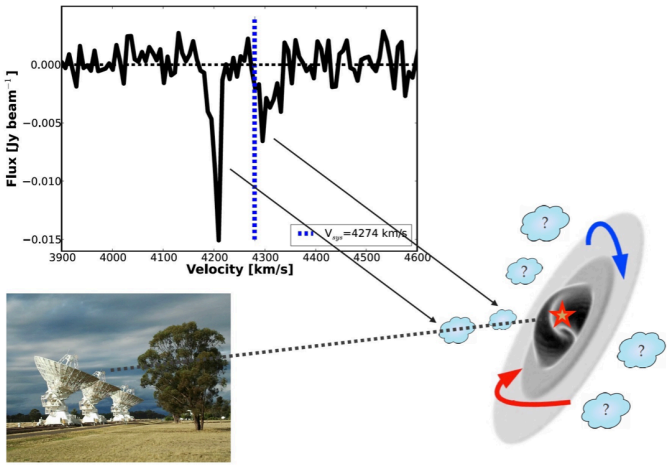
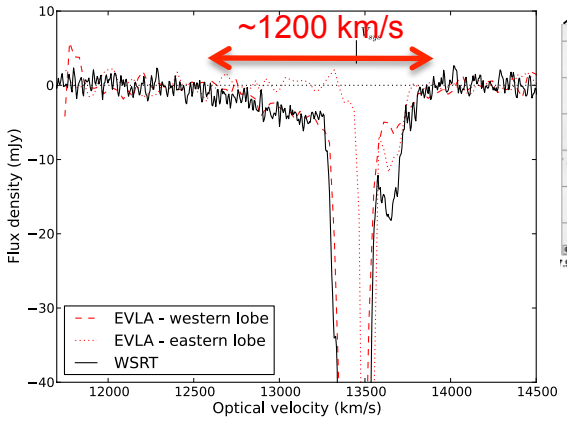
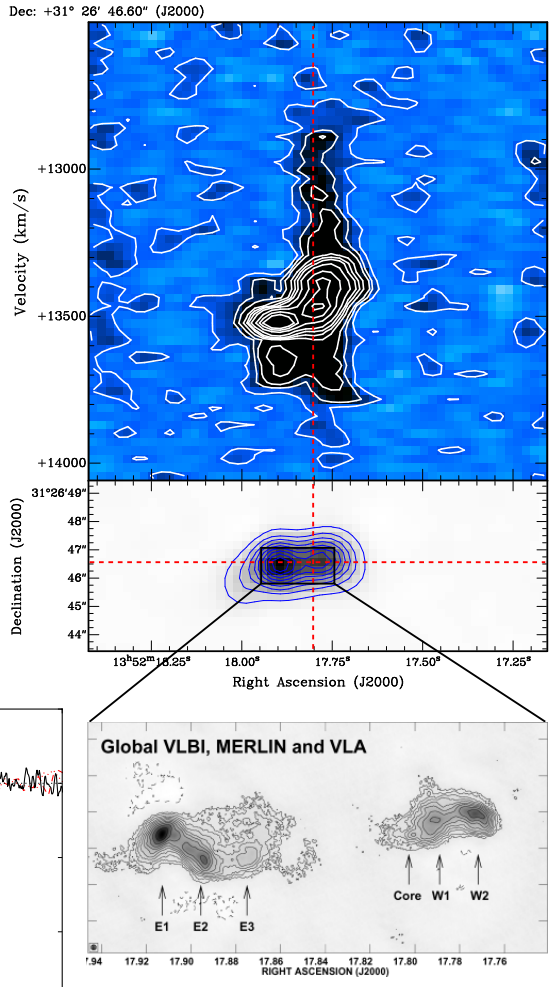
Why search for HI in absorption?

- Probe the fueling and feedback mechanisms in AGN
  - Study the distribution of cold gas in the central regions of radio AGN
    - Is the gas infalling or in outflow?
    - How do the radio-jets interact with the ISM? Does it play a role in regulating SF? Or in driving outflows?



