The Prototype All-Sky Imager (PASI)

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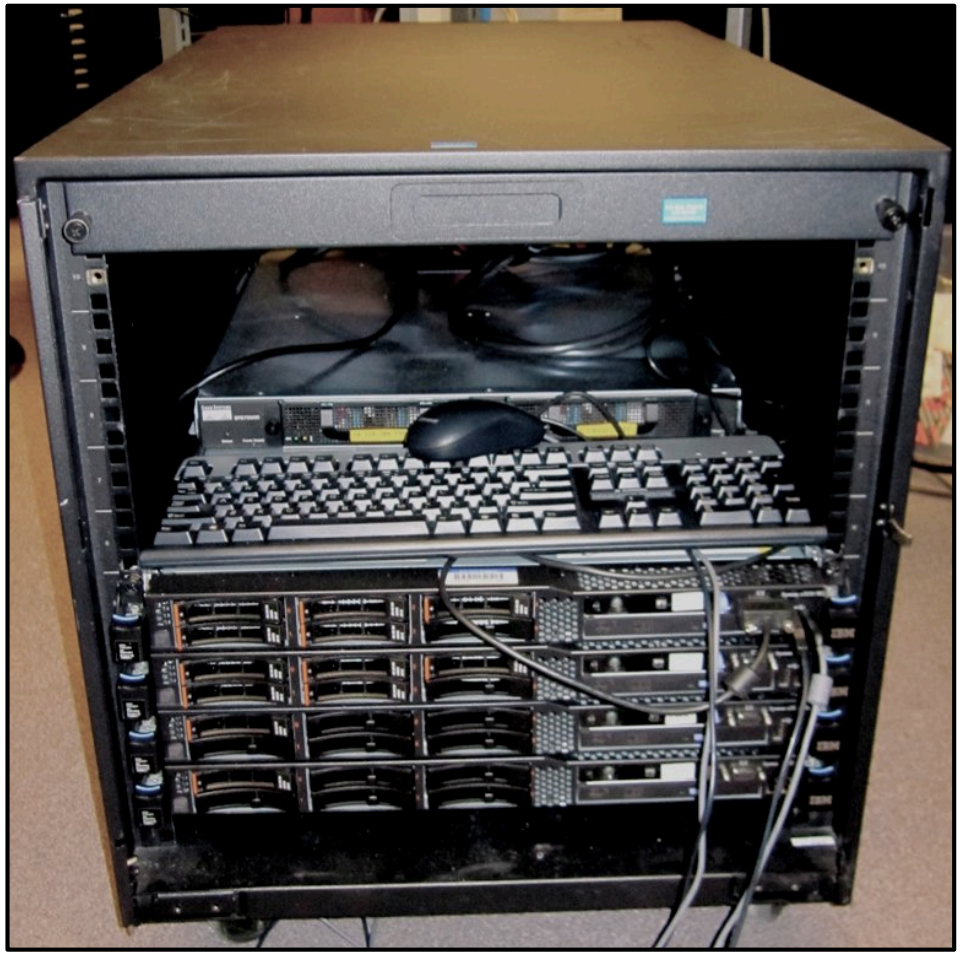
The Prototype All-Sky Imager (PASI)

- A backend to the LWA1's digital processor, to be located in the RFI shelter
- Receives the TBN data stream: continuous 100 kSPS data from all the dipoles
- Using a software FX correlator, PASI will image the entire sky (≈1.5 π sr) *many times per minute* to a few Jy
- This is a virtually unexplored region of transient phase space! (radio frequency, sky coverage, imaging cadence, uptime)

