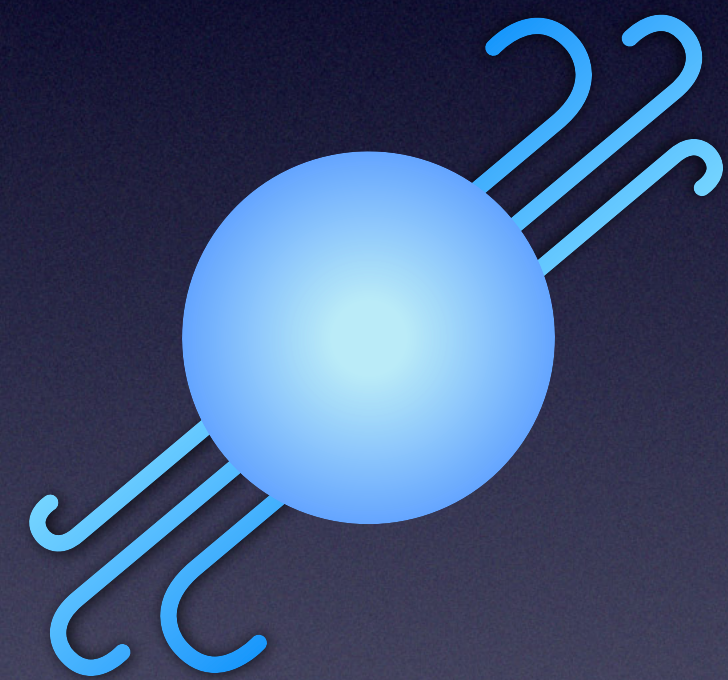


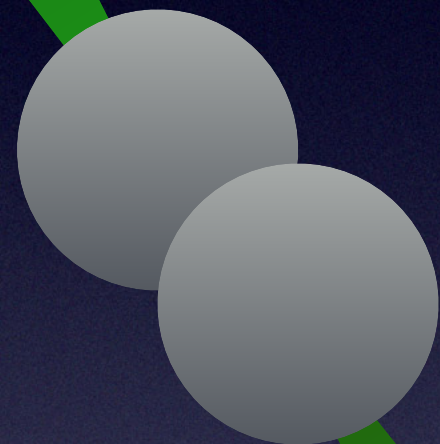
Connecting FRBs and Cosmic Transients Across the Spectrum

Yuxin (Vic) Dong, Northwestern University
NSF Graduate Research Fellow

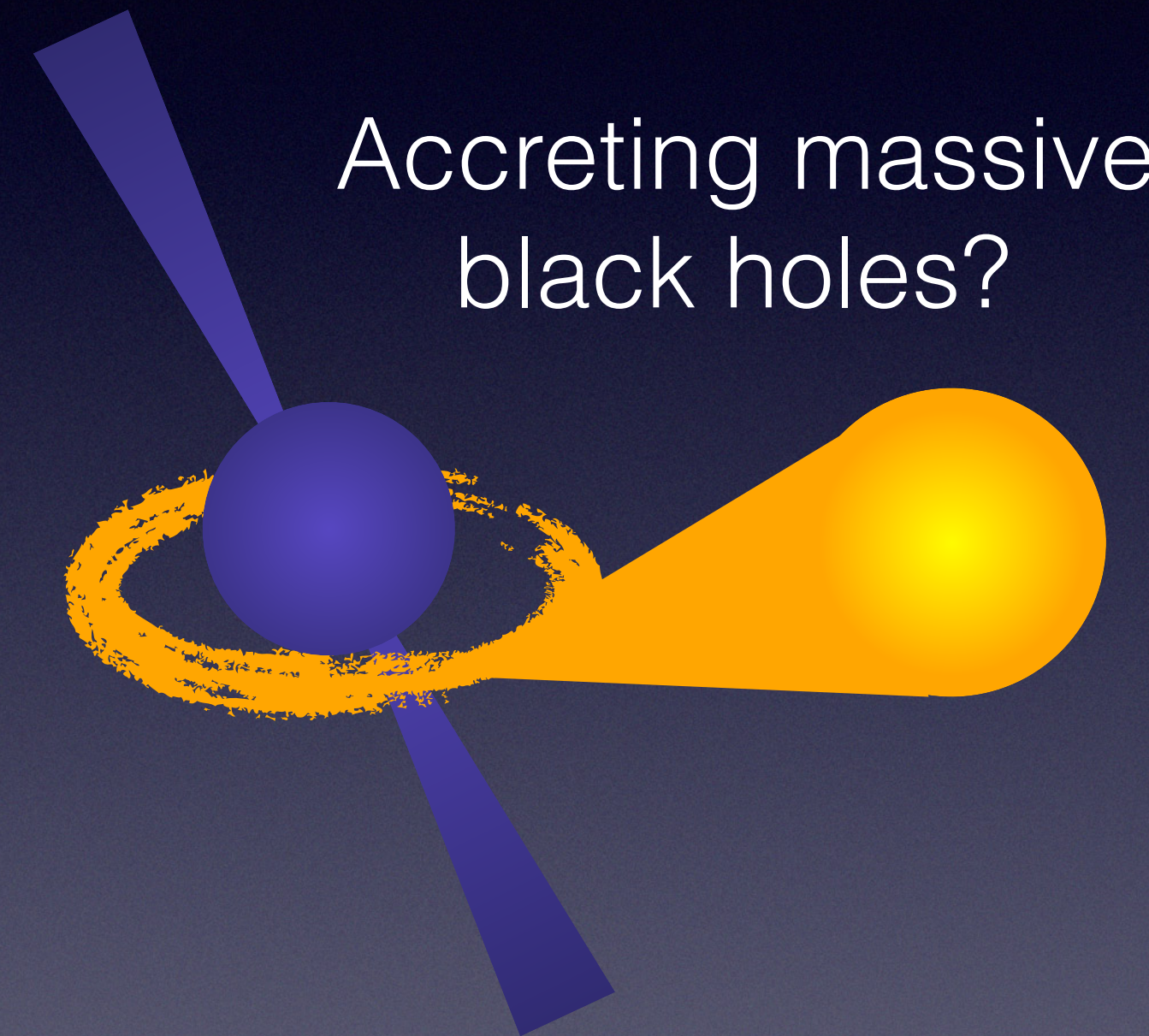
FRB origin(s) are still a mystery!



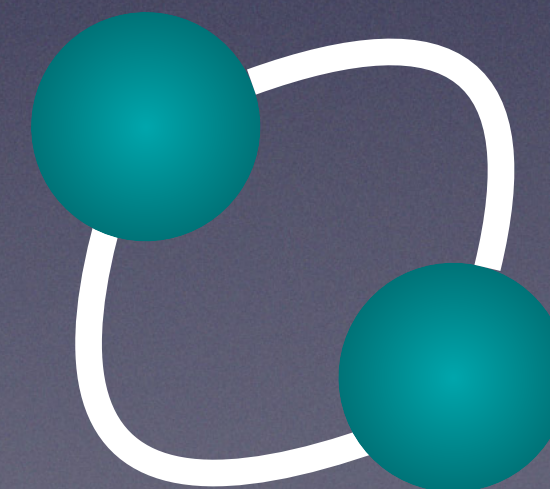
Magnetars?



Binary neutron
star mergers?

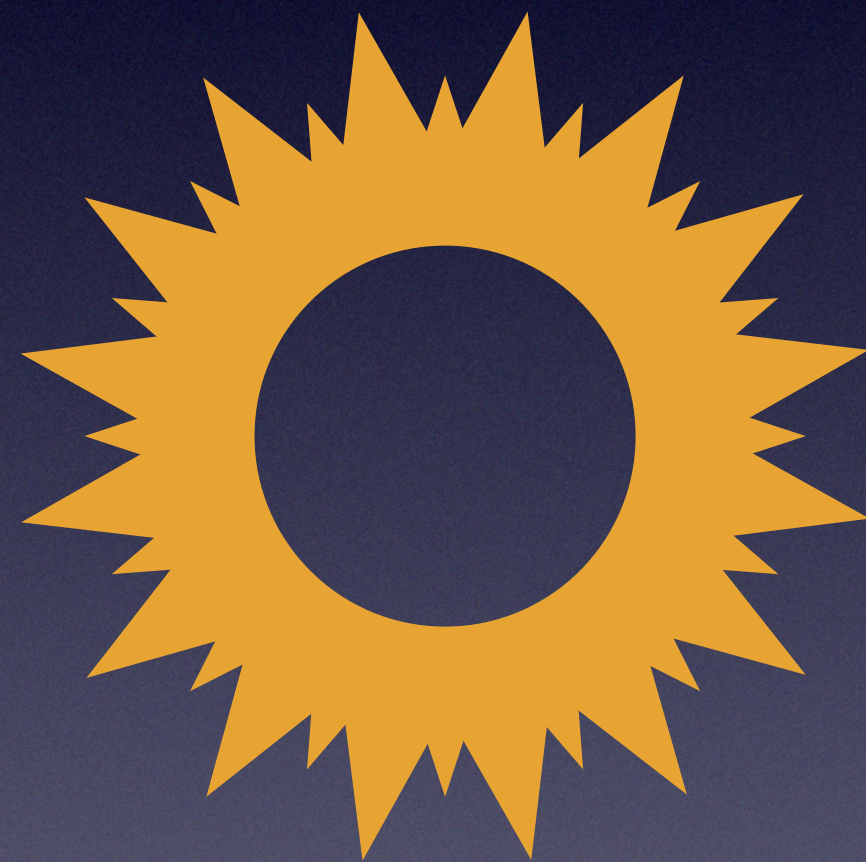


Accreting massive
black holes?



Interacting
binaries?

Clues from Other Cosmic Transients

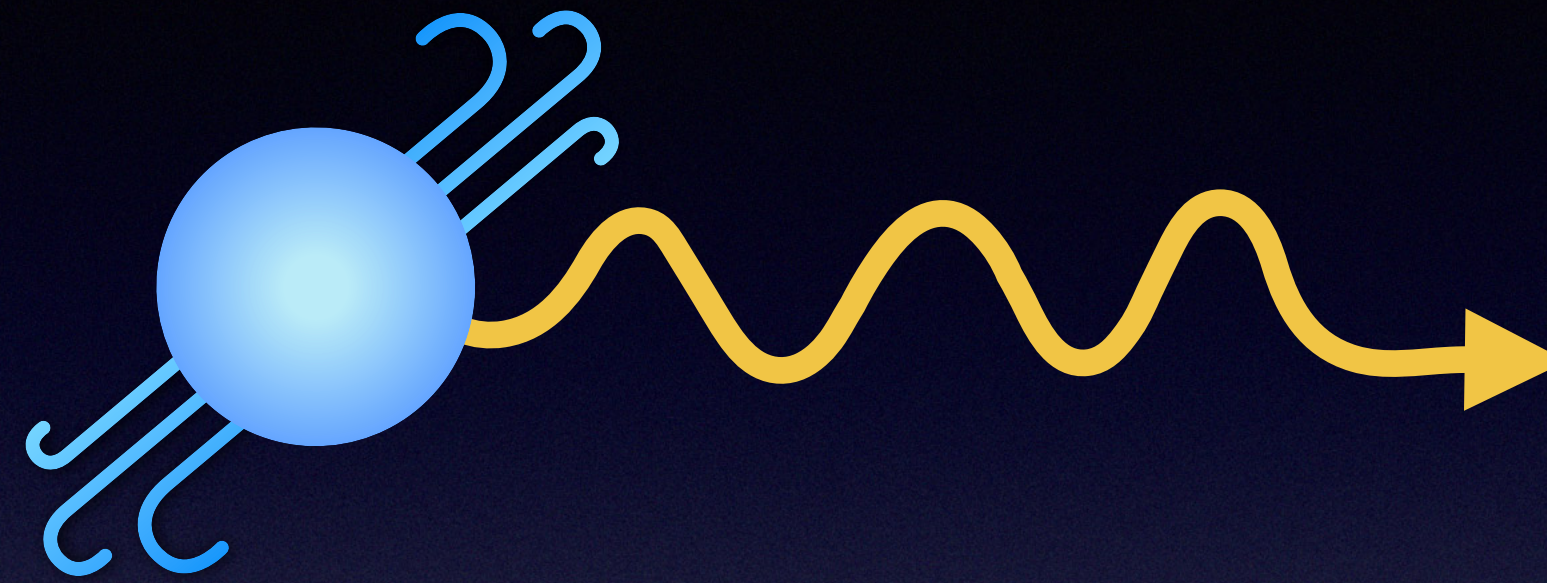
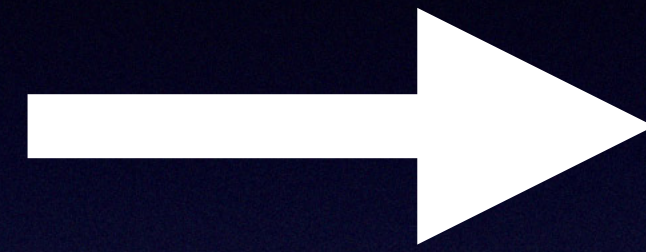
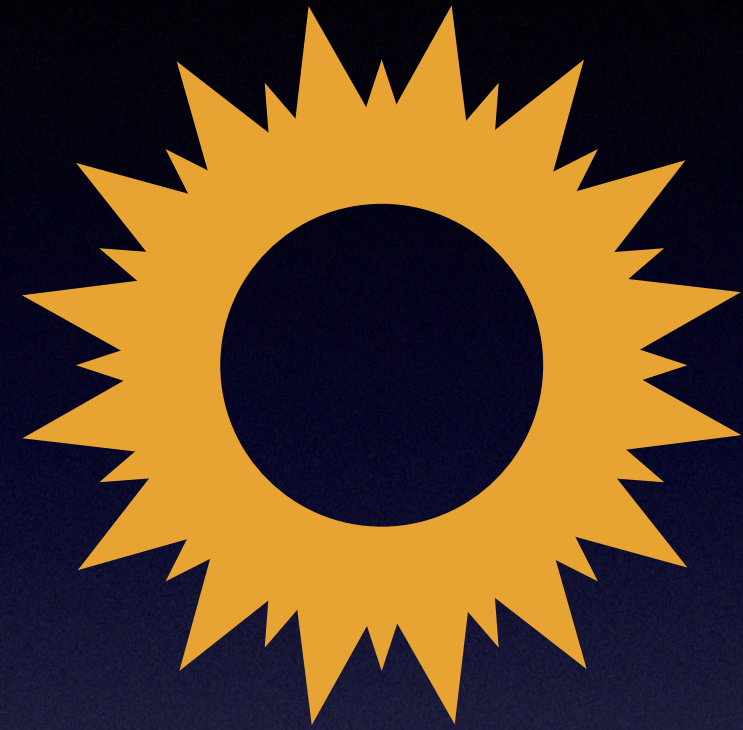


