Prevalence of neutral gas in centres of low-z galaxy mergers

H I Absorption Workshop 2018

ASTRON, Dwingeloo, The Netherlands

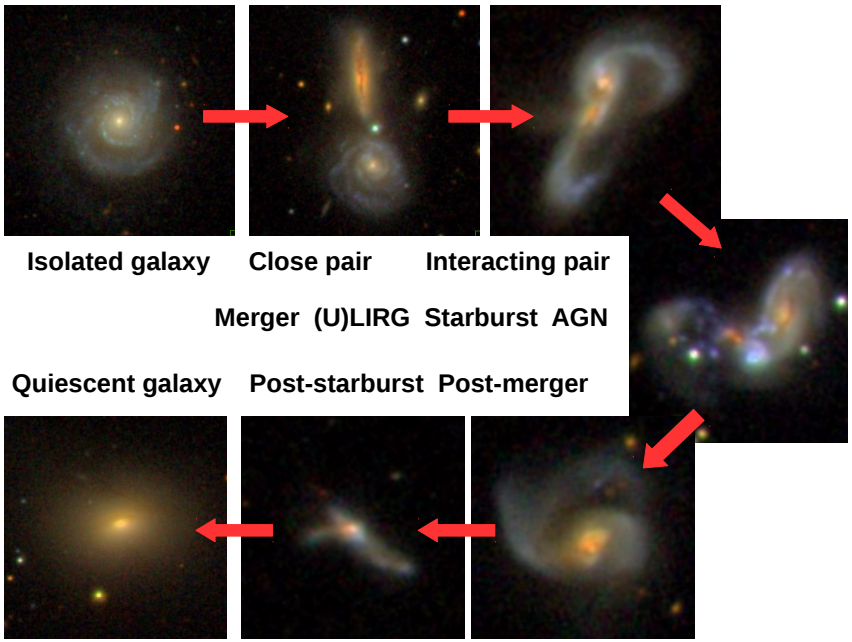
Who? Rajeshwari Dutta

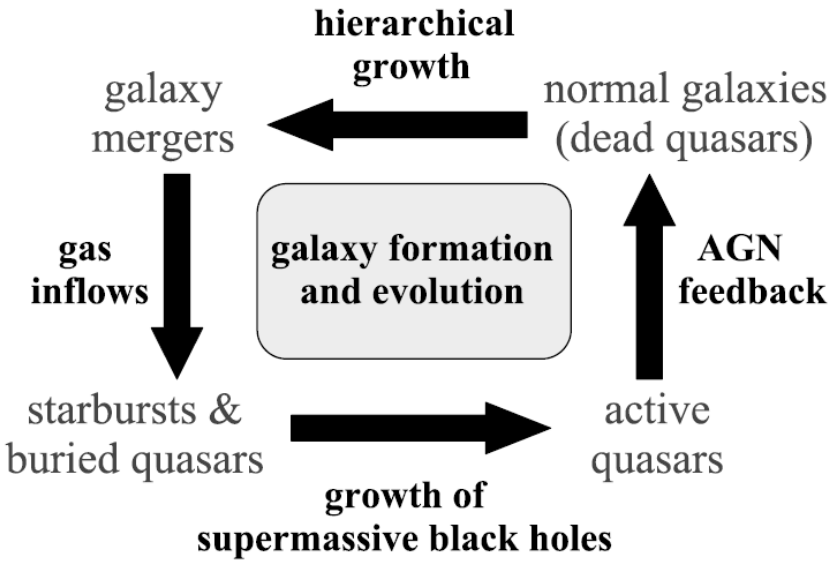
(with R. Srianand & N. Gupta, IUCAA, India)

From? ESO, Garching

When? 31 August 2018

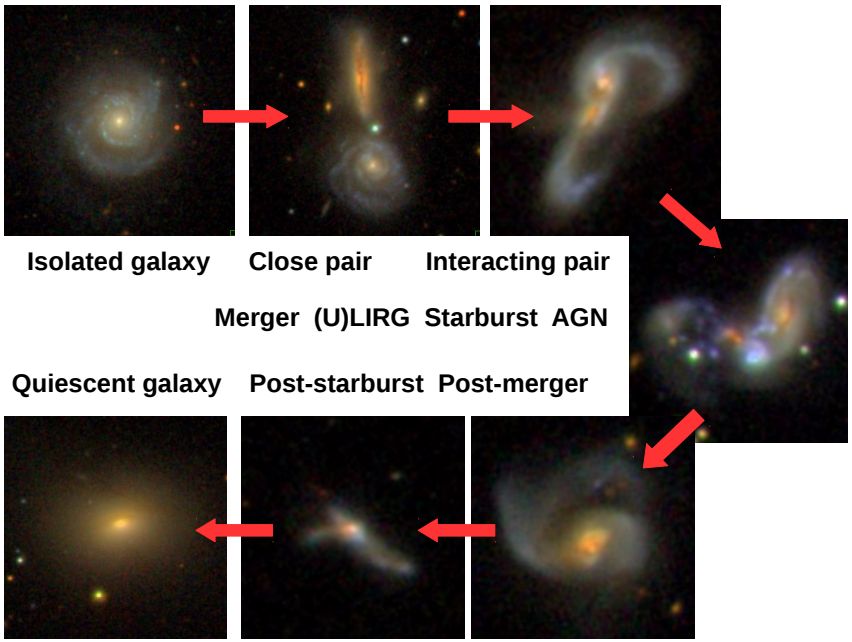
Galaxy merger & AGN connection?

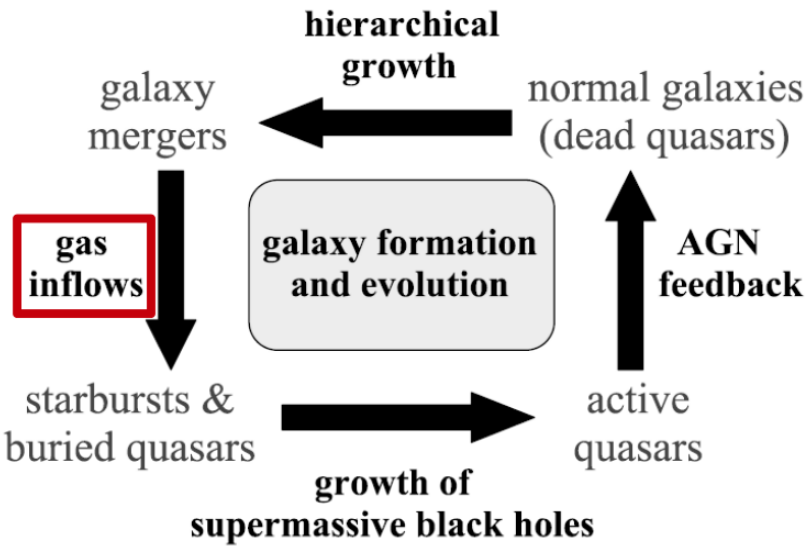




Hopkins+2006

Galaxy merger & AGN connection?





Hopkins+2006

Sample & Observations

Optical images (SDSS) + Radio images (FIRST, > 50 mJy)

$\Downarrow$

Sample of 10 $z \leq 0.2$ galaxy mergers

$\Downarrow$

Optical spectra (SDSS/SALT)