Maccagni et al., 2014





Mahony et al., 2013

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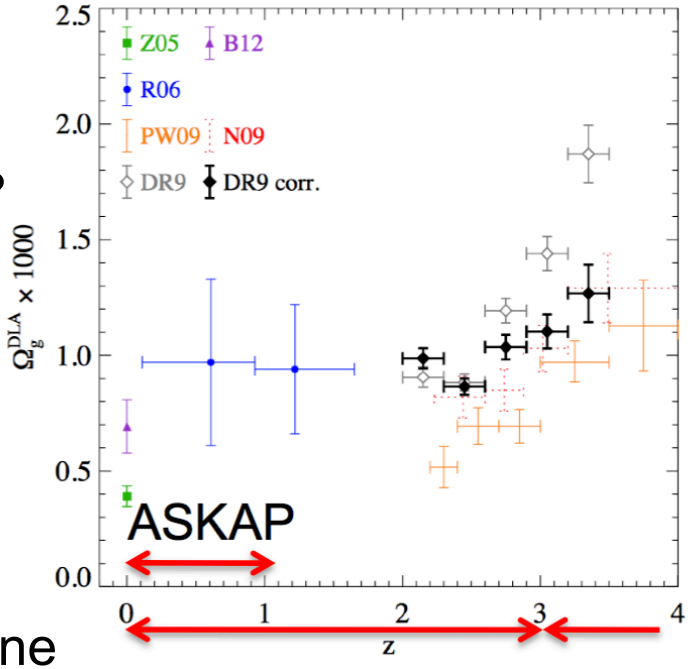

- Detection rate dependent on the background continuum source
  - Can go out to higher redshifts than emission line surveys

The First Large Absorption Survey in HI (FLASH)

- Goals of the FLASH survey (PI: Elaine Sadler):
  - Observe over 150,000 sightlines to bright radio sources
  - Goal of >1000 detections of HI absorption, an order-of-magnitude gain over current surveys
  - Probe neutral gas in the redshift range z=0.5-1. Fill in the gap between low-z HI emission surveys and high-z Lya surveys
  - Accurate spectroscopic redshifts in distant radio galaxies
  - Blind survey – provide an unbiased sample of HI absorbers, both associated and intervening.

ASKAP-FLASH

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The First Large Absorption Survey in HI (FLASH)

ASKAP-FLASH

FLASH Commissioning observations

- Commissioning observations with the 6 antenna BETA array.
- Formed a number of small, targeted samples where we might detect HI absorption
  - GPS/CSS sources (Allison +2015, Allison+ in prep)
  - Known X-ray absorbers (Moss+ in prep)
  - Intervening sample (Sadler+)
  - Red QSOs (Glowacki+)
  - 2-Jy sample (this talk)