Supernova



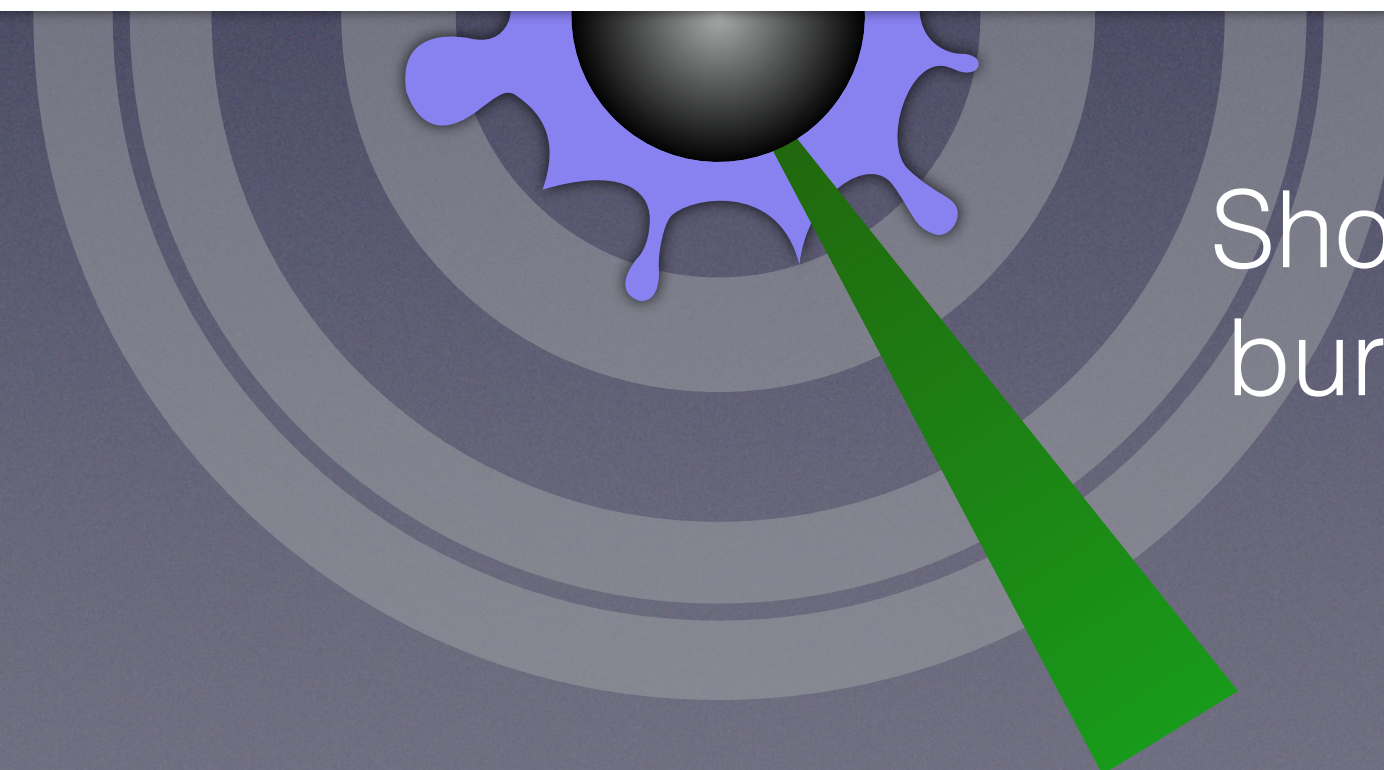
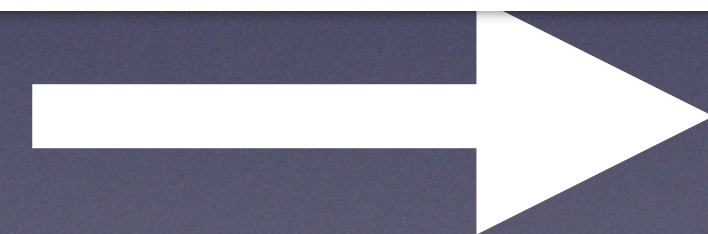
Magnetar
SGR 1903+2154

Clues from Other Cosmic Transients



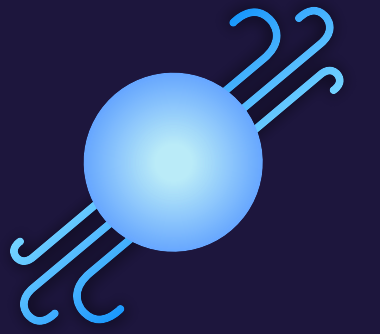
Connecting to known transients may be the key to uncovering their origins

Binary neutron
star merger

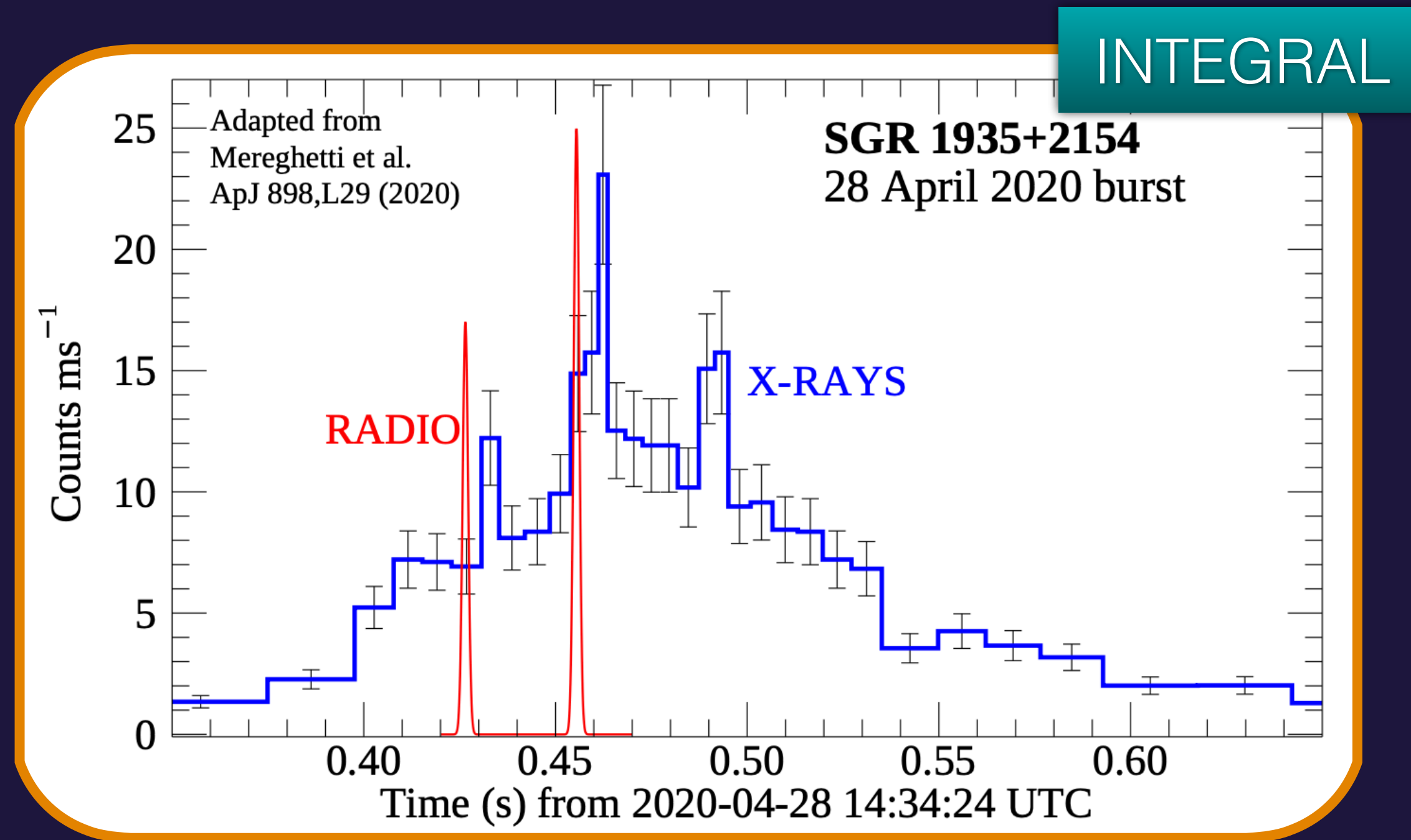


Short gamma-ray
burst + kilonova

High-energy counterparts

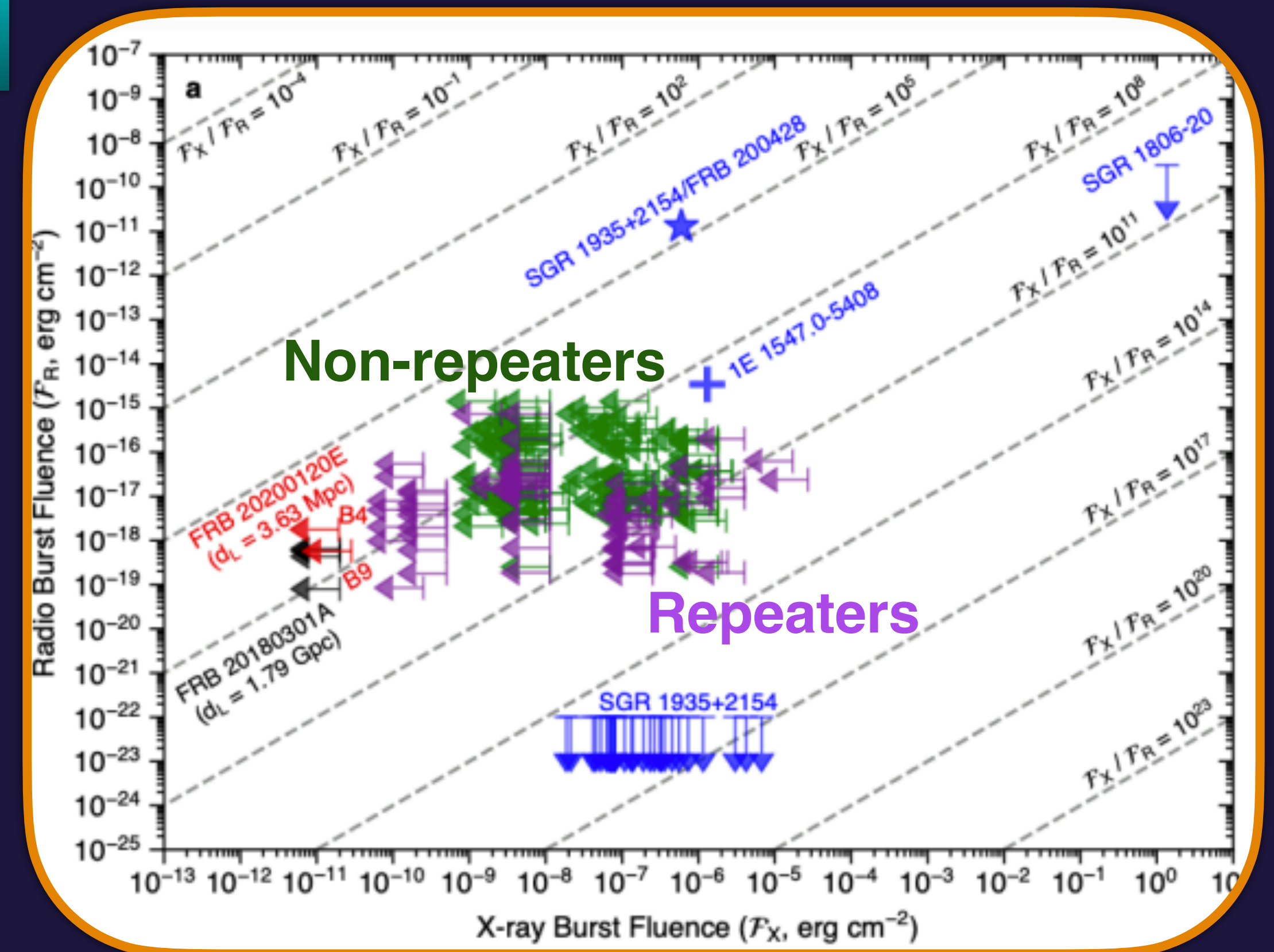


X-ray/gamma-ray emission are expected from a magnetar progenitor



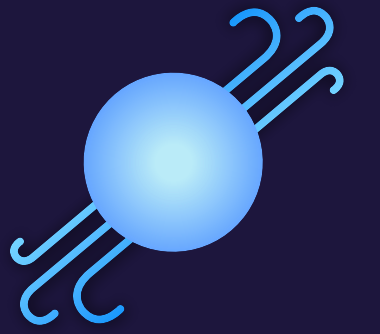
Petroff+22

No HE counterparts have been detected for an extragalactic FRB so far (e.g., Scholz+17, Cunningham+19, Pilia+20, Scholz+20, Mereghetti+21, Principe+22, Pearlman+25)