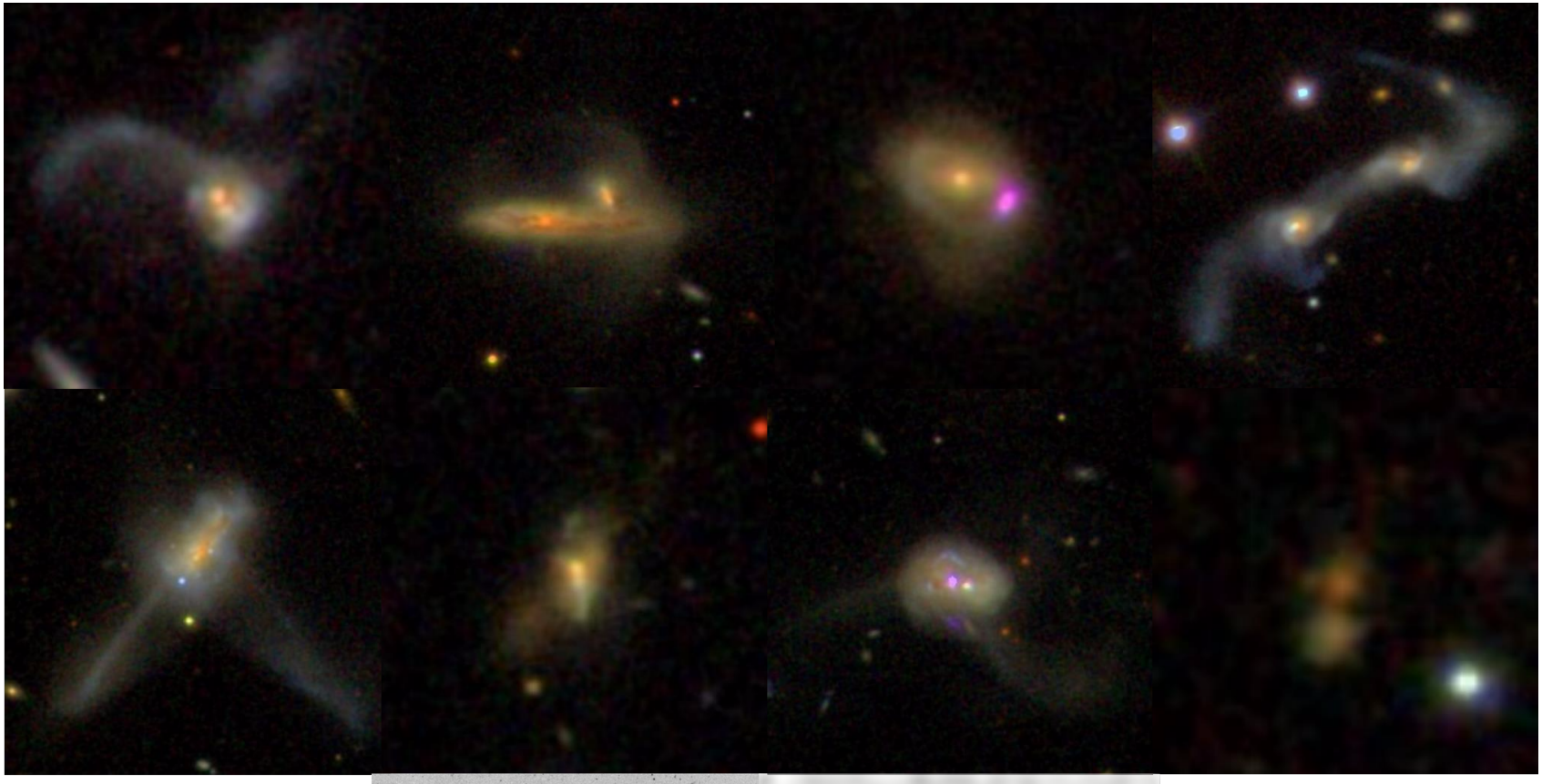
$\Downarrow$

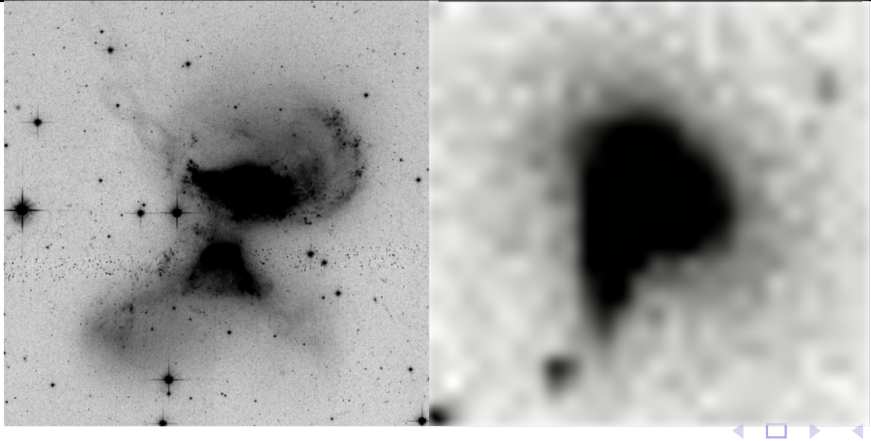
H I 21-cm absorption spectra (GMRT/VLA)

