

Cosmic Fireworks: First light

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GW170817

Discovery

GW trigger:

17 Aug 2017

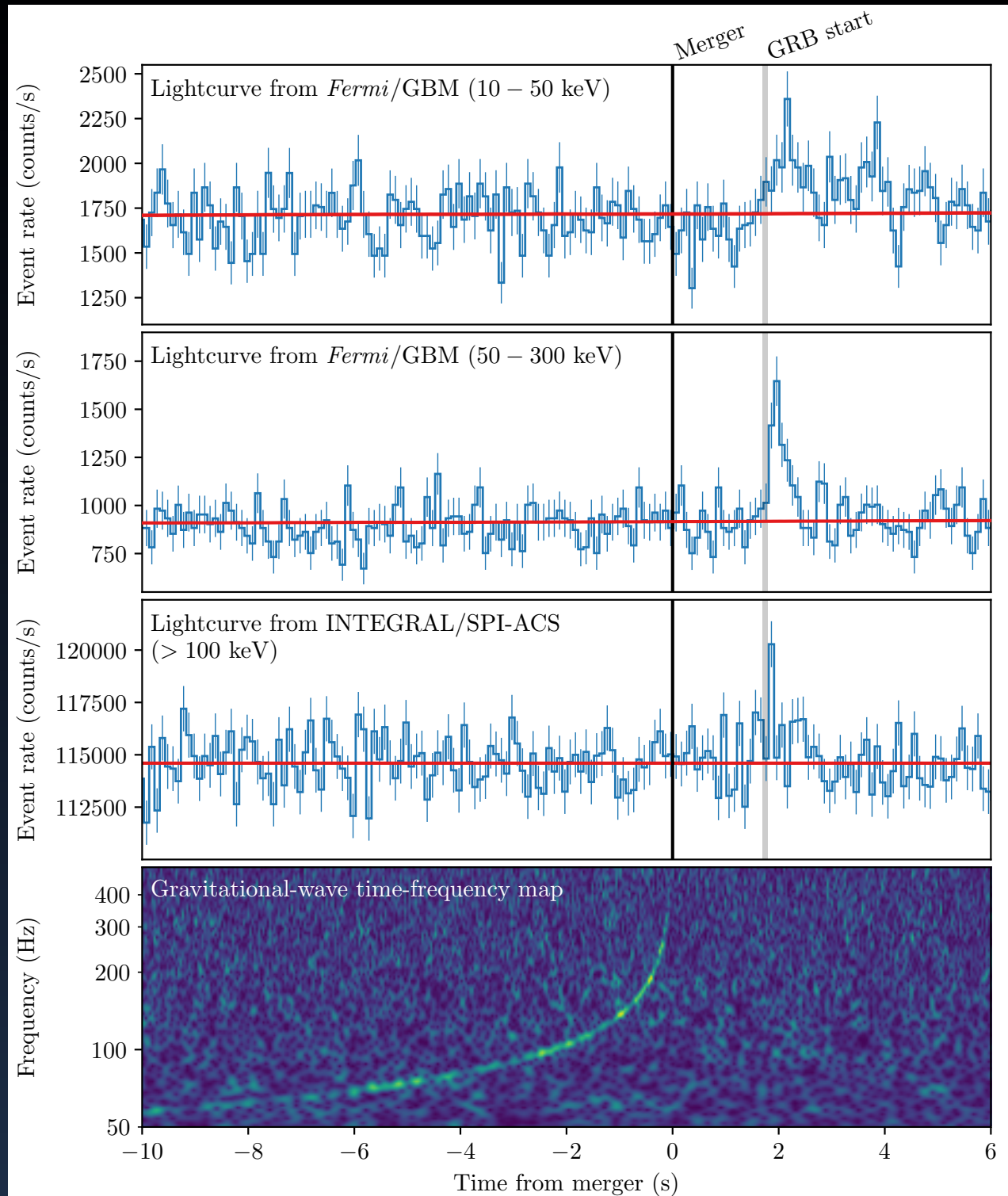
12:41:04 UT

Gamma rays:

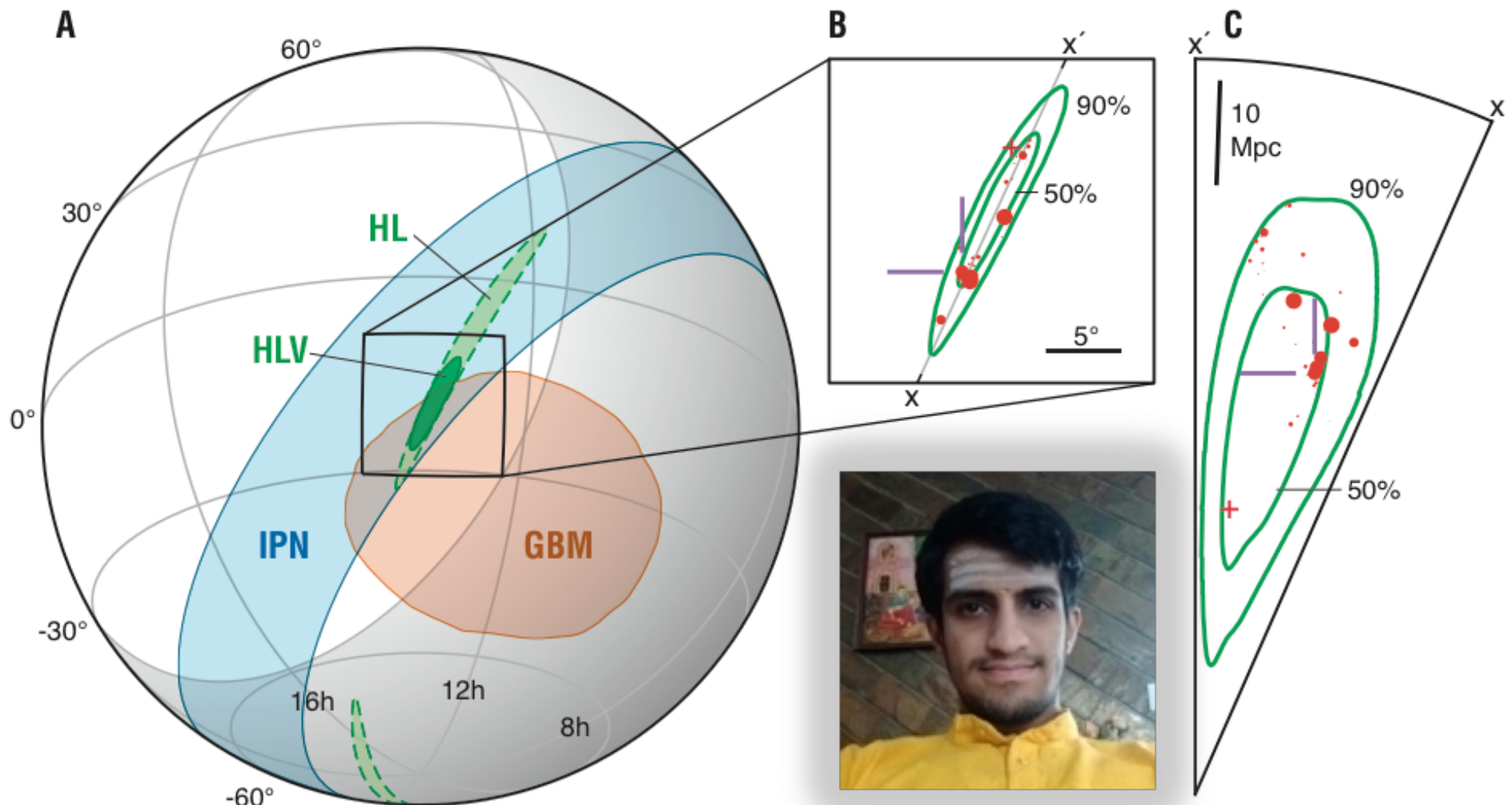
17 Aug 2017

12:41:06 UT

LSC et al, 2017, ApJL



AstroSat: location by non-detection



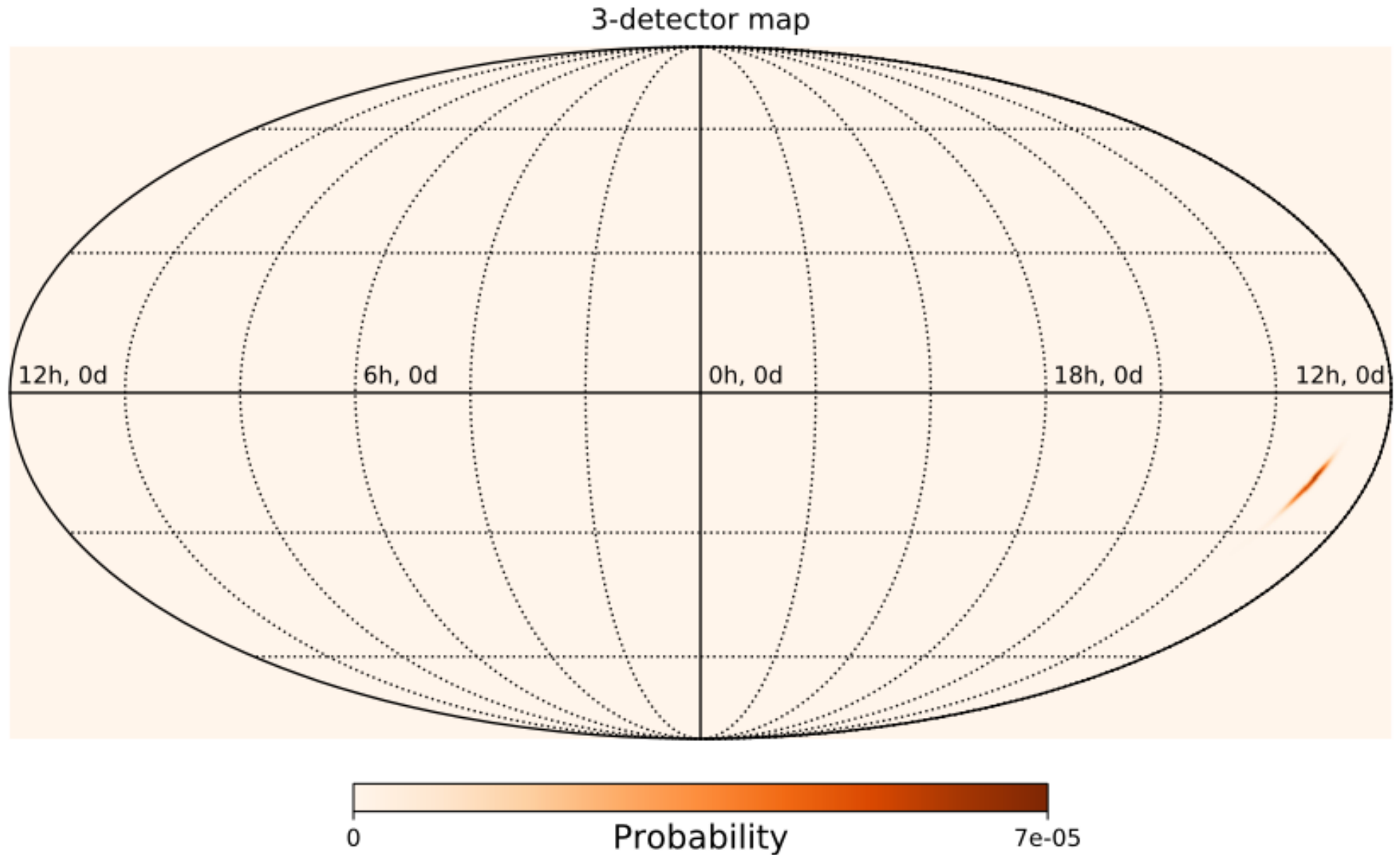
GBM: von Kienlin et al., GCN 21520; IPN: Svinkin et al., GCN 21515

Arvind. B / Leo Singer / GROWTH collaboration, Kasliwal et al, 2017, Science

Initial follow-up

- 6 neutrinos within ± 500 s : Hanle follow-up
 - » (IceCube, GCN 21508)
- Fermi, Integral detection
 - » See joint paper by LVC, Fermi, Integral
- IPN triangulation into a band
 - » GCN 21515
- Nothing seen by AstroSat CZTI, Insight-HXMT, Swift/BAT, AGILE MCAL/GRID
 - » GCNs 21514, 21518, 21524, 21525, 21526

Evolution of localisation



LSC et al, GCN 21509, 21513

TITLE: GCN CIRCULAR

NUMBER: 21529

SUBJECT: LIGO/Virgo G298048: Potential optical counterpart discovered by Swope telescope

DATE: 17/08/18 01:05:23 GMT

FROM: Edo Berger at Harvard U <eberger@cfa.harvard.edu>

D. A. Coulter, C. D. Kilpatrick, M. R. Siebert, R. J. Foley (UCSC), B. J. Shappee, M. R. Drout, J. S. Simon, and A. L. Piro (Carnegie)

report on behalf of the One-Meter Two-Hemisphere (1M2H) collaboration:

On 2017 Aug 18 UT in the process of observing several galaxies coincident with the highest-likelihood localization region for the LIGO/Virgo G298048 trigger (LVC GCNs 21509, 21513) with the 1-m Swope telescope at Las Campanas Observatory, we detect a source **5.3" E and 8.8" N of NGC 4993**, an S0 galaxy in the NGC 4993 / ESO 508-G018 group at a distance of ~ 40 Mpc (Tully-Fisher distance to the group; Freedman et al., ApJ, 553, 47, 2001). The object is:

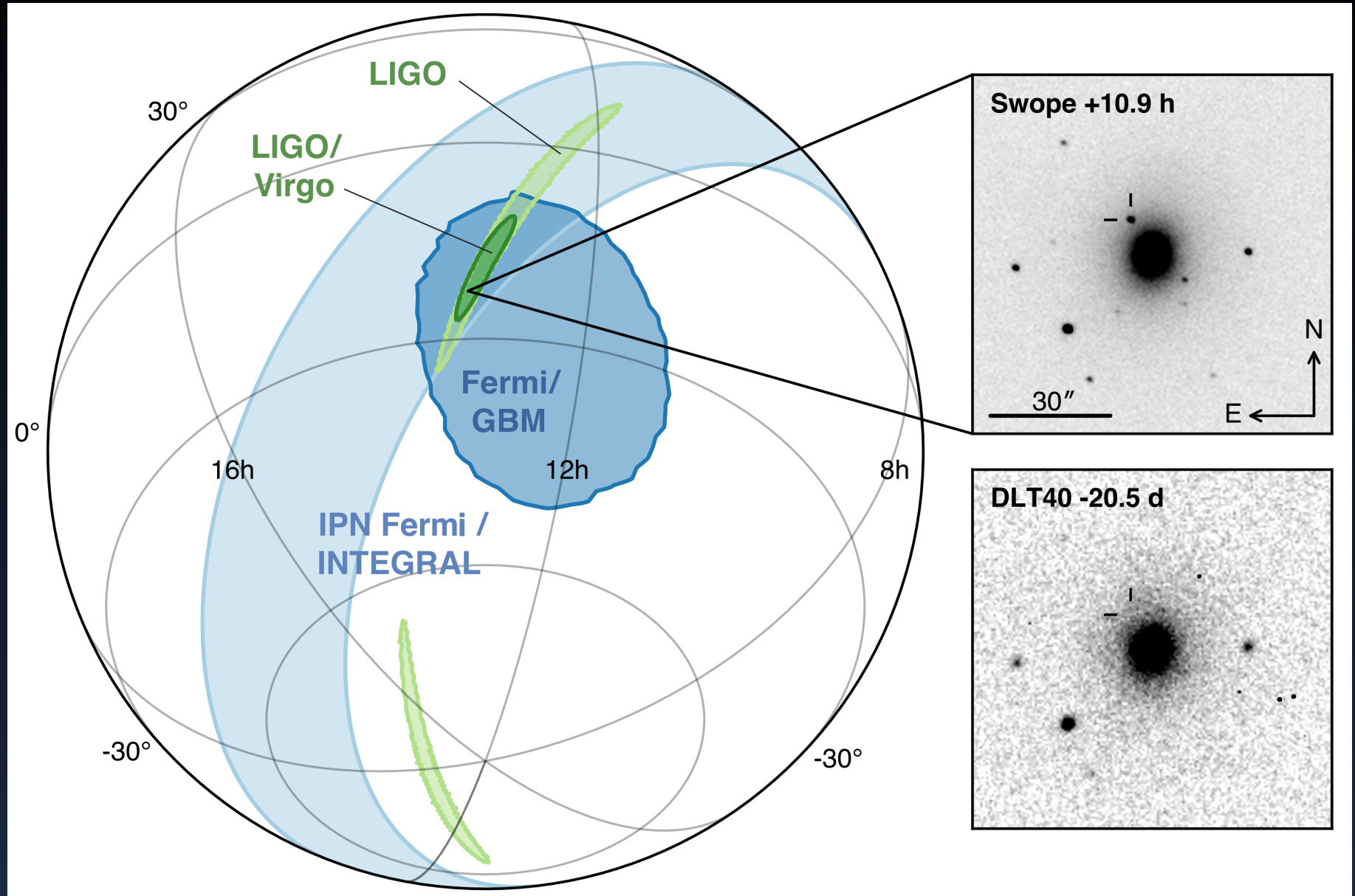
SSS17a 13:09:48.089 -23:22:53.35

and had a brightness of **$i = 16.0$ mag.**

We have checked the minor planet center and previous SN discoveries, and have found no cross-matches. This source could possibly be optical emission associated with the LIGO/Virgo G298048 trigger.

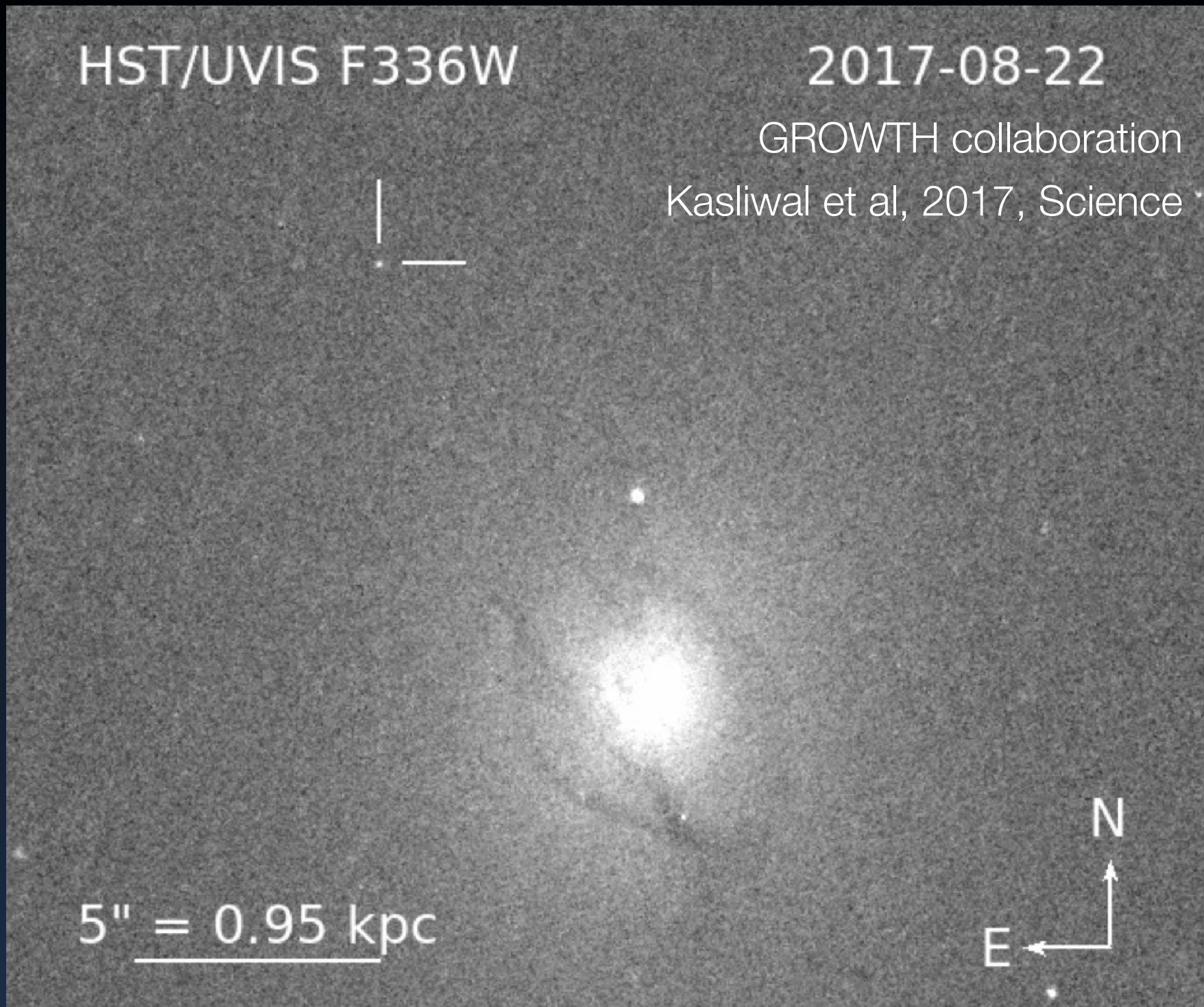
Spectroscopic observations are under way. Additional photometry has been obtained and is being analyzed. Additional observations are encouraged.

