A search for intervening HI absorption in galaxies from HIPASS

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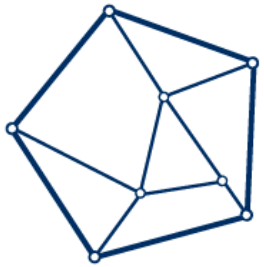

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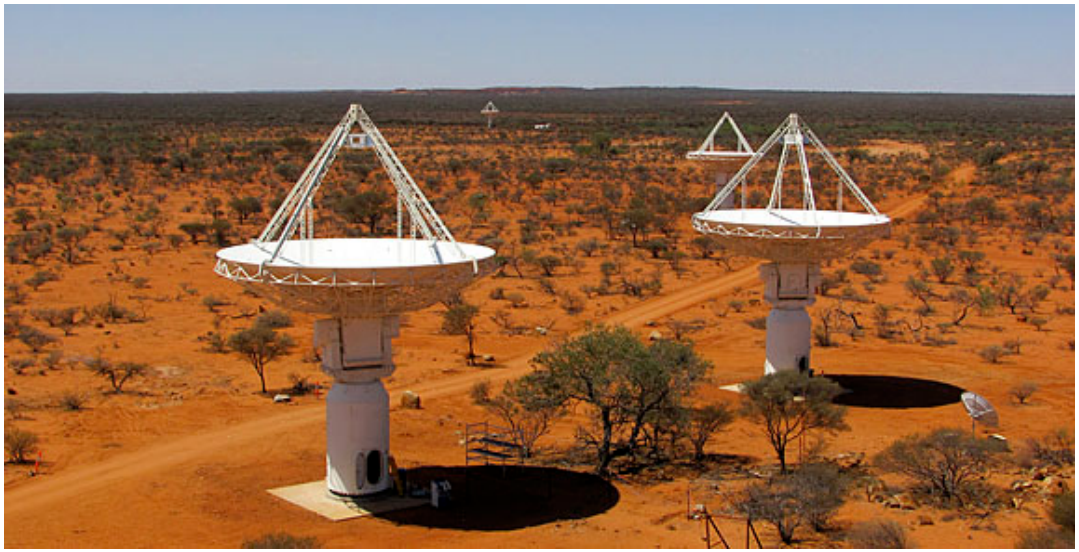
A new Era for HI Astronomy



Driven by new technology:

- Wide bandwidths
- Large field-of-view
- Powerful correlators
- Also: Radio Quiet Environment (see RFI workshop)

Will allow us to conduct the first large-scale, blind HI absorption-line surveys

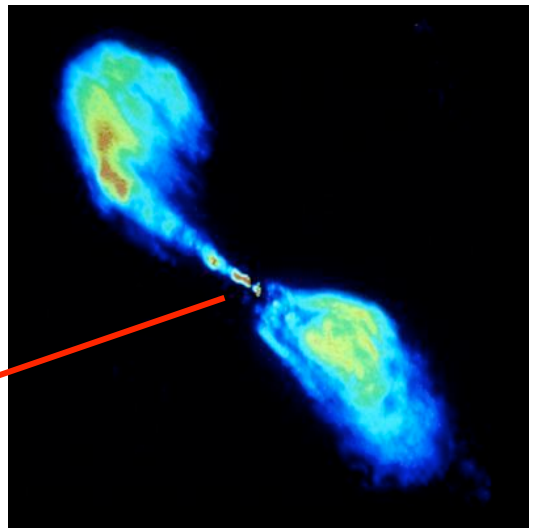
ASKAP-FLASH

- FLASH: 'First Large Absorption Survey in HI'
- Main FLASH survey: redshifts $0.5 < z < 1.0$
- Will target 150,000 sightlines to known continuum sources (blind in redshift-space)
- WALLABY-FLASH piggyback survey: redshifts $0 < z < 0.25$

ASKAP-FLASH
First Large Absorption Survey in HI

Intervening HI absorption

$$N_{\rm HI} = 1.823 \times 10^{18} \frac{T_{\rm spin}}{f} \int \tau_{\rm obs}(v) {\rm d}v$$