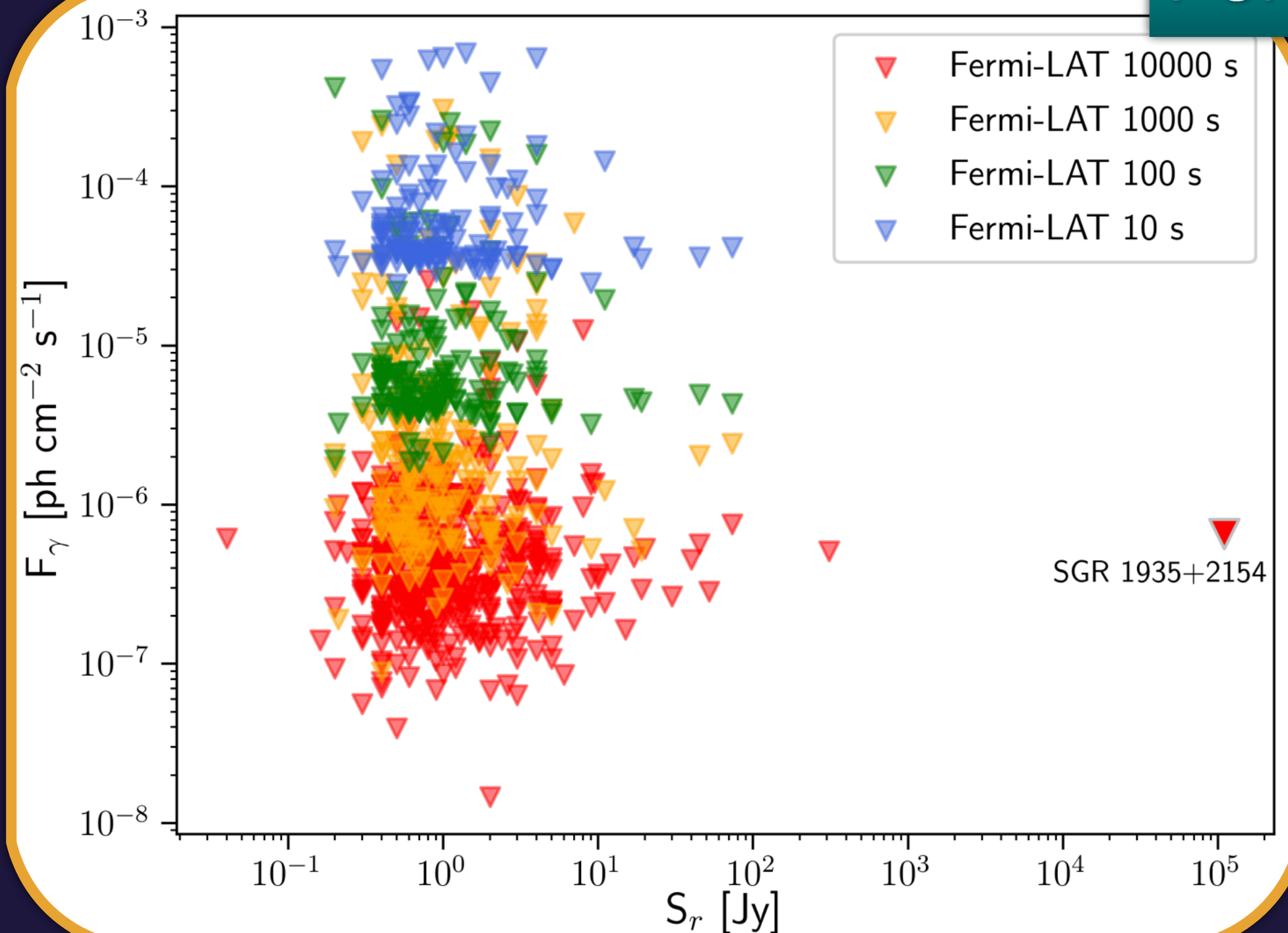
Pearlman+25

High-energy counterparts

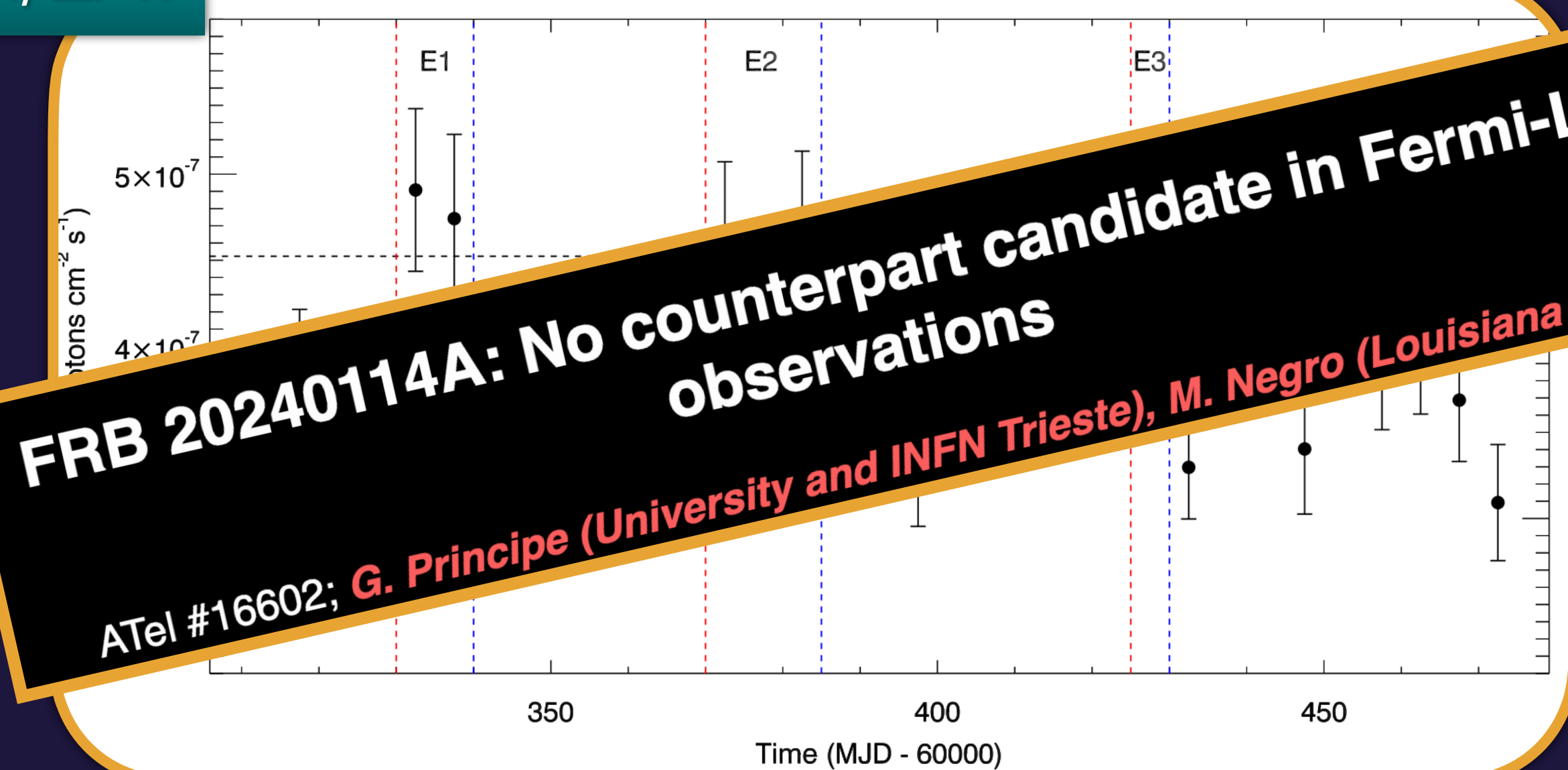


X-ray/gamma-ray emission are expected from a magnetar progenitor

Fermi/LAT



Principe+23

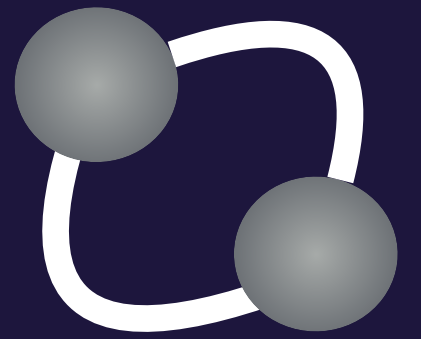


FRB 20240114A: No counterpart candidate in Fermi-LAT observations
ATel #16602; **G. Principe (University and INFN Trieste), M. Negro (Louisiana State)**

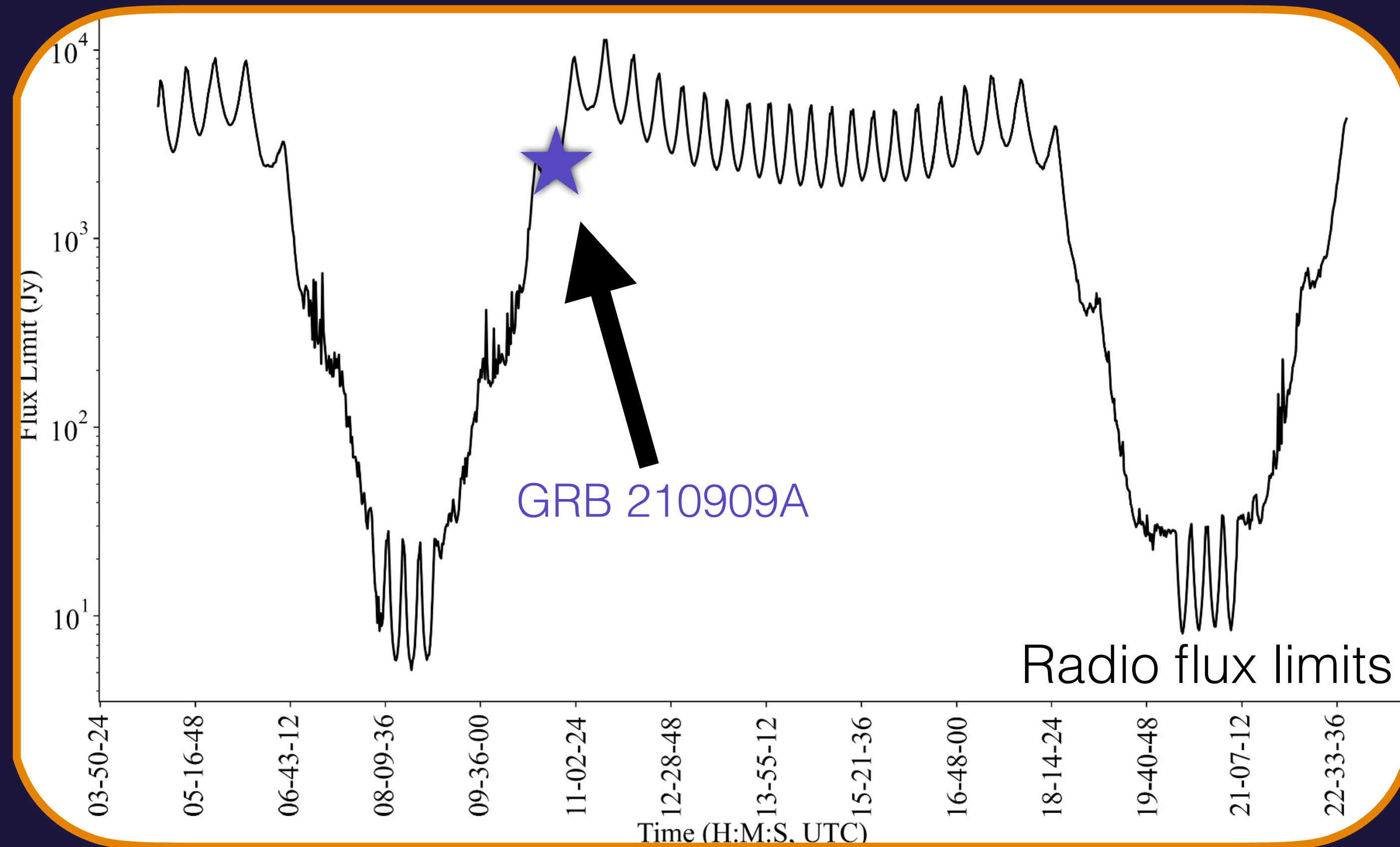
gamma-ray counterpart candidate with
FRB20240114A (R147)?

Xing+24

High-energy counterparts



The search for spatial or temporal coincidences between FRBs & GRBs: no significant matches were found, however...

