OzGrav
ARC CENTRE OF EXCELLENCE FOR GRAVITATIONAL WAVE DISCOVERY

Radio variability with ASKAP and LOFAR

MW follow-up of radio transient and vice versa

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ASTRO-COLIBRI Workshop 2025

Swinburne University of Technology · Monash University · The University of Melbourne · The University of Queensland · Australian National University · The University of Adelaide · The University of Western Australia · The University of Sydney · LIGO Virgo KAGRA · CSIRO

Outline

Follow-up of radio transients
- slow
- fast

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Radio follow-up of
- optical
- multi messenger
- high-energy transients

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Identifying and studying
- Synchrotron transients
- Long-period radio transients

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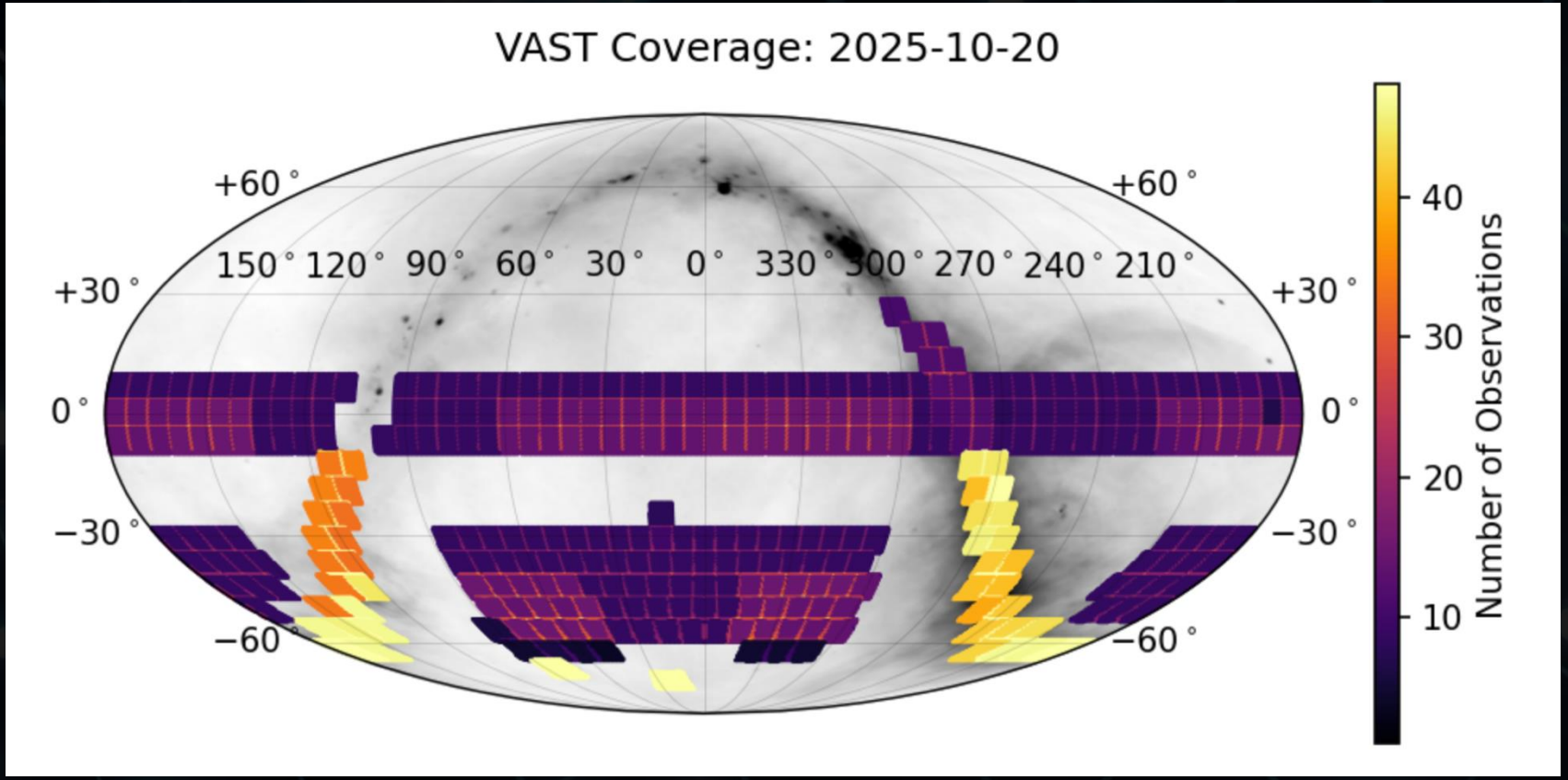
Radio follow-up of
- Recurrent novae
- GW170817
- Gamma-ray bursts