Results in *Dutta et al. 2018, MNRAS, 480, 947; arXiv:1807.04298*

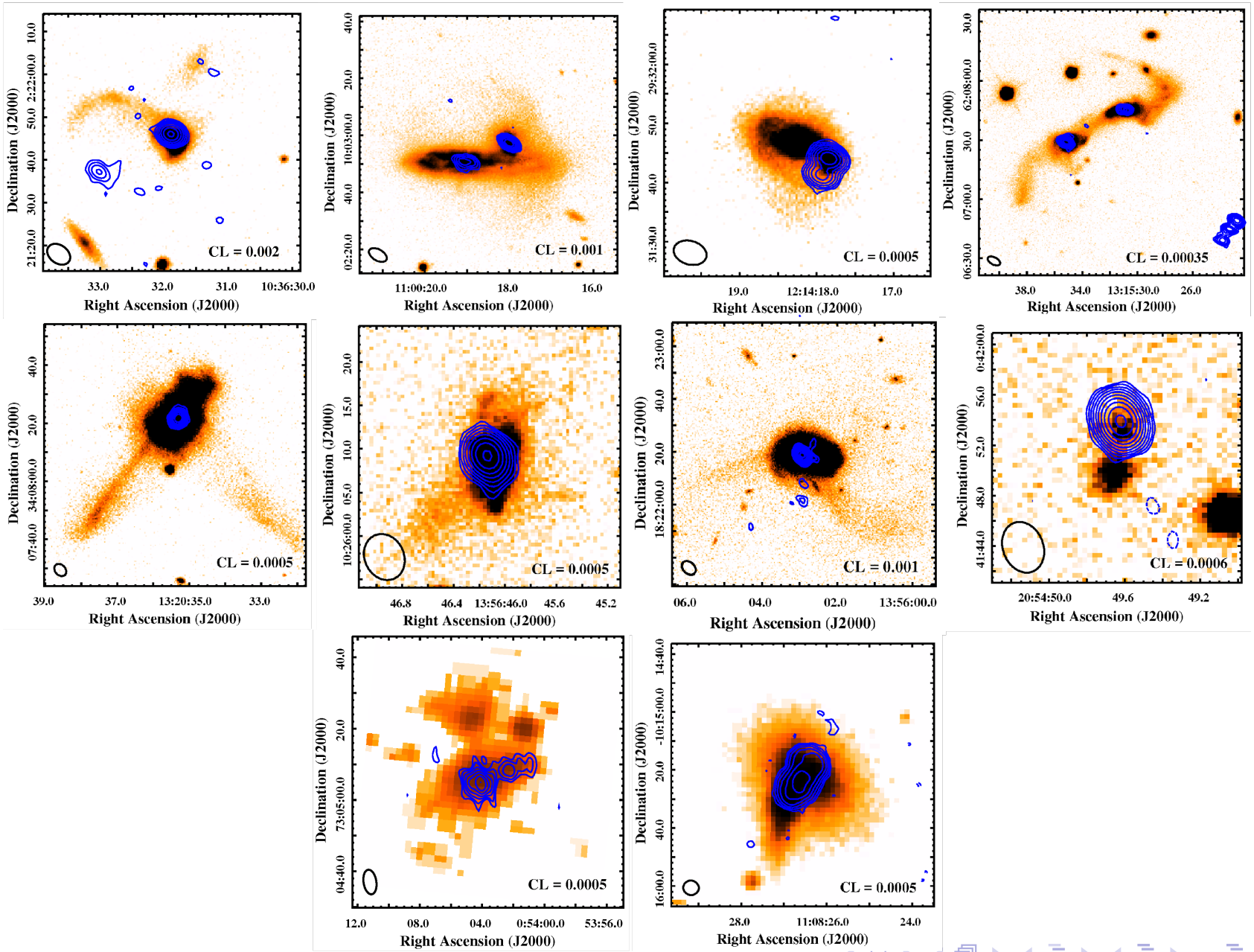
GMRT

Galaxy merger sample

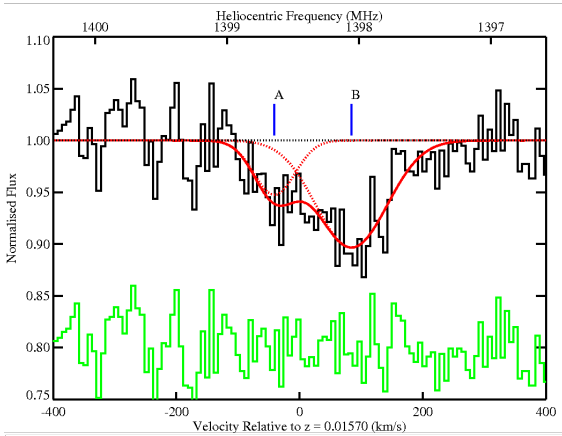


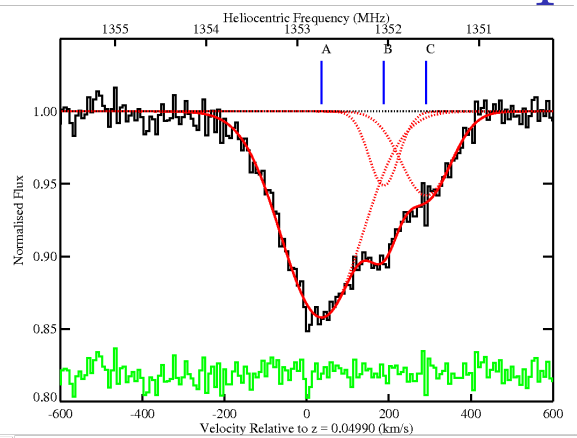


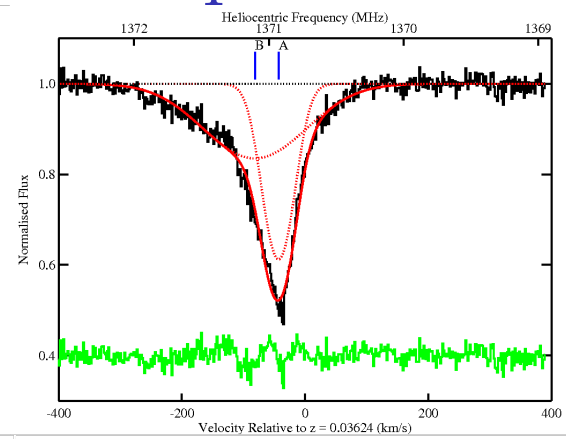
Galaxy merger sample

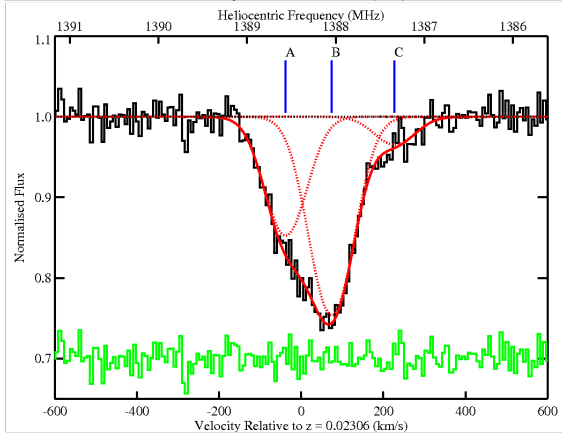


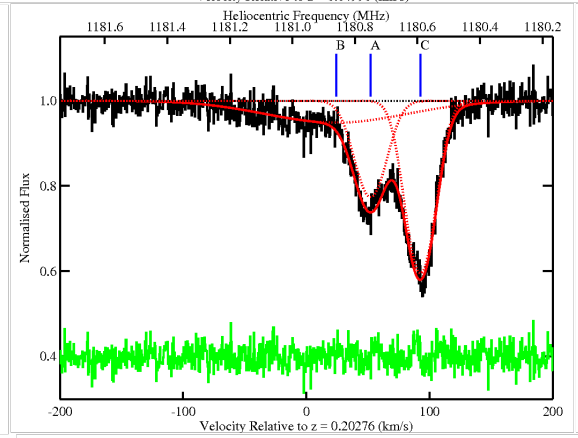
H I absorption spectra

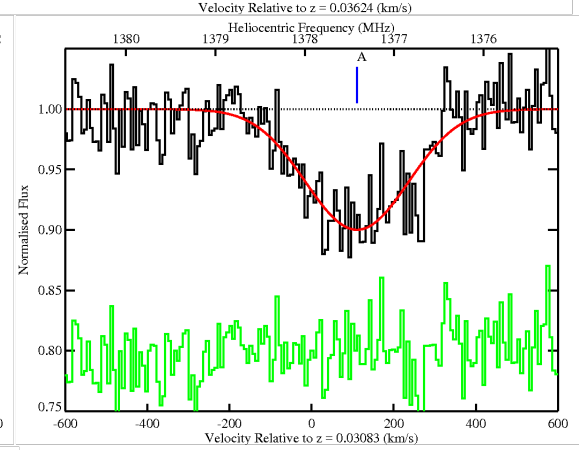


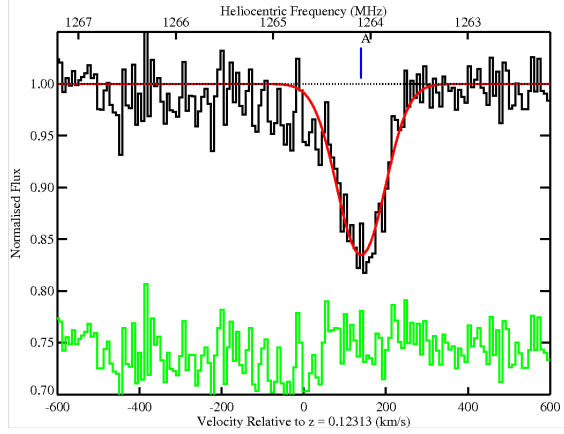




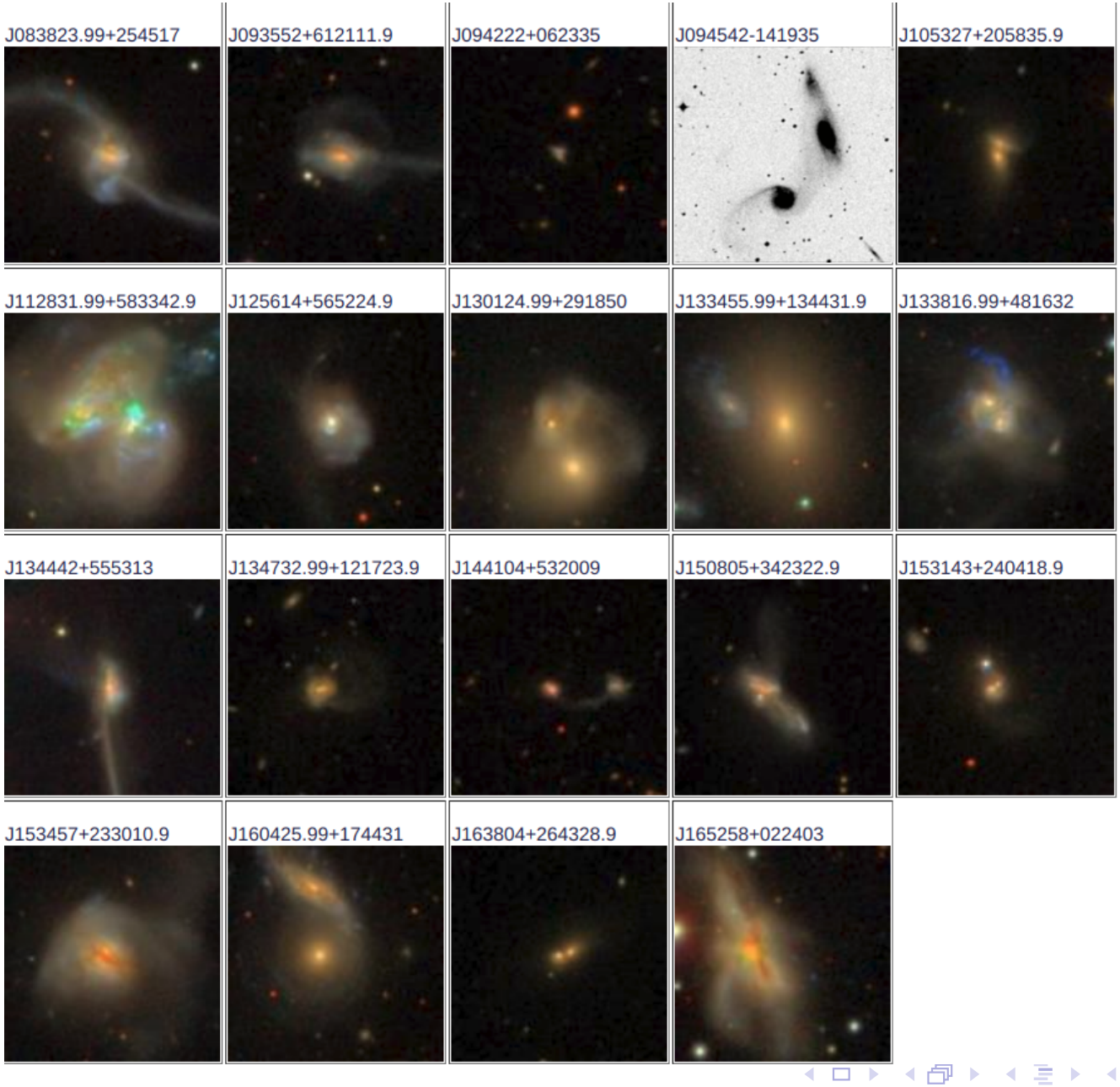








Literature sample

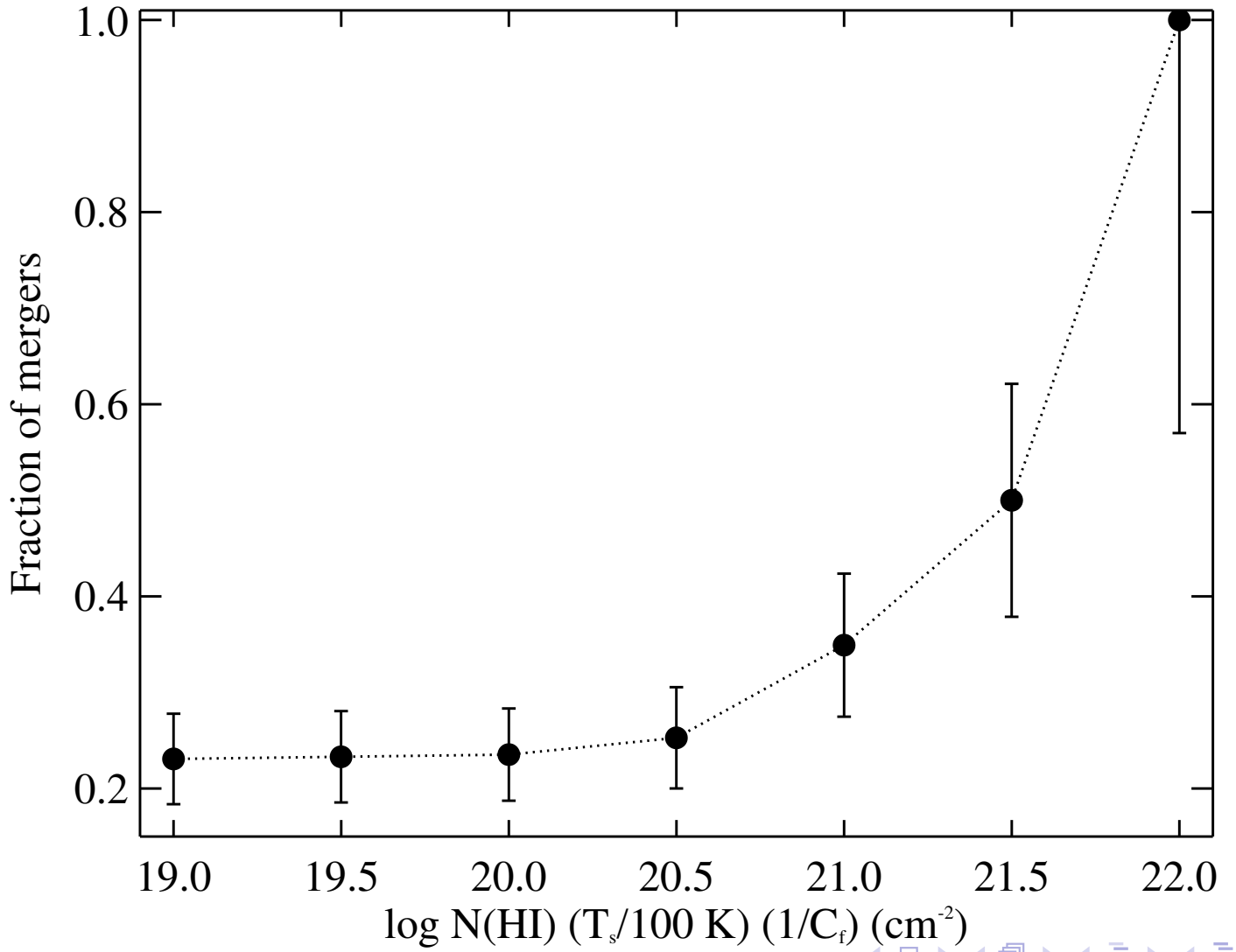


Incidence of H I

- Our merger sample $\Rightarrow 70 \pm 26\%$
- Ours + literature merger sample $\Rightarrow 83 \pm 17\%$
- Low-z radio sources $\Rightarrow \sim 20 - 30\%$ (Gupta+2006, Maccagni+2017, etc.)