PASI hardware



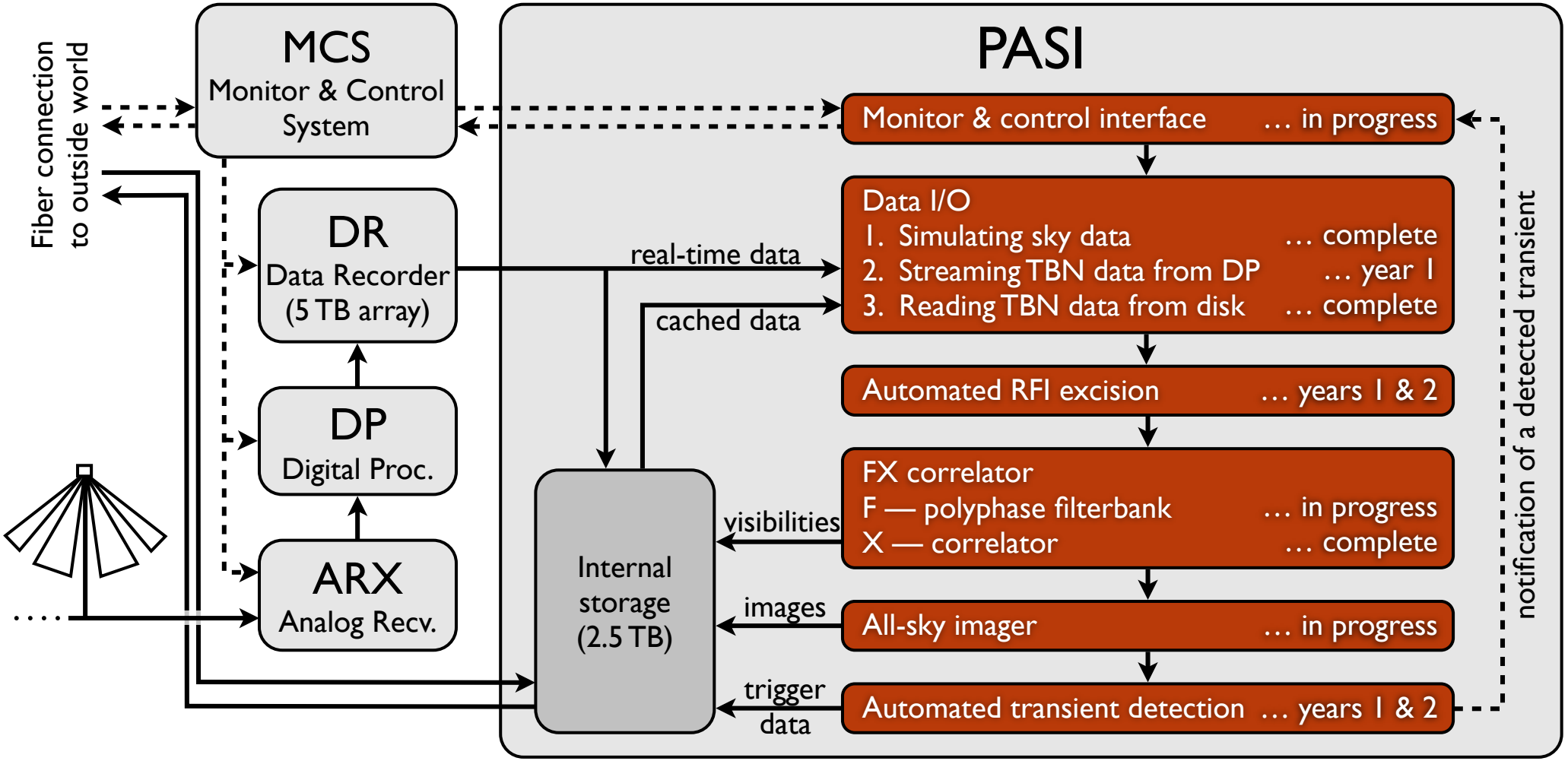
An additional backend, to be located in the RFI shelter

- 4 × 8 × 2.93 GHz Nehalem cores
- Infiniband switch
- 10 GbE port(s)
- Provided by LANL

