Optical follow-up of ASKAP detections

Elizabeth Mahony | CASS Research Scientist

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CSIRO ASTRONOMY AND SPACE SCIENCE
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The FLASH Survey

The First Large Absorption Survey in HI:

- Search ~150,000 sightlines for HI in absorption
- Blind approach: No pre-selection on background target sources
- HI-selected galaxy sample at 0.4<z<1.0.

Detections can be split into two categories:

- **Intervening absorbers:** Study the *cosmic evolution of HI*, testing current galaxy evolution and mass assembly models
- **Associated absorbers:** Study *AGN fuelling and feedback* processes in powerful radio galaxies

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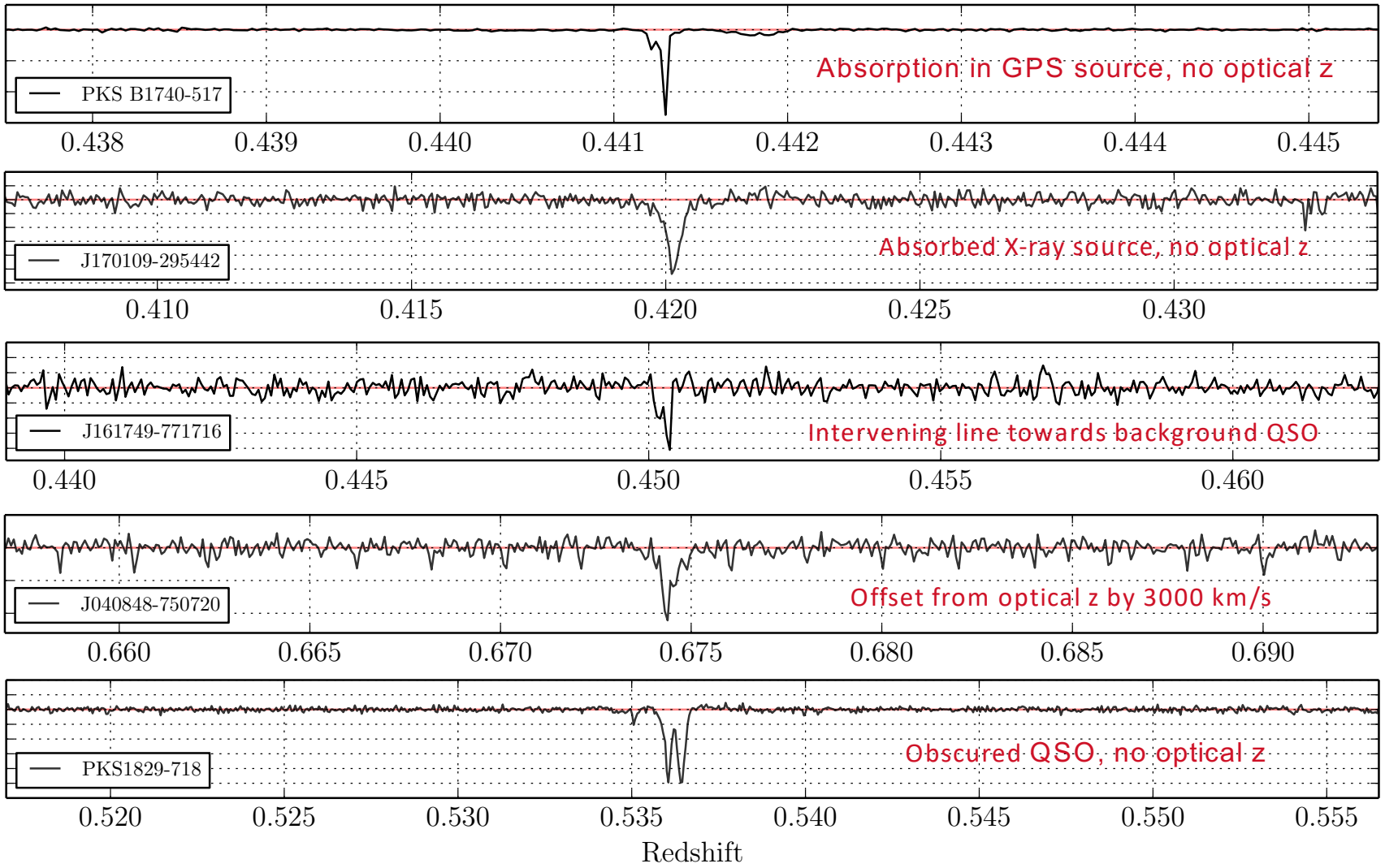
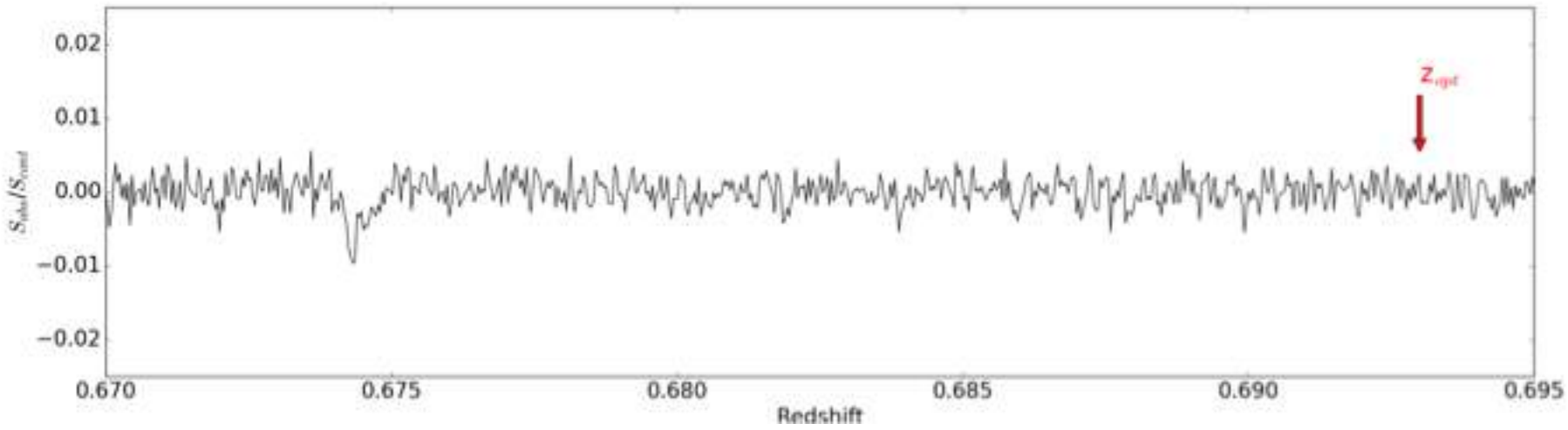
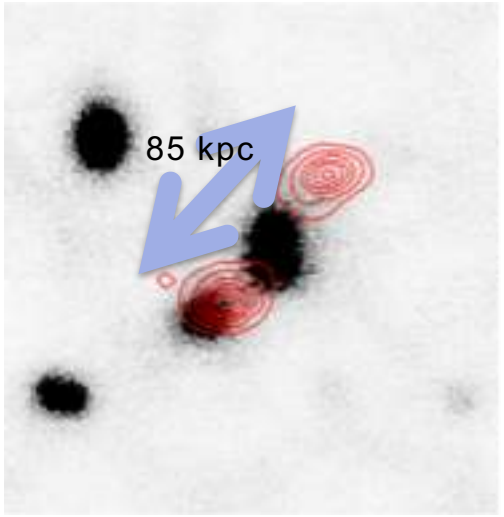
New ASKAP detections



