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Galactic transients and variables with S4

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Overview

Why S4 is revolutionary for Galactic transients

Types of objects for which S4 can make important measurements

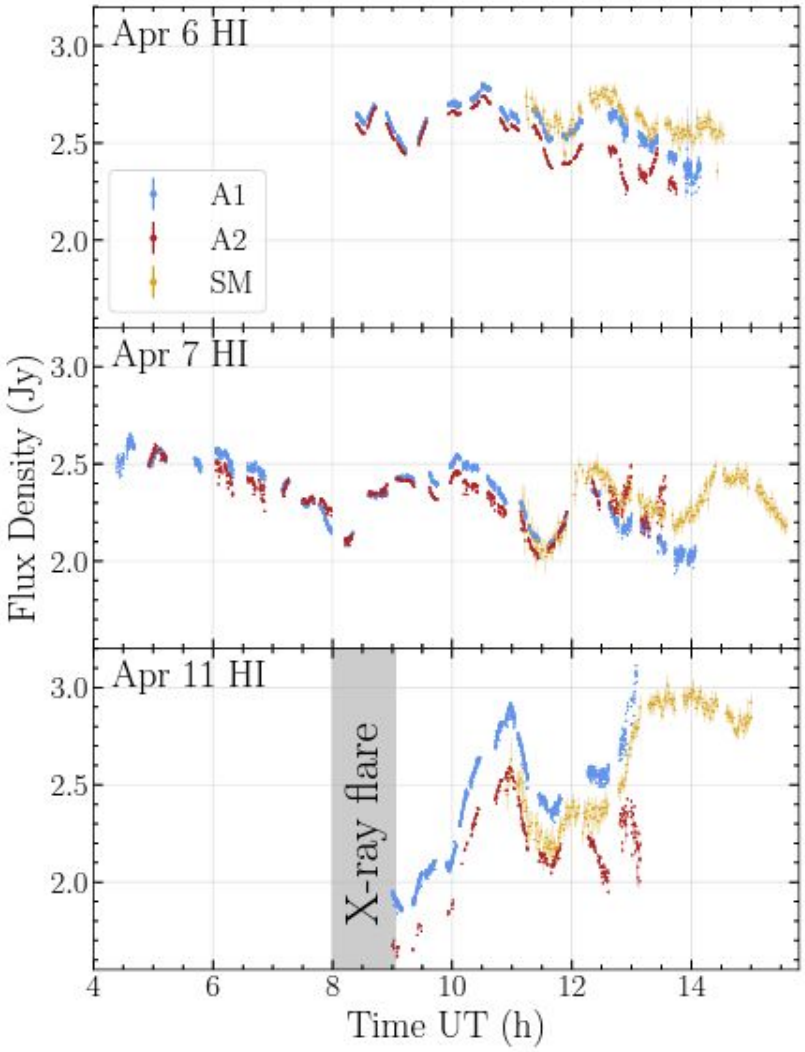
Mostly stellar/stellar remnant science

Broad range of questions without the same kind of unifying theme as much of the rest of S4

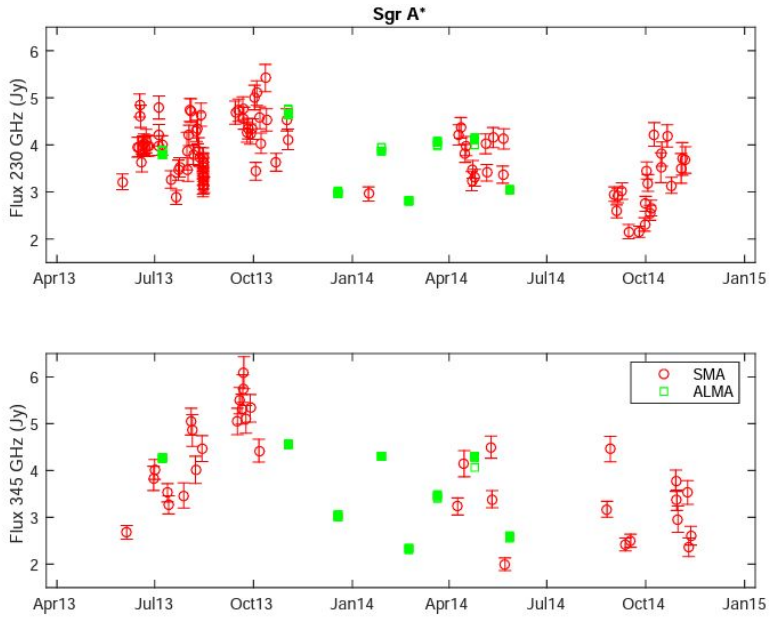
Most stars do not emit radio/sub-mm, so the ones that do are unusual and interesting.

