ICRAR

International Centre for Radio Astronomy Research

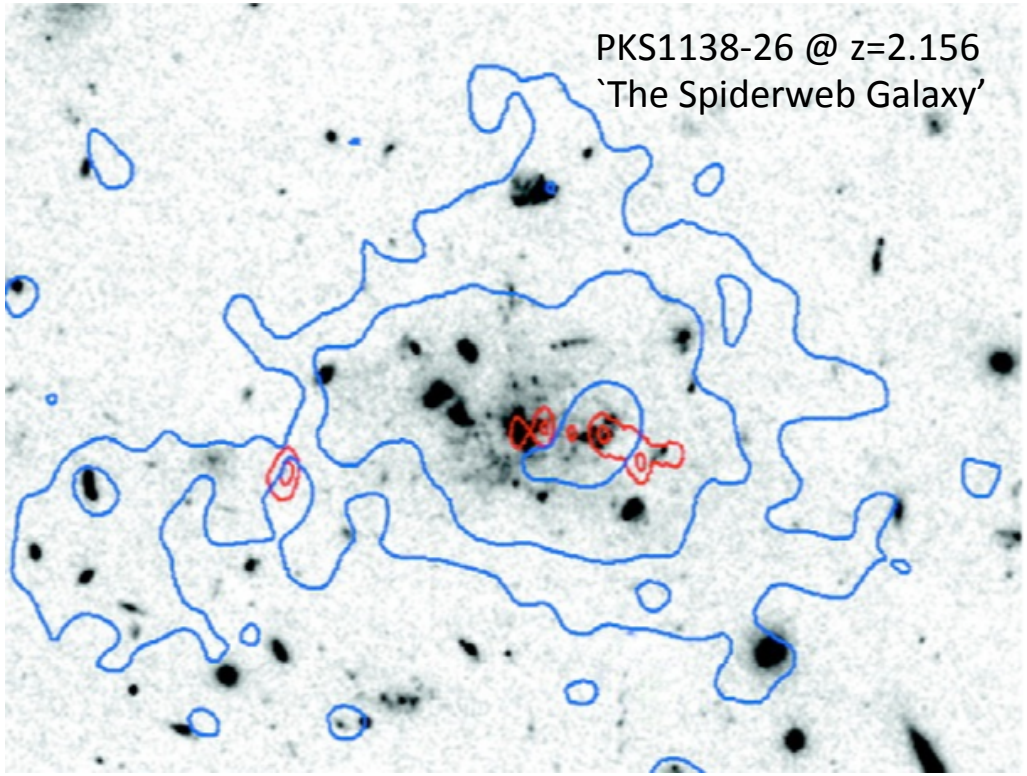
Probing the First Black Holes and Clusters with the MWA

Nick Seymour – Back@the Edge – 16th March 2015

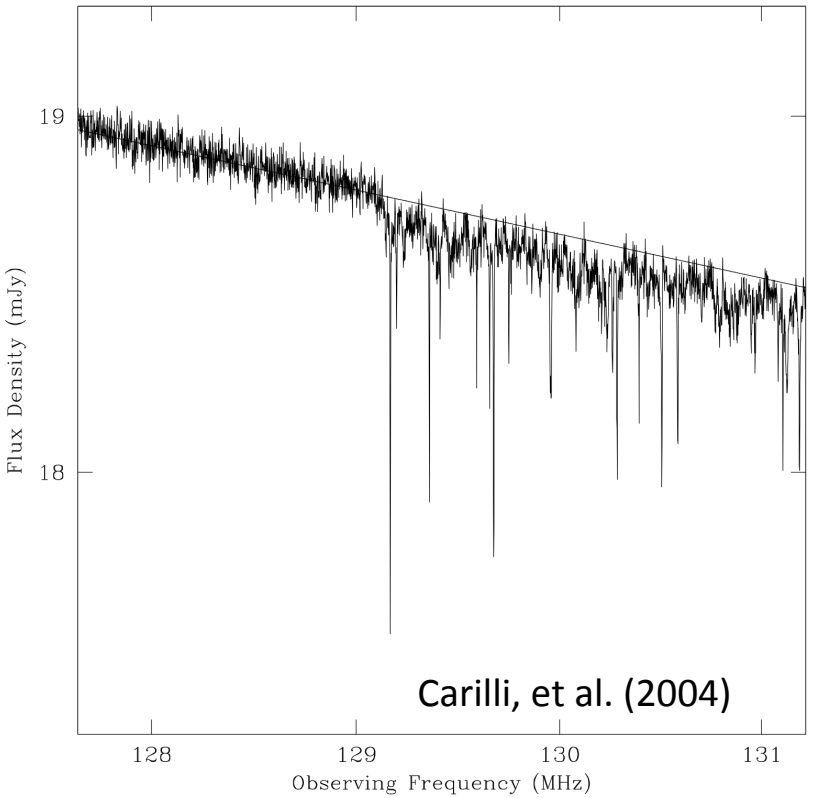
Curtin University

The University of Western Australia

Why Search in the Radio?