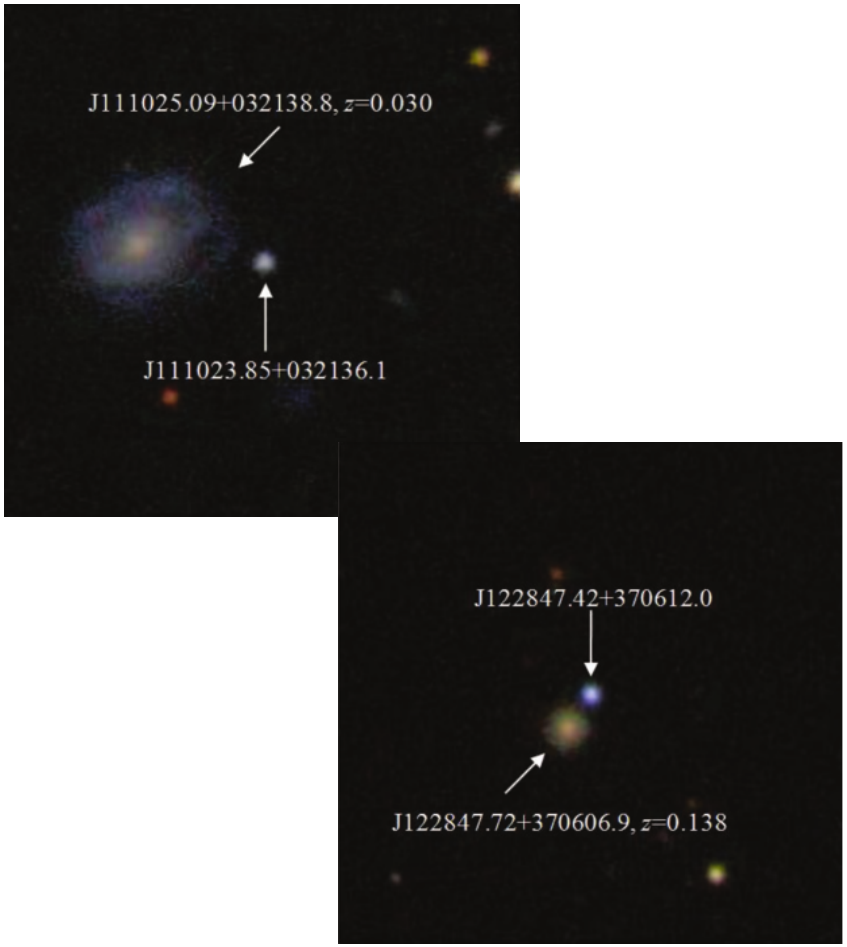
- HI absorption provides a distance-independent probe of neutral hydrogen
- Measurements of neutral hydrogen at different epochs provide important tests of galaxy evolution models

Tests in the Local Universe

- How does the detection rate of intervening absorbers vary with distance from the galaxy?
- Related to HI distribution (but not the same thing!)
- What is T_{spin} in the disks of spiral galaxies?
- And what about f (covering factor)?
- Need to understand these factors in order to correctly interpret FLASH results (galaxy properties)

Previous Work - Gupta et al. (2010)

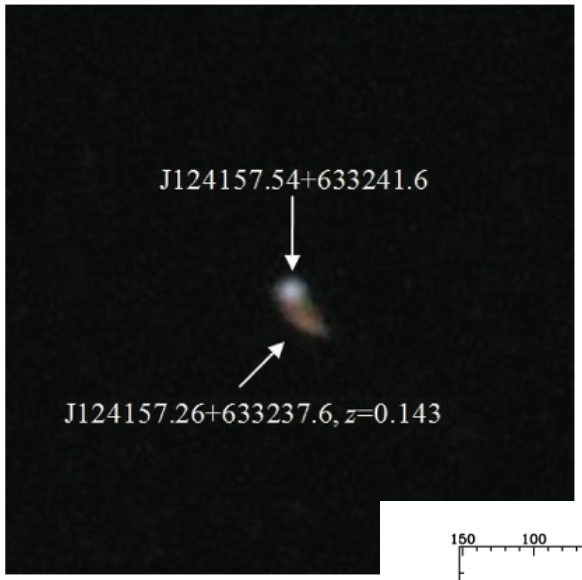
- Gupta et al. (2010):
  - Searched 9 sightlines for absorption (~10-55 kpc)
  - Targets: Quasar-Galaxy Pairs (QGPs)
- Combine with other studies of QGPs in the literature (15 additional sightlines):
  - Borthakur et al. (2010)
  - Hwang & Chiou (2004)
  - Carilli & van Gorkom (1992)
  - Corbelli & Schneider (1990)
  - Boisse et al. (1988)
  - Haschick & Burke (1975)