Probes stars in earliest and latest stages!

Sgr A* monitoring



Wielgus et al. 2022



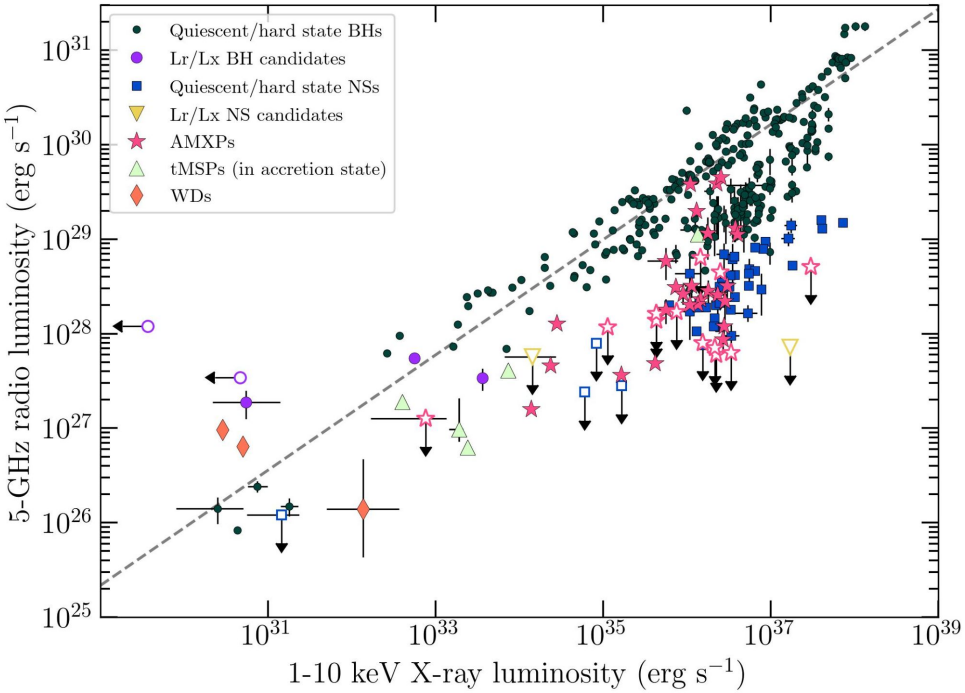
Bower et al. 2015

Jet or inner hot flow?

Frequency dependent lags can help sort this out!

Stellar Mass Black Hole Jets

- Physics of jet production best probed via stellar mass objects
- Steady jets and ballistic ejections both seen (triggering ngEHT)