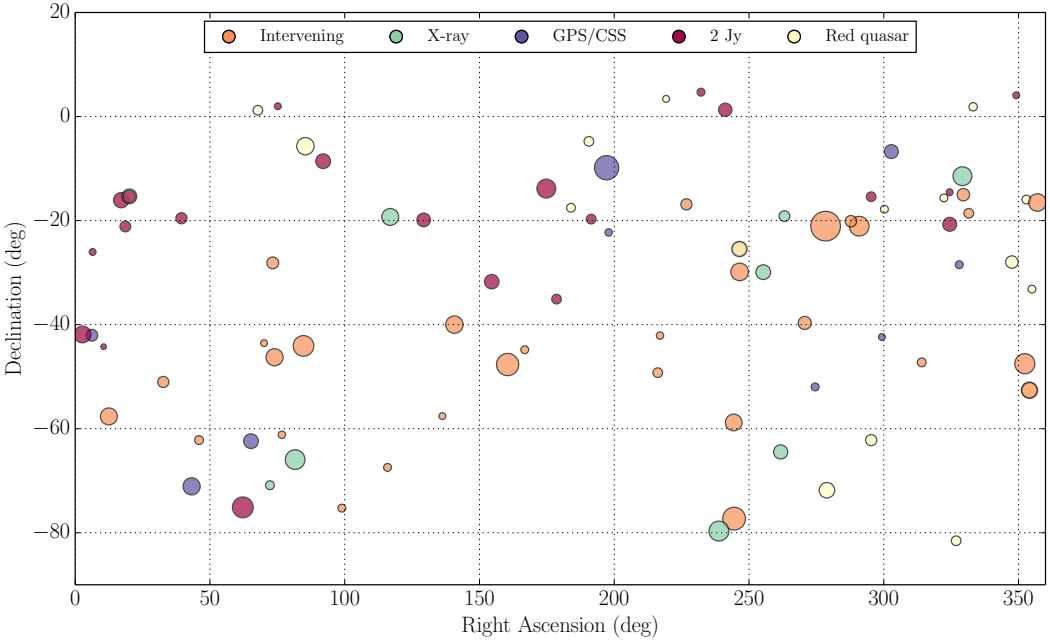


Image credit: Vanessa Moss

- Over 100 sources observed, so far 5 new detections! (data reduction still ongoing)

The 2-Jy sample

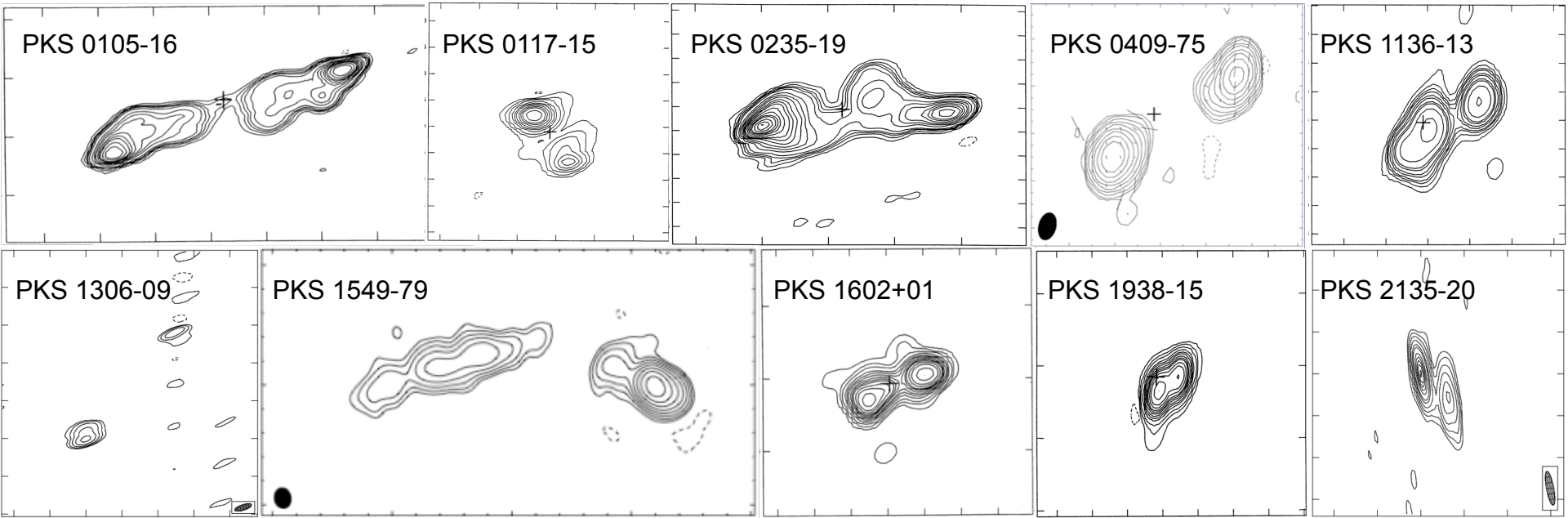
- Sample of the brightest southern radio sources (Wall+ Peacock 1985)
  - Brighter than 2Jy @2.7 GHz
  - Dec<+10
  - Redshift range up to z=0.7
  - http://2jy.extragalactic.info/The_2Jy_Sample.html