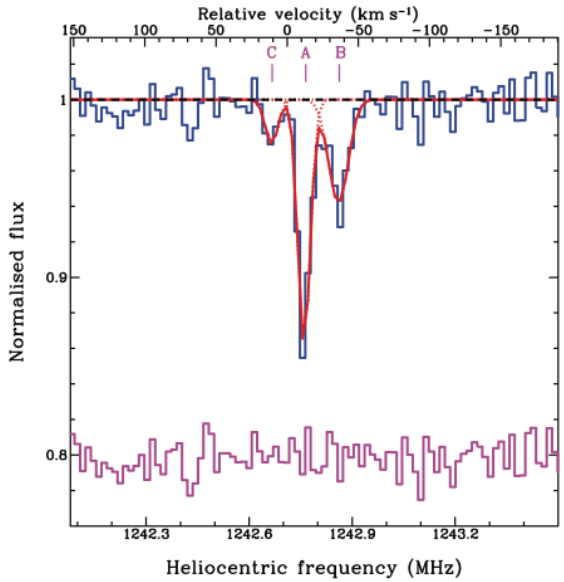


Gupta et al. (2010) - Results

Results:

- Gupta: one absorption-line (impact parameter ~11 kpc)
- Literature search: 6 detections (impact parameters ~2-15 kpc)
- Determine that non-detections are due to sightline not piercing galaxy disk
- Estimate 50% detection rate for impact parameters < 20 kpc and τ_{int} > 0.1 km/s

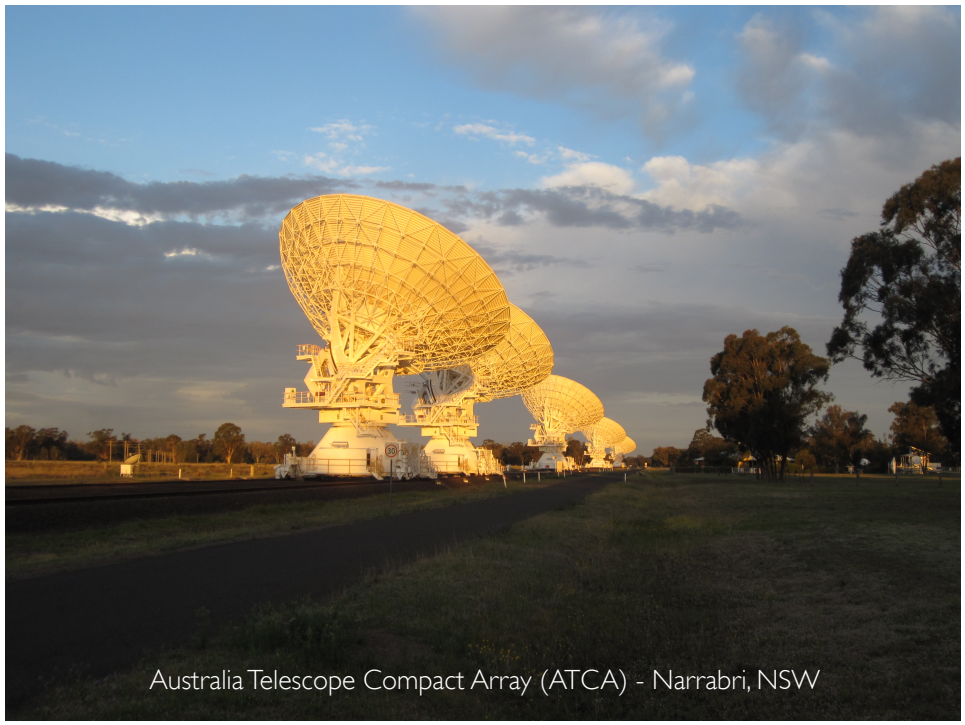




ATCA Project C2573

- Aim: investigate the conditions that lead to the detection of intervening absorption