Location

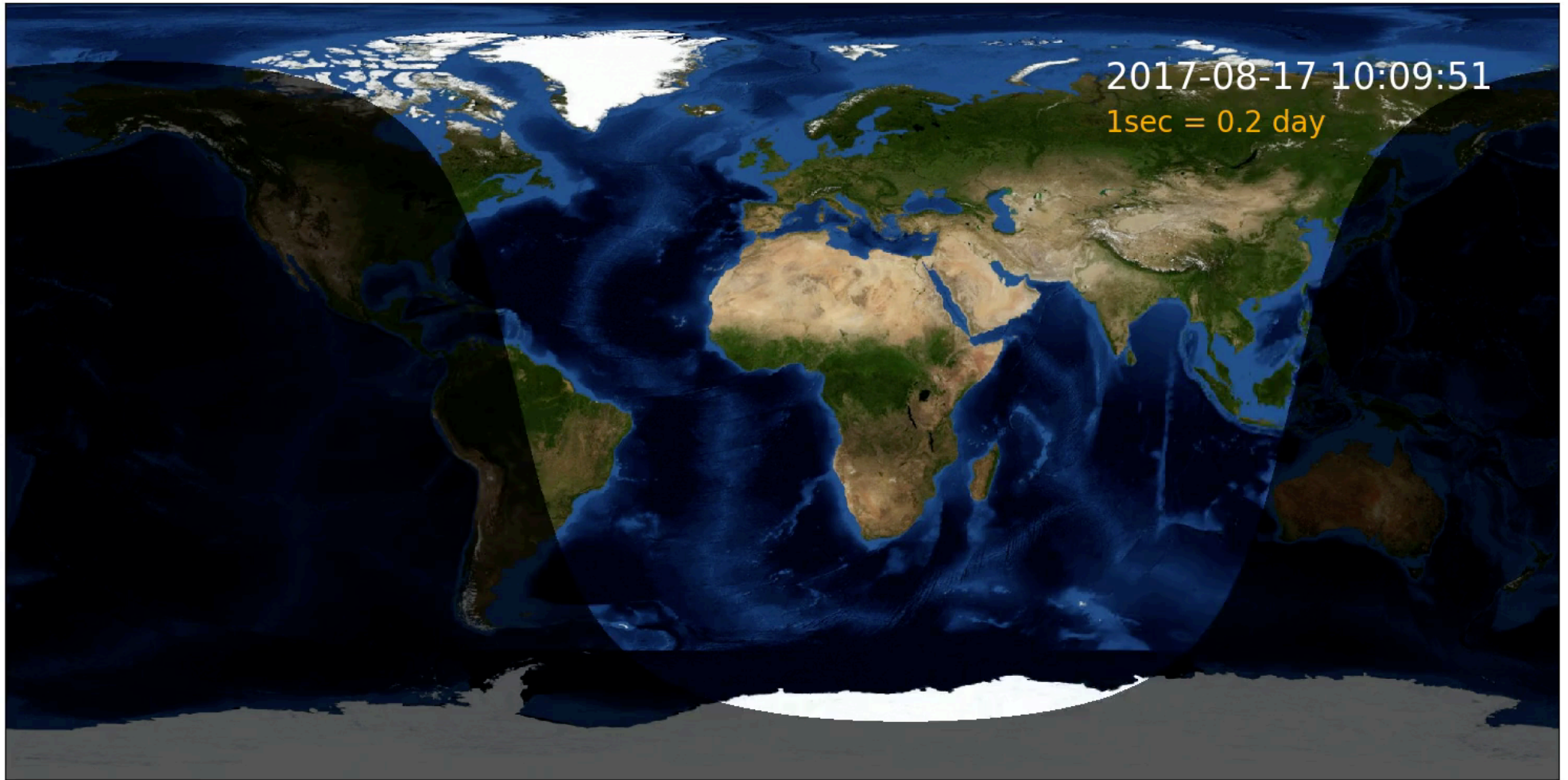


LSC et al, 2017, ApJL; Swope: Coulter et al., GCN 21529;
GBM: von Kienlin et al., GCN 21520; IPN: Svinkin et al., GCN 21515

Counterpart!

