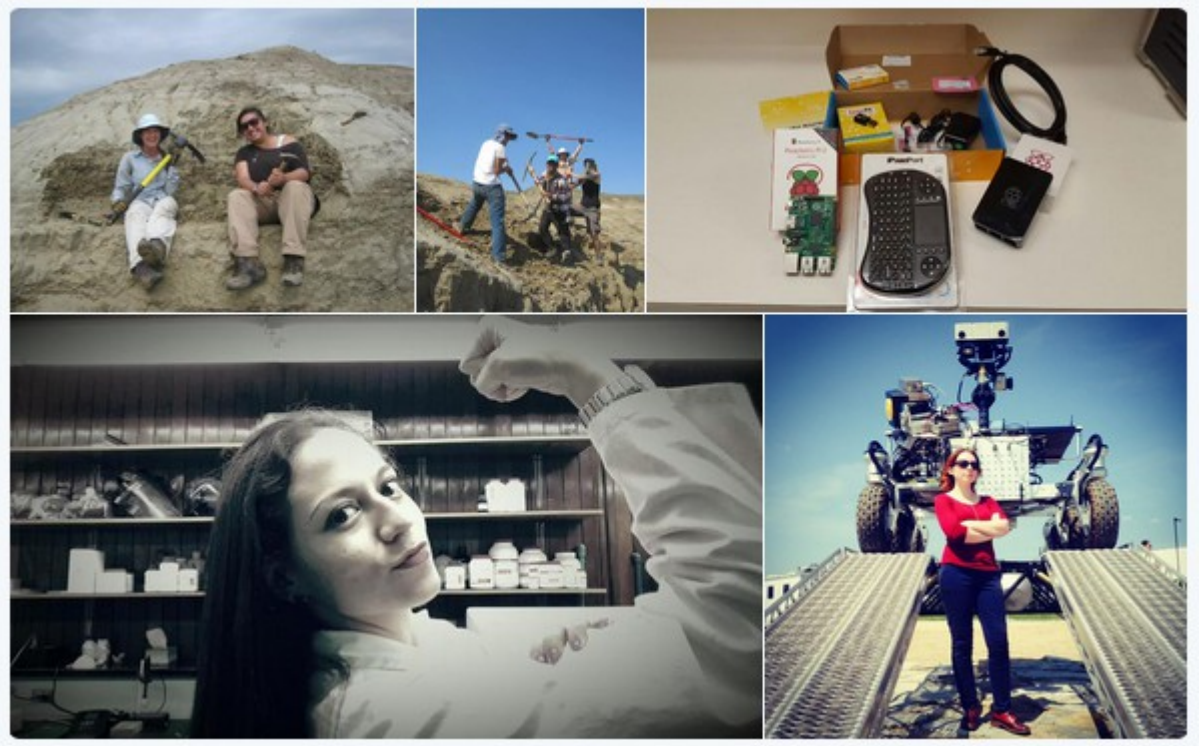
Joint Radio-Optical Searches for Transients

Kunal Mooley

Collaborators:

G. Hallinan, S. Bourke, M. Anderson, S. Kulkarni, Y. Cao, M. Kasliwal (**Caltech**),
S. Myers, D. Frail (**NRAO**), A. Horesh (**Weizman**), S. Cenko (**GSFC**)

boy with toys

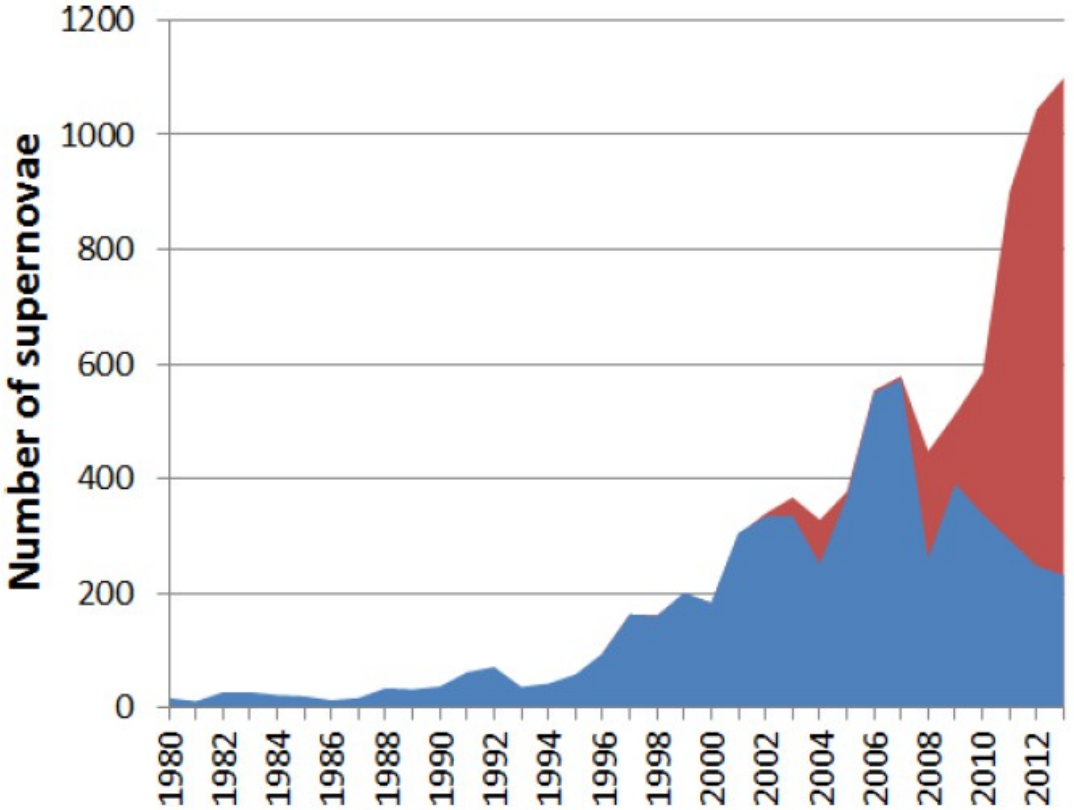


#GirlsWithToys

– Synoptic surveys have revolutionized transient science in optical, X-ray and gamma-ray bands