PKS 0409-75: HI absorption against radio lobe

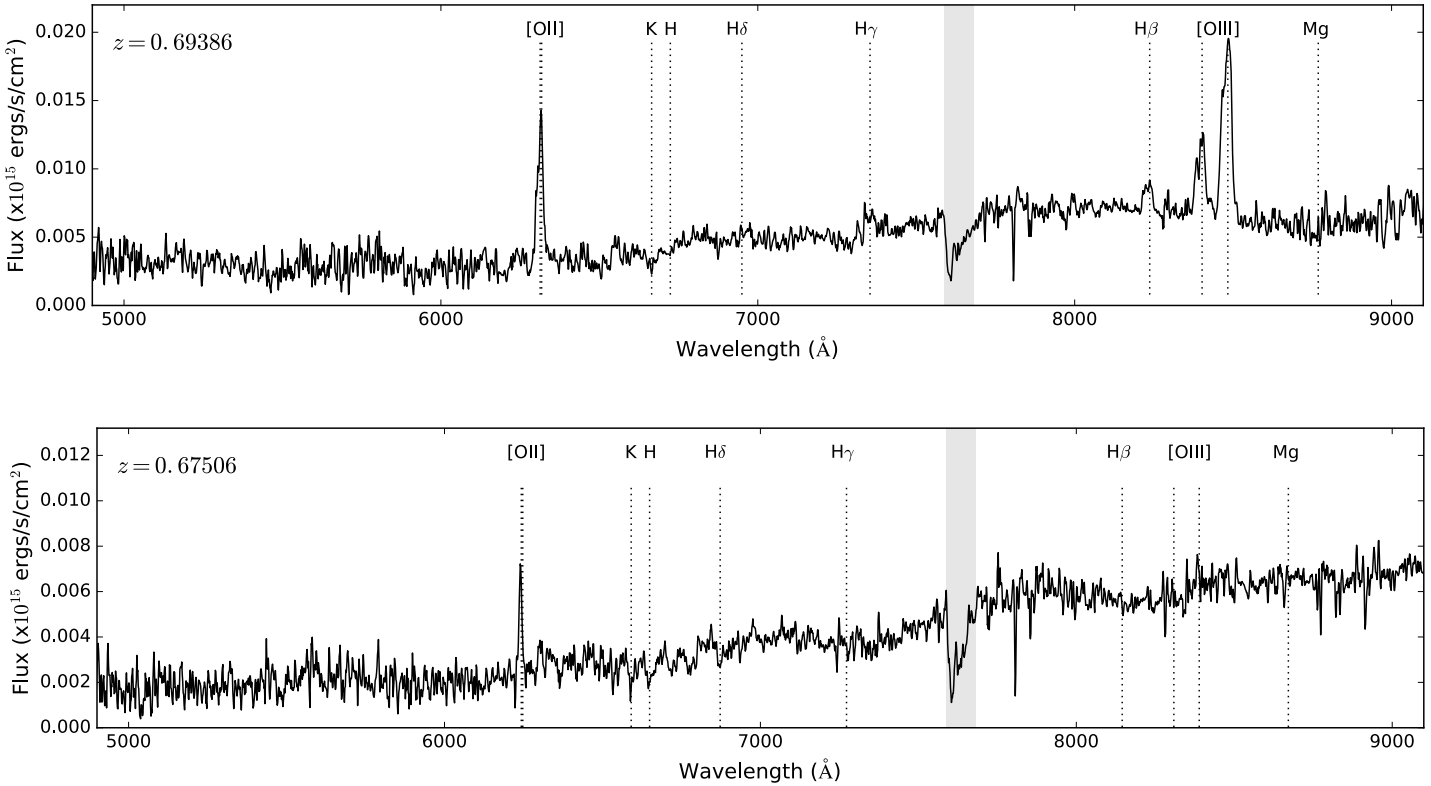


- z_{HI} = 0.674, but z_{opt}=0.693 -> HI blueshifted by 3000 km/s
  - Is this absorption associated with the host galaxy?
  - Or associated with another galaxy in the group?
    - Need follow-up observations for confirmation: optical spectroscopy of nearby source, ALMA
  - A chance alignment?



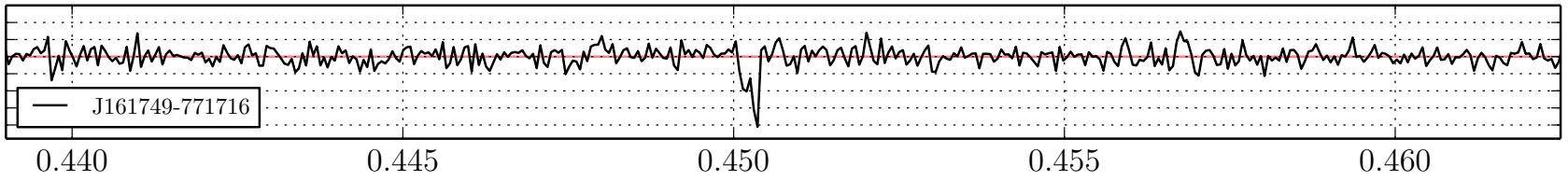
Mahony+ in prep

PKS 0409-75: HI absorption against radio lobe



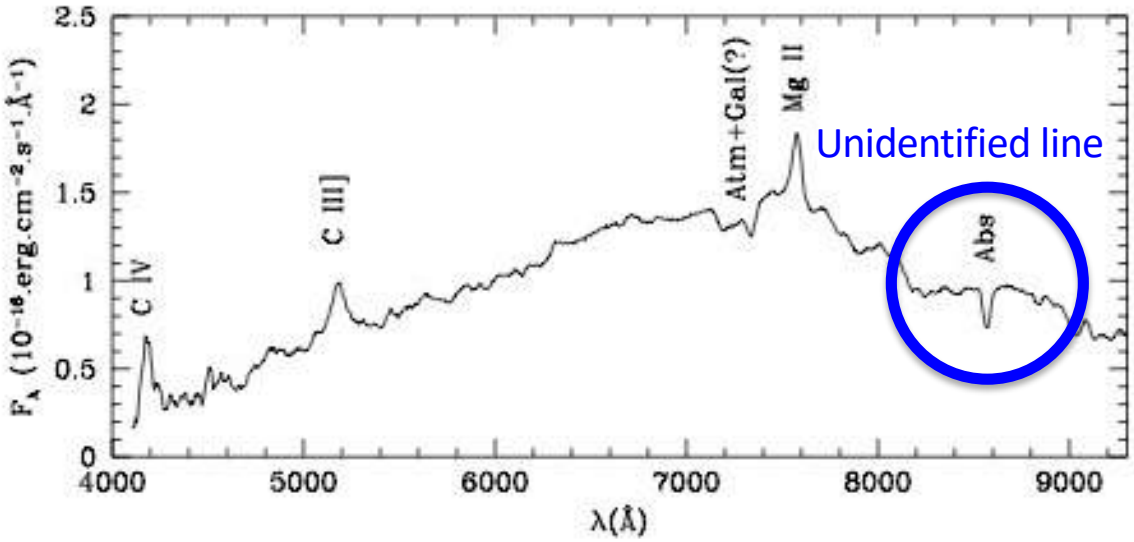
PKS 1610-77: Intervening absorption towards background QSO