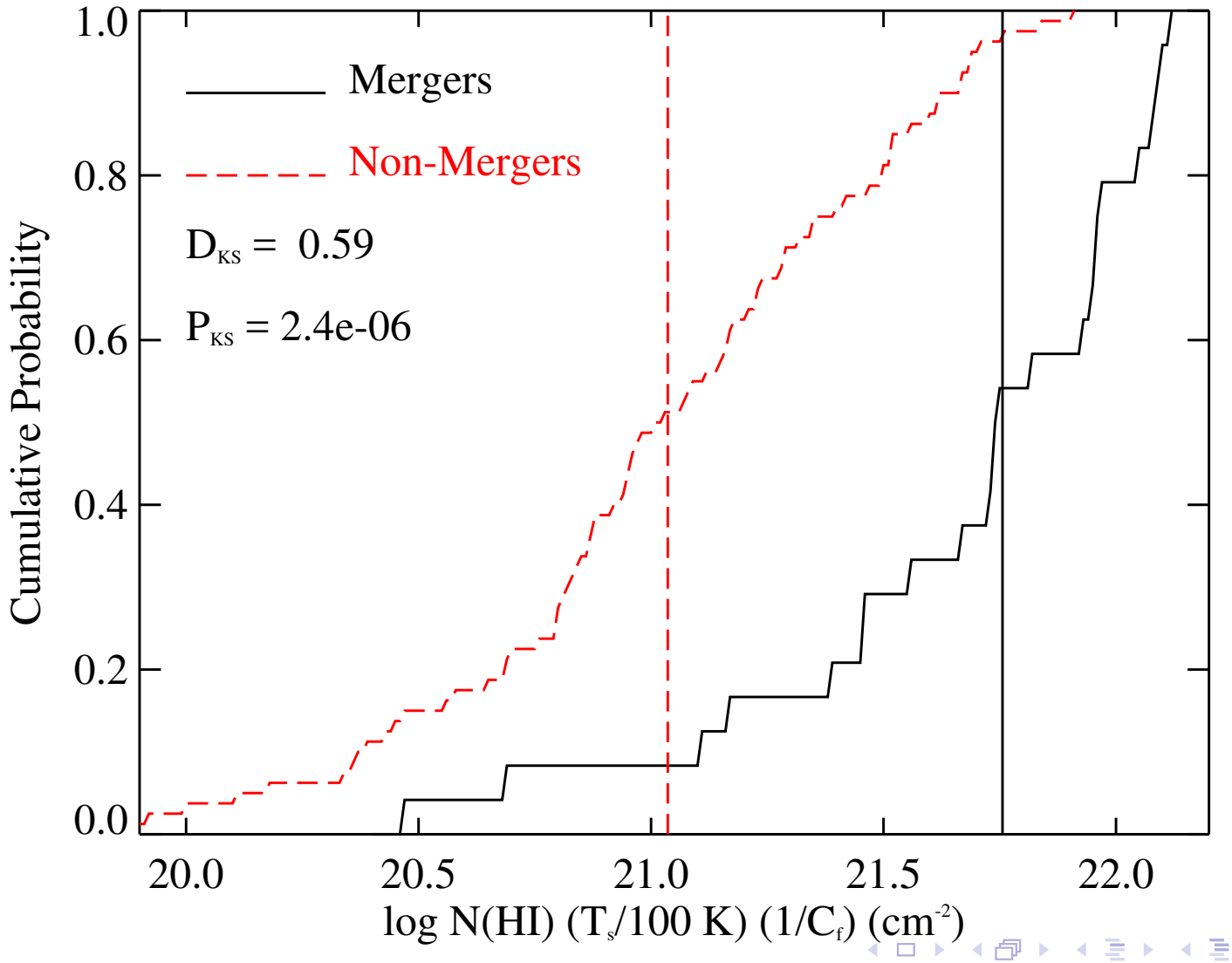
Merger fraction

$N(\mathrm{H\,I}) > 10^{21} \Rightarrow 40\%$; $N(\mathrm{H\,I}) > 3 \times 10^{21} \Rightarrow 50\%$; $N(\mathrm{H\,I}) > 10^{22} \Rightarrow 100\%$



