

# Transients SWG Report

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*The Fifth National Workshop on the SKA project - From precursors to SKAO: shaping the future of Italian radio astronomy,  
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# Transients Working Group Introduction

- Coordinators
  - Current: James Miller-Jones (Aus), Kaustubh Rajwadeh (UK)
  - Previously: Patrick Woudt (S.A.), Jason Hessels (NL/Can)
- ~100 members, 19 from Italy - 8 at this workshop, 4 in this session
- Sources of interest: FRBs, LPTs, GRBs, TDEs, XRBs, CVs, novae, SNe, variable stars/AGNs, unknowns...

Duration: **fast** ( $< \sim 10^{-3}$  s) vs **"slow"** ( $10^0$ - $10^4$  s)

Emission mechanism: **coherent** vs **synchrotron**

Occurrence: **One-off** vs **repeating/recurring/variable**

Location: **Galactic** vs **extragalactic**

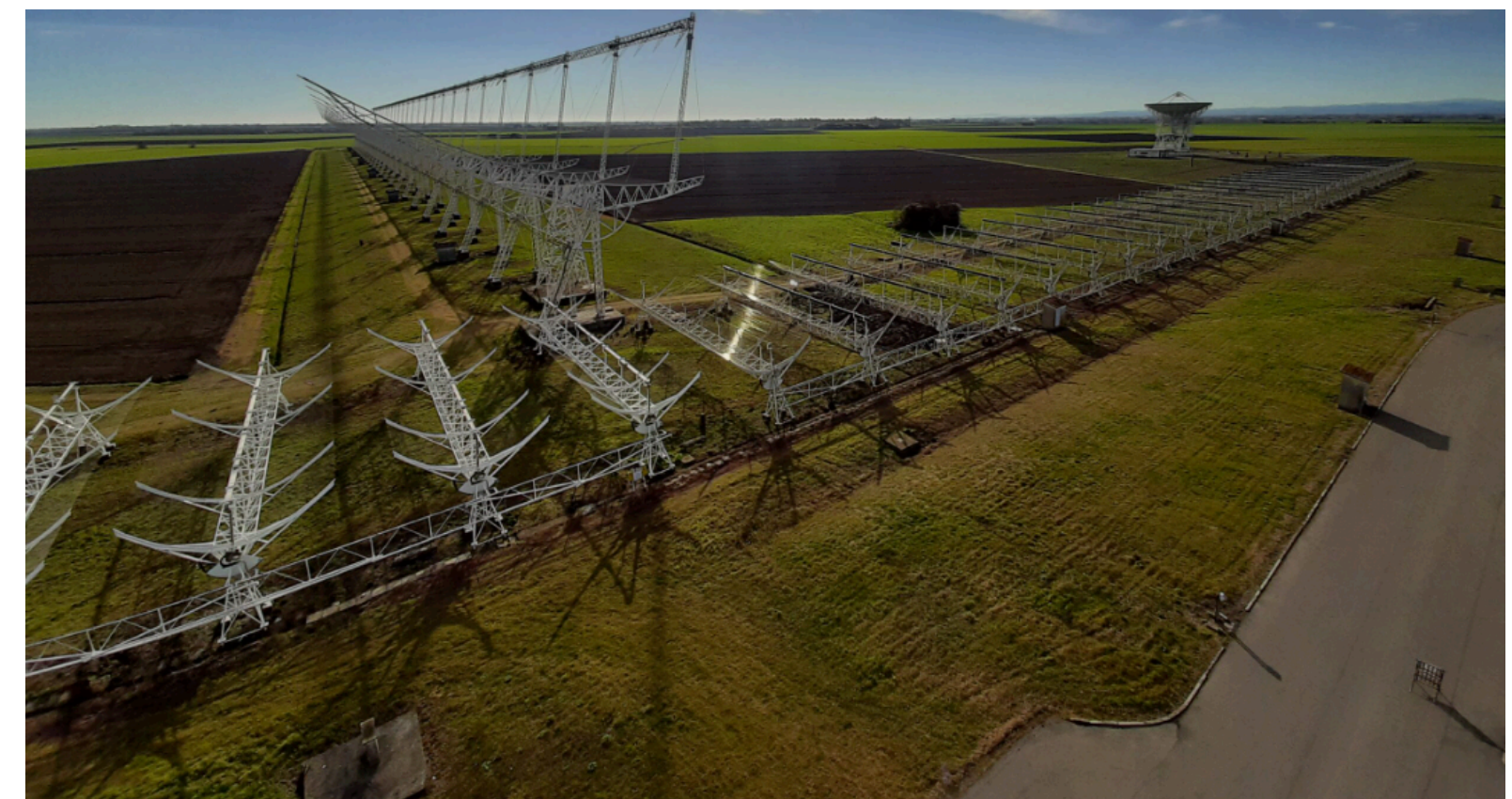
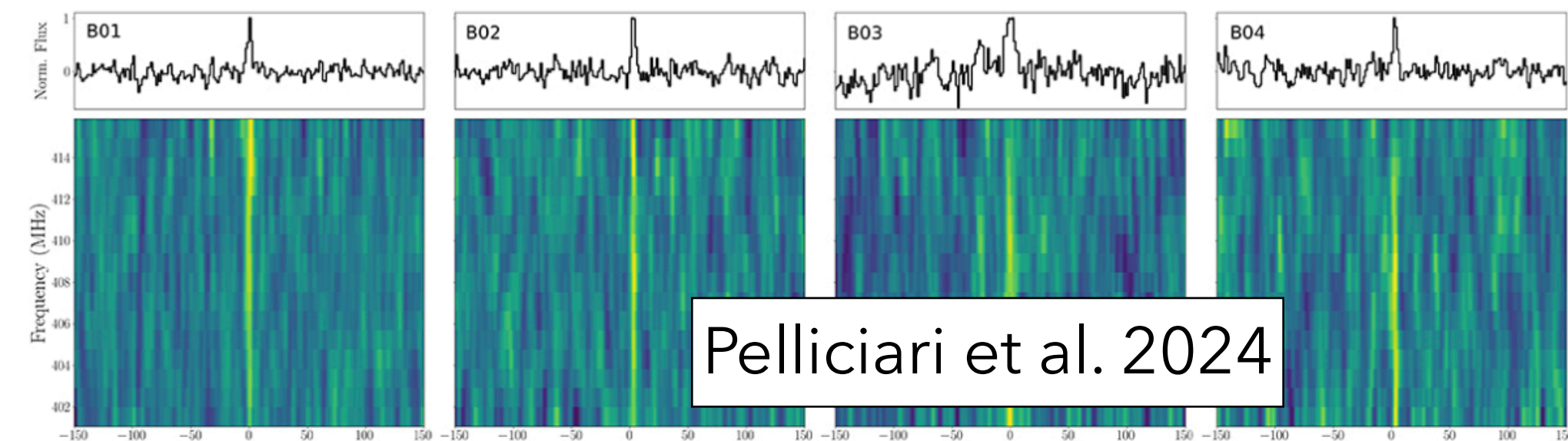
SED: **Radio-only** vs **MWL/MM**

