Cold gas reservoir feeding a distant interacting young radio galaxy

A case study from ASKAP FLASH & ALMA

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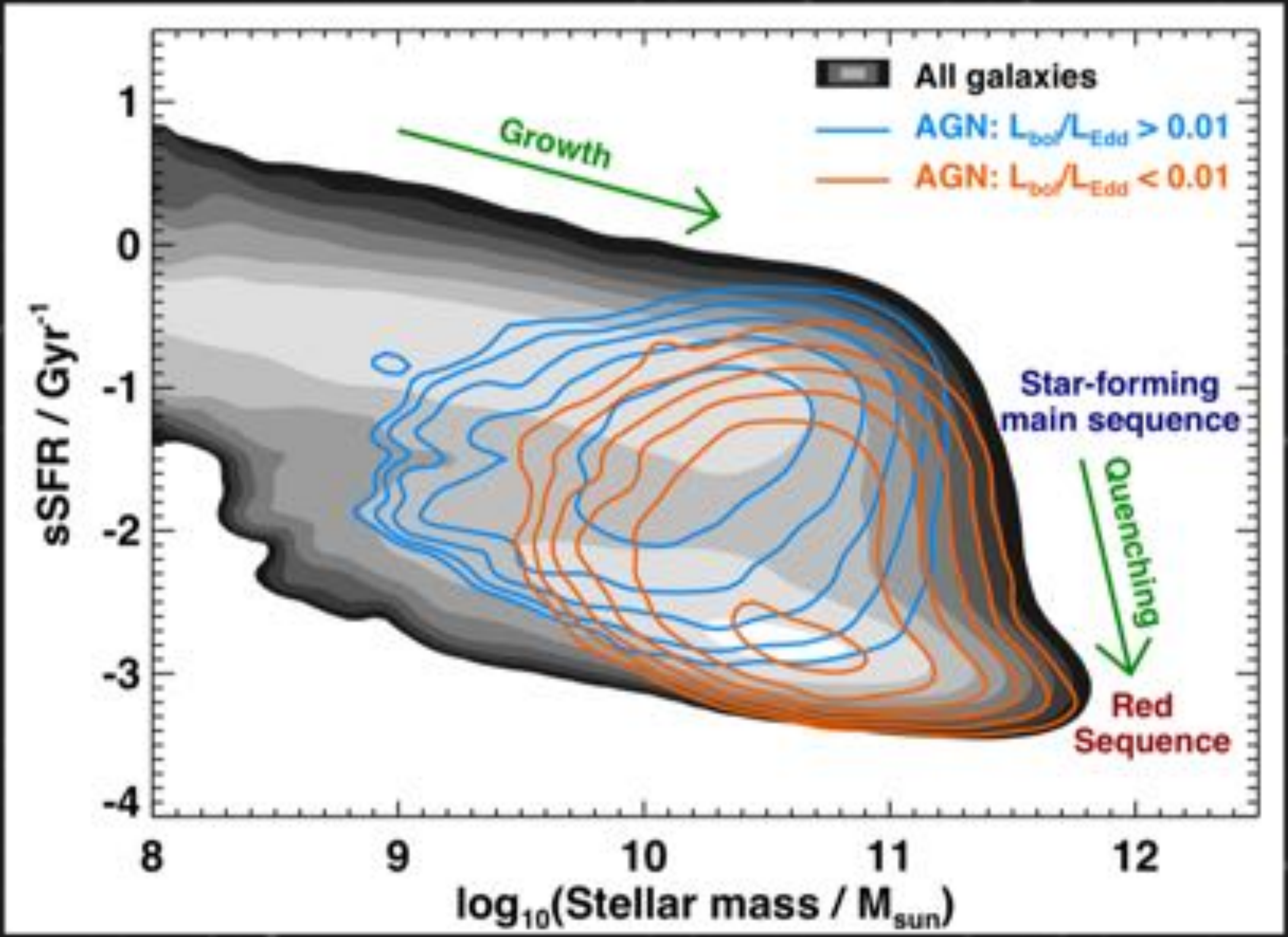
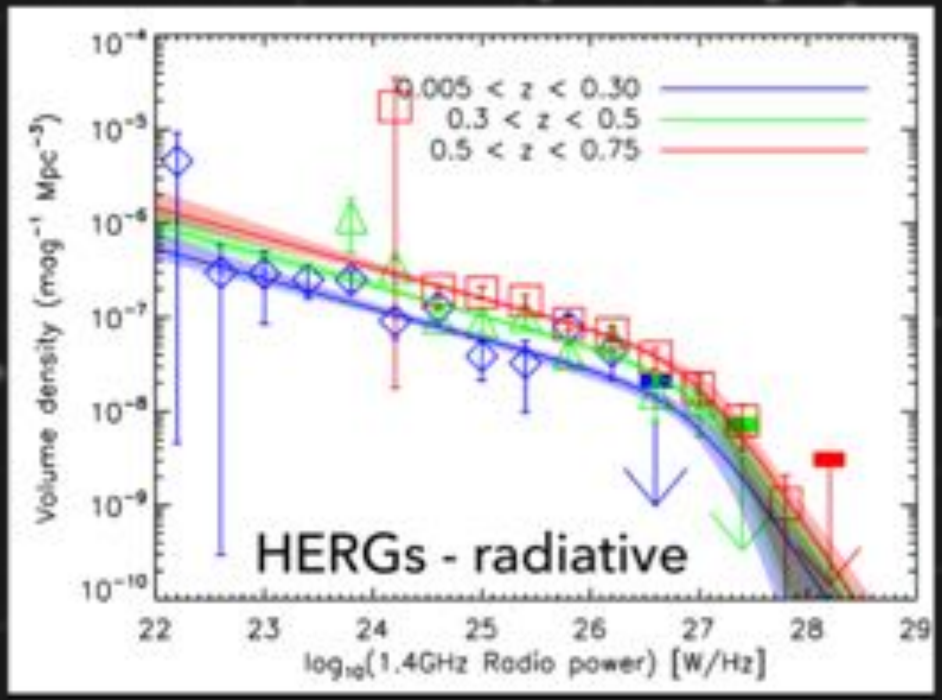
University of Sydney / ASTRO 3D

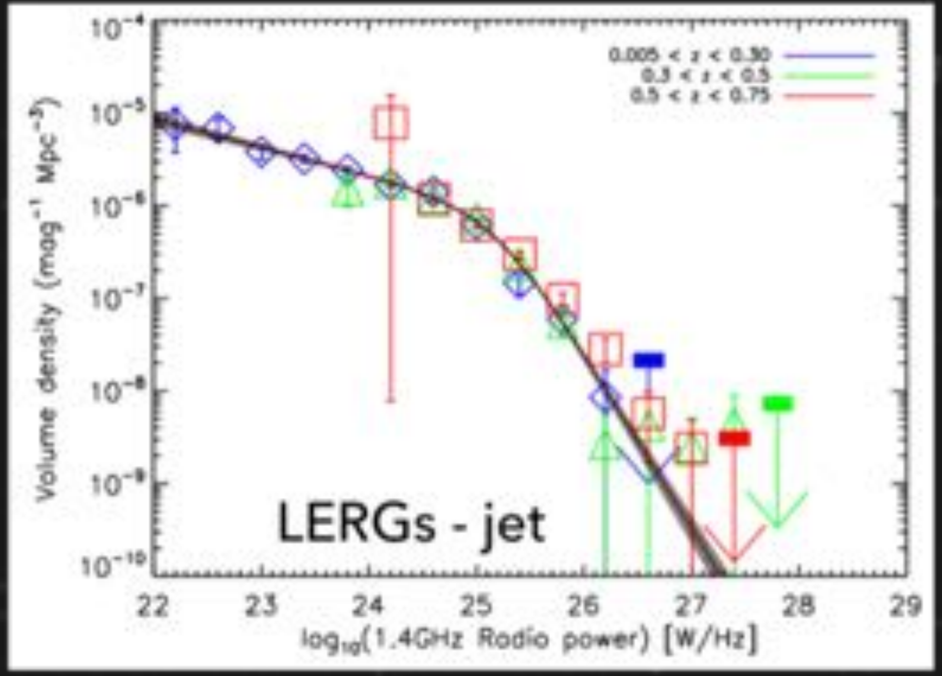
DICHOTOMY OF AGN HOST GALAXIES



Heckman & Best 14

DOES THE COLD GAS IN AGN HOSTS REFLECT THIS DICHOTOMY?





Pracy+ 16

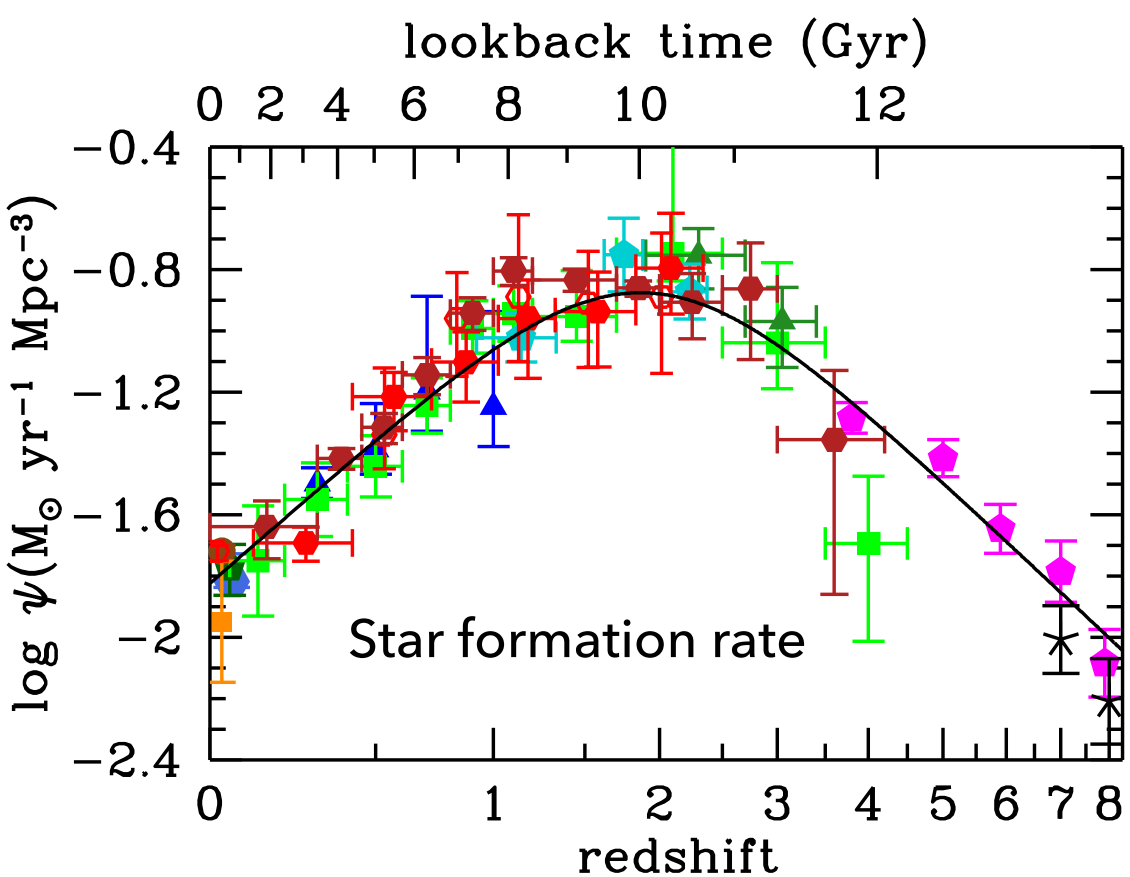
High excitation RGs:

- Radio-loud radiative mode AGN (L_{bol} > 1% L_{Edd})
- Typically central star forming hosts
- ~$(1+z)^3$ evolution

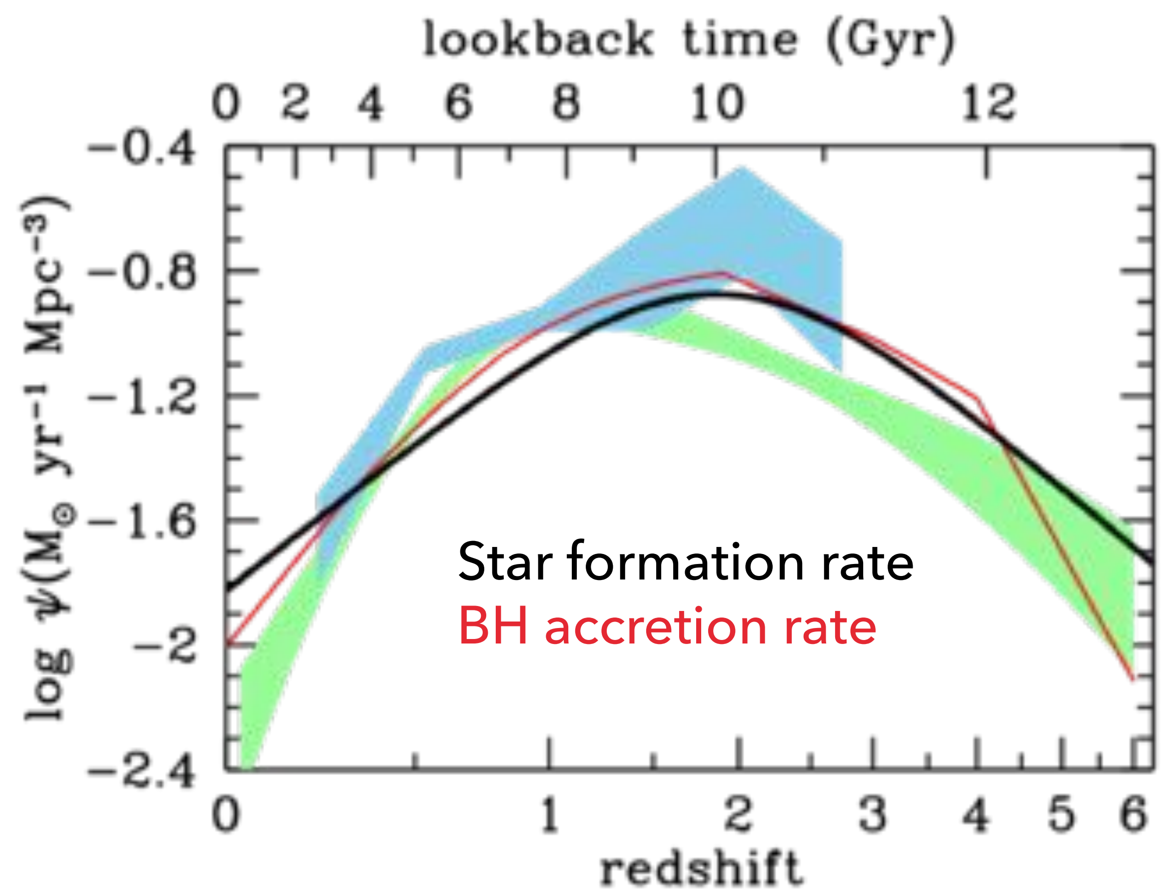
Low excitation RGs:

- Radio-loud jet mode AGN (L_{bol} < 1% L_{Edd})
- Typically passive hosts
- little evolution over past 10Gyrs

DOES THE COLD GAS TRACE SFR AND SMBH EVOLUTION?



Madau & Dickinson 14



(Shankar + 09)

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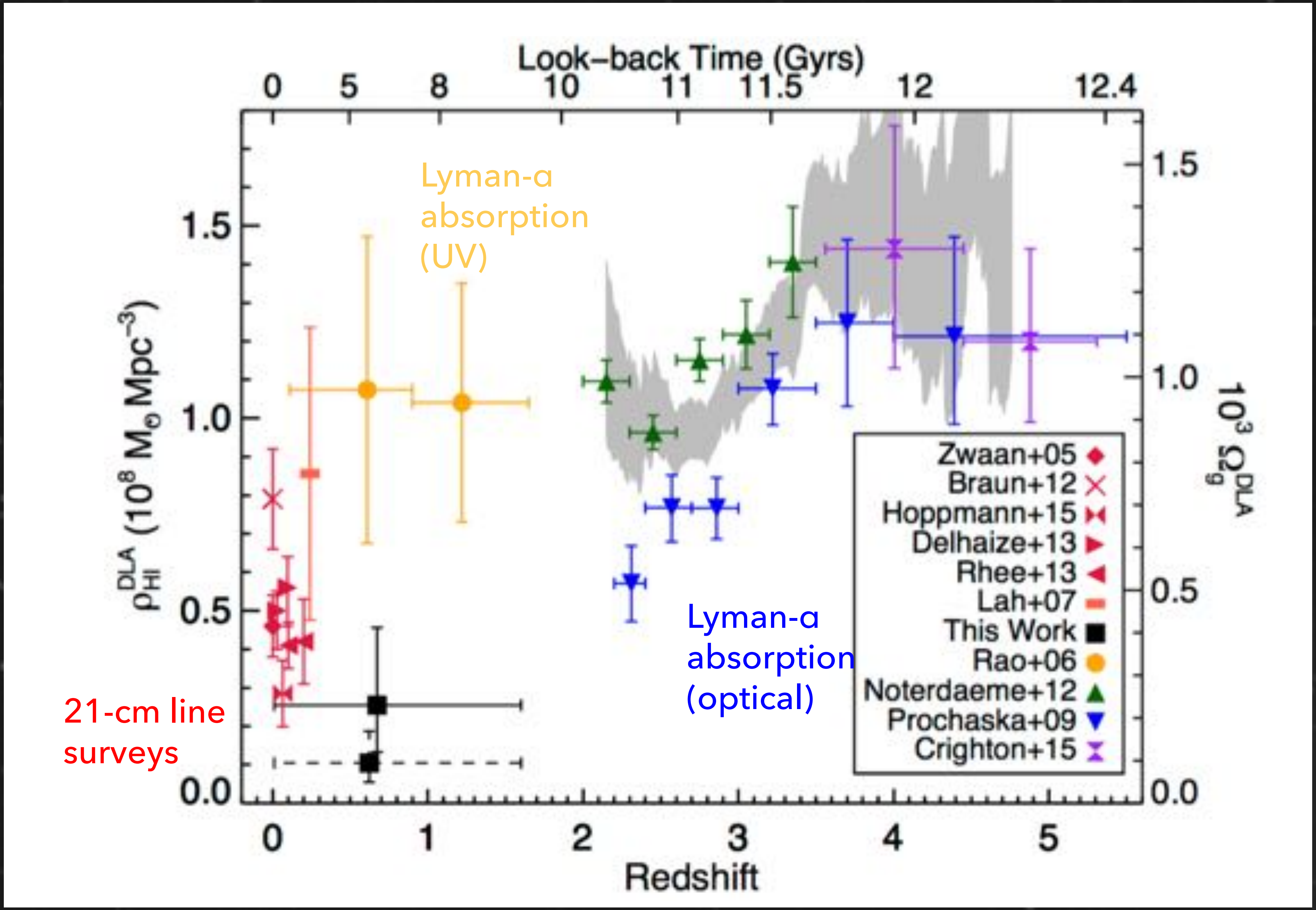
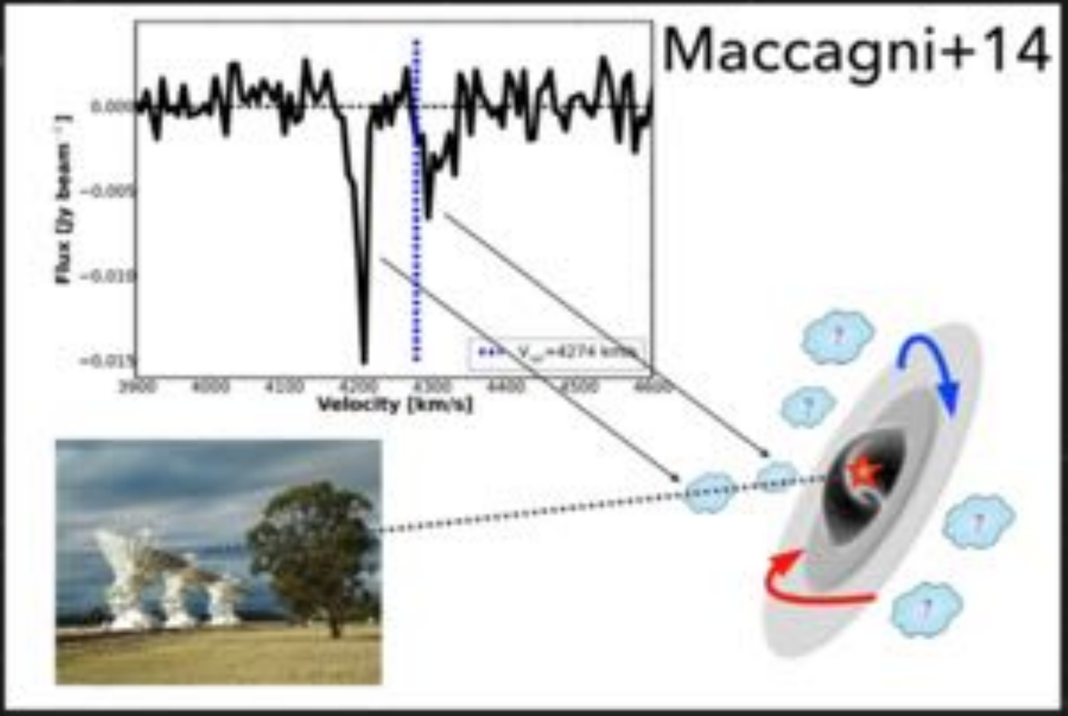
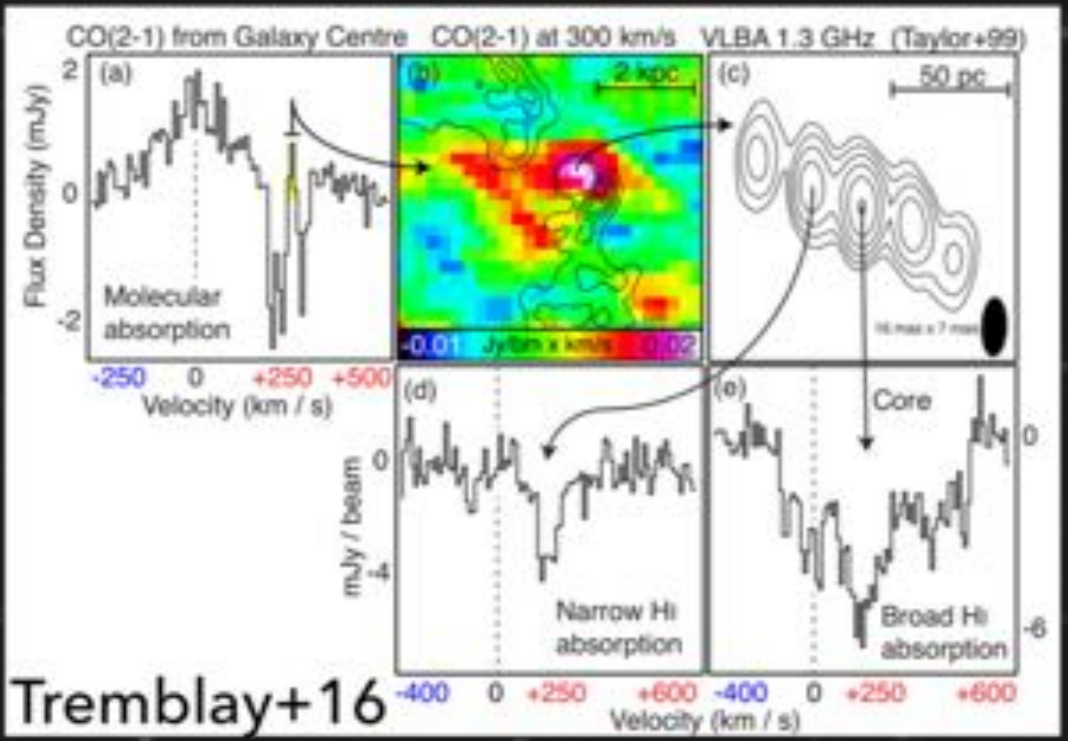


