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OCRA: the One Centimetre Receiver Array

Mike Peel
Jodrell Bank Centre for Astrophysics, University of Manchester

On behalf of the OCRA collaboration

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Collaboration

- **Torun Centre for Astronomy**
  Roman Feiler, Dr Marcin Gawronski, Dr Bartosz Lew, Prof. Andrzej Kus, Bogna Pazderska, Eugeniusz Pazderski, Dr Boud Roukema

- **University of Bristol**
  Abdulaziz Alareedh, Prof. Mark Birkinshaw, (Dr Katy Lancaster)

- **University of Manchester**
  Dr Richard Battye, Prof. Ian Browne, Prof. Richard Davis, Dr Mike Peel, Prof. Peter Wilkinson, (Dr Stuart Lowe)

- **Jodrell Bank Observatory (engineering)**
  Colin Baines, Eddie Blackhurst, John Edgley, Dr Danielle Kettle, John Kitching, Don Lawson, Jason Marshall, Neil Roddis, Frank Winder

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OCRA

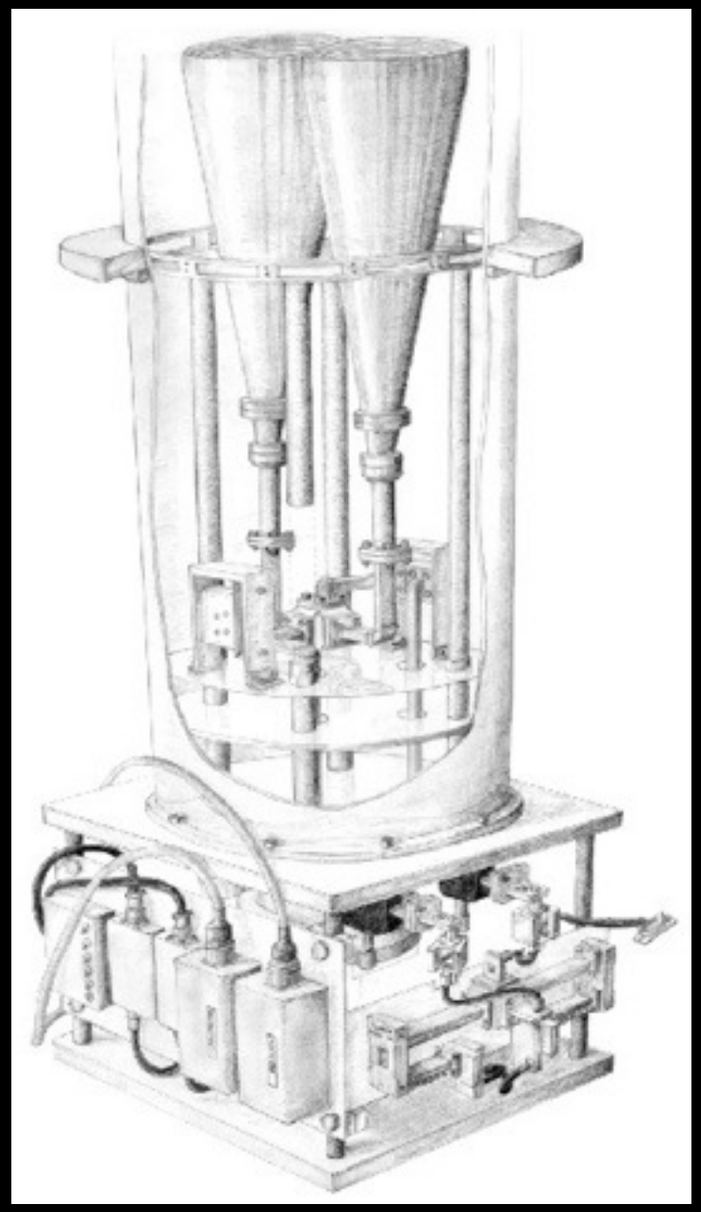

Image credit: S. Lowe

Image credit: M. Peel

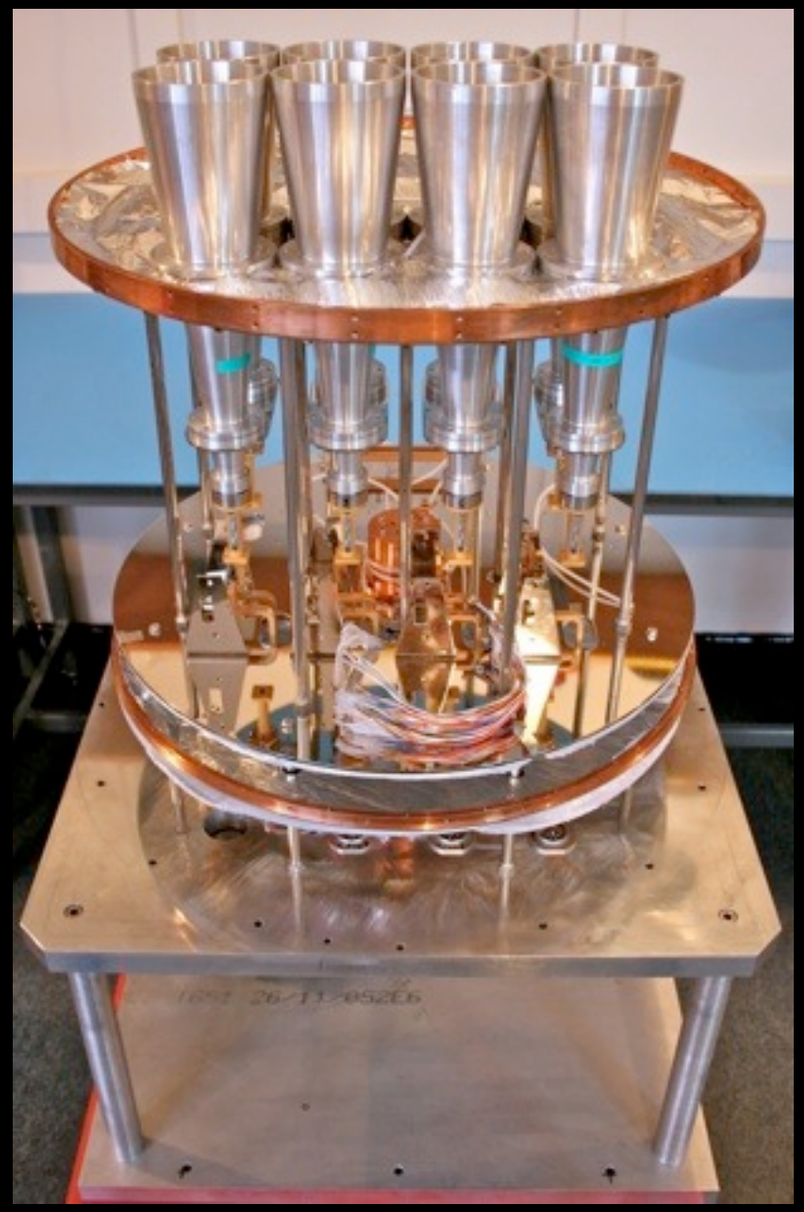

Image credit: M. Peel

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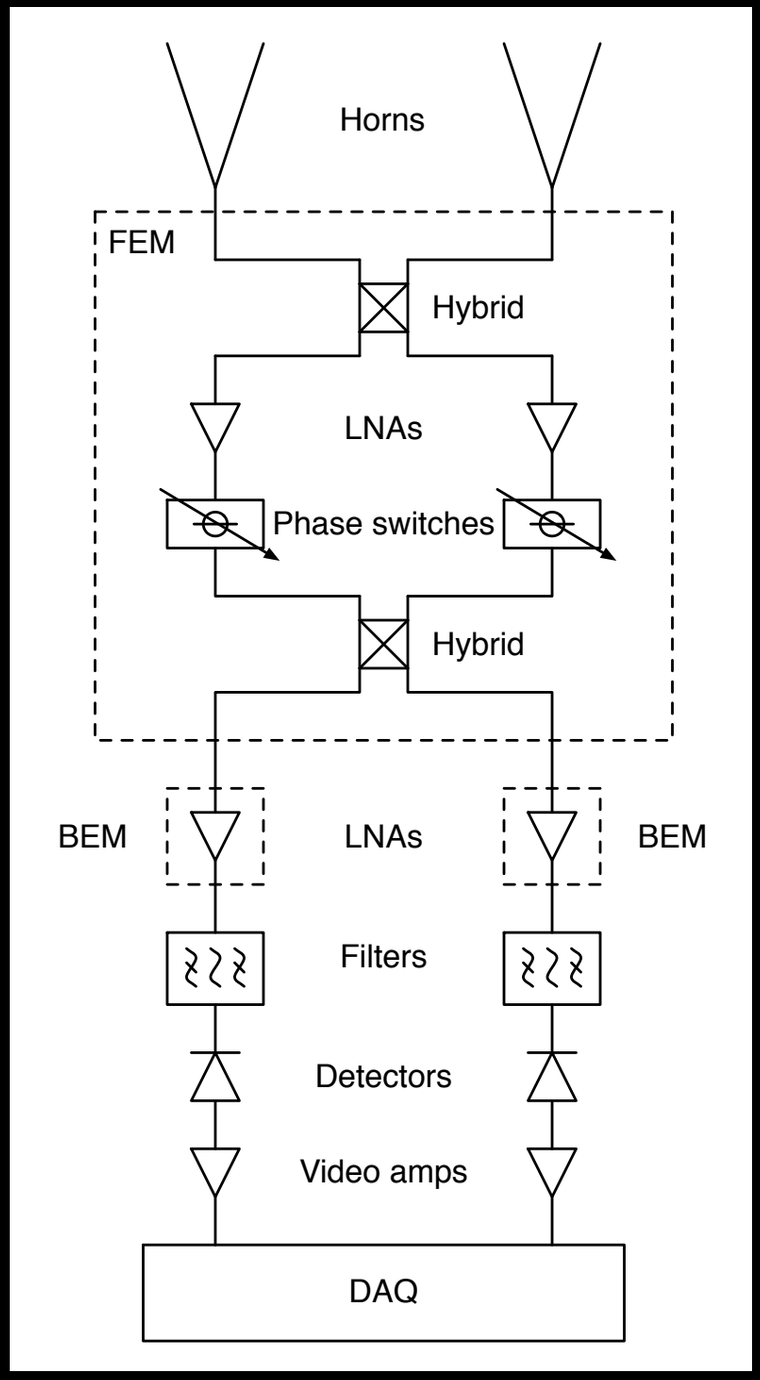
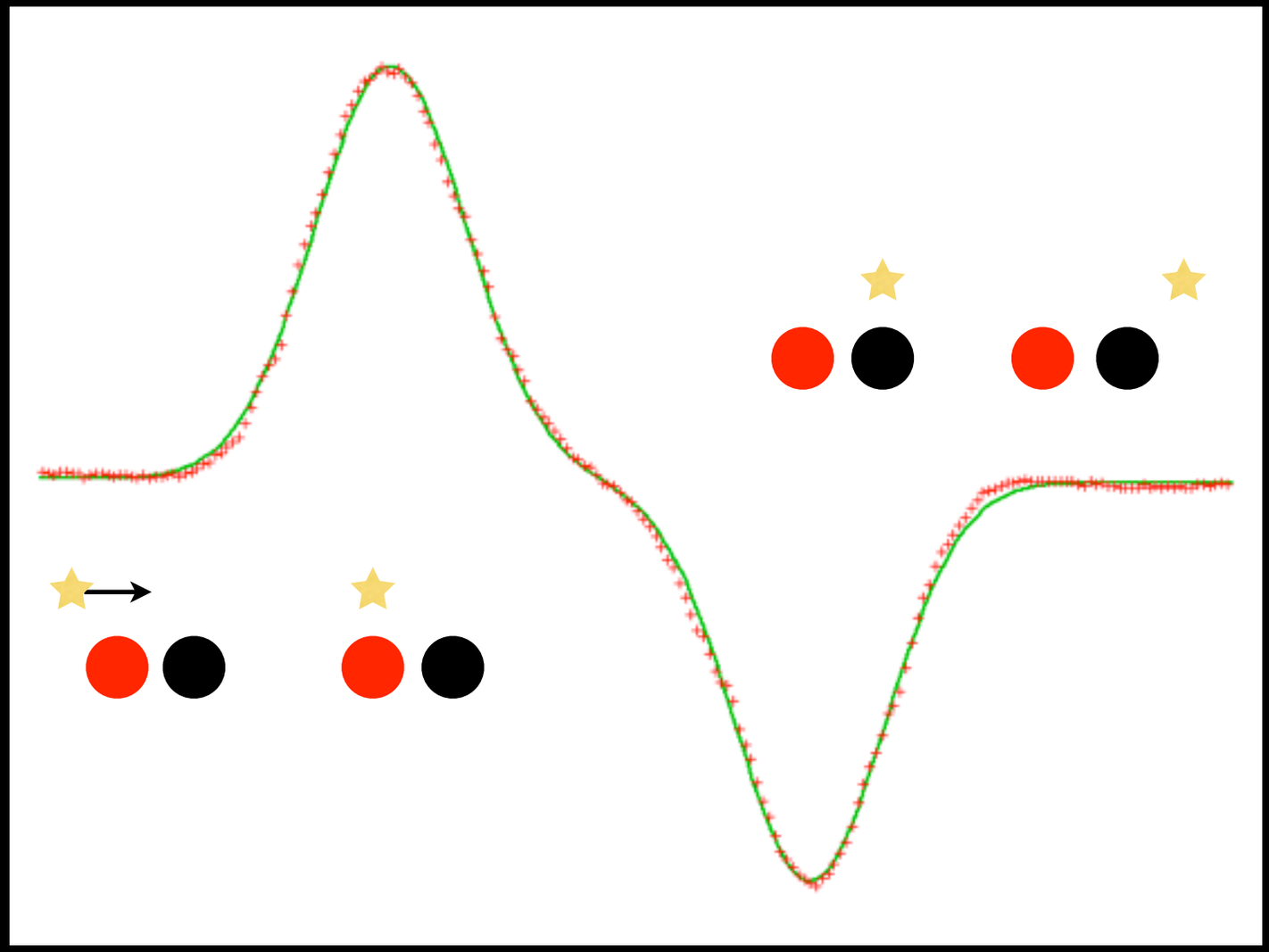
OCRA observations





Cross-scans of strong sources
(over 150 mJy)