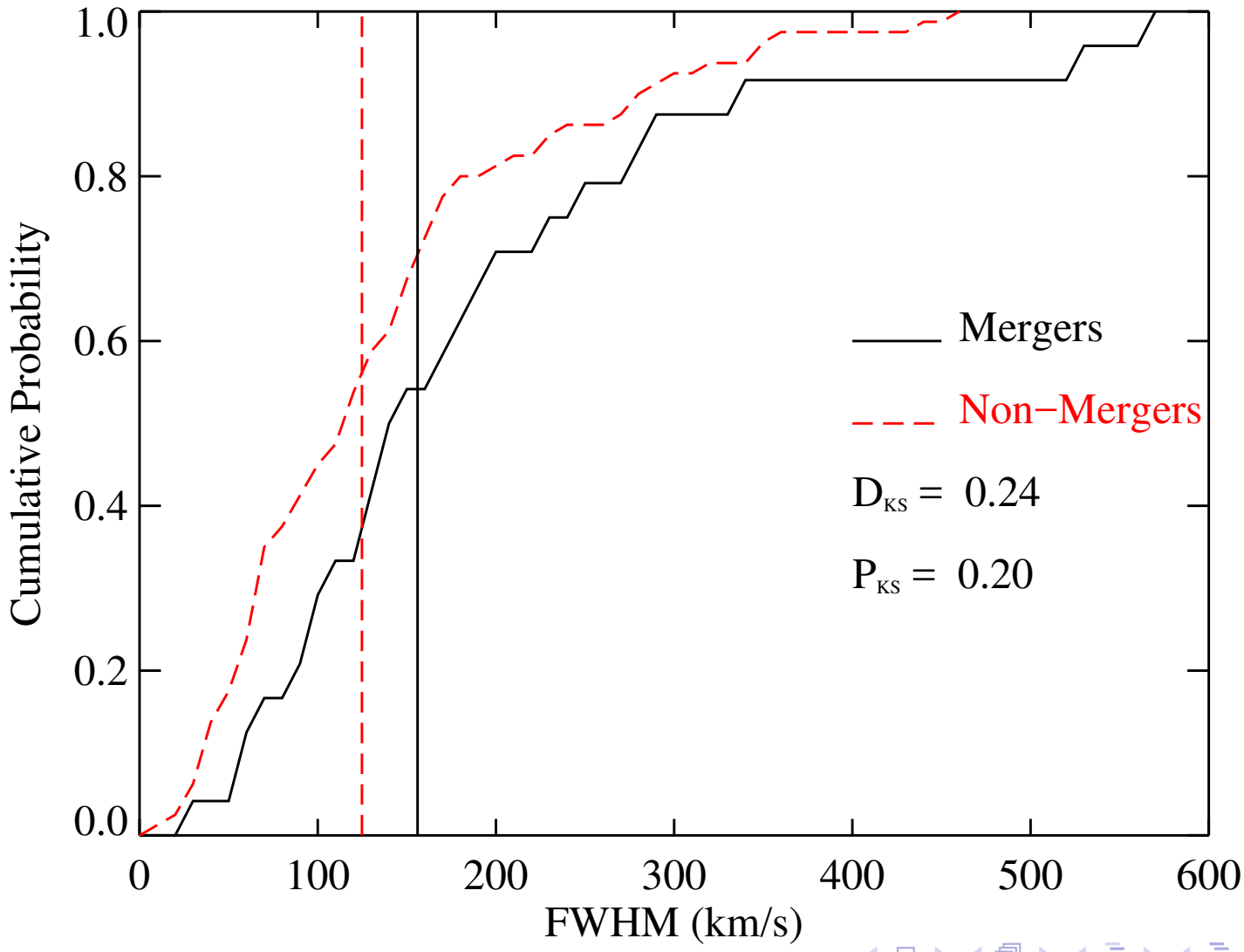
N(H I) distribution

Mergers have six times higher N(H I) on average

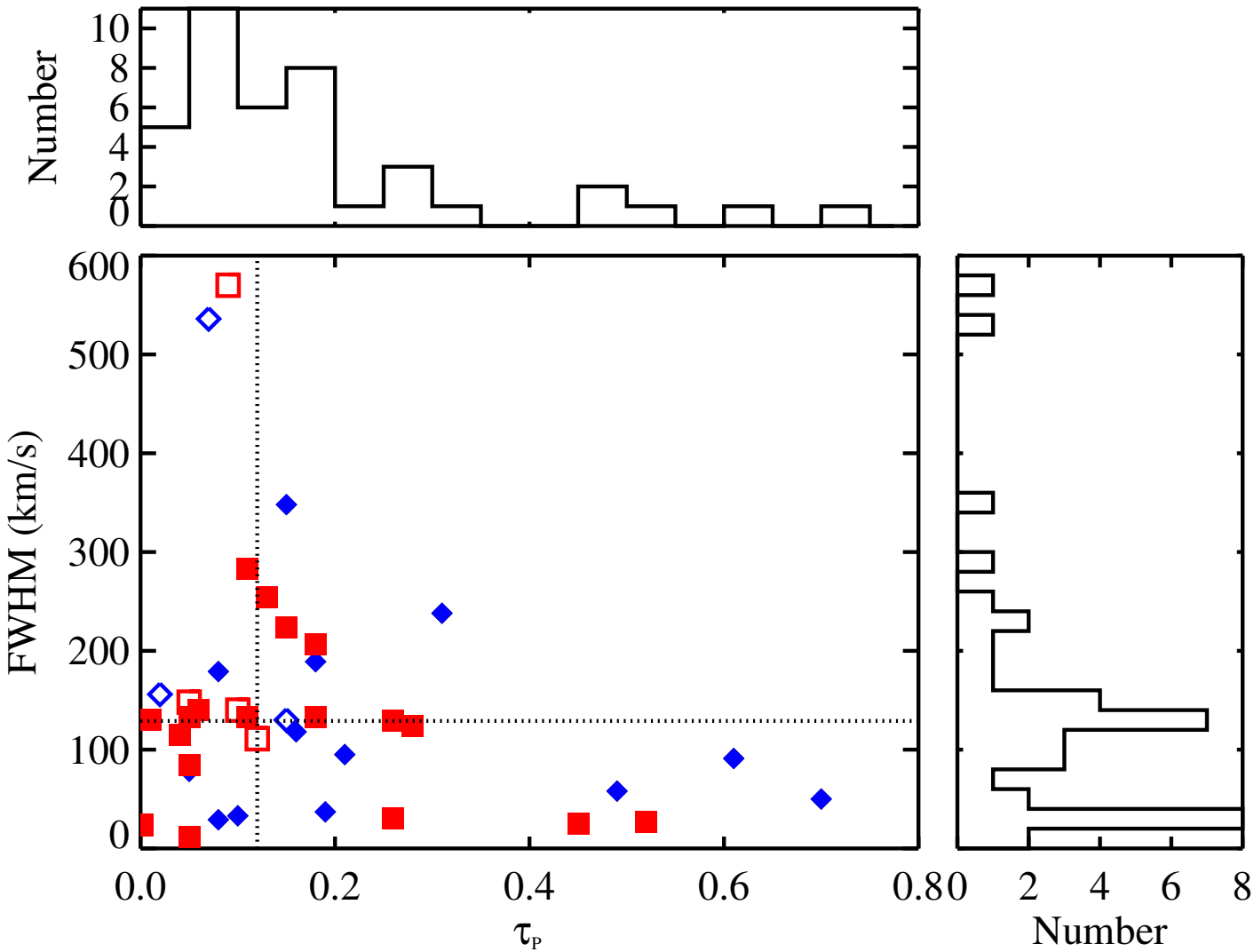


Kinematics of H I

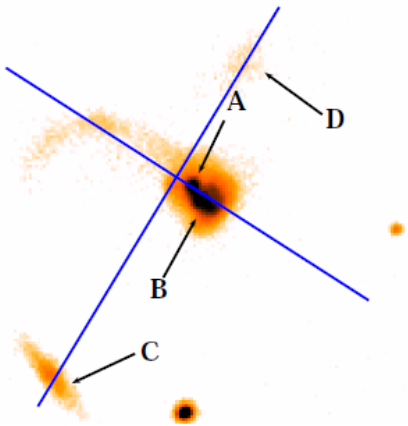
Mergers have slightly larger widths on average

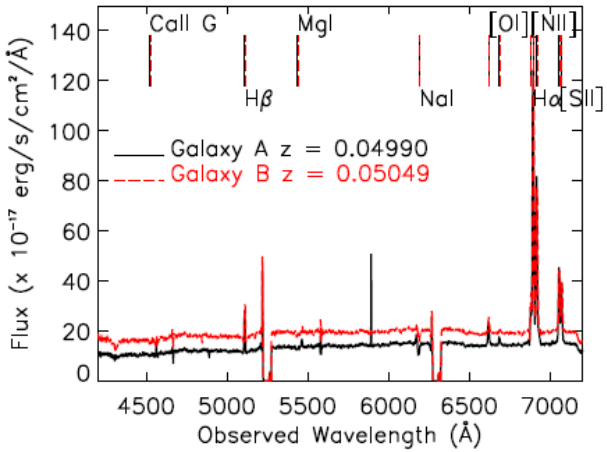


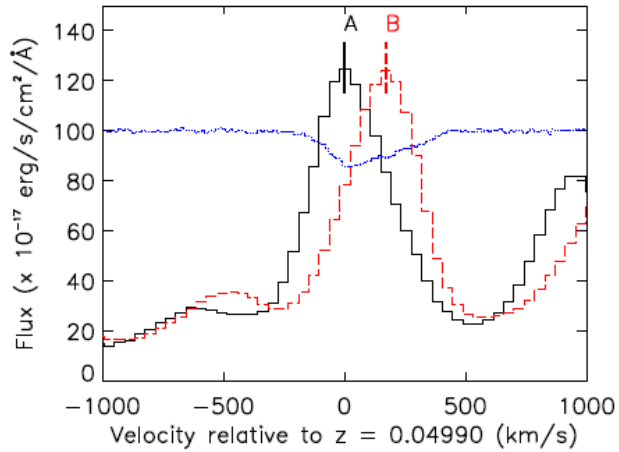
Kinematics of individual absorption components