Proto-clusters at z>2



Line of sight measures of the EoR

MWA/GLEAM in a Nutshell

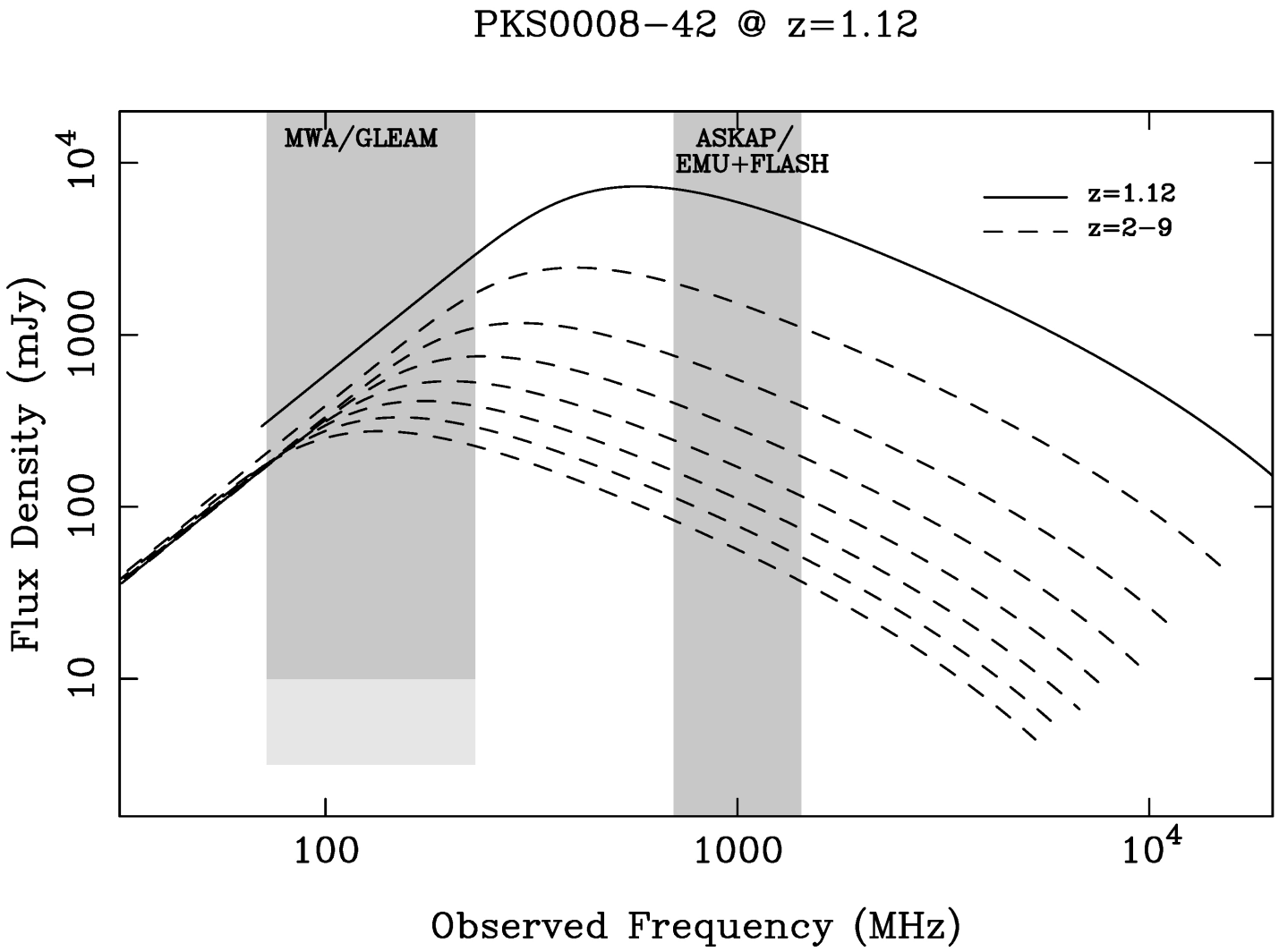
Murchison Widefield Array

- 2048 dual polarisation tiles
- Optimised for 80-300MHz
- 128 tiles (4x4 dipoles)
- Pointing electronic not mechanical
- Very wide field-of-view
- Baselines up to 3km
- 8128 baselines
- Stokes (I,Q,U,V)
- Located at MRO
- International collaboration (Aus, Ind, NZ and US)

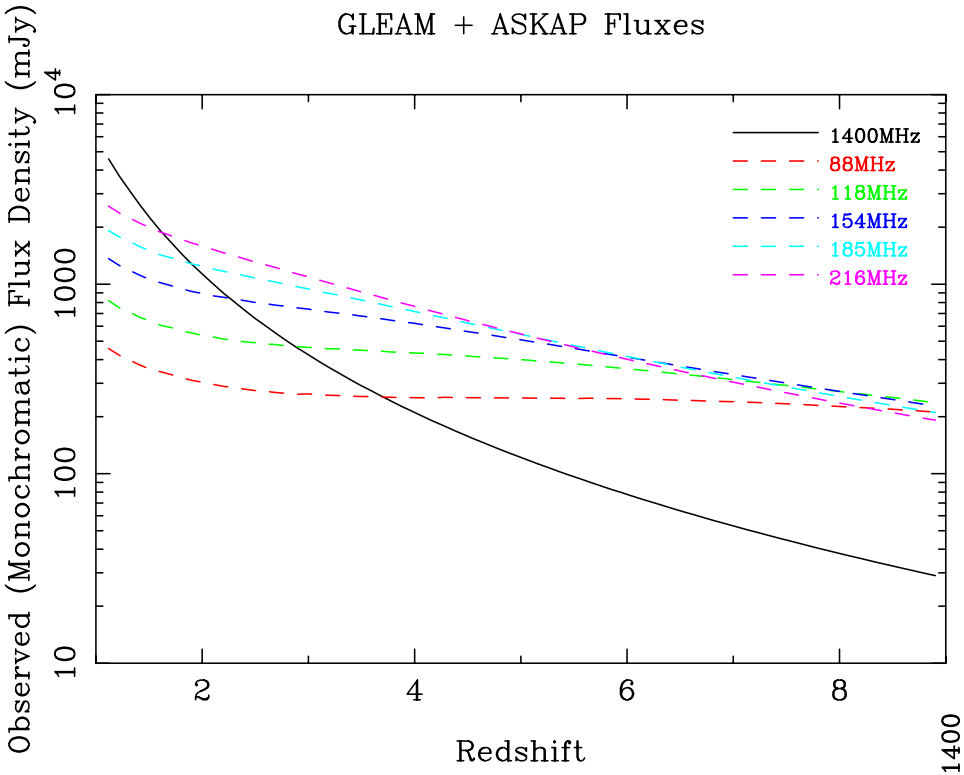
GLEAM

- GaLactic and Extragalactic All-Sky MWA Survey
- meridian drift scans ~8 hours of RA.
- 5x2min integration per pointing
- Covering 72-231MHz in 5x30MHz bands
- RMS ~ 2-6mJy/beam but limited by confusion
- Returns ~20 sources deg^{-2} = 0.5M over 2.5π steradian
- Resolution ~2arcmin