Plan to move the cluster to the shelter this summer

LWA
Long Wavelength Array

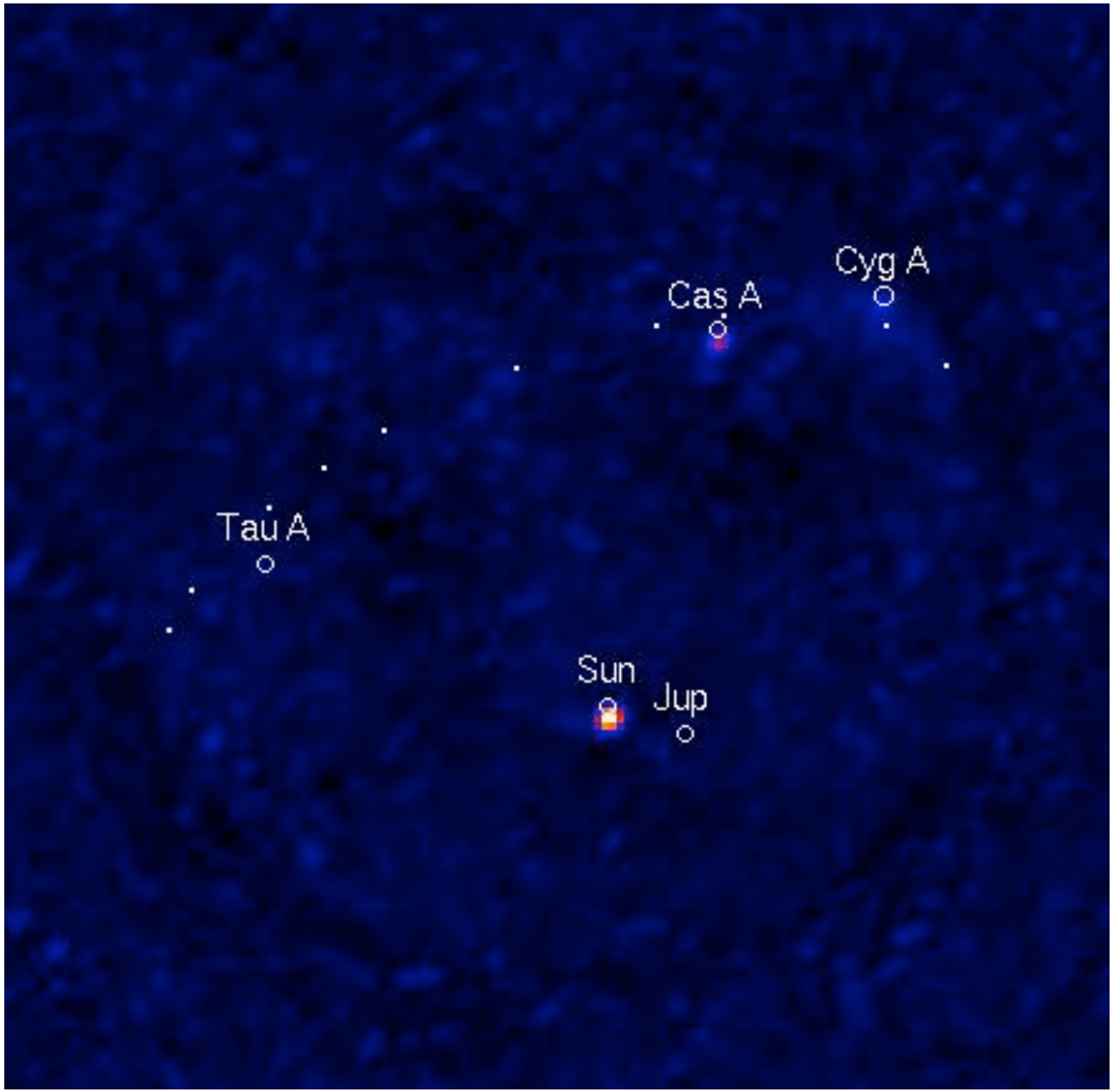
PasiFX software correlator and imager



Look-back time: 10–20 hr for raw data
weeks for visibilities
images kept forever

LWA
Long Wavelength Array

Recently began imaging



April 21

77 MHz, 80 kHz BW
30 s integration
175 stands

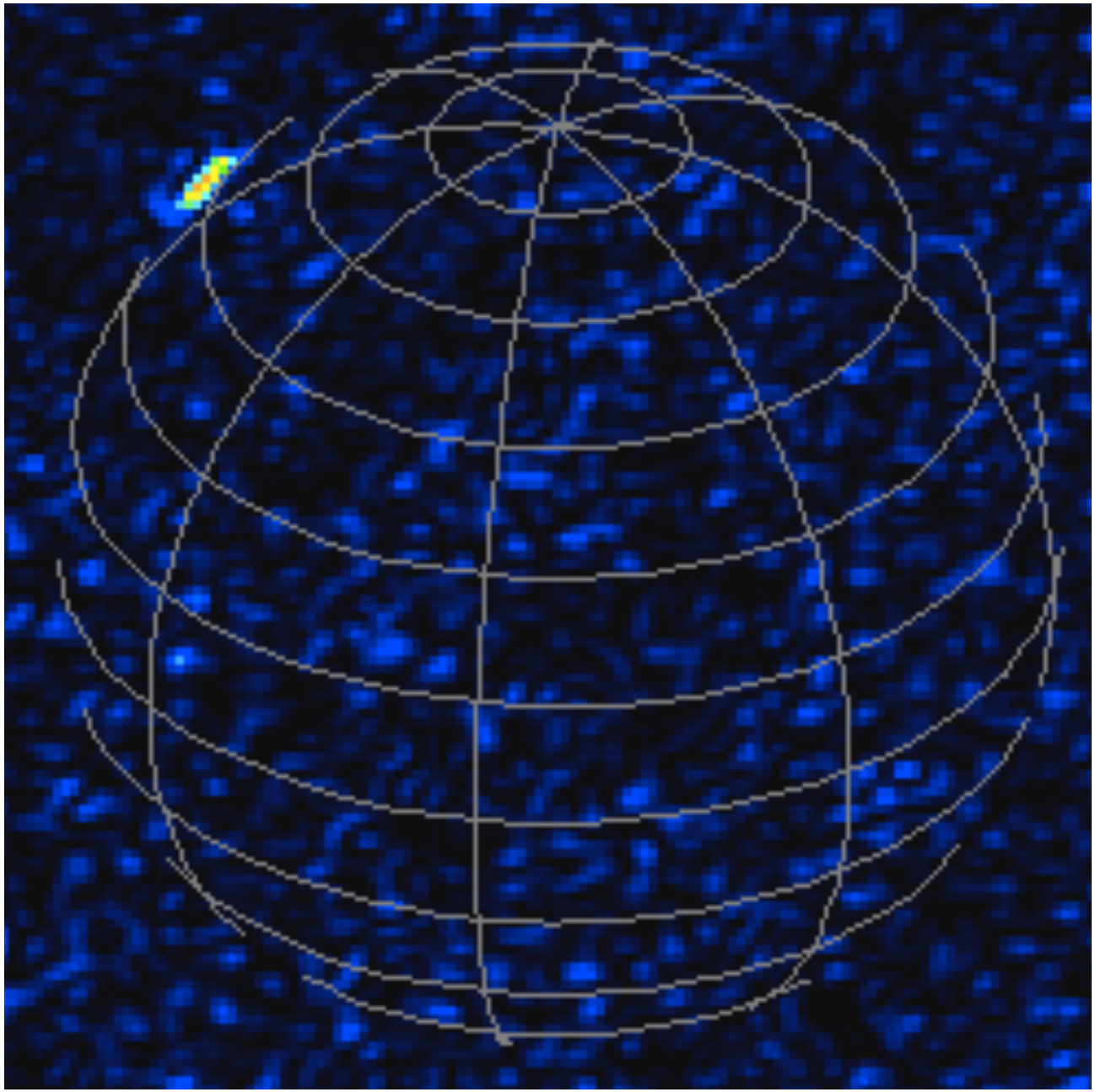
Dirty image (quite!)