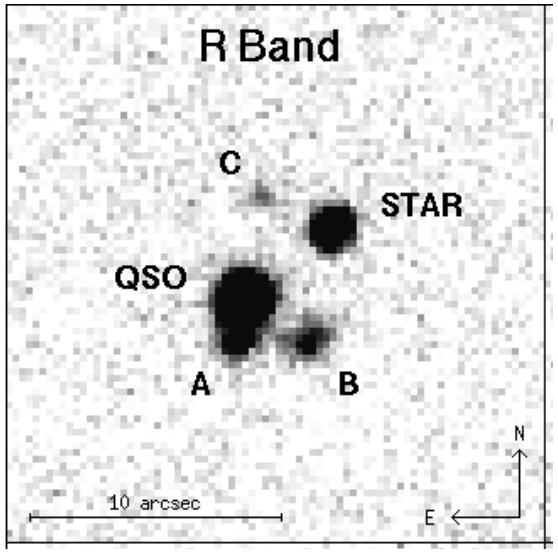
ASKAP spectrum



Sadler+ in prep

QSO @ z = 1.7





Courbin+ 1997

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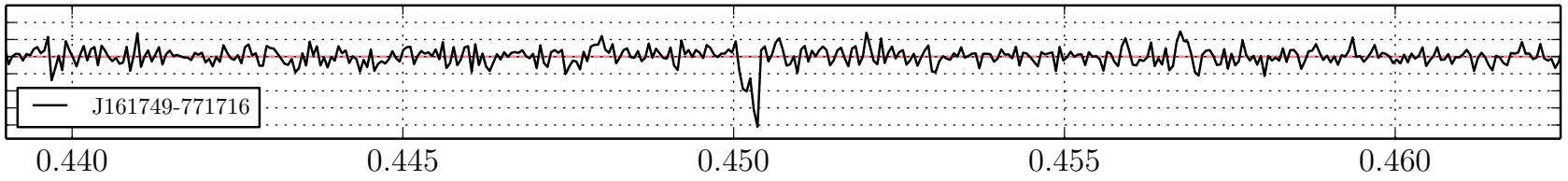

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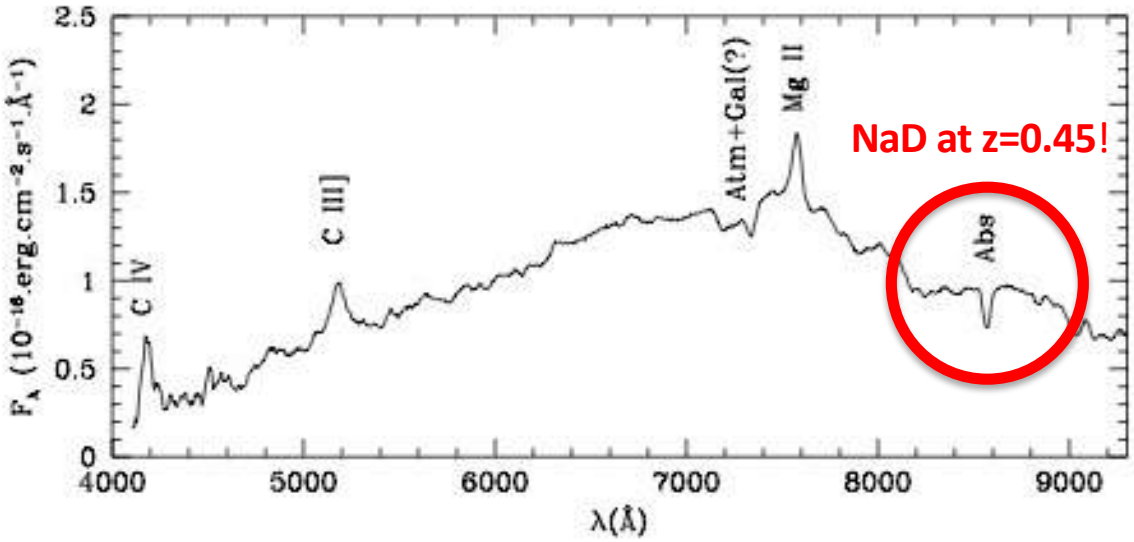
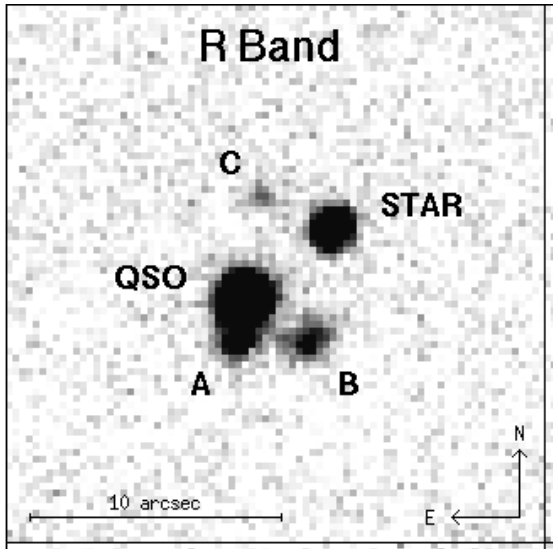
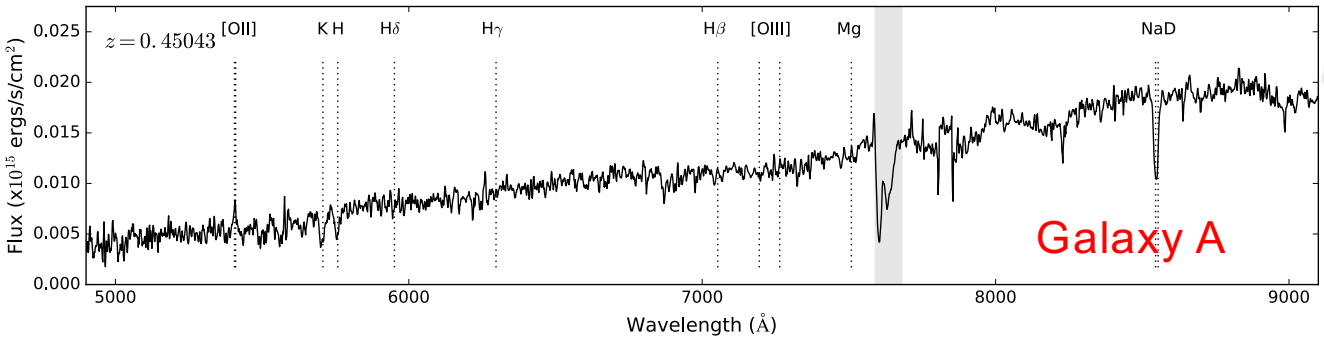