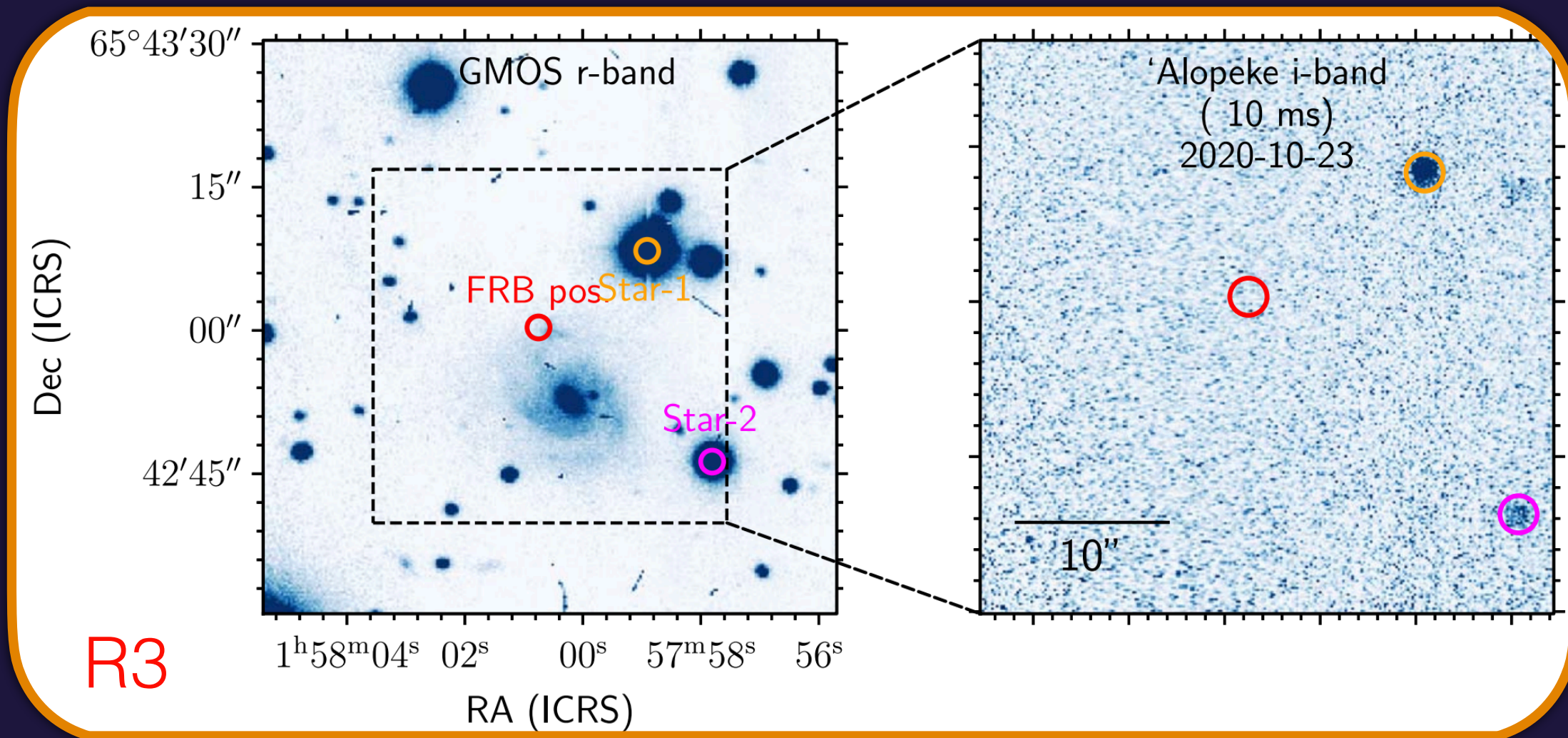


Constrained FRB-like radio emission from SGRBs

Curtin+23, 24a

Optical counterparts

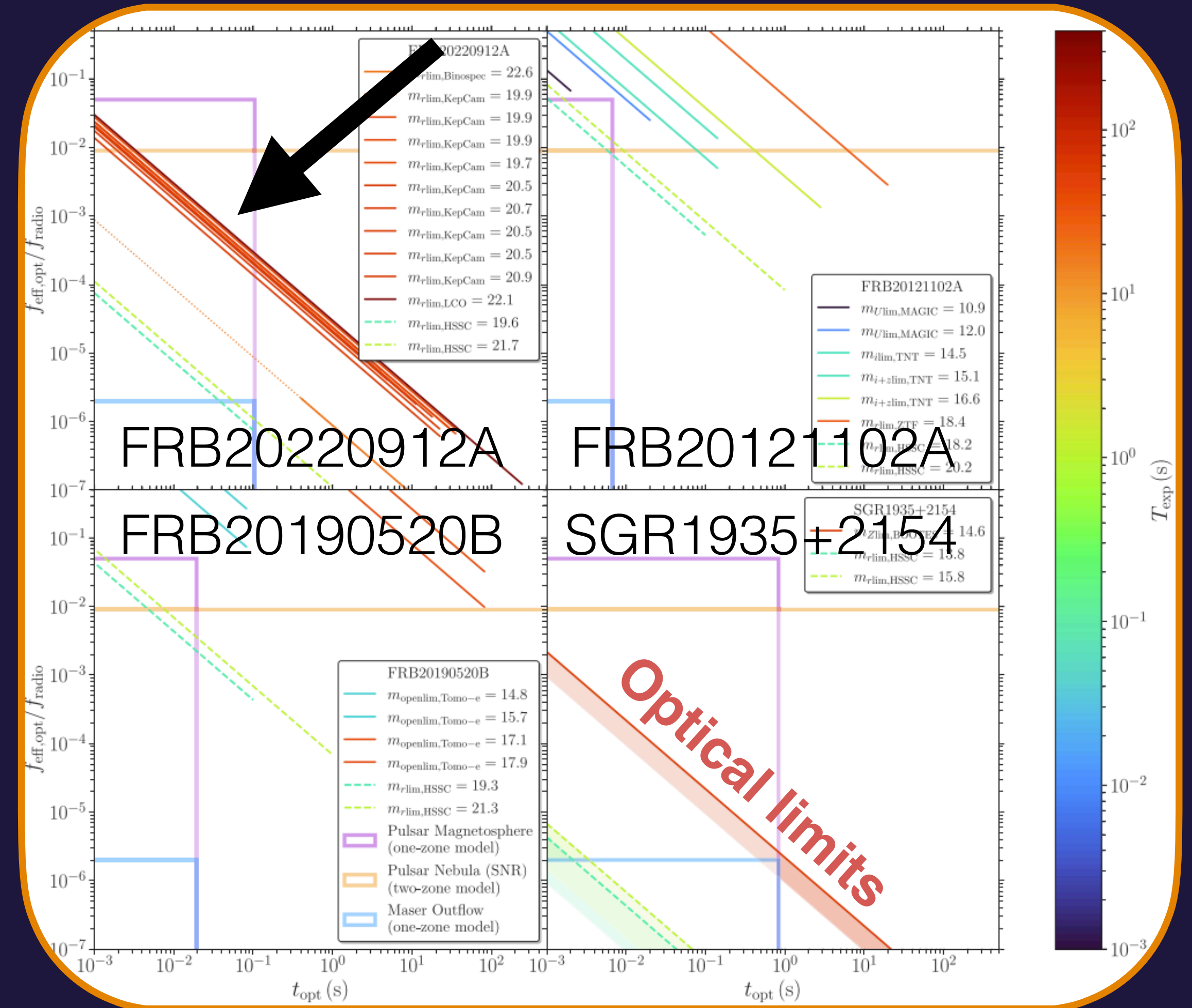
Prompt optical emission associated with FRBs



R3

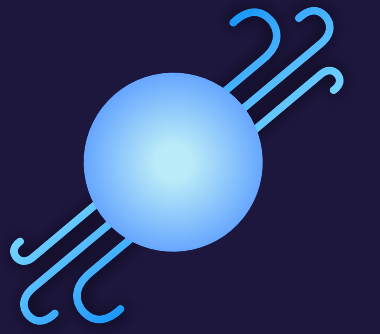
Kilpatrick+24

Deep, simultaneous optical limits for FRBs are used to constrain FRB progenitor models.

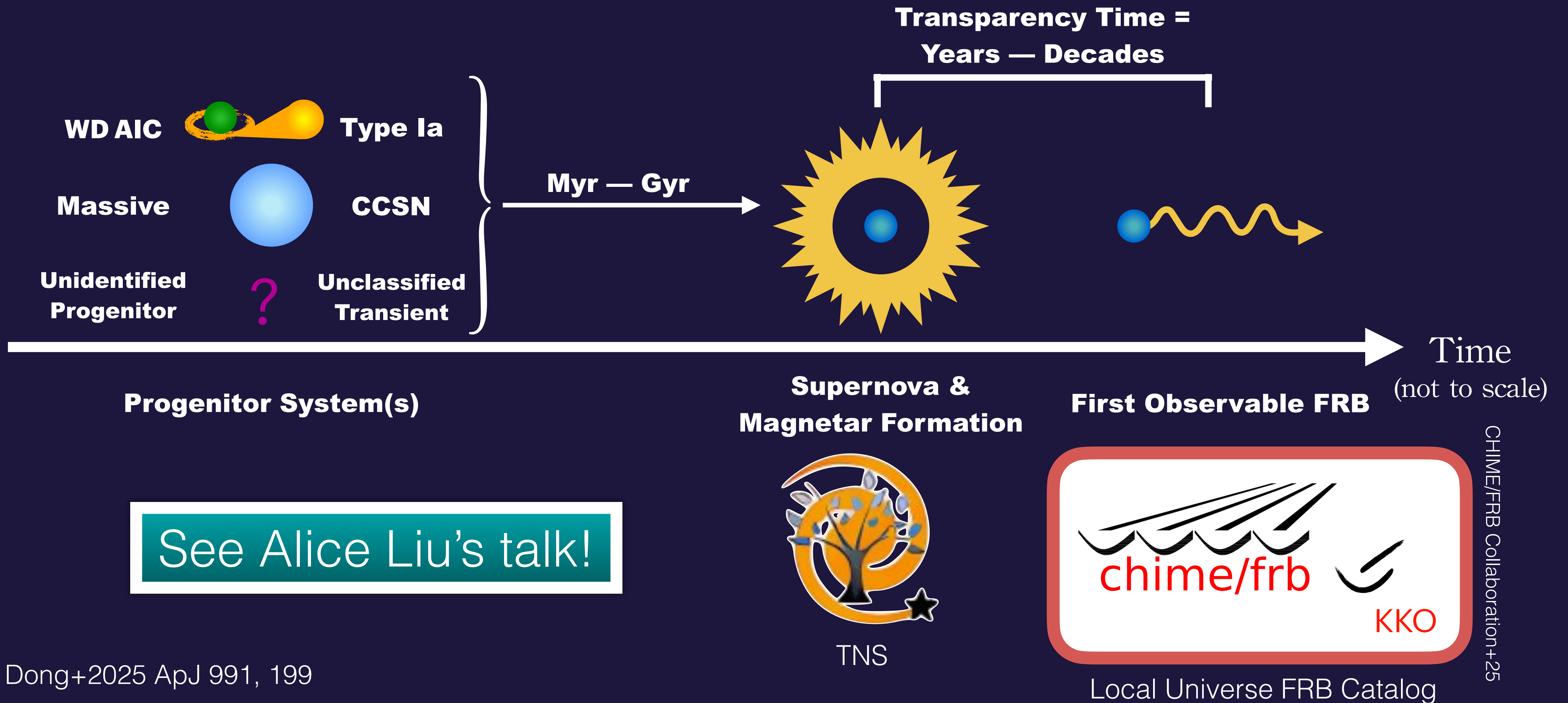


Hiramatsu+23

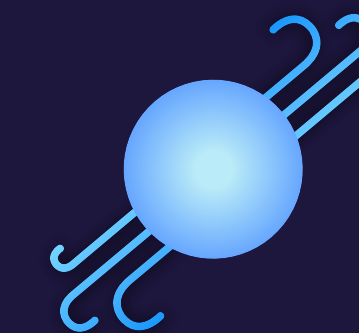
Optical counterparts



Finding past supernovae that led to the birth of FRB progenitors

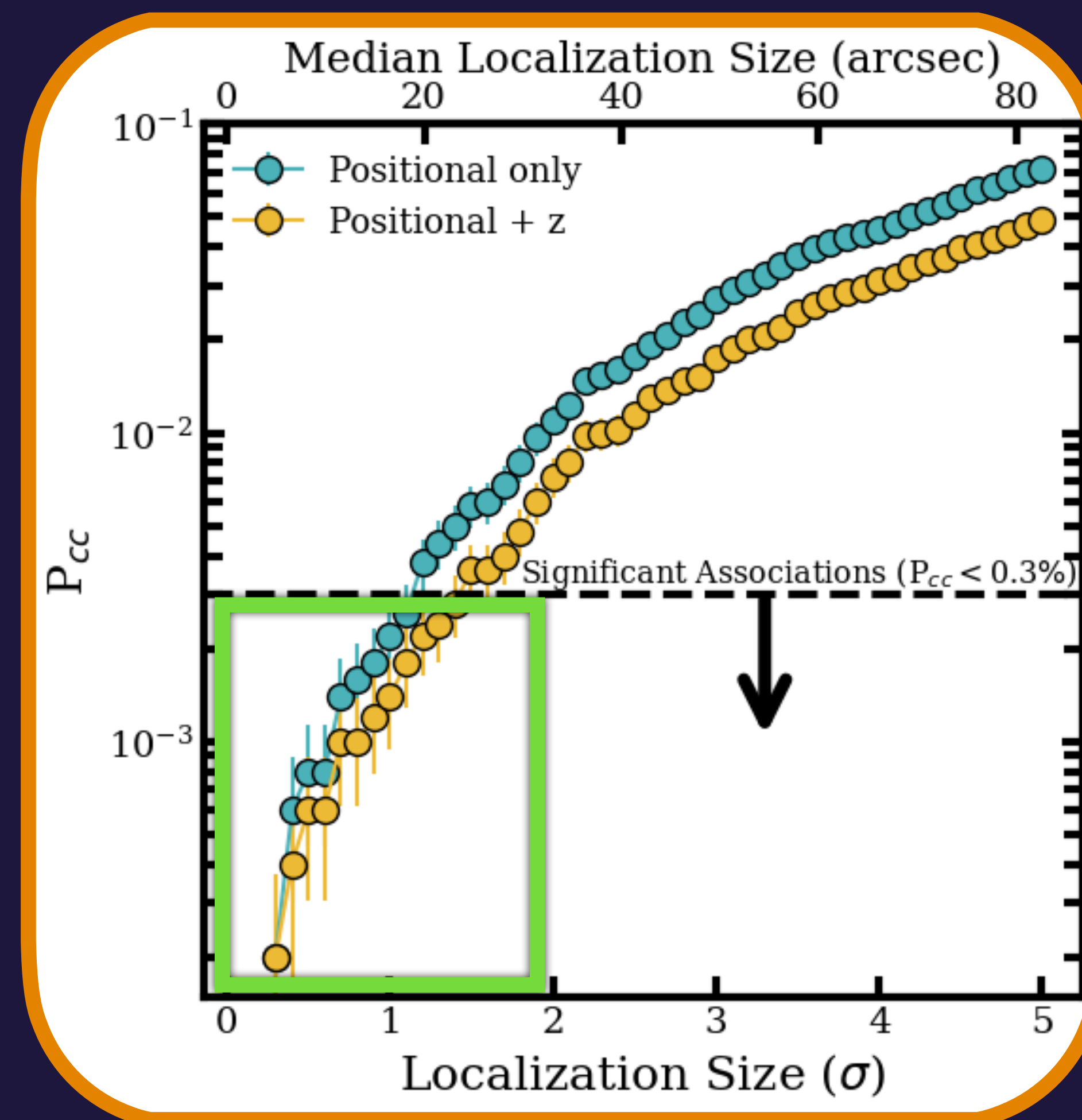


Optical counterparts

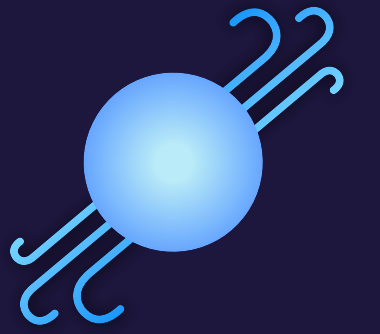


No positional (5-sig) or redshift (95% CL) associations were identified between an FRB and TNS transient

- The probability of chance coincidence will decrease with better localizations
- Low spatial density of SNe makes a **single match** with a classified SN even more **significant**

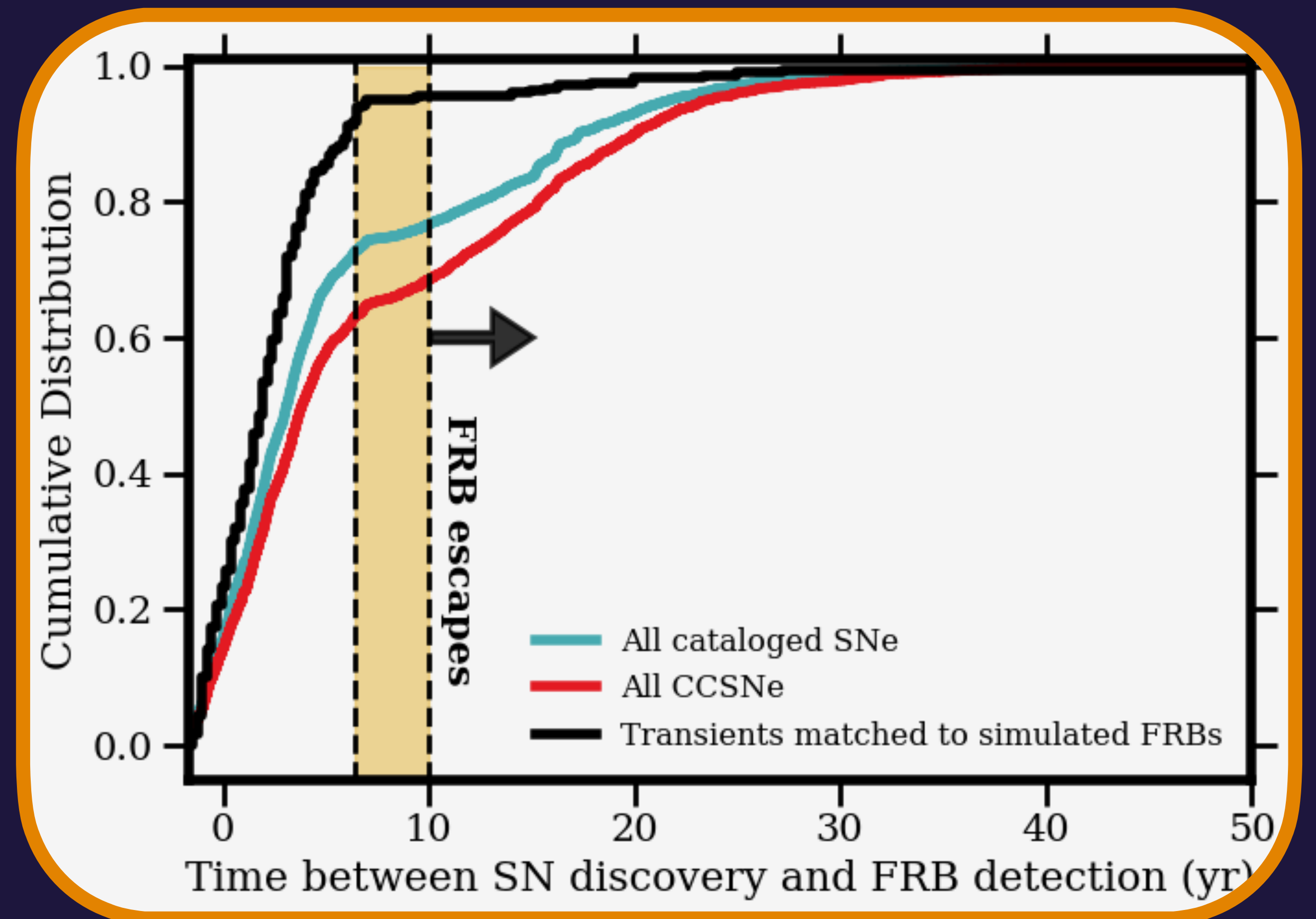


Optical counterparts

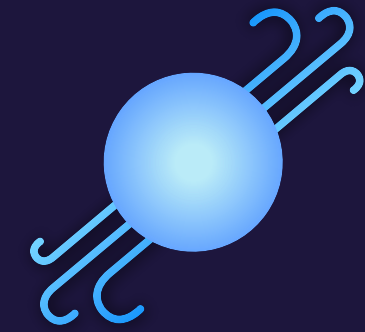


Comparing transparency timescale in which the FRB can escape from the SN ejecta to SN discovery time