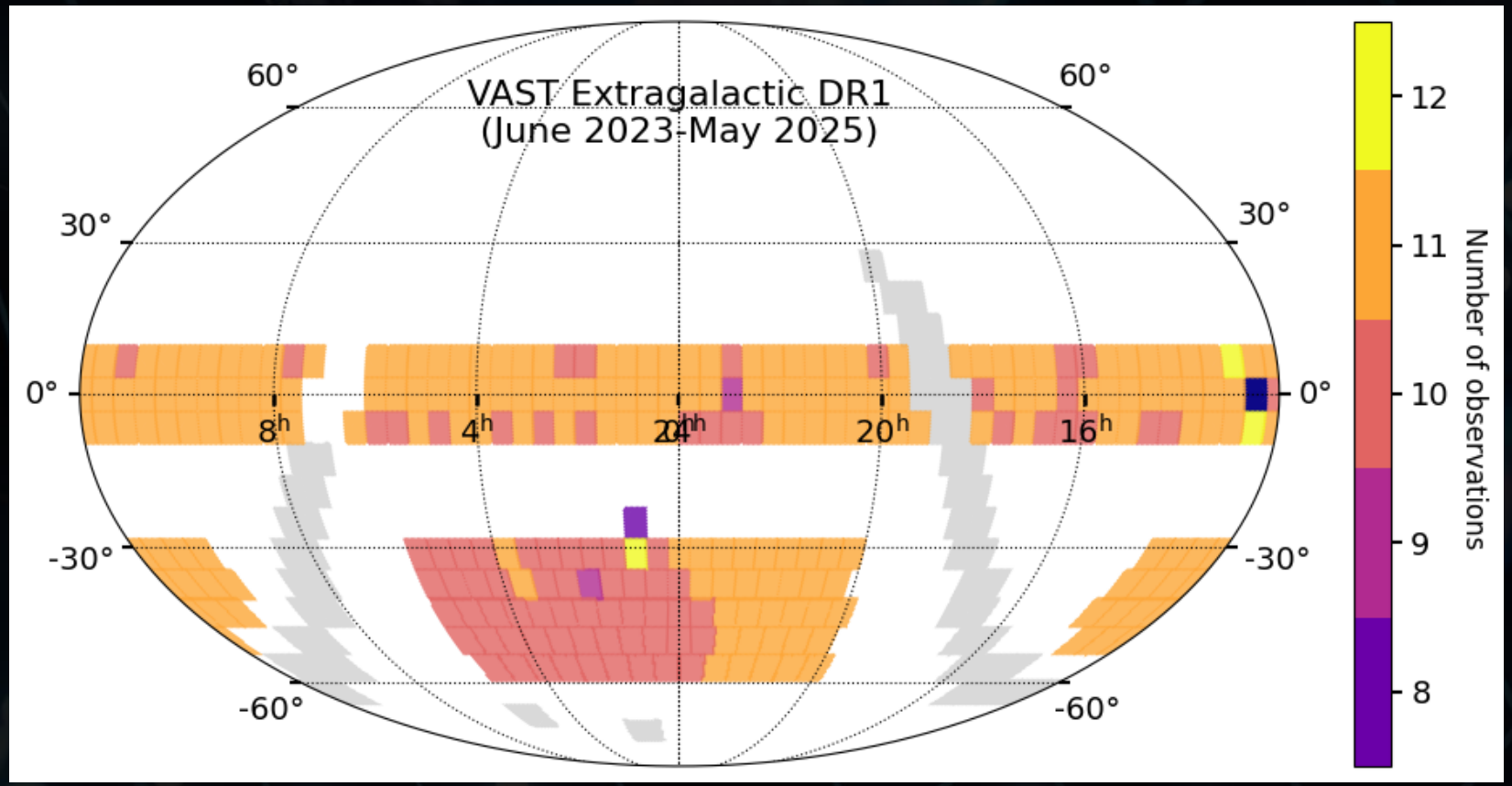
Identifying radio transients (1) dedicated surveys

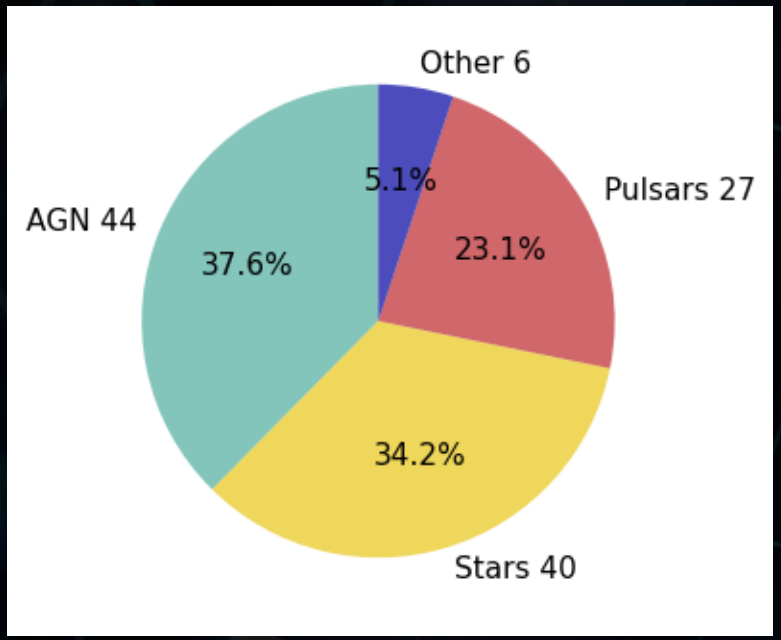
Variables and Slow Transients (VAST) survey science project on ASKAP (Murphy et al. 2013/2021)