- Comprehensive multi-wavelength follow-up (Morganti+93, Tadhunter+93:
  - Deep optical imaging + spectroscopic data from Gemini+ESO
  - Extensive radio imaging with ATCA+VLA across a range of frequencies
  - Near, mid and far-IR from UKIRT, Spitzer, Herschel
  - Chandra and XMM imaging

The 2-Jy sample

› Observations:

- Used band 1 (700MHz – 1GHz), corresponding to redshifts of 0.4-0.7
  - High-z analogue of Morganti+ 2001
- Approximately 3-4 hrs on source. Aim to get to optical depth of ~few per cent.
- Sample of 10 objects



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The 2-Jy sample

Source	z	Cont. flux (Jy)	Hrs obs.	5σ op. depth
PKS 0105-16	0.400	8.6	2.5	2%
PKS 0117-15	0.565	9.1	2.5	2%
PKS 0235-19	0.620	6.5	3	3%
PKS 0409-75	0.693	21.1	3	0.8%
PKS 1136-13	0.554	8.0	4	4%
PKS 1306-09	0.464	7.0	7	1.5%
PKS 1549-79	0.483	6.0	3	2%
PKS 1602+01	0.462	7.7	7.5	1.5%
PKS 1938-15	0.452	12.3	3	2%
PKS 2135-20	0.635	3.8	4	5%

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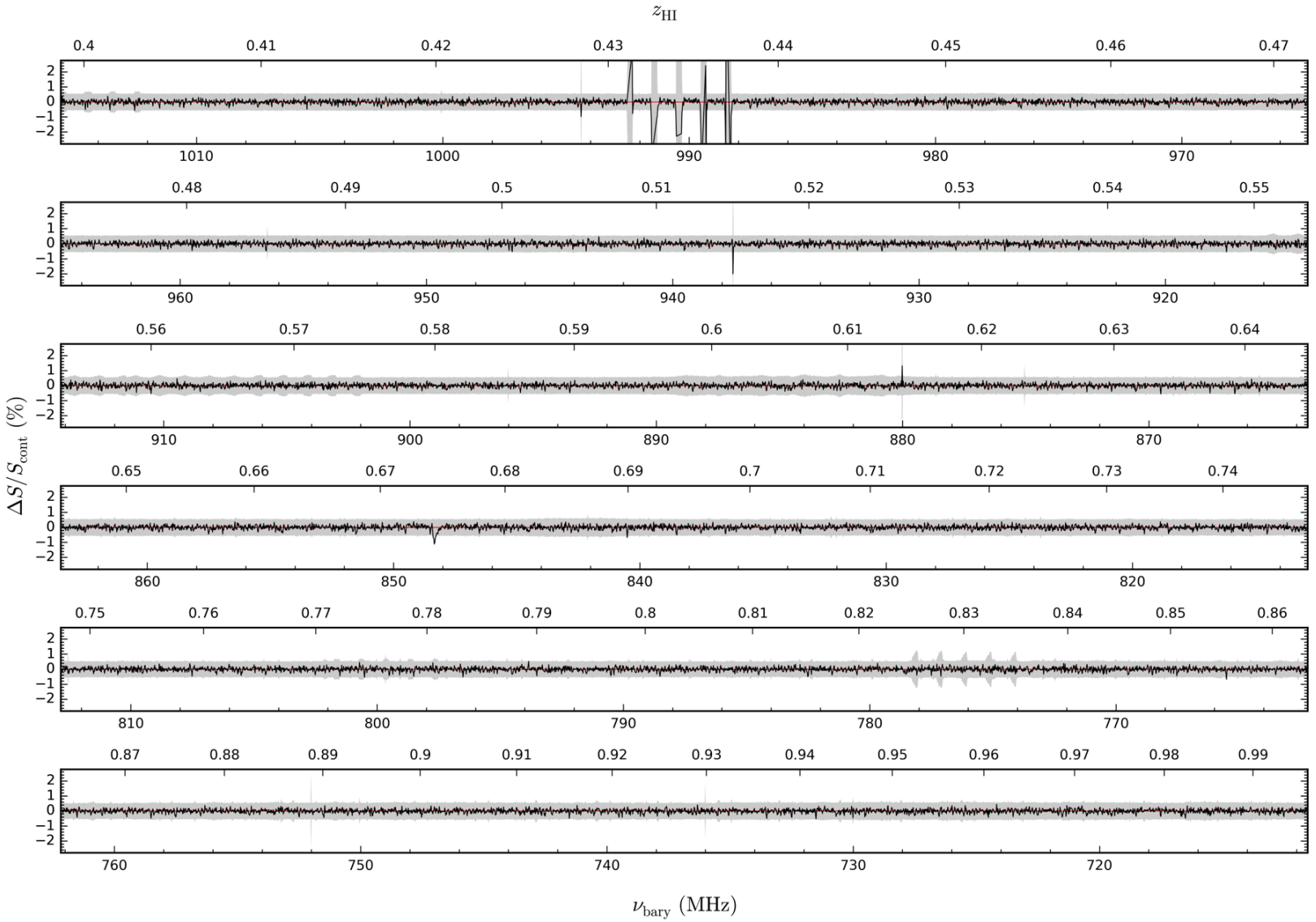
BETA spectra