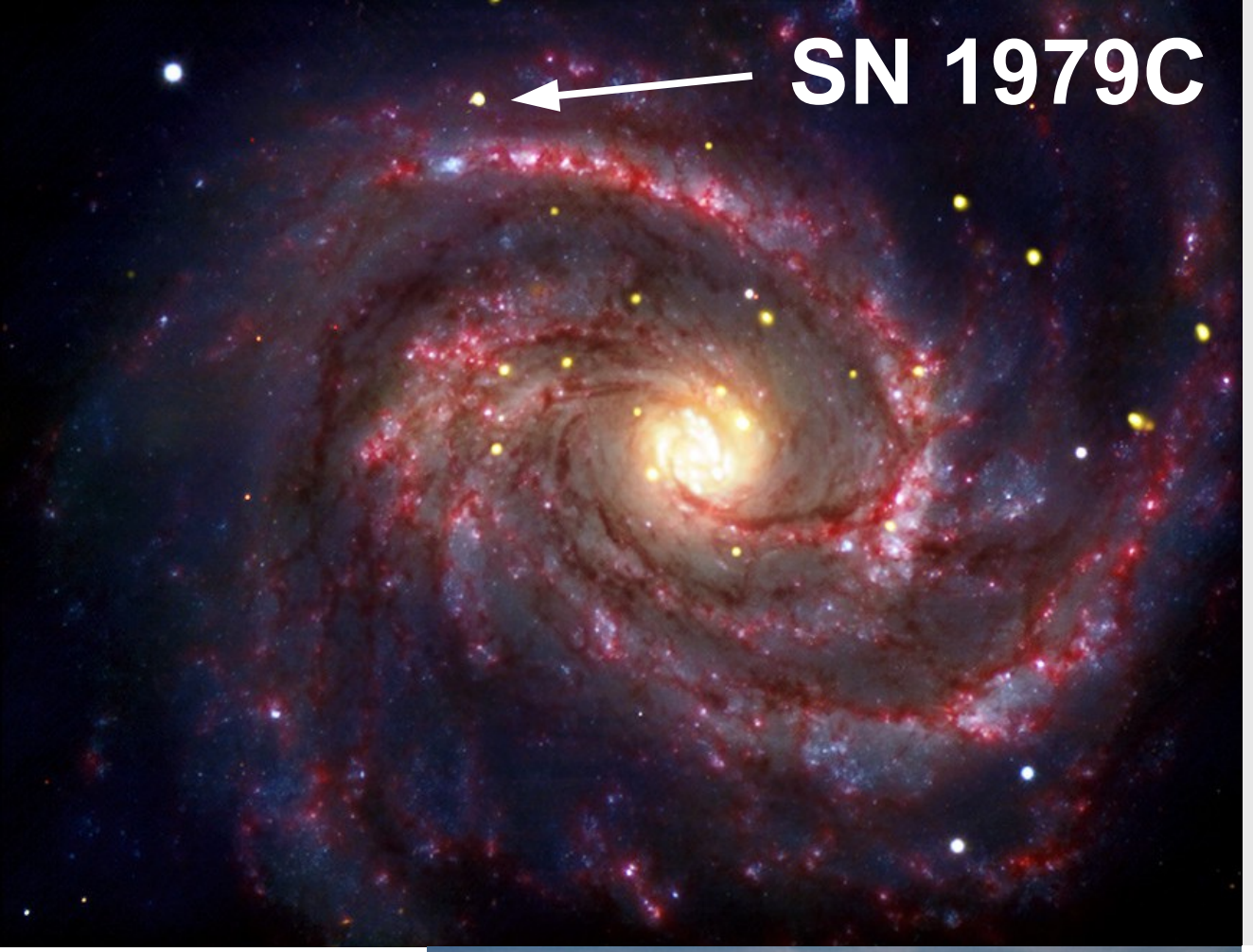
– BATSE, Swift, Fermi → GRBs

– PTF, Pan-STARRS → supernovae



Radio transient surveys lag optical and higher energy surveys by at least a decade.