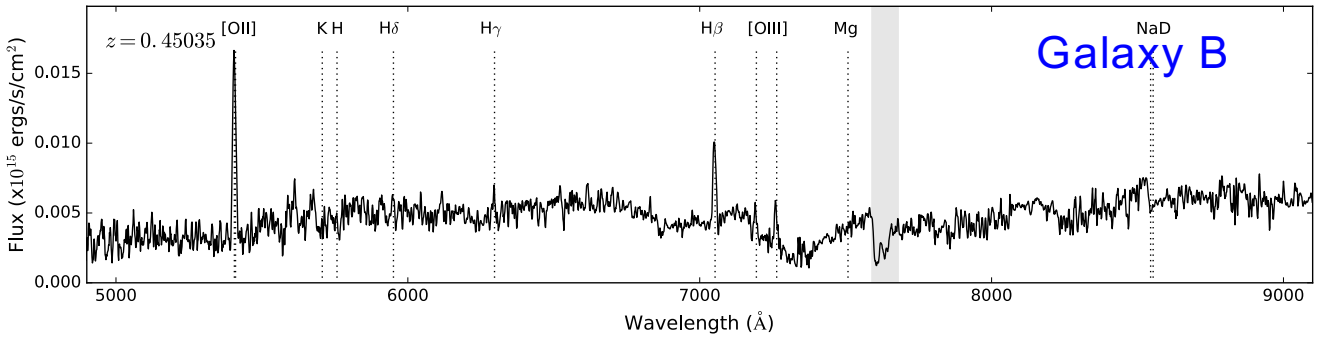


Courbin+ 1997

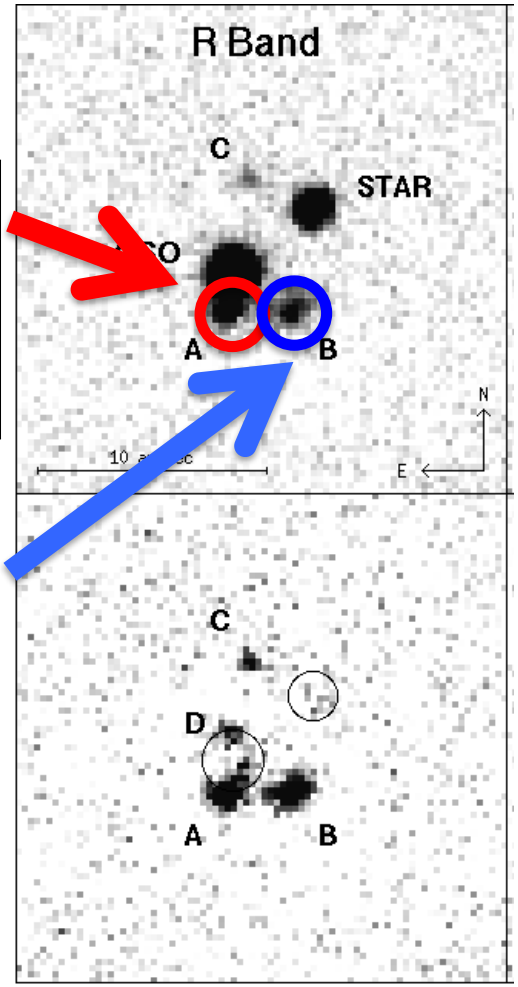
PKS 1610-77: HI selected galaxy group at z=0.45

- Optical follow-up with Gemini-South:

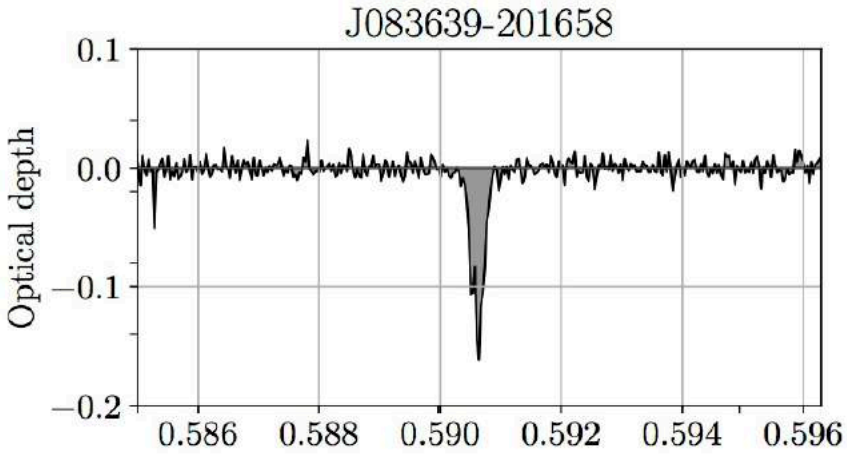




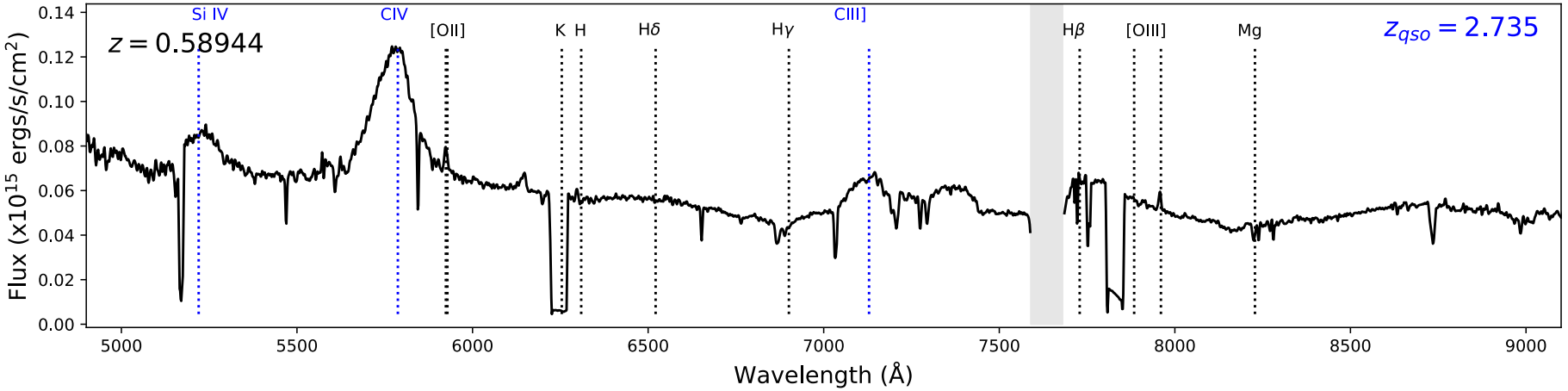
Sadler+ in prep



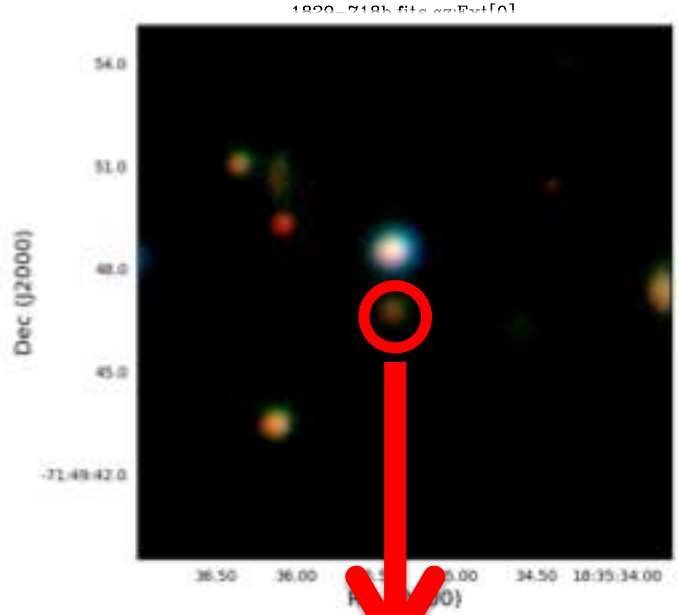
PKS 0834-20 – a new intervening detection