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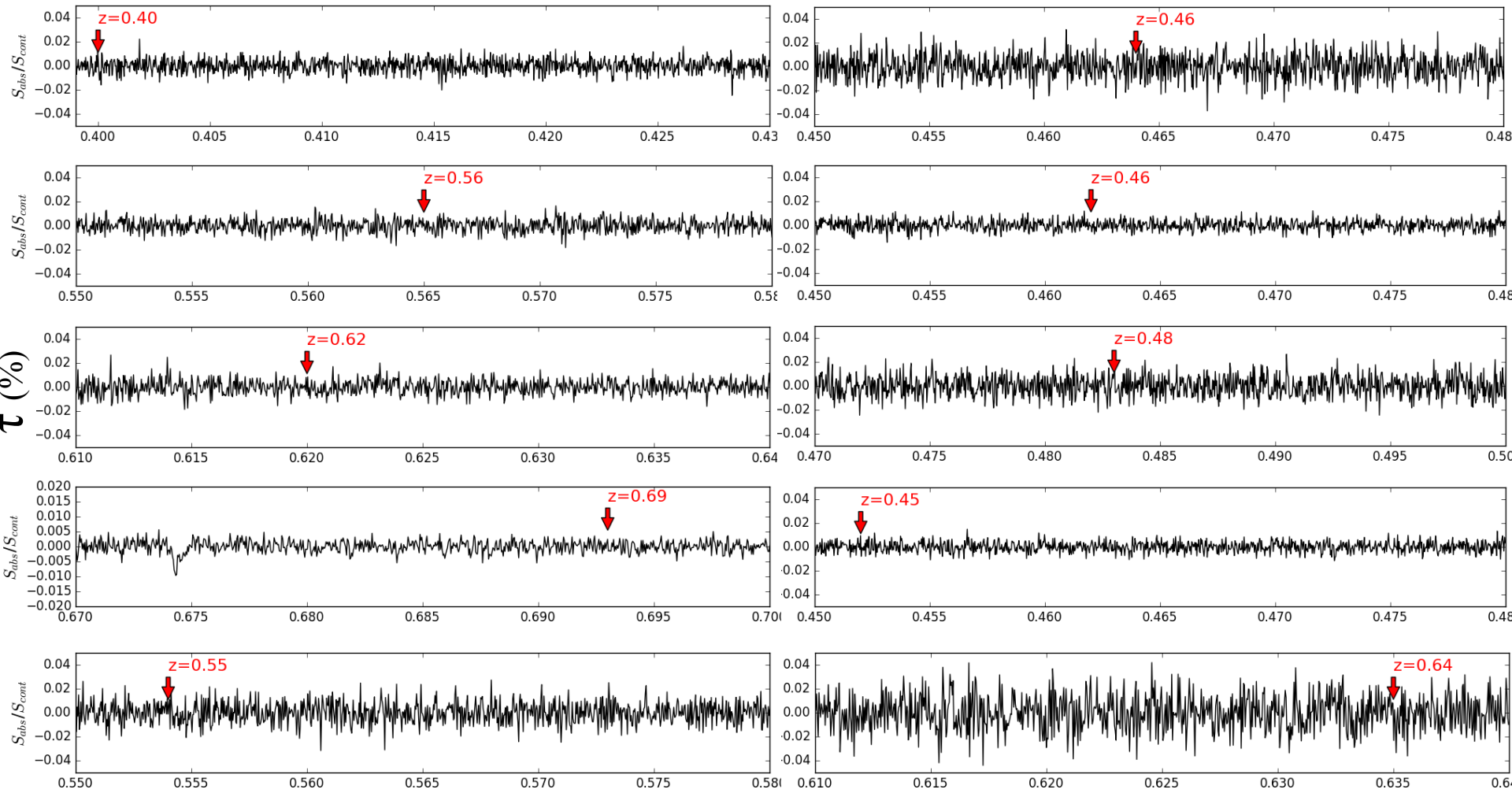