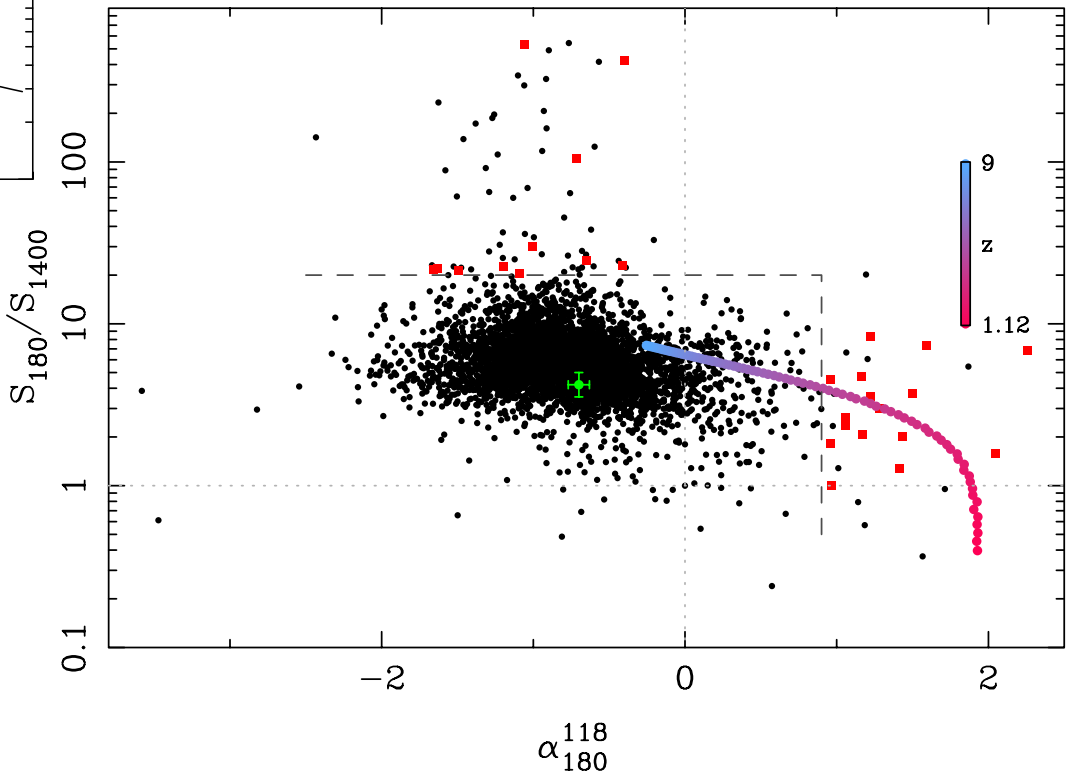
The First Black Holes: GPS



The First Black Holes: in GLEAM

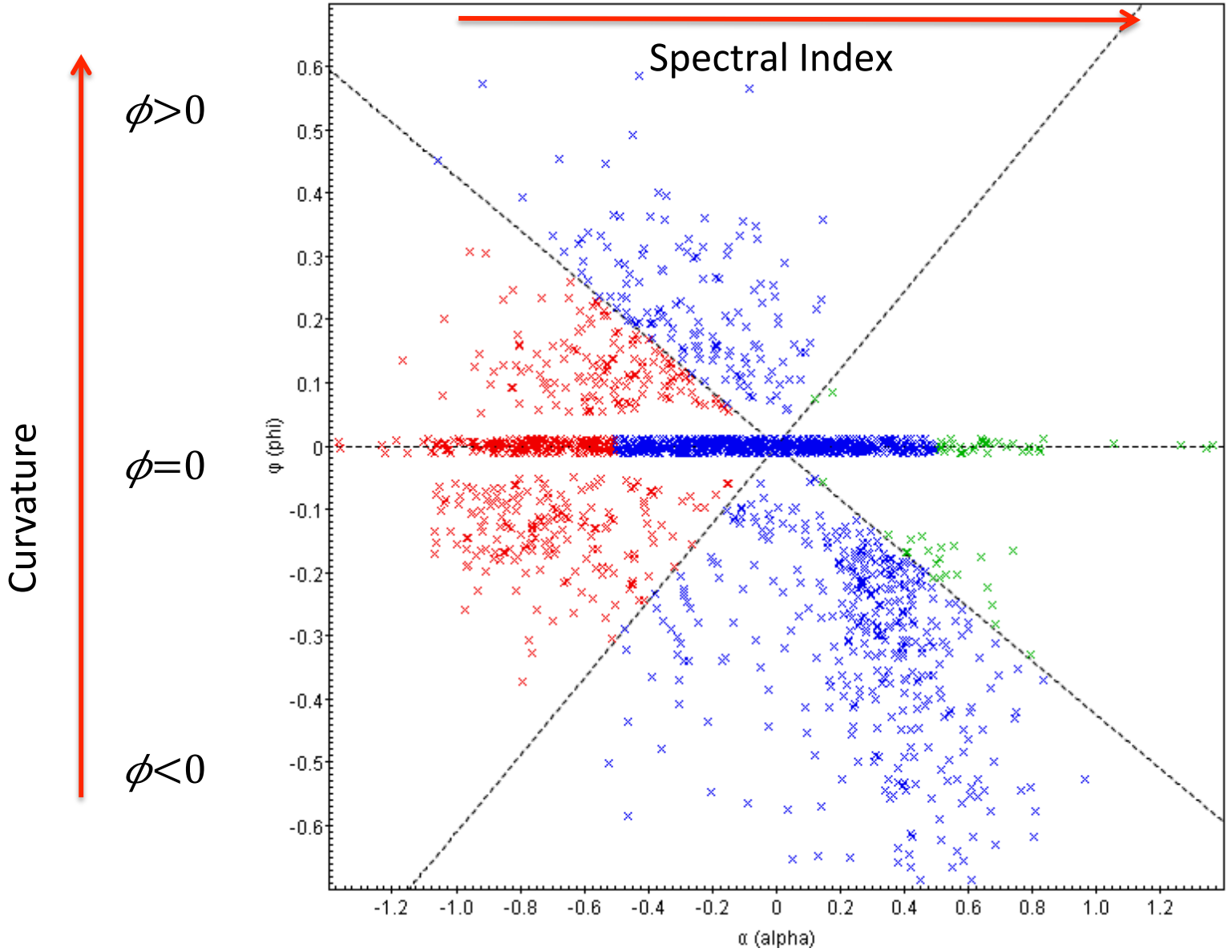


Low-nu flux density ~constant with redshift