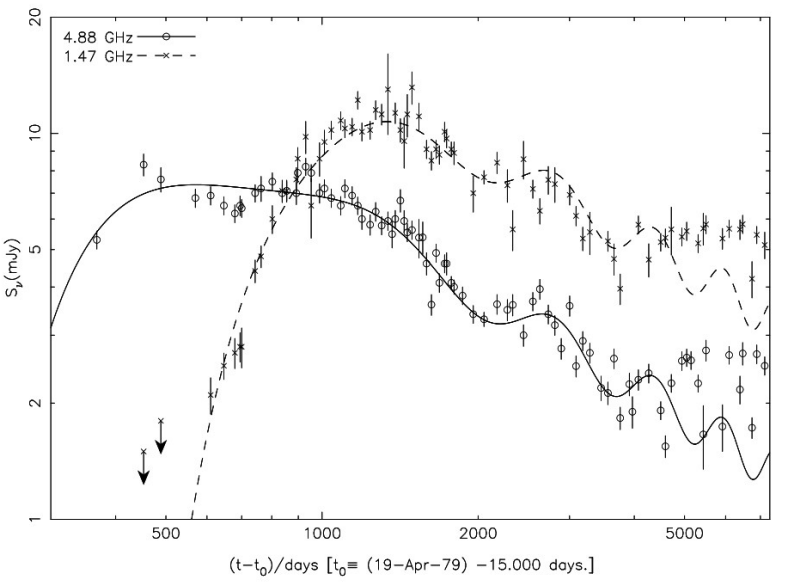
From Gregg Hallinan



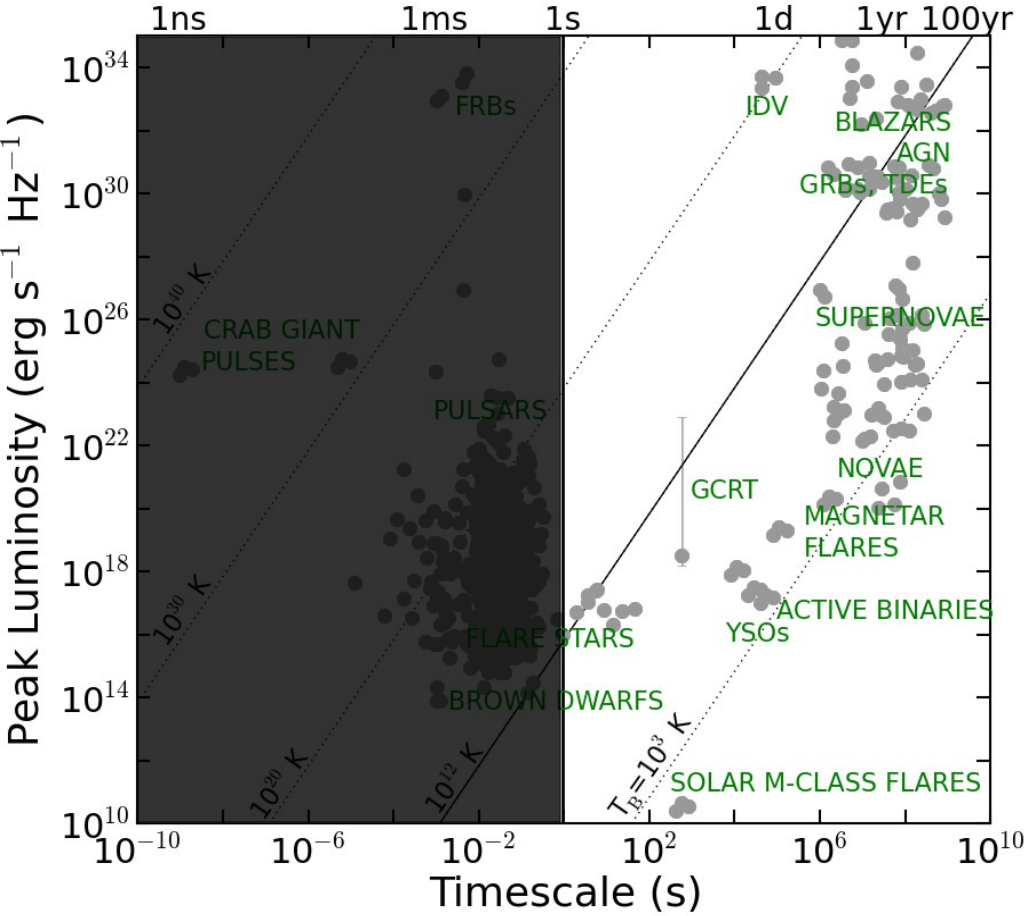
Supernova in M100 at 17 Mpc

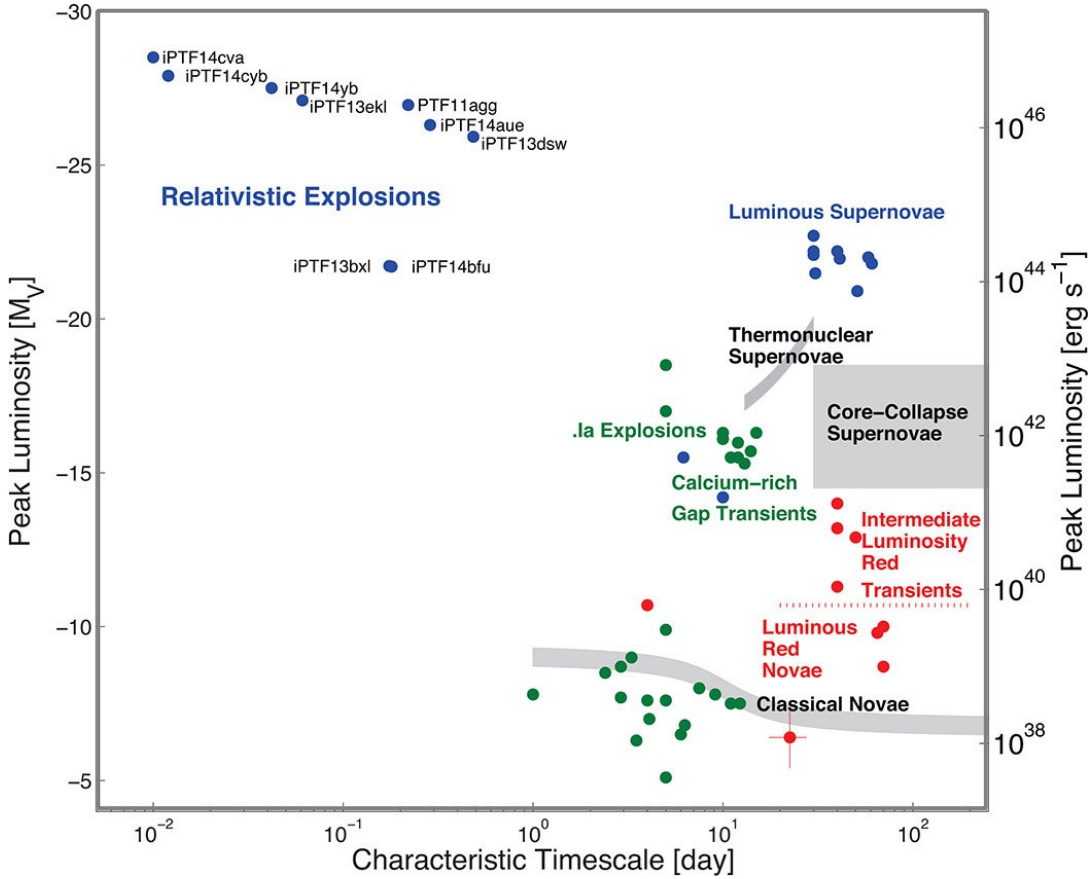
Peak optical mag: ~12.2

Peak radio flux: ~10 mJy



Phase Spaces





Joint Radio-Optical

1) offers a more complete census of transients

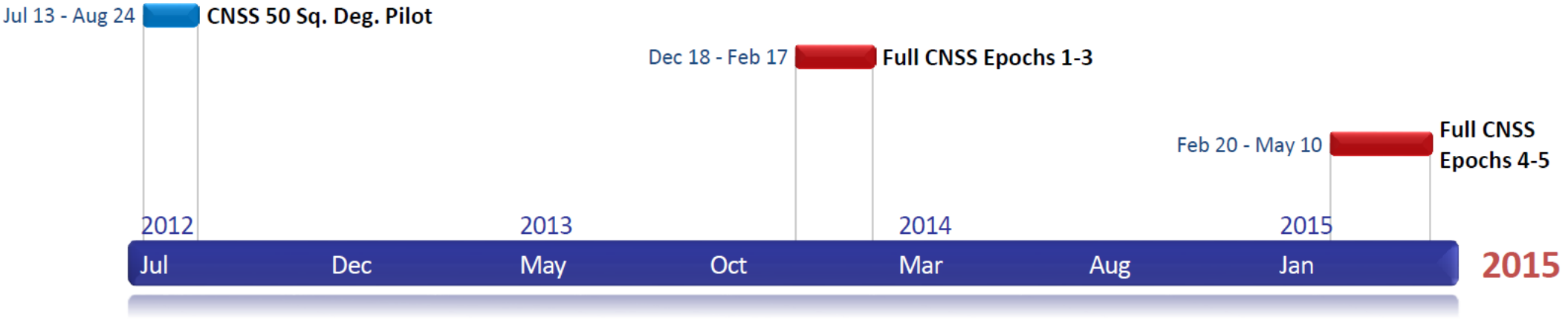
2) a better means of rapidly vetting and classifying transients via light curves

3) simultaneous studies:
   – thermal/non-thermal emission
   – correlated emission in radio and optical

4) direct comparison of the dynamic radio and optical skies

Stripe 82 Survey

altech



From Gregg Hallinan

2.5 deg

SDSS Stripe 82

109 deg

AIPS *Lite*

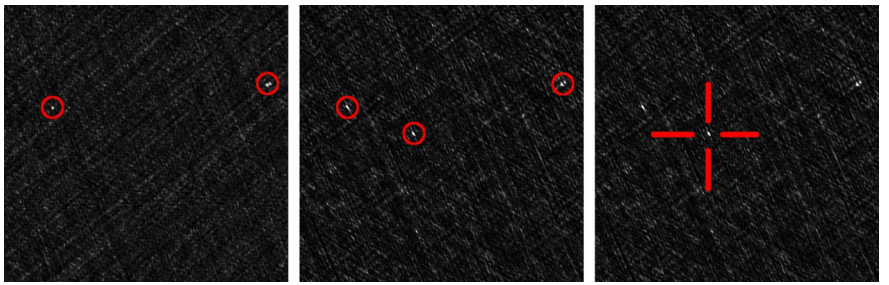
1. Calibration

- Dynamically-scheduled
- Required commissioning of on-the-fly mapping (OTF)

