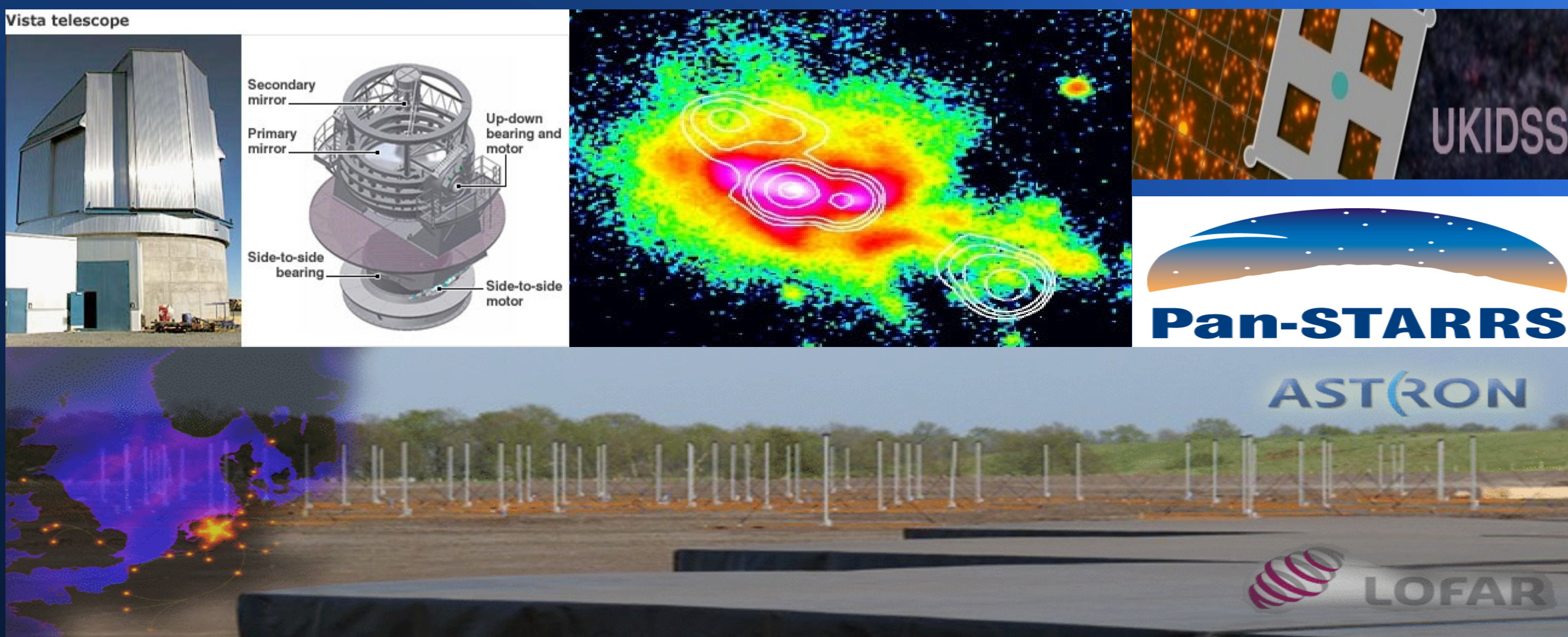
The Search for the Highest Redshift Radio Galaxies

Louise Ker,
IfA Edinburgh



Collaborators: Philip Best, Emma Rigby, Huub Rottgering, Melanie Gendre

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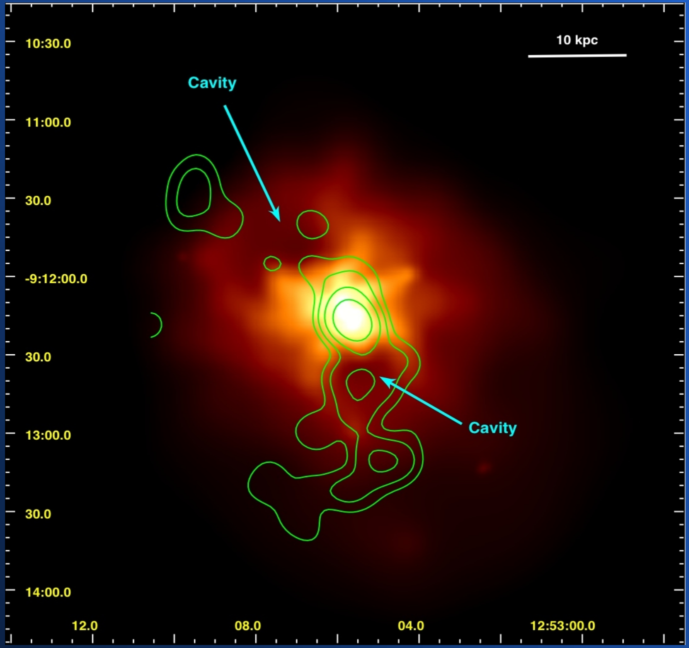
Motivation

What are the Most Efficient Means of Locating High z Radio Galaxy Candidates?

Studying radio AGN at the highest redshifts essential to understand feedback processes on galaxy evolution over cosmic time.

Locating z>6 radio galaxies would allow a search for absorption signatures of neutral hydrogen, and trace changes in the ionisation state of the Universe with cosmic time.