- Sample:
  - HI-selected sample (HIPASS)
  - Uniform sample $z < 0.04$
  - 16 galaxies



Australia Telescope Compact Array (ATCA) - Narrabri, NSW

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Sample Selection - Final Targets

SUMSS
(Sydney University Molonglo Sky Survey)

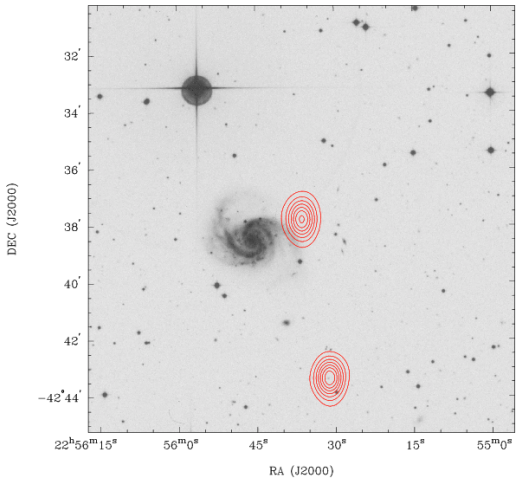
HIPASS BGC
(Bright Galaxy Catalogue)

S_{843} > 50 mJy

Select galaxy-continuum source pairs within 20 kpc

Manual inspection

ATCA Project C2573
Final list of targets



Observations and Data Reduction

- ATCA observations
- CABB 64M-32k configuration - spectral resolution 6-7 km/s
- Using 750m arrays we obtain simultaneous HI absorption *and* emission data
- Include baselines to antenna 6
- Integrate 12 hours per object
- Reduced data with a variety of weighting schemes

	Uniform	Natural	noCA06
Res.	5"	25"	60"
Noise	1-2 mJy	1-2 mJy	2-3 mJy

Pilot Sample	Second Sample
ESO150-G005	ESO300-G014
ESO345-G046	ESO357-G012
ESO402-G025	ESO363-G015
IC1954	IC1914
NGC7412	NGC1249
NGC7424	NGC1566
	NGC2188
	NGC5156
	NGC7162A