Neeleman + 16

OBSERVING COLD GAS ACCRETION & FEEDBACK IN AGN

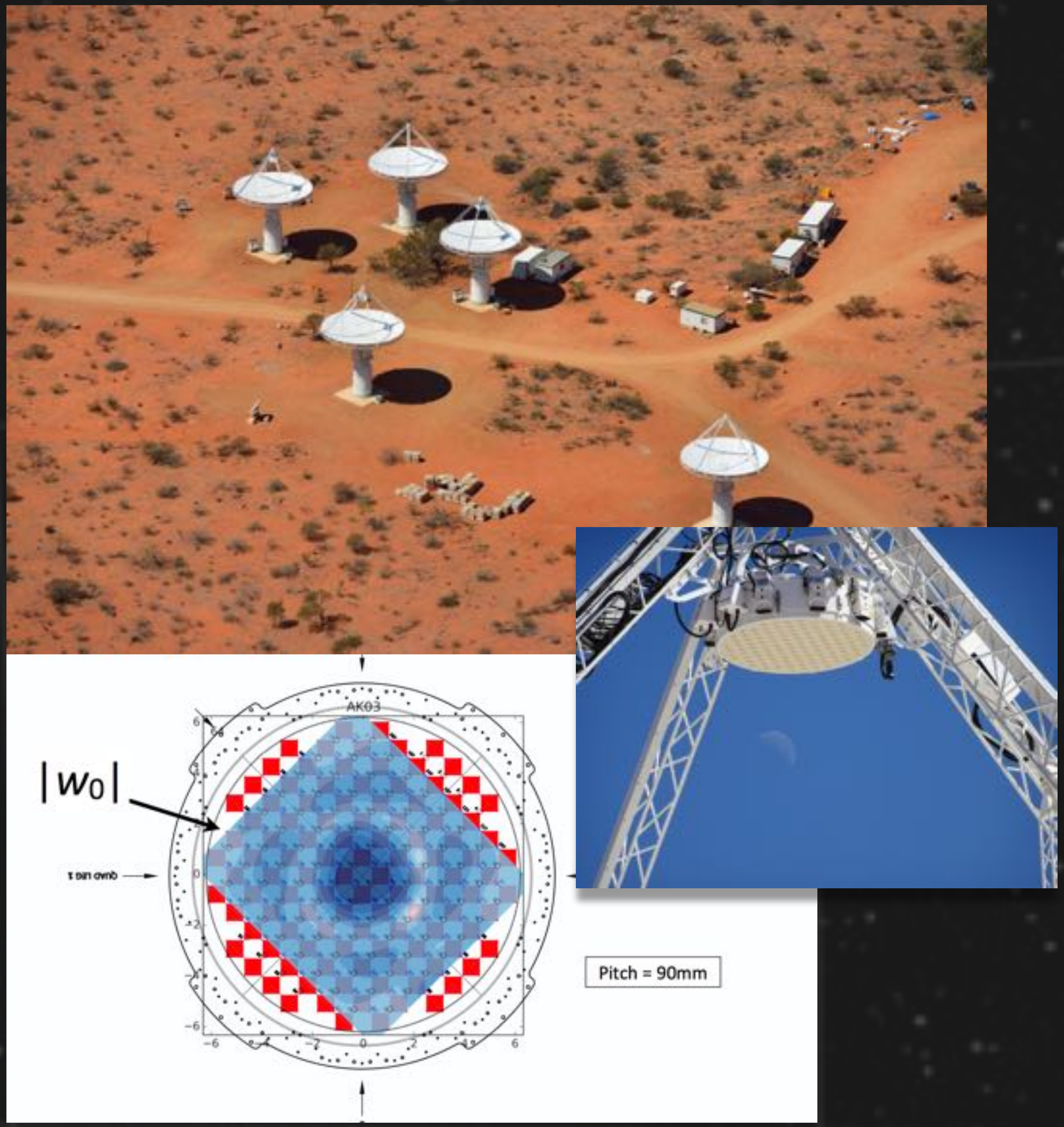
- Atomic and molecular absorption lines illuminate gas on sight-line towards radio emission
- Velocity offsets from system indicative of disturbed gas associated with accretion or outflows
- Literature examples of nearby radio galaxies have found 1000km/s outflows and clouds of infalling gas
- Mostly focused on nearby, well-resolved, radio-loud AGN





HI 21-CM ABSORPTION WITH THE AUSTRALIAN SKA PATHFINDER

- Wide field of view → survey many radio sources quickly
- Wide fractional bandwidth + good RFI environment → survey large redshift range
- Phased Array Feeds produce good spectral baselines for high dynamic range spectral line observations



THE FIRST LARGE ABSORPTION SURVEY IN HI

- PIs Elaine Sadler (Sydney) and James Allison (Oxford)
- 50 members, incl. Raffaella Morganti & Vanessa Moss
- All southern sky survey for HI 21-cm line absorption
- 150,000+ sight lines to extragalactic radio sources
- **0.4 < *z* < 1.0 (~5 billion years of look back time)**

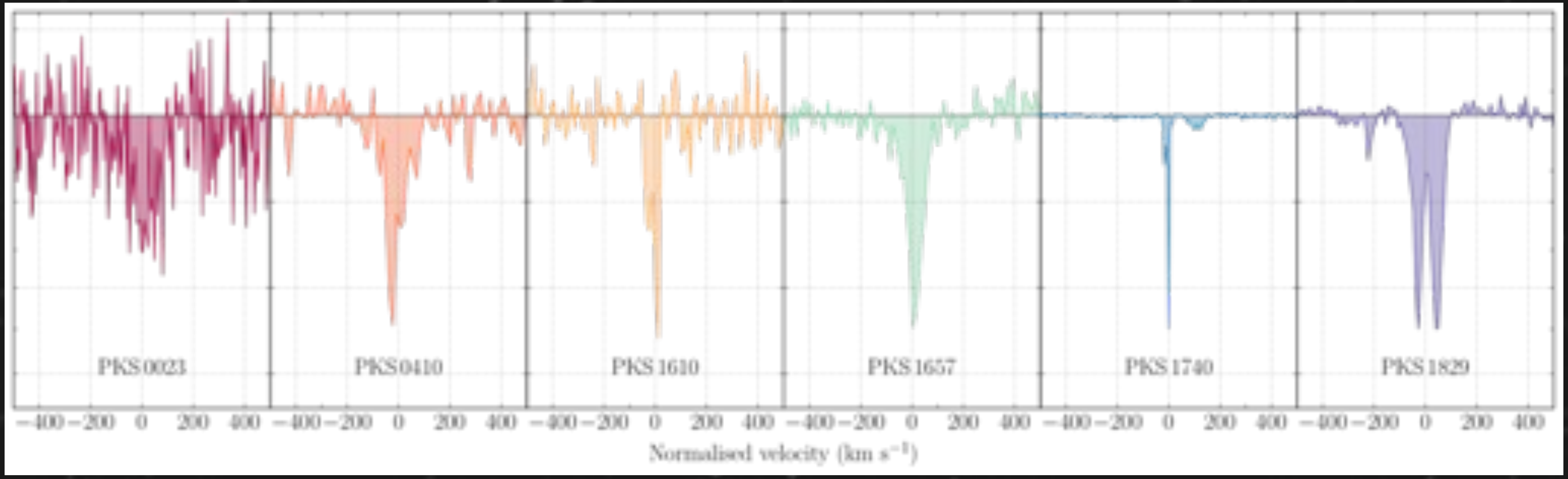
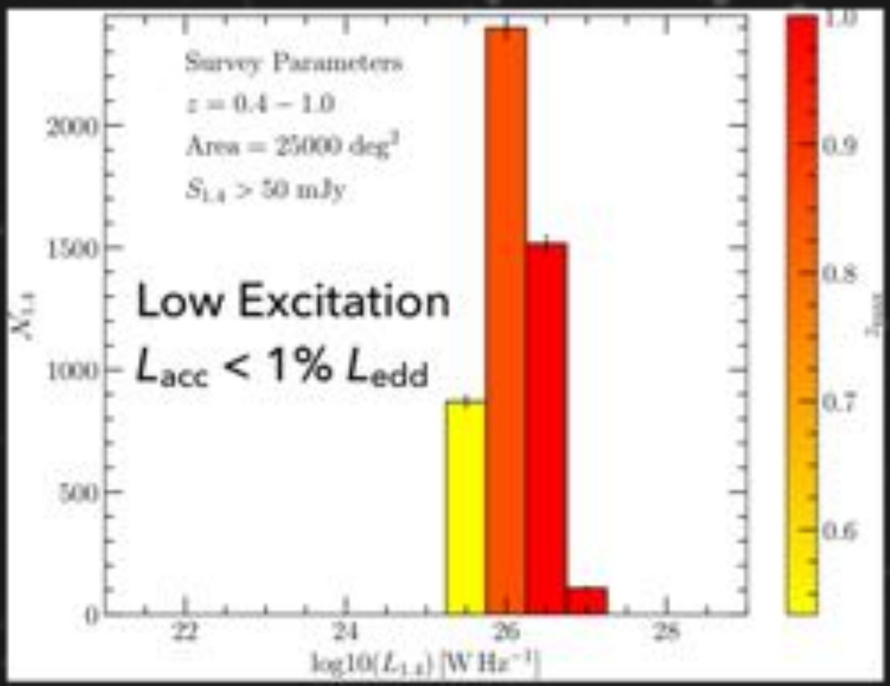