Occupy unique part of colour-colour space

Fitting radio SEDs across 0.1-20GHz



Red: $\alpha \lesssim 0$ Blue: $\alpha \approx 0$ Green: $\alpha \gtrsim 0$

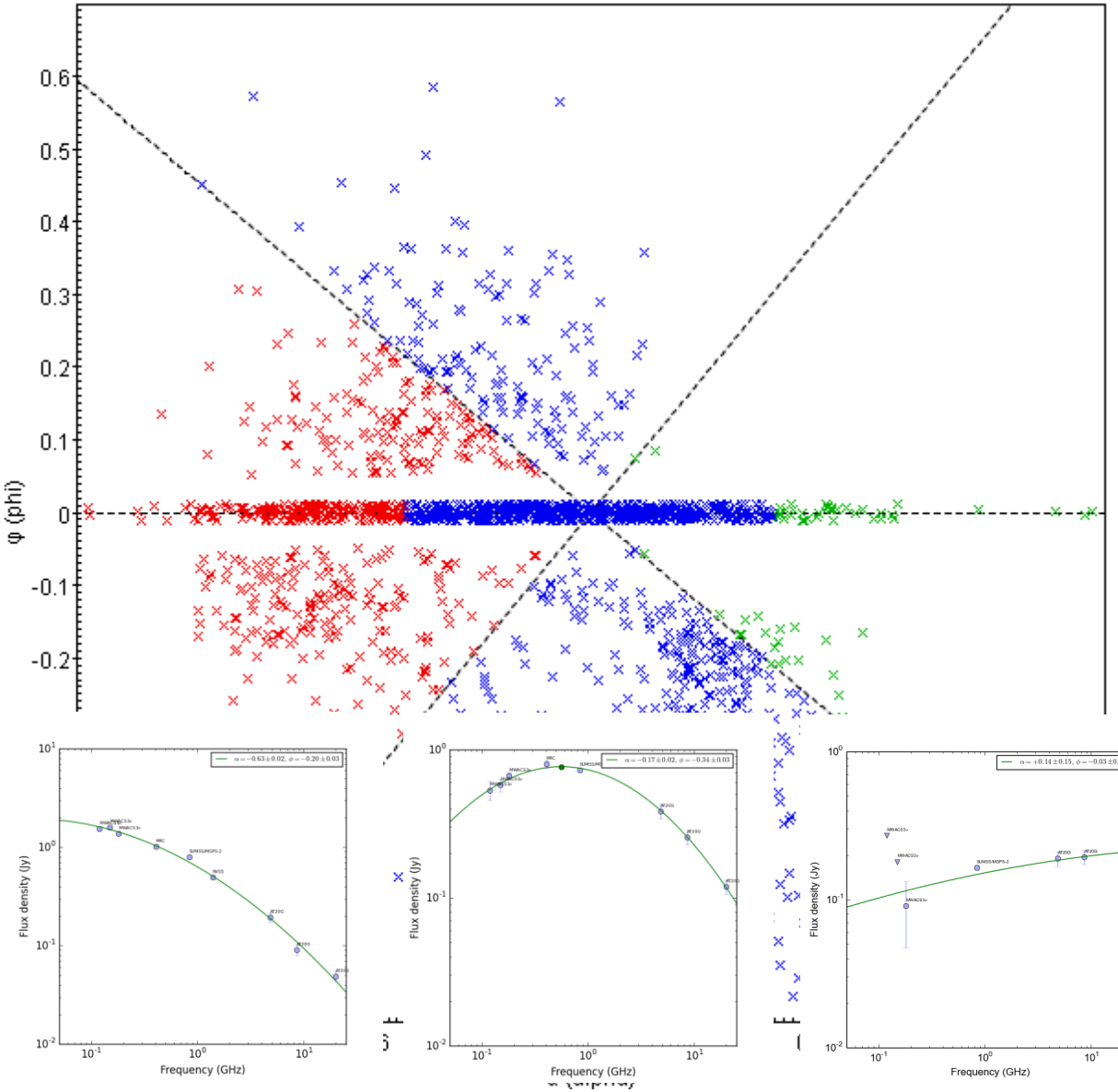
Harvey, [Seymour] et al. in prep.