Studied as: **targets** or **probes**, for **discovery** or **follow-up**,  
in **time-domain** or **image-domain**



# Fast Radio Bursts

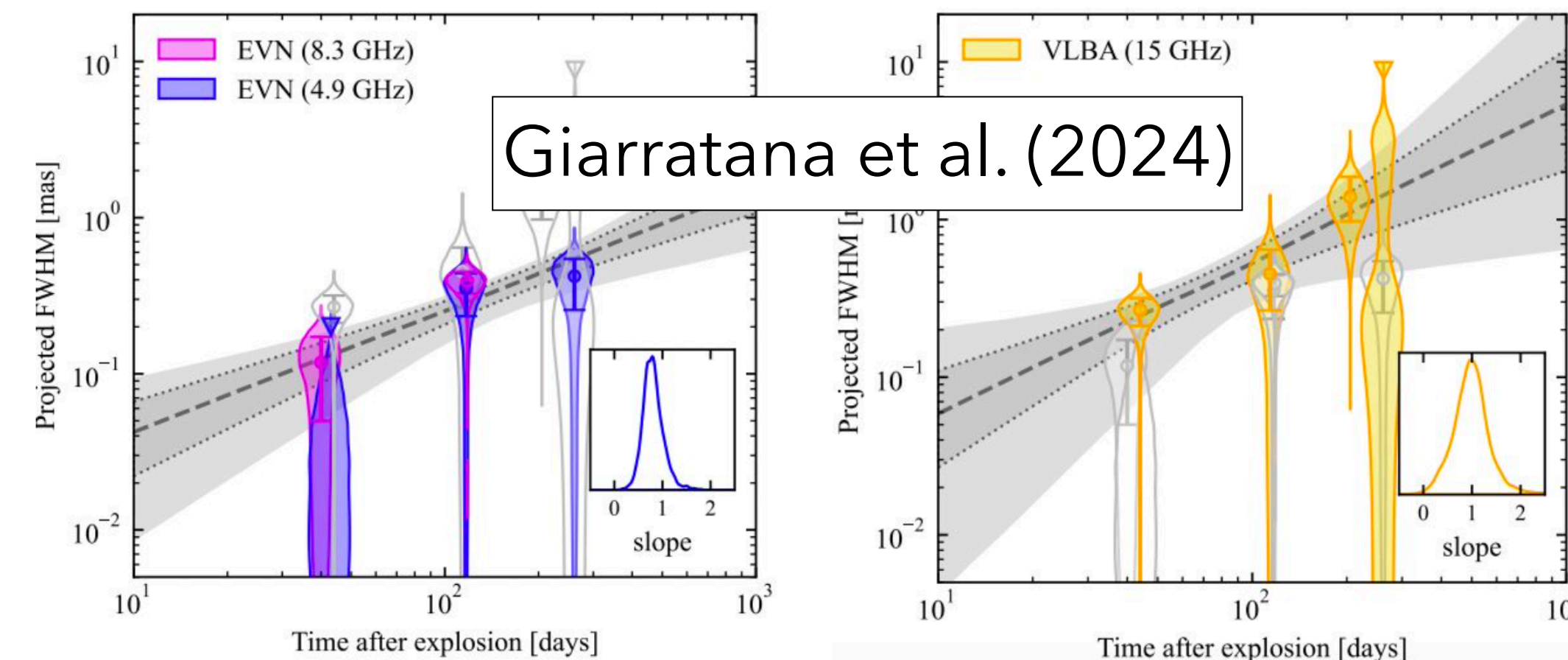
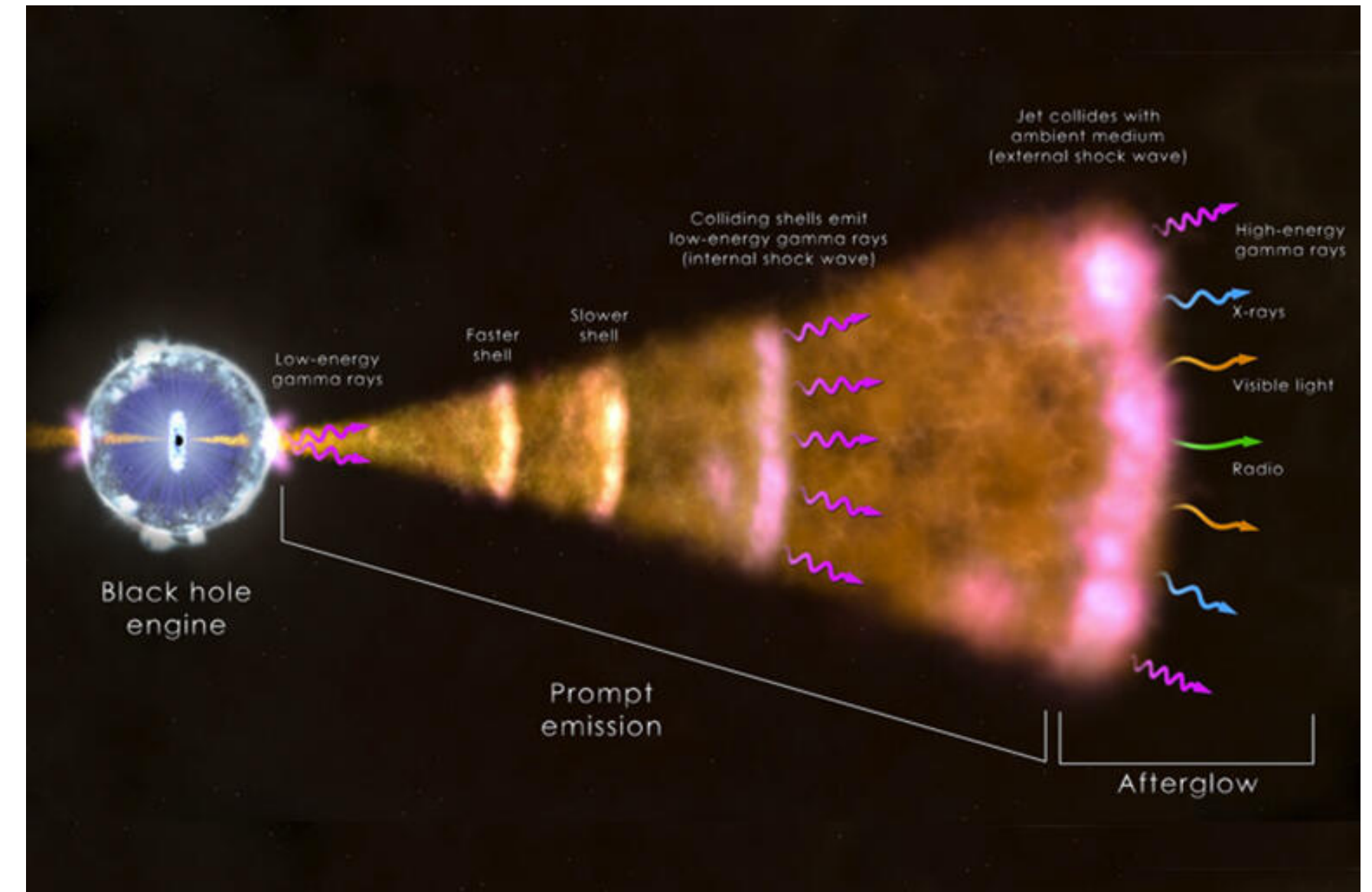
- **Extragalactic** sources, as indicated by **large DM** and detected **hosts**
- Most **one-off**, some **repeating**, a few with **~periodicities**
- Large and variable linear and circular **polarisation**
- Patchy emission in **frequency**
- Main **instruments** now: CHIME, ASKAP, MeerKAT; upcoming: CHORD, DSA2000
- Open **issues**: one or more populations? Progenitors? Association/connection with PRS? Use for cosmology
- **Italian** contributions: Northern Cross, PRECISE, MeerKAT/VLA/GMRT (for search of radio sources)
- Talks today: **Pilia, Bruni, Pellicciari**