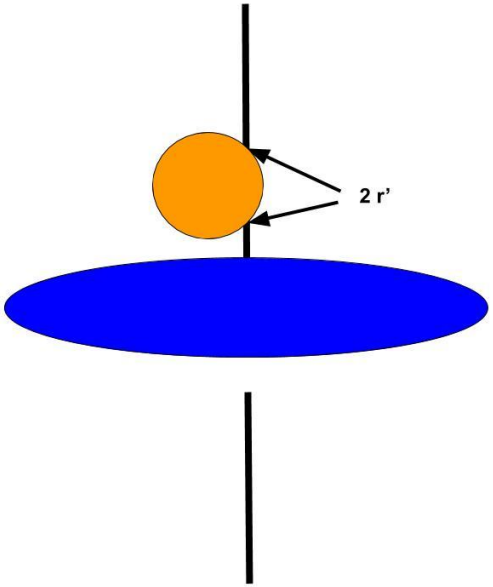


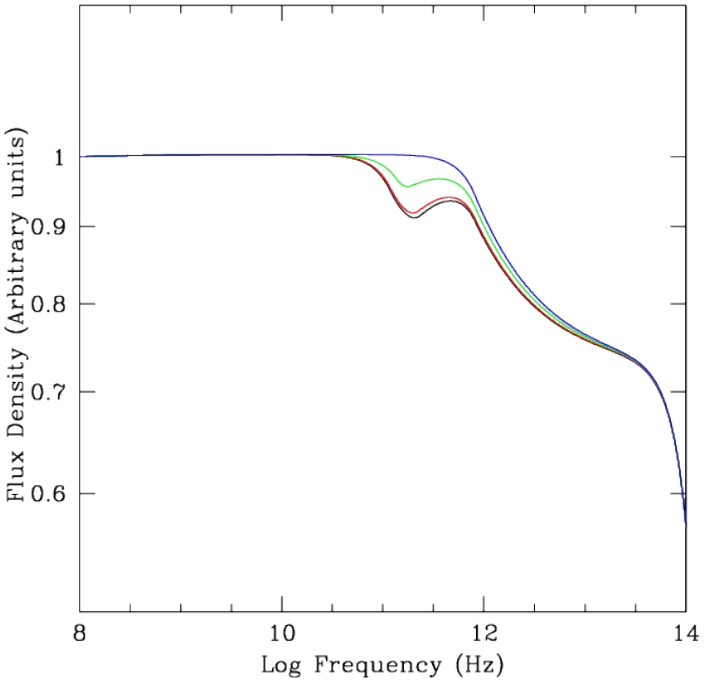
Plot from Arash Bahramian's compilation; see e.g. Hannikainen et al. 1997

Crooked branch: beaming (e.g. Motta et al. 2018)? Disk structure (e.g. Carotenuto et al. 2021)