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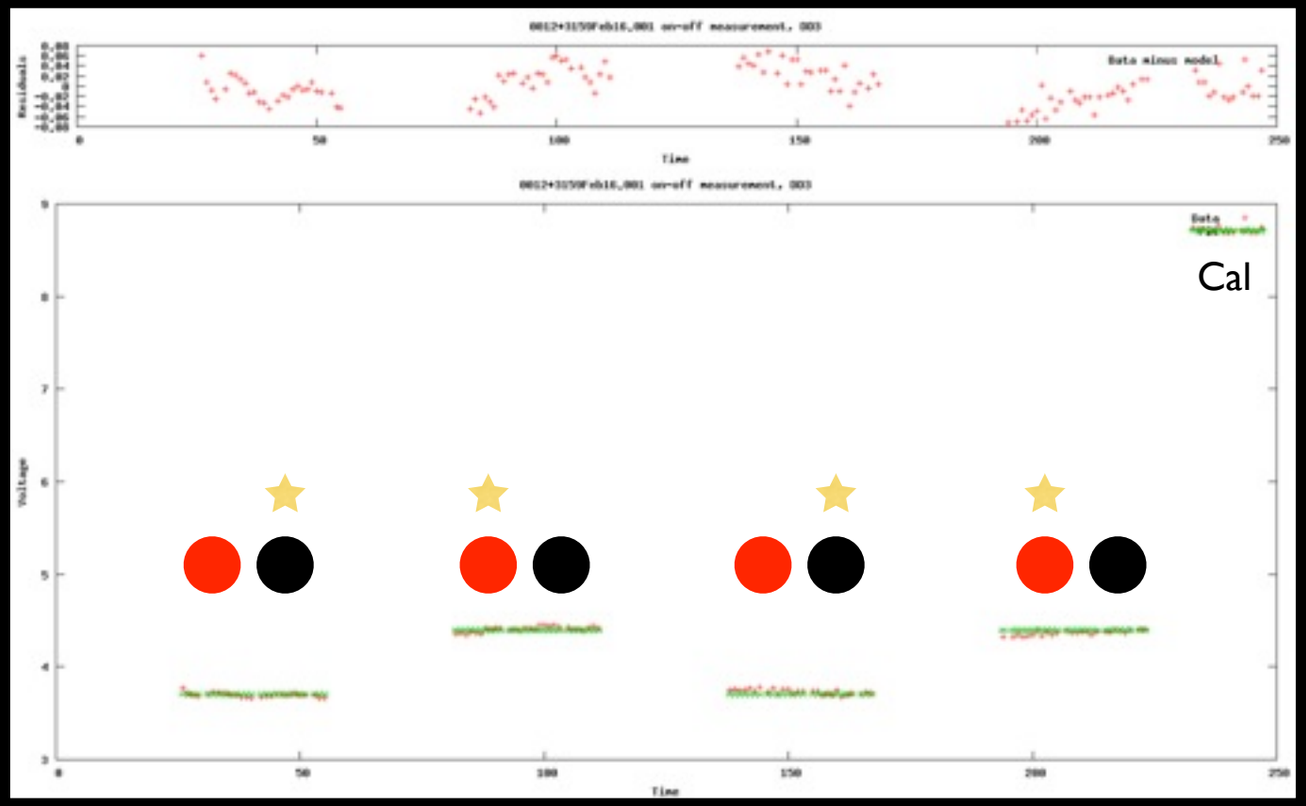
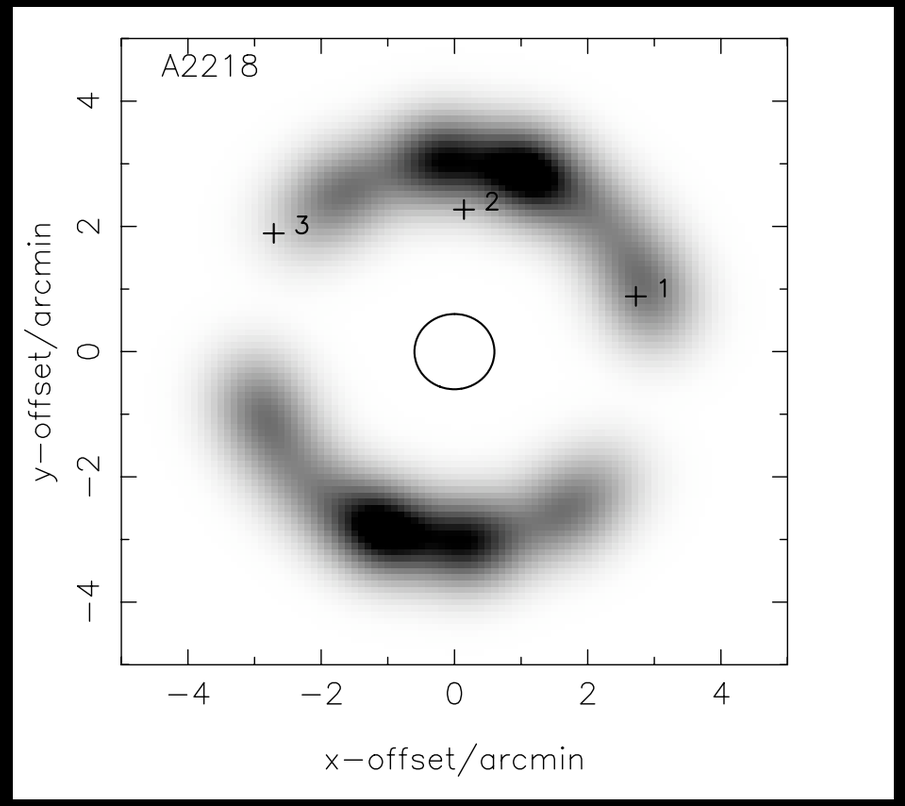


On-offs of weak sources
(3-150mJy)



Integration on SZ sources
(0.2-3mJy)

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Radio source studies

- Strong sample (293 sources):
  Lowe *et al.* **(2007)**, A&A, 474, 673, arXiv:0707.3368
  "30 GHz flux density measurements of the Caltech-Jodrell flat-spectrum sources with OCRA-p"

- Intermediate sample (605 sources at north Ecliptic pole):
  Peel *et al.* **(2011)**, MNRAS, 410, 2690, arXiv:1007.5242
  "One Centimetre Receiver Array-prototype observations of the CRATES sources at 30 GHz"

- Weak sample (121 sources; 57 > 5mJy - AMI 15GHz selection):
  Gawronski *et al.* **(2010)**, MNRAS, 406, 1853, arXiv:0909.1189
  "30 GHz observations of sources in the Very Small Array fields"

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Radio source studies

- No unexpected source population found at 30GHz
- 30GHz 10mJy source density 2.2 ± 0.4 deg^{-2}
- Fewer flat spectrum sources at low 30GHz flux density (more steep spectrum)
- Number of GPS sources identified
  - 42 in CJF sample
  - 38 + 29 possibles in CRATES sample
- Variable sources (J1849+6705, J1852+4855, J2006+6424 increased more than a factor of 2; J0954+7435 down by factor of 7)
- Clear Eddington bias in WMAP source catalogue
- Strong Gamma ray-Radio correlation (best to date?)