Full Stokes

Imaged using PasiFX and CASA in ~20 s

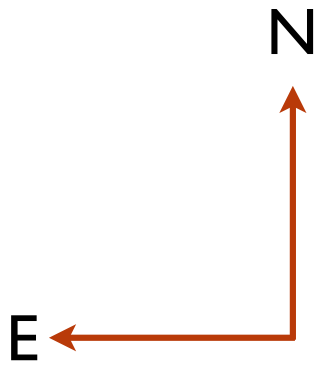
LWA
Long Wavelength Array

Recently began imaging



April 27

77 MHz, 80 kHz BW
30 s integration
175 stands



LWA
Long Wavelength Array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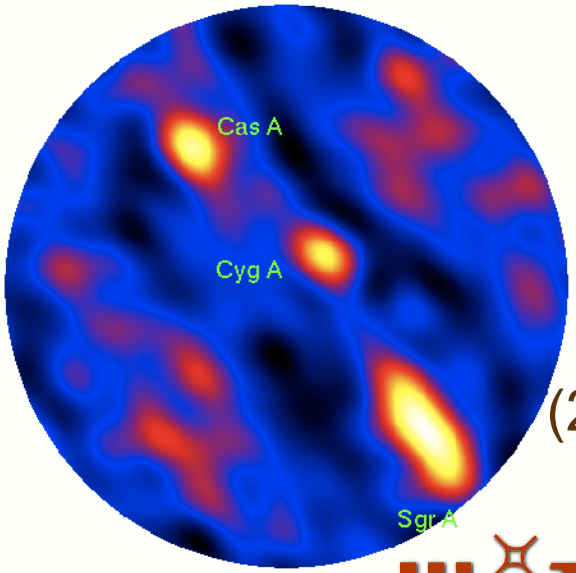
Sensitivity

- Confusion limit is 25 Jy/beam at 74 MHz, but this limit is dominated by constant sources
- Search strategies:
  - + Image differencing
  - + Comparison of point sources (as returned by CLEAN)
  - + Searching for polarization
- Noise limits for 74 MHz frequency, 80 kHz bandwidth —
  10 s integration: 2 Jy/beam
  2 hr integration: 100 mJy/beam
- Few comparable studies:
  LWDA transient search (106 hr)
  had a noise level of 500 Jy/beam



Lazio et al. (2010)

LWA
Long Wavelength Array

Comparison with LOFAR monitoring

	LWA1 PASI	LOFAR RSM
technique	correlator	24 beams
integration	5 s	5 s
frequency	75 MHz	75 MHz
bandwidth	80 kHz	4 MHz
field size	16,000 deg^2	420 deg^2
resolution	2º	8’
sensitivity	5 Jy	0.1 Jy
RFI risk	lower	higher

(Fender et al. 2006)

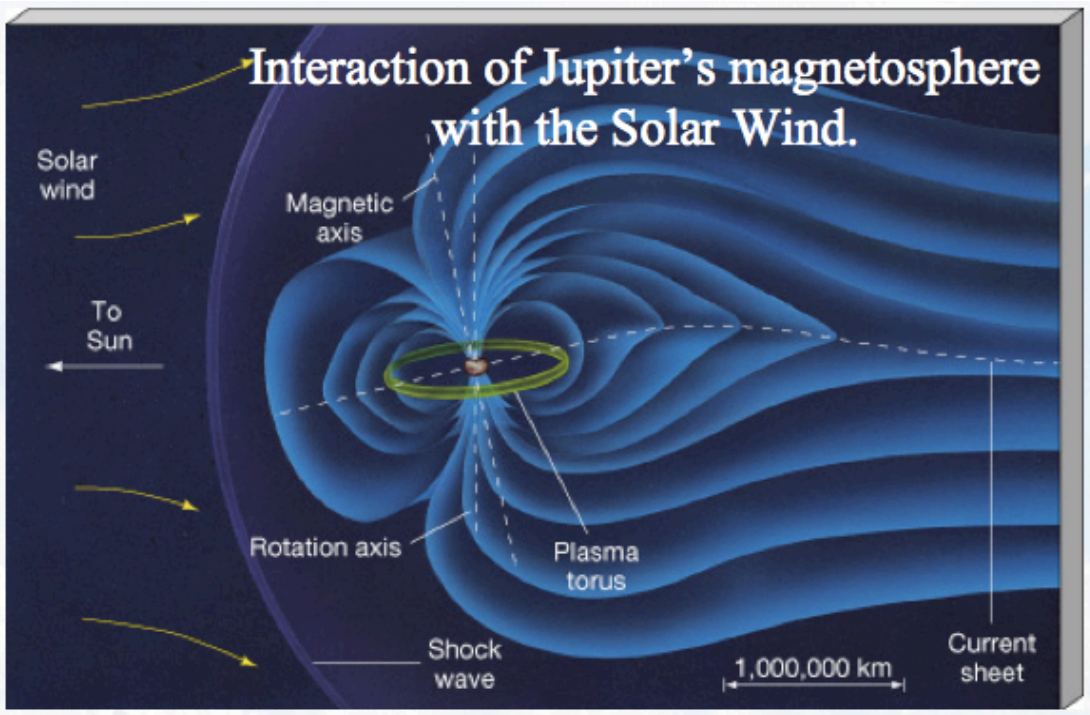
complementary approaches!