Need more monitoring to solve. Spectral indices help

Neutron star X-ray binaries

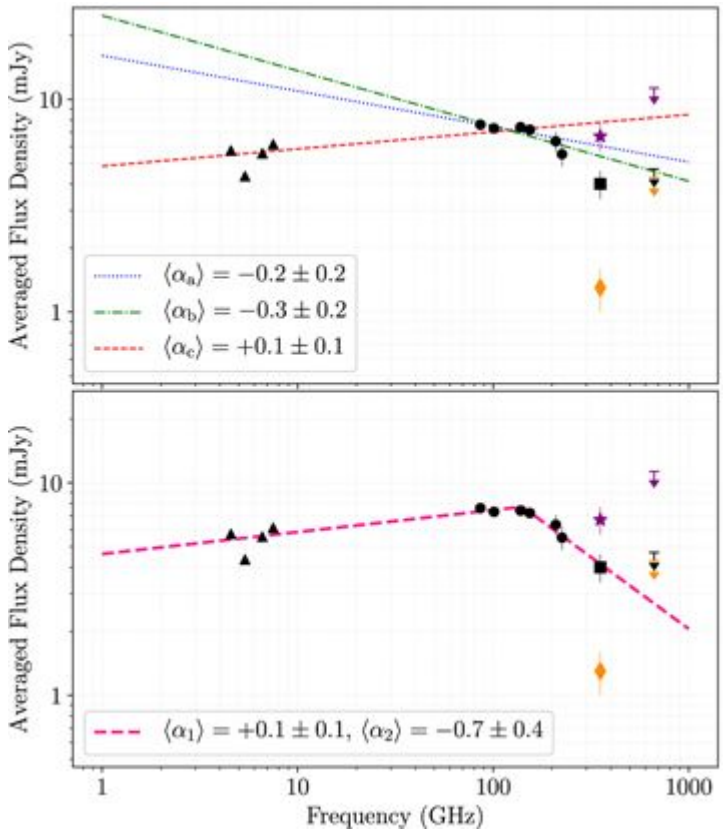




From Maccarone et al. 2020

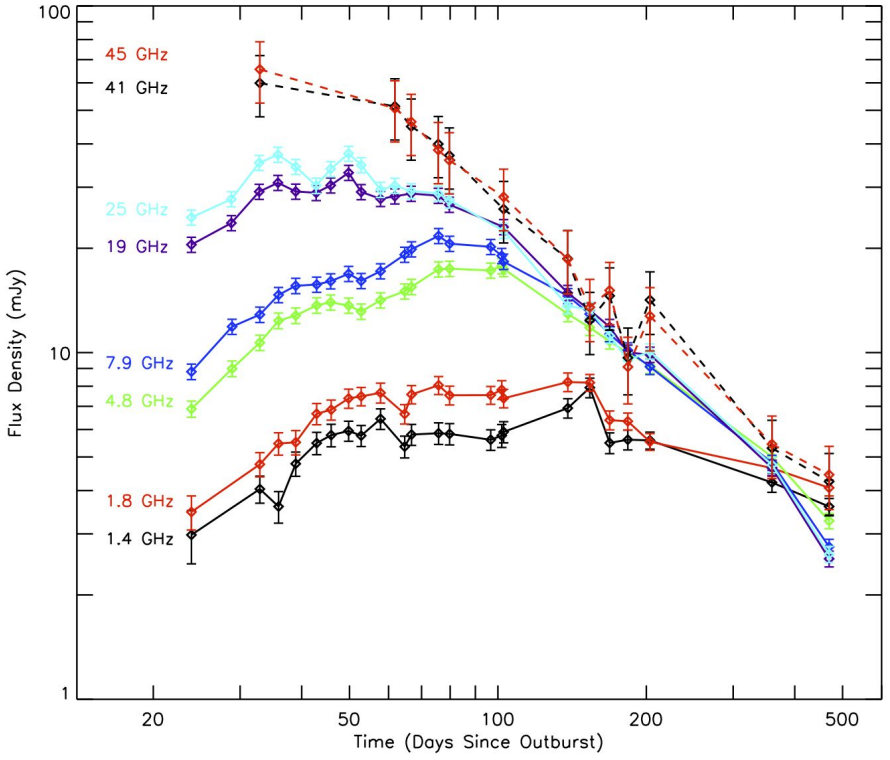
Neutron stars powered by magnetic field decay

Show flat spectrum radio emission during outbursts, probably associated with X-ray flares



Classical Novae

- Thermonuclear explosions of accreted material on white dwarf surfaces
- Understanding them may be relevant to understanding Type Ia supernova progenitors
- Many are missed in the Galactic Plane due to foreground extinction
- Shocks, thermal, or both?