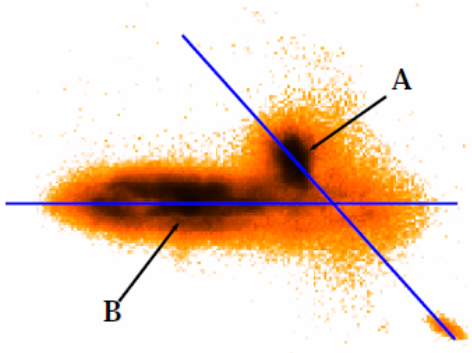


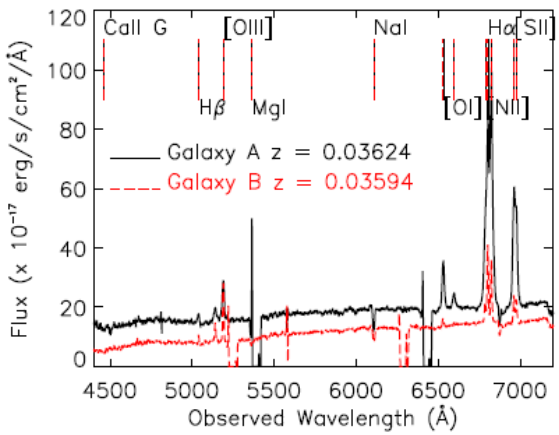
SALT long-slit spectra

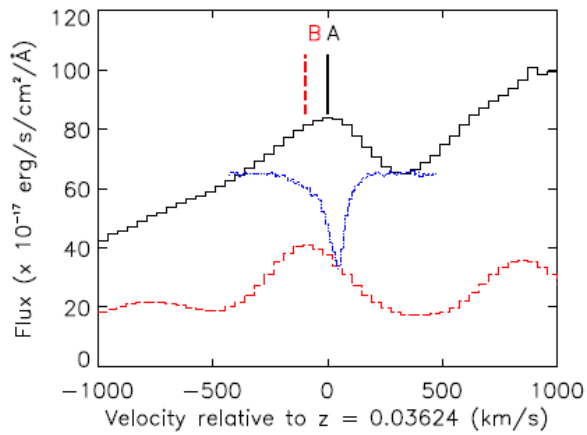






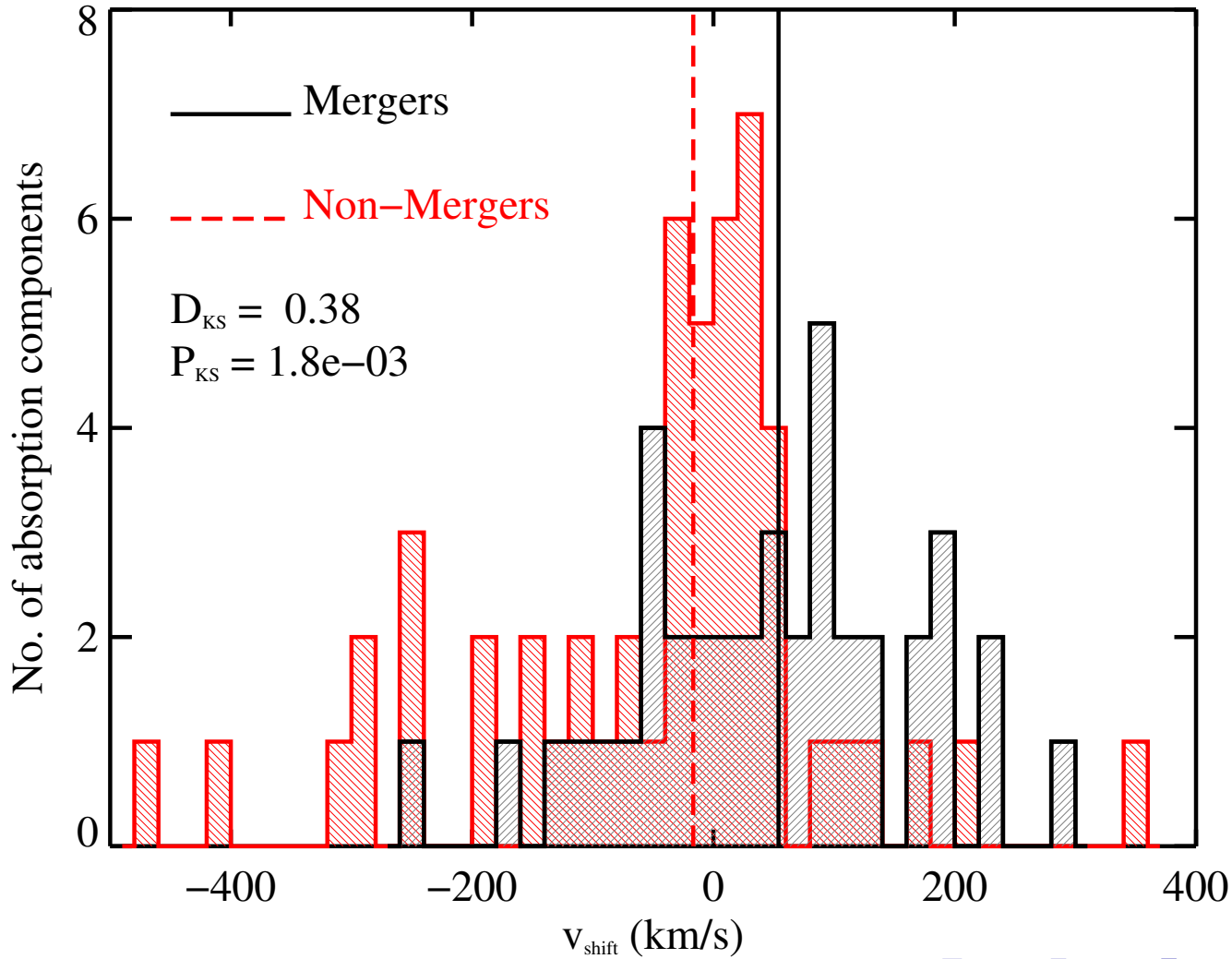






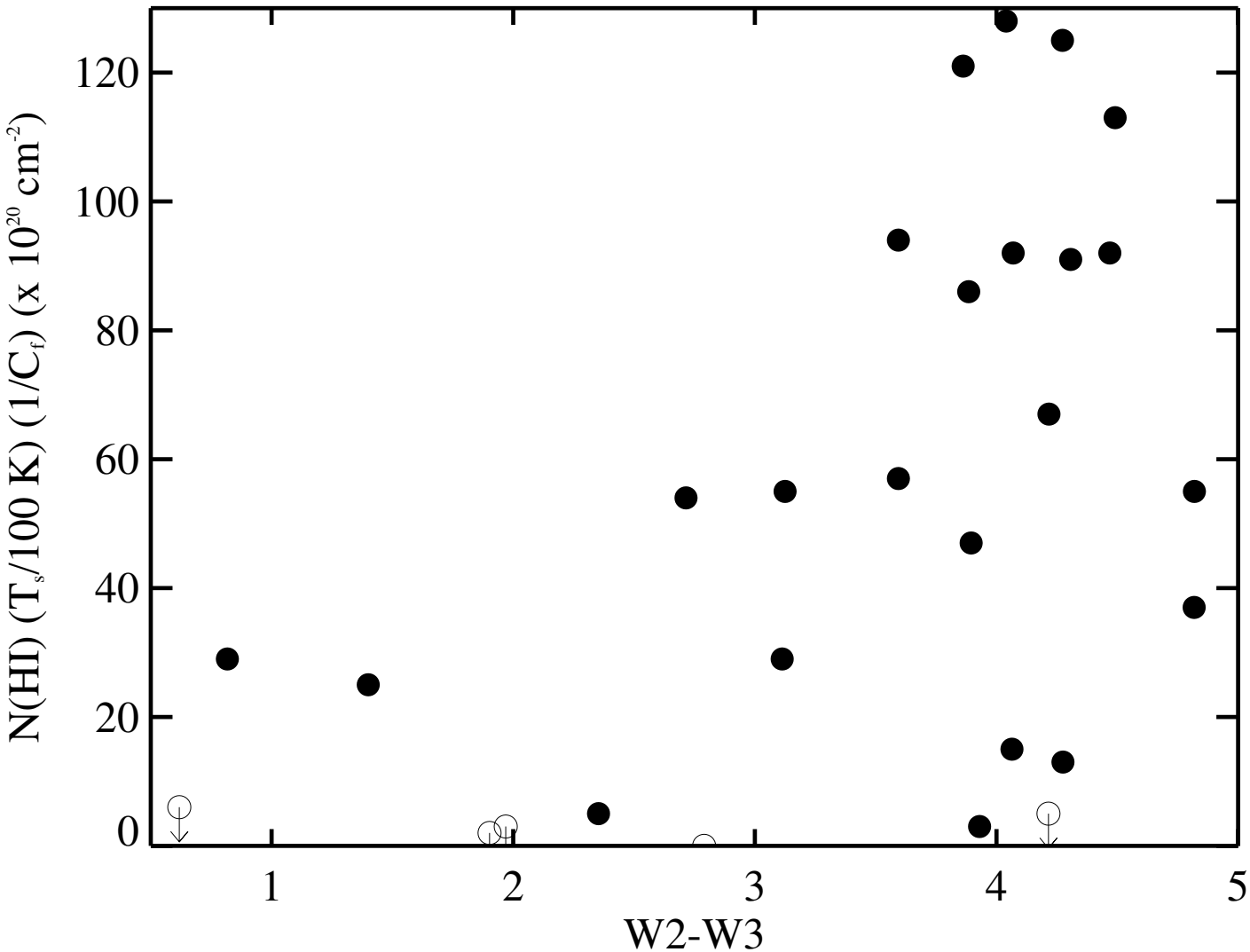
Kinematics of H I

$\sim 60\%$ (30%) of absorption components have velocity shift from systemic velocity of radio source $\geq 0\,\mathrm{km\,s^{-1}}$ ($\geq +100\,\mathrm{km\,s^{-1}}$)