Identifying radio transients (1)
VAST Extragalactic DR1

Full survey started in 2023 -> 10-12 observations per field



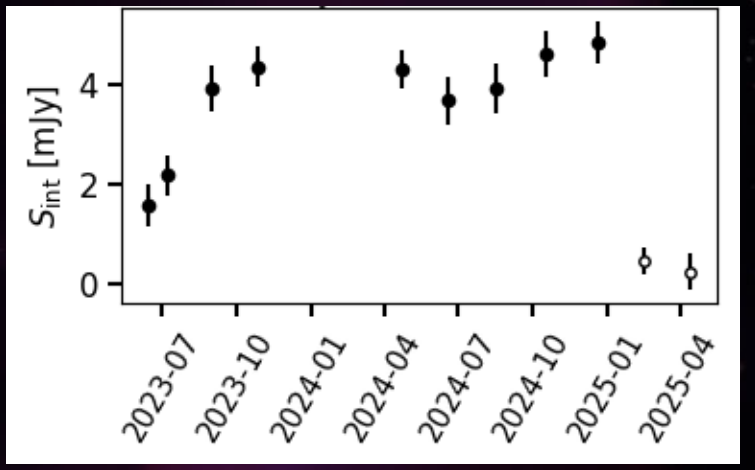


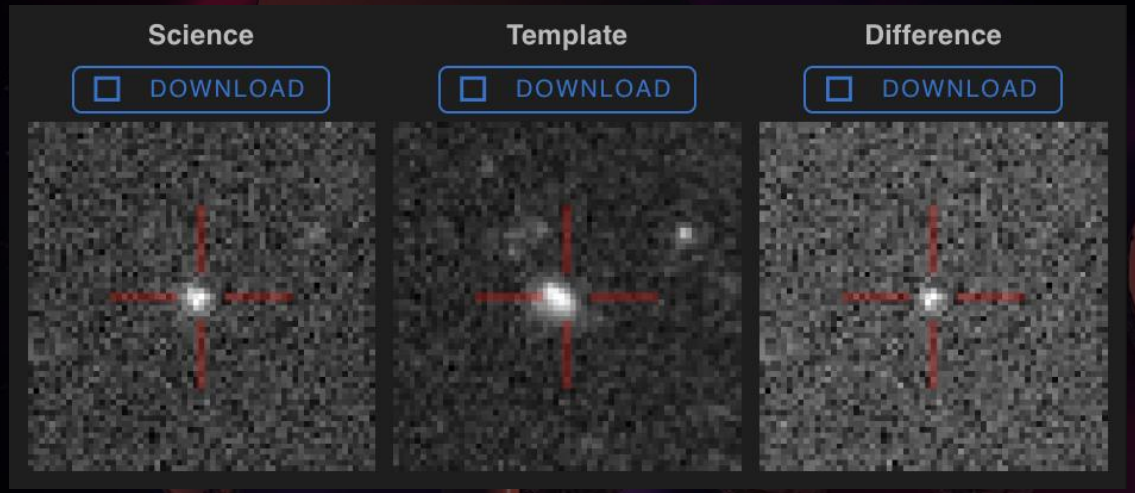
de Ruiter et al. (in prep)

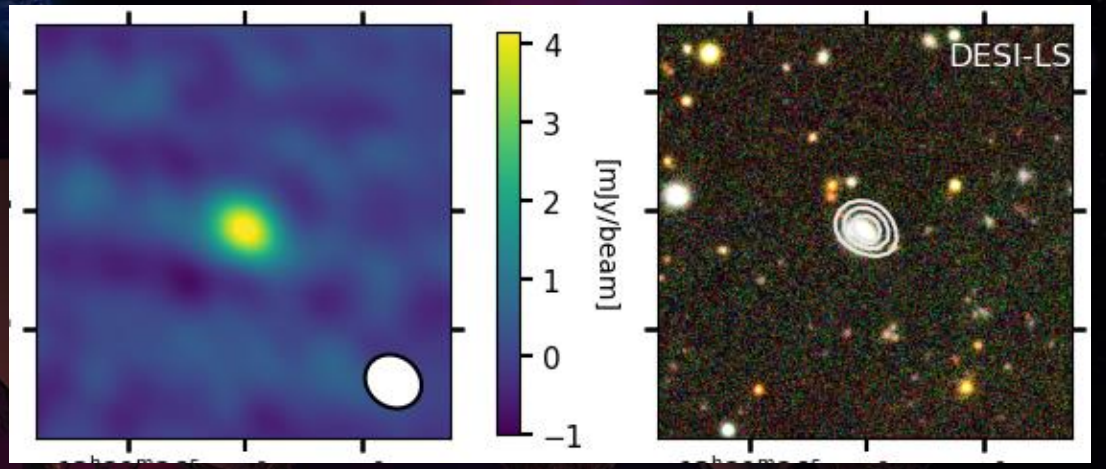
Slow transients: supernova candidate

Highly variable radio source in VAST
Dwarf galaxy at $z_{phot} = 0.034 \pm 0.015$
Peak radio luminosity $\sim 10^{29}$ erg s^{-1} Hz^{-1}

AleRCE ZTF explorer







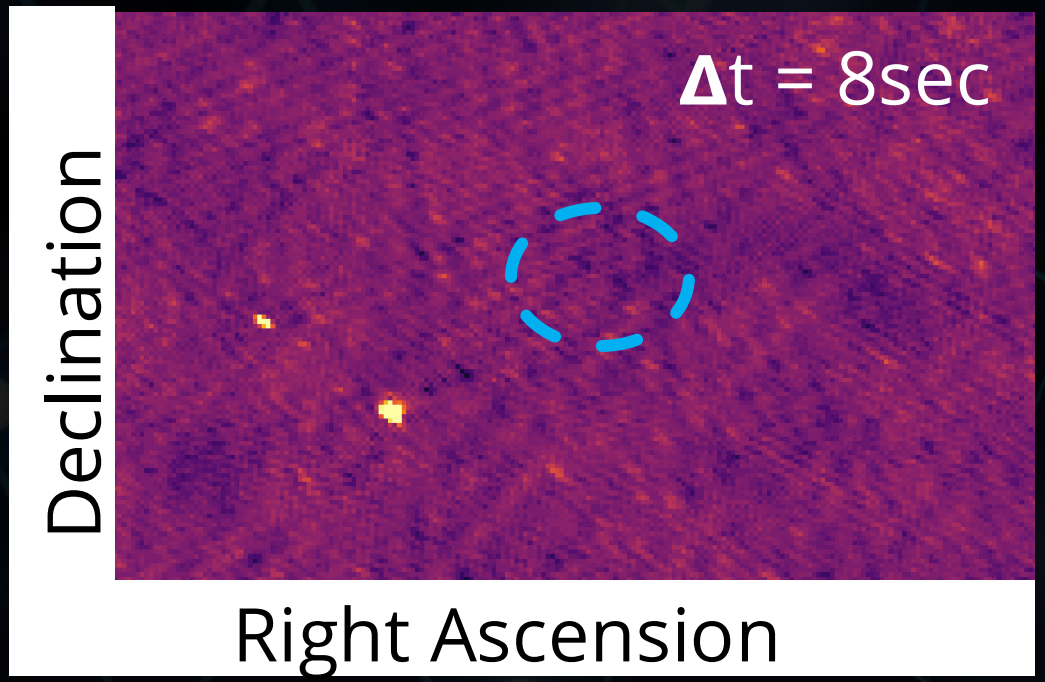
Identifying radio transients (2) commensal searches

Single observation – multiple science cases

High time resolution imaging is a recent development

(de Ruiter et al. 2025)

Complementary to
beamformed searches (FRBs)