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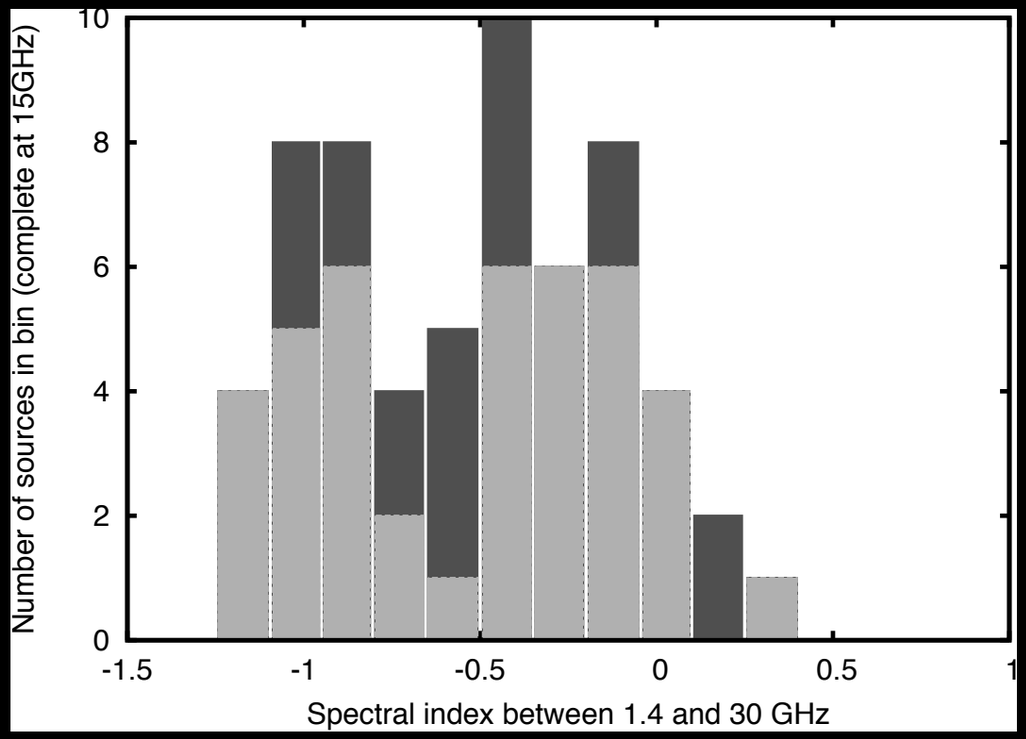
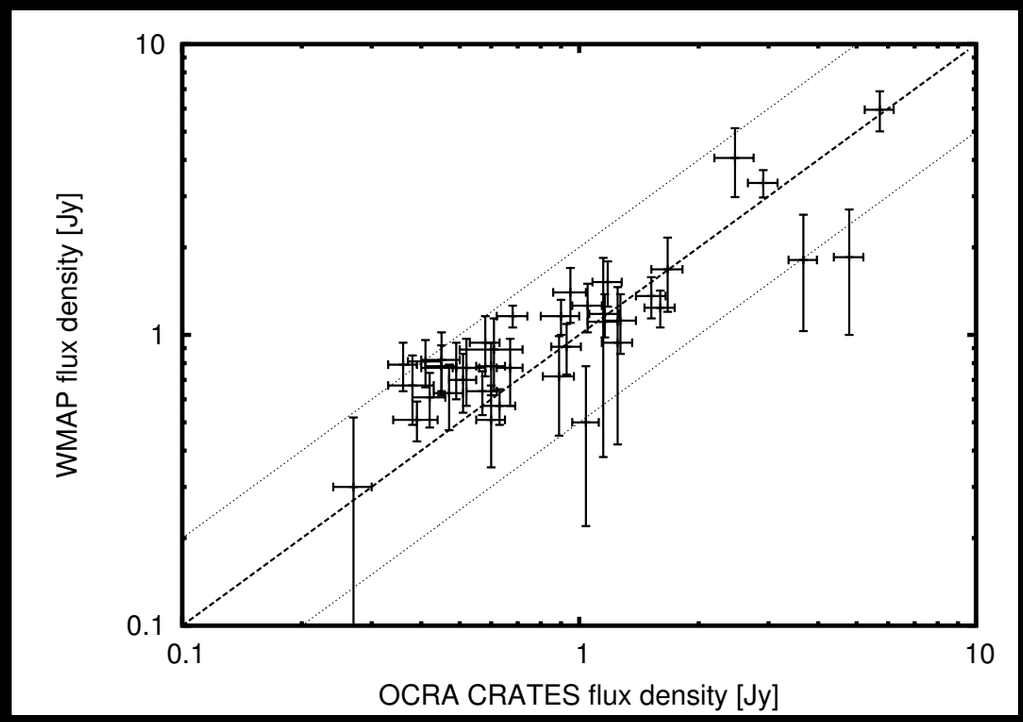
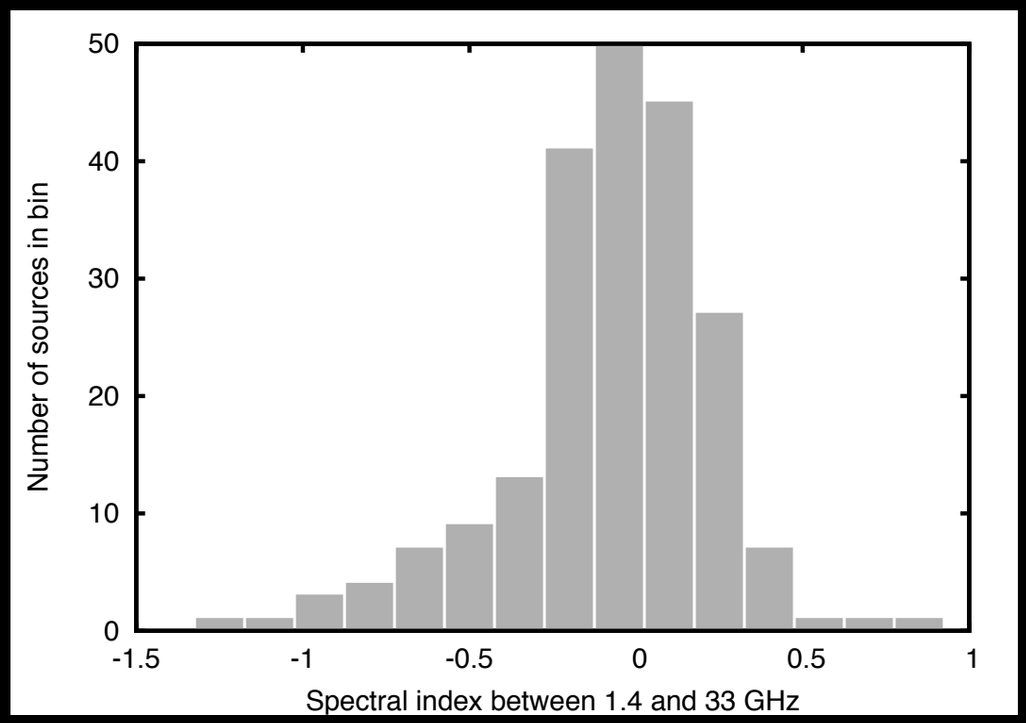
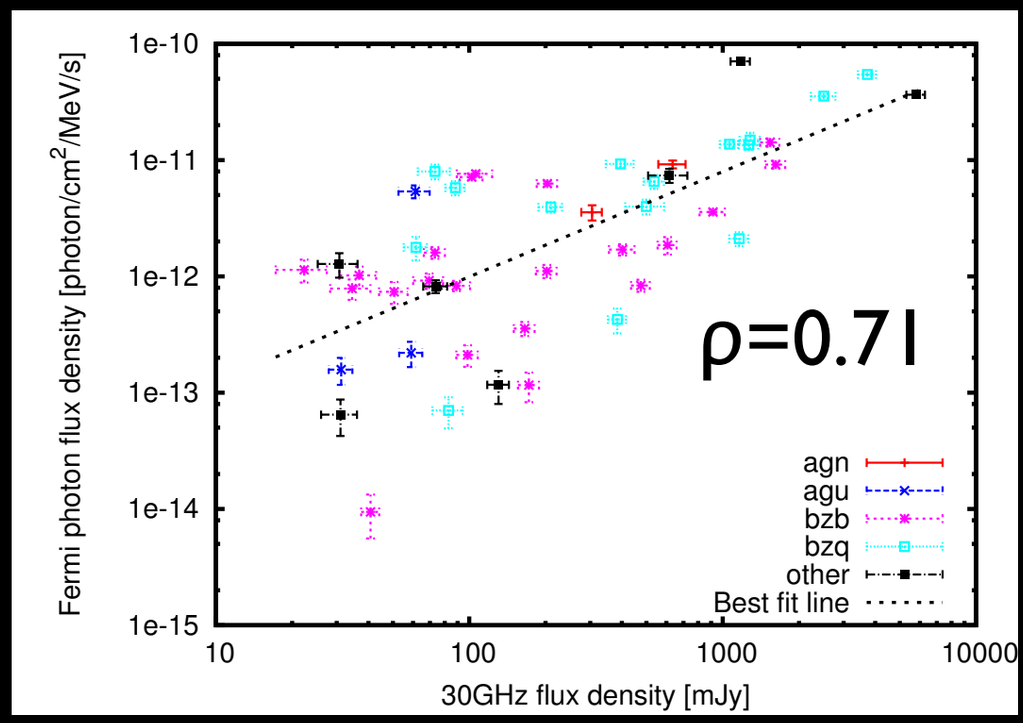
Radio source studies









