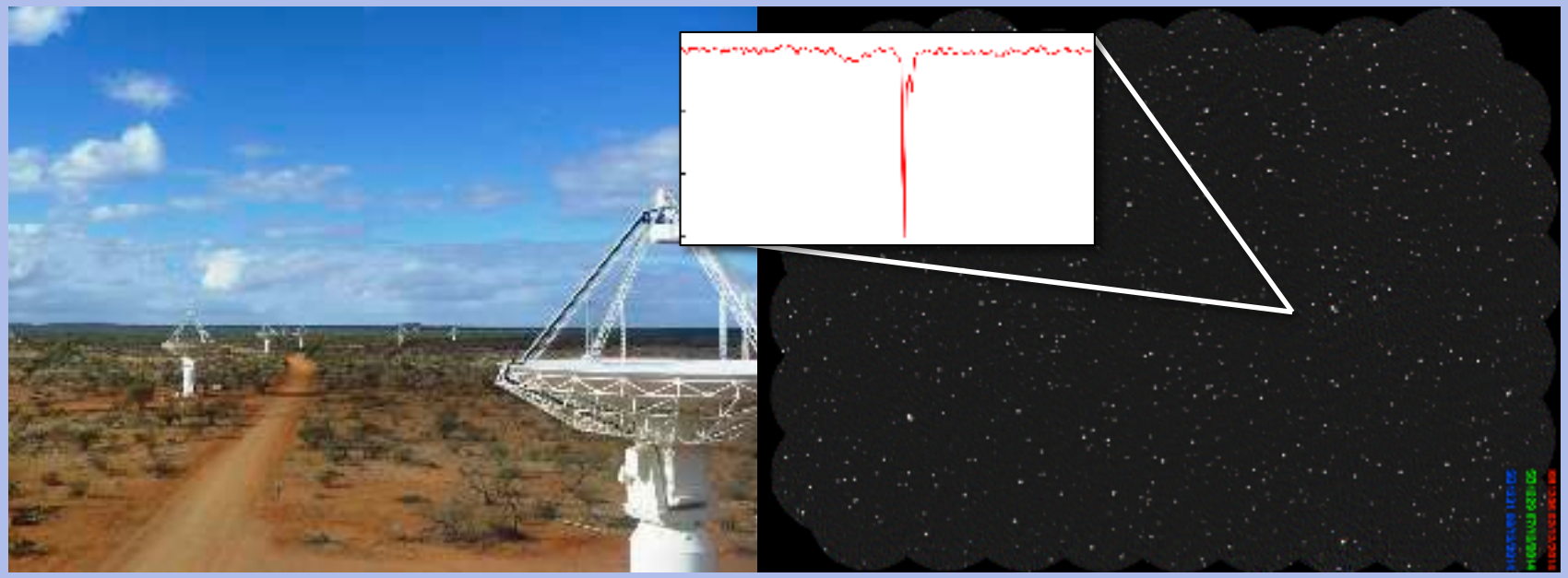


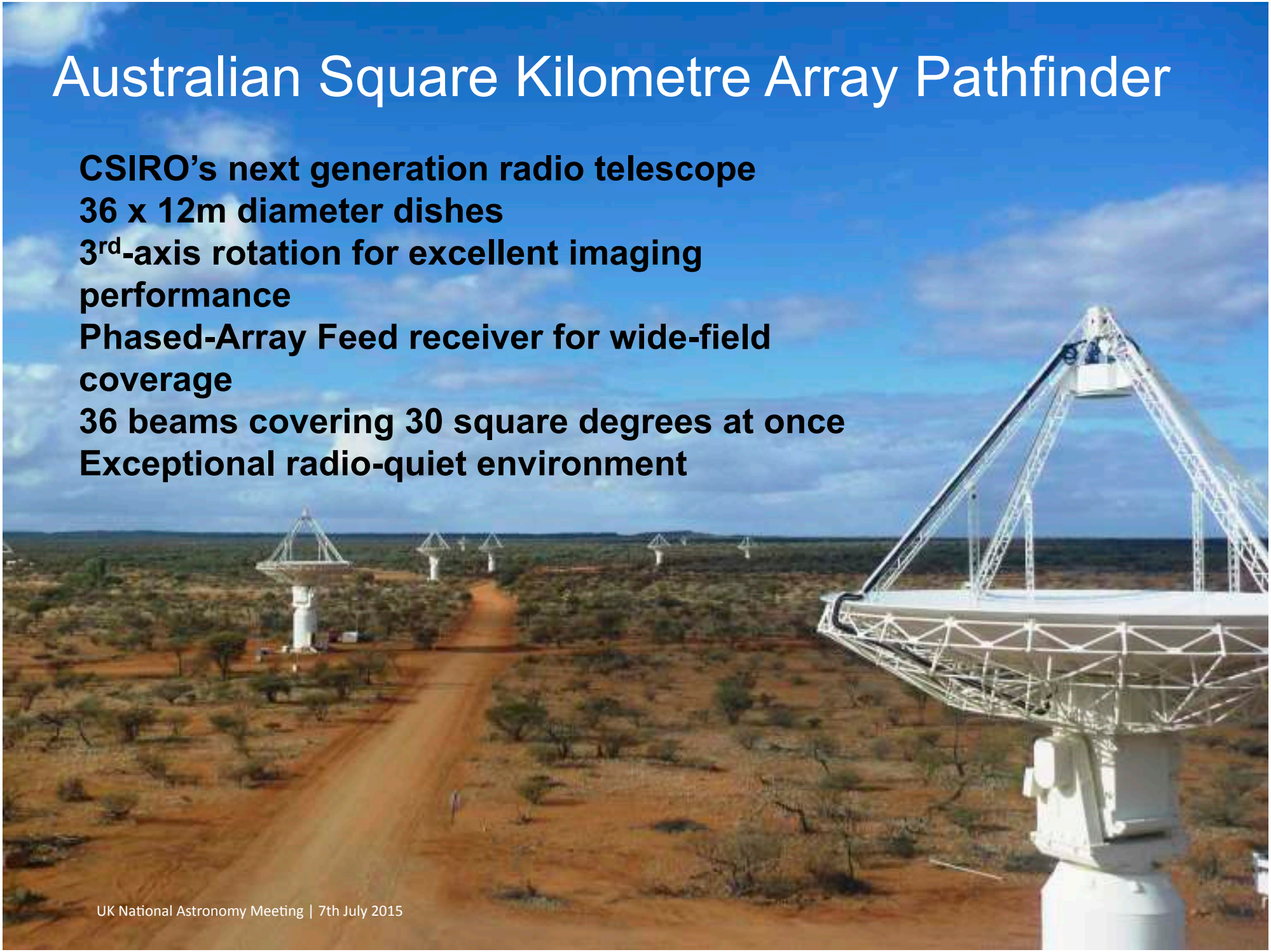
Discovery of HI absorption in a distant young radio galaxy with ASKAP