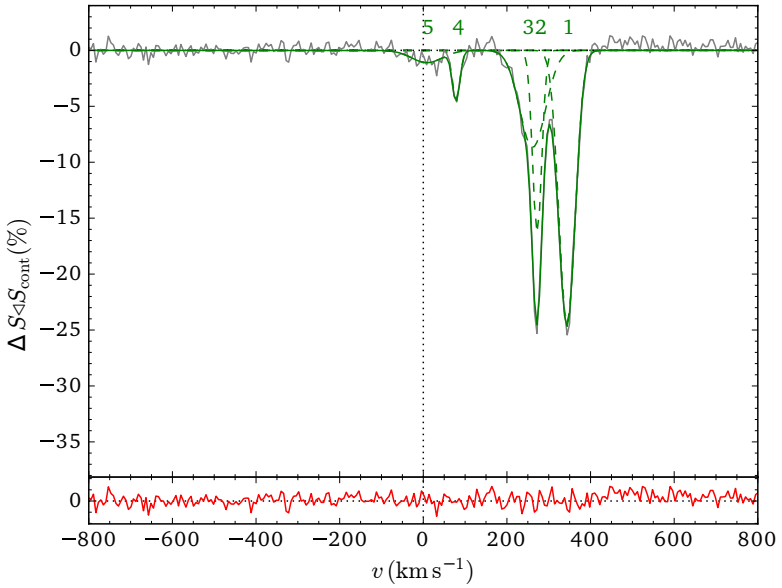


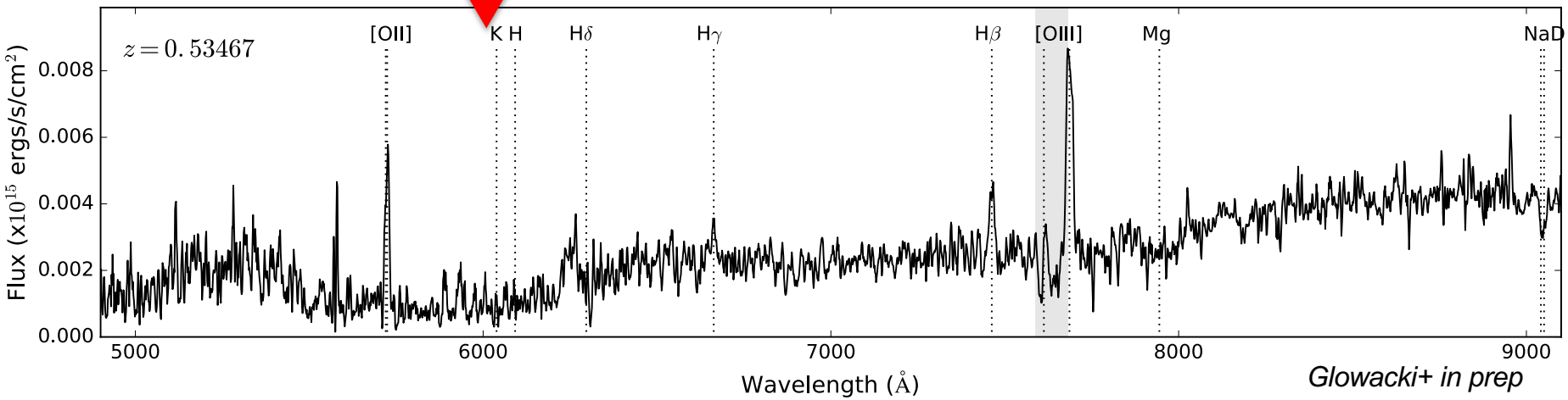
Detection of neutral hydrogen in a galaxy at z=0.59 along the line of sight to a powerful QSO at z=2.7



PKS 1829-718: associated absorption at z=0.54



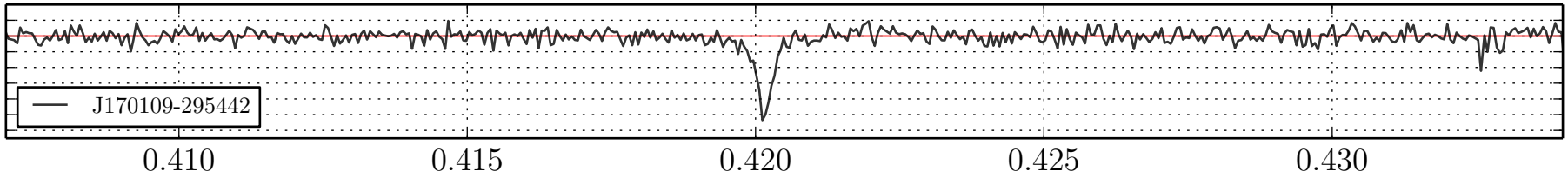




Glowacki+ in prep

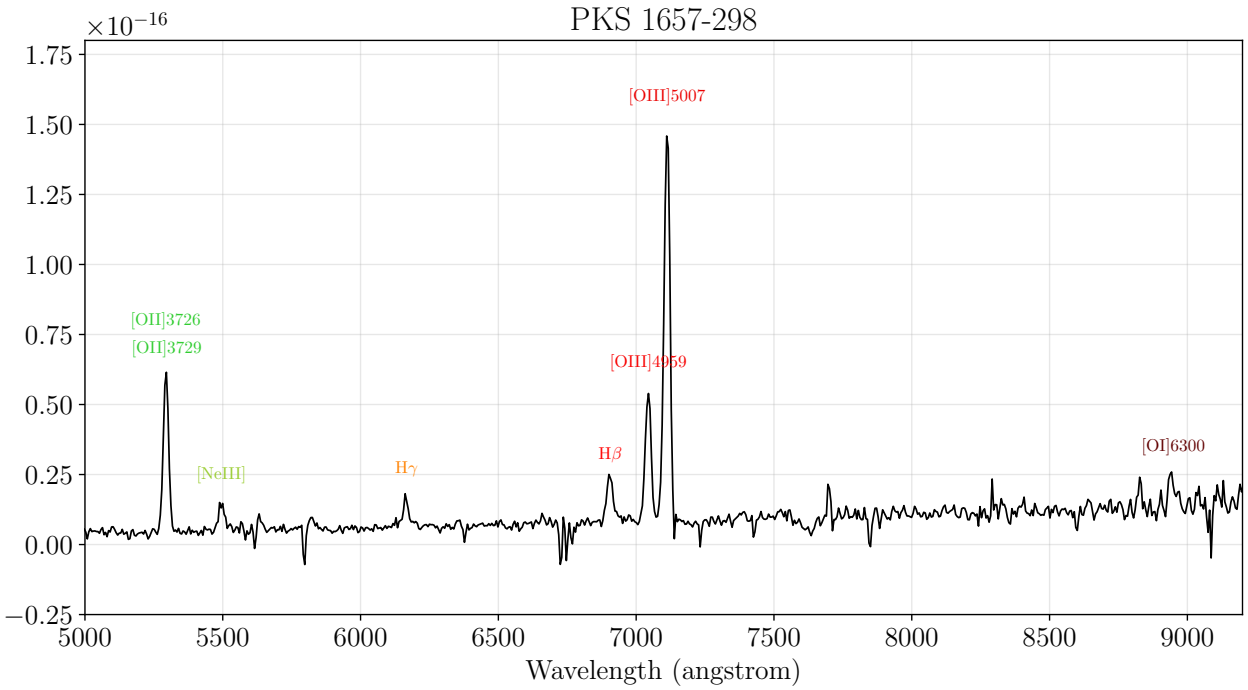
PKS 1657-298: associated absorption at z=0.42