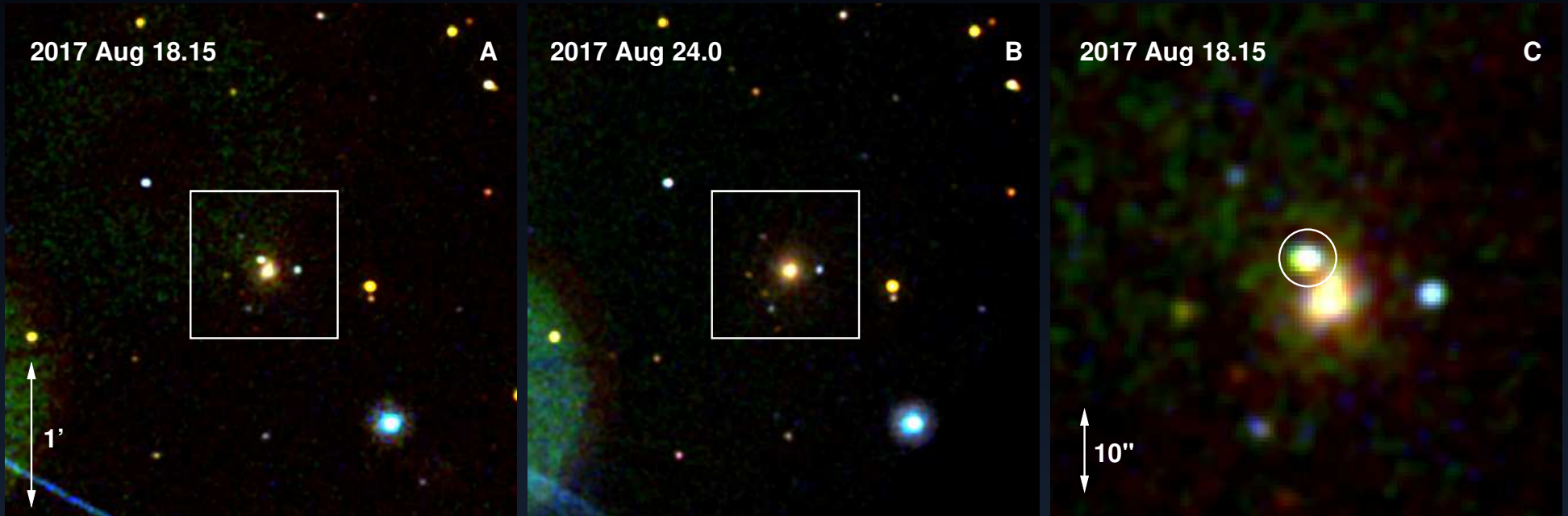


Ground-based follow-up



Credits: Pavan Hebbar, Varun Bhalerao (IITB), David Kaplan (UW Milwaukee),
Mansi Kasliwal (Caltech), GROWTH collaboration

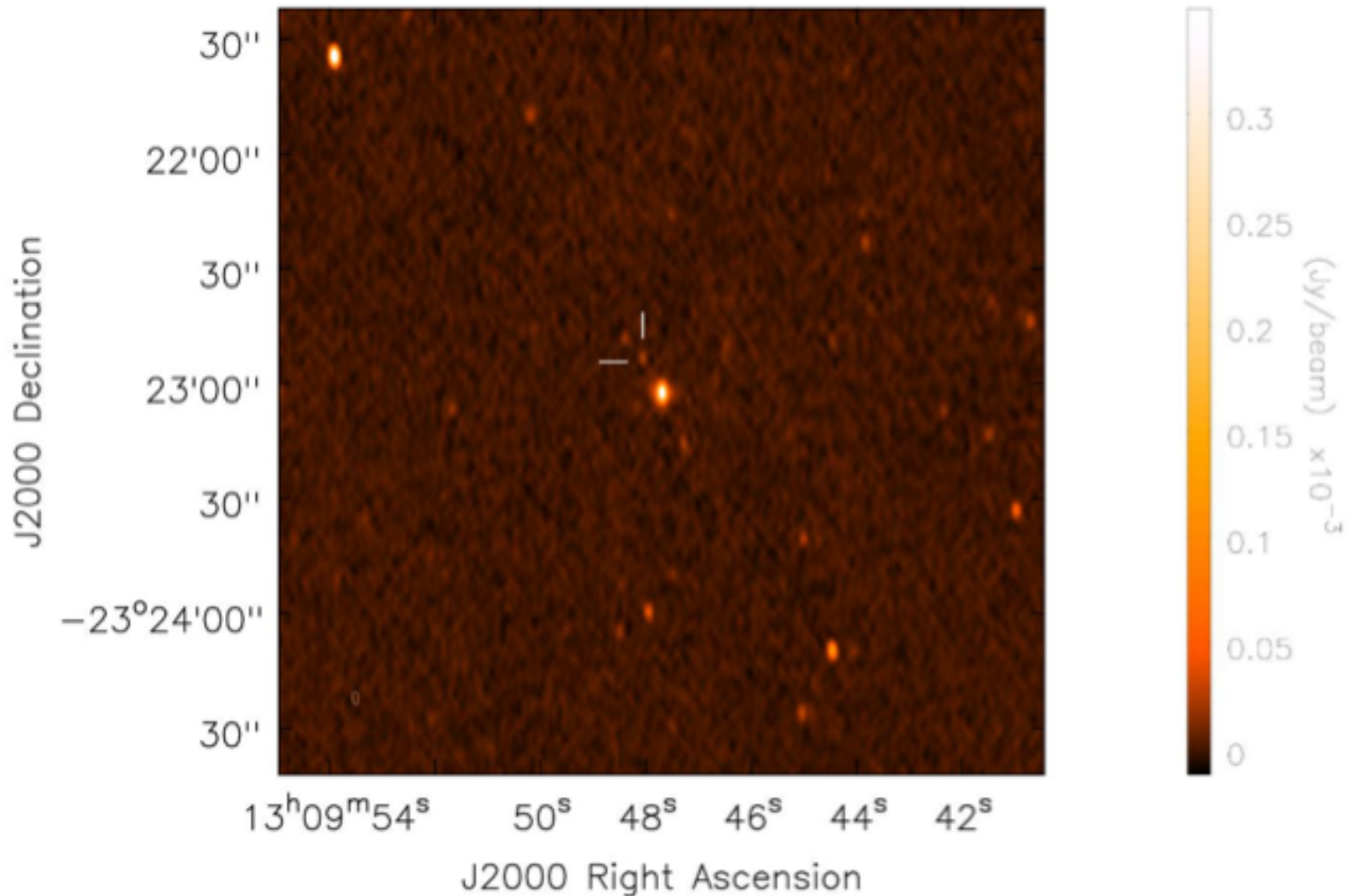
Ultra-violet detection



Credit: Evans et al., 2017 (Science)

Xrays: Not seen at first, seen 9 and 15 days later

Radio detection



GROWTH collaboration, Hallinan, Corsi et al, 2017, Science

GMRT



GROWTH collaboration, Hallinan, Corsi et al, 2017, Science
Kim, S., Schulze, S., Resmi L et al., 2017, ApJ Letters

So what is this object?