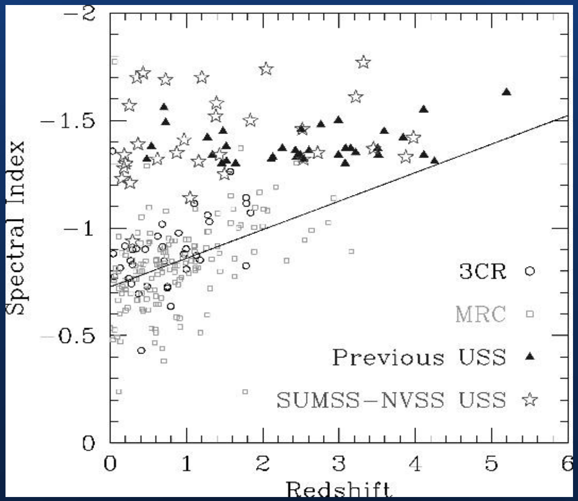


Credit: http://www.sr.bham.ac.uk/exgal/feedback.php

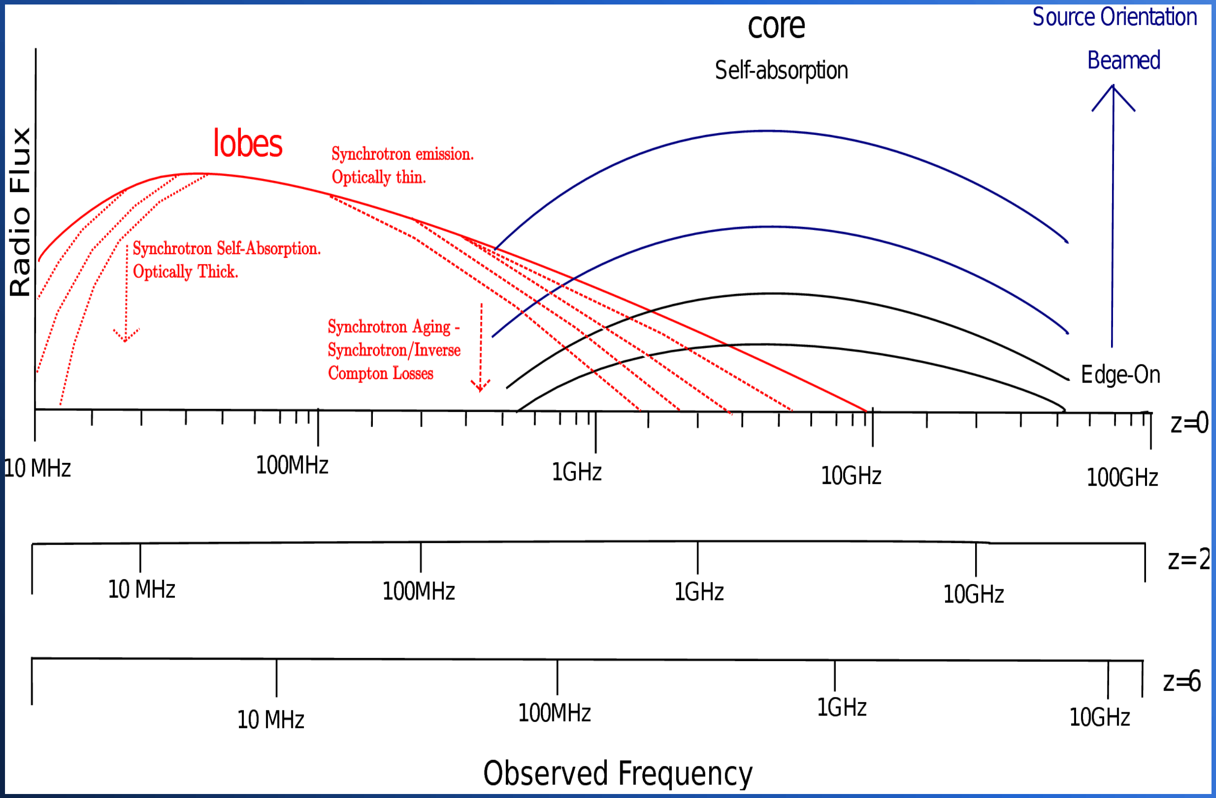
Radio AGN trace most massive galaxies - allowing study of upper end of supermassive black hole mass function.

Opportunity: **Many new (exciting!) wide-field & deep radio/optical/near-infrared surveys coming up....**

How: Radio Spectra

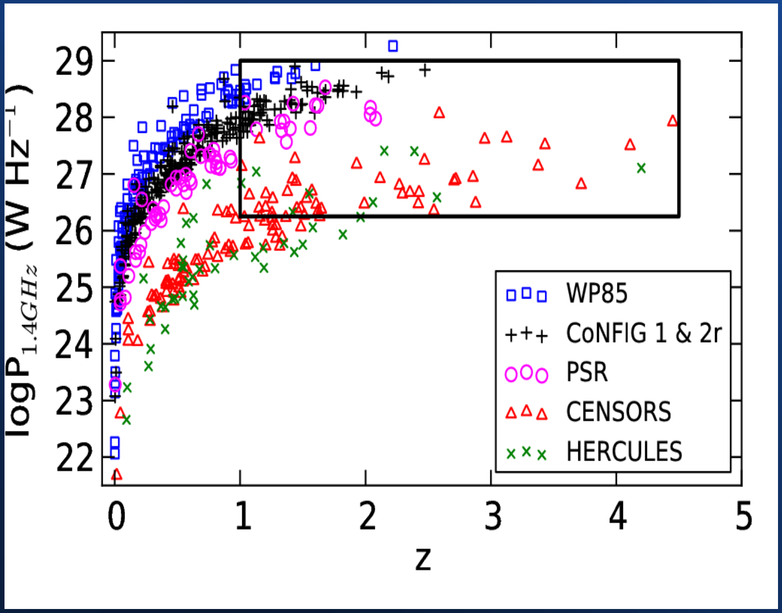


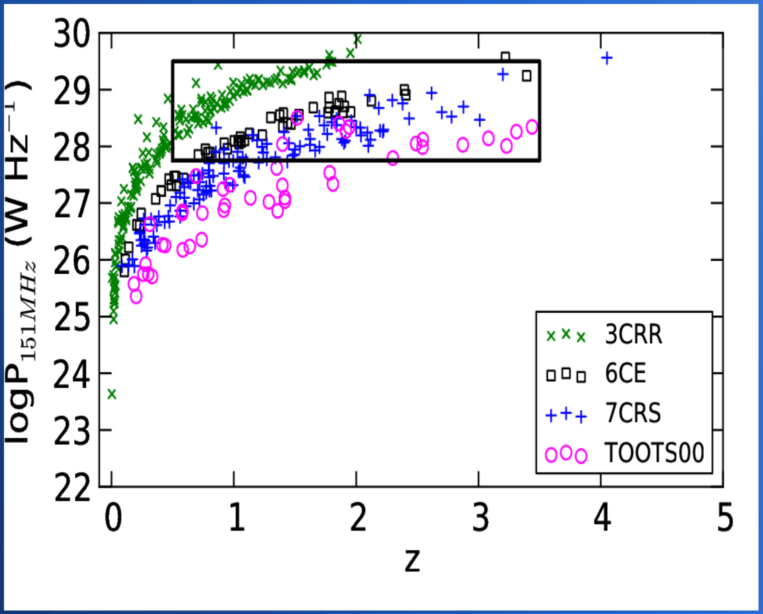
Credit:http://www.atnf.csiro.au/news/newsletter/oct05/Earliest_massive_galaxies.htm



K-correction? Malmquist bias? Enhanced inverse-Compton losses at high z?