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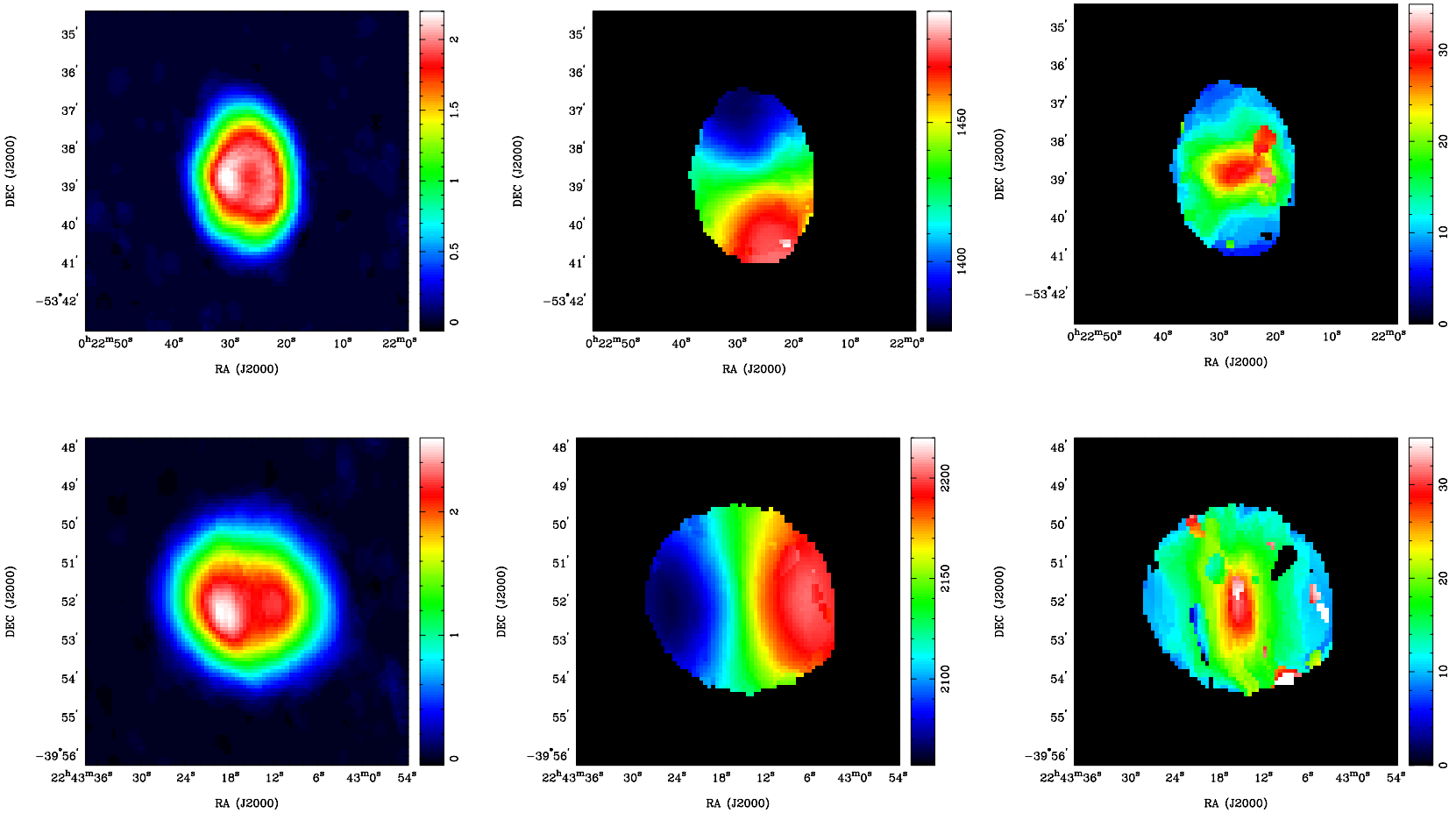
Results - HI emission