Current commensal, high-time resolution imaging searches

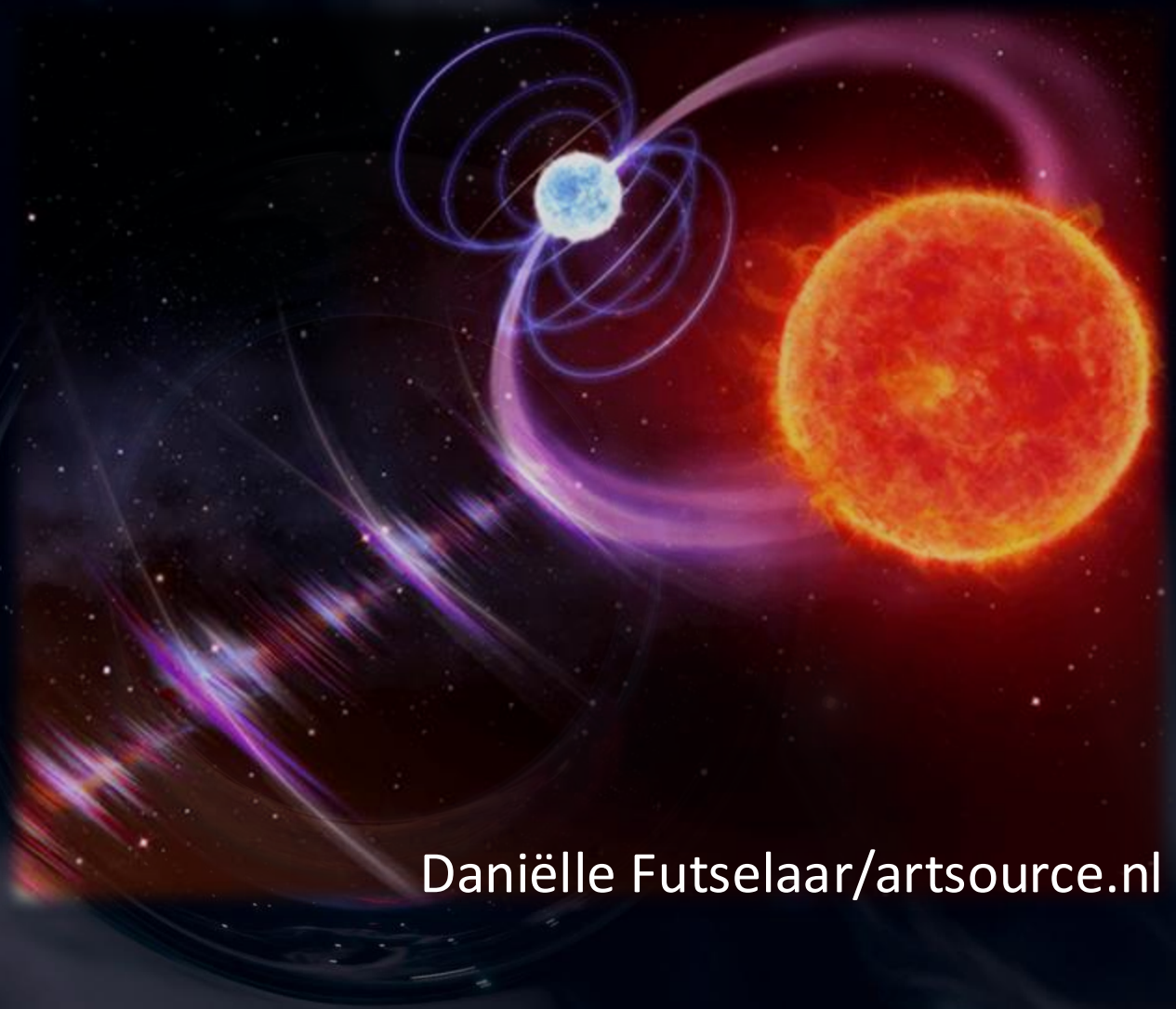
Custom pipelines for:

- MeerKAT – TRON (Smirnov et al. 2025)
- MWA (Horváth et al. 2025)
- ASKAP – VASTER (Wang et al. 2023)
- LOFAR (de Ruiter et al. 2024)

Fast transients: long-period radio transients

- Bright second to minute radio bursts
- Periods of minutes to hours

Slowly spinning pulsars?



Daniëlle Futselaar/artsource.nl

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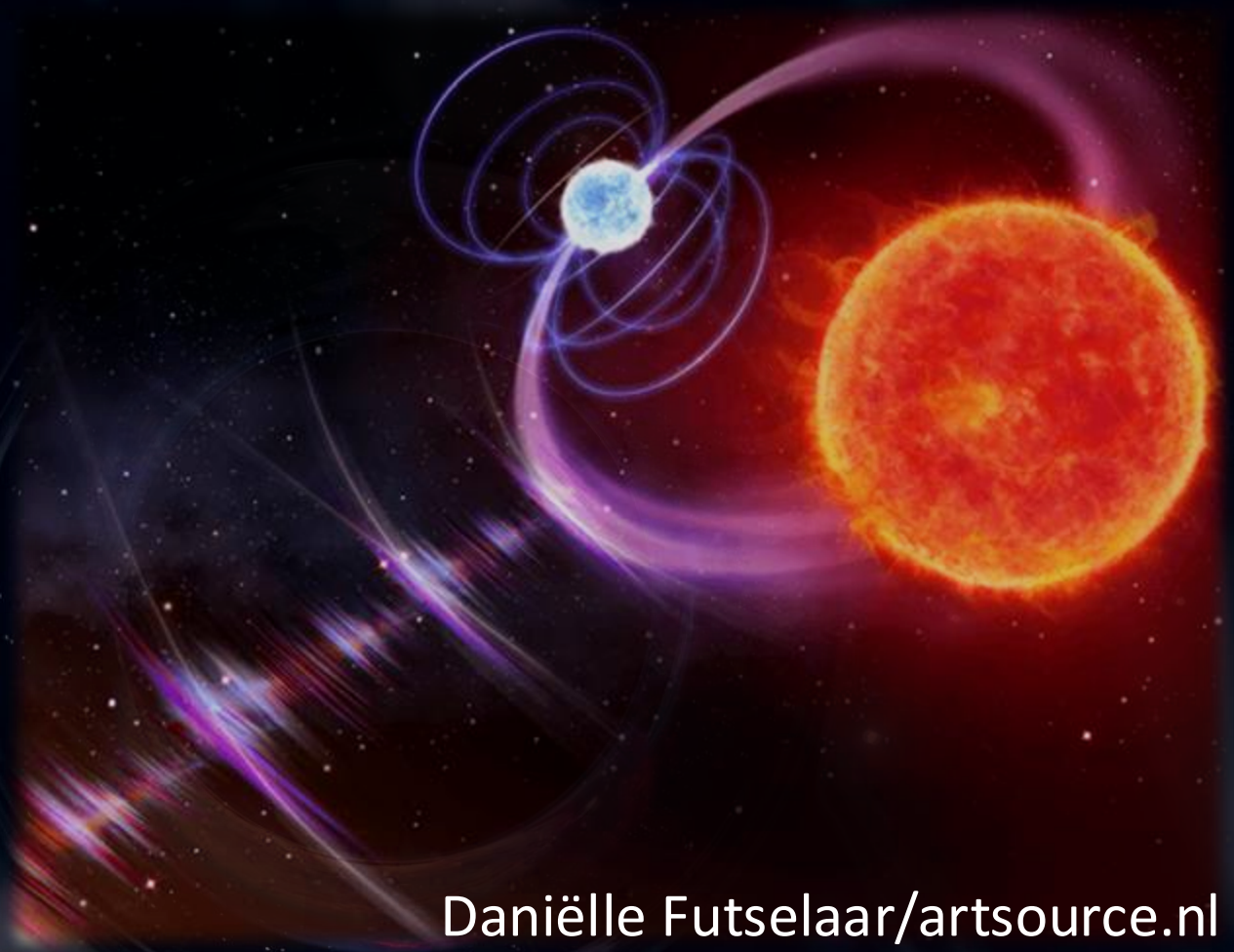