Fitting radio SEDs across 0.1-20GHz

$\phi>0$

$\phi=0$

$\phi<0$



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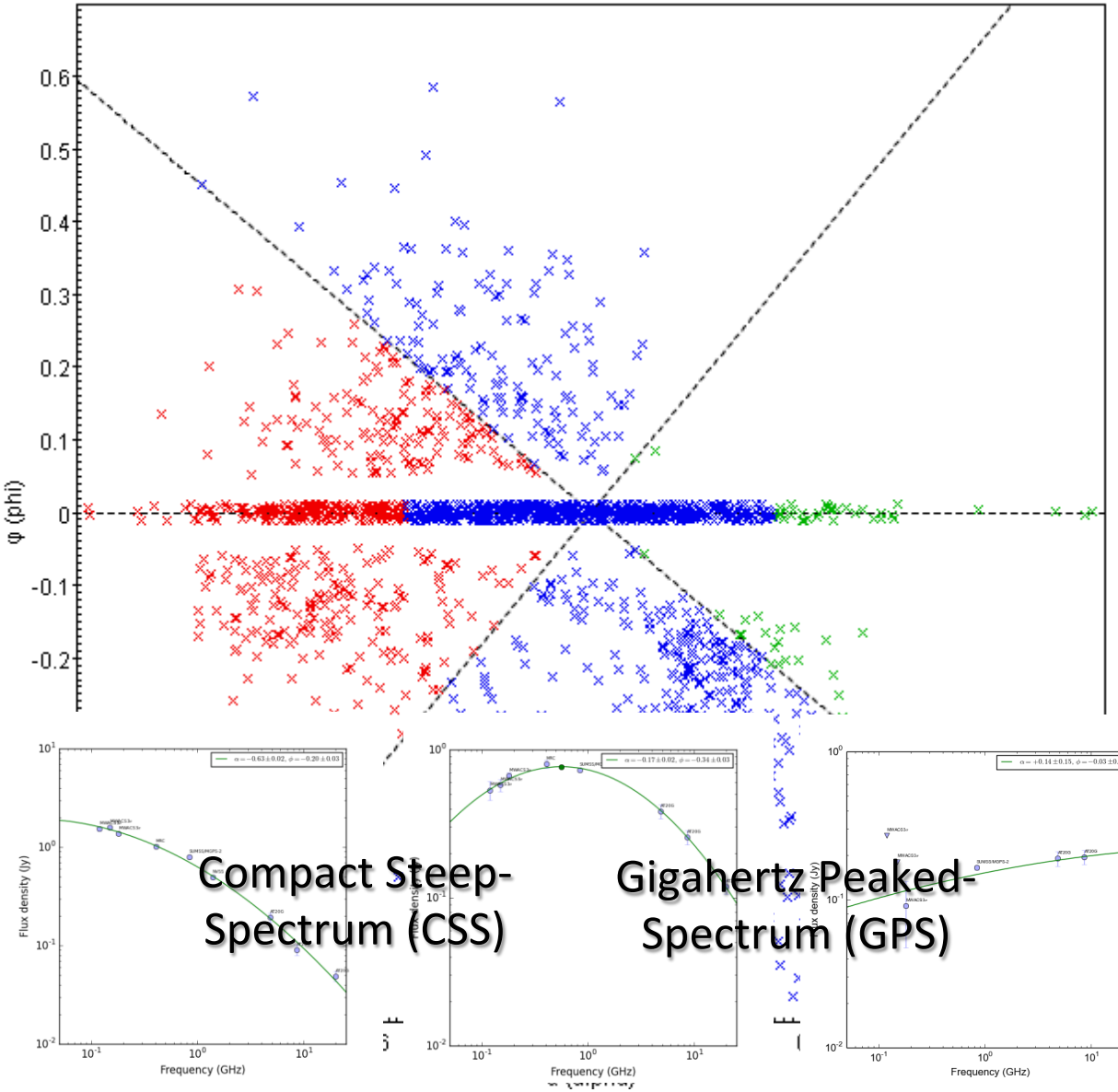

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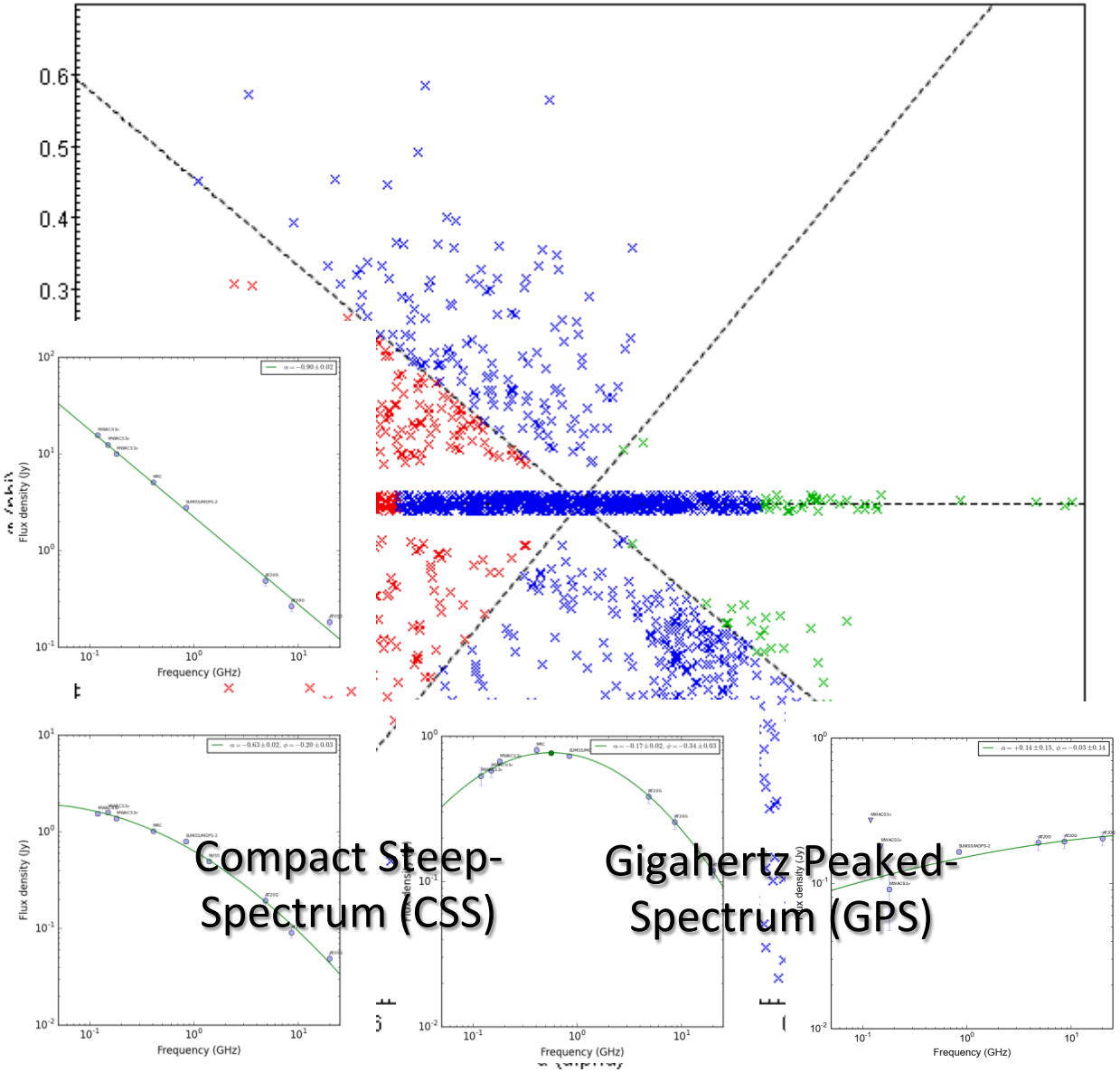

Compact Steep-Spectrum (CSS)

Gigahertz Peaked-Spectrum (GPS)

Harvey, [Seymour] et al. in prep.