James Allison (Bolton Fellow)

CSIRO ASTRONOMY & SPACE SCIENCE
www.csiro.au

Australian Square Kilometre Array Pathfinder

CSIRO's next generation radio telescope
36 x 12m diameter dishes
3rd-axis rotation for excellent imaging performance
Phased-Array Feed receiver for wide-field coverage
36 beams covering 30 square degrees at once
Exceptional radio-quiet environment



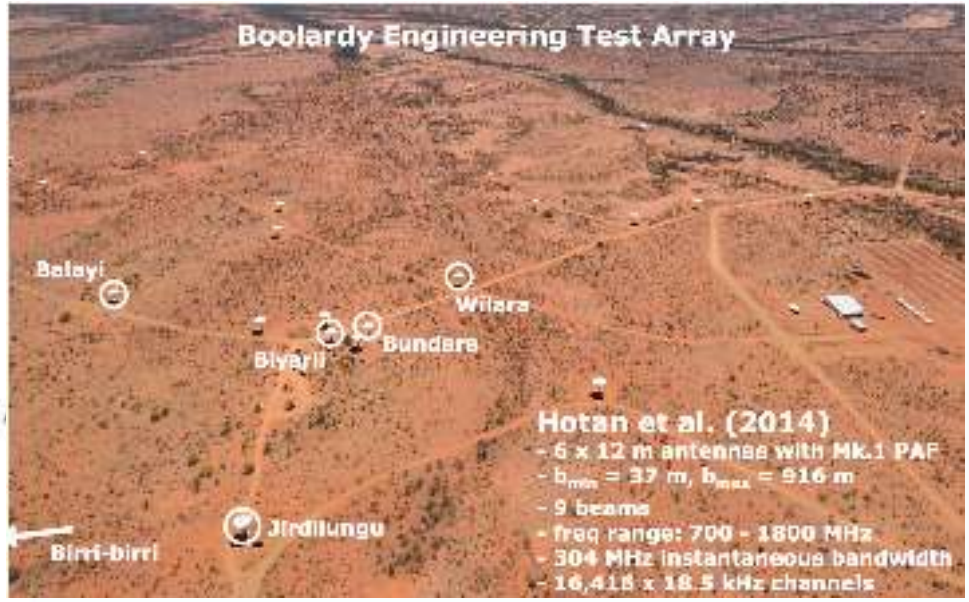
BETA - the Boolardy Engineering Test Array

What is BETA?

- a prototype for ASKAP
- 6 antennas fitted with Mark I PAFs and signal processing backend
- limited to 9 dual-pol beams

Table 1 Key parameters of the BETA telescope.