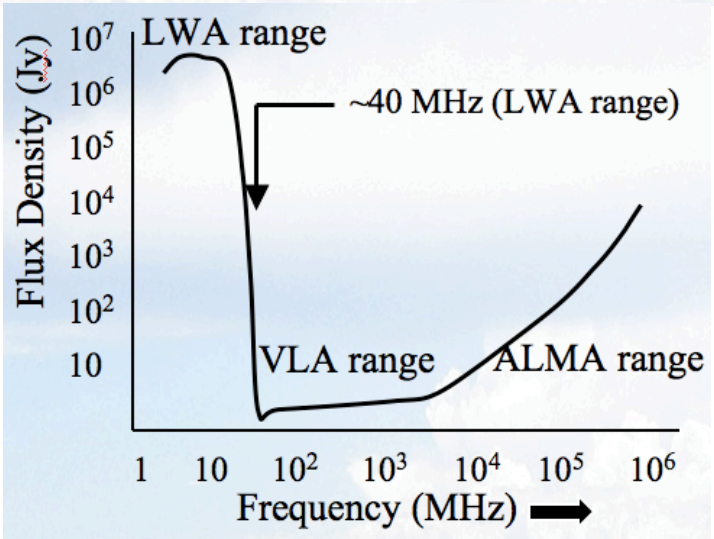
LWA
Long Wavelength Array

Science targets

Transients that are BRIGHT and RARE:

- Bright flares from Hot Jupiters
- Giant flares from magnetars
- Rotating radio transients (RRATs)
- Prompt GRB emission
- The unknown …





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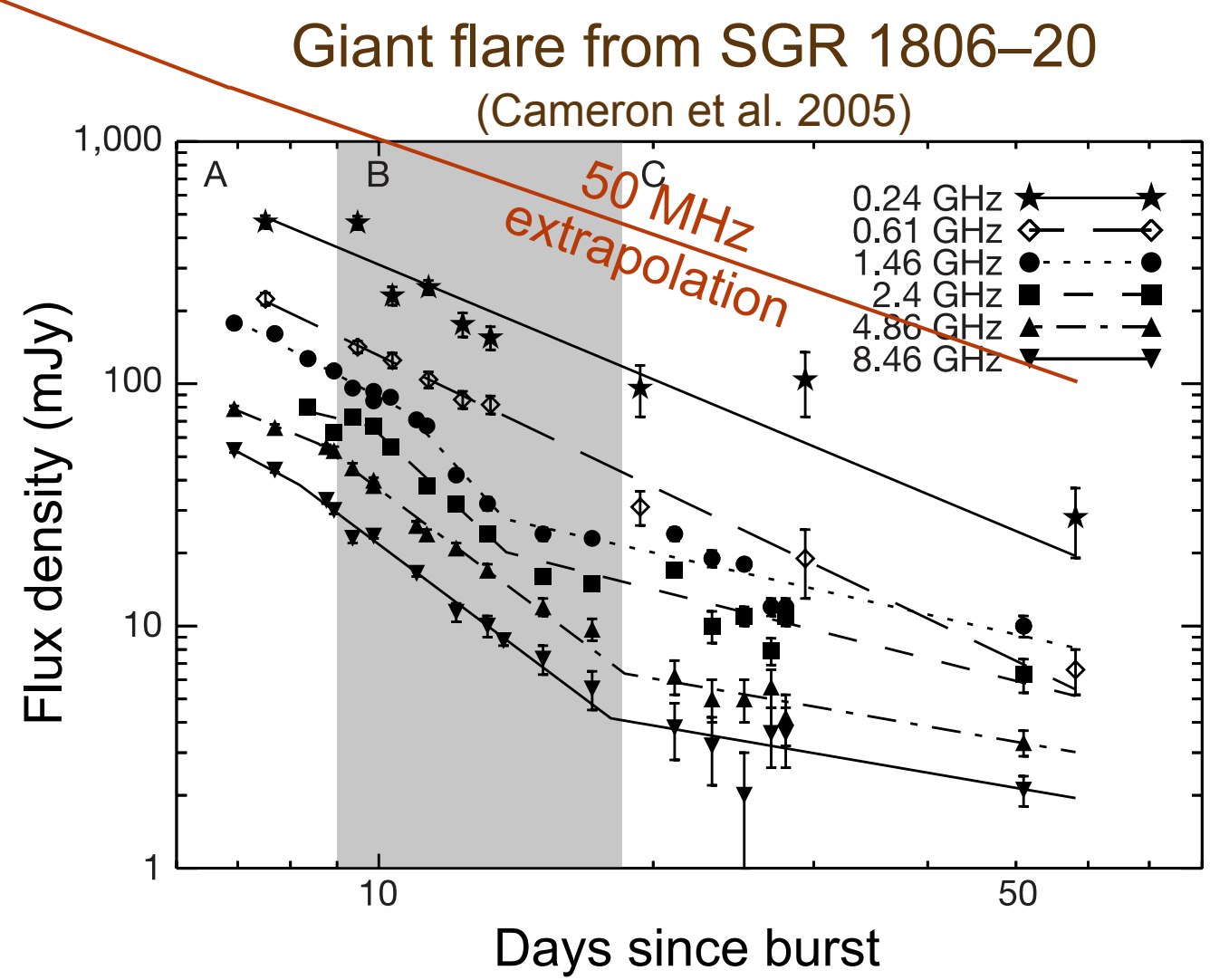

