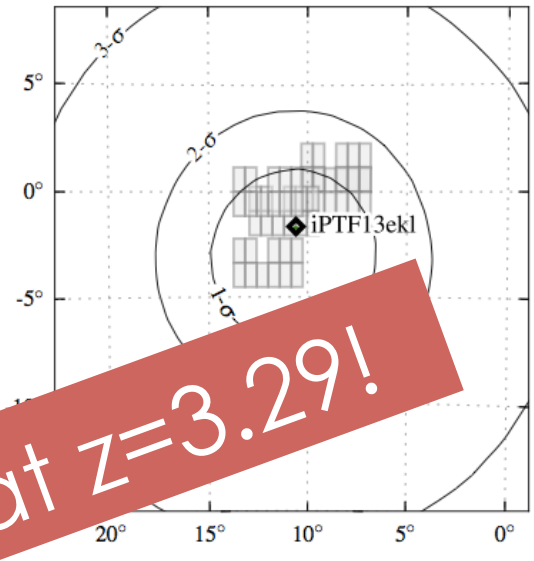


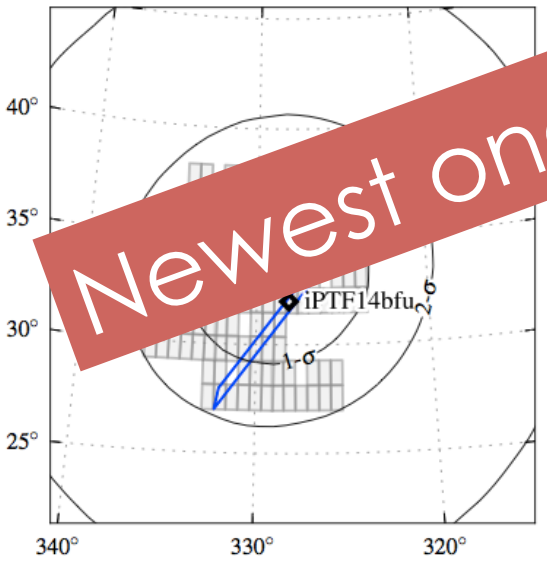
Singer et al. 2013

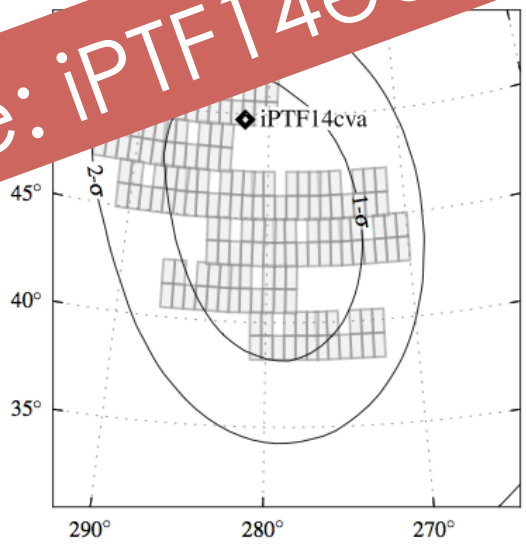