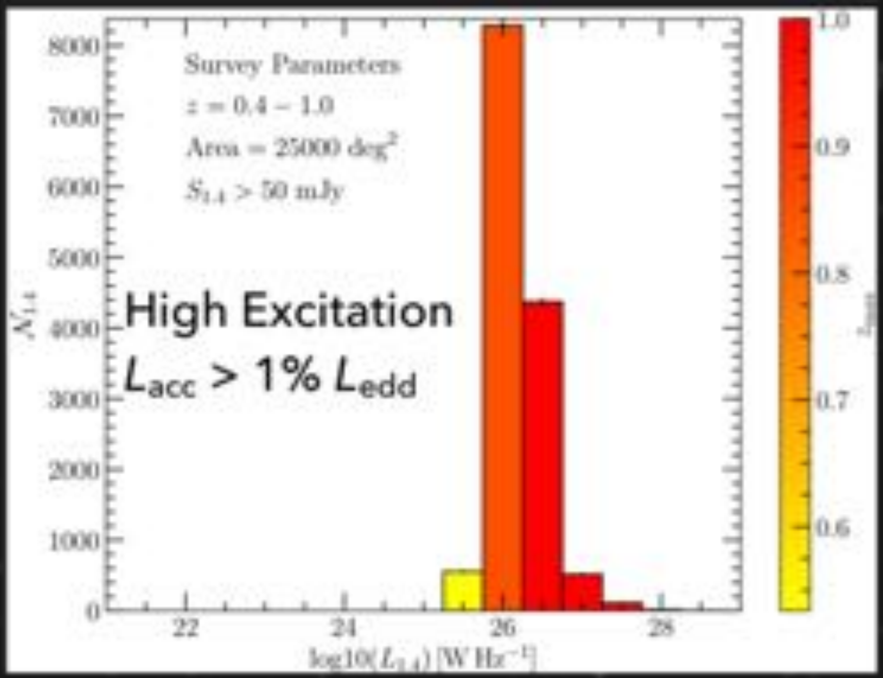
Image credit: Vanessa Moss

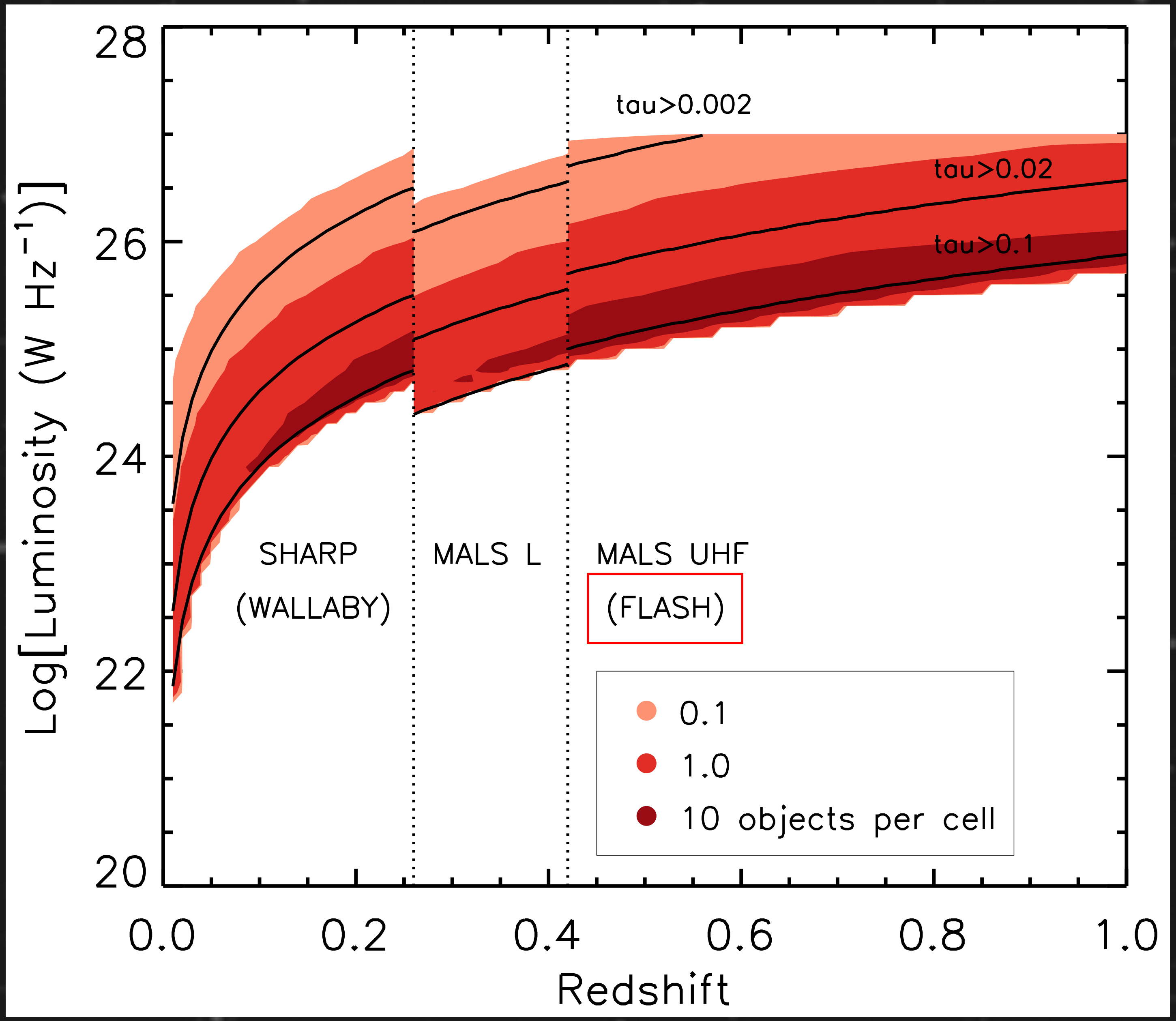
THE UNIVERSITY OF SYDNEY ASTRO 3D

FLASH: 25,000 POWERFUL RGs @ 0.4 < z < 1.0

ASKAP-FLASH

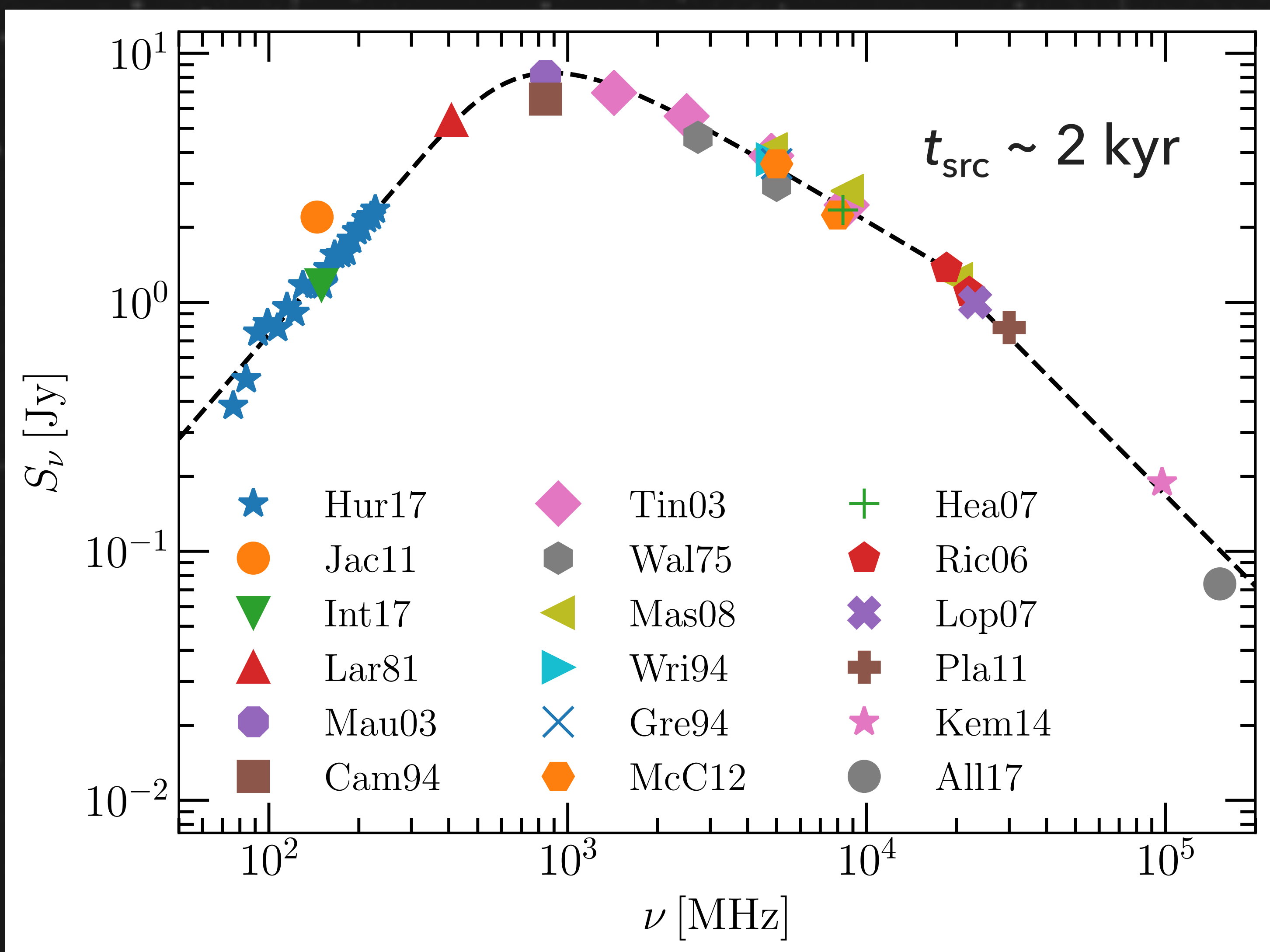


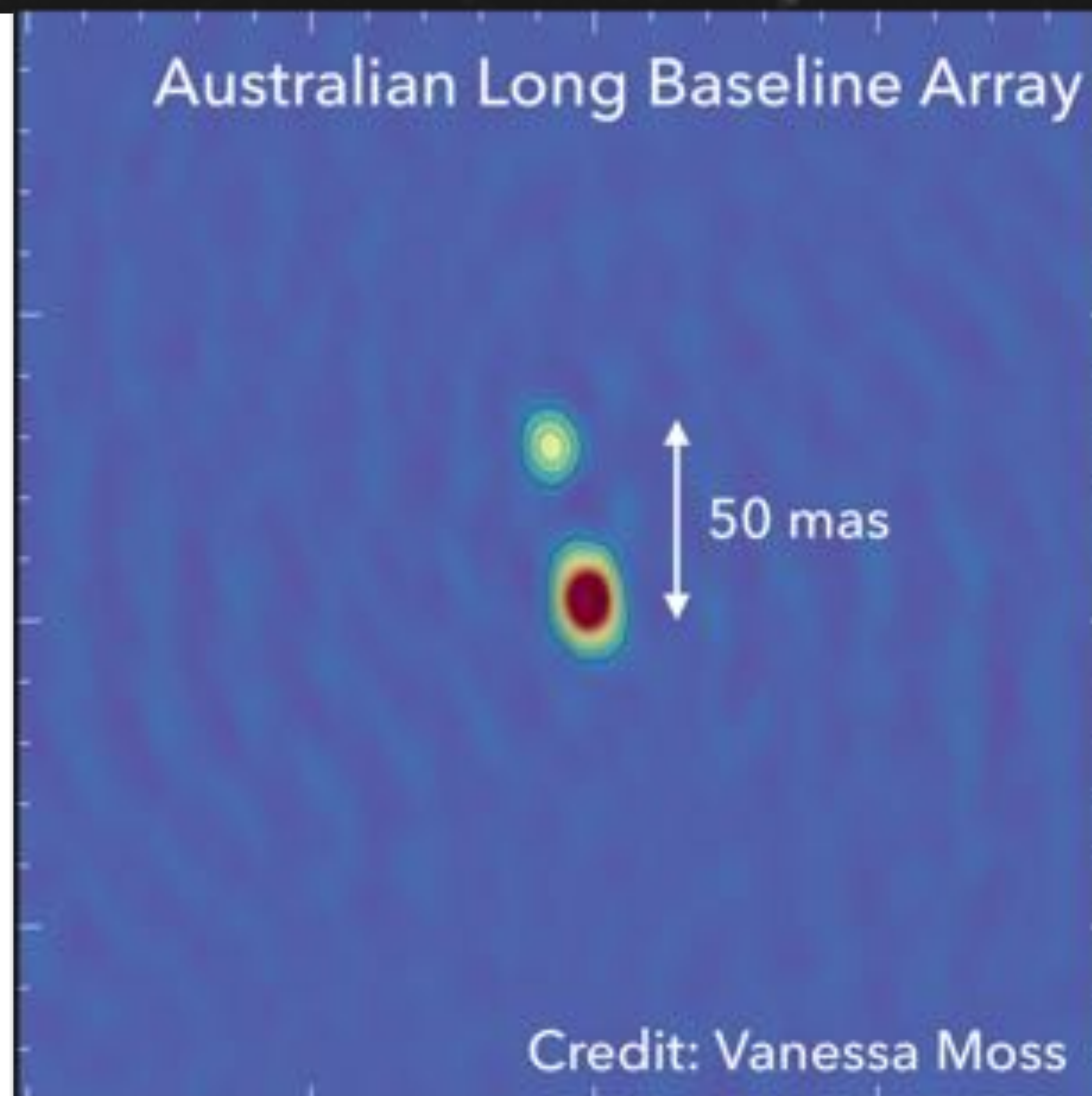