First HI emission-line maps of the target galaxies

noCA06



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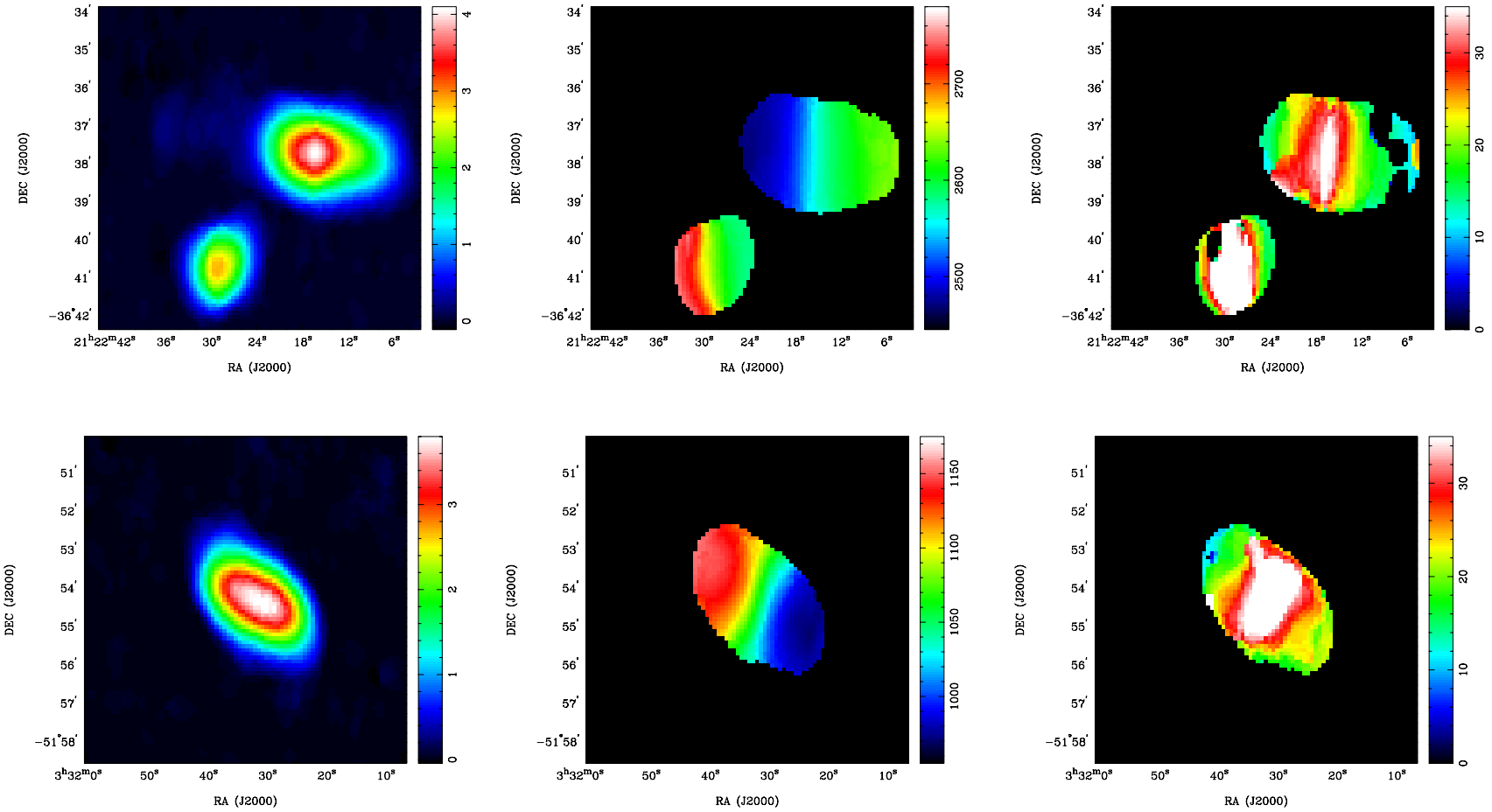
Results - HI emission