Seven more times…

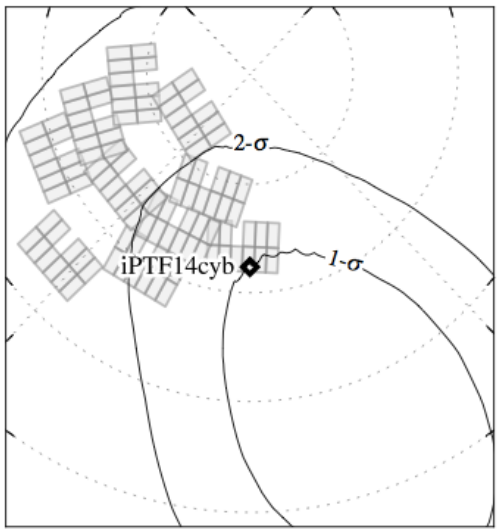










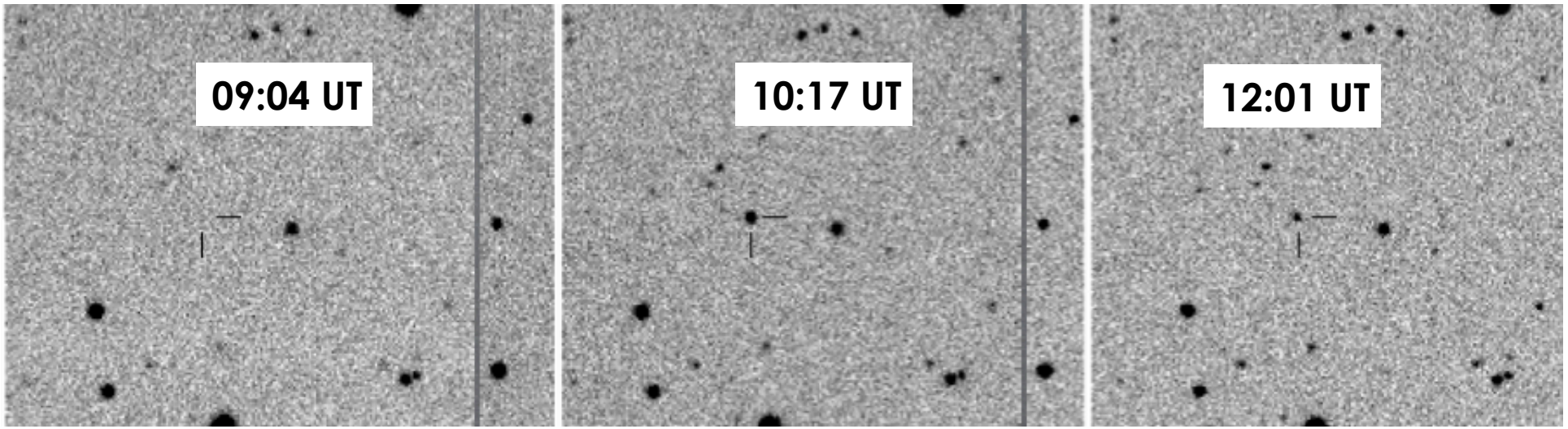


Newest one: iPTF14eag at z=3.29!