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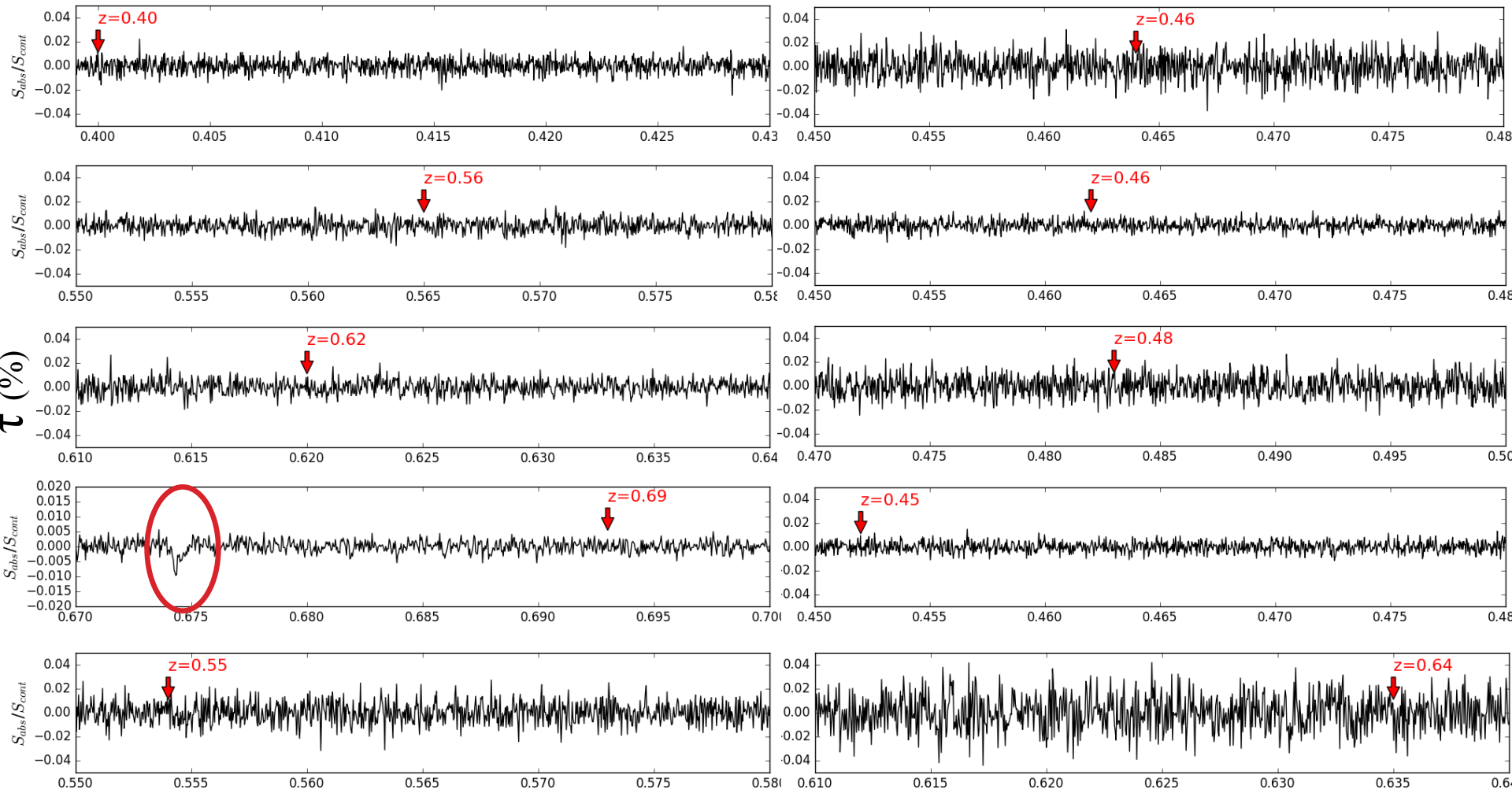