GW event

High energy
trigger

Afterglow

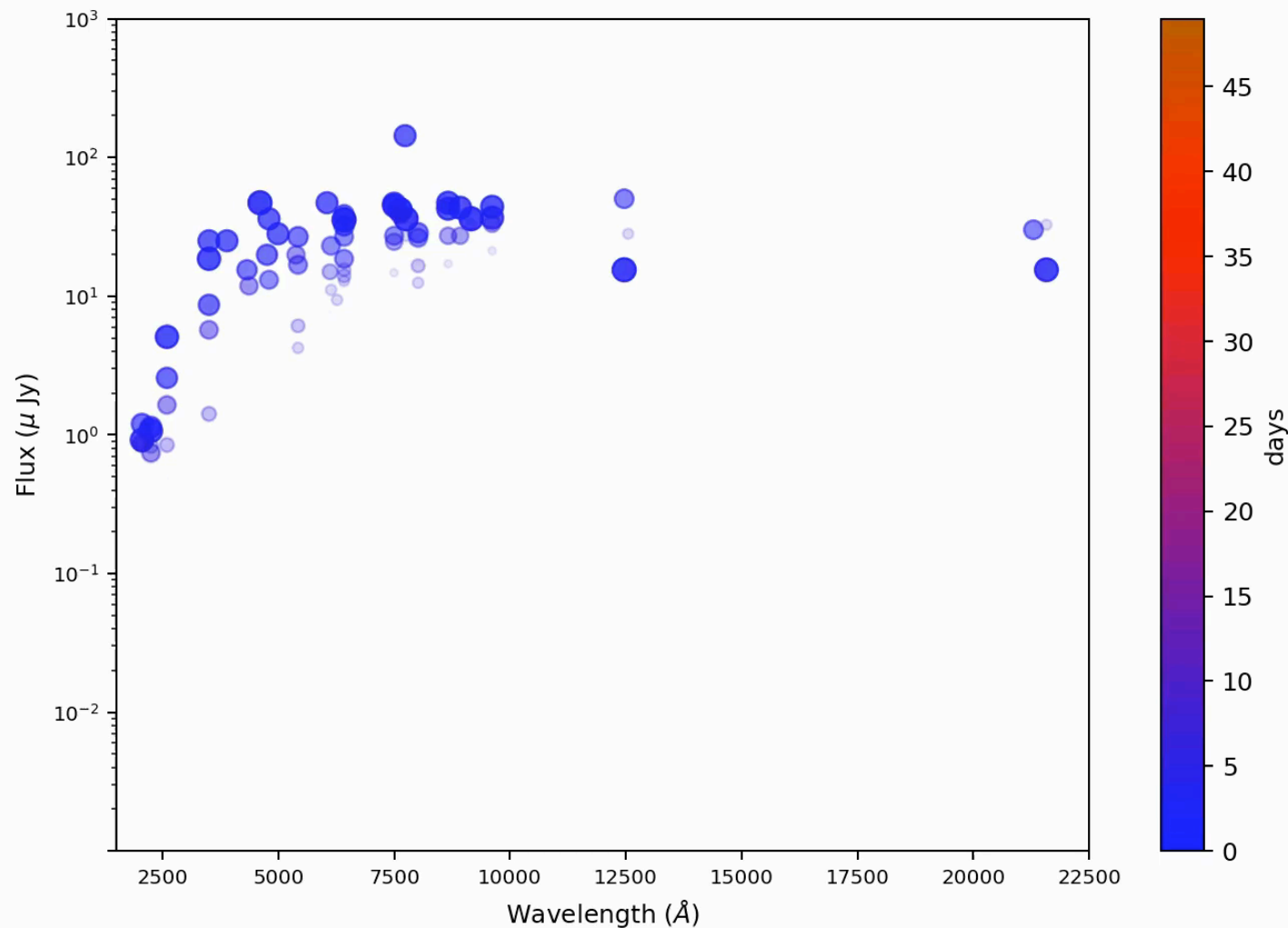
GW + High Energy

- What are the chances of randomly finding a GRB and a GW event **close in time**?
- What are the chances of randomly finding them in the **same part of the sky**?

Like no other

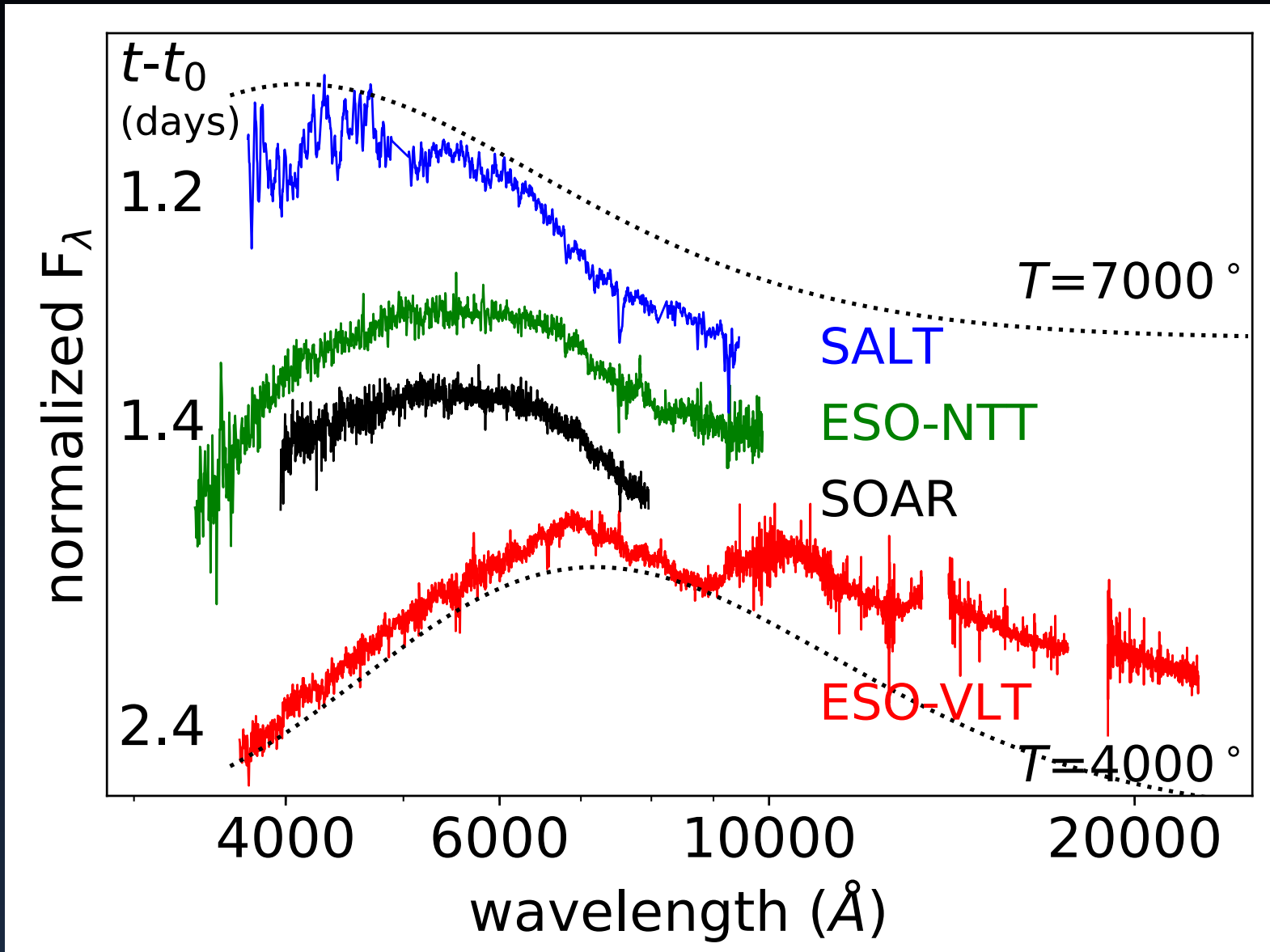
- Supernova?
- Nova?
- Flare star?
- Afterglow of something else?