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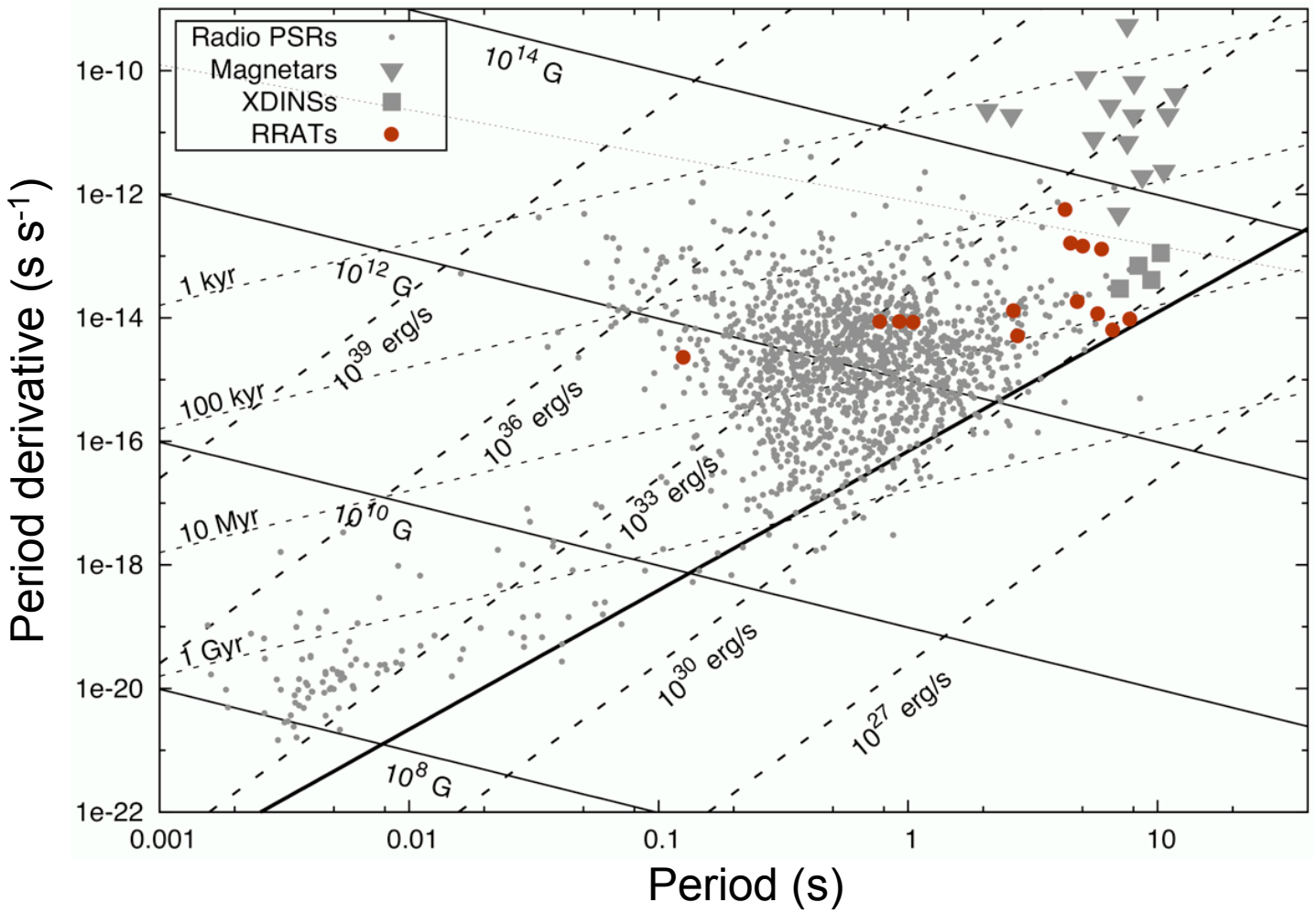
RRATs on the P–$\dot{P}$ diagram

(Keane et al. 2011)