Method Efficiency with Complete Radio Samples





Selection: 5 complete samples selected at 1.4 GHz, and 4 at 151 MHz, with spectral index < -0.5 . Purely evidence-based.

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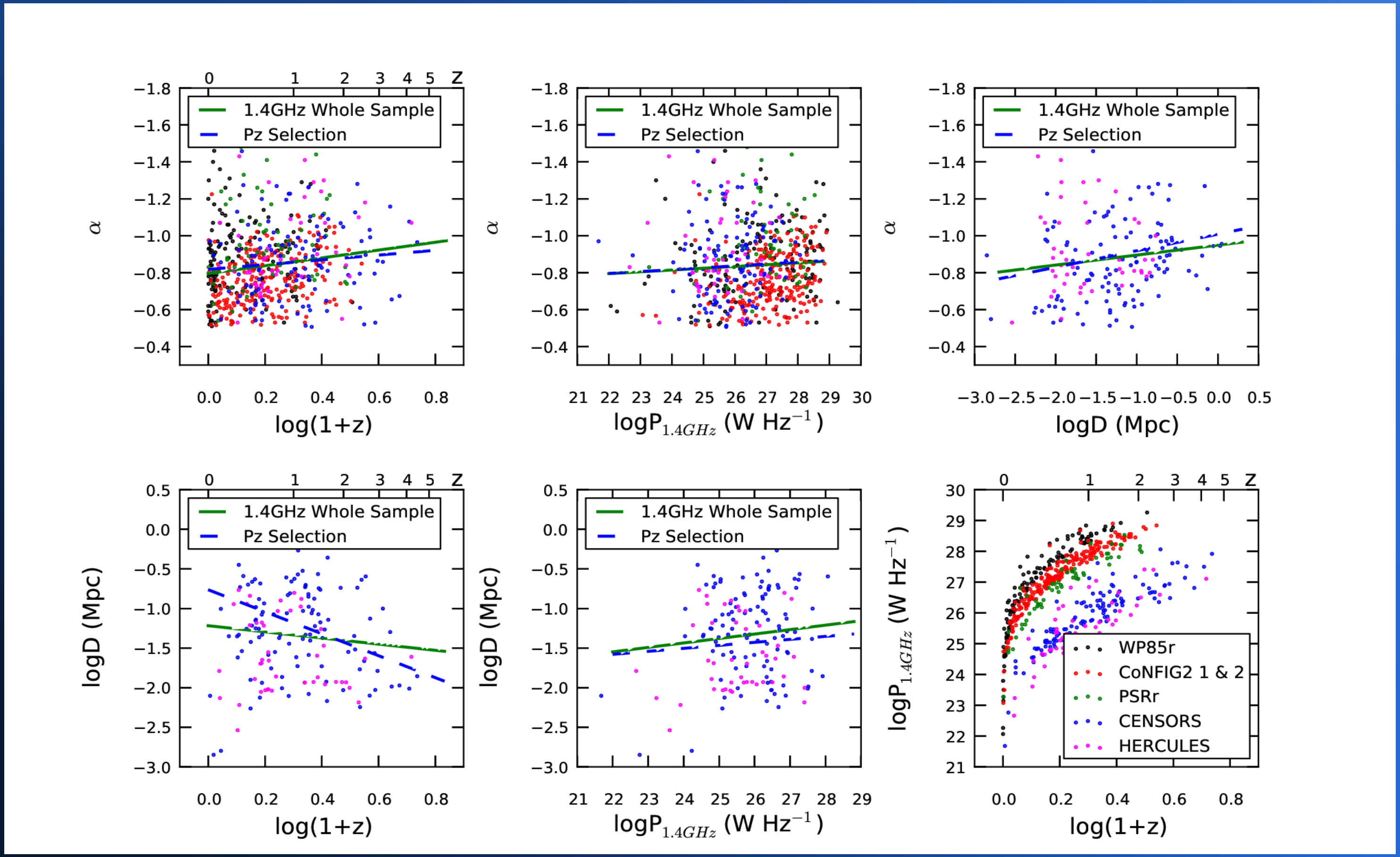
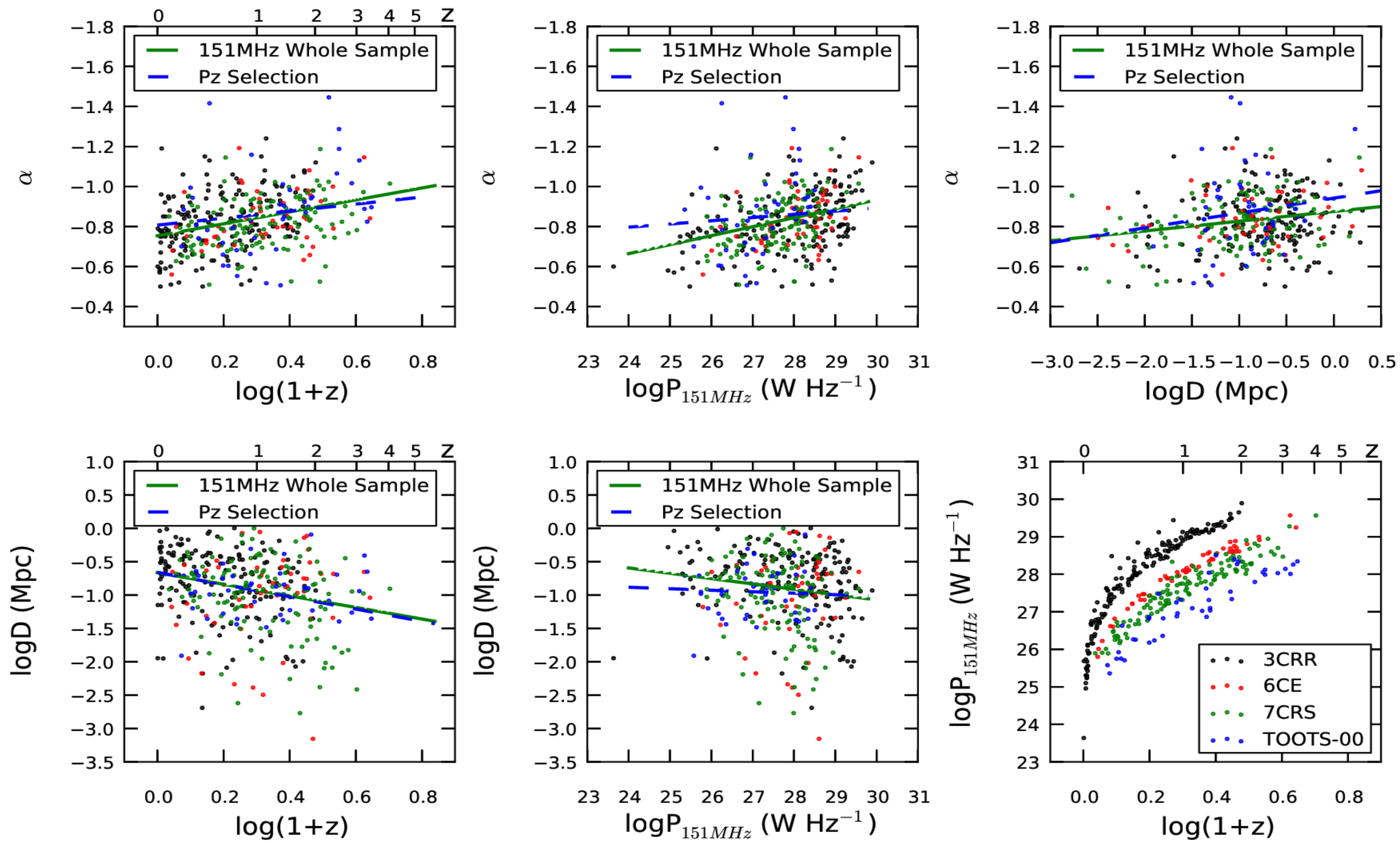
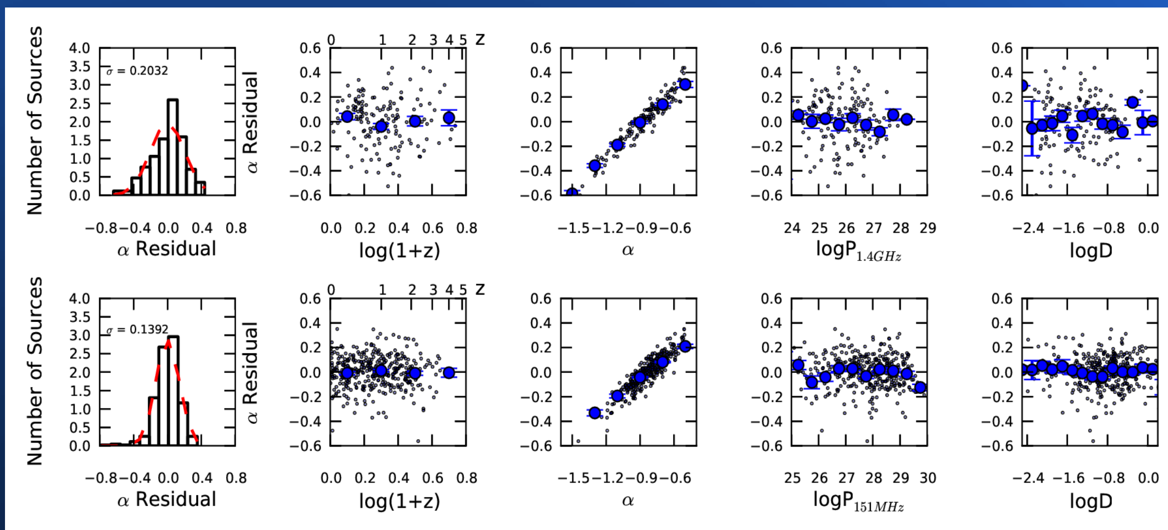
Observed Correlations High Frequency (1.4 GHz selected)