L. Singer, PhdT 2014

"Orphan" Afterglows

On 2014 Feb 23…

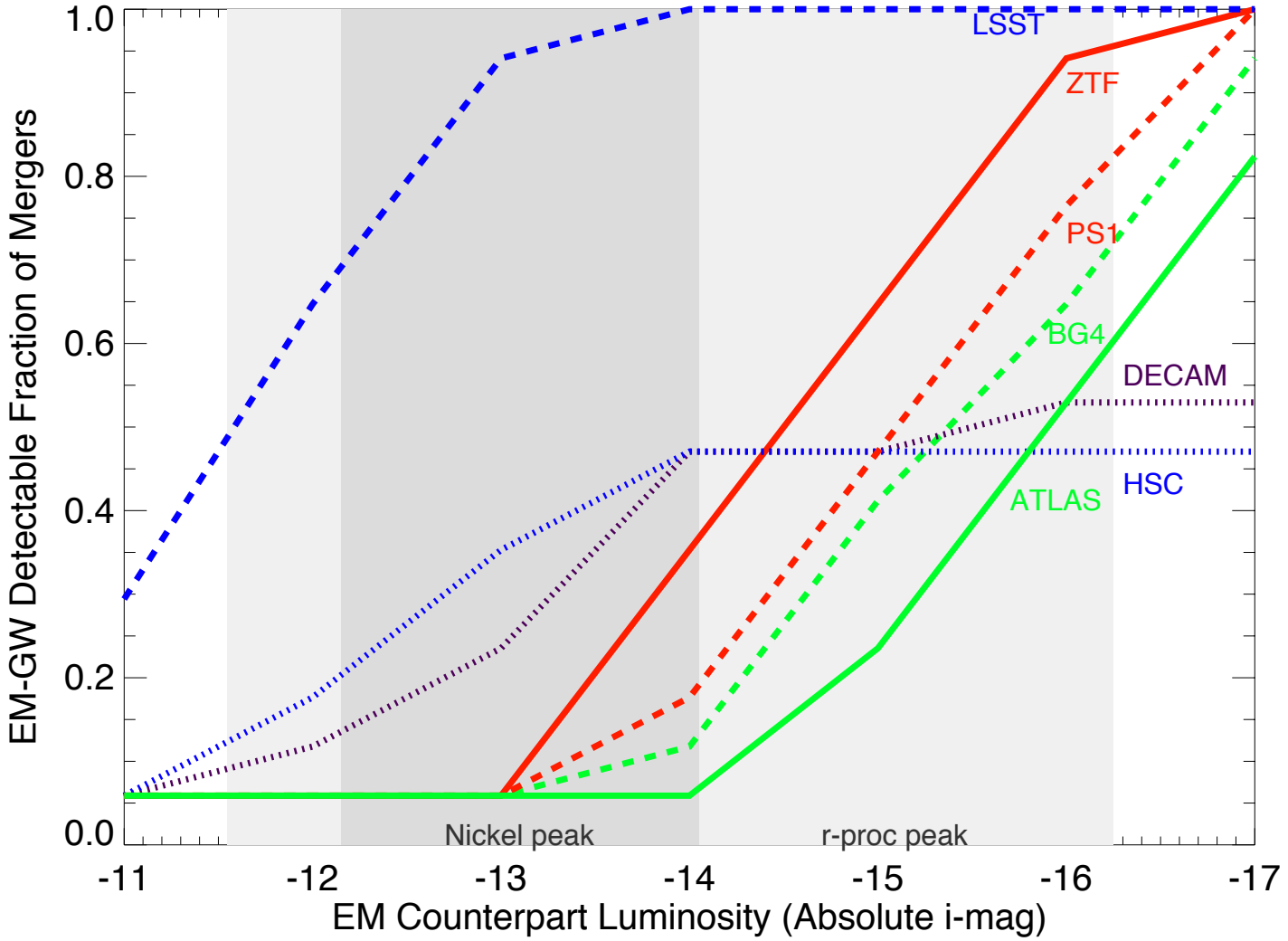


@ 14:21 CARMA and EVLA radio triggered
@ 15:26 Keck Optical Spectrum: z=1.98!
@ 17:11 Swift X-ray & Ultraviolet observations

Case of iPTF14yb: Gamma-Ray Parents Found Afterwards!
Untriggered afterglow
Case of PTF11agg: Gamma-Ray Parents Missing! Dirty fireball?