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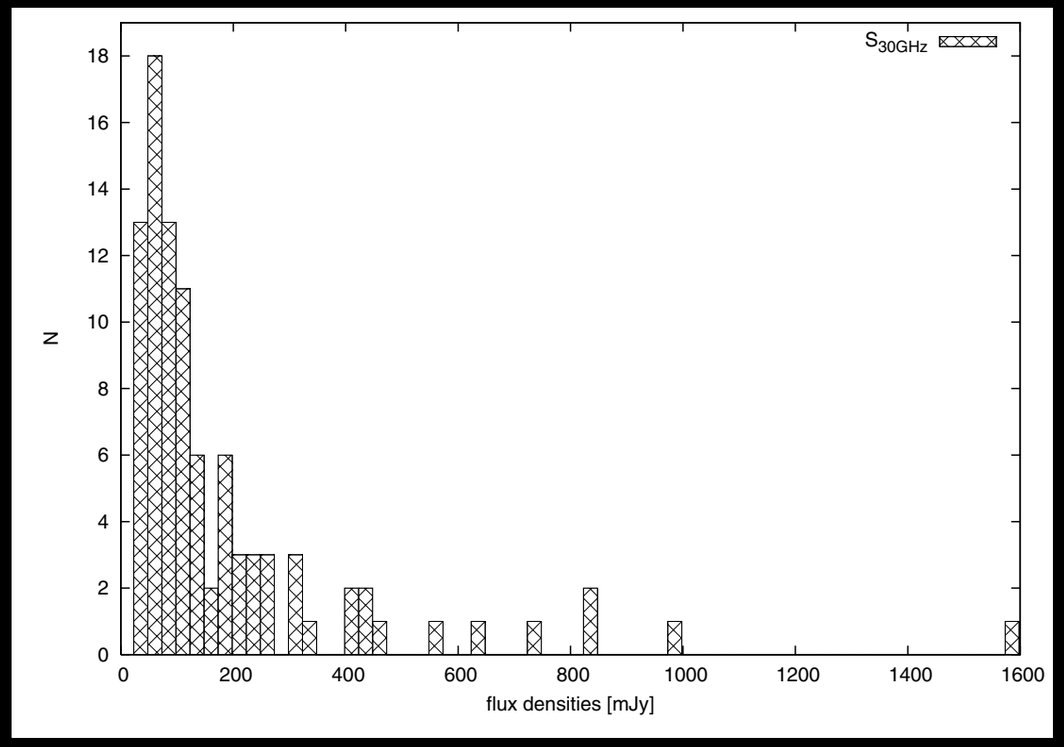
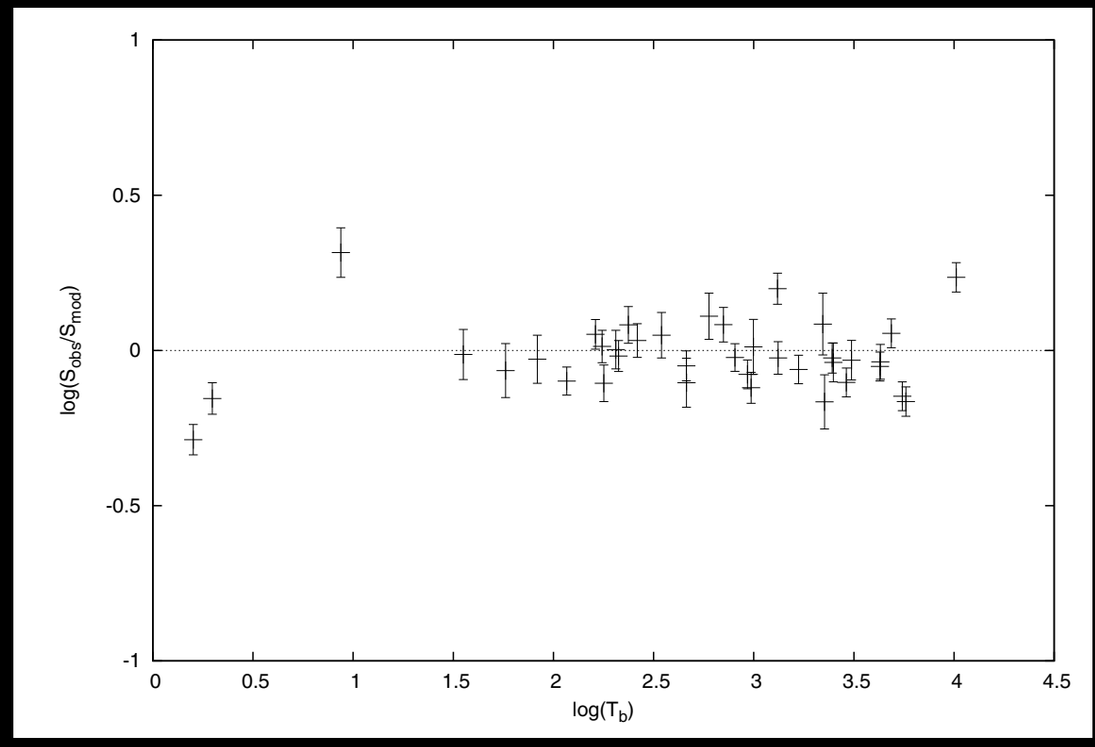
Planetary nebulæ

- **Pazderska** *et al.* **(2009)**, A&A, 498, 463, arXiv:0902.3945
  "Survey of planetary nebulae at 30 GHz with OCRA-p"
- 442 PNes observed; 93 detected at 30GHz
- No evidence for anomalous microwave emission (AME)
  Only free-free emission needed to fit spectra to 30GHz
  (Subsample of 41 sources with sufficient ancillary data)