Observed Correlations Low Frequency (151 MHz selected)



How Dependant is Radio Spectral Index on Other Observables: Radio Size (D), Luminosity(P), and Redshift (z)?



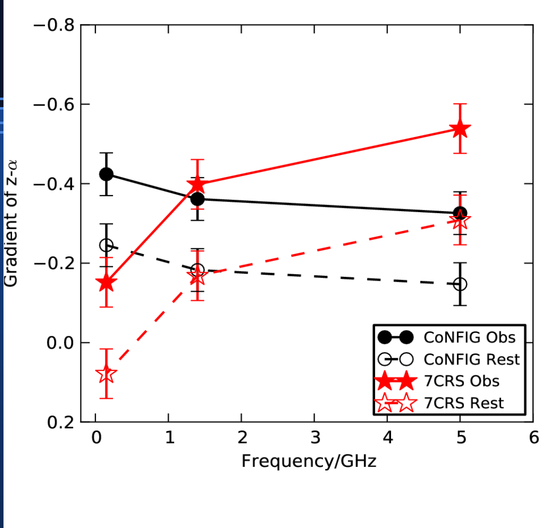
Fitting alpha = a*log*(1+z) + b*log*P + c*log*D + d

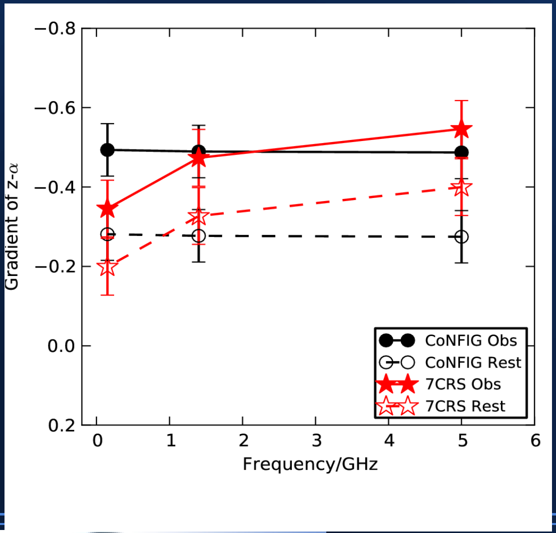
Answer: Very little

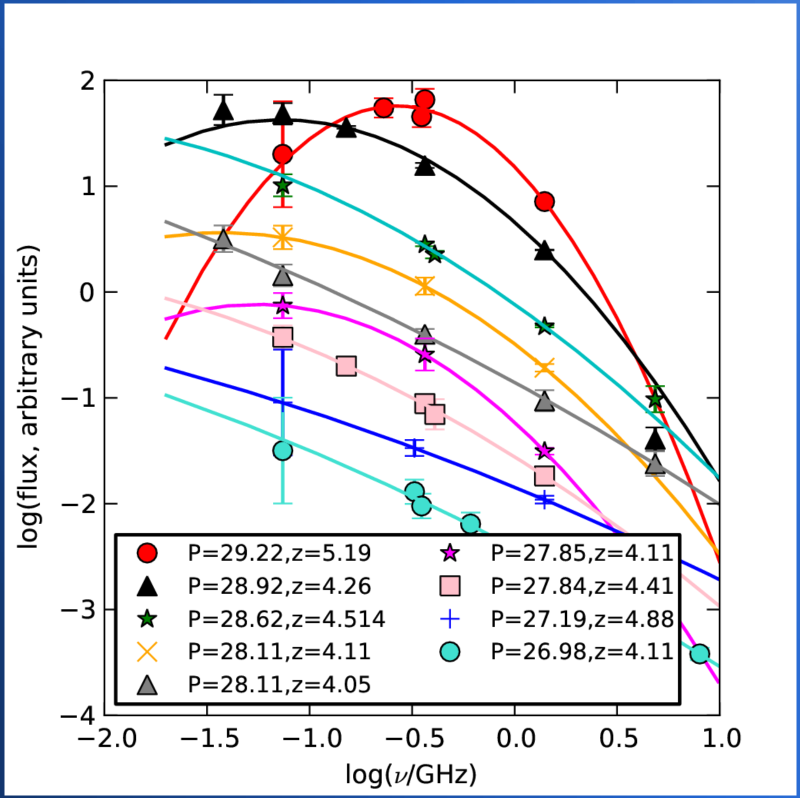
The strongest correlation is between spectral index and linear size.

There is a weak correlation between z and spectral index, but intrinsic scatter in spectral index is much greater than that arising from any physical trends with other observables present in the data sets.

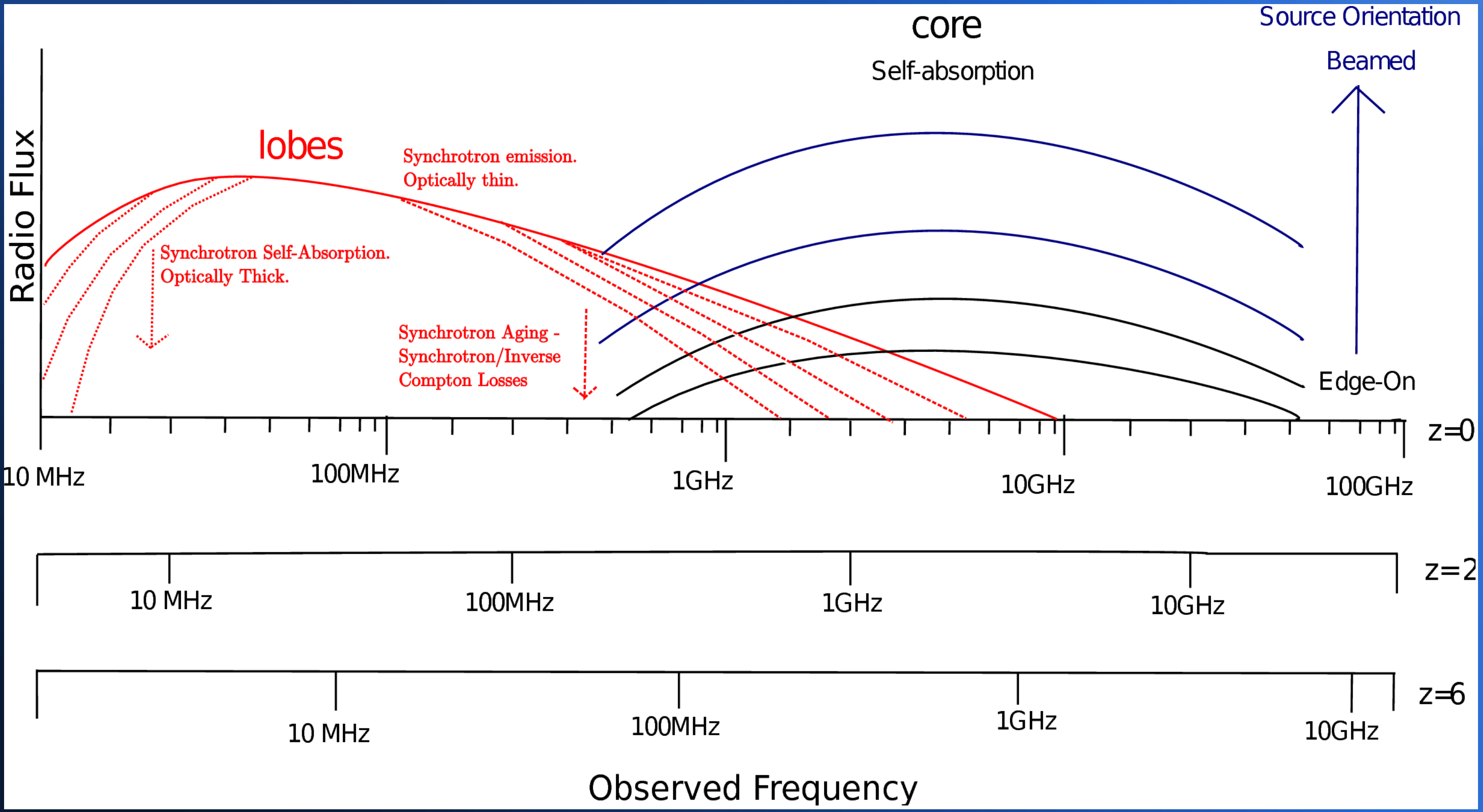
Does z-alpha arise from a 'K-correction'?