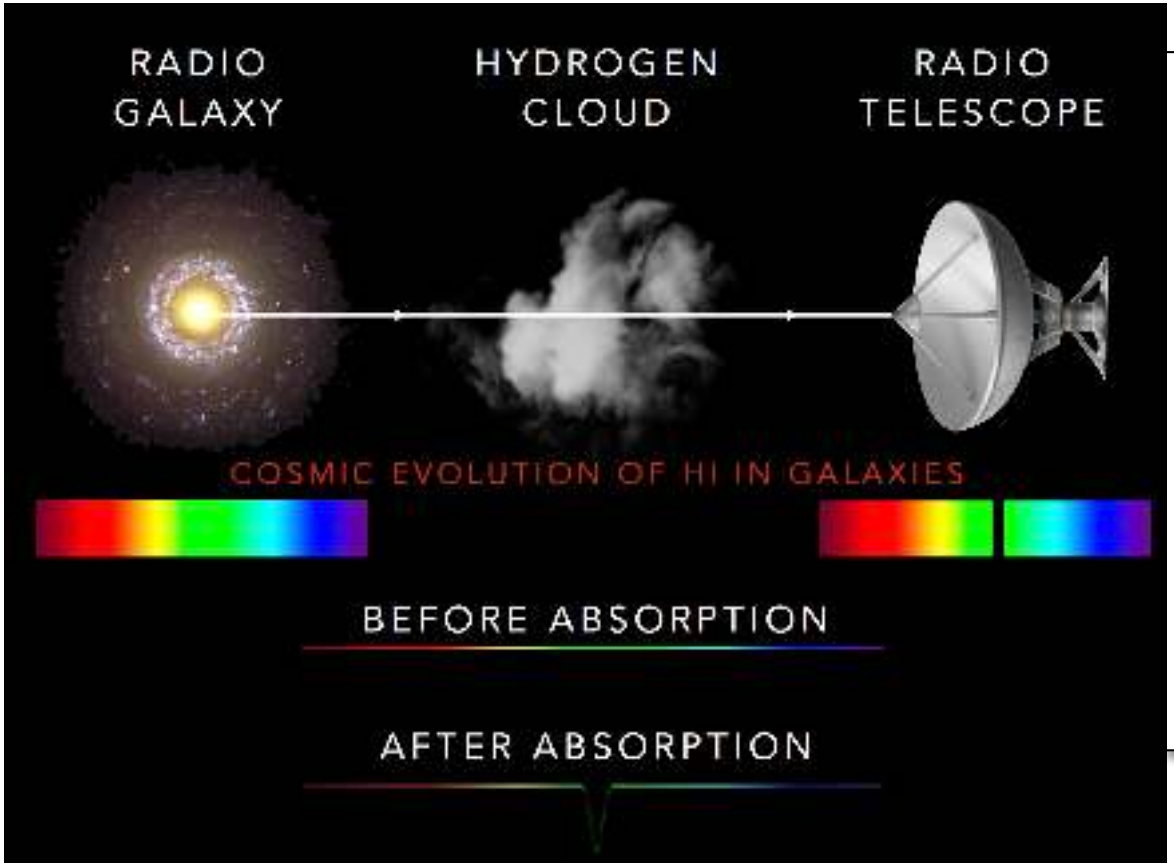
Number of Antennas	6
Antenna Diameter	12 m
Total Collecting Area	678.6 m^2
Maximum Baseline	916 m
Angular Resolution	1.3′ (see Fig. 4)
Observing Frequency	0.7 to 1.8 GHz
Simultaneous Bandwidth	304 MHz
Frequency Channels	16416
Frequency Resolution	18.5 kHz
Simultaneous Beams	9 (dual-pol)
Minimum Integration Time	5 s

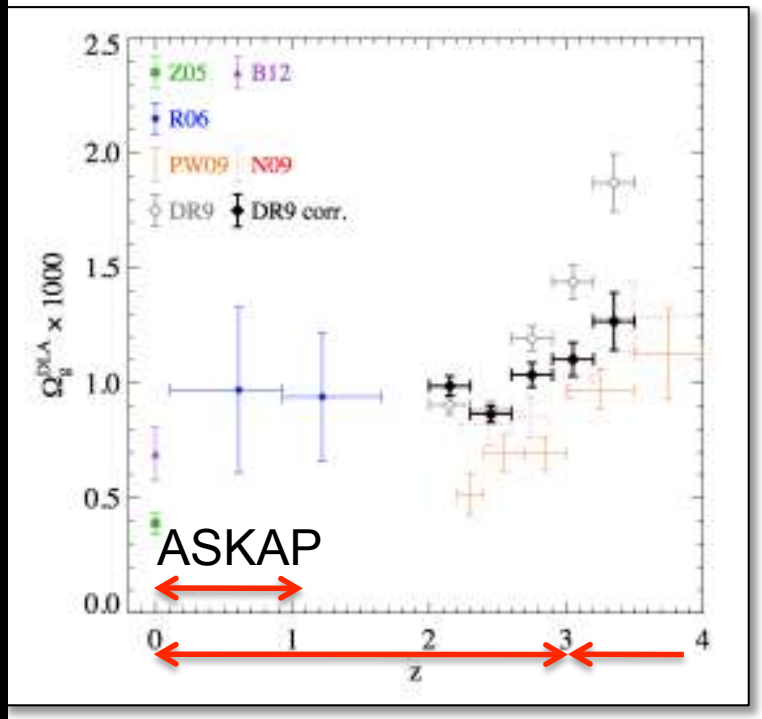


The Tucana Field (Ian Heywood/CSIRO)