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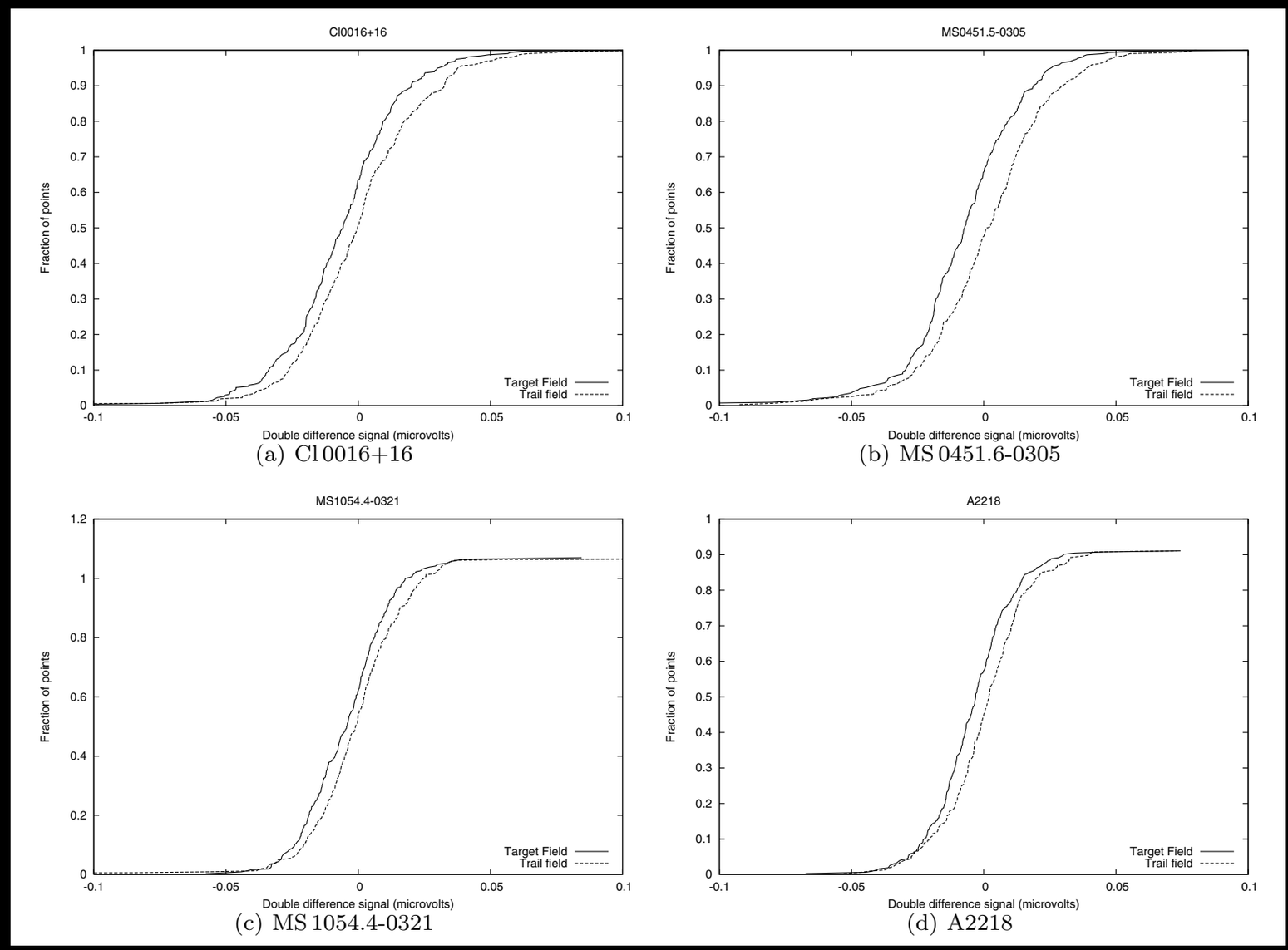
SZ observations

- **Lancaster** *et al.* **(2007)**, MNRAS, 378, 673, arXiv:0705.3336 "Preliminary Sunyaev-Zel'dovich observations of galaxy clusters with OCRA-p"
- Observations of 4 clusters: CL0016, MS0541 MS1054, A2218
- All detected at 4-6σ level in 10.5-13.5 hours



(a) Cl 0016+16 (b) MS 0451.6-0305 (c) MS 1054.4-0321 (d) A2218

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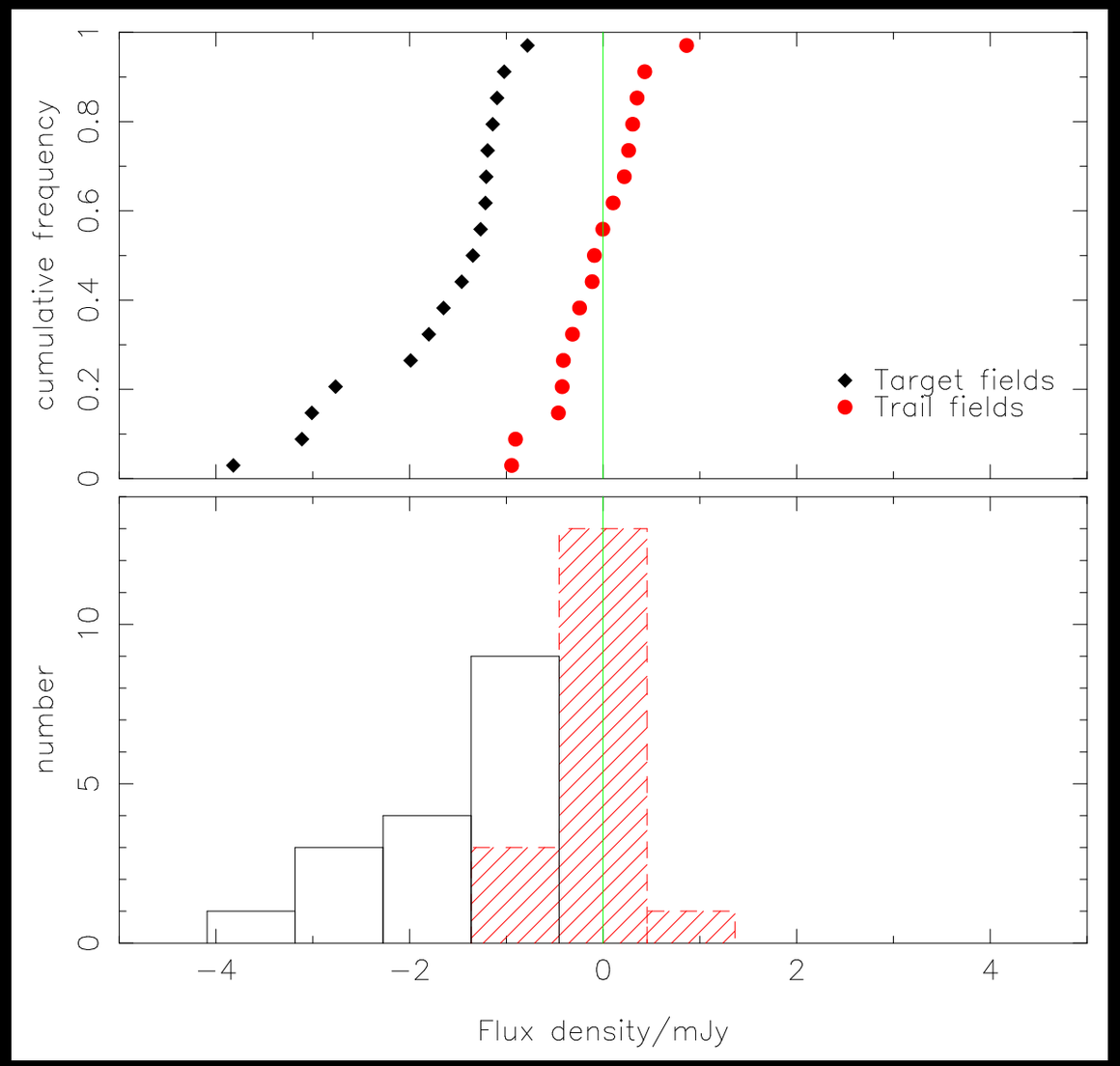
SZ observations

- **Lancaster** *et al.* **(2011)**, MNRAS (submitted)
  "Sunyaev Zel'dovich observations of a statistically complete sample of galaxy clusters with OCRA-p"

- 18 most X-ray luminous clusters at z>0.2 (ROSAT)
  13 detected at >3σ

- SZ-X-ray scaling relations in good agreement with self-similar models

- Sample will be extended to 33 clusters in future paper.