ASKAP spectrum



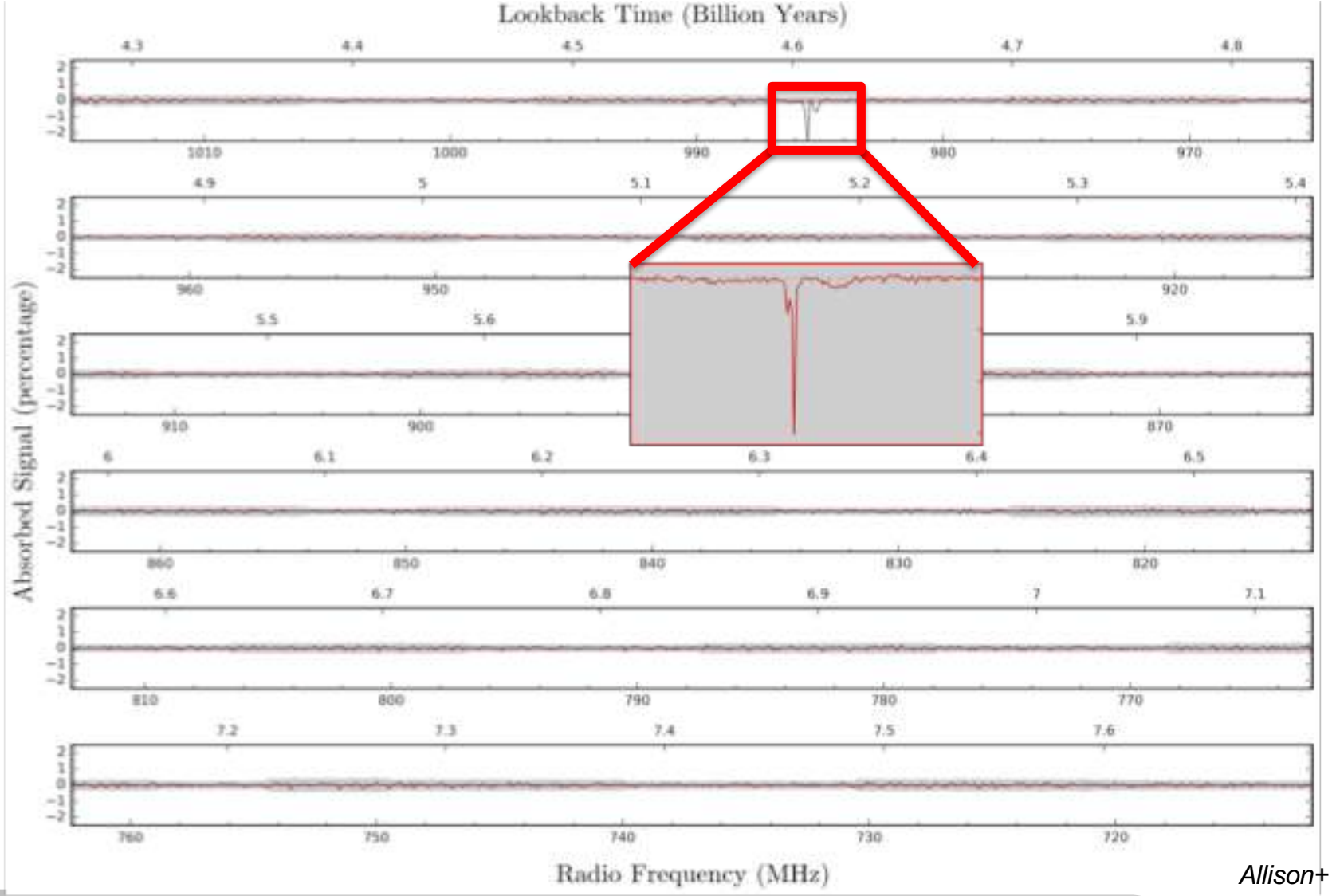
- Optical follow-up with NTT
- Confirms associated system at z=0.42