Light curve evolution



Credit: Atharva Patil, Arvind B, Himanshu Verma, Varun Bhalerao (IIT Bombay), and GROWTH collaboration

Observed spectra

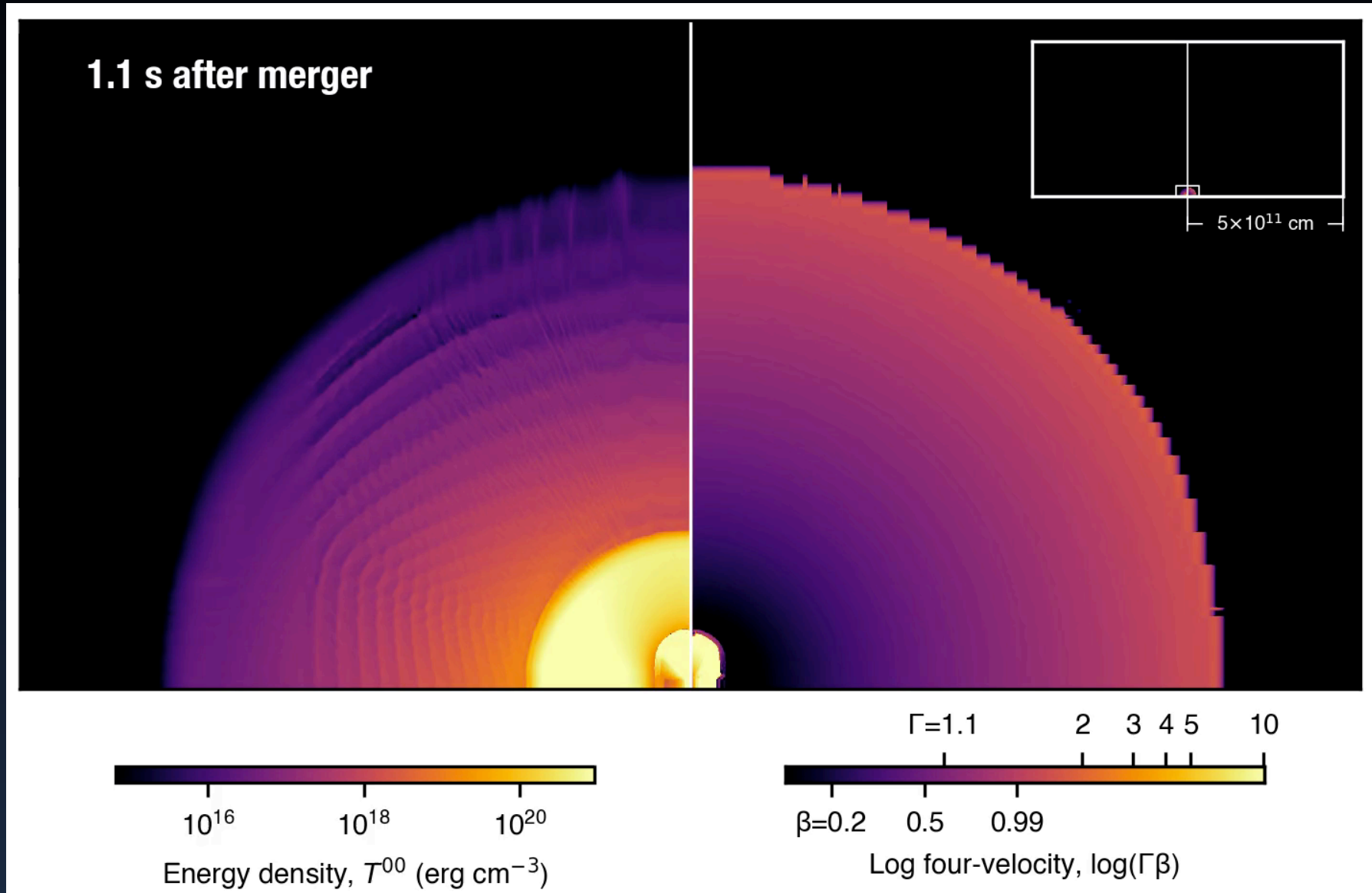


Credit: LSC et al, 2017, ApJL

The meaning of it all

Interpretation

Kilonova models: Brian Metzger's talk!