# Gamma Ray Bursts

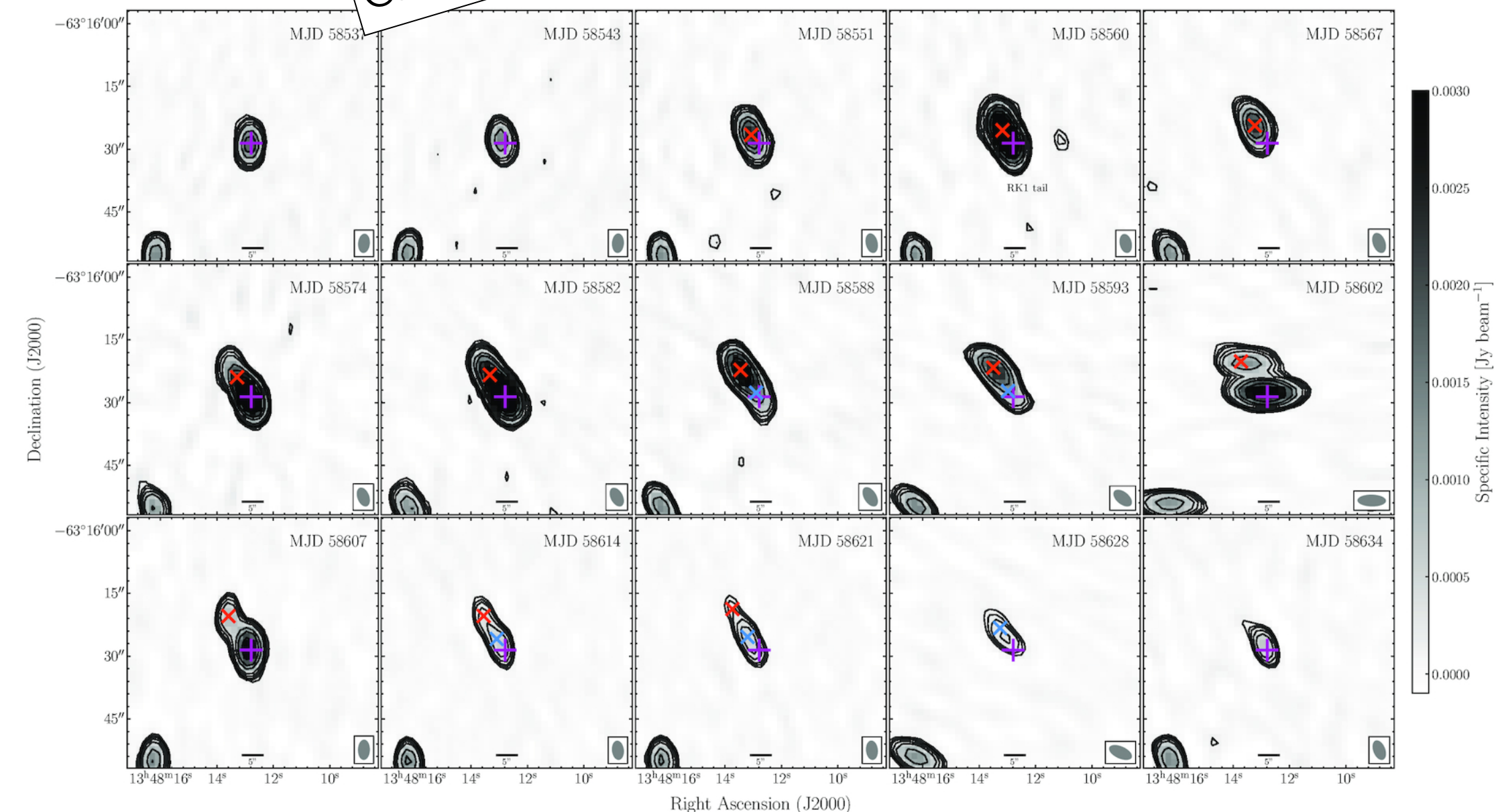
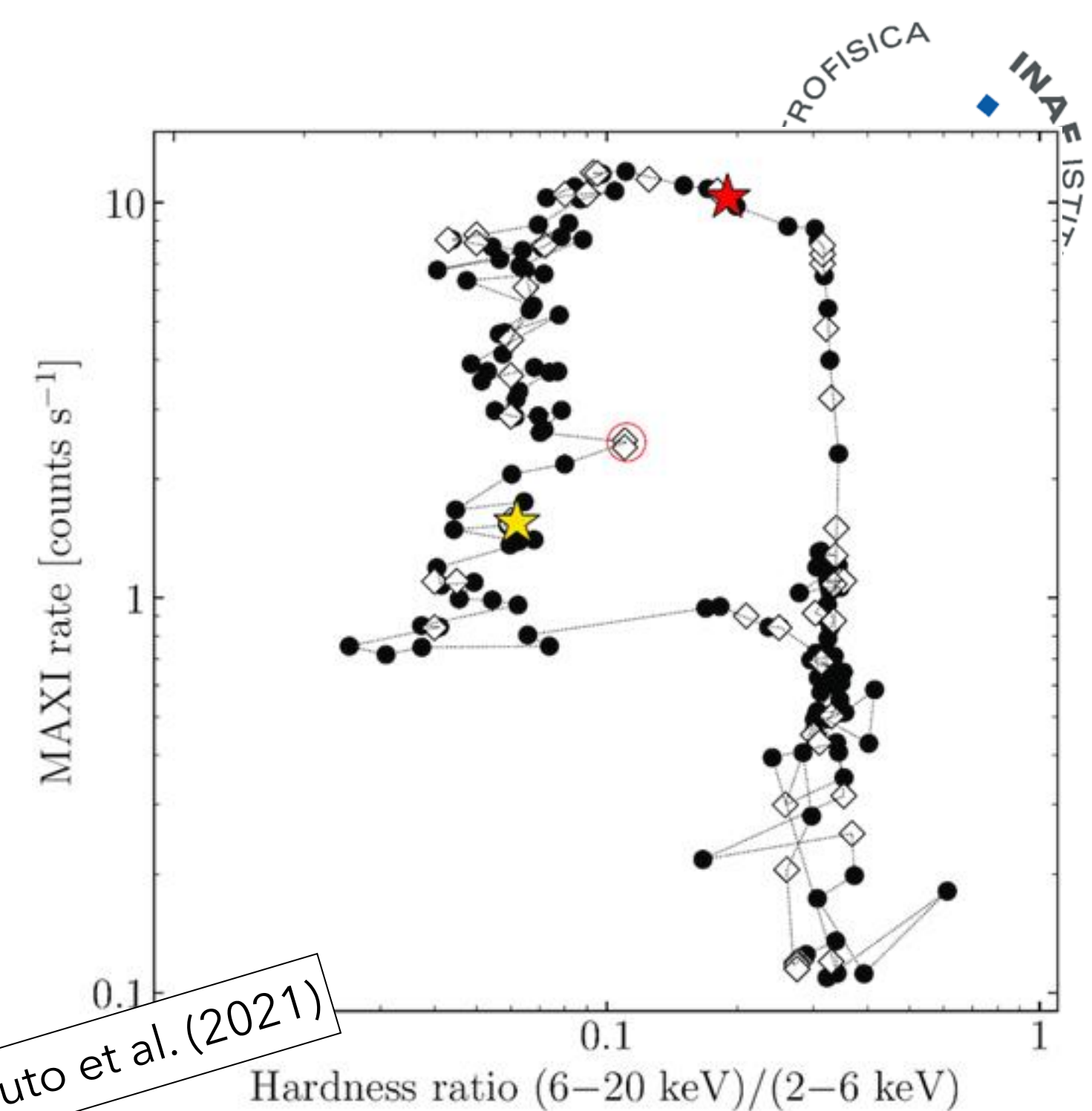
- **Beamed relativistic jetted** emission following the collapse of massive stars or the merger of neutron stars
- **Prompt** emission detected in gamma rays, **afterglow** from gamma rays to **radio** (with increasing duration/time scales)
- Study of **progenitors**, of particle/jet **acceleration**, probes of **high-z** environments
- **Radio unique** for the study of late stages, evolution of the **physical parameters**, search for misaligned/**orphan events**, structural changes with **VLBI**
- Inherently **MWL targets**; Italian contributions at all wavelengths from space/ground
- Talks/posters today: **Giarratana, Giroletti, Gianfagna**