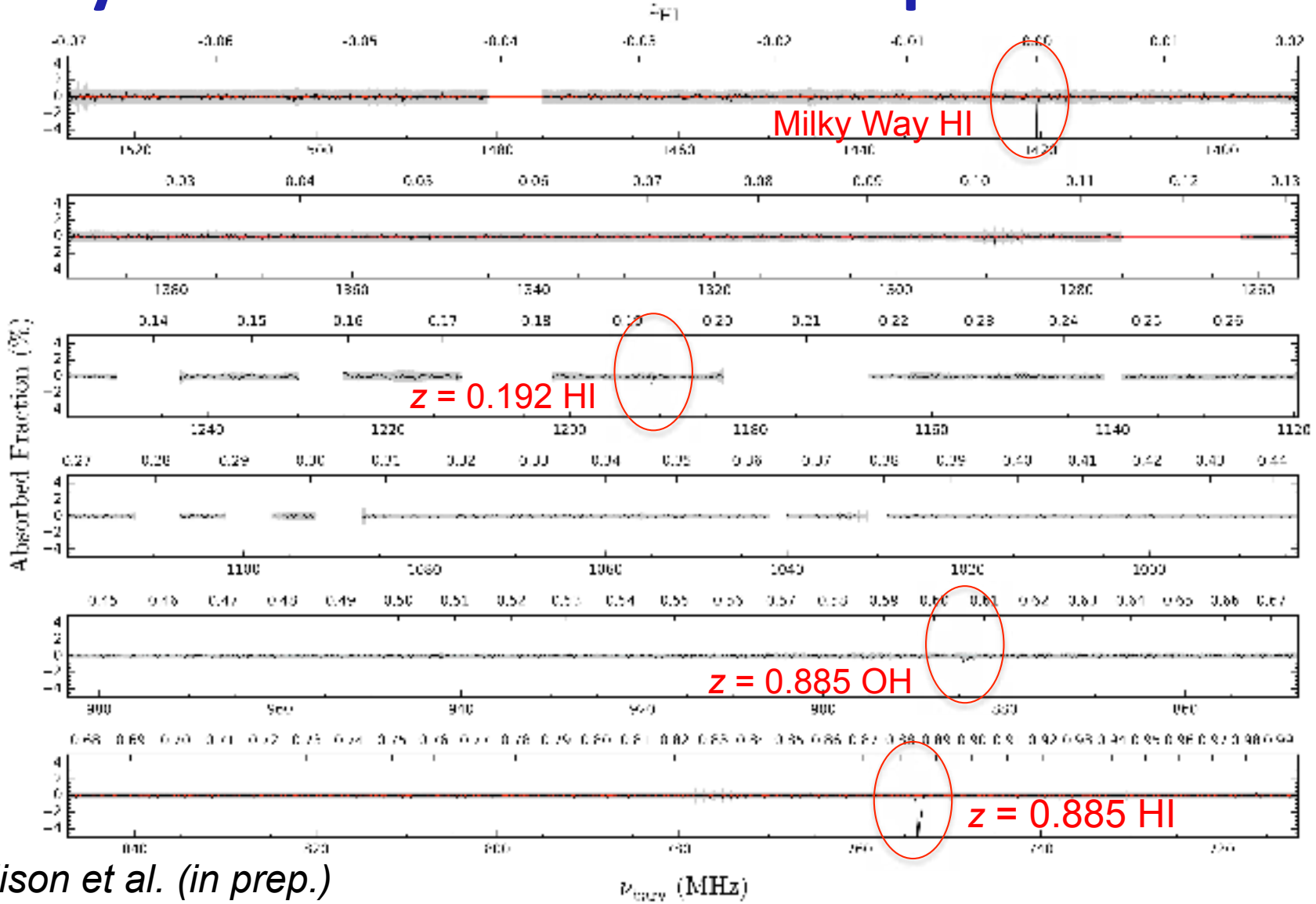
HI absorption & ASKAP: Intervening Galaxies