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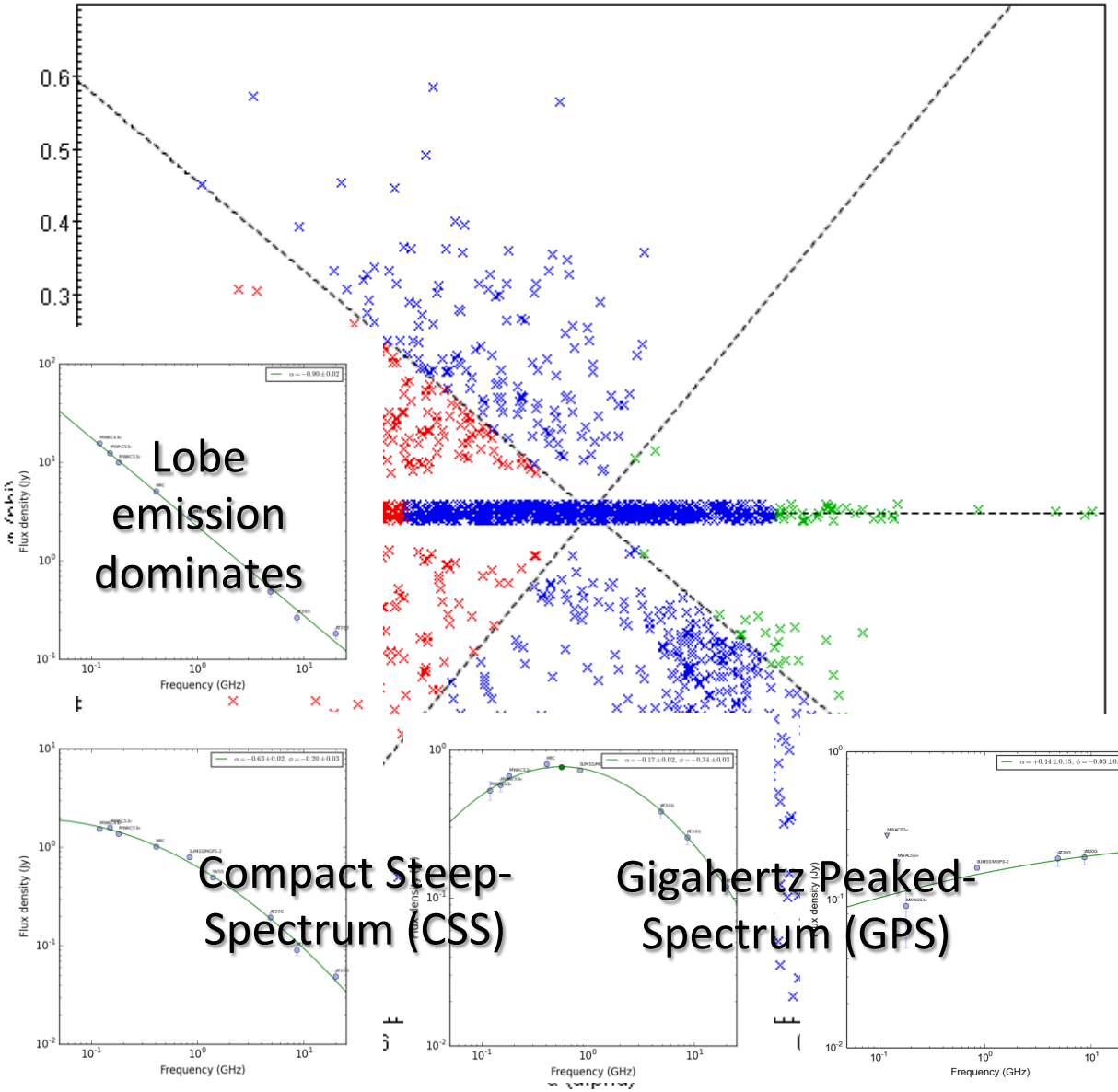

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Fitting radio SEDs across 0.1-20GHz

$\phi>0$

Signs of core activity, possibly restarted radio galaxies

$\phi=0$

Lobe emission dominates

Peculiar effects (relativistic beaming, etc.)