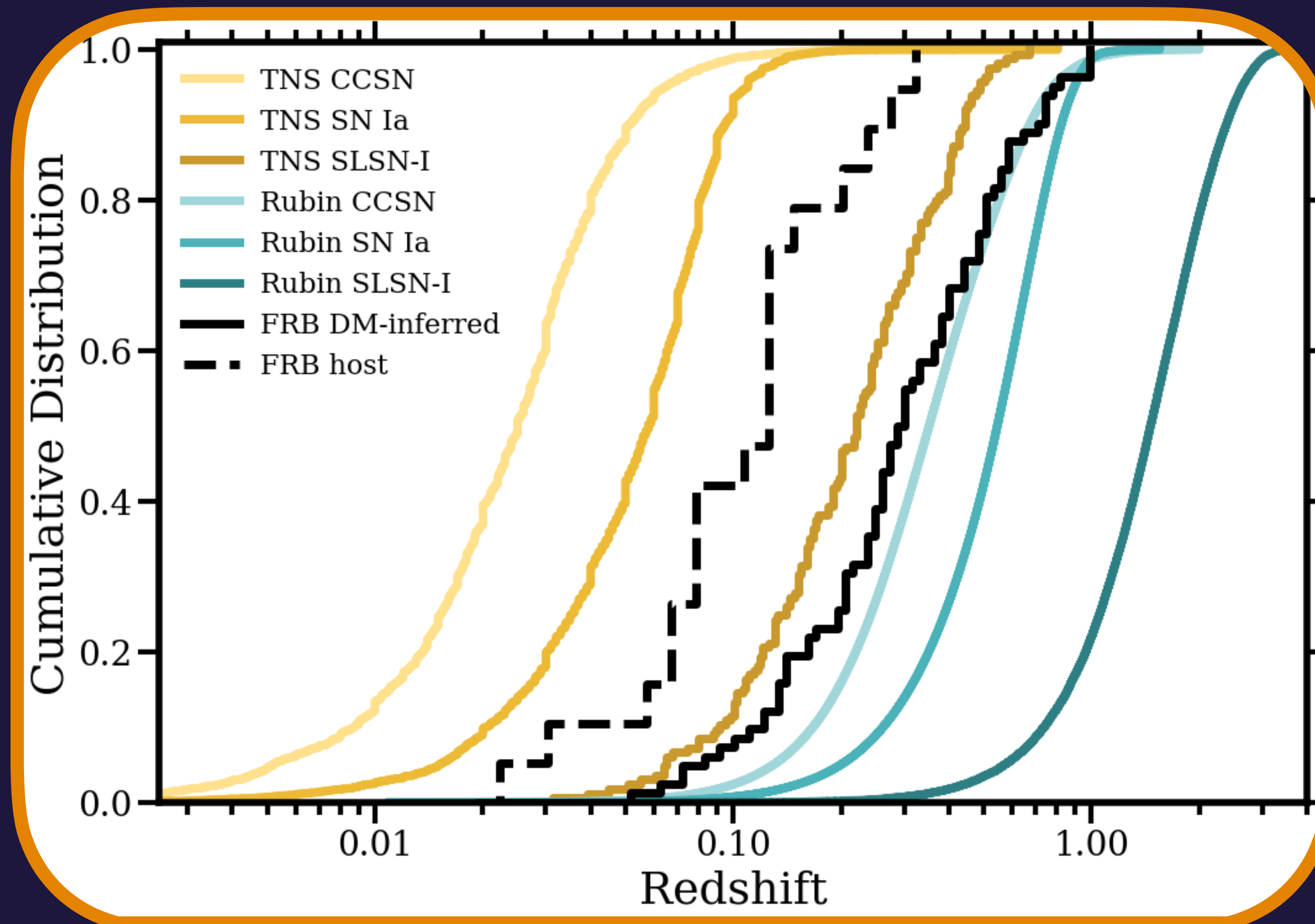
- FRB detection is more likely as these transients age!
- In principle, some fraction of optical transient/SNe could have detectable FRB emission today



Optical counterparts

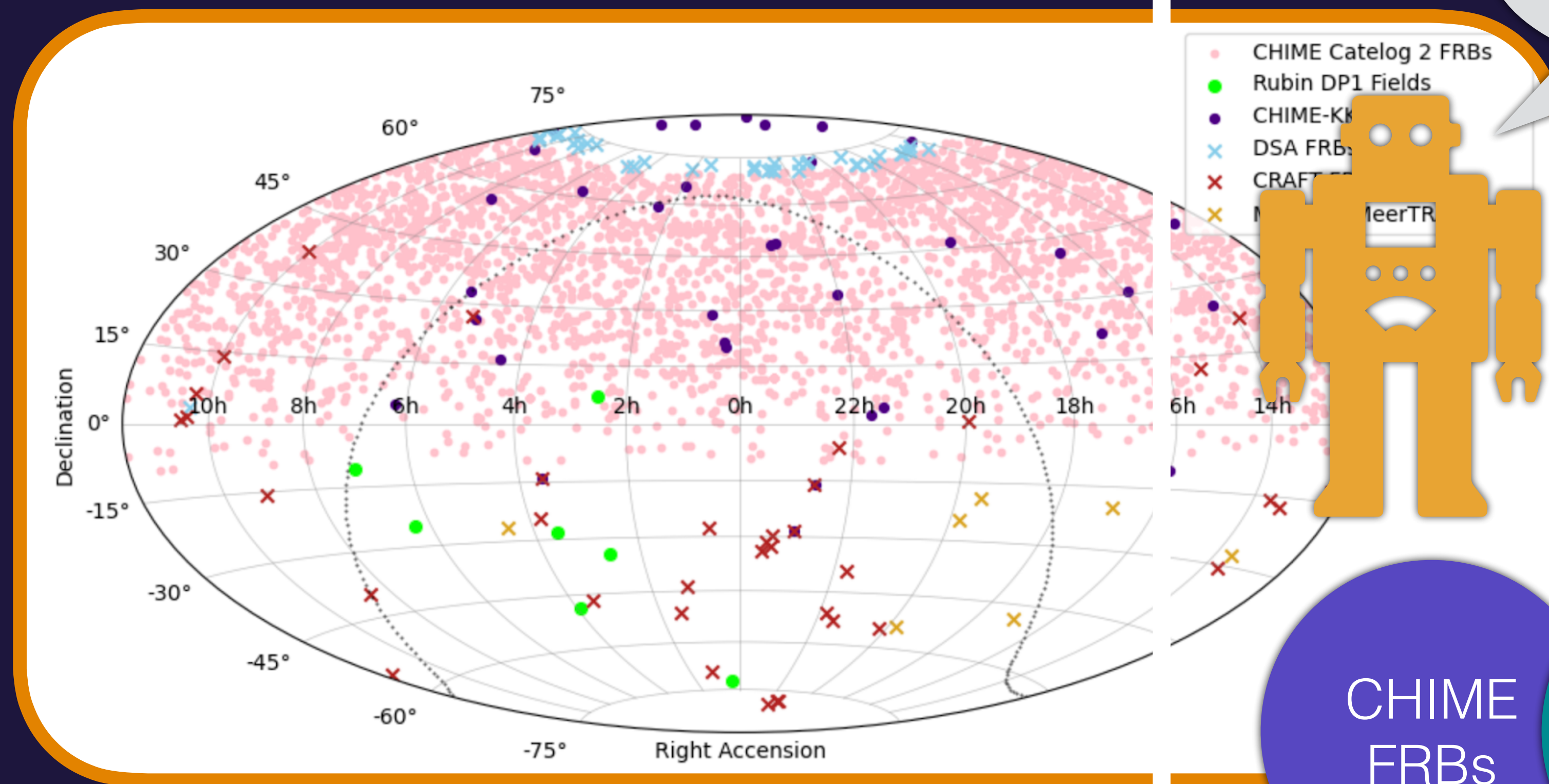


Rubin will increase the redshift overlap and boost expected FRB-SN associations, even out to higher z