2. Distributed Imaging

3. Mosaicking

4. Source finding
5. Catalog cross-matching & Transient search
6. Elimination of false positives



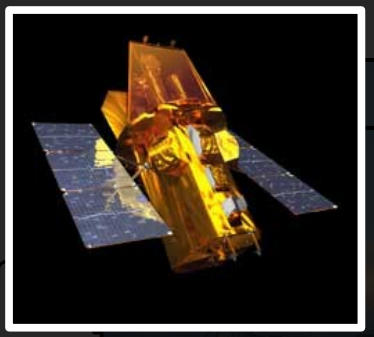
Bourke, Mooley & Hallinan 2014

2.5 deg

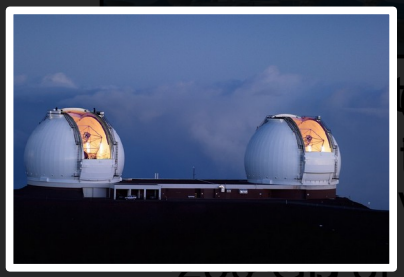
SDSS Stripe 82

109 deg

AIPS Lite

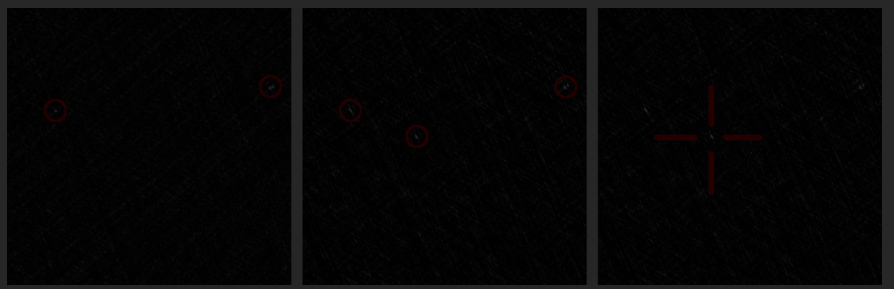


1. Calibration

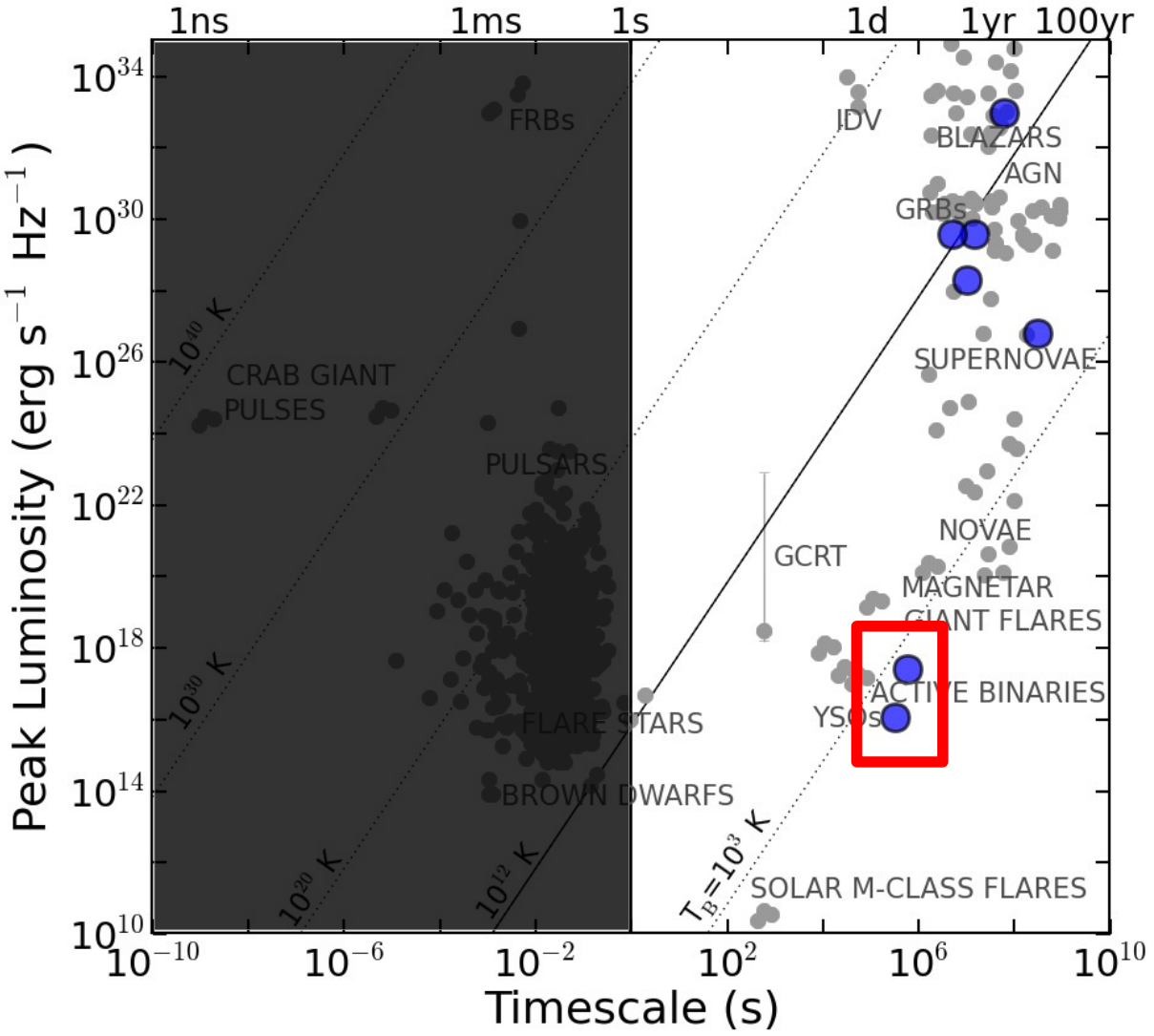


SDSS III

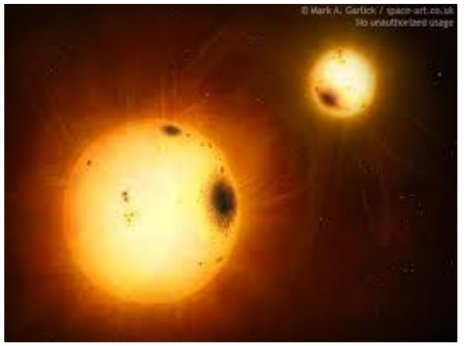