$\phi<0$

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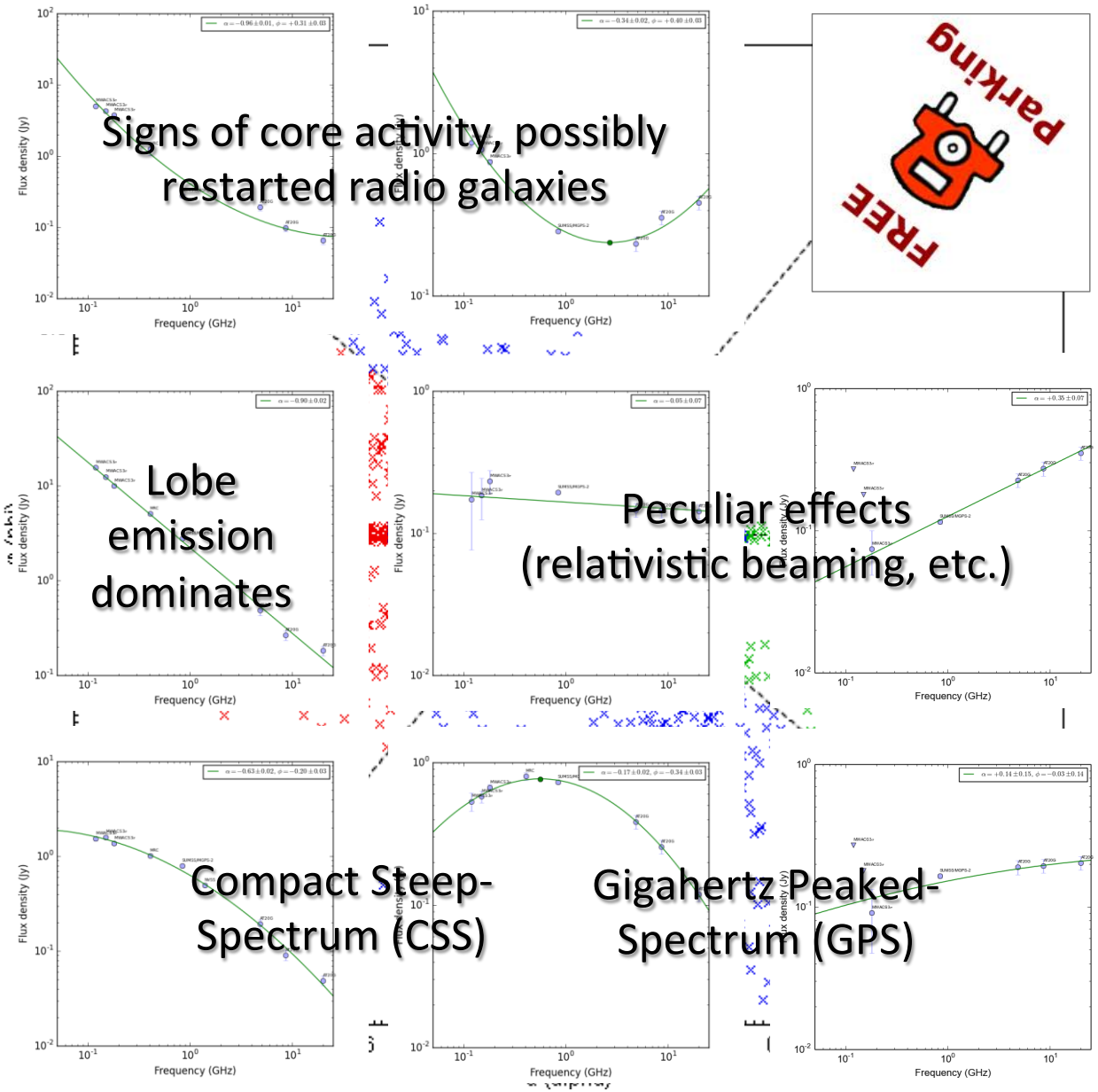
Gigahertz Peaked-Spectrum (GPS)



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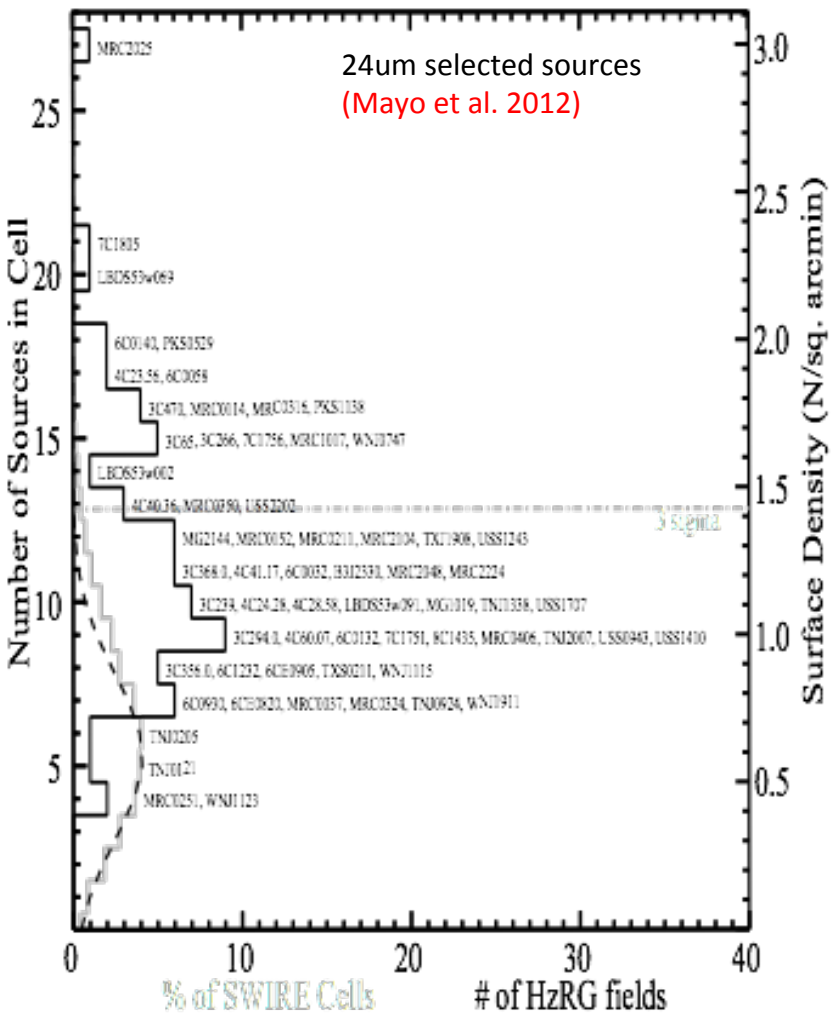
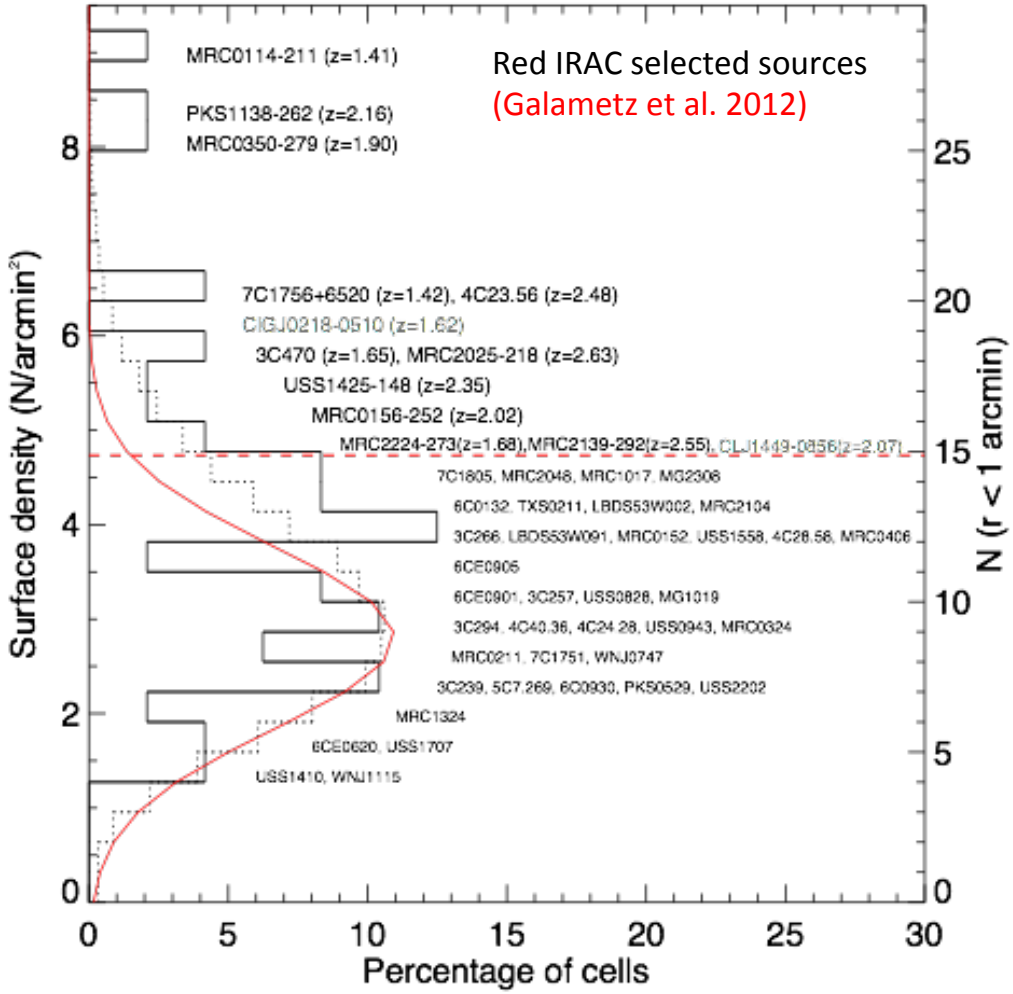
Proto-cluster at High-z