“Cocoon model” - Kasliwal et al, 2017, Science

Future outlook

Strength in numbers

> 3500 authors

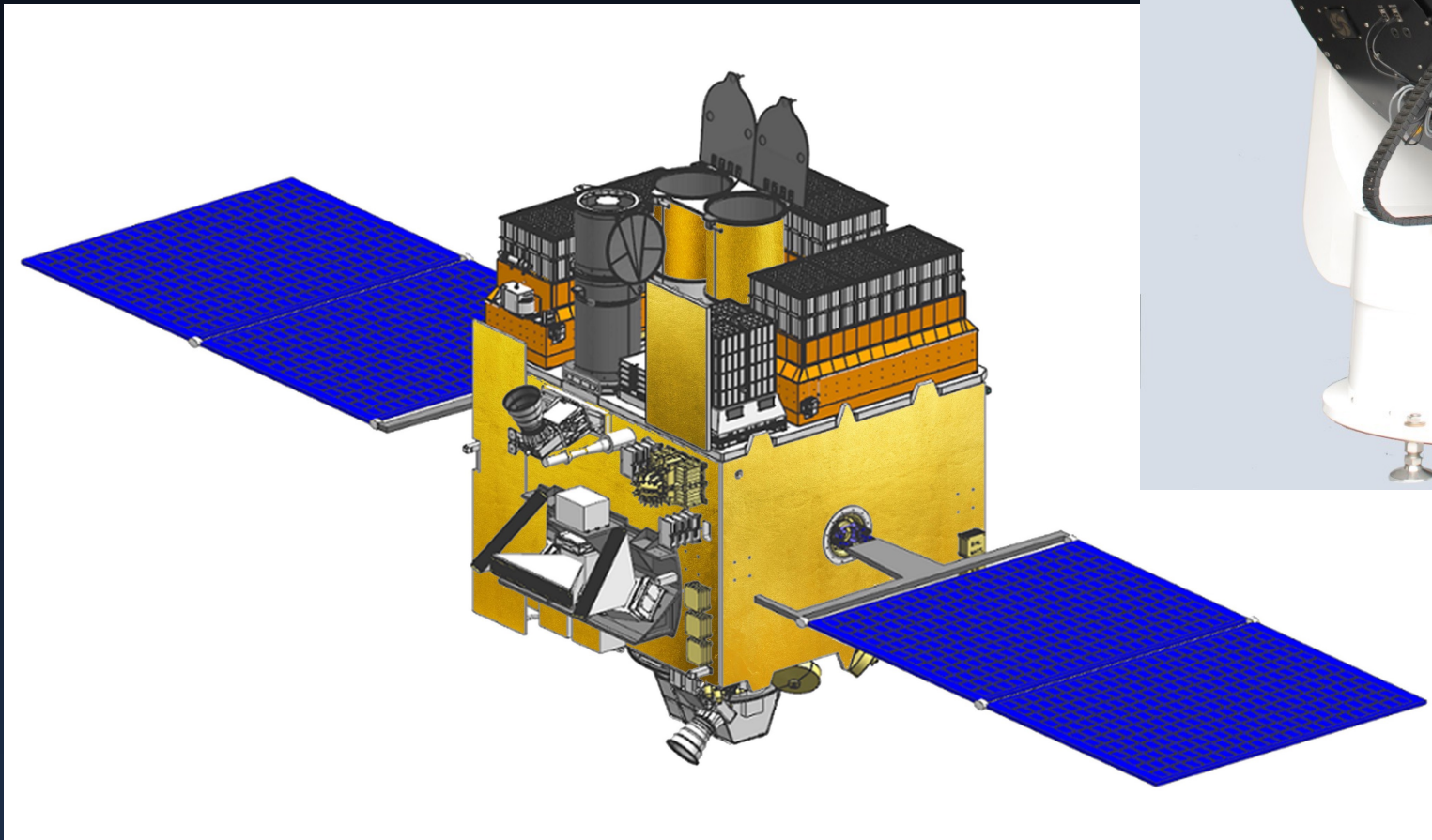
~ 950 institutes

~48 followup groups (MMA paper)

70 observatories

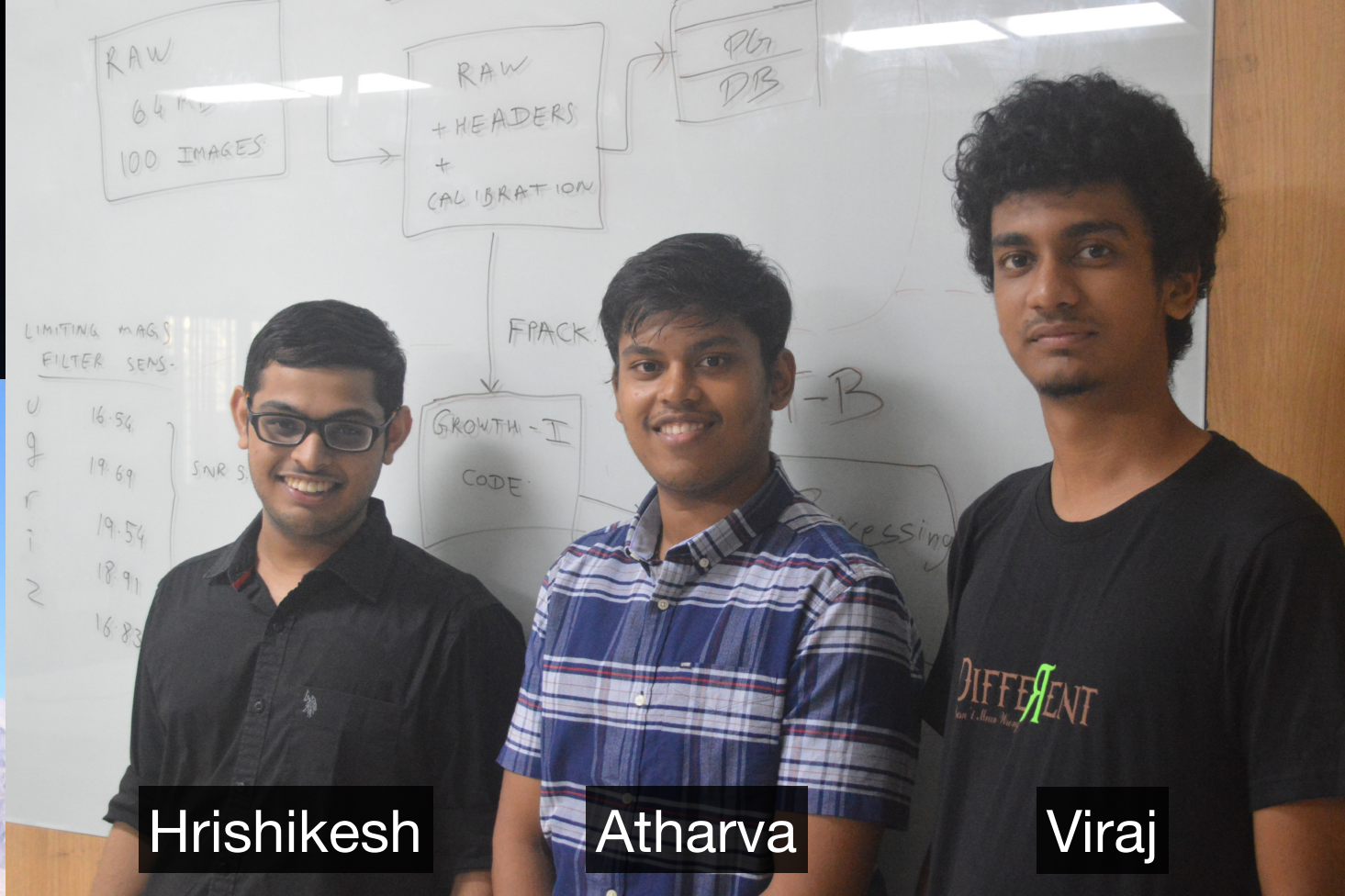
>100 instruments

Future: Indian Perspective



GROWTH India

Tarun



Hrishikesh

Atharva

Viraj



The future is bright!