- Tracing the evolution of cold HI gas in galaxies over z = 0 - 1





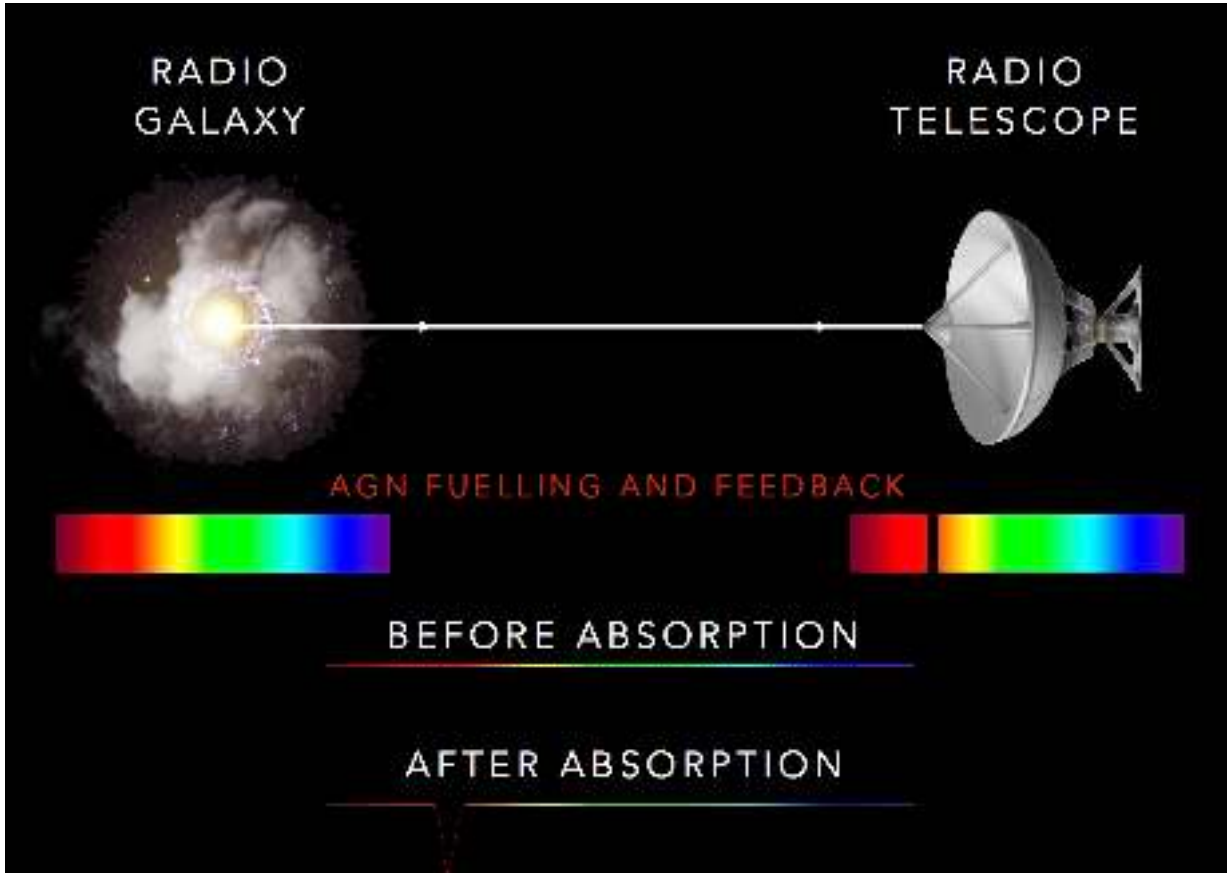
Early demonstration: z = 2.5 quasar

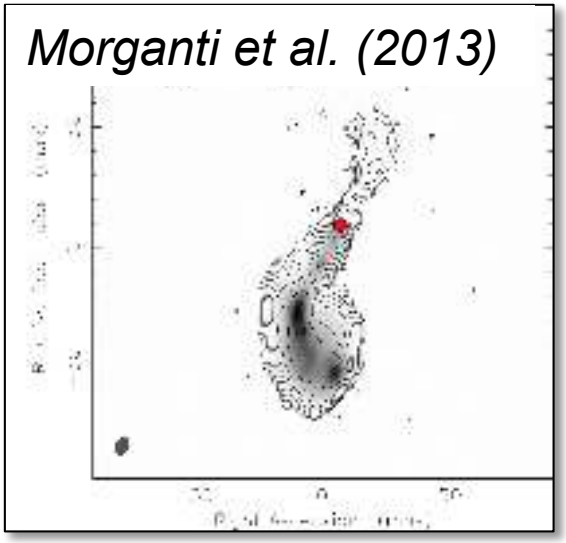


Allison et al. (in prep.)