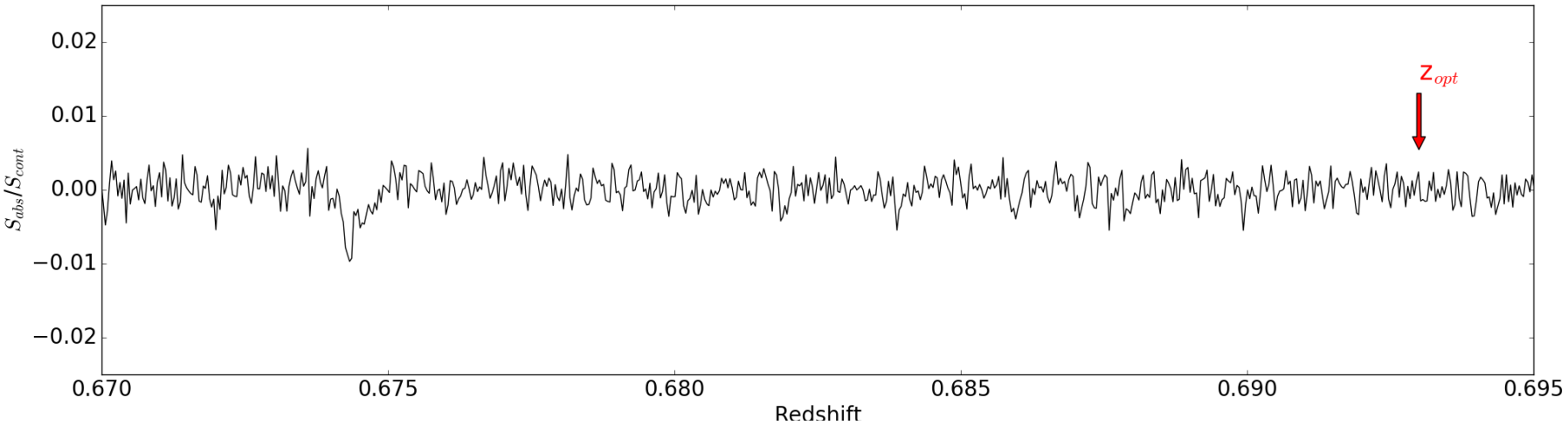
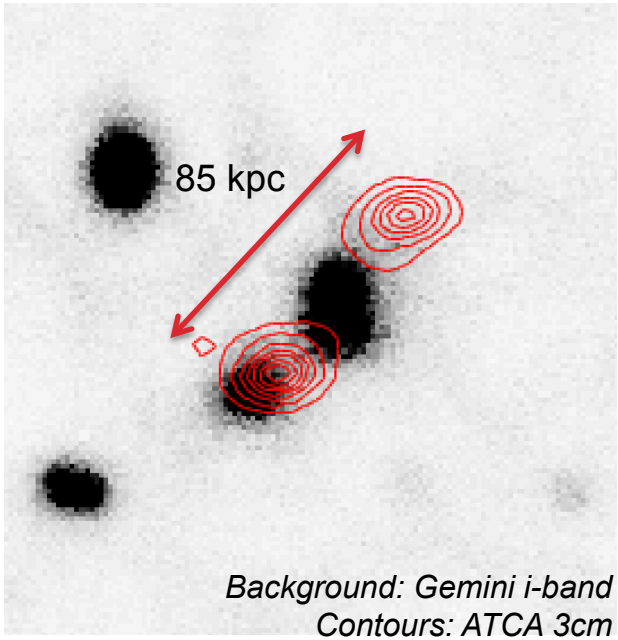
BETA spectra