Optical counterparts

Rubin/LSST and cross-matching alert systems



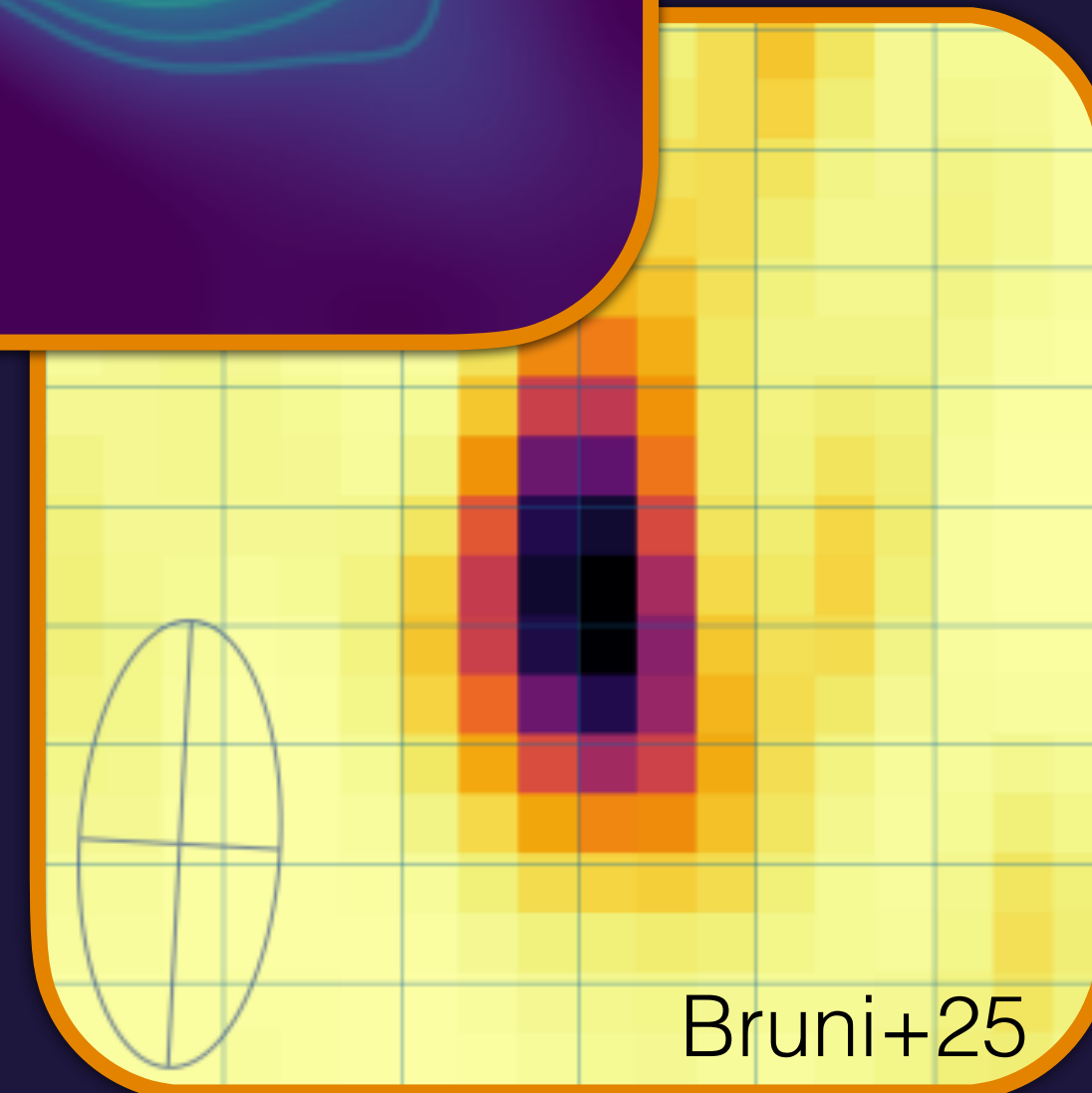
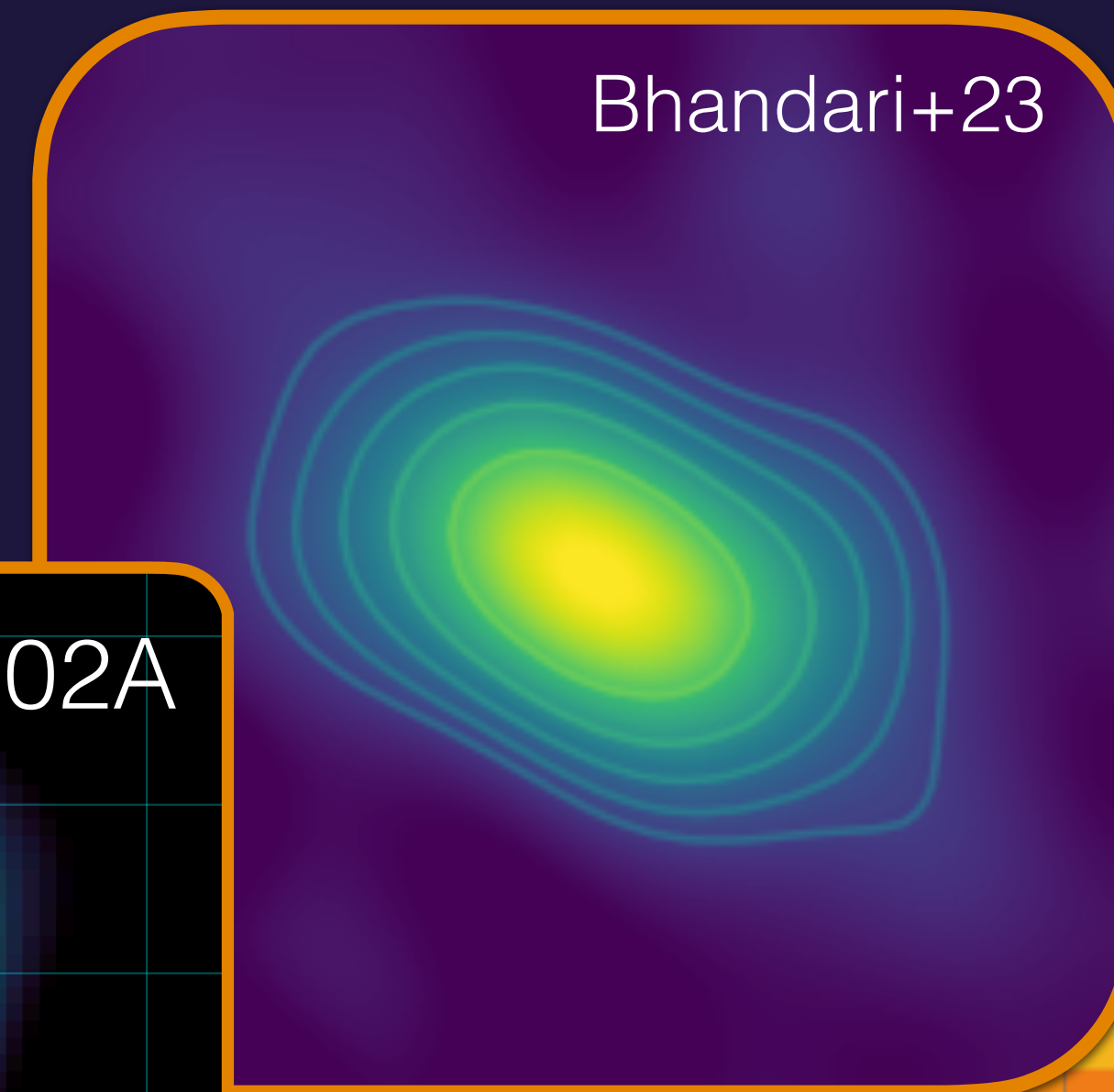
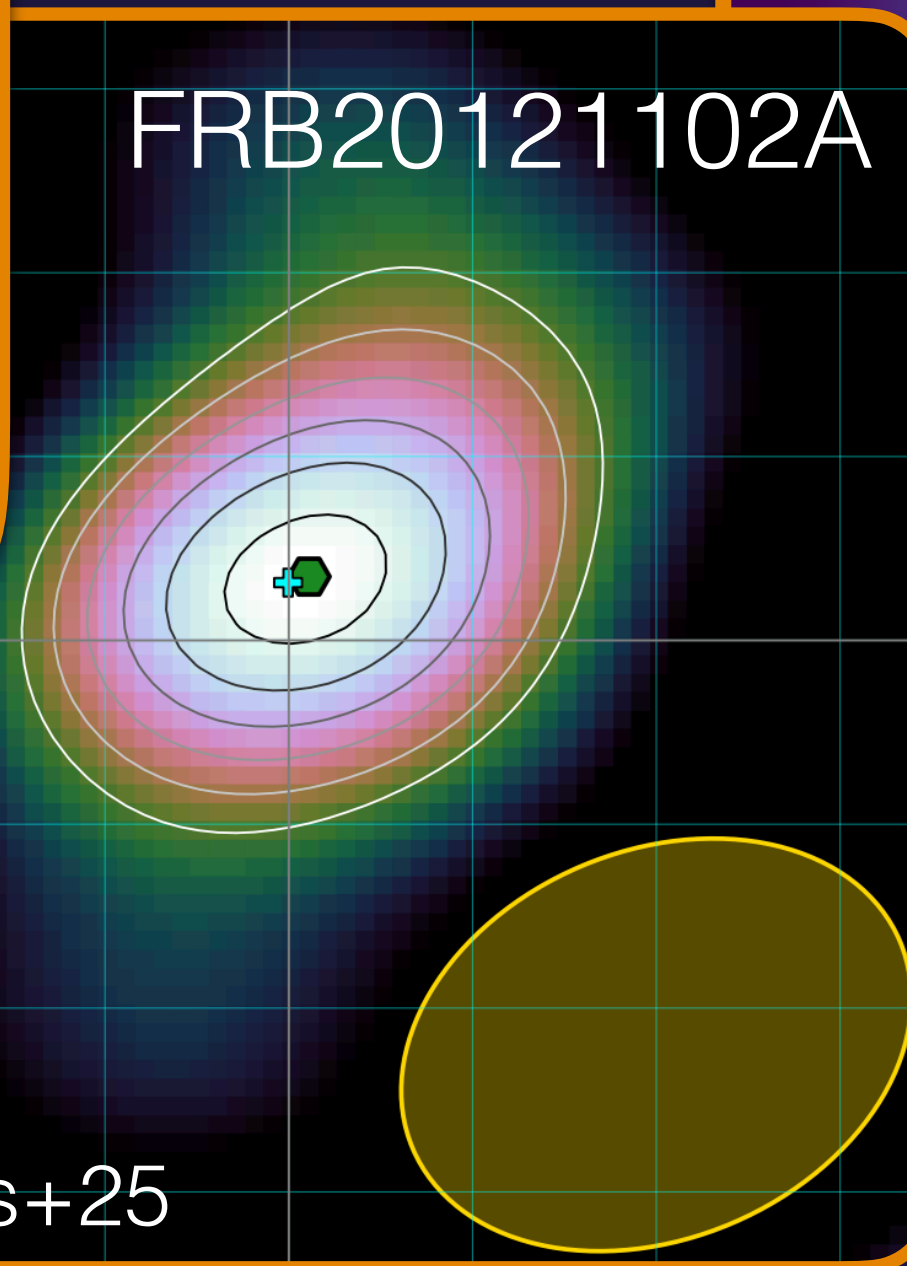
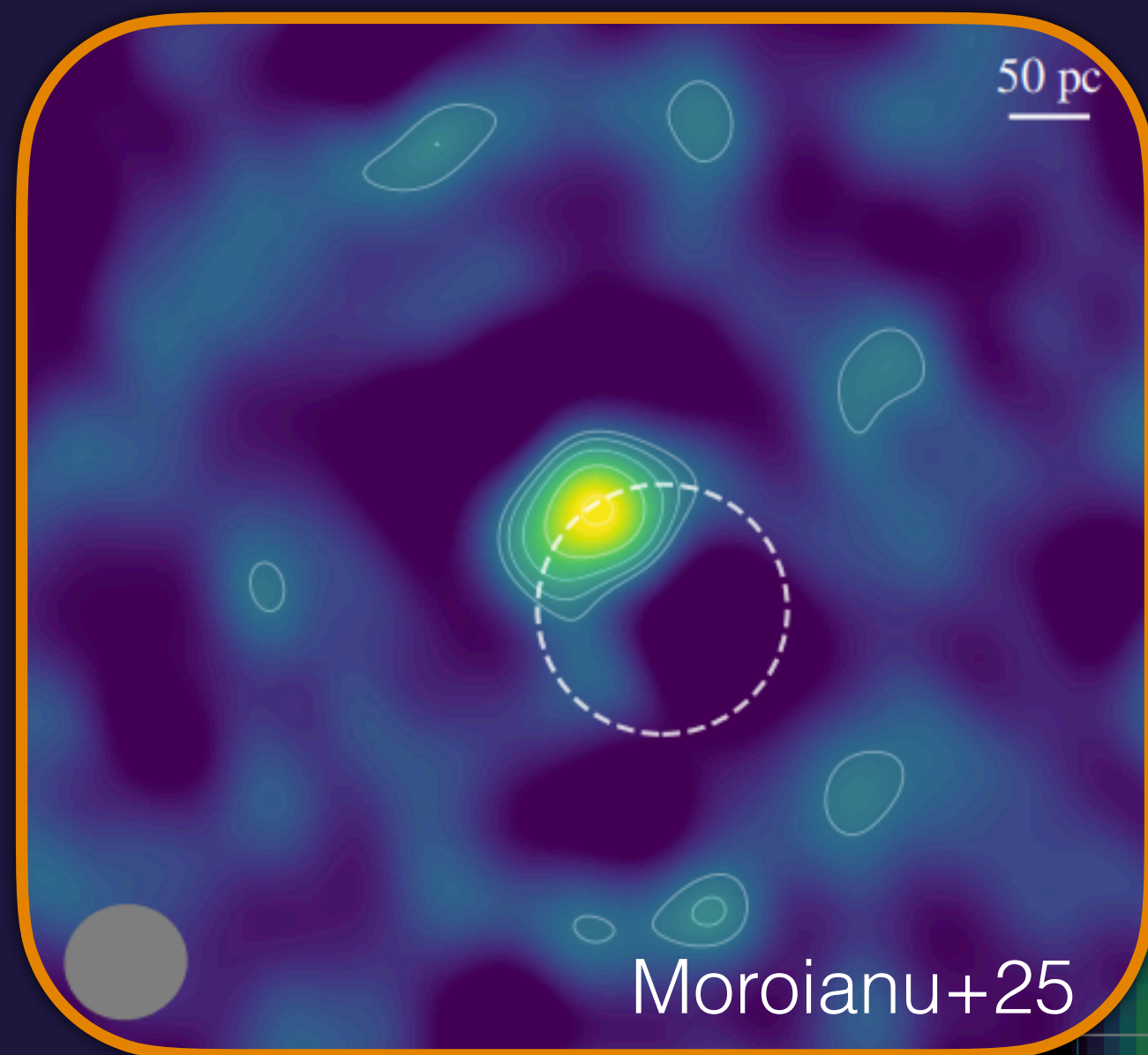
Credit: Erin Nothdorf (IIT), Ketan Sand (CHIME), & Yuanming Wang (CRAFT)

CHIME
FRBs

SNe, GRBs,
GWs...