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ILTJ1101+55 (de Ruiter et al. 2025)

- Optical counterpart
- White dwarf – M dwarf binary

Other wavelengths

- Two X-ray detected LPTs (Wang et al. 2025, Anumarlapudi et al. 2025)
- Optical variability (Marsh et al. 2016; Pelisoli et al. 2023)

and vice versa

Radio follow-up of
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‘Traditional’ approach for synchrotron transients

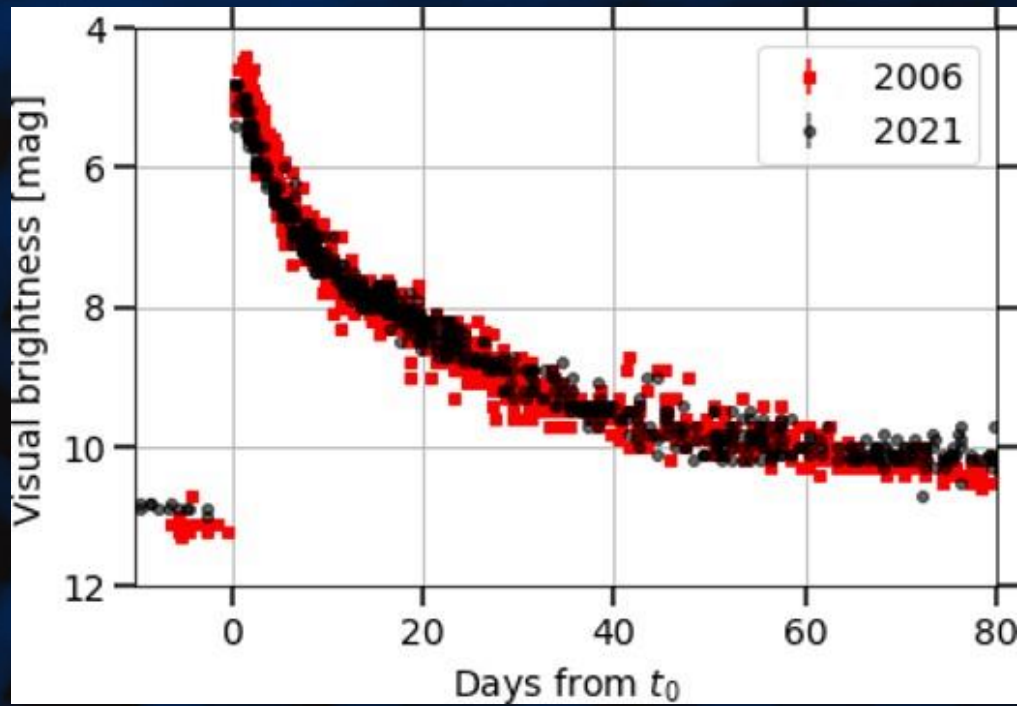
RS Ophiuchi

Recurrent nova system

White dwarf accreting from companion

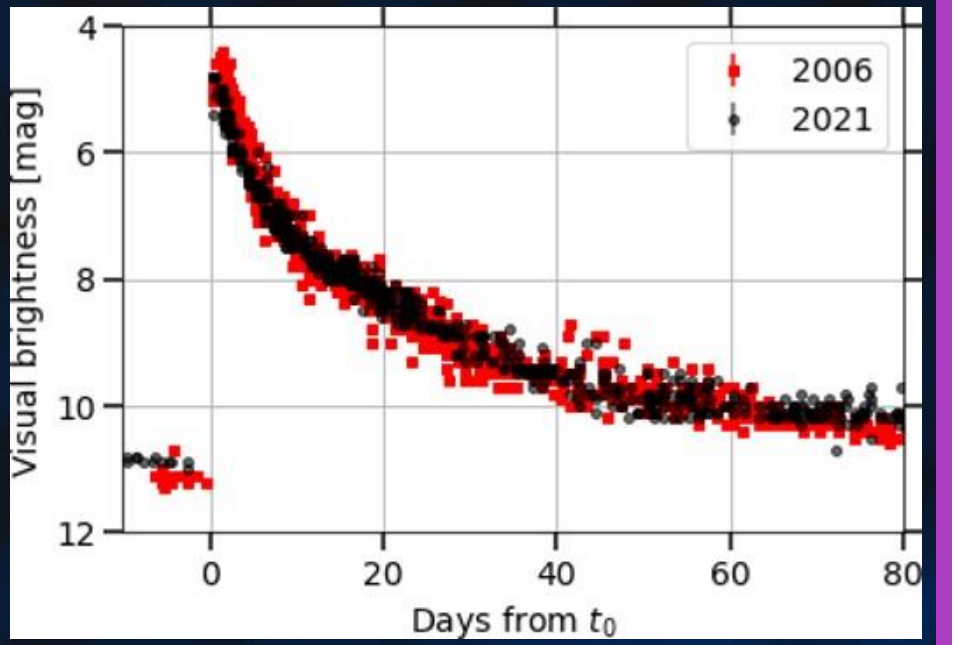
Type 1A Supernova?