Mosaicking



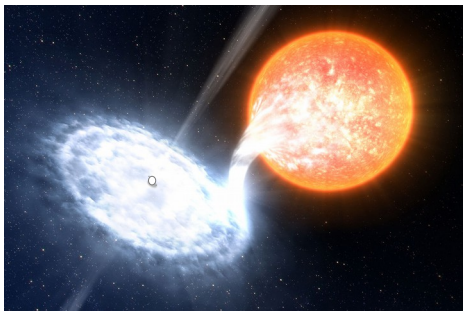
Galactic Transients



Active binaries

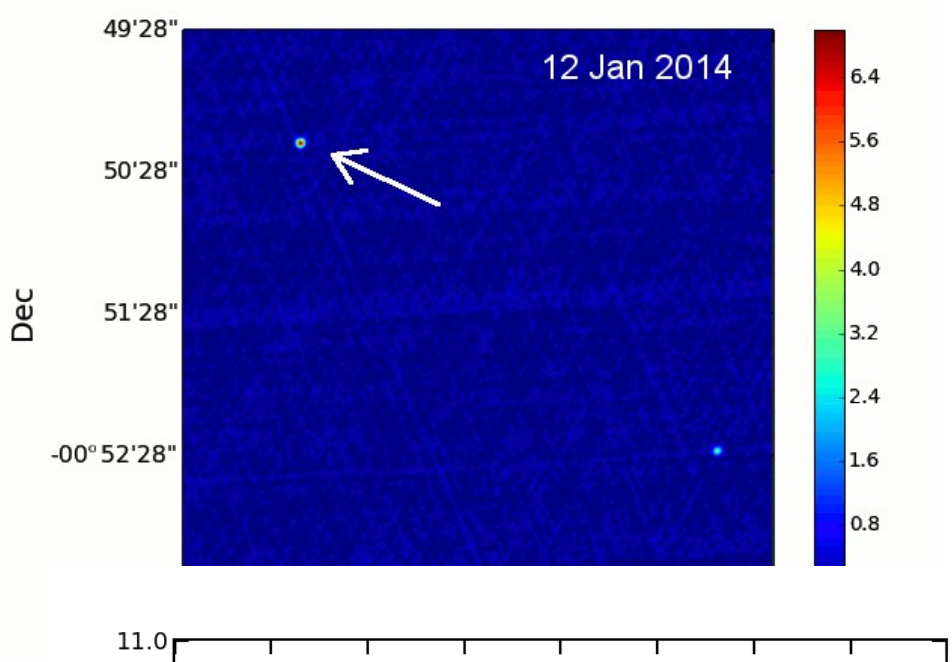


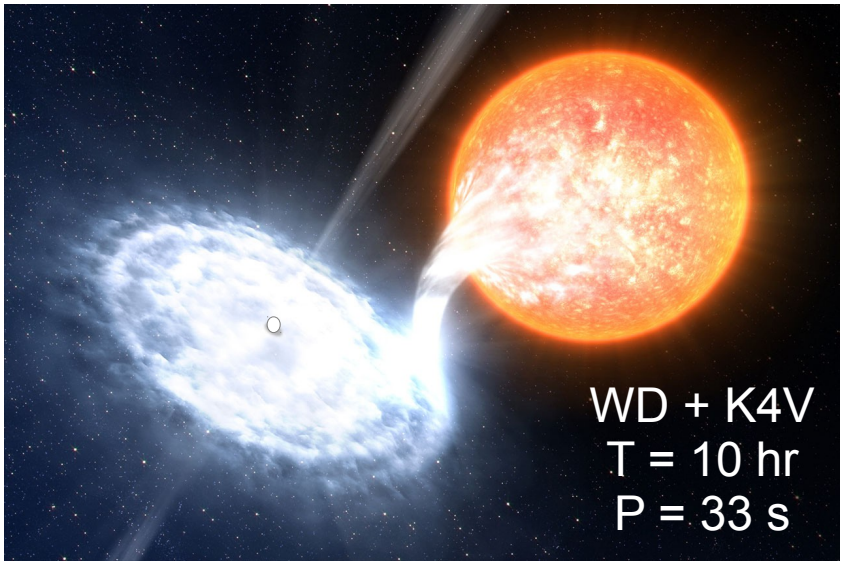
CVs



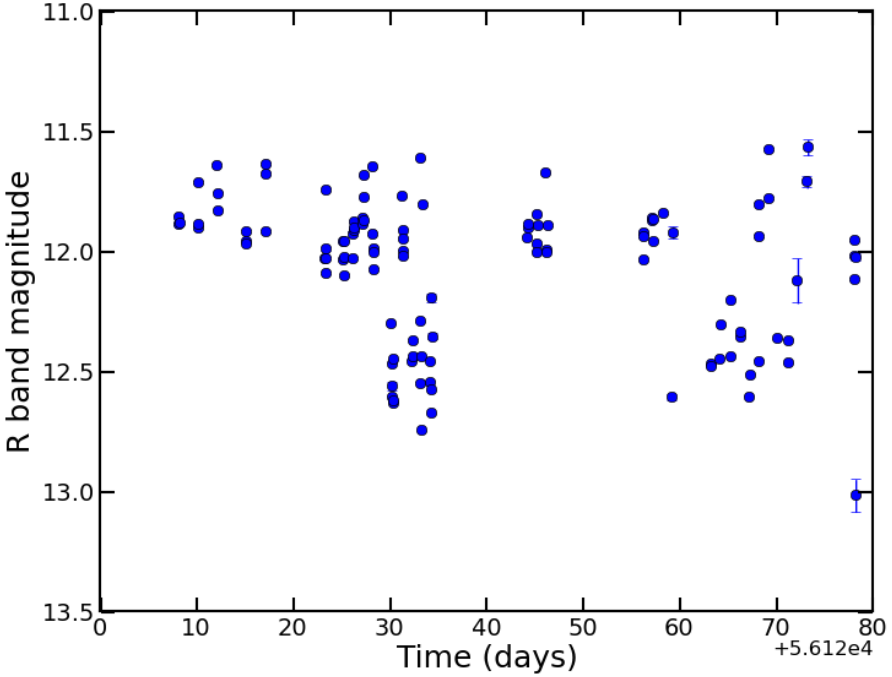
Flare stars

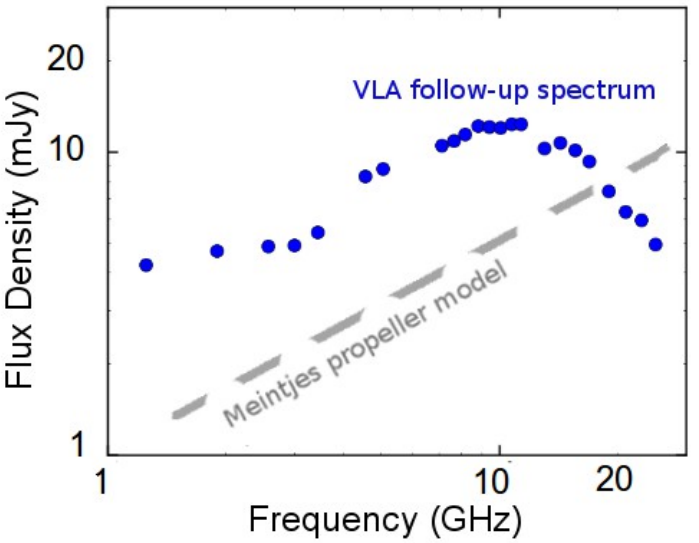
CNSS2040-00: Cataclysmic Variable



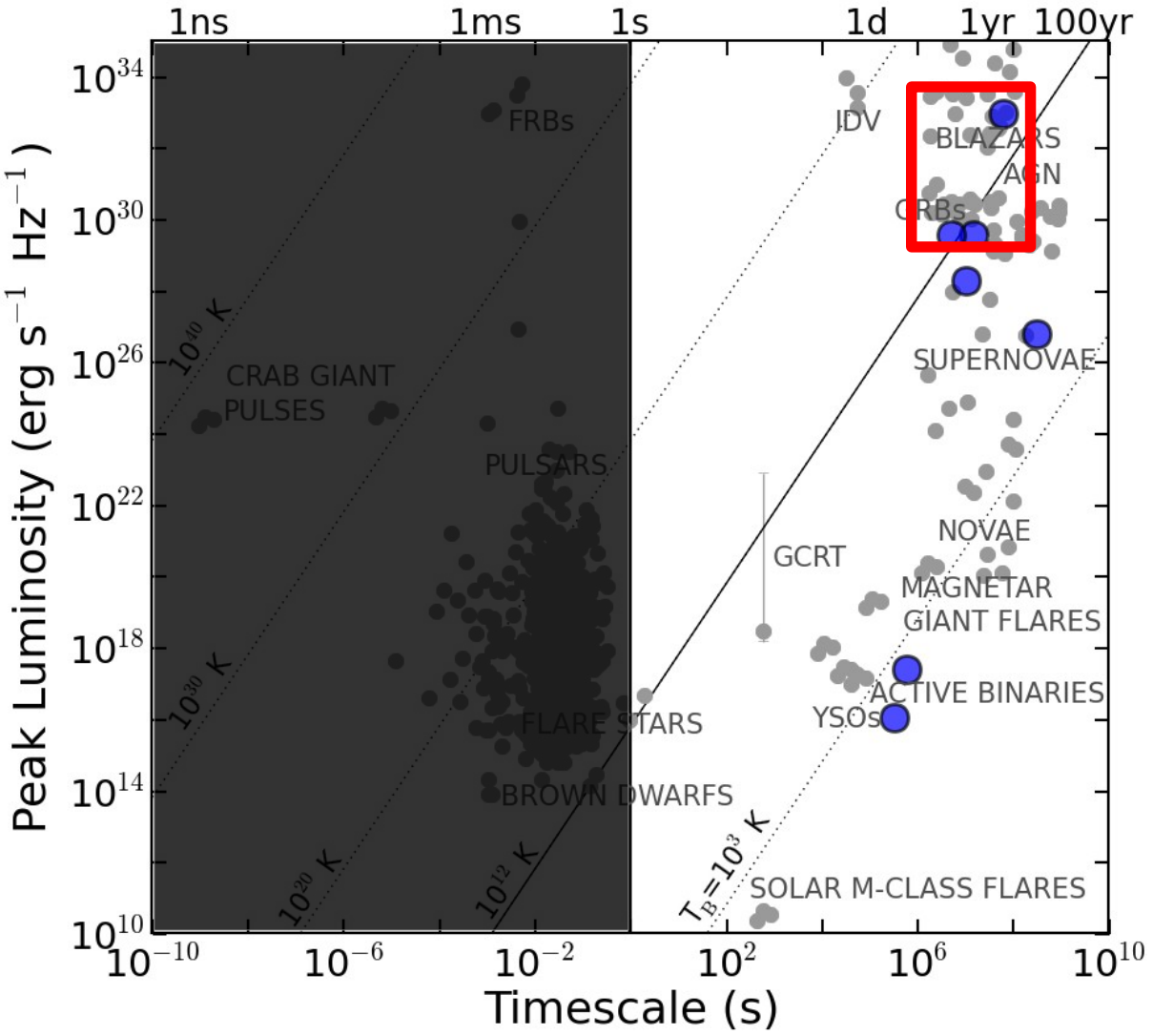


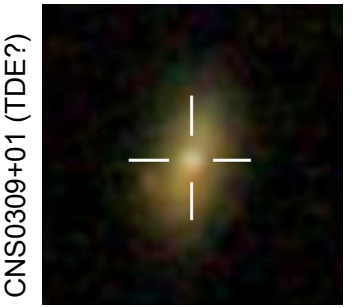
ESO/L. Calçada.