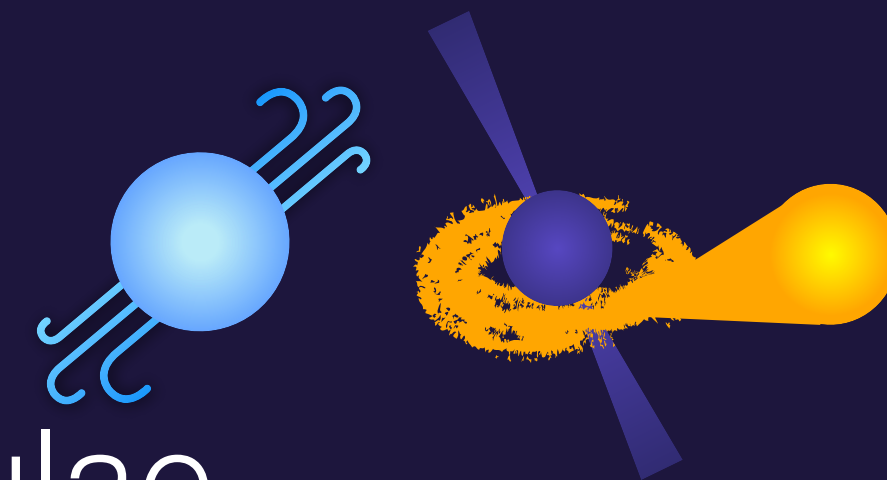
Radio counterparts

Persistent radio sources (PRSs) associated with FRBs

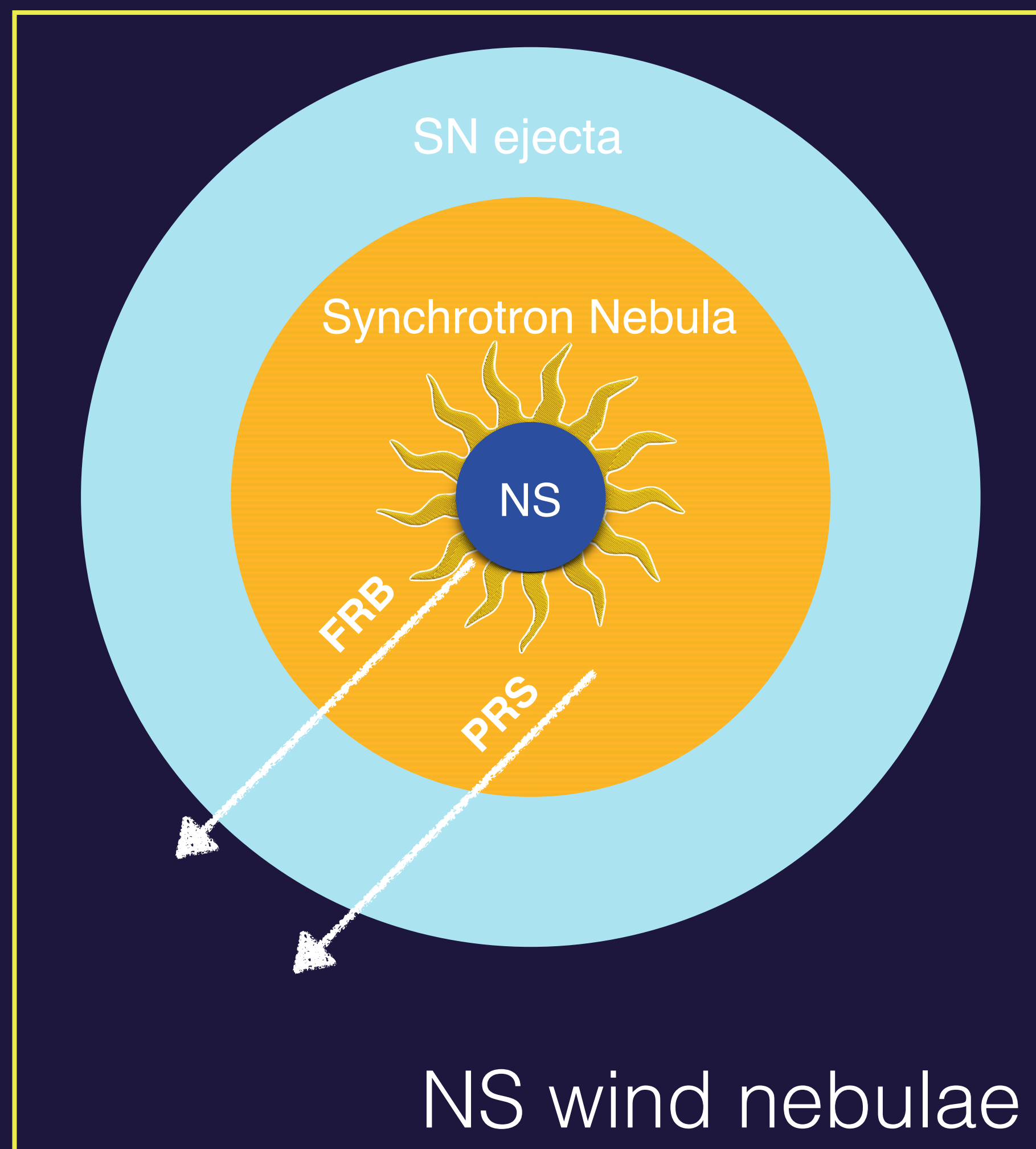


FRB-PRS: constant radio emission distinct from FRBs and ongoing star formation

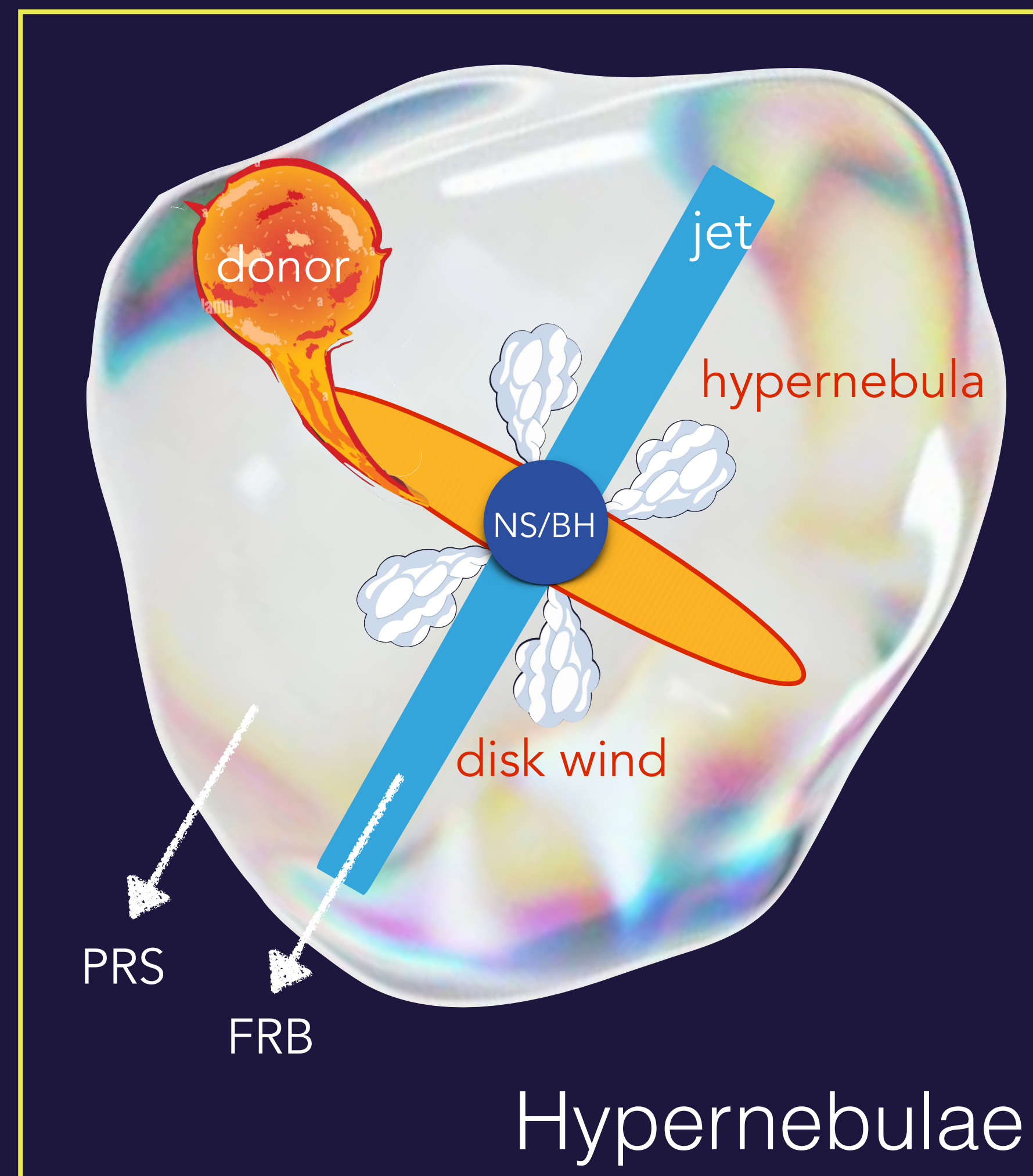
Radio counterparts



PRSs as synchrotron radio emission from wind nebulae



Murase+16, Margalit & Metzger+18, Margalit+19

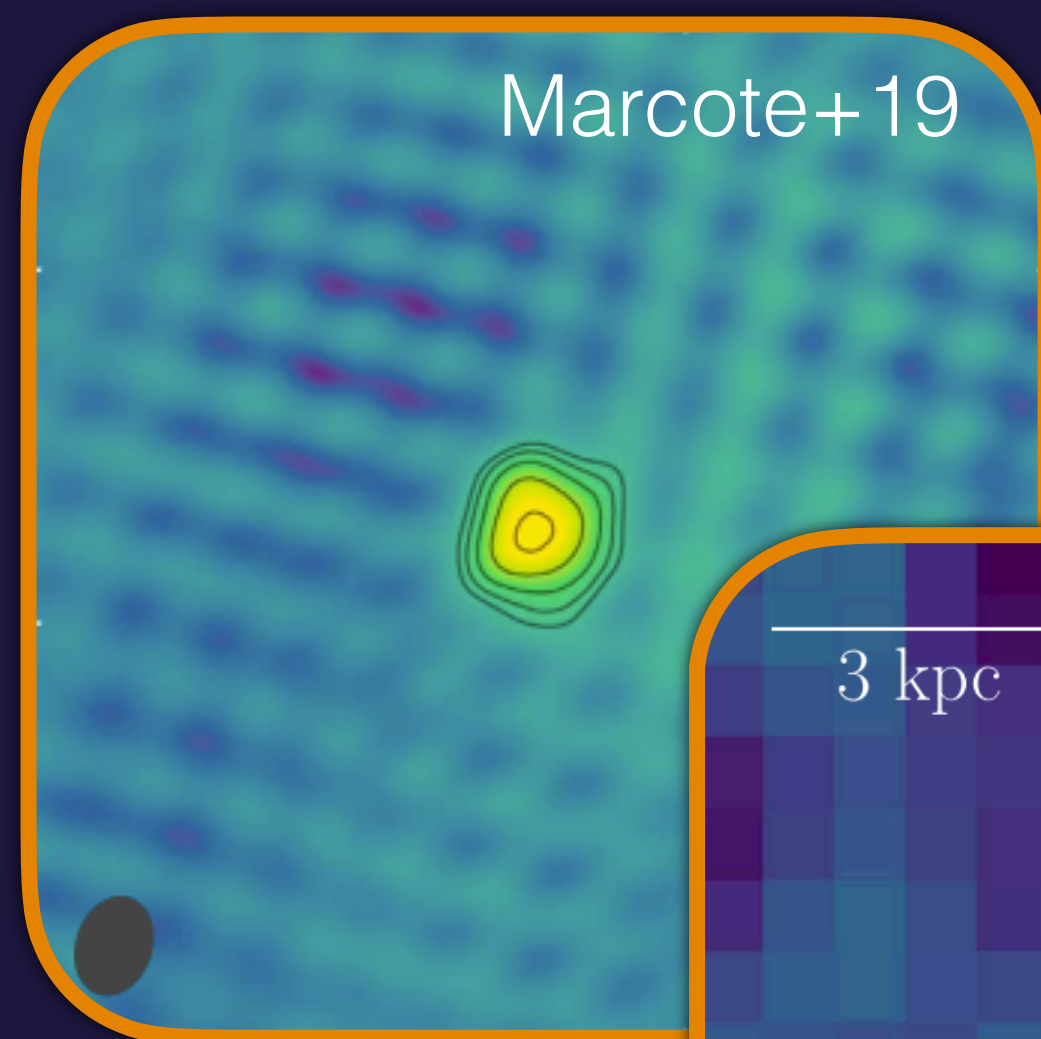


Sridhar&Metzger+22, Sridhar+24

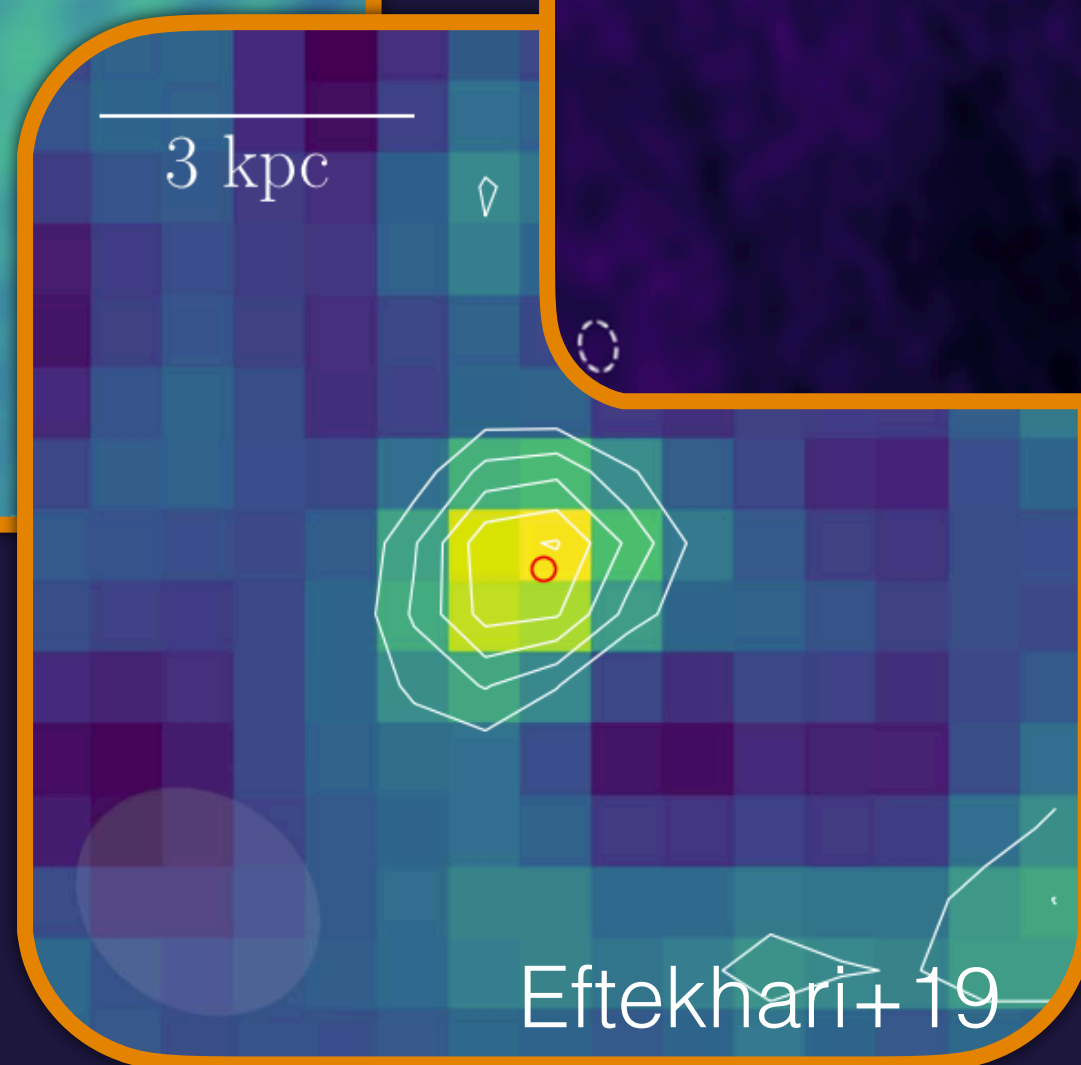
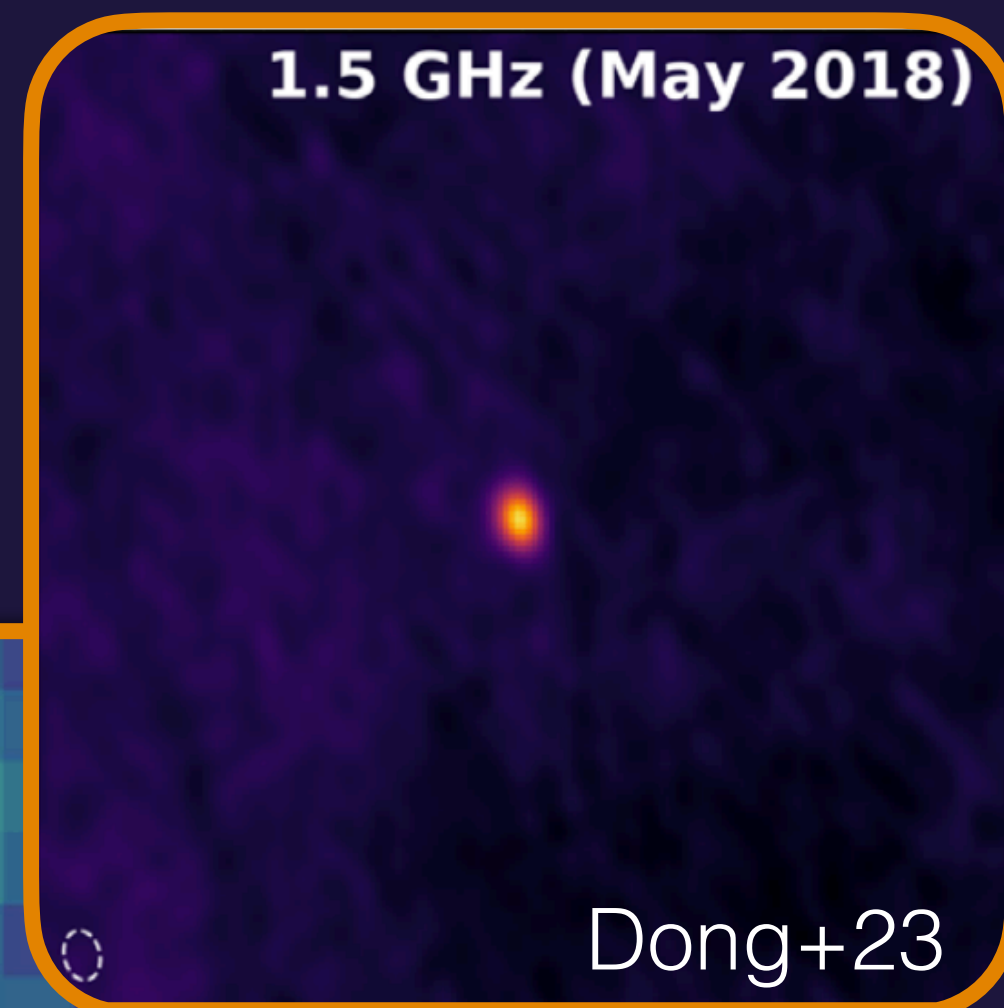
Radio counterparts