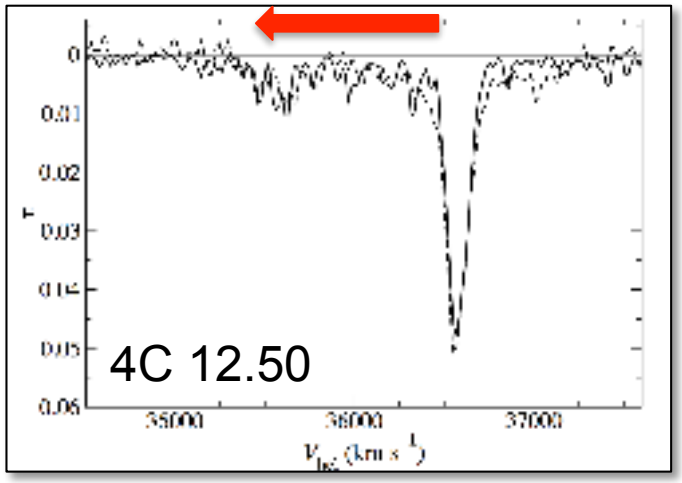
HI absorption & ASKAP: Radio Galaxies

- Study fuelling and feedback mechanisms in radio AGN

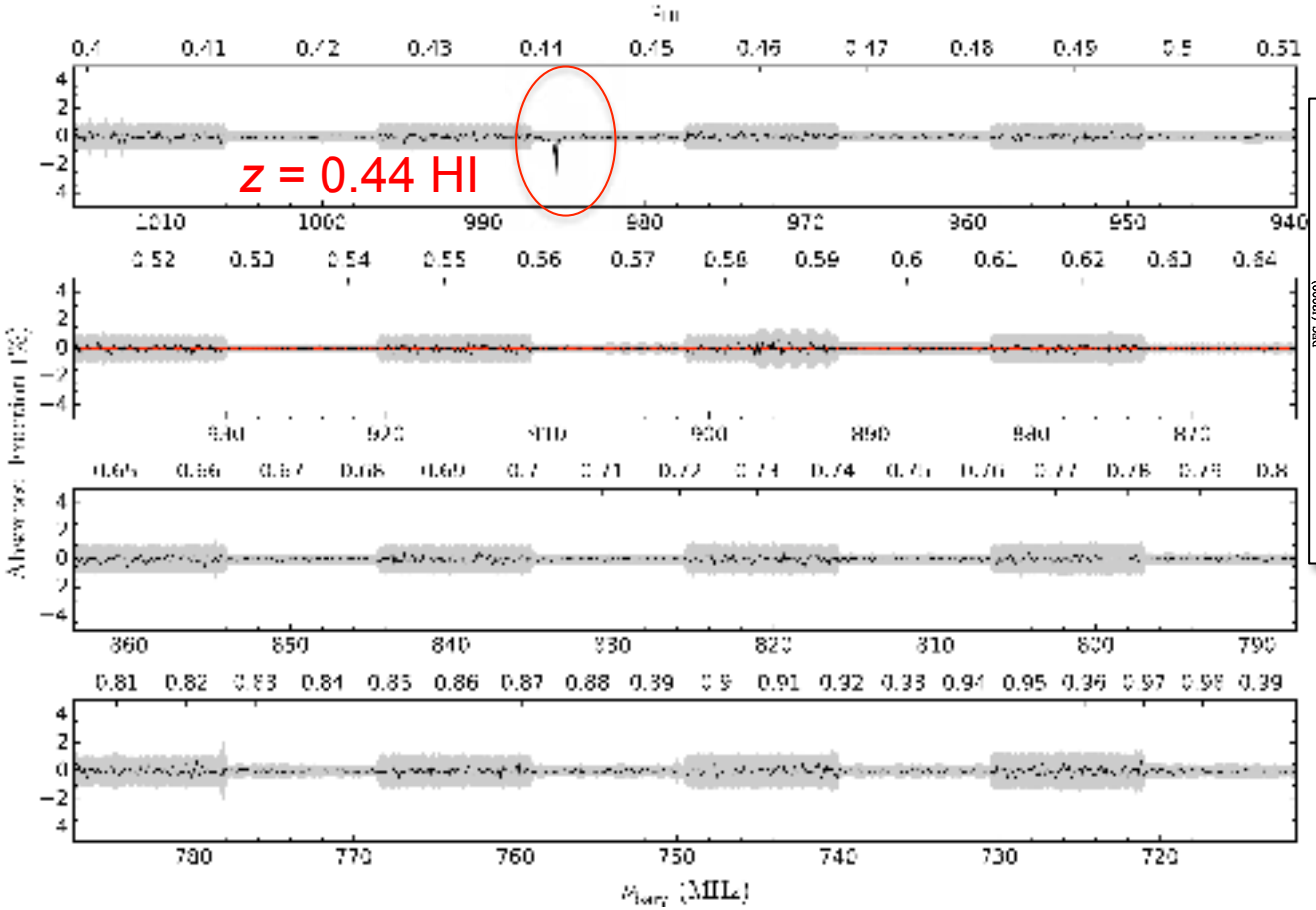


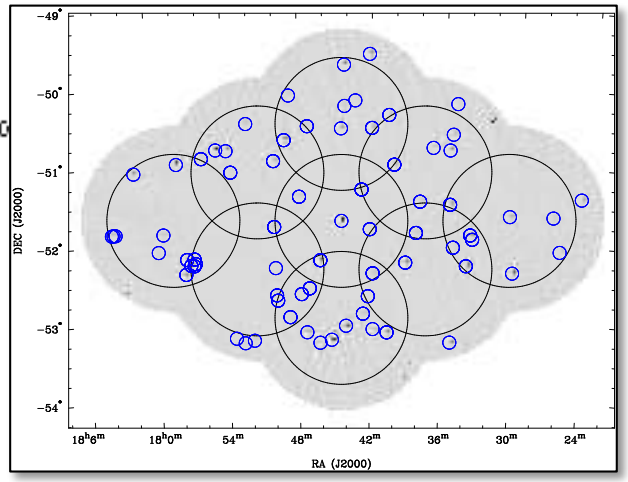


1000 km/s



Early demonstration – blind detection

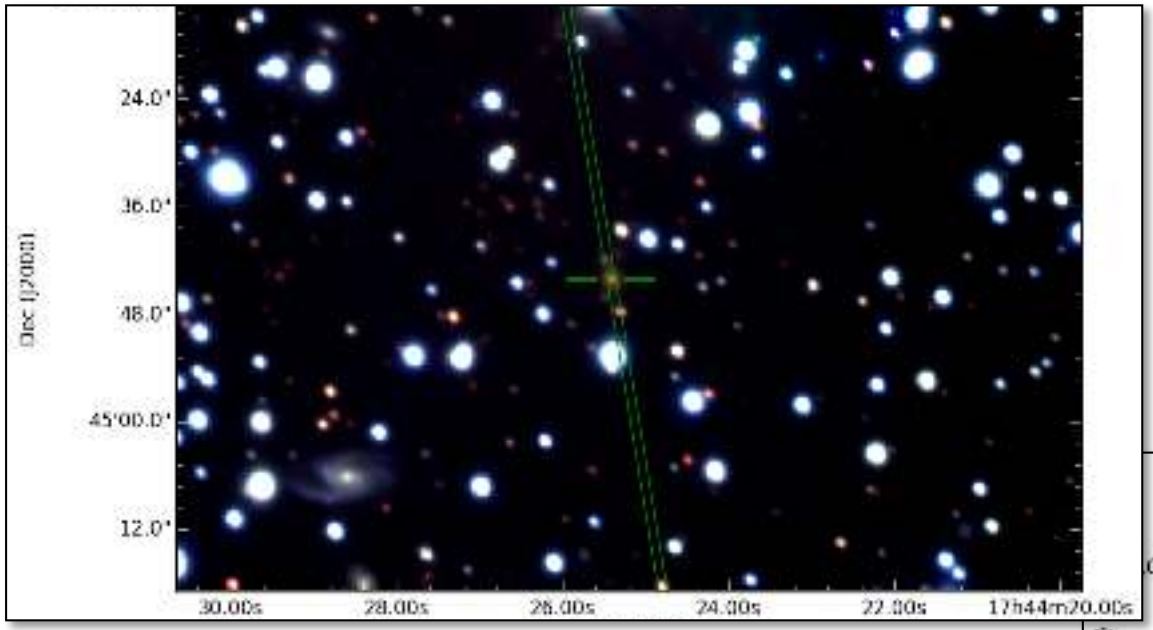




8Jy compact radio source, redshift unknown, close to the galactic plane and centre

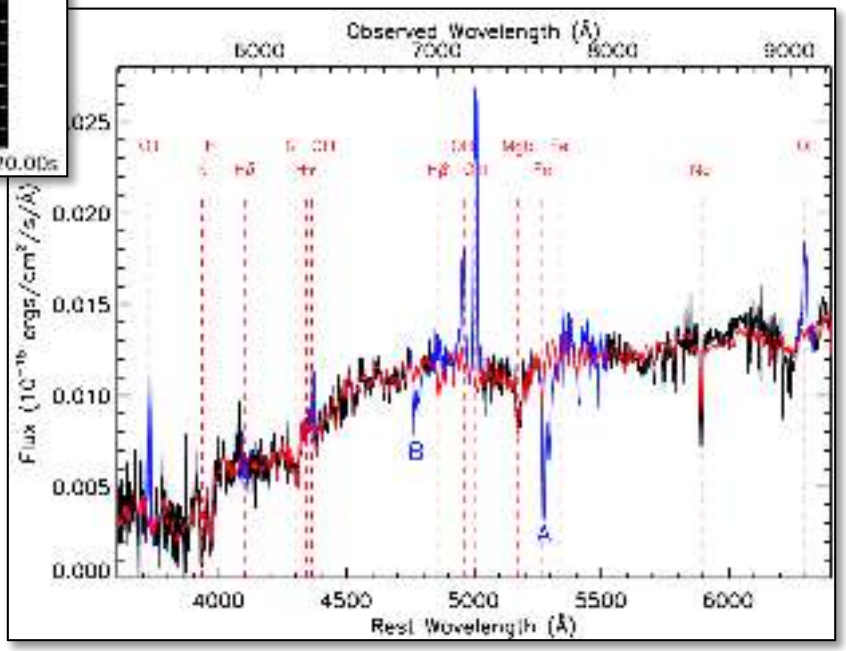
Allison et al. (2015; arXiv:1503.01265)