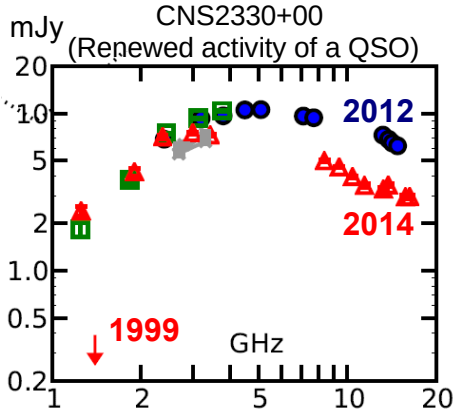




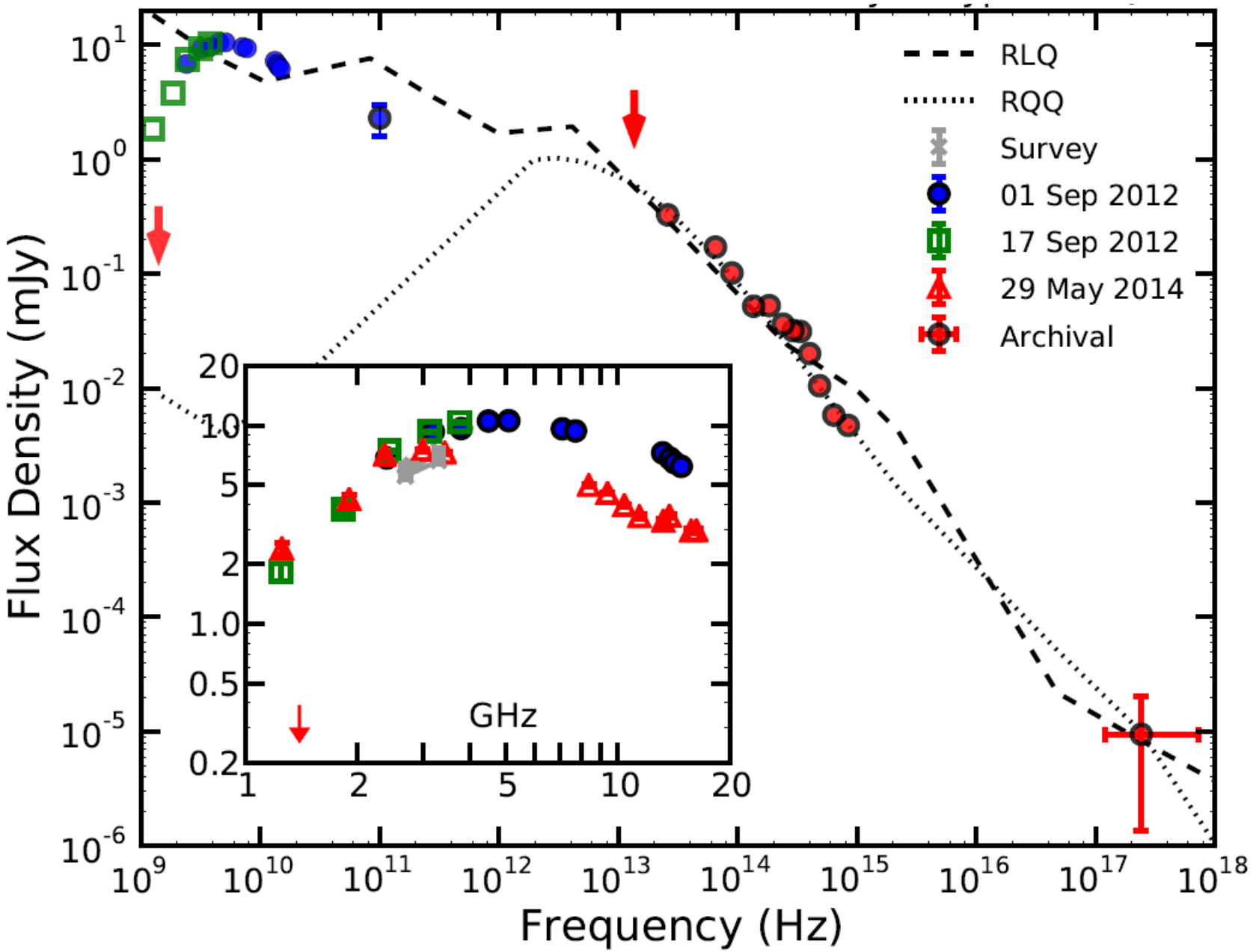
AGN Phenomena





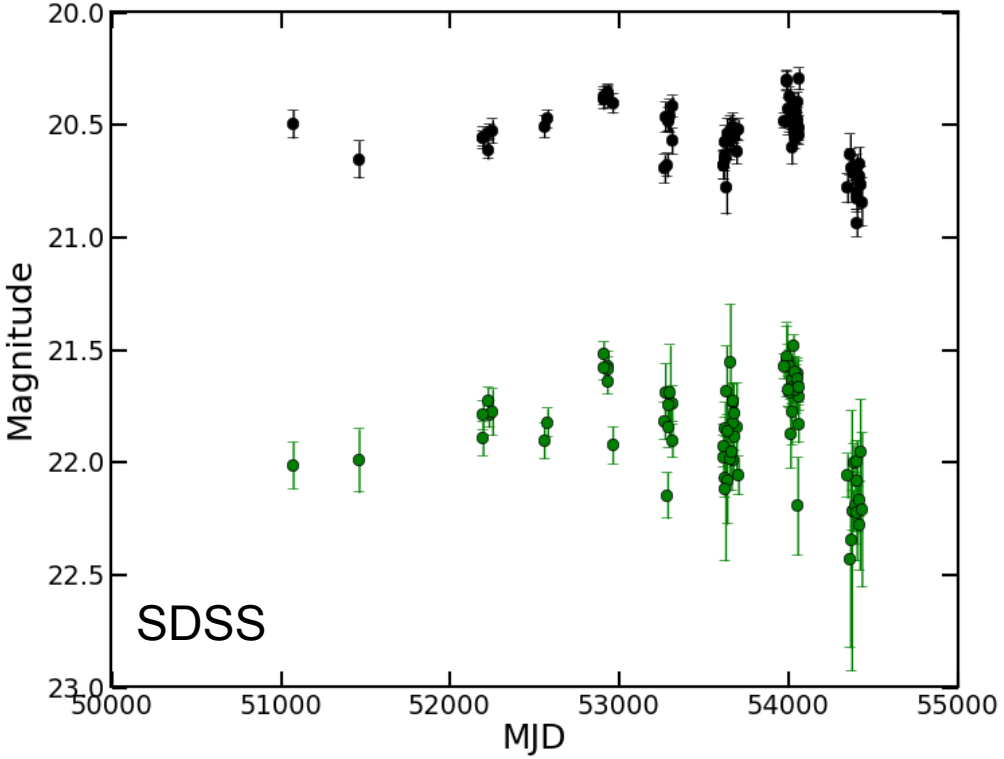


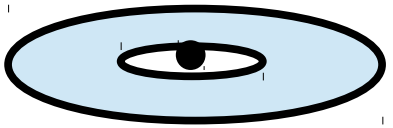
CNSS2330-00: Renewed Activity of AGN



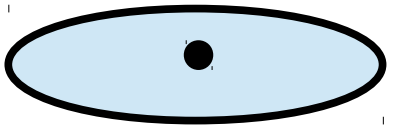
Mooley et al. 2015

CNSS2330-00: Renewed Activity of AGN

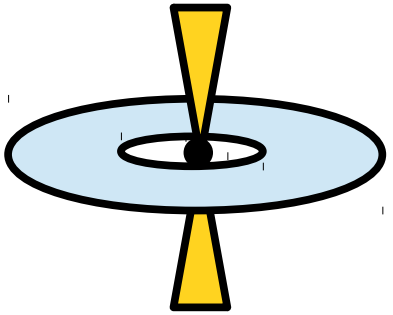




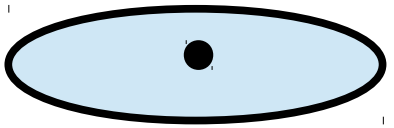