Maccagni+ 17

CASE STUDY: PKS1740-517





Allison+ 15; Allison+ 18 in prep.

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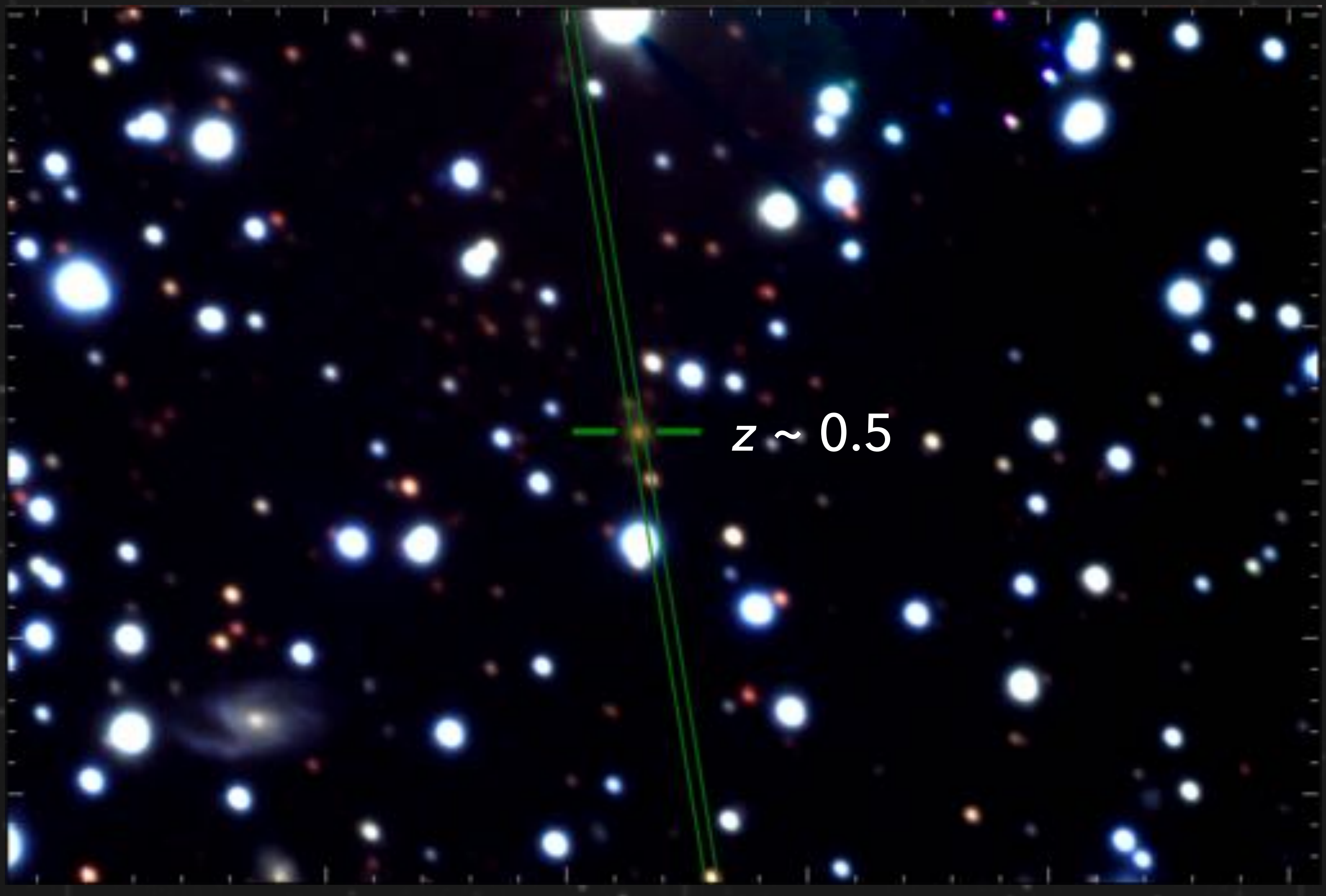

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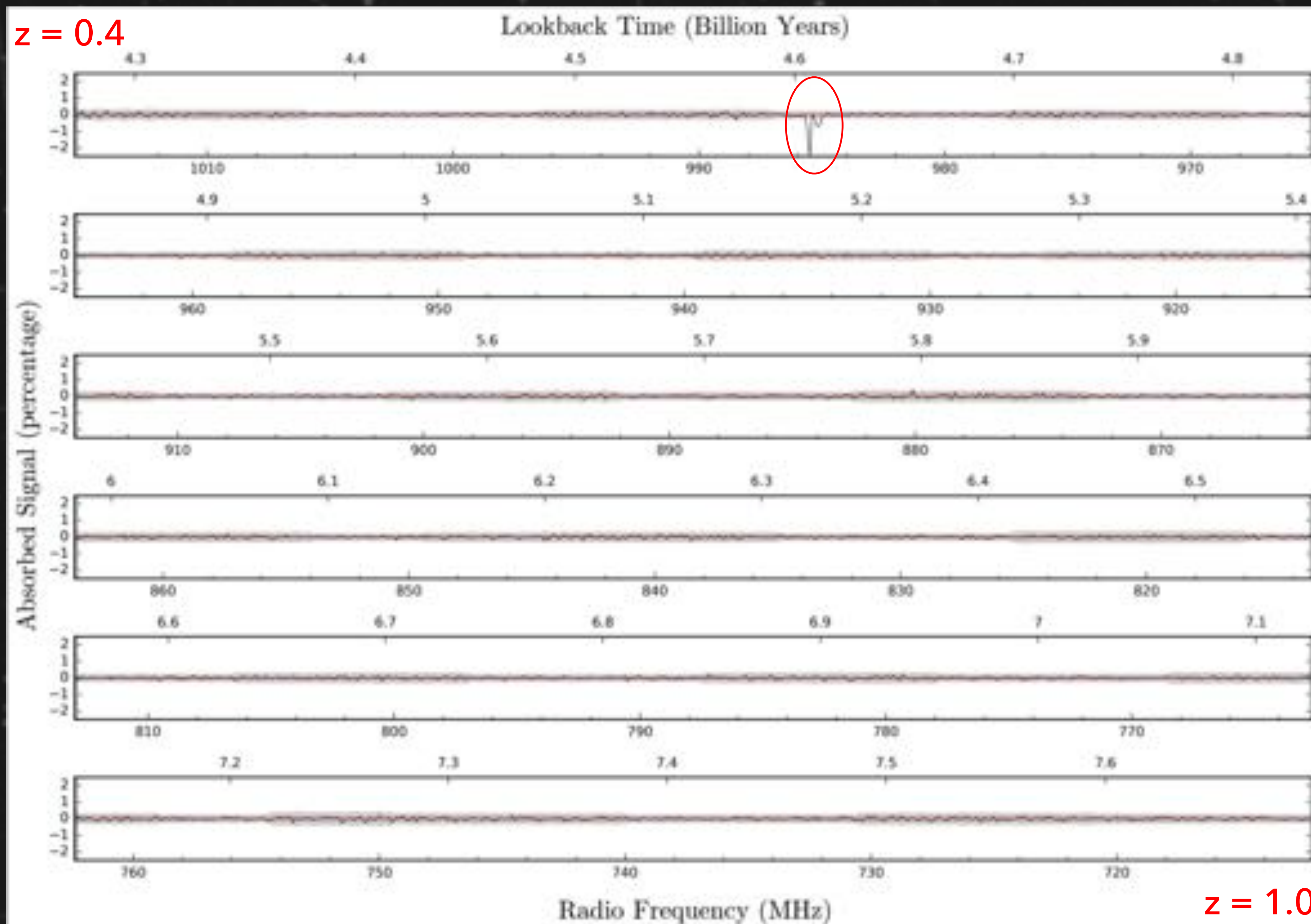
ASKAP DETECTION OF HI ABSORPTION



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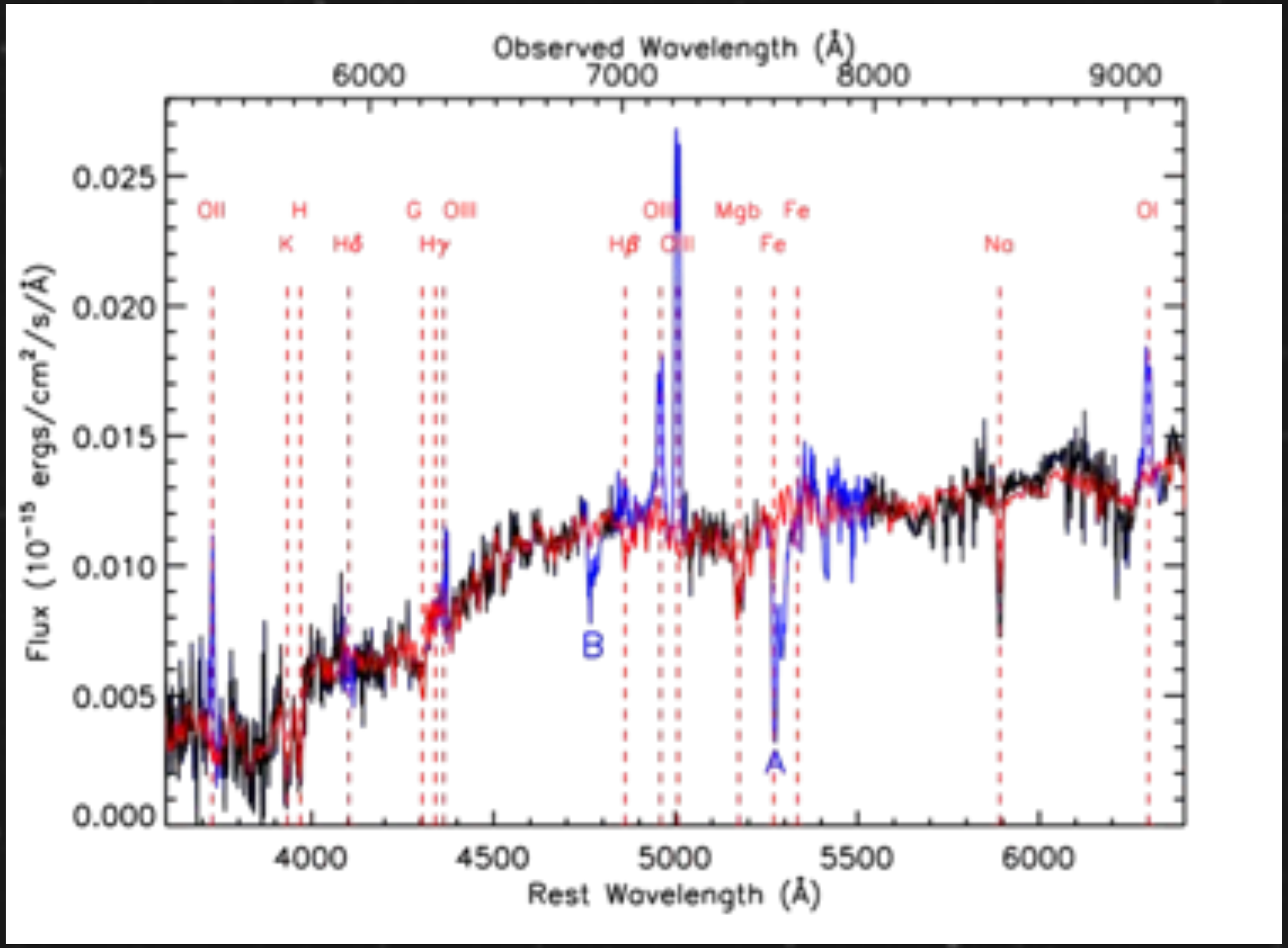
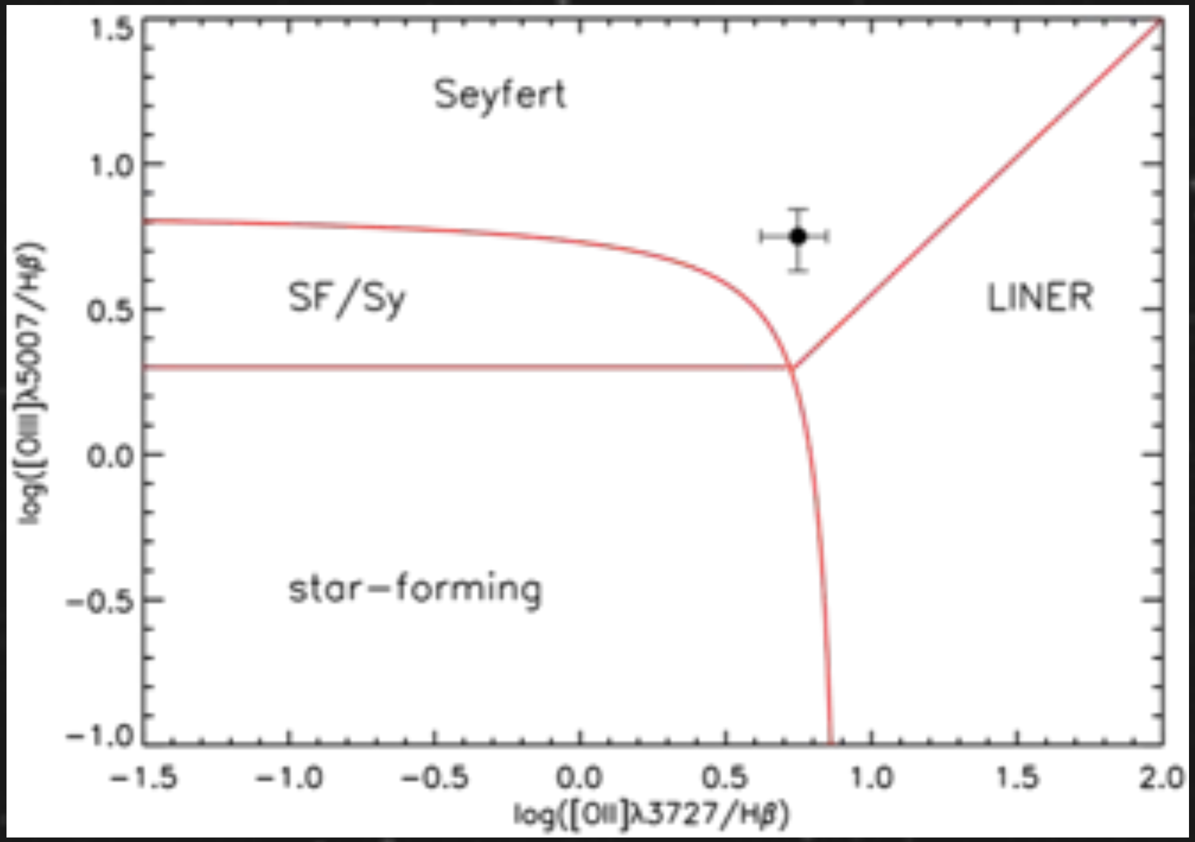
ASSOCIATION WITH A STRONG EMISSION LINE AGN (HERG)



z_{sys} = 0.4418



Blue diagram for high-*z* (Lamareille+ 10)

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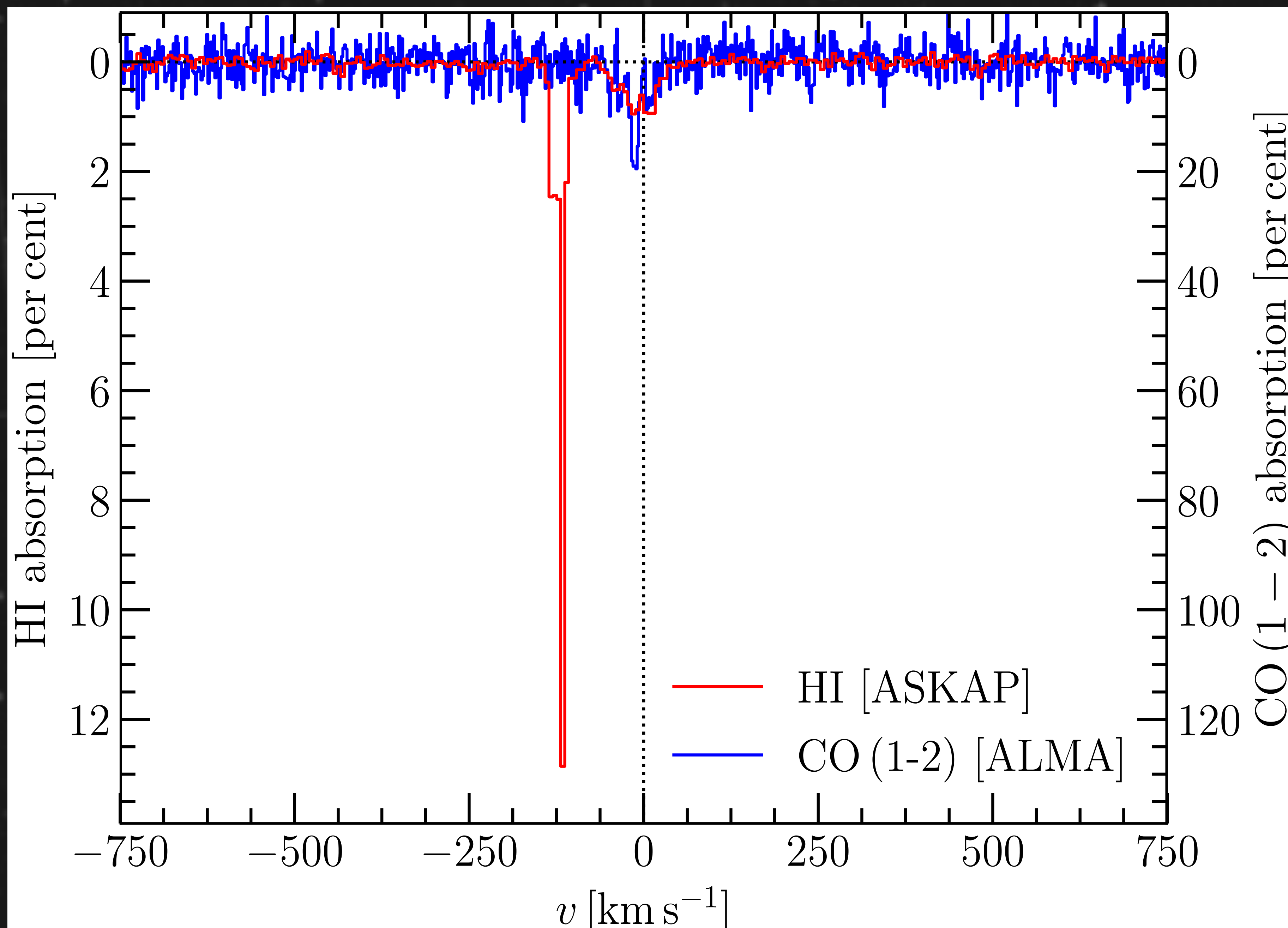
LINE OF SIGHT COLD GAS KINEMATICS



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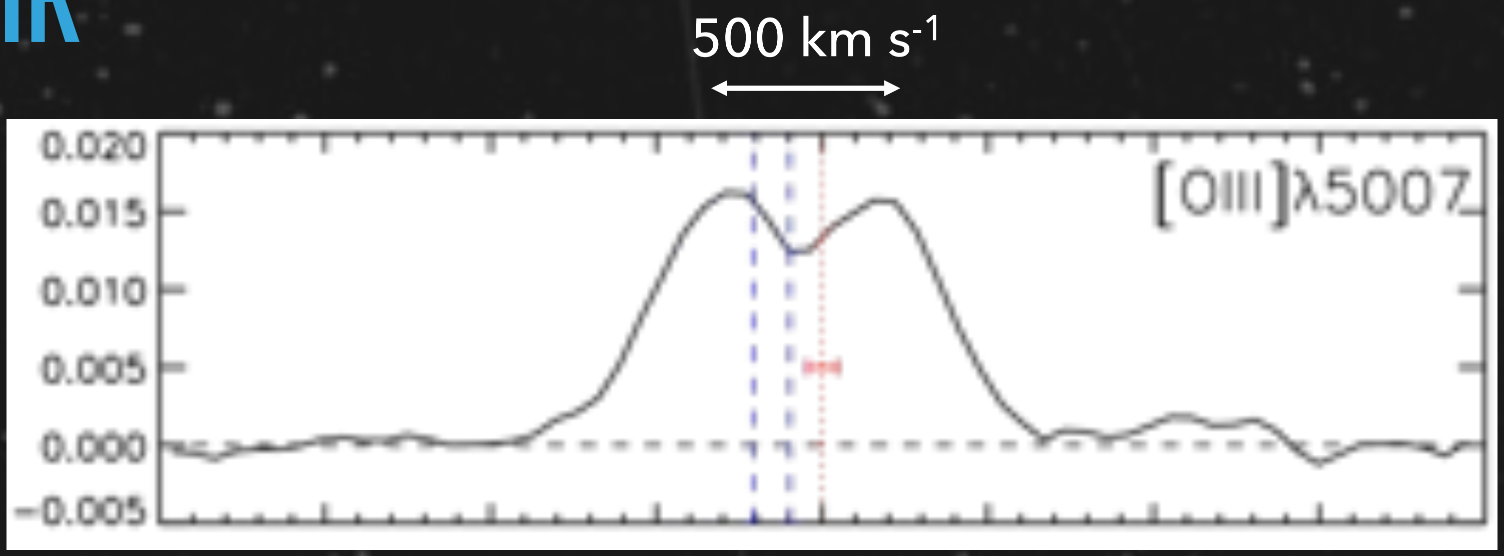
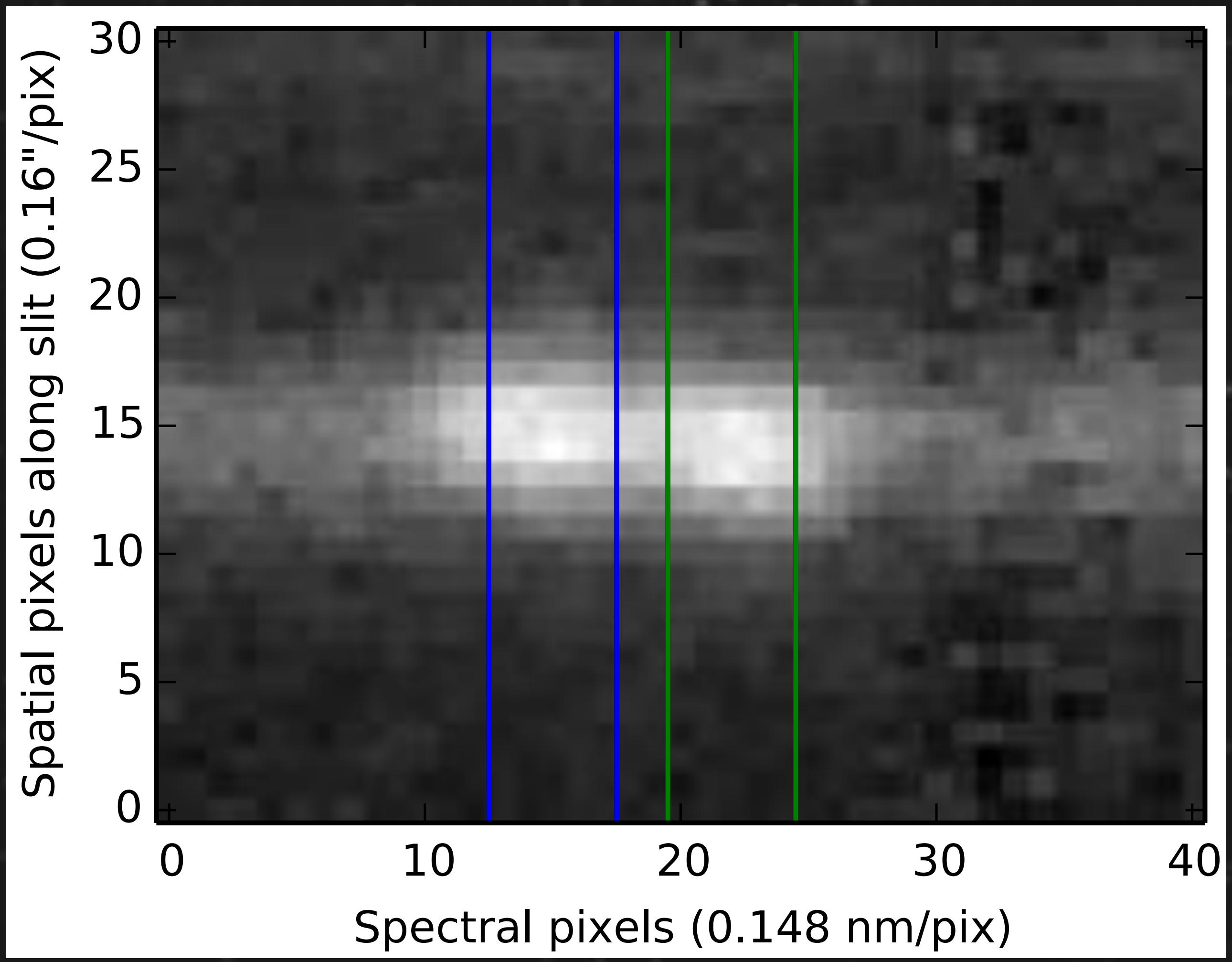
GAS RESERVOIR





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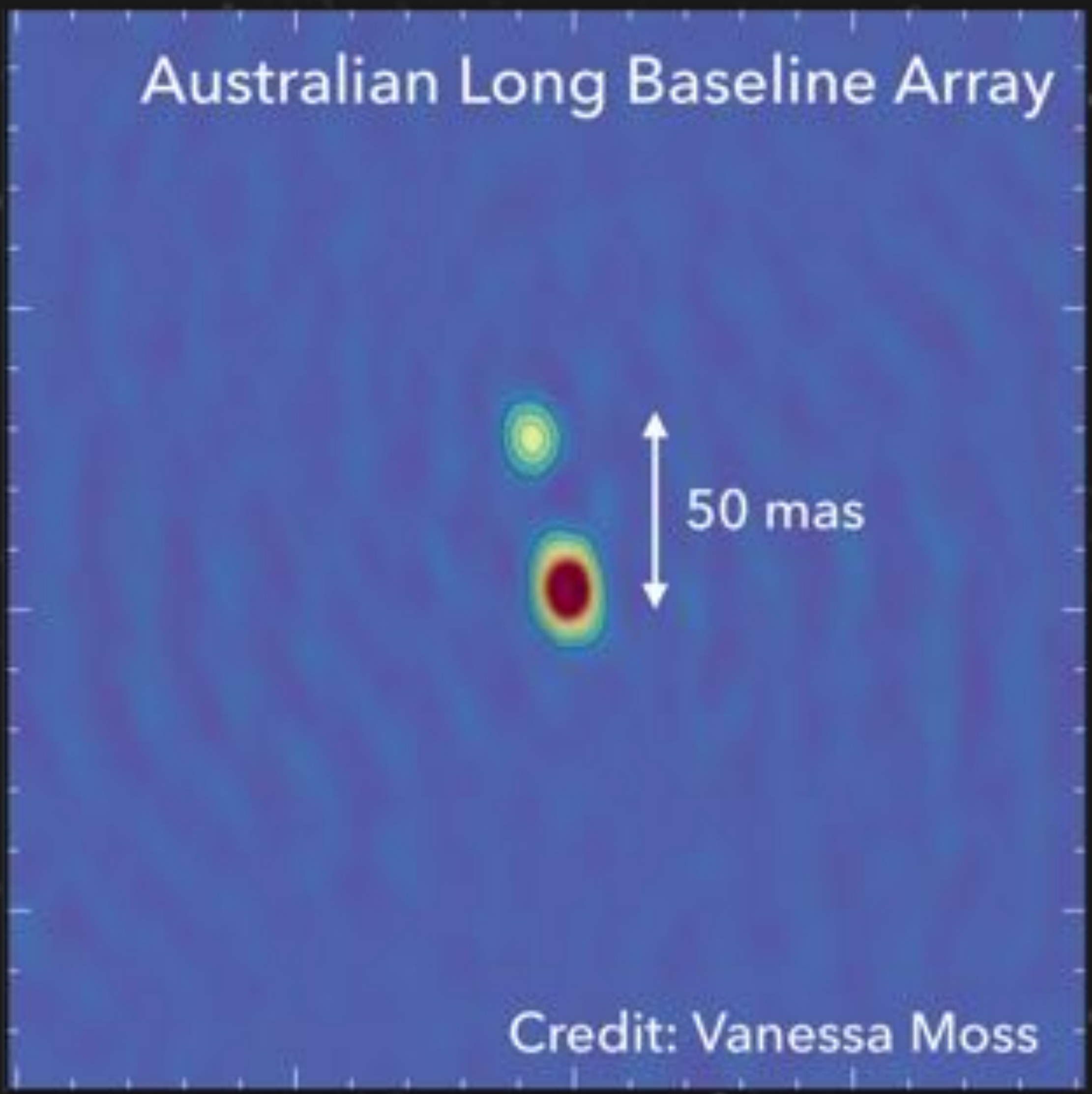

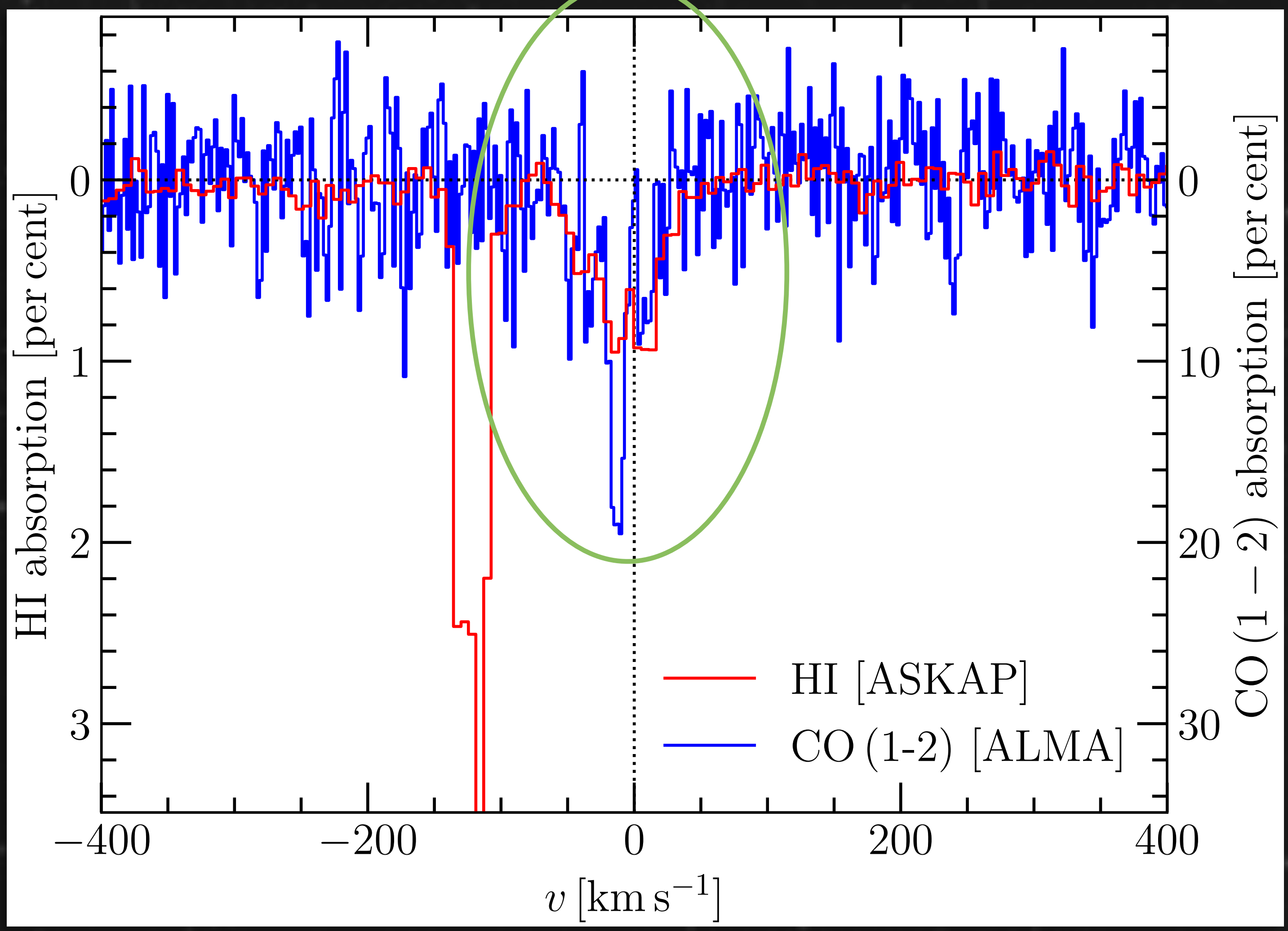

$N_{HI} = N_{H2} \sim 10^{20}$ cm^{-2}

M_{HI}(r<3kpc) ~ 4.7 x 10^6 $M_\odot$

M_{H2}(r<3kpc) ~ 1.4 x 10^7 $M_\odot$

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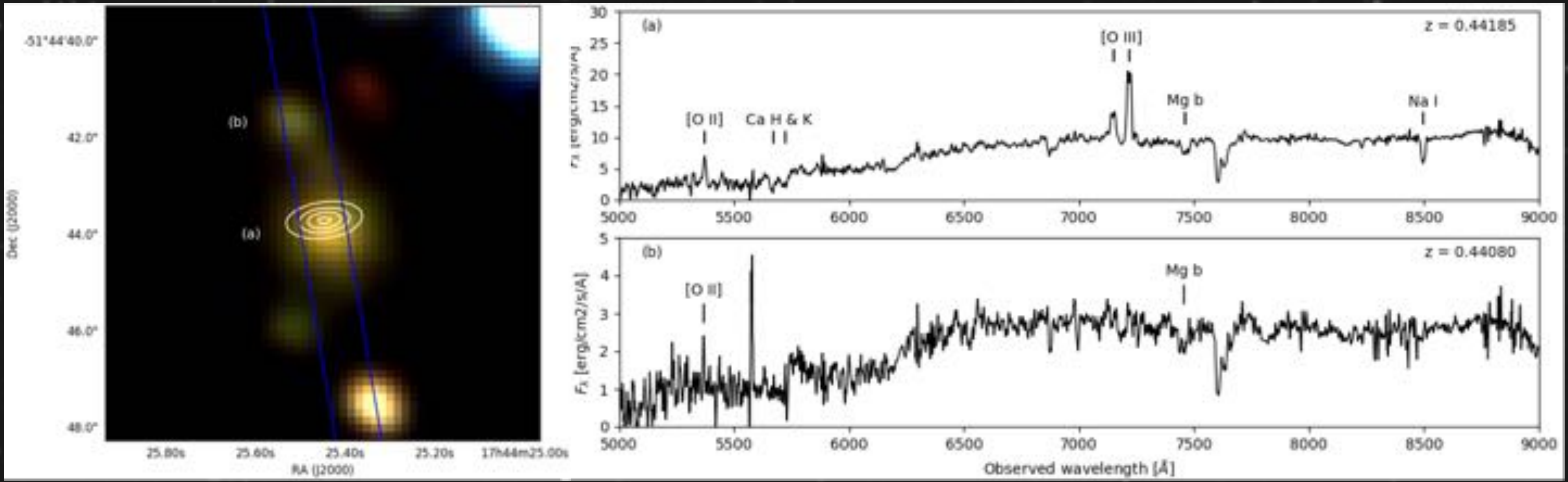
FEEDING THE GAS RESERVOIR (?)



t_{dyn} ~ few 100 Myr
t_{src} ~ 2 kyr

Companion (b) SFR ~ 0.2 $M_{\odot}\,yr^{-1}$
$\Rightarrow M_{stellar}$ ~ few $10^9\,M_{\odot}$
$\Rightarrow M_{HI+H2}$ ~ few $10^8\,M_{\odot}$

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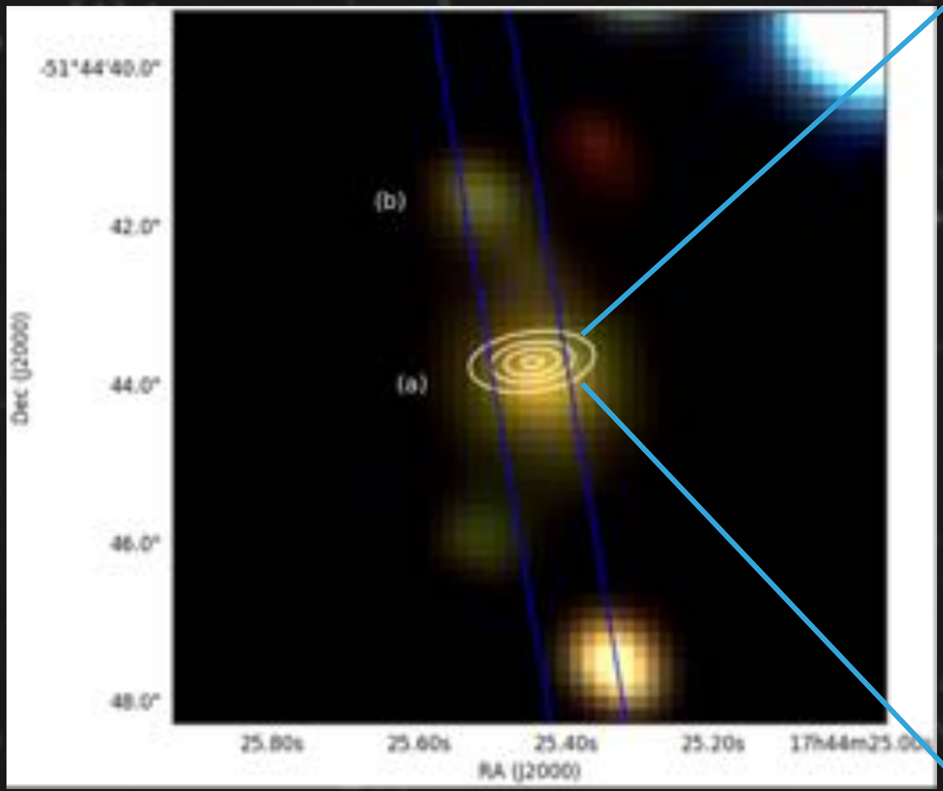

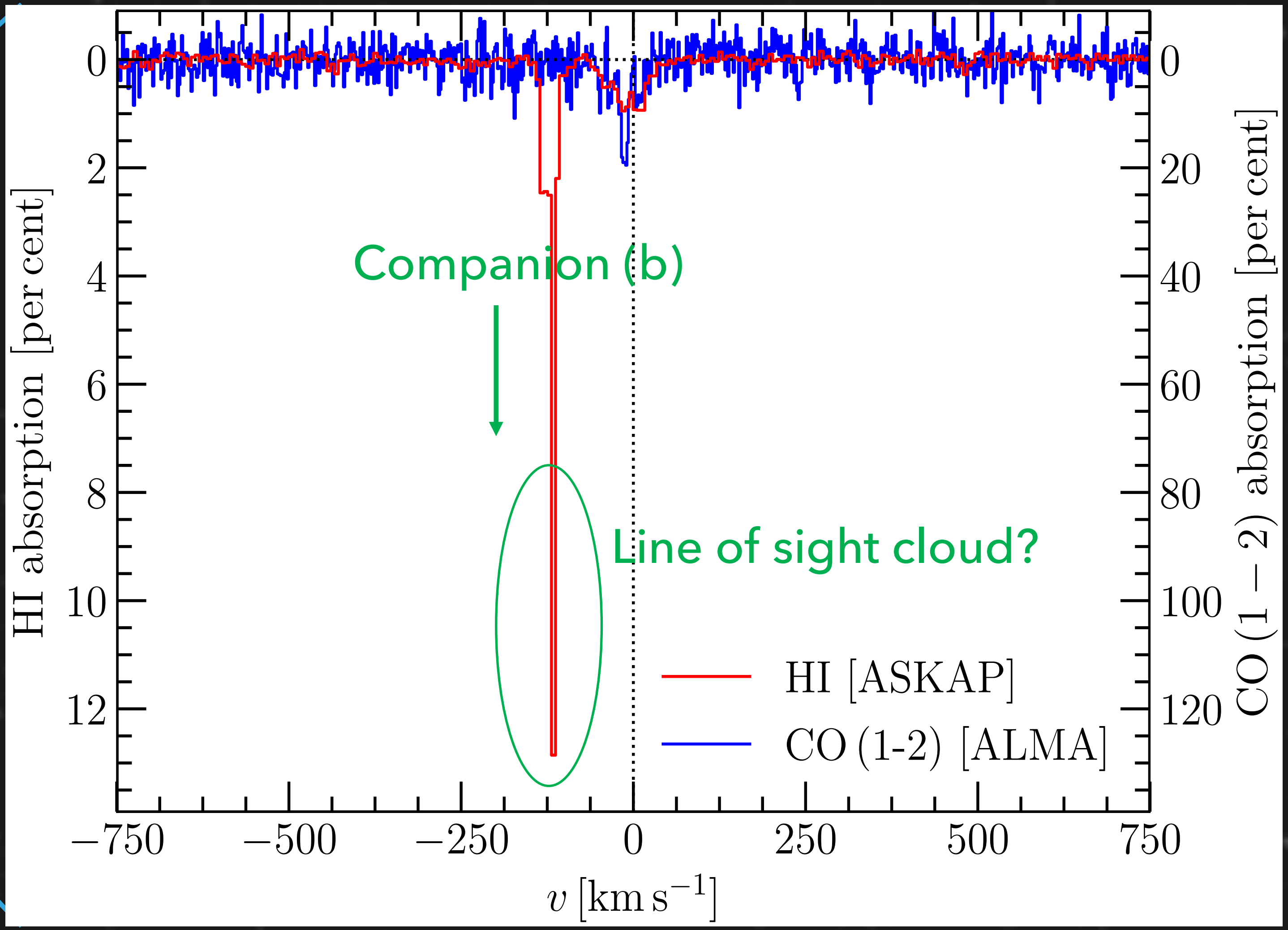

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SUMMARY

- ASKAP FLASH survey will directly observe accreting (and outflowing) neutral gas in powerful distant radio galaxies
- Test for the gas accretion mechanisms that drive the observed dichotomy in radio galaxies
- ASKAP commissioning data have been used to "blindly" detect HI absorption in several distant radio galaxies, including young (t_{src} ~ 2kyr) PKS1740-517
- Evidence of ~10^7 $M_\odot$ HI and H_2 reservoir within 3kpc of AGN
- Interaction with neighbouring star-forming companion galaxy
- Evidence for further replenishment of neutral gas through tidal interaction