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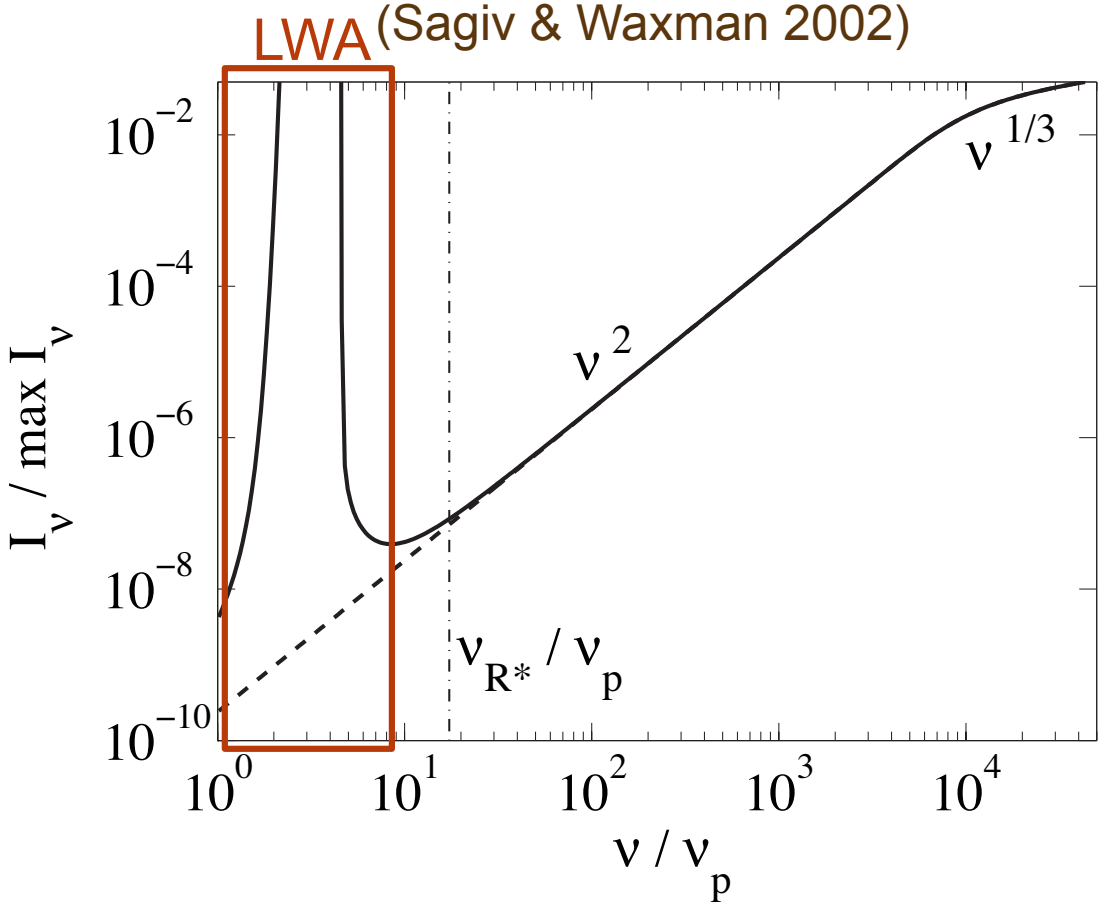
Circularly polarized synchrotron maser emission from GRB shock (Sagiv & Waxman 2002)



(Typical plasma frequency: $\nu_p \sim 10^7$ Hz)

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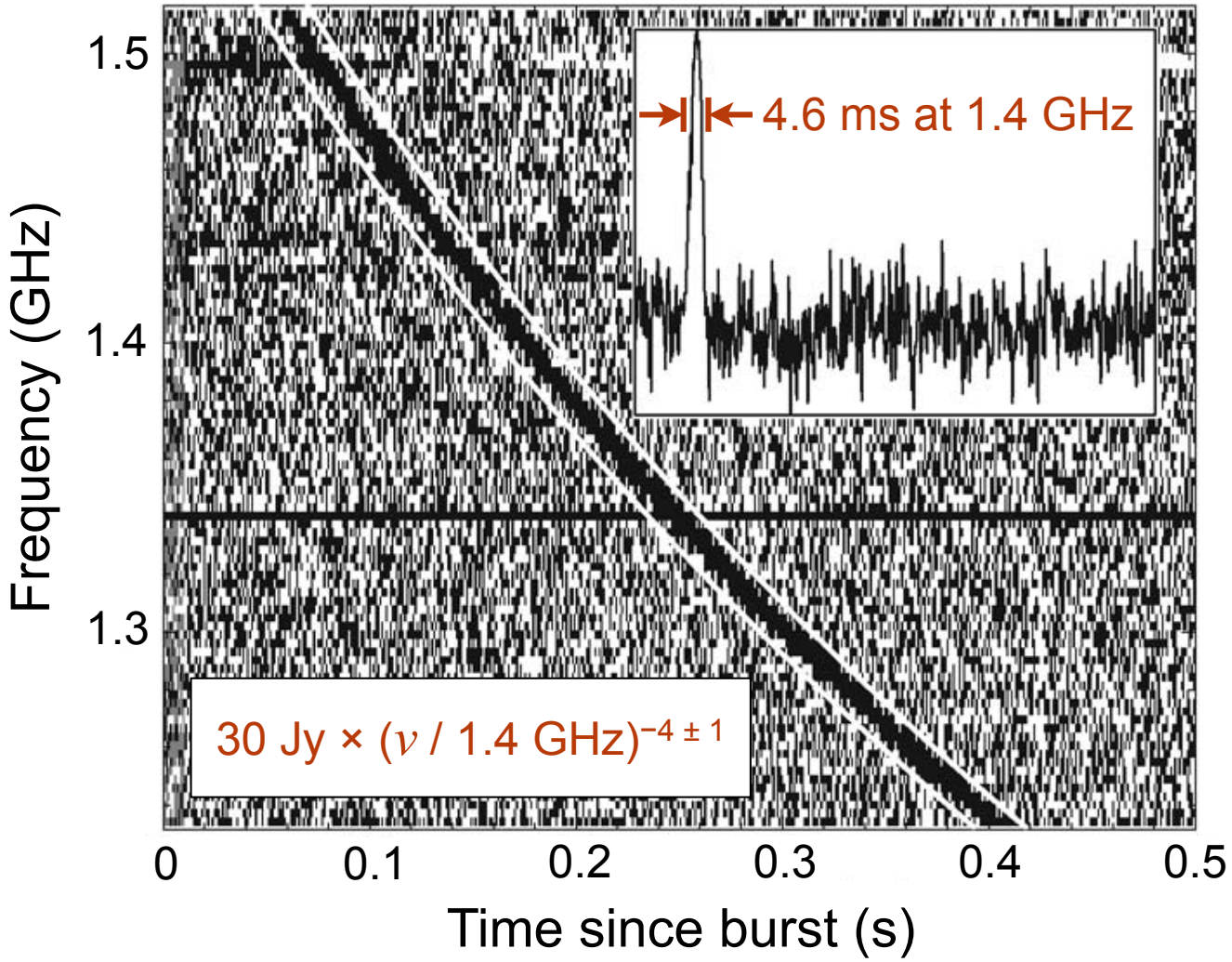
Lorimer bursts?
(Lorimer et al. 2007)