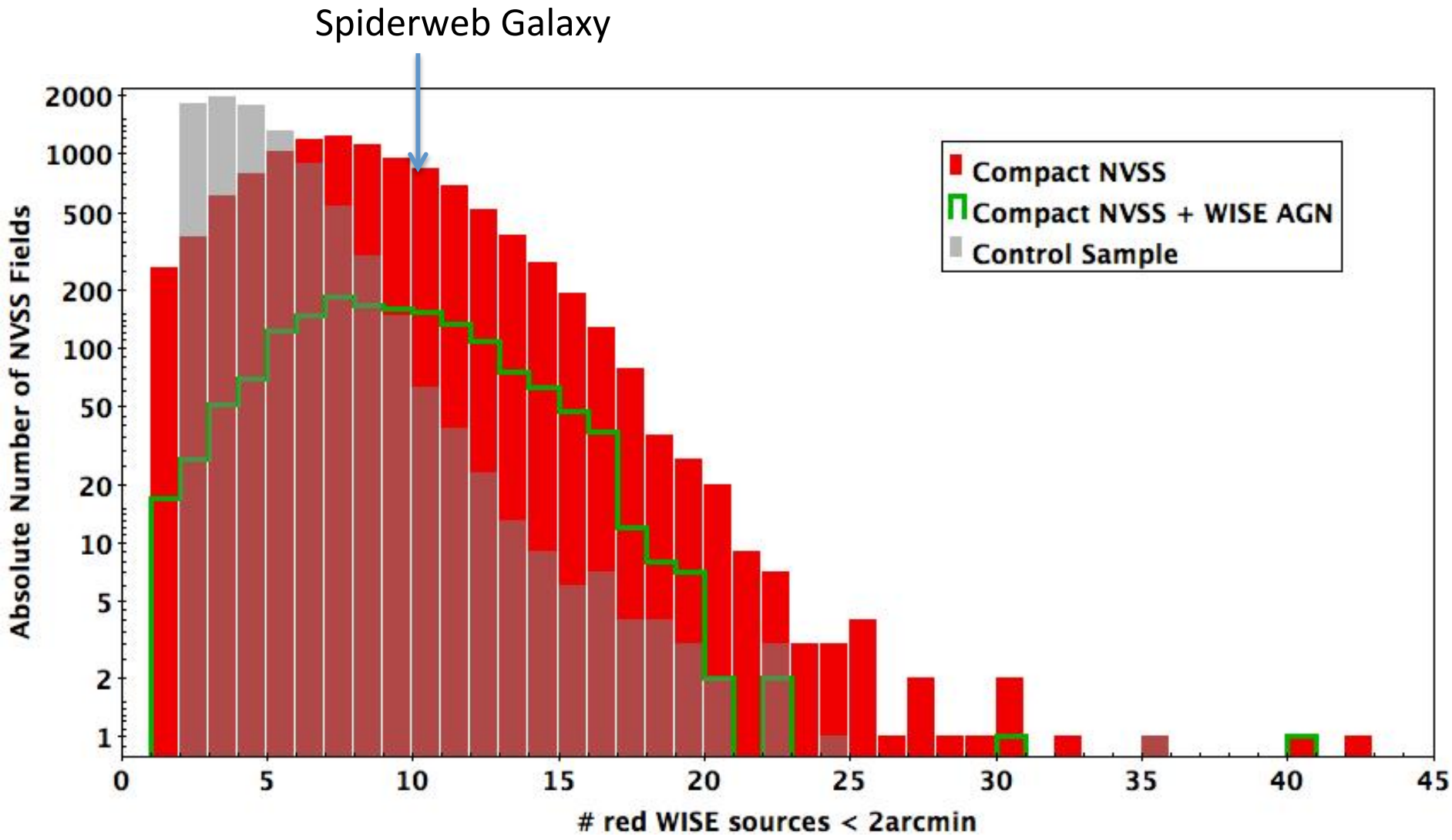
Number of IR sources within one arcmin





Number of radio galaxy fields

WISE Over-densities



Seymour (in prep)

Conclusions

- **Radio surveys are unique tool to explore early Universe**
- **Trace growth of large scale structure**
- **Important for EoR:**
  - Characterise foregrounds
  - Measure EoR directly along single line of sight