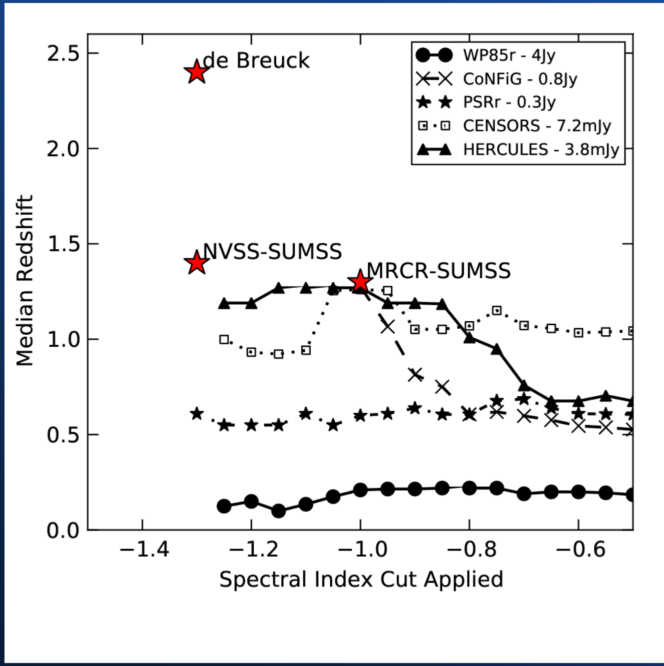


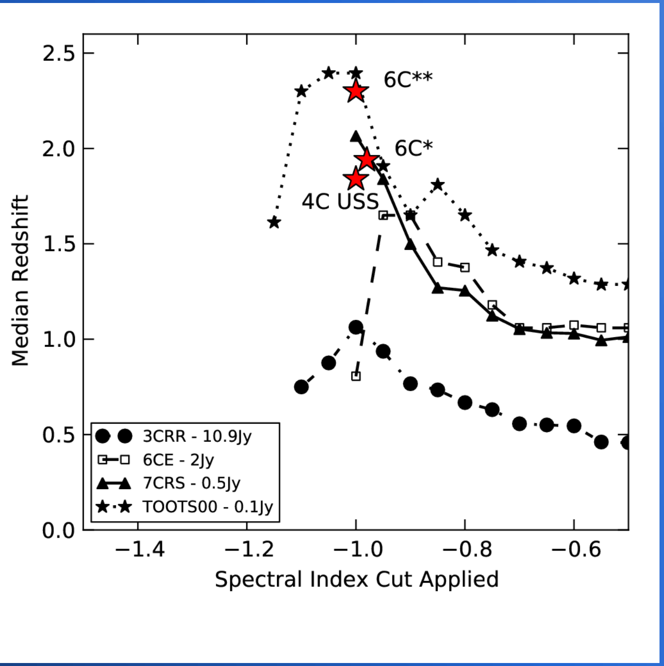


Reminder: Radio Spectra

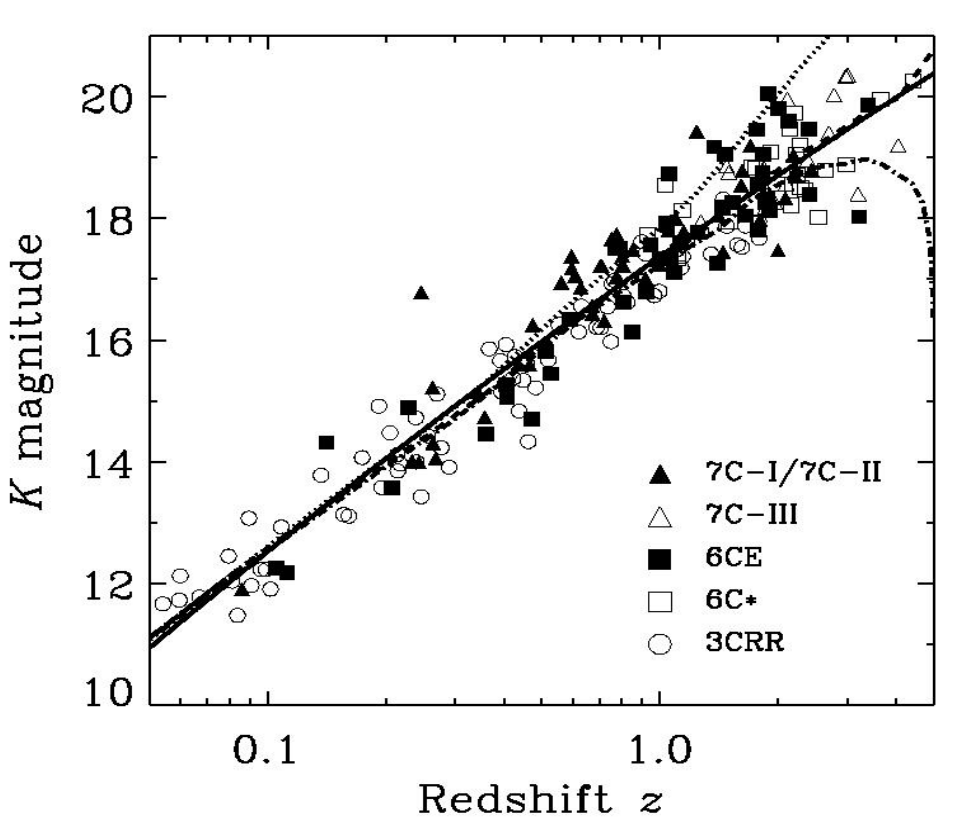


Real Life: Applying a Spectral Index Cut to a Radio Survey





K-band Magnitude



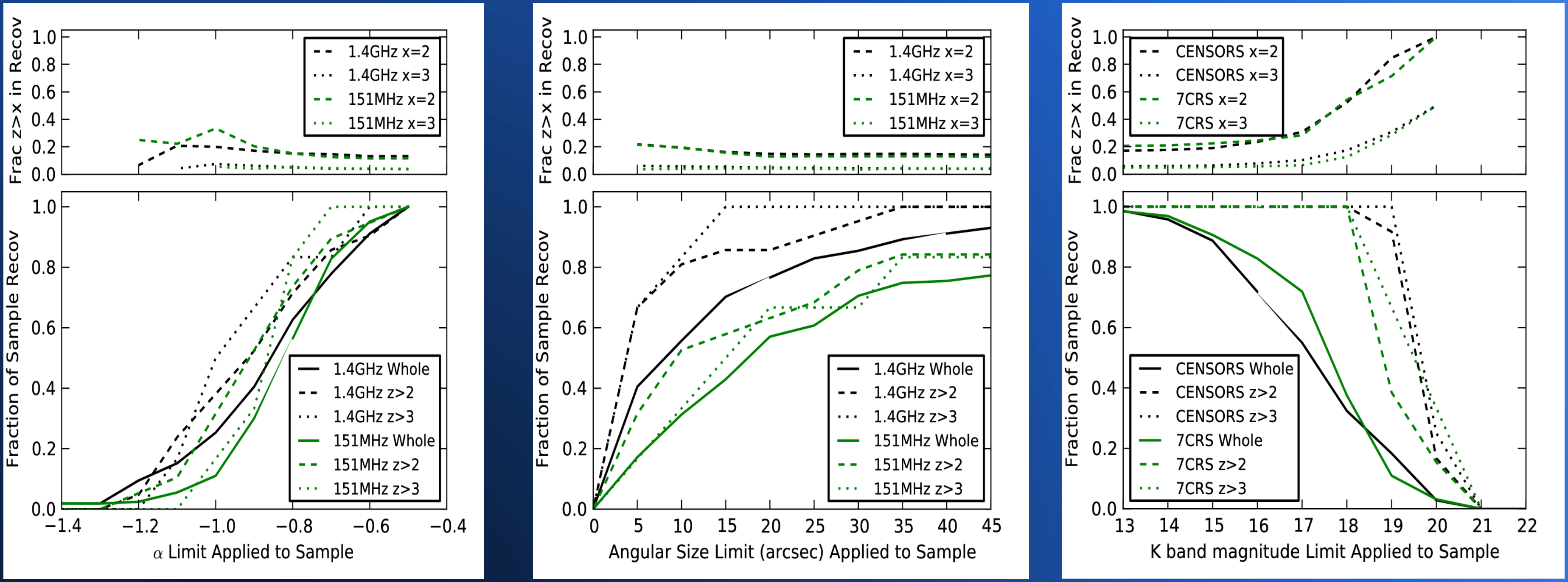
Credit:https://www.astrosci.ca/users/willottc/kz/kz.html

Radio galaxies observed to follow relationship between K magnitude and redshift.

In the past, this has been difficult to use for large searches, as deep, wide-field K-band observations required.

With deep, wide, UKIDSS, VISTA surveys underway, time is right for this to be revisited..

Searching Efficiencies of Radio Spectral Index, Angular Size and K-band Magnitude Cuts.



The bottom panels show the fraction of all sources* (solid lines) and the fraction of z > 2 (dashed) and z > 3 (dotted) radio galaxies that have steeper spectral indices/smaller sizes/fainter K band magnitudes than the given limit, as a function of that limit, for both the 1.4GHz- (black) and 151 MHz-selected (green) samples. The top panel displays the fraction of high-z radio galaxies in the sample recovered by these cuts.

**all radio galaxies in the case of the K magnitude plot, as K-z relation does not hold for quasars (see arXiv:1111.5244).*