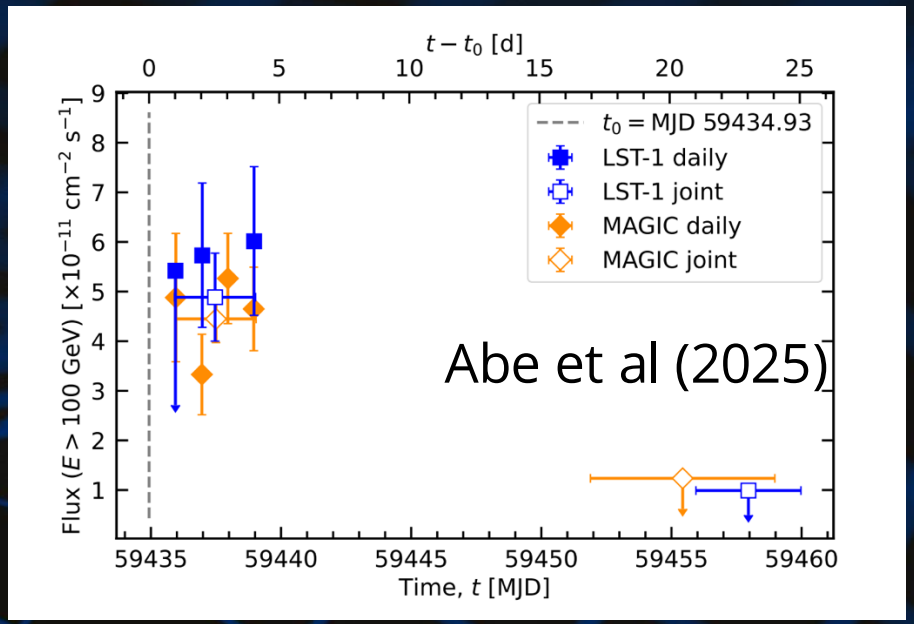
Maximum white dwarf mass?