Redshift confirmation with Gemini South



Oxygen to Hβ emission line ratios consistent with AGN ionisation – probably type-2 nucleus

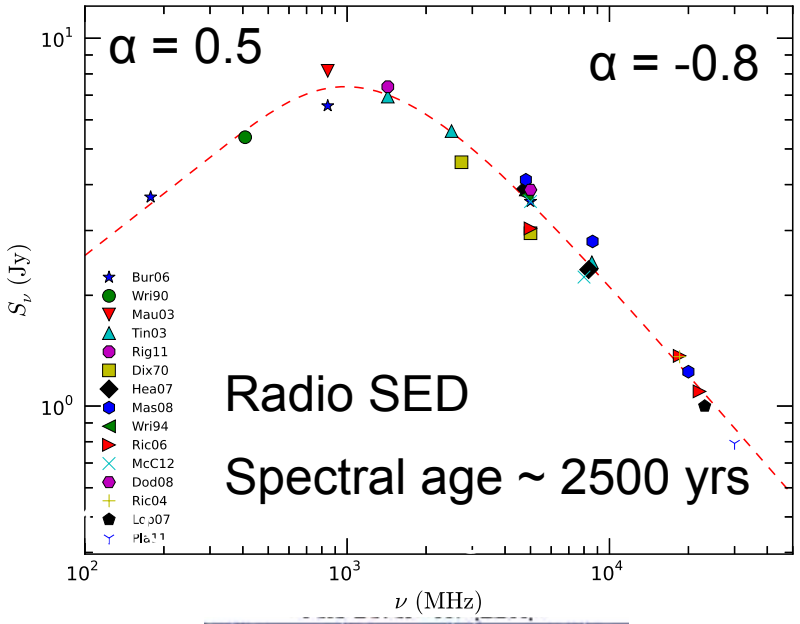
Strong [OI] emission indicate shocks → jet ISM interaction?

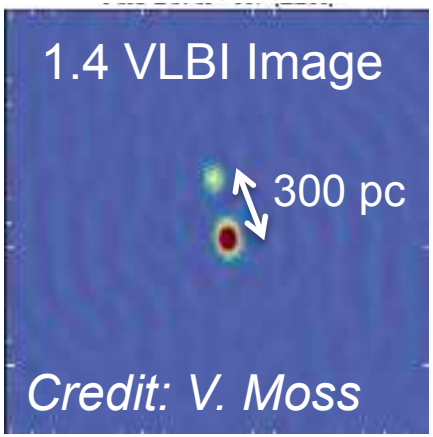


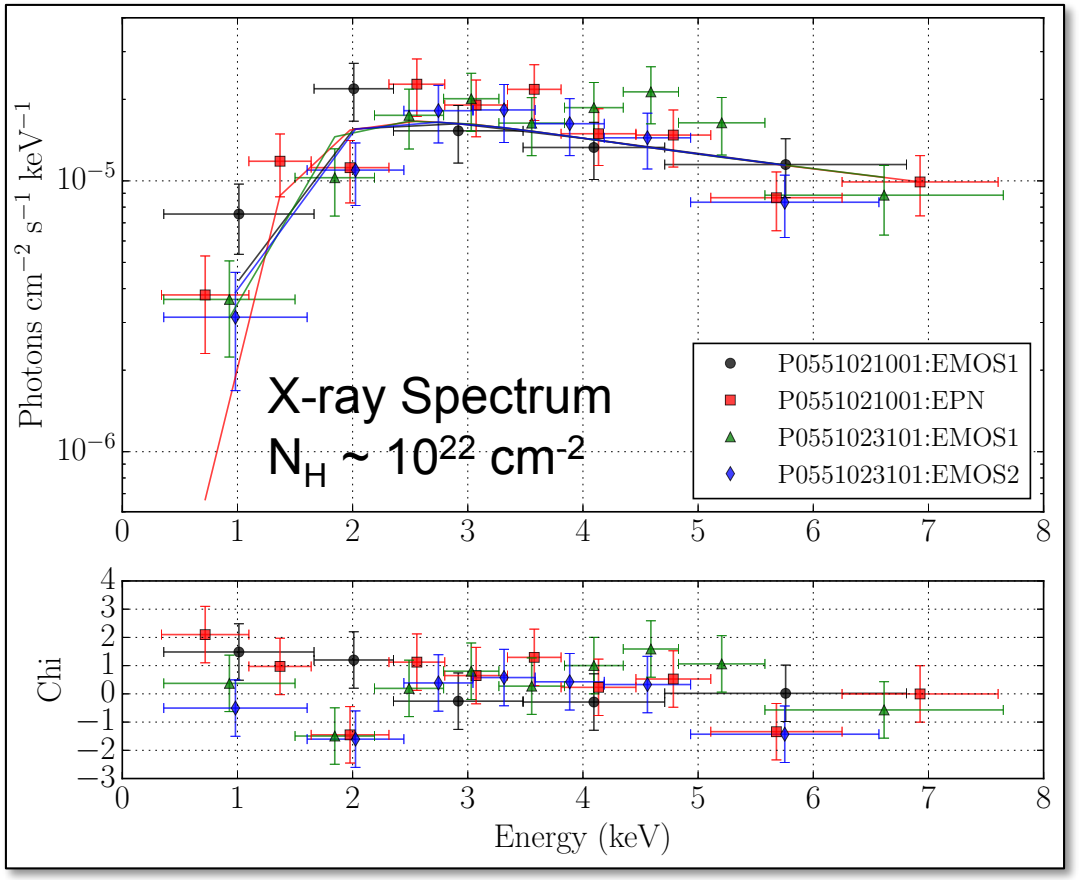
Fit to stellar continuum **confirms** HI absorption arising in AGN host galaxy