Empty inner disk; no X-rays; Jet



Filled inner disk; X-rays; no jet

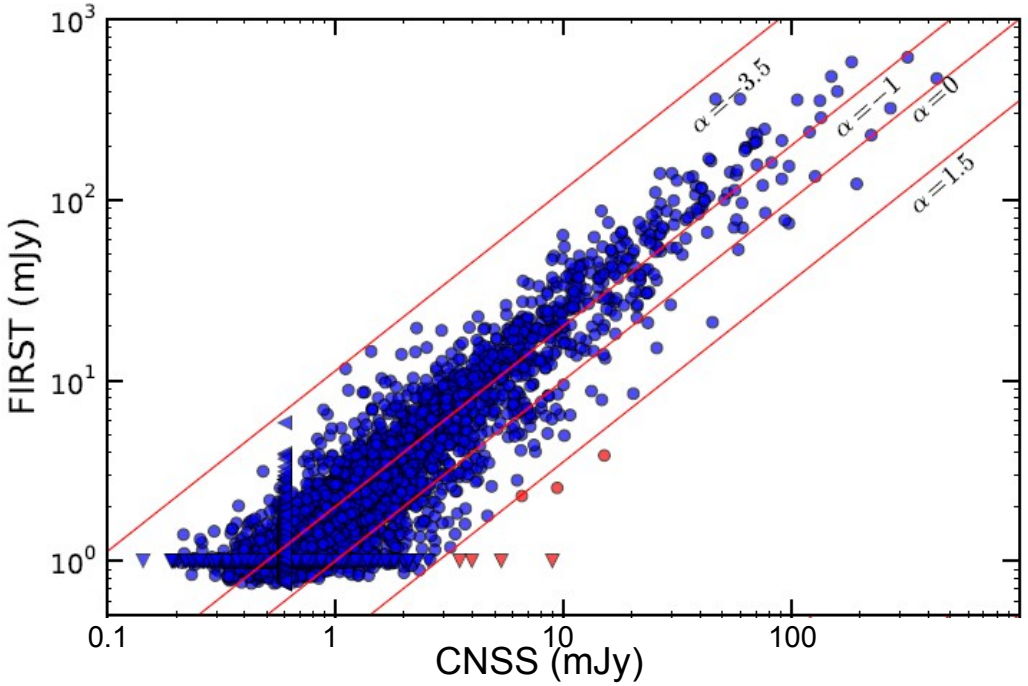


Empty inner disk; no X-rays; Jet



Filled inner disk; X-rays; no jet

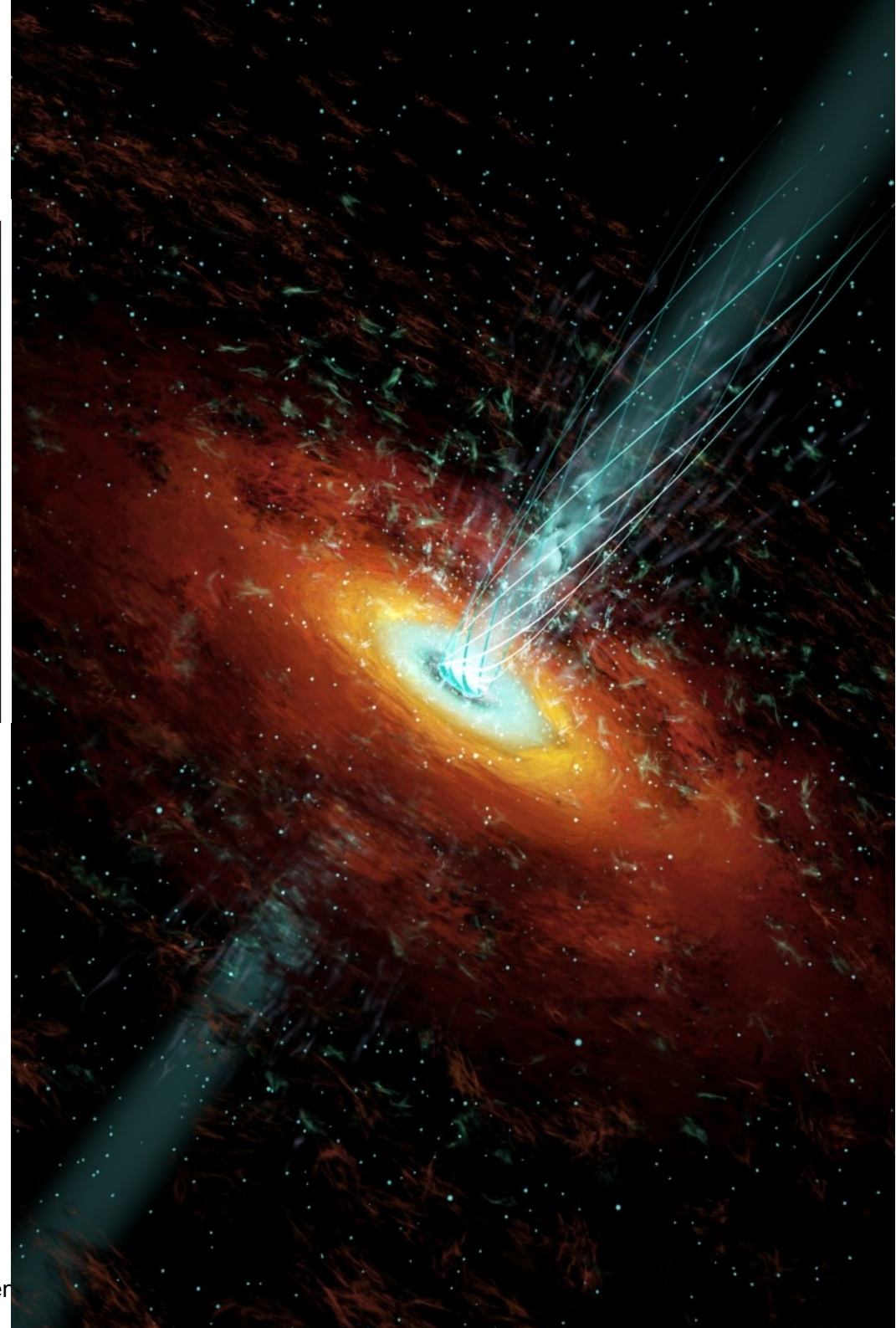
Rates for extreme variability of AGN



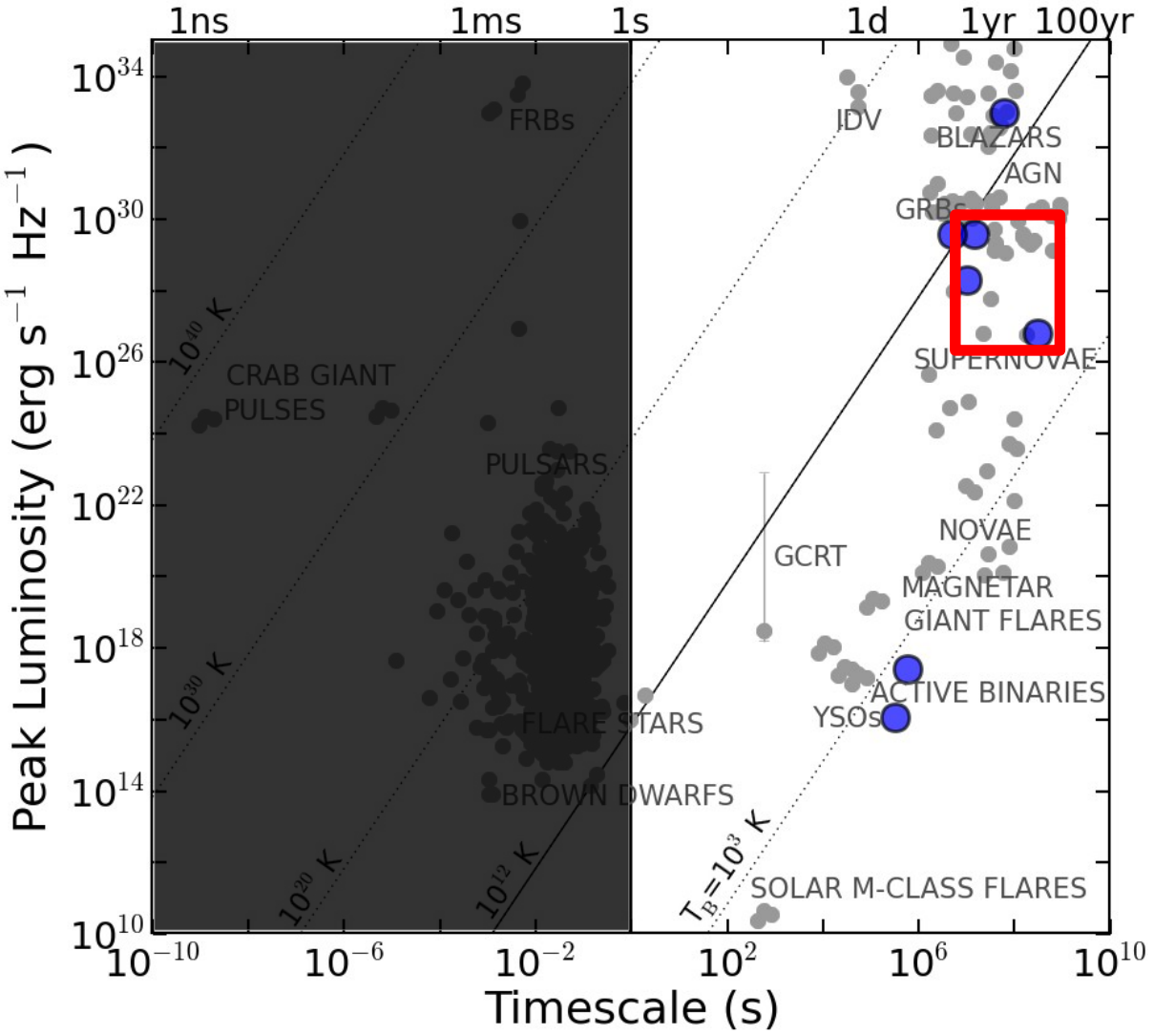
R ~ 2 (100 deg^2, S > 3 mJy)

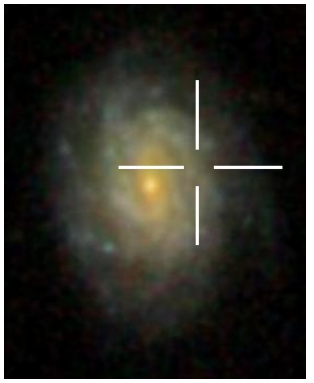