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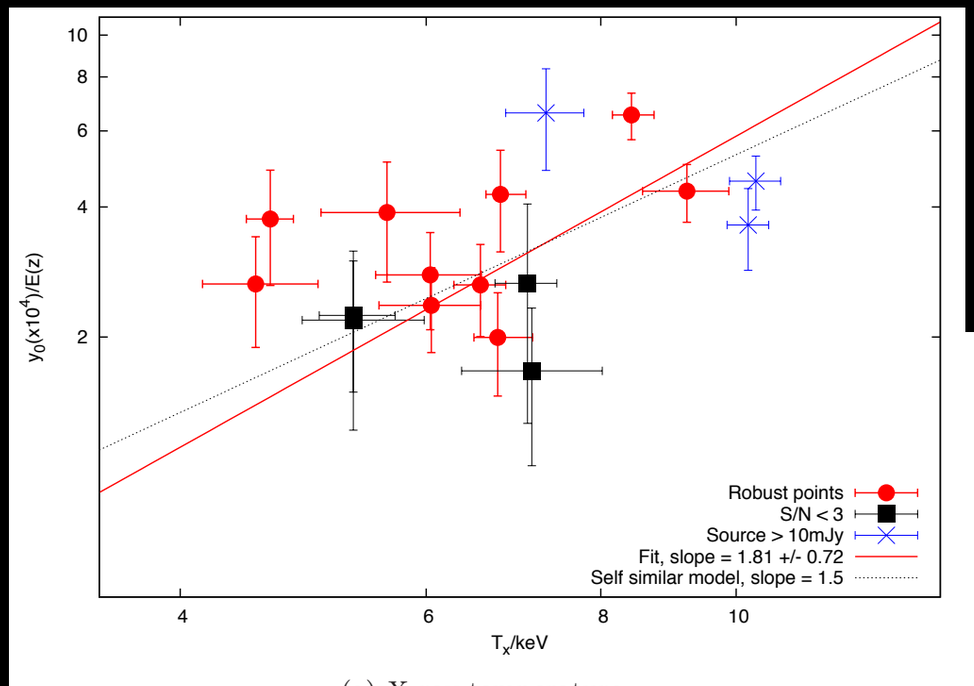
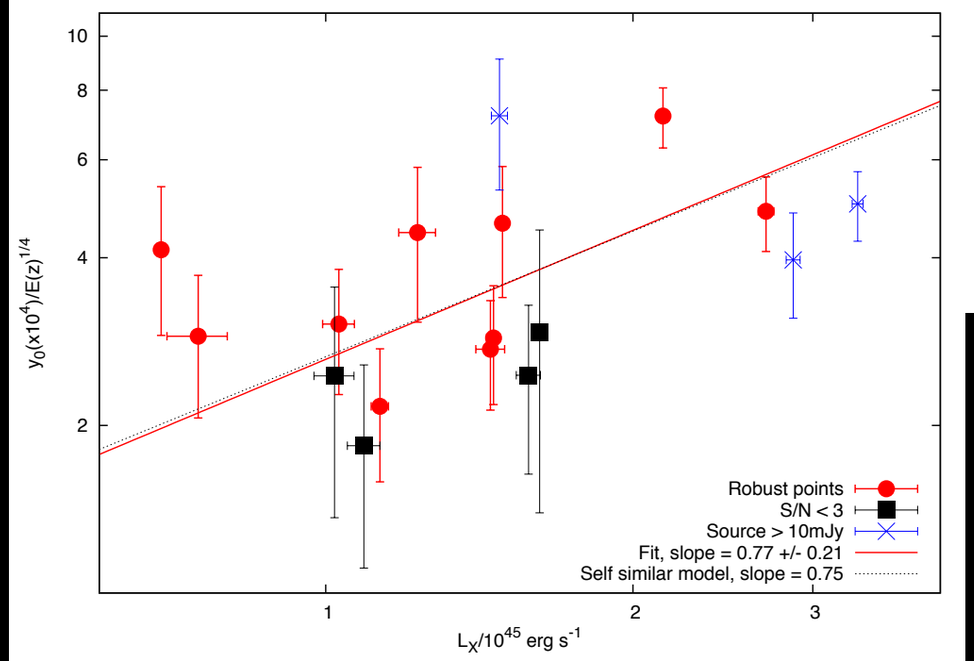
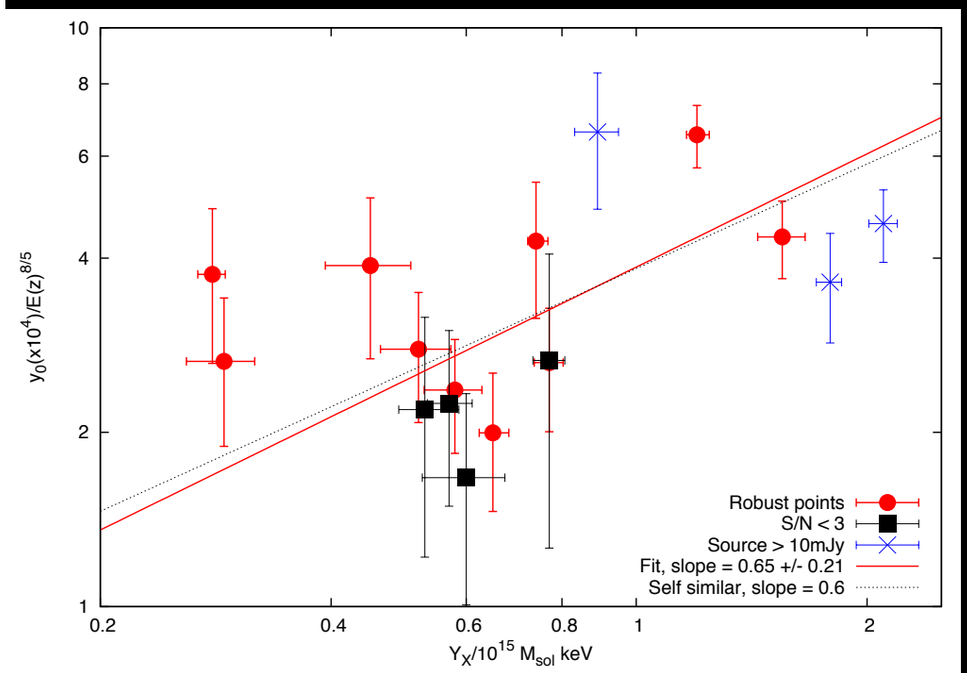


(a) X-ray temperature



(b) X-ray luminosity



(c) Y_X parameter

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Transient sources

- Eyers et al. (2009), MNRAS, 395, 1533
  "Double radio peak and non-thermal collimated ejecta in RS Ophiuchi following the 2006 outburst"
  Incorporating OCRA-p monitoring of RS Oph.