- See Vanessa's talk tomorrow



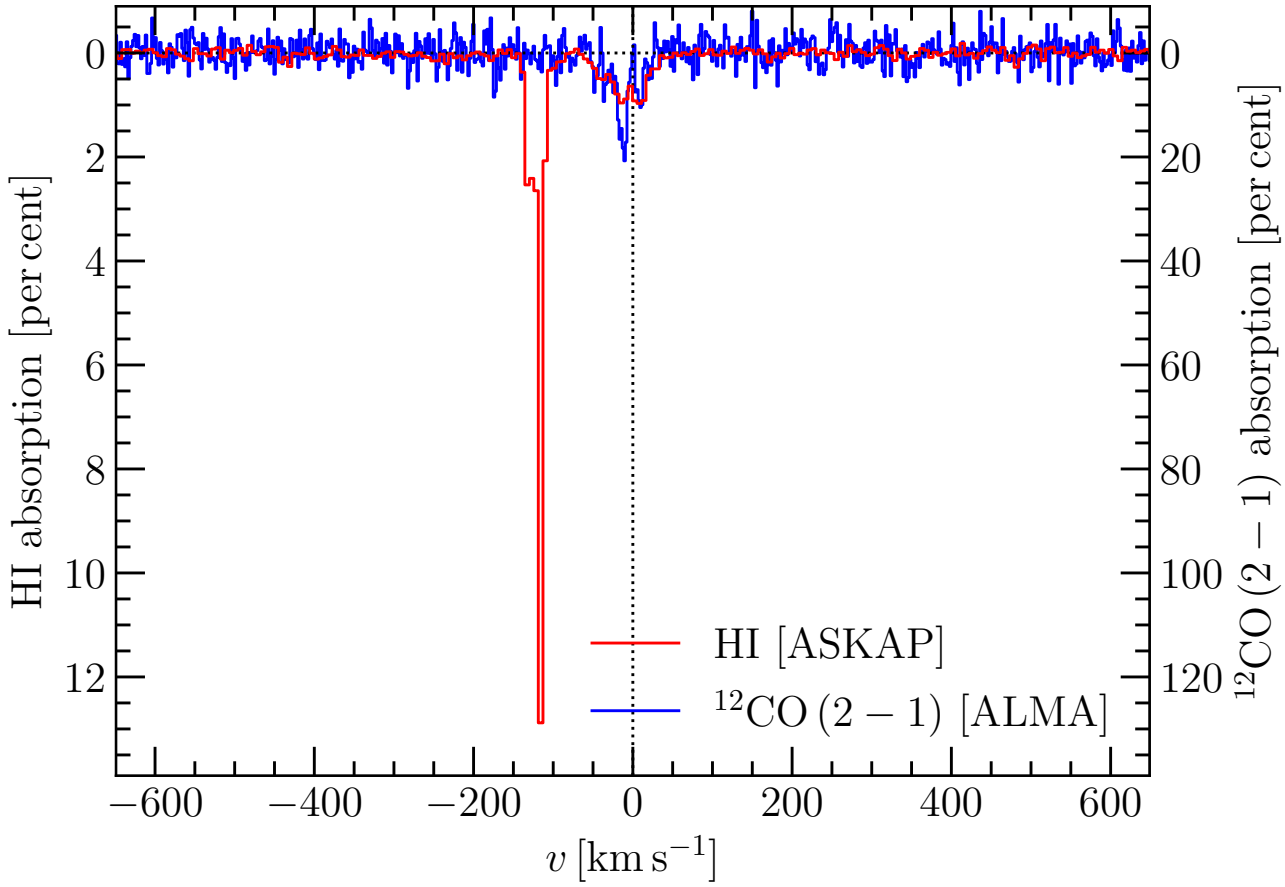
Moss+ in prep

PKS 1740-517: The first new ASKAP detection



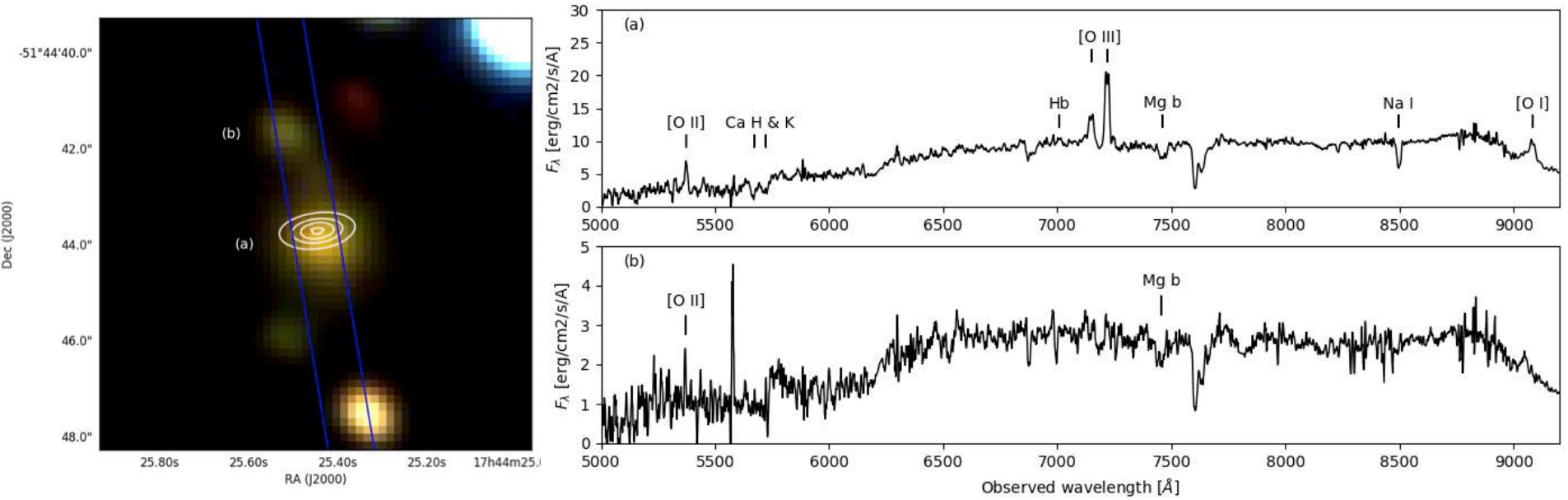
Allison+ 2015

PKS 1740-517: ALMA follow-up



Allison+ submitted

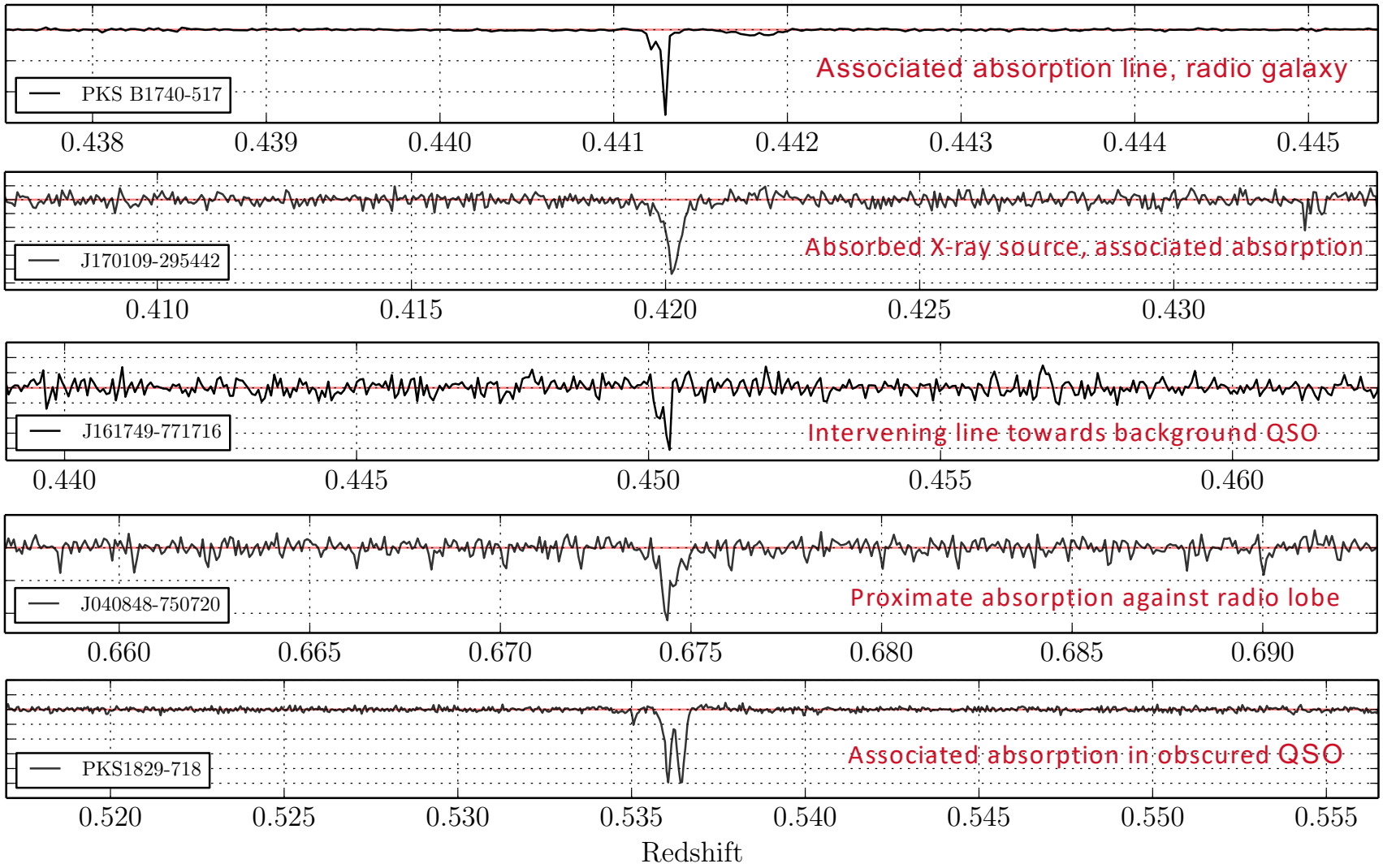
PKS 1740-517: ALMA follow-up



Allison+ submitted

- Optical follow-up indicates interacting satellite galaxy + tidal stream
  - Is this responsible for the narrow HI absorption?