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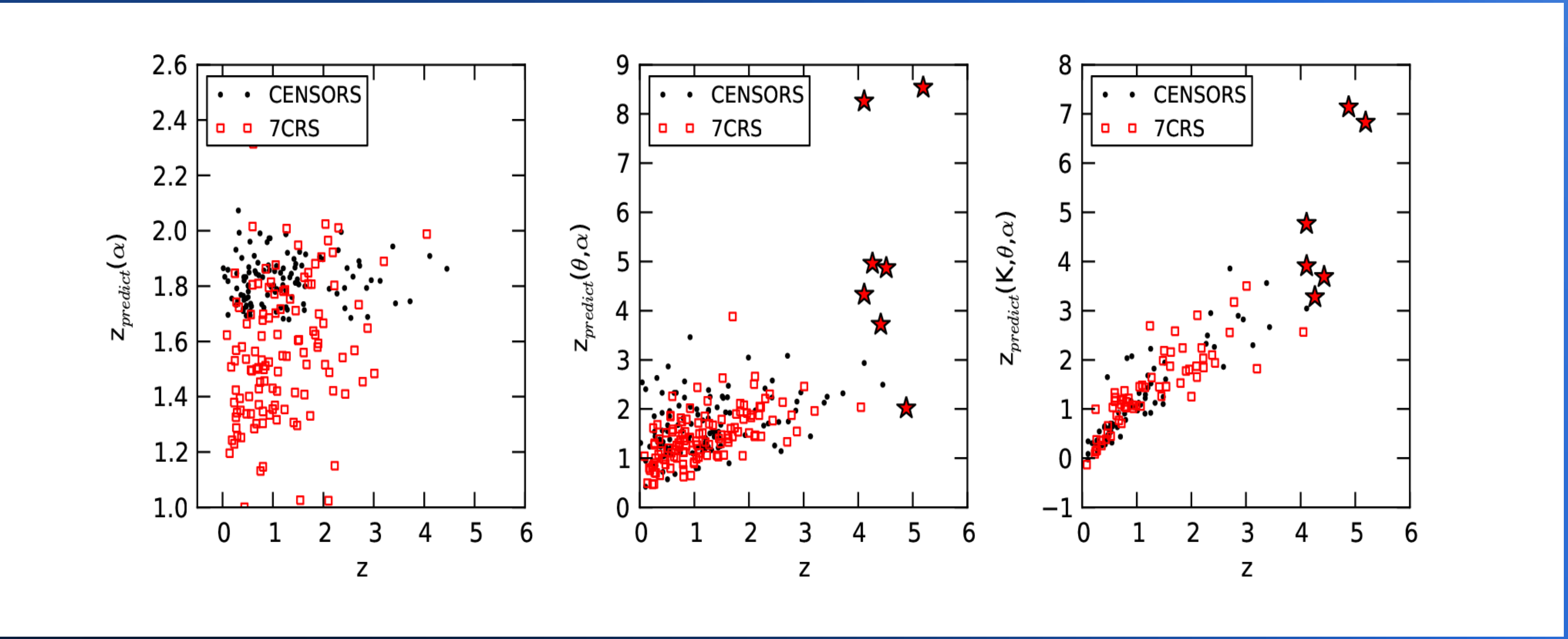
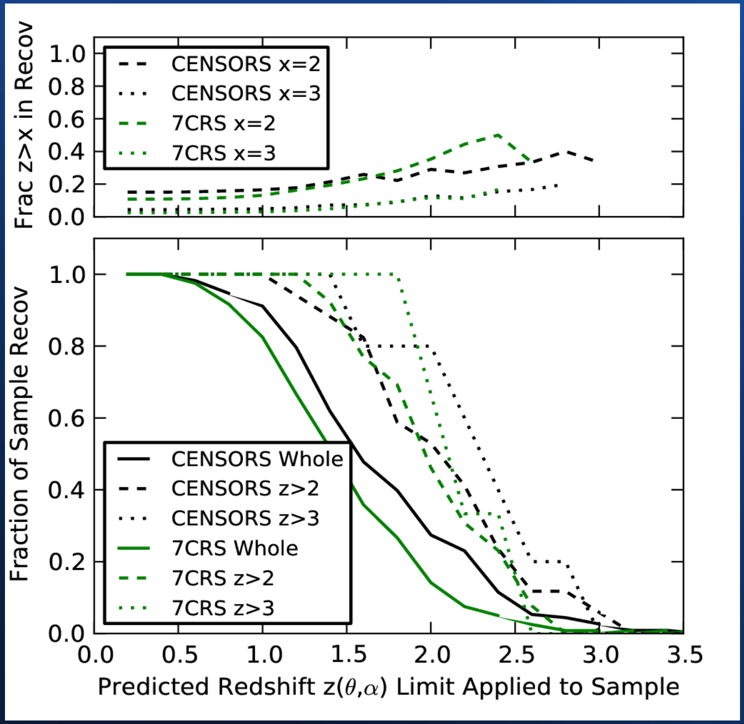
Louise Ker, DEX VIII, Durham, 12/01/12

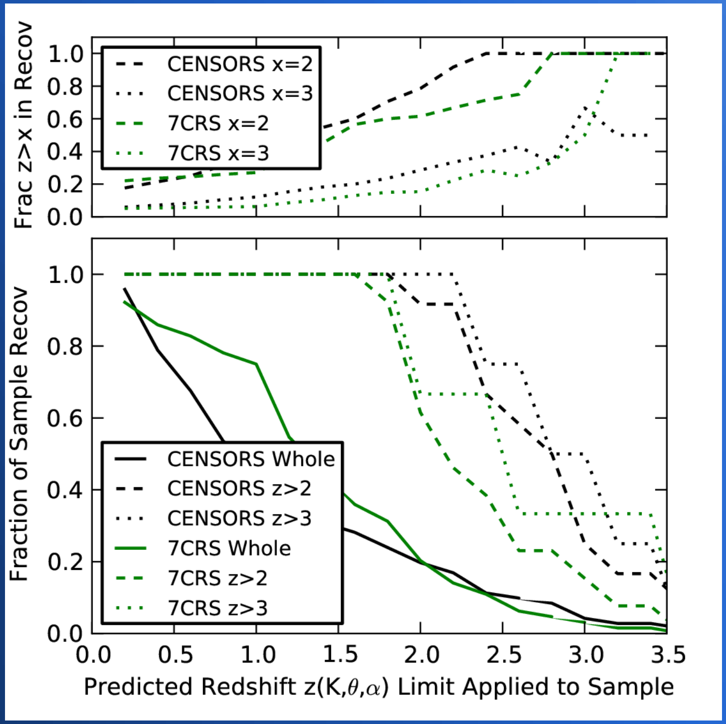
Fitting Functions of Radio Spectral Index, Angular Size, and K-band Magnitude to Complete Samples: Predicted Redshifts



z(alpha) z(alpha, angular size) z(K, alpha, angular size)

Fitting Functions of Radio Spectral Index, Angular Size, and K-band Magnitude to Complete Samples: Predicted Redshifts





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Conclusions

- Strongest relation measurable in D, P, z, alpha dataset is that between D and alpha.
- Observed z-alpha correlation reaches max strength for observed alpha measured at high frequencies, in a low frequency selected sample.
- Up to 50% of the gradient of the z-alpha correlation can be attributed to a k-correction. This is important as almost all known z>4 radio galaxies display curvature in their spectra (& often display characteristics consistent with being young sources).
- Selecting z>2 sources based only on their observed alpha provides only a small increase in searching efficiency, and only for low frequency selected samples.
- Searching based on a combination of criteria, such as alpha + size, alpha + size + K magnitude provides optimal efficiency.
- Interested? See arXiv:1111.5244