- ATels 2511 & 2905: "OCRA monitoring of V407 Cyg at 30GHz"
- Observed V407 Cyg from Apr-Oct 2010
  Peak at 50mJy in mid Jun
- V407 Cyg was interesting as it also flared in gamma-ray (*Fermi*)

- Others ongoing; e.g. B2 0619+33 (gamma-ray flare from blazar)

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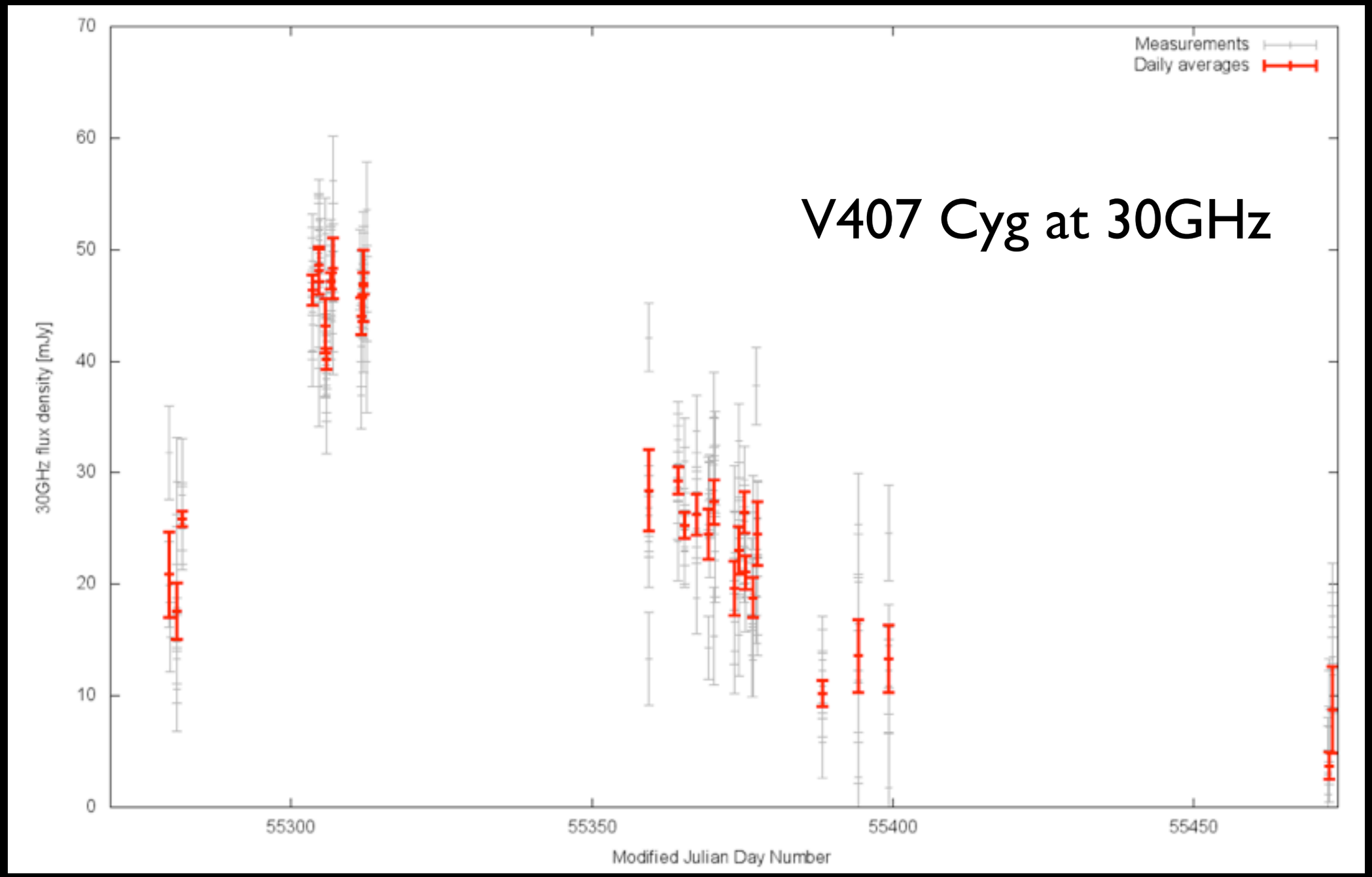
Transient sources



April 2010

October 2010

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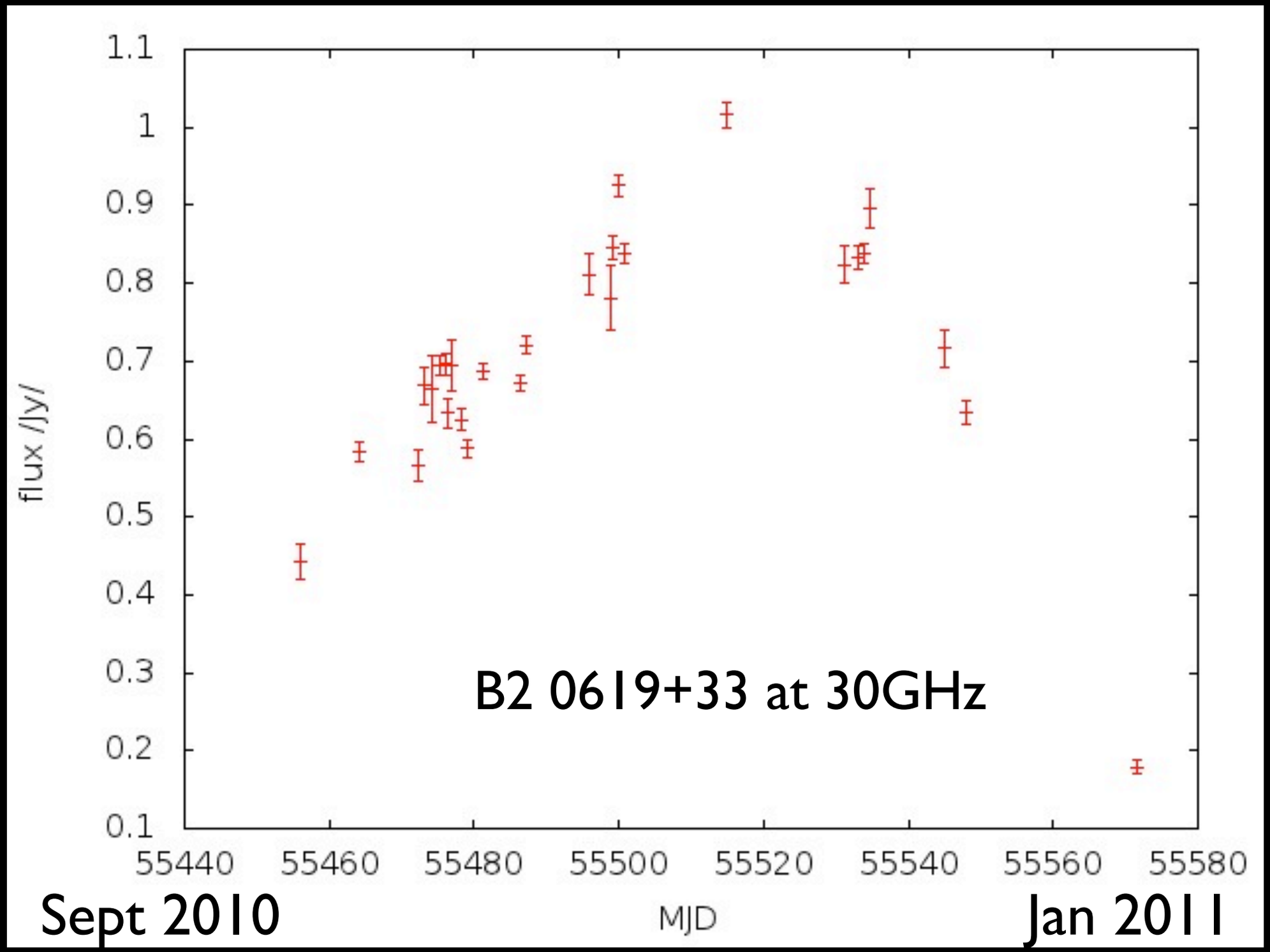
Transient sources



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Ongoing

- Surveys of *WMAP* and *Planck* ERCSC sources
- *Fermi* source monitoring
- KNoWS follow-up / confirmation observations
- Survey of Extragalactic Nuclear Spectral Energies (SENSE)
- Transient source follow-up
- Additional SZ observations

- OCRA-F commissioning (taking rather longer than expected...)
  - Blind point source and SZ surveys
  - Mapping of extended surveys

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Fun with foam...