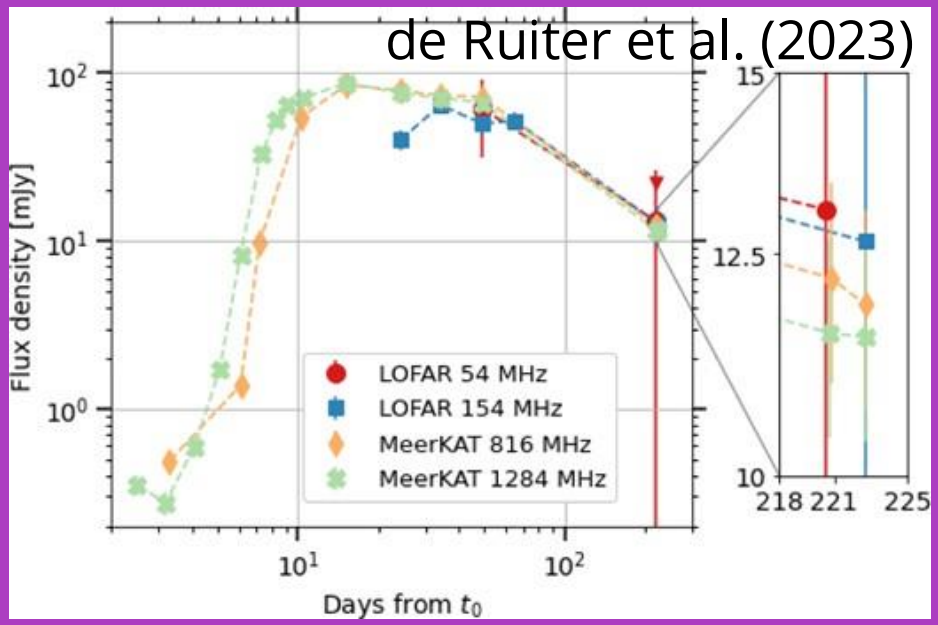
RS Ophiuchi

2021 outburst
A wide range of multi-wavelength follow-up

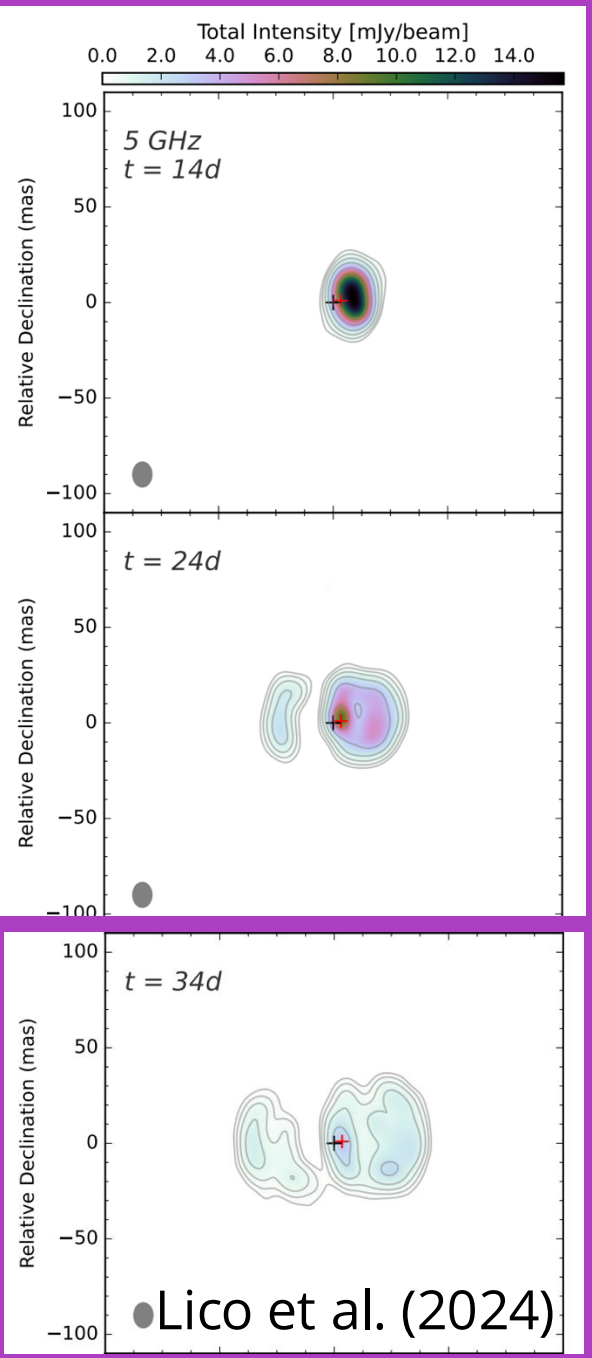




Abe et al (2025)



de Ruiter et al. (2023)



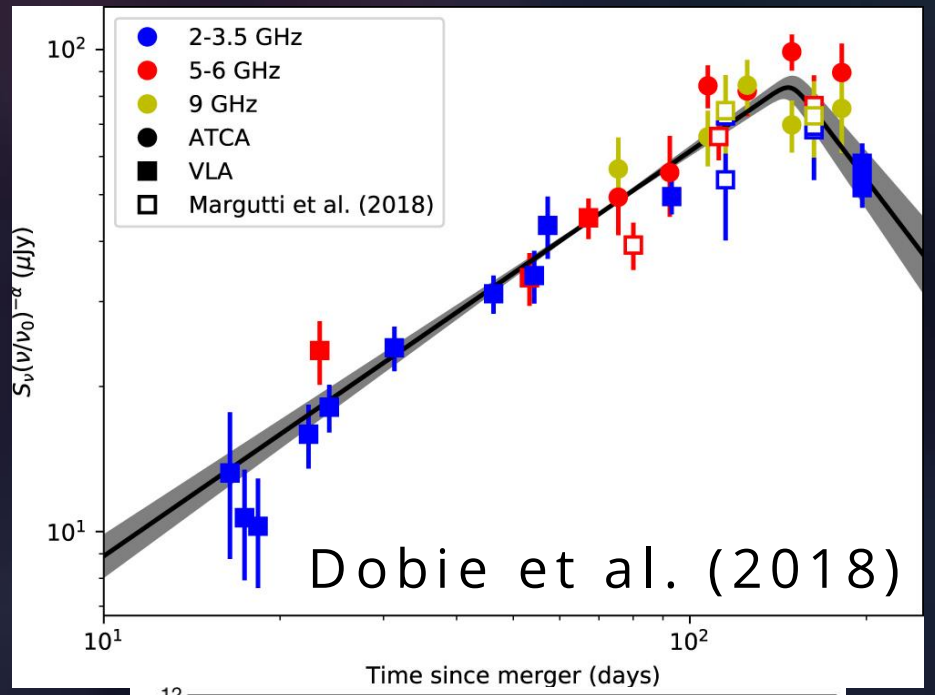
Lico et al. (2024)

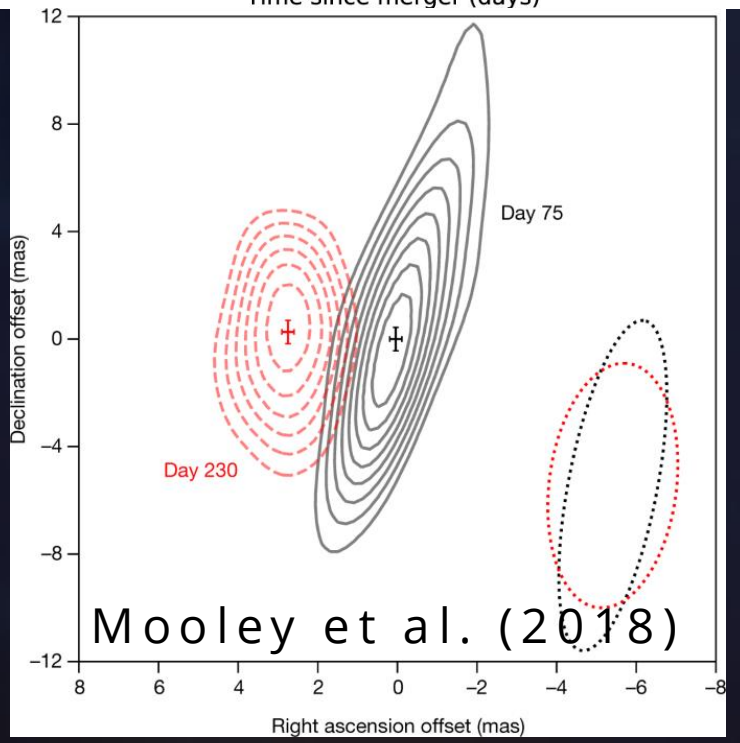
GW170817

GW170817 associated with a sGRB
(Abbott et al. 2018)

Unique constraints on:

- Energetics
- Circumbinary material
- Jet structure (cocoon/top-hat)