τ ~ 20 years

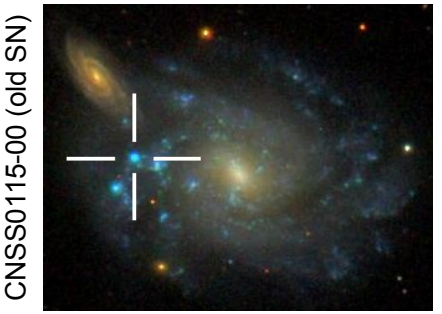
T ~ 40,000 years



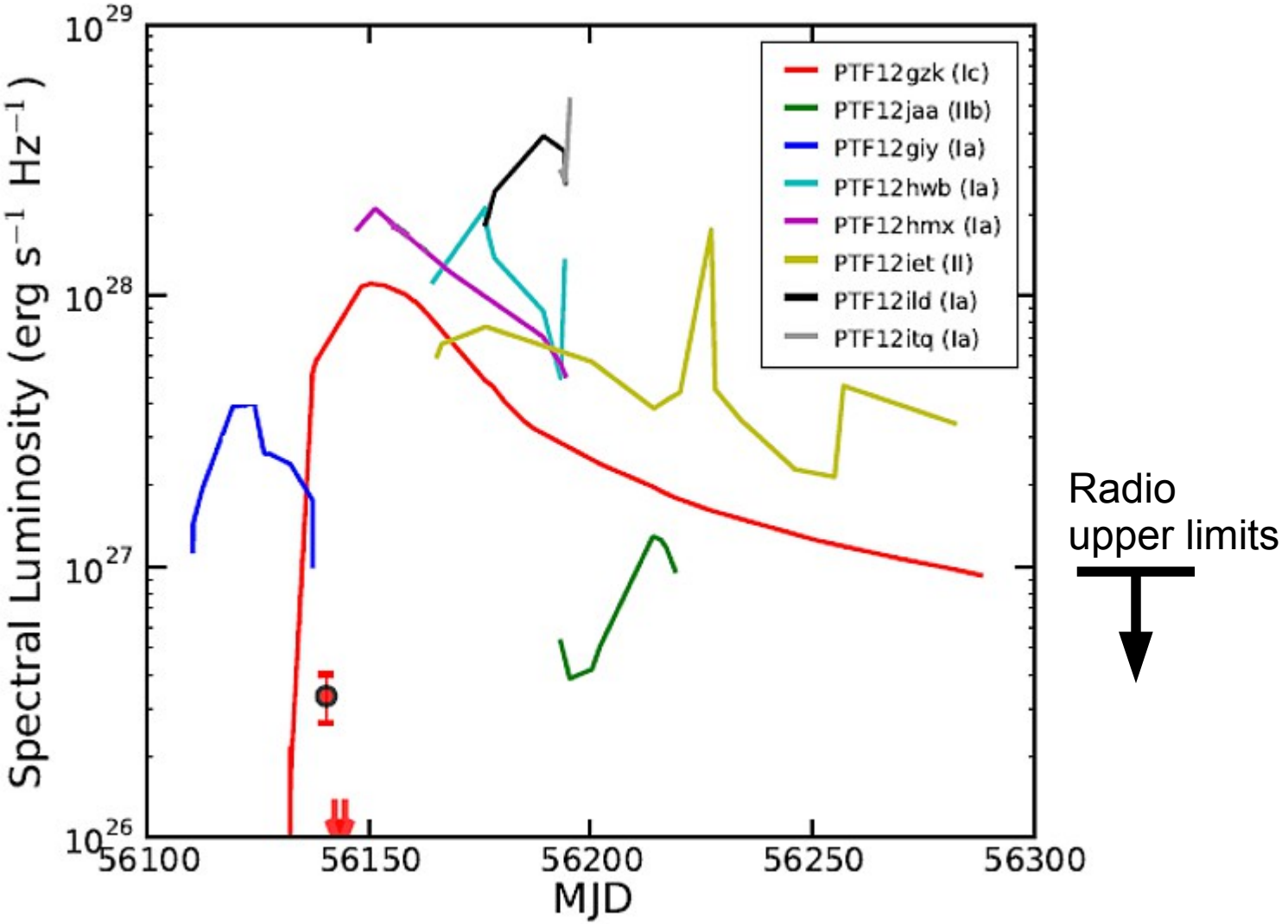
Extragalactic Explosions?



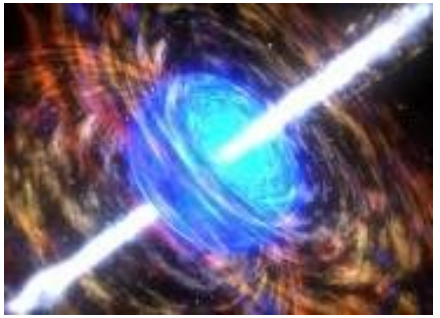




Optical Explosive Transients



Short Summary



We have a basic understanding of radio-optical.

MeerKAT-MeerLICHT will be interesting.

More joint experiments planned with ZTF

Need to gear up for SKA-LSST