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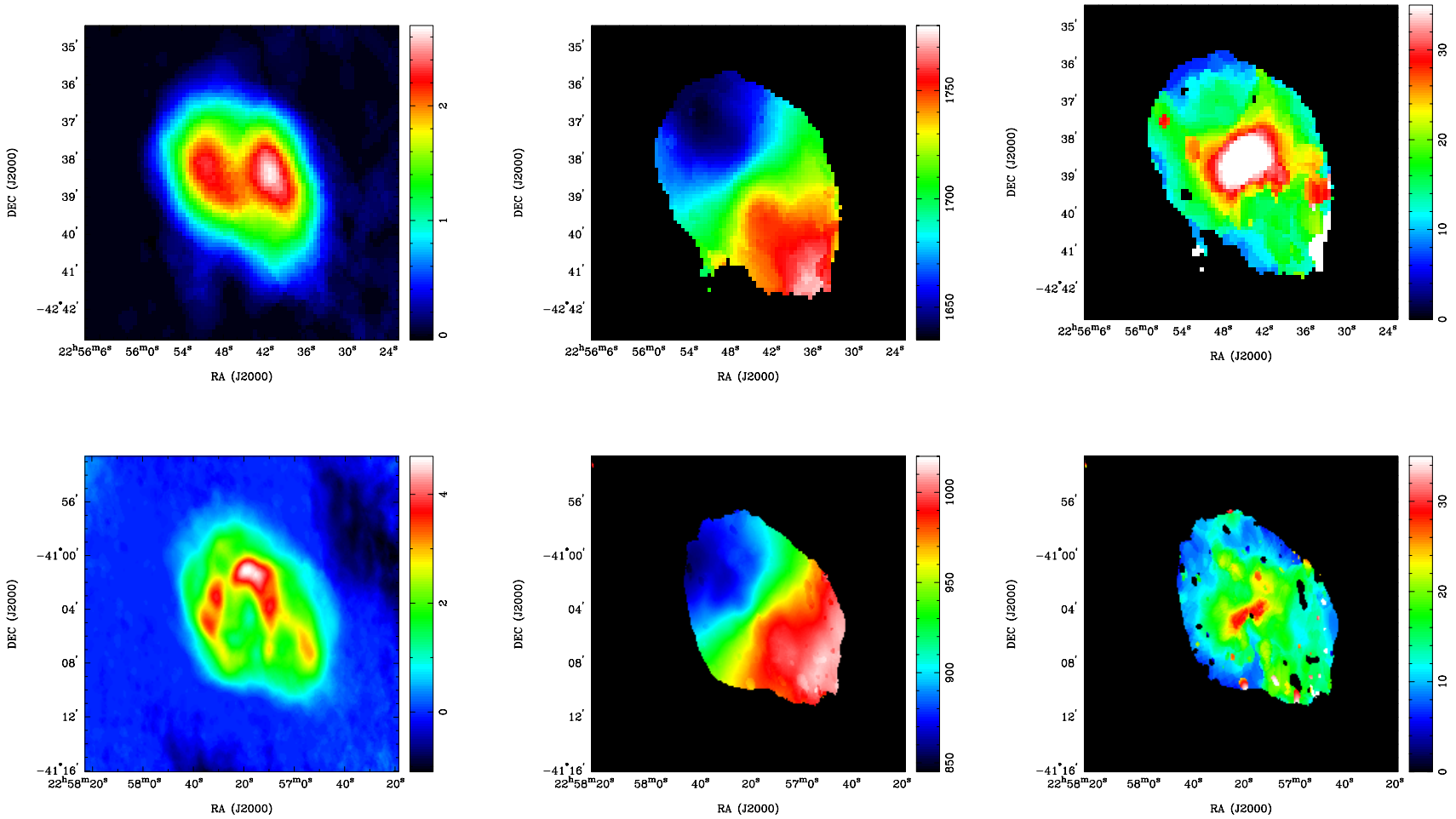
Results - HI emission



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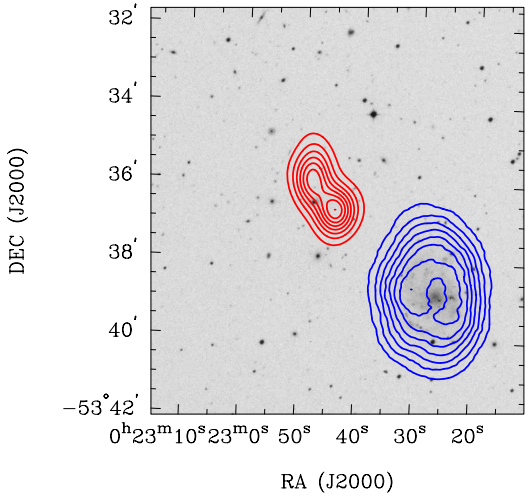
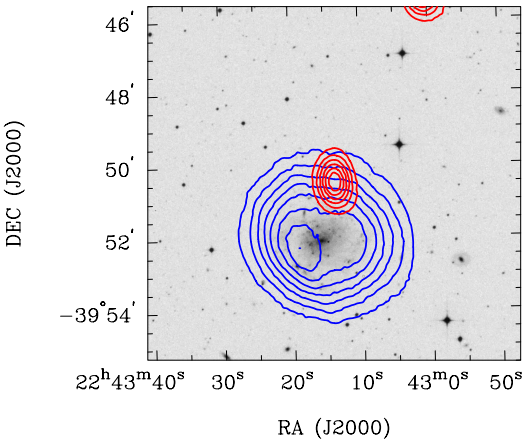