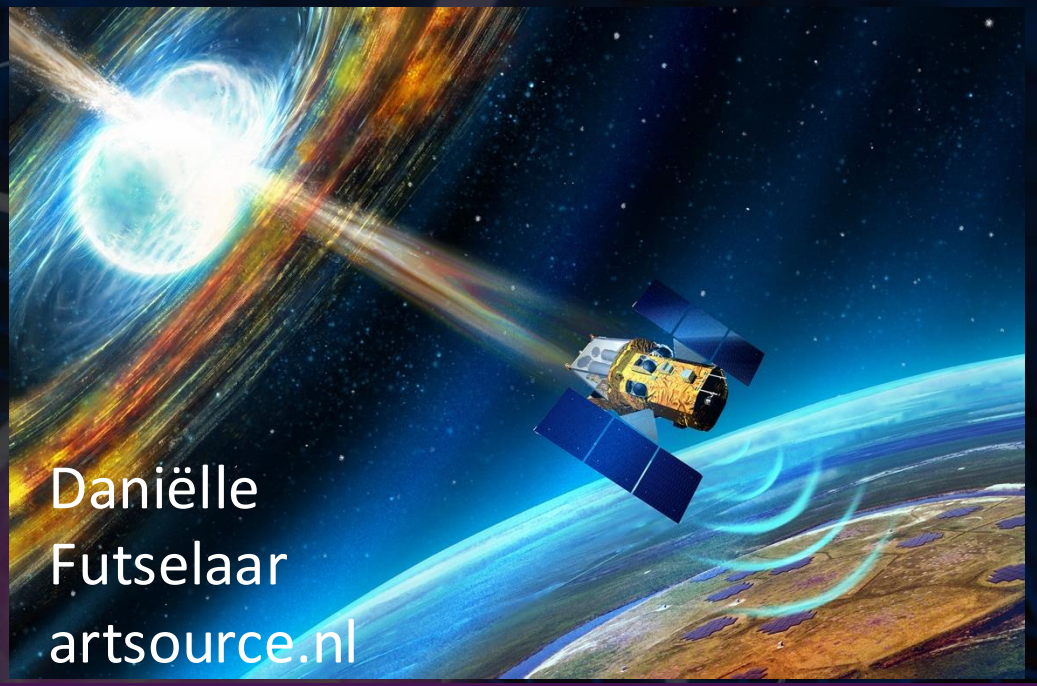


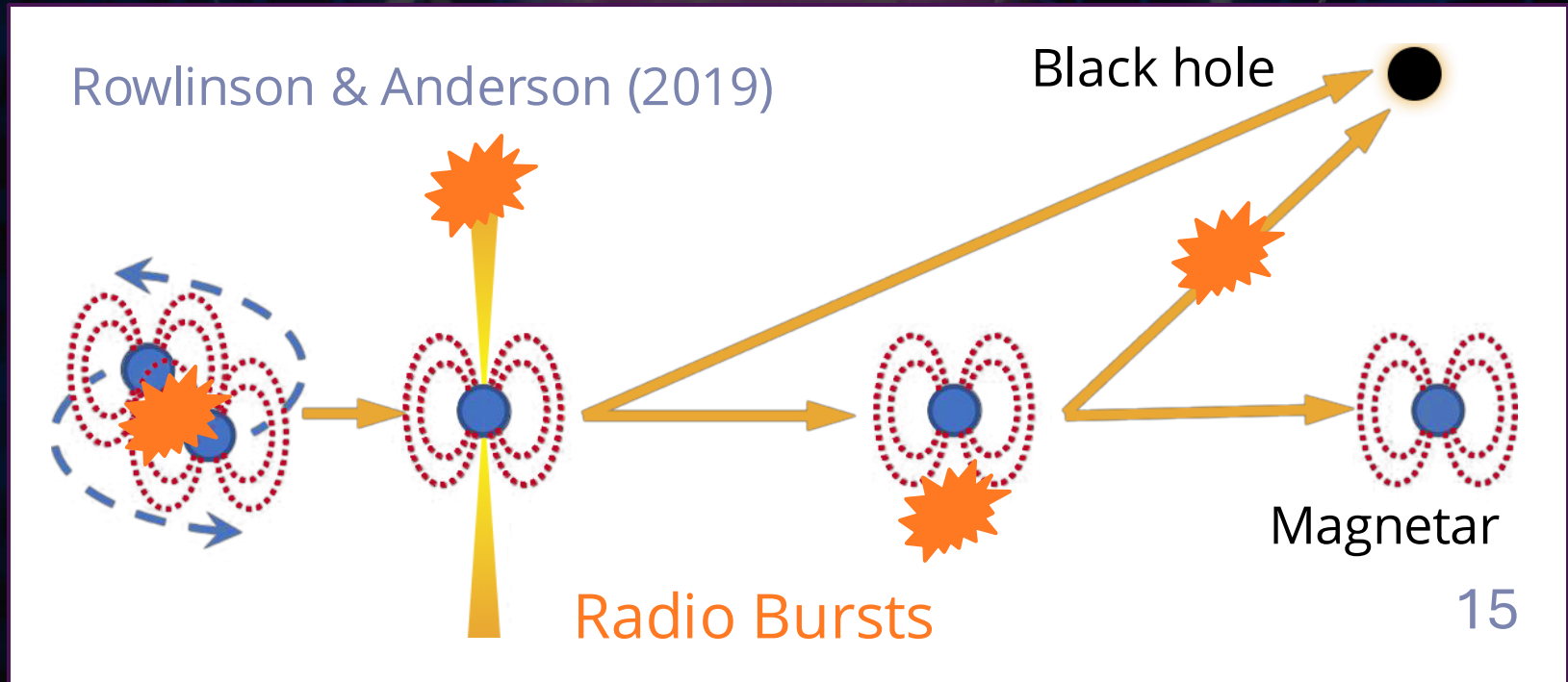
(Short) GRBs

Radio probes the afterglow emission
Prompt radio burst

Rowlinson et al. (2024)

- Rapid response modes on LOFAR, ATCA, MWA
- All-sky monitors





Future

MW follow-up of radio transients: Exploiting the next generation radio telescopes (LOFAR 2.0, SKAO, ngVLA, DSA-2000) requires robust algorithms with short turn around between detection and transient alert.

SKAO

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SKAO

Radio follow-up of MW transients:
Limited radio follow-up facilities, how to identify the most promising events?

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Radio follow-up of MW transients:
Limited radio follow-up facilities, how to identify the most promising events?

Excited to learn from and collaborate with transient communities at other wavelengths!

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