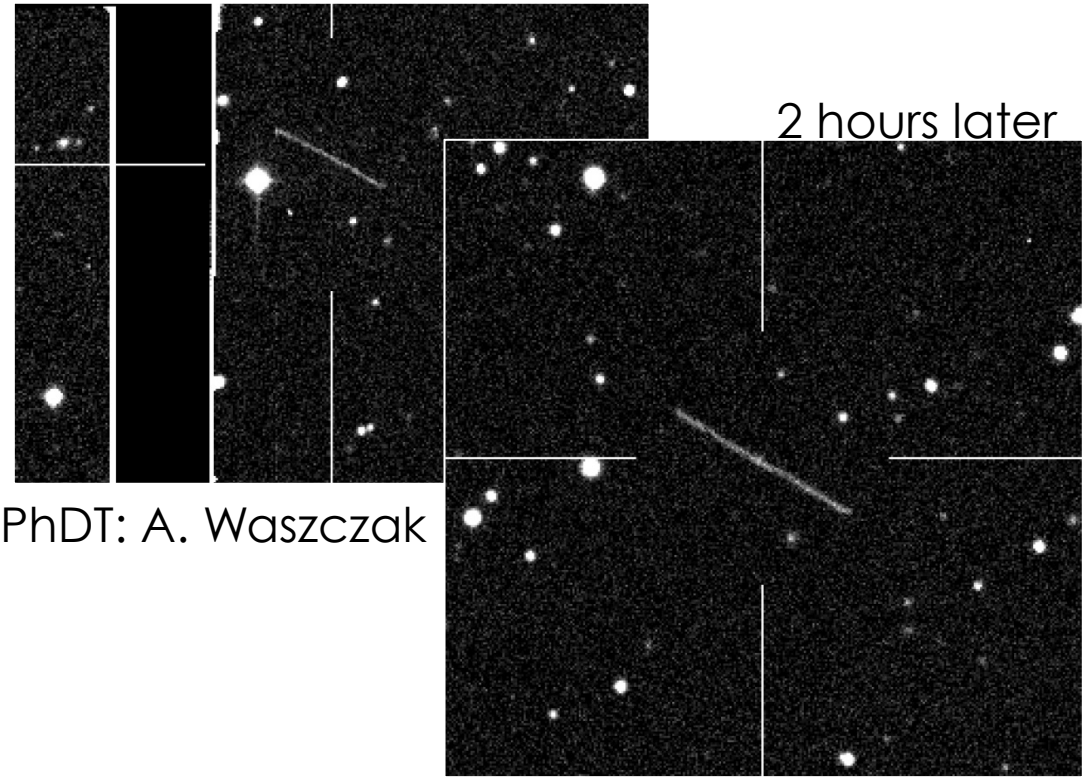
Cenko et al. 2013, 2014

EM-GW Surveys: Relative Sensitivity



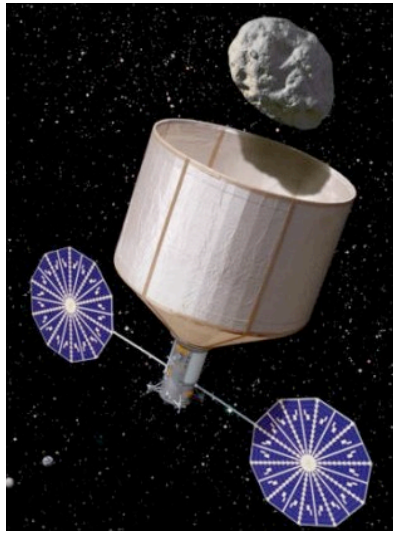
Kasliwal & Nissanke 2013

IV. Asteroids:
iPTF discovery of NEA 2014 JG55



2 hours later

PhDT: A. Waszczak

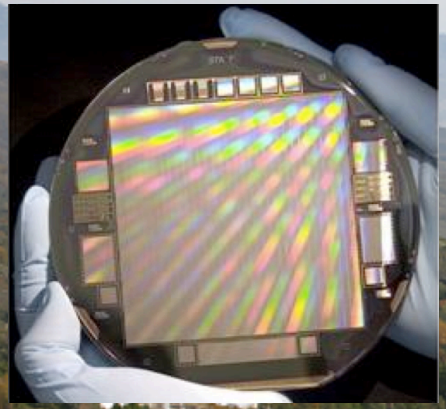


NASA
Asteroid Redirect Mission

This 10m asteroid came within ¼ of the earth-moon distance!
The streak became brighter by 1 mag and faster by 50% in 2 hours.

ZTF will be 20x better at finding NEAs than iPTF

Zwicky Transient Facility (ZTF)



P48
Discovery
47 sq deg!
PI: S. Kulkarni
(Jan 2017)

P200:
Spectroscopy

P60
Classification
The SED
Machine
PI: N. Konidaris
(2015)

Survey Speed of 3750 sq deg per hour!

Thank You