# X-ray binaries

- Compact object + companion
- Study of **accretion/ejection** on human time scales
- **MeerKAT** already revolutionary to study late emission, monitor discrete ejecta and measure jet energy, speed and mass
- **MWL** sources (typically in X-ray)
- Italian community active in X-ray observations, MeerKAT's ThunderKAT and **X-KAT**, also **VLBI** and single dish
- Talks today: **Motta, Carotenuto, Mariani**



# More transients of relevance

- **Novae**

- White dwarf outbursts after accretion from companion
- radio useful to study both thermal and non-thermal emission after outbursts, directly reveal ejecta with VLBI

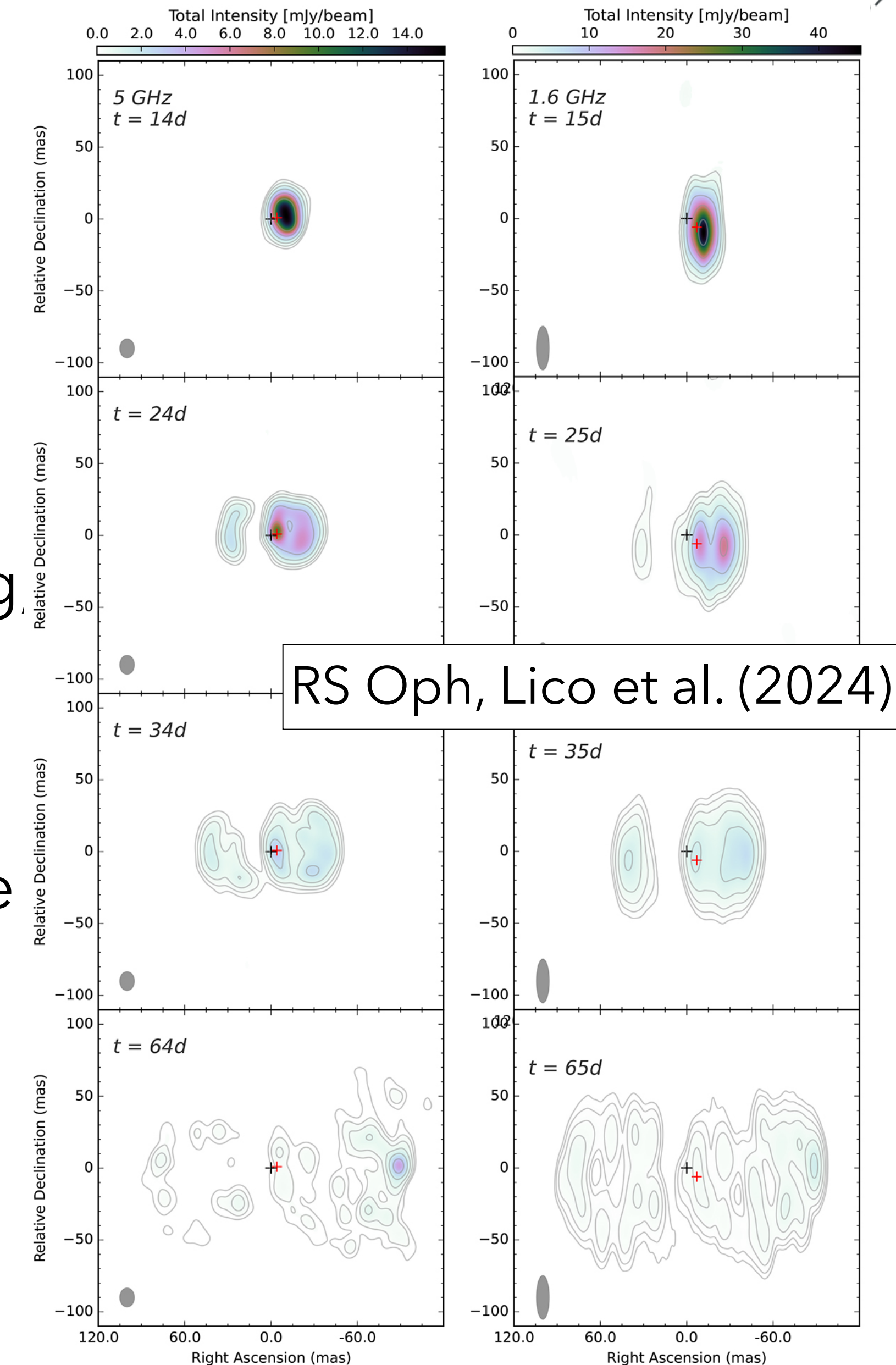
- **SNe:**

- Structure of ejecta, interaction with medium, rebrightening, from single sources to population studies (poster: Izzo)

- **Tidal disruption events:**

- stars being disrupted by gravitational pull of supermassive black holes, typically detected in optical/X-rays
- Radio useful to study ejection when occurring

- **Variability** in **stars** and **active galactic nuclei** (radio loud, changing look)





# Towards the SKAO

- Variability - compactness - high angular resolution - high frequency: MeerKAT+ and Band 5B highly relevant
- Mode of operations: searches in beamformed/image plane data, single source studies/follow up, surveys, commensality, VLBI
- VLBI: strong connection (many cross-references chapters), unique contribution in structural evolution monitoring and independent physical constraints, significant operational challenges, crucial role of uv-plane coverage, other African dishes
- SKA-LOW important for large field of view and steep spectrum emission
- Unknown unknowns...
- KSP & timeline of SKAO w.r.t. other instruments



# Chapter list



- Ch 1: A Fresh View on the Transient Universe with the SKA - Existing and new co-chairs
- **Ch 2: Gamma-ray Bursts and Kilonovae from Gravitational Wave Events - Susanna Vergani & Marcello Giroletti**
- Ch 3: Interacting Compact Object **Binaries** - James Miller-Jones & Rob Fender
- Ch 4: **Tidal Disruption Events** and Transients from the Centres of Galaxies - Tao An
- Ch 5: **Fast Radio Bursts** as **Astrophysical** Probes - Franz Kirsten & Jason Hessels
- Ch 6: **Fast Radio Bursts** as **Cosmological** Probes - Laura Spitler & Evan Keane
- Ch 7: Time Domain Studies of **Active Galactic Nuclei** with the SKA - Hayley Bignall
- Ch 8: **Supernovae** with the Square Kilometre Array - Yuhei Iwata & Poonam Chandra
- **Ch 9: Novae and Symbiotics with the Square Kilometre Array - Marcello Giroletti & Rocco Lico**
- Ch 10: **Long period transients** with the SKA - Manisha Caleb & Harry Qiu
- Ch 11: The variability of **radio stars** - Tara Murphy & Laura Driessen
- Ch 12: **Rapid response** triggering for radio transients with the SKA - Gemma Anderson
- Ch 13: **Commensal** transient searches with the SKA - Antonia Rowlinson
- Ch 14: SKA and the **unknown unknowns** - Ben Stappers