PKS0409-75



- z_{HI} = 0.674, but z_{opt}=0.693 -> HI blueshifted by 3000 km/s
  - Is this absorption associated with the host galaxy?
  - Or associated with another galaxy in the group?
    - Need follow-up observations for confirmation: optical spectroscopy of nearby source, ALMA
  - A chance alignment?



Background: Gemini i-band
Contours: ATCA 3cm

Multiwavelength data is essential!

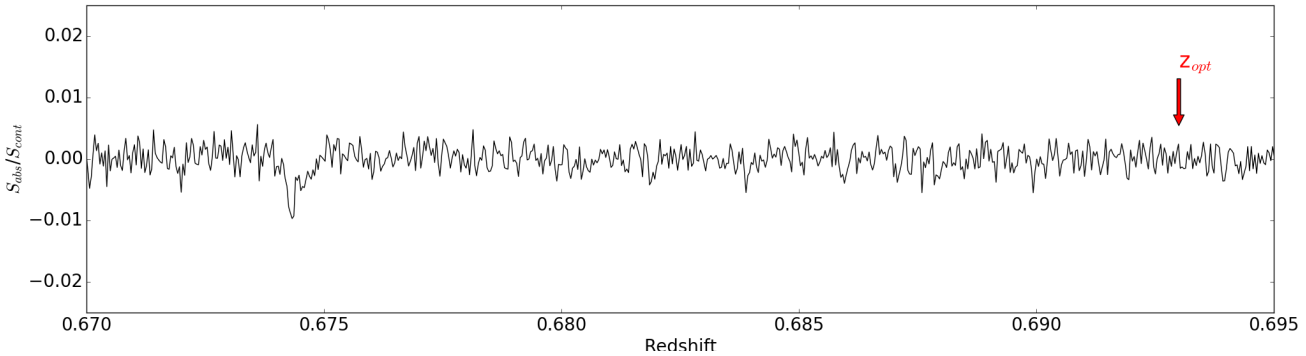
- Already starting to get interesting results even with commissioning data
  - Largely thanks to the unique redshift range and RFI-clean bandwidth.

- BUT – only possible because we already have extensive multi-wavelength data for this sample
  - FLASH will not *just* be a HI survey – multiwavelength data is essential to understand the processes involved. How do we follow-up detections?
    - ALMA -> molecular gas, redshift confirmation
    - MeerKAT -> higher sensitivity
    - ASKAP-MeerKAT VLBI -> higher spatial resolution



Conclusions

- Observed 10 sources selected from the 2-Jy sample with BETA
  - Detected HI absorption in PKS0410-75 at z=0.67, offset from the systemic by 3000 km/s.



- This sample highlights the need for complementary multi-wavelength data to maximise the scientific return of future HI surveys
  - Extensive follow-up of detections will be essential
  - Can we use pilot studies like this to model the source population and extrapolate for larger surveys?

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