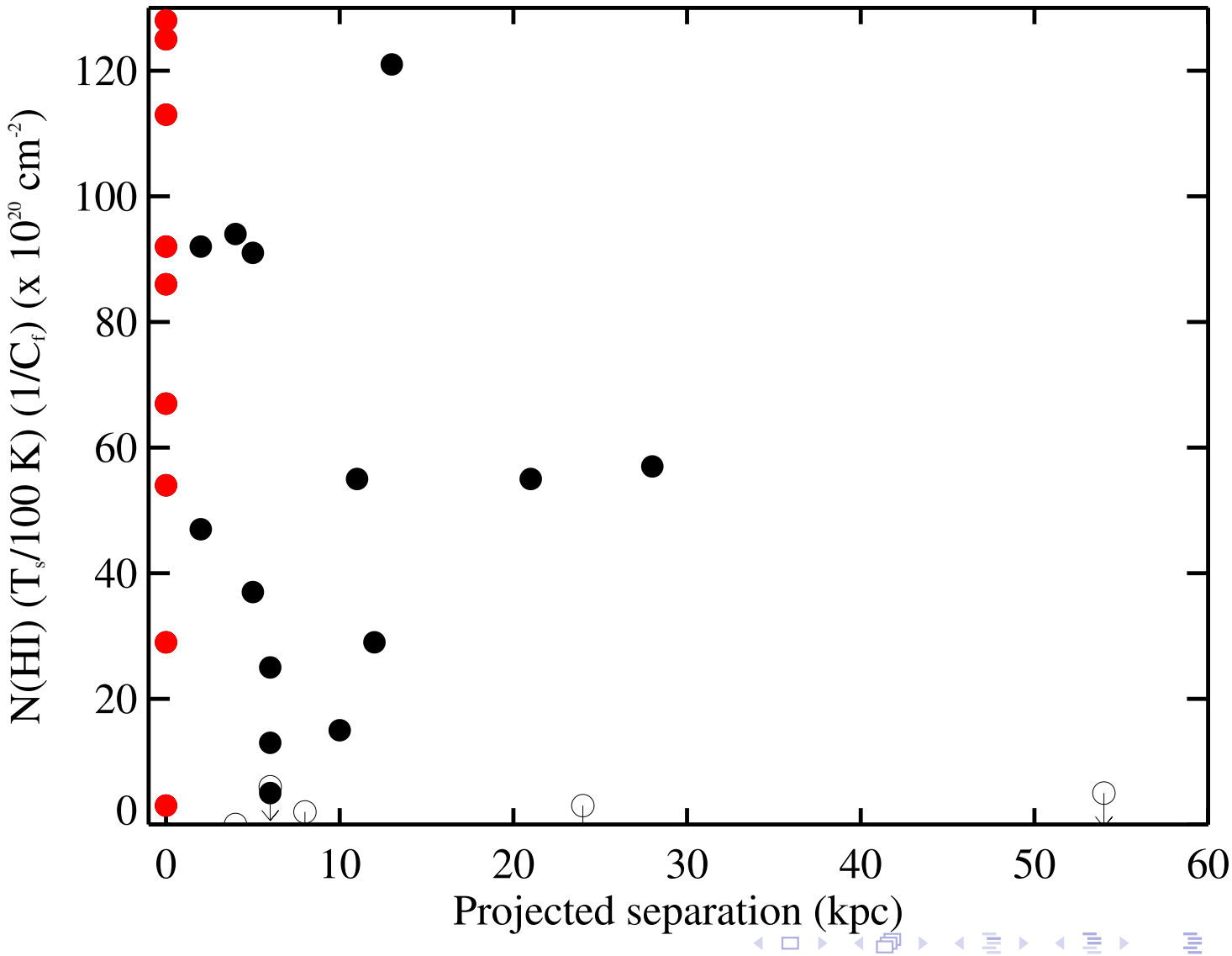
Galaxy properties

No significant dependence on optical and infrared colours, radio power

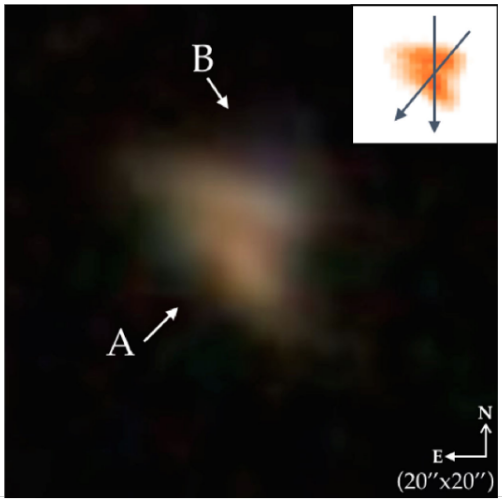


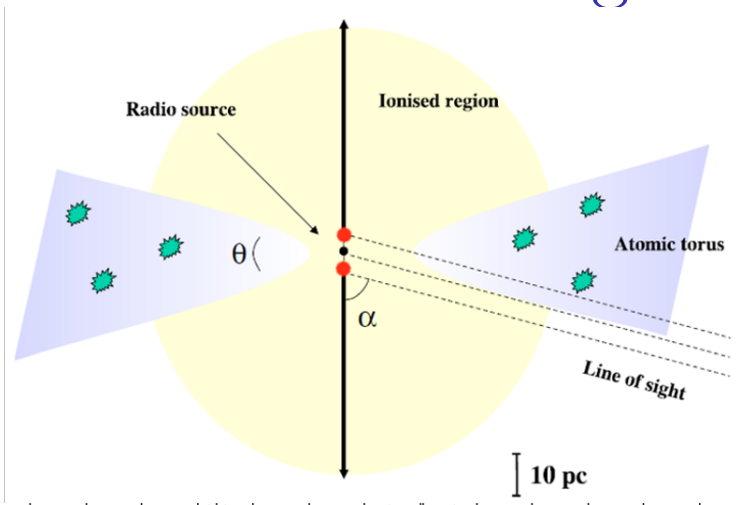
Galaxy properties

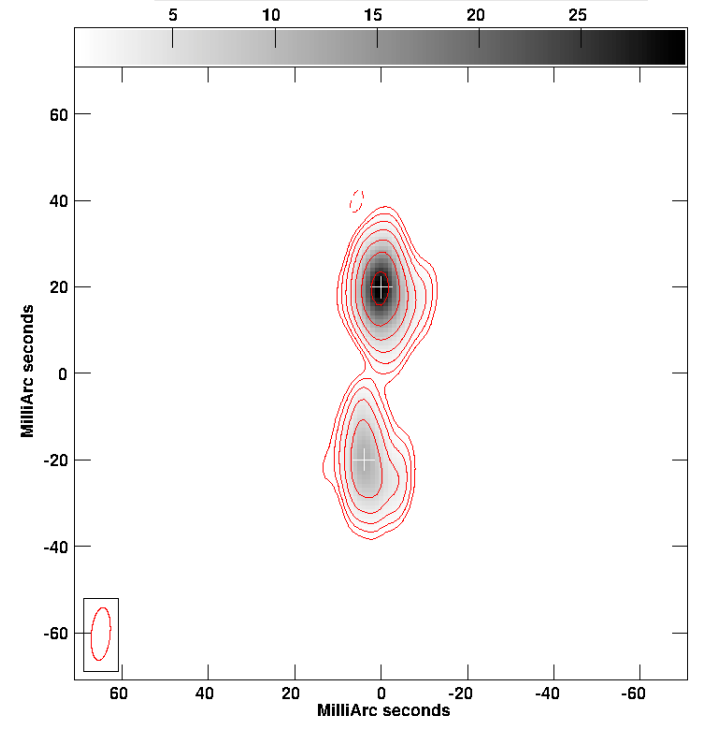
No significant dependence on projected separation and morphology