- z_{HI} ~ 0.4413
- $z_{\star}$ ~ 0.4423

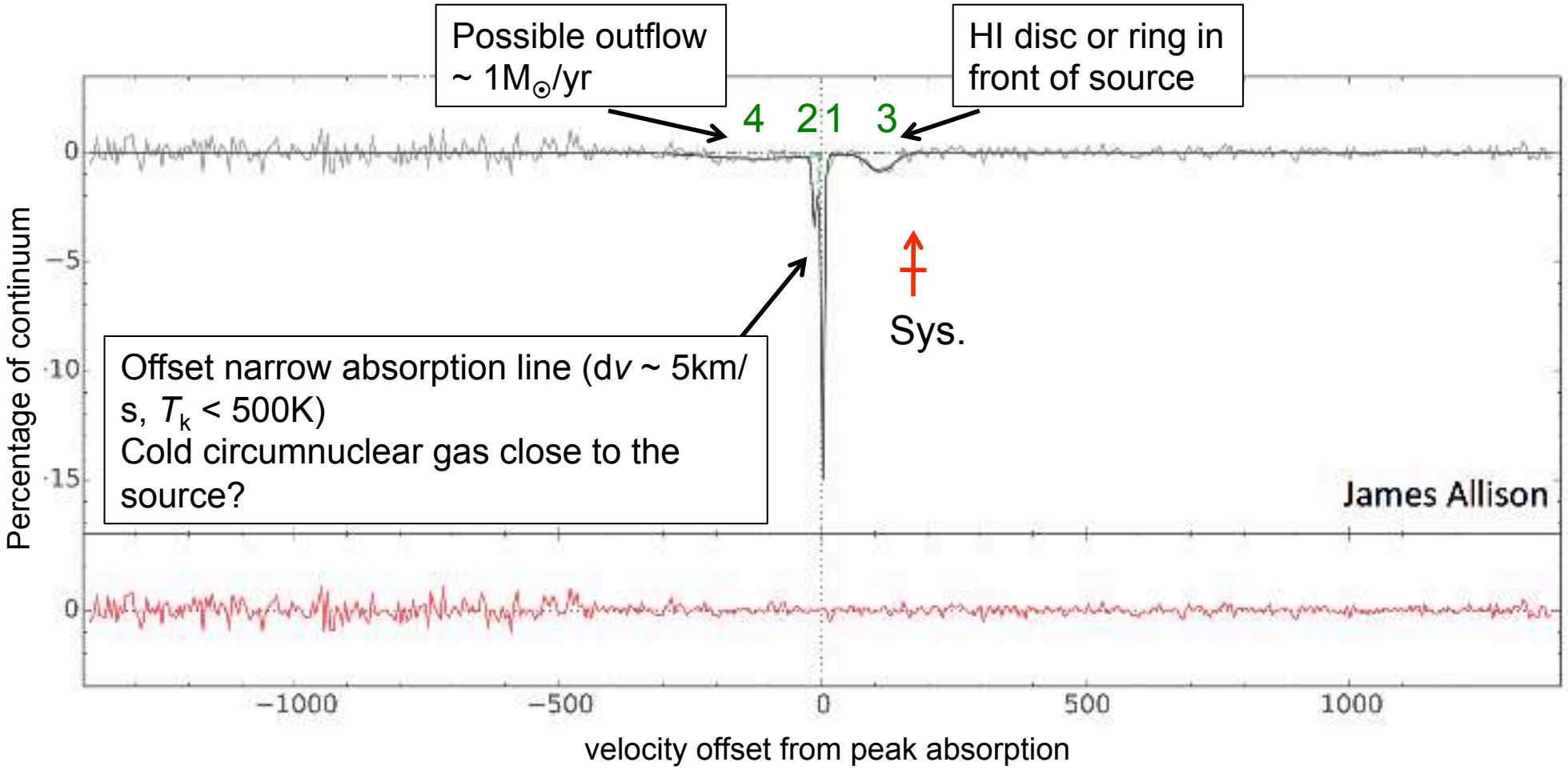
Dense natal cocoon of a young radio galaxy







Interpreting the HI kinematics



Summary

- The 6-antenna ASKAP BETA telescope is now taking early science data and we can carry out a **blind search for HI** absorption in an unprecedented redshift range between ***z* = 0.4 – 1** in radio sources brighter than **>1Jy**

- We obtained a "**blind**" discovery of HI gas (i.e. **no optical redshift**) towards PKS1740-517, a powerful compact radio AGN with GHz peaked radio spectrum

- Optical spectroscopic follow up confirmed **association** with host galaxy, narrow emission lines and soft X-rays strongly absorbed

- Complex HI profile and multi-wavelength data point to gas associated with the dense and dusty natal cocoon of a young radio AGN