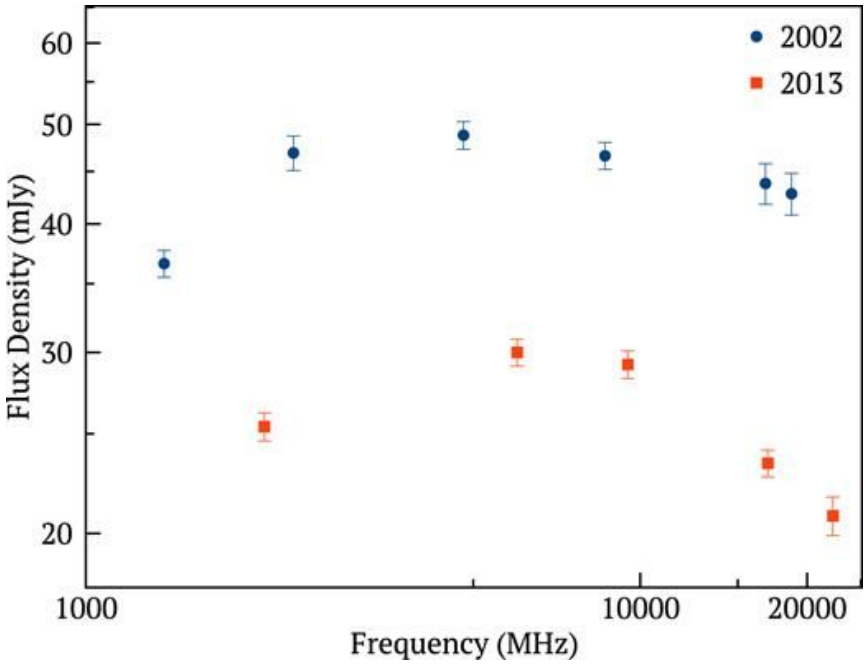
JVLA nova team

S4 should detect lots of young PNe as bright persistent sources

Small fraction vary

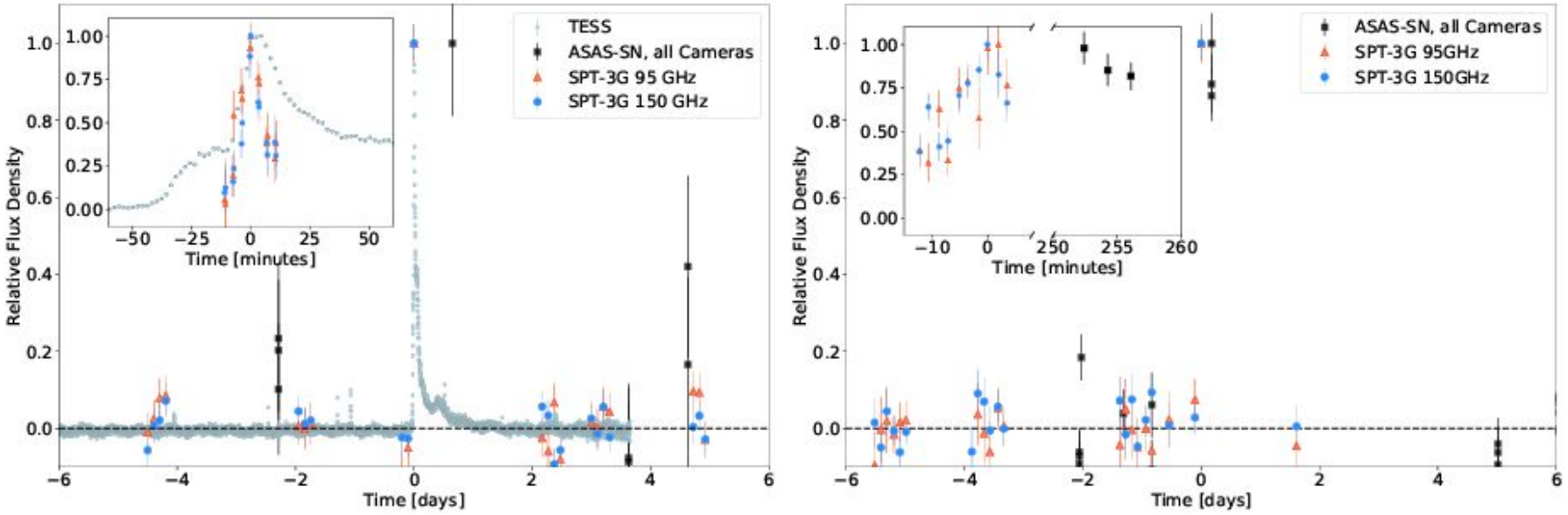
Late thermal pulses?

Jets escaping from nebula?