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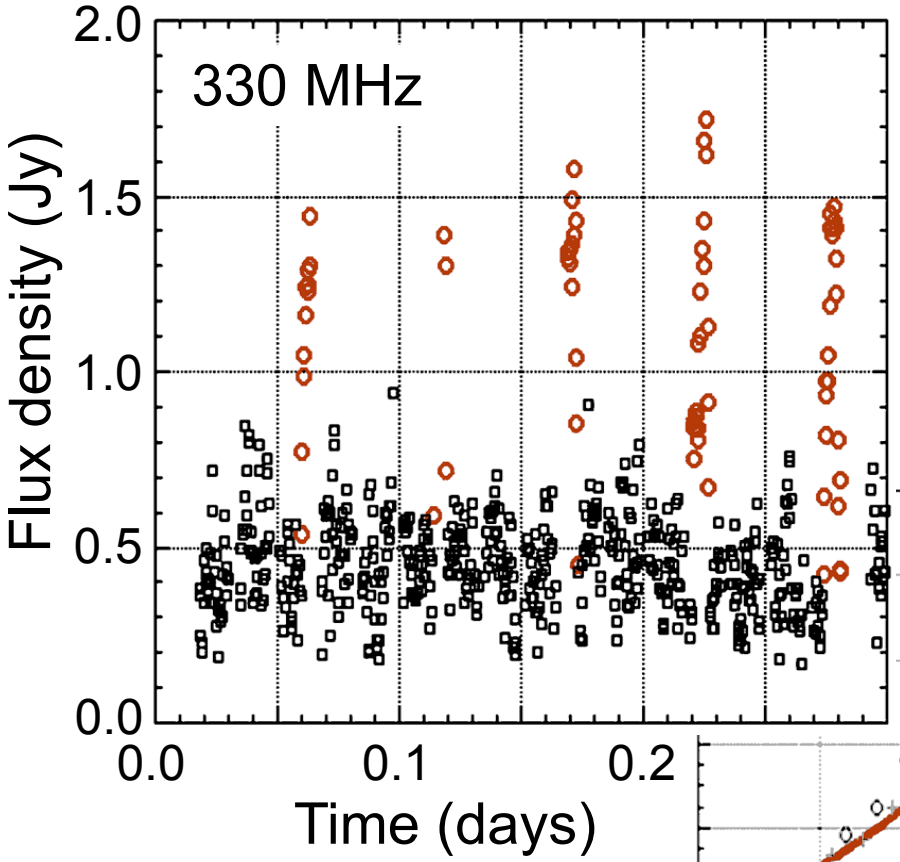
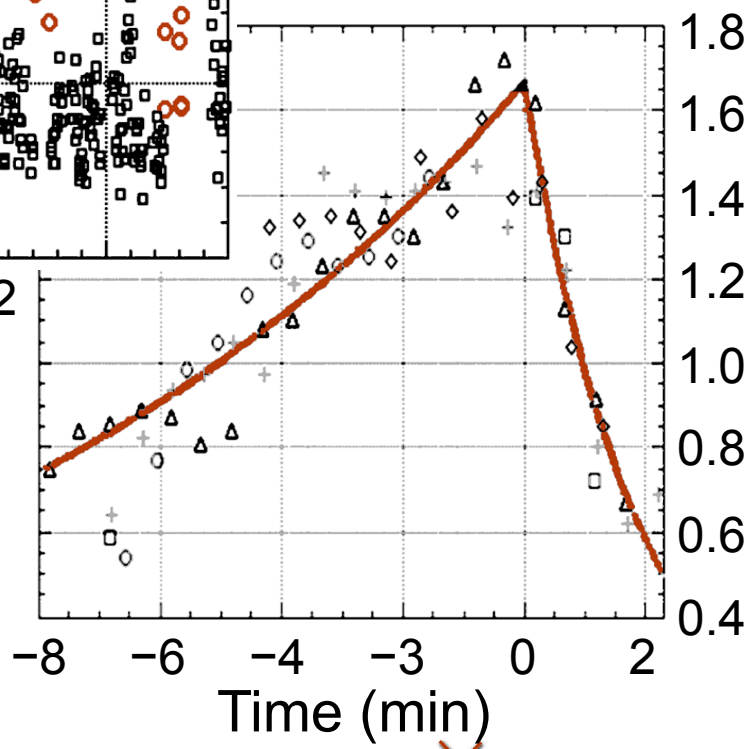


Galactic Center Radio Transient J1745−3009
(Hyman et al. 2005)



Highly polarized!
(Roy et al. 2010)

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Summary

- Will open up a radically new region of transient phase space, imaging the entire sky at Jy level, many times per minute
- Will provide “look back” capabilities for GRB follow-up, etc.
- Ultimately will generate our own transient alerts
- Software development in progress; first animations of the sky expected soon!