New ASKAP detections – what have we learned?



Multiwavelength follow-up is essential!

- FLASH will not *just* be a HI survey – multiwavelength data is essential to understand the processes involved. How do we follow-up detections?
  - Redshift of background radio sources -> Taipan, photo-z's?
  - High resolution radio data -> VLBI, MWA IPS

Need in advance

  - Deep optical/IR imaging of HI absorber -> 8m telescopes?
  - Molecular/ionised gas properties -> ALMA, MUSE, SAMI/Manga
  - Higher sensitivity absorption -> MeerKAT, uGMRT

Follow-up

Future follow-up strategies – Taipan survey

Taipan is a multi-object spectroscopic galaxy survey starting observations in late 2017 that will cover the whole southern sky and will obtain spectra for over 1 million galaxies in the local Universe (z<0.3) over 4 years. This will be ***the most comprehensive spectroscopic survey of the southern hemisphere ever undertaken***.

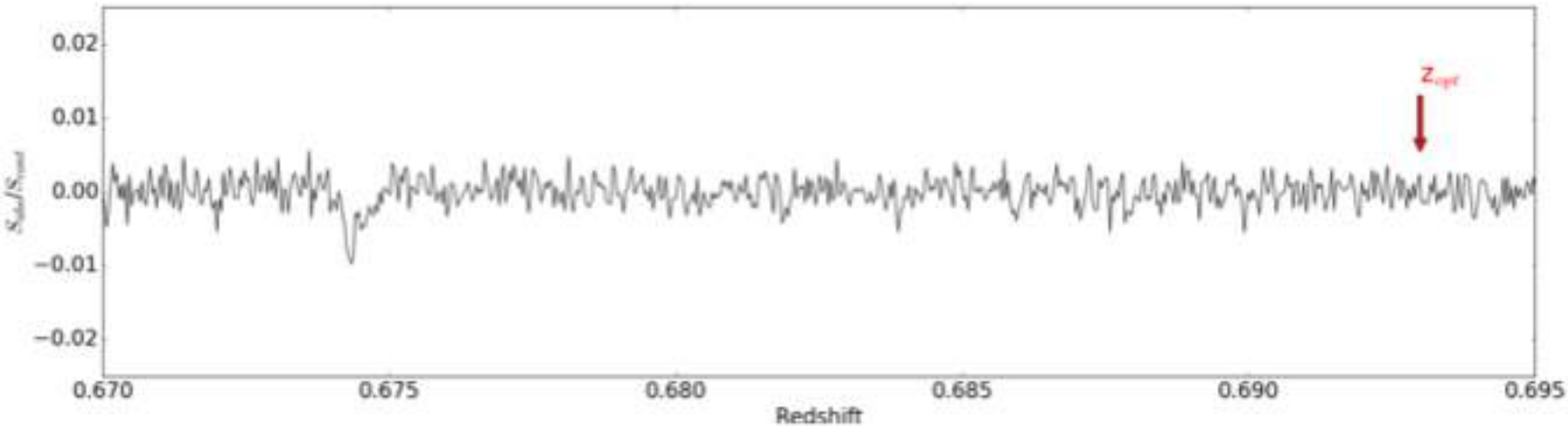
- Main survey K-band selected (2MASS extended sources)
  - 300 fibres over 6 sq. deg
- Approved 'ancillary science' for 20,000 FLASH targets
- Selection criteria:

- SUMSS/NVSS sources above 40 mJy.
- declination < +10
- exclude galactic plane (|b|>10)
- WISE match within 5 arcsec (from the AllWISE catalogue)
- W1<17 & W1-W2>0.6 (i.e. QSOs and HERGs)

How do we scale up to full FLASH survey?

- Primary goal -> separate between associated and intervening absorbers
  - Are there other ways to do this besides spectroscopic follow-up?

- Are photometric redshifts good enough?



How do we scale up to full FLASH survey?

- Are there other methods for separating associated vs. intervening?
  - E.g. machine learning?

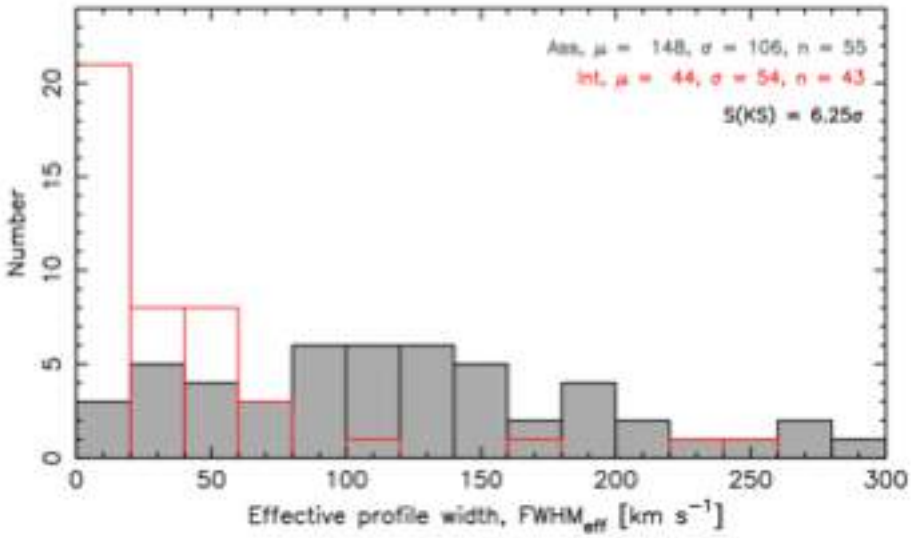


Table 5. The confusion matrices for the models in Table 4.

	Whole sample	Excluding $\tau_{peak} \geqslant 0.3$
Bayesian Network	$\begin{bmatrix} 43 & 12 \\ 7 & 36 \end{bmatrix}$	$\begin{bmatrix} 44 & 8 \\ 7 & 31 \end{bmatrix}$
Sequential Minimal Optimisation	$\begin{bmatrix} 39 & 16 \\ 5 & 38 \end{bmatrix}$	$\begin{bmatrix} 37 & 15 \\ 6 & 32 \end{bmatrix}$
Classification Via Regression	$\begin{bmatrix} 43 & 12 \\ 8 & 35 \end{bmatrix}$	$\begin{bmatrix} 41 & 11 \\ 11 & 27 \end{bmatrix}$
Logistic Model Tree	$\begin{bmatrix} 44 & 11 \\ 8 & 35 \end{bmatrix}$	$\begin{bmatrix} 40 & 12 \\ 8 & 30 \end{bmatrix}$
Random Forest	$\begin{bmatrix} 46 & 9 \\ 9 & 34 \end{bmatrix}$	$\begin{bmatrix} 44 & 8 \\ 9 & 29 \end{bmatrix}$

Curran+ 2016

- How can we best combine observations and simulations?

We acknowledge the Wajarri Yamatji people as the traditional owners of the Observatory site.

Thank you

CSIRO Astronomy and Space Science
Elizabeth Mahony

t +61 2 9372 4143
e elizabeth.mahony@csiro.au