Other radio sources as possible analogs of FRB-PRSs in dwarf galaxies

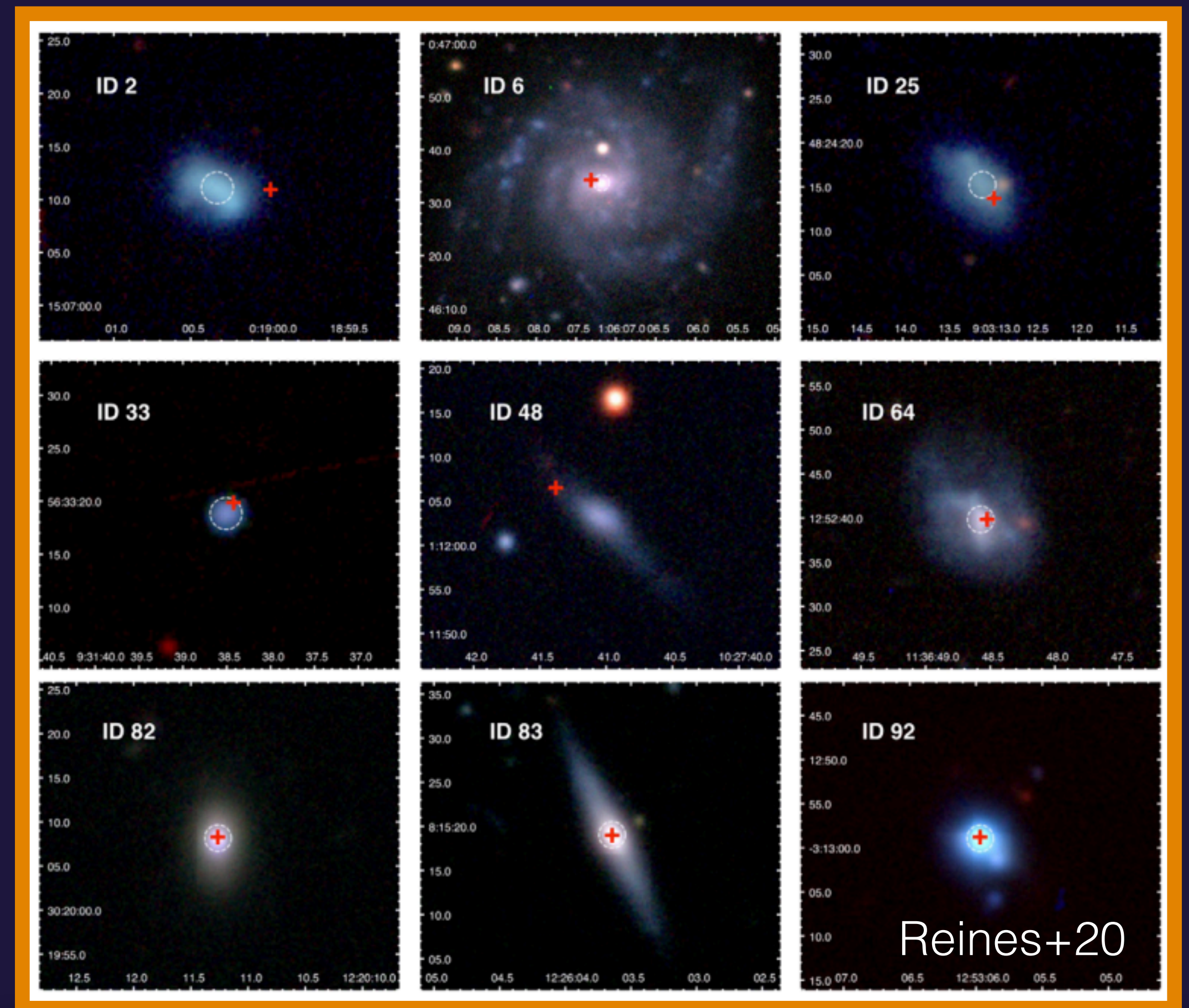
Decades-long radio transient



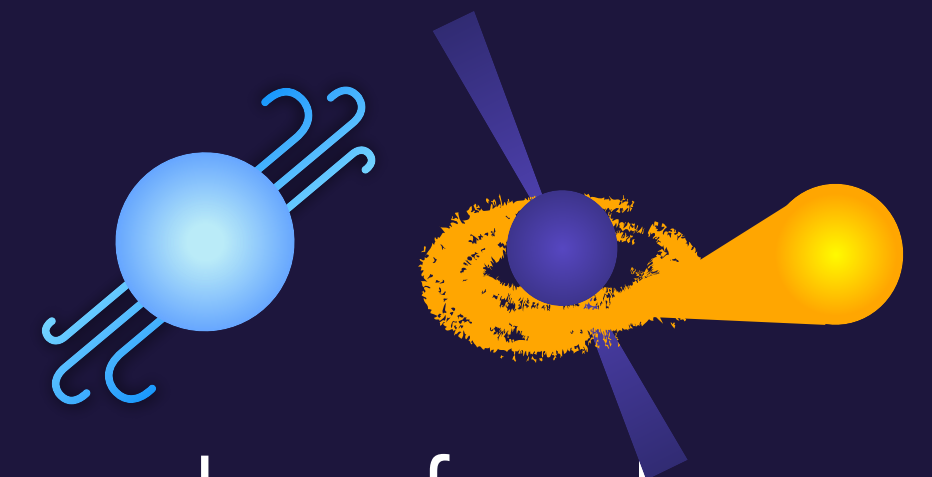
Flat-spectrum radio transient



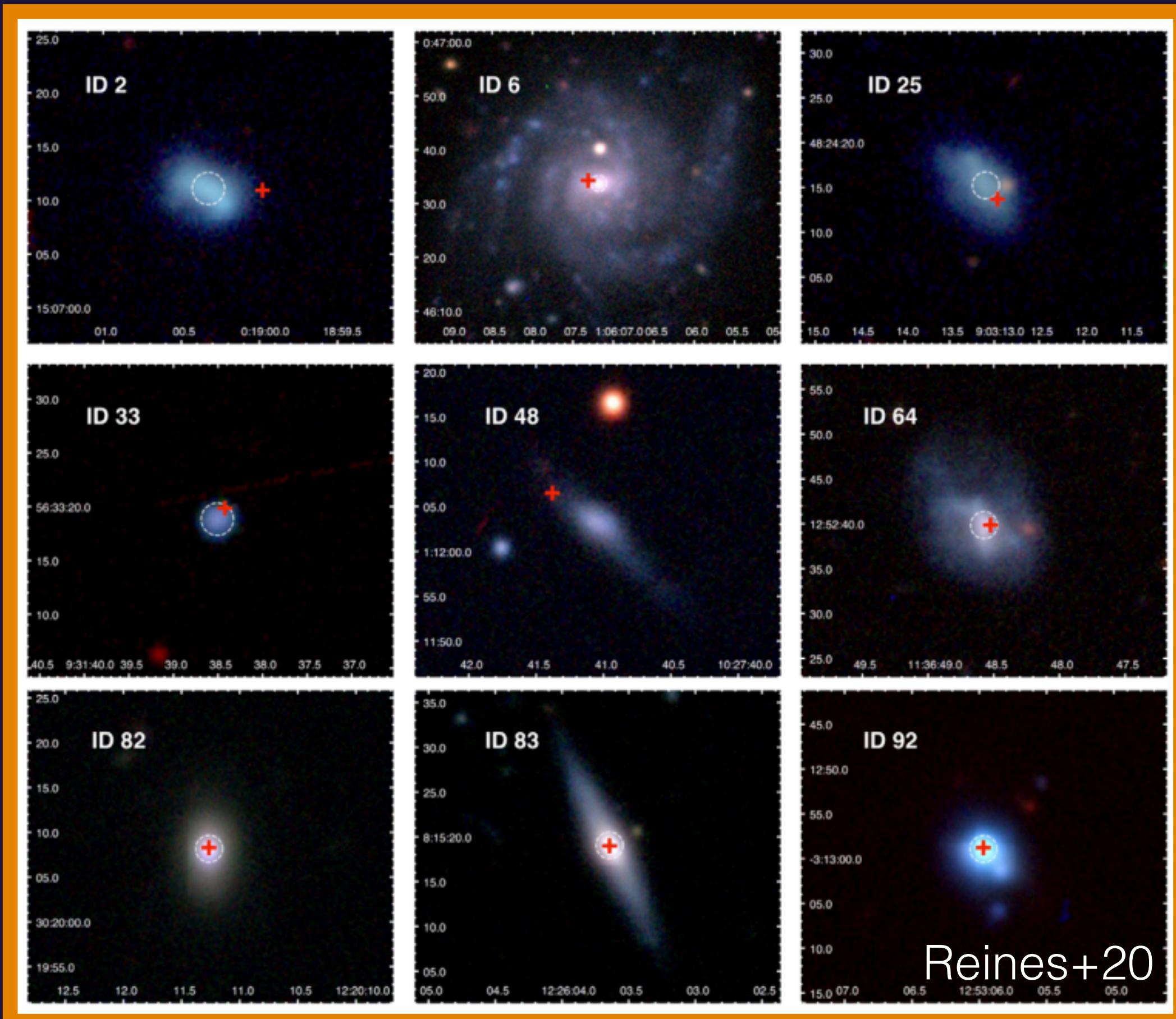
SLSN radio source



Radio counterparts



Using PRSs as signposts for FRBs: One promising candidate in a nearby dwarf galaxy



Sargent+22

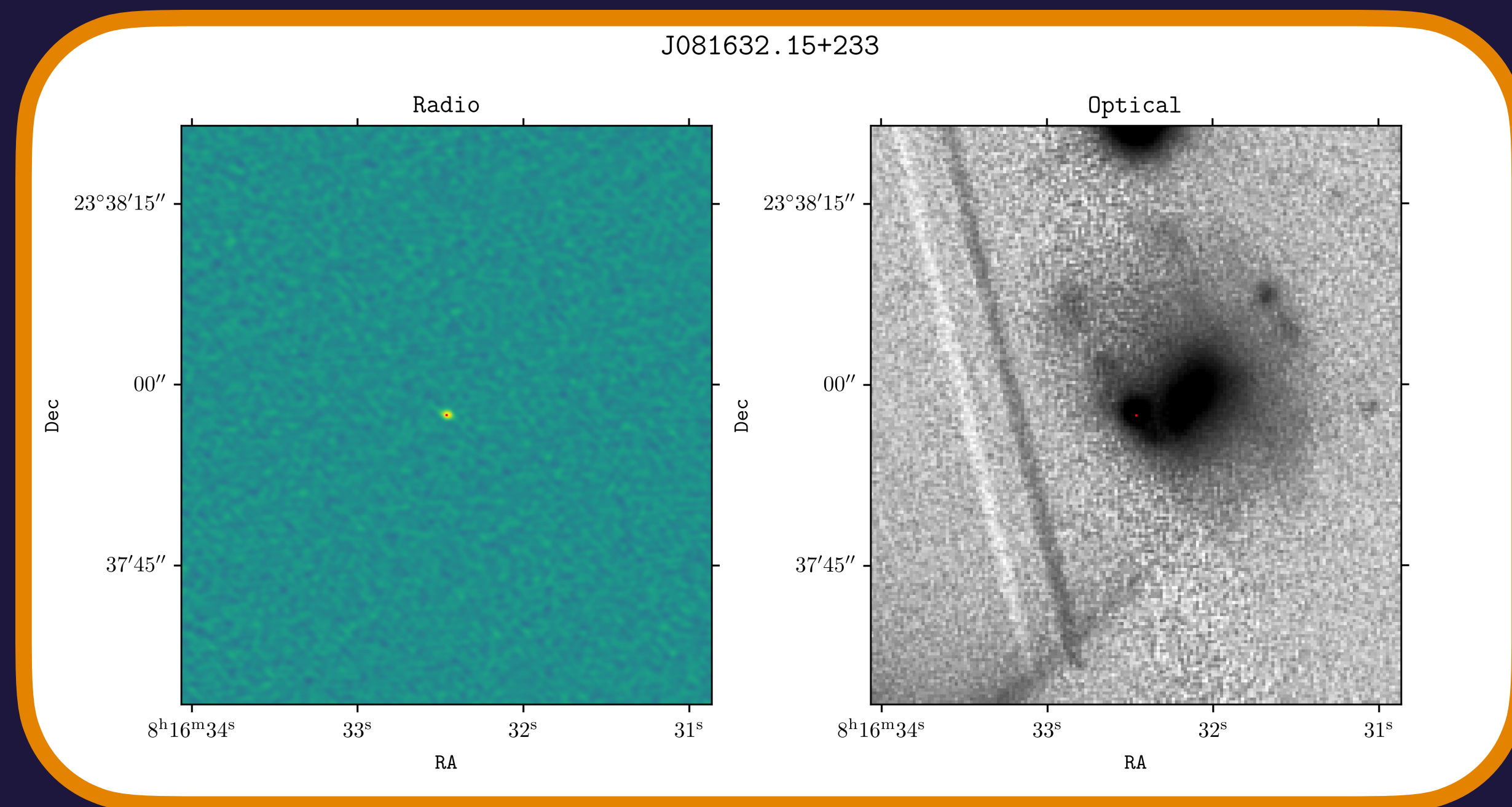


Compact, offset from galaxy center, and observed radio properties are consistent with FRB-PRS models.

Radio counterparts



Going one step further: finding a new population of extragalactic radio sources and finding FRBs associated with PRS candidates



VLA23B LLP (PI: T. Eftekhari)



GBT24B (PI: Y. Dong)



FRB origin(s) are still a mystery, and other transients might be the missing piece!

- ★ **Connecting FRBs to other types of cosmic transients offers powerful clues to their progenitors.**
- ★ **Systematic searches and dedicated multi-wavelength follow-up will be key to uncovering these connections.**
- ★ **In the era of well-localized FRBs, I'm hopeful that we'll soon find a definitive association with another transient class!**