Stingray Nebula with ATCA, from Harvey-Smith et al. 2018

Stellar Flares

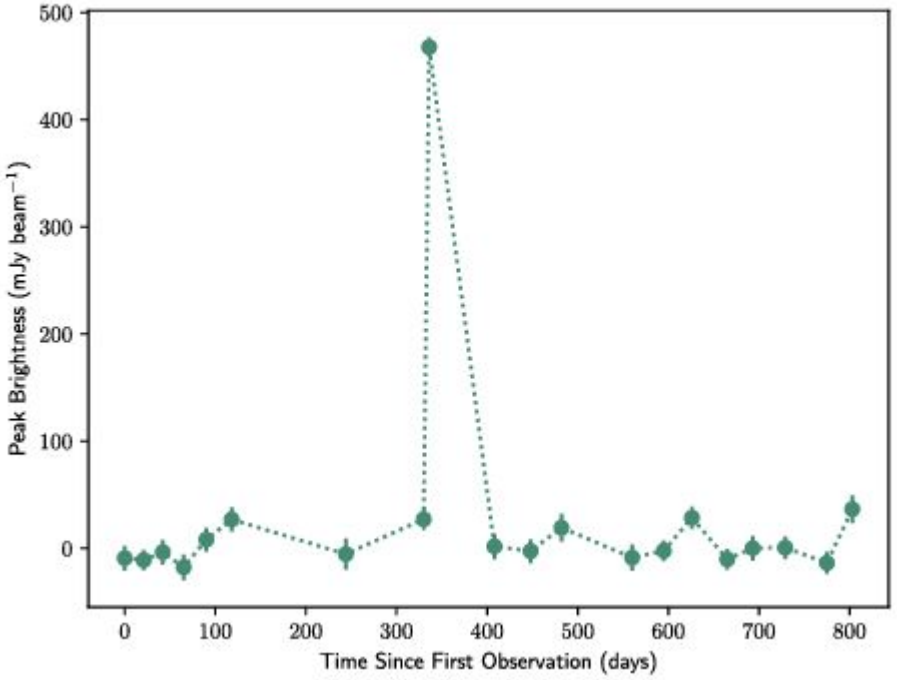


Guns et al. 2021

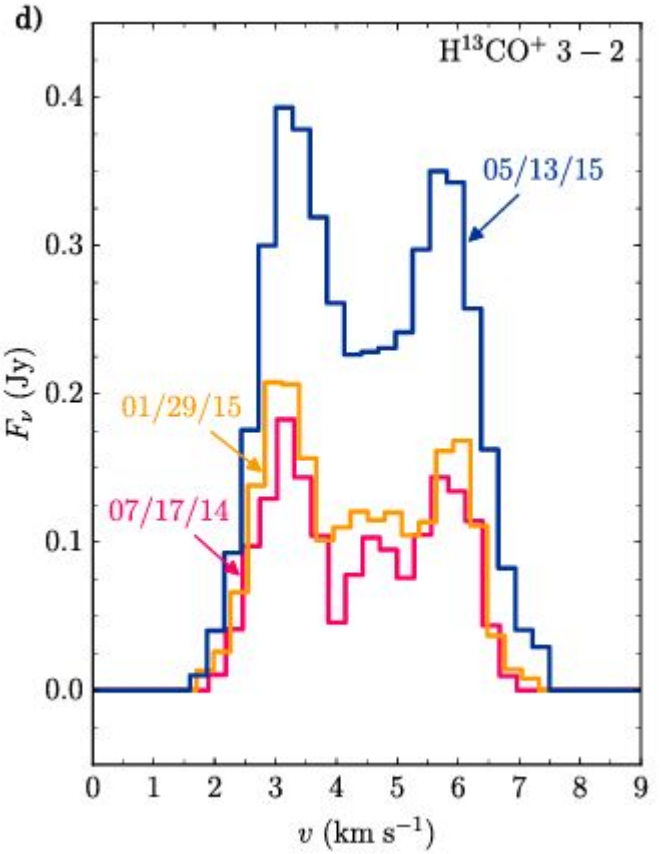
Understand stellar magnetism

Understand flares' impact on planetary habitability

Young stellar object flares



Mairs et al. 2019



Cleeves et al. 2017

Synergies with other facilities

Radio: MWA/LWA (quasi-all-sky), SKA (~100 sq deg)

Optical/IR: Evryscope/Argus (quasi-all-sky) Gattini-IR (25 sq. deg), LSST (fast scanning)

X-ray: Swift/Fermi, Lobsters (~1000 sq deg), STROBE-X, eXTP (~⅓ of sky)

Gamma-ray: CTA (80 sq. deg)

- Follow-up with other millimeter facilities
- ALMA:maybe "overly" sensitive
- SMA: well matched, but in wrong hemisphere

Conclusions

Broad range of stellar astrophysics possible with S4

Some of it can be enabled by coordinating observations done by other facilities with S4 schedule

Current reporting times are largely sufficient, but there could be some benefit to faster reporting of lower quality alerts