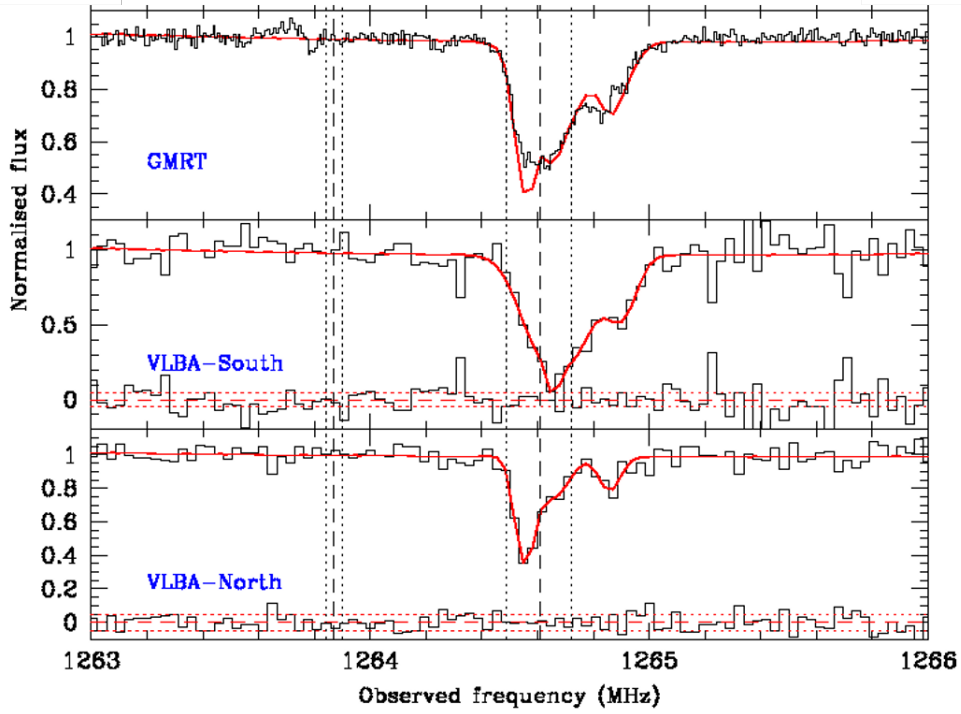


Parsec-scale circumnuclear gas



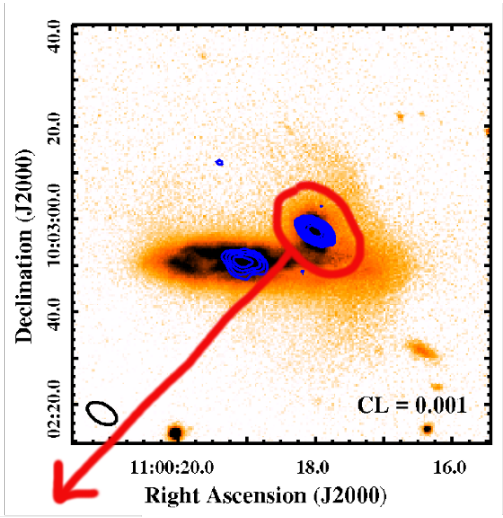


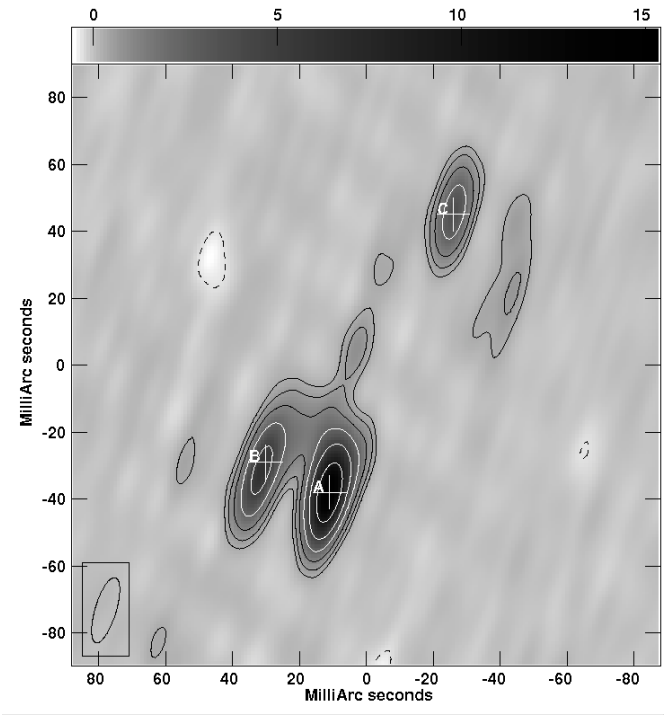


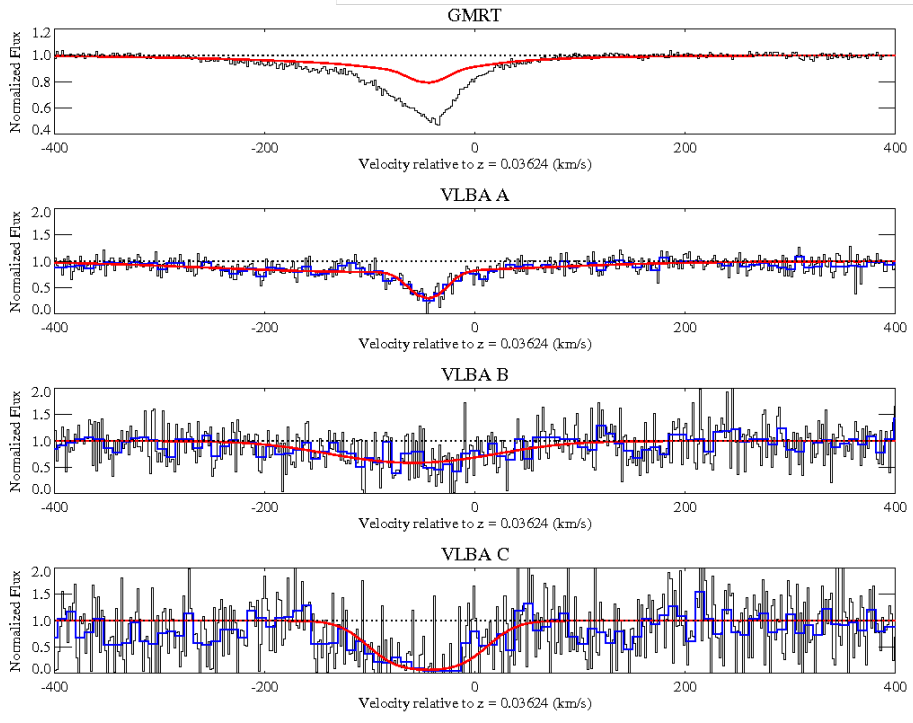


Srianand+2015, Orienti+2006

Parsec-scale circumnuclear gas *(Preliminary)*





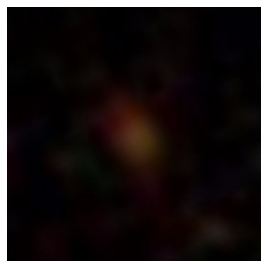
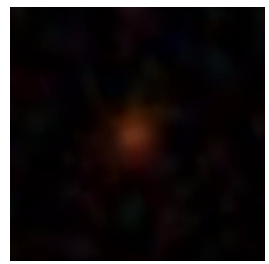


Take home points

- Incidence of neutral gas ($N(\mathrm{H\,I}) \sim 10^{21-22}\,\mathrm{cm}^{-2}$ for $\mathrm{T}_s = 100$ K and $C_f = 1$) in $z \lesssim 0.2$ radio-loud galaxy mergers $= 83 \pm 17\%$; $\sim 3-4$ times higher than that found for low-z radio sources
- Fraction of intrinsic absorbers that are associated with mergers increases with increasing $N(\mathrm{H\,I})$ threshold; 40% (100%) of the absorbers with $N(\mathrm{H\,I}) > 10^{21}\,\mathrm{cm}^{-2}$ ($> 10^{22}\,\mathrm{cm}^{-2}$) arise from mergers
- Distribution of $N(\mathrm{H\,I})$ among mergers is significantly different from that among non-mergers; mergers give rise to 6 times stronger absorption on average
- Fraction of redshifted absorption components (with respect to systemic velocity of radio source) among mergers is higher by $2-3$ times compared to that for non-mergers

Looking forward

- H I 21-cm absorption efficient tool to detect gas-rich galaxy mergers $\Rightarrow$ expand sample of low-z mergers with 21-cm
- N(H I) distribution in samples of radio-loud AGNs $\Rightarrow$ statistically identify mergers at high-z and in upcoming blind 21-cm absorption surveys
  - Space-based high spatial resolution imaging follow-up of high N(H I) systems at $z > 0.2$ for confirmation

  - Follow-up spatially-resolved multi-wavelength spectroscopy $\Rightarrow$ exact connection between H I absorbing gas & AGN activity

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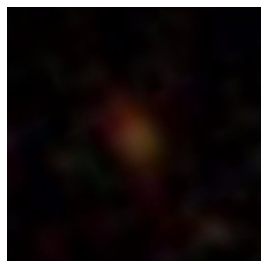
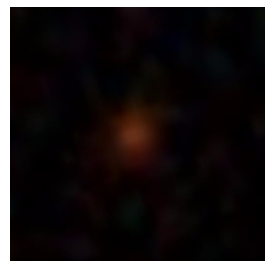

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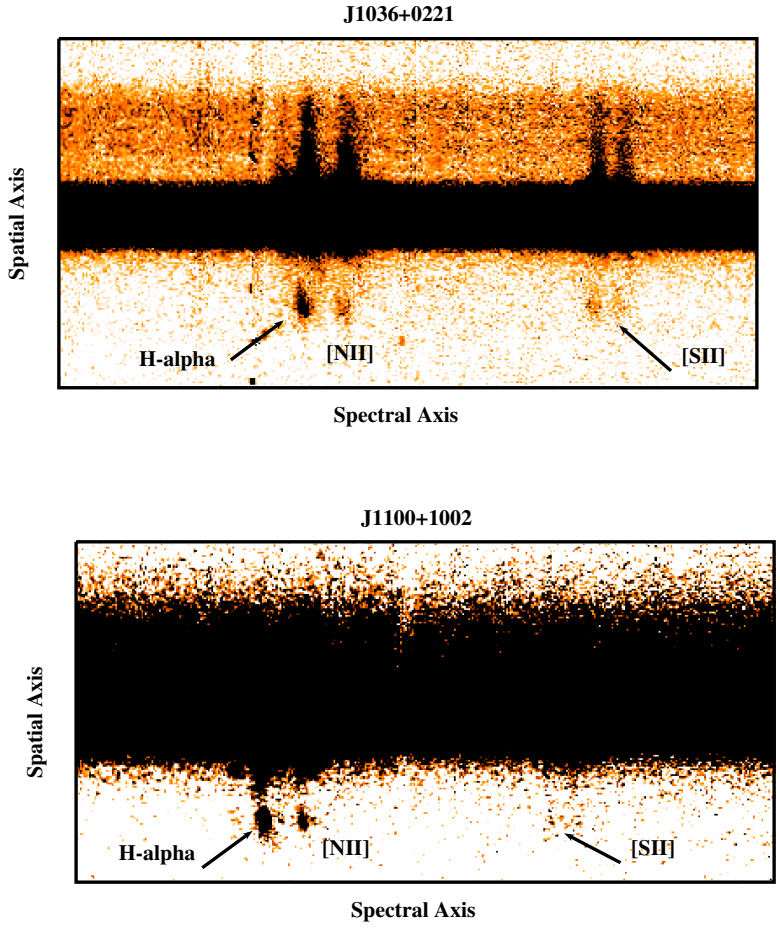
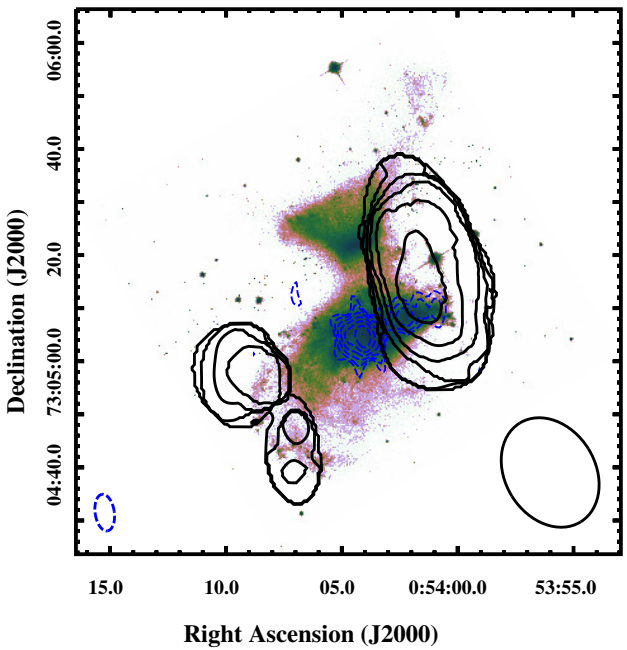
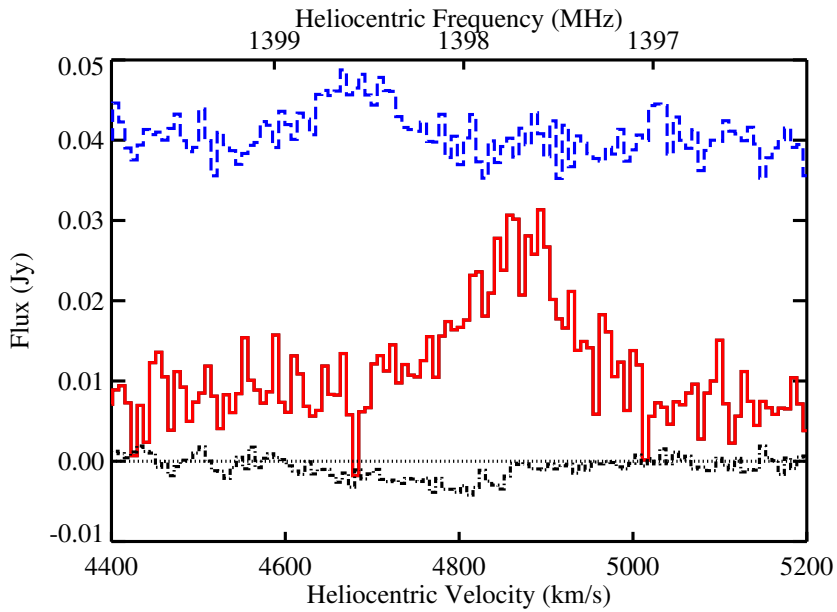
THANKS!

Extra slide: Extended nebular emission



Extra slide: H I emission & absorption





Extra slide: Kinematics of H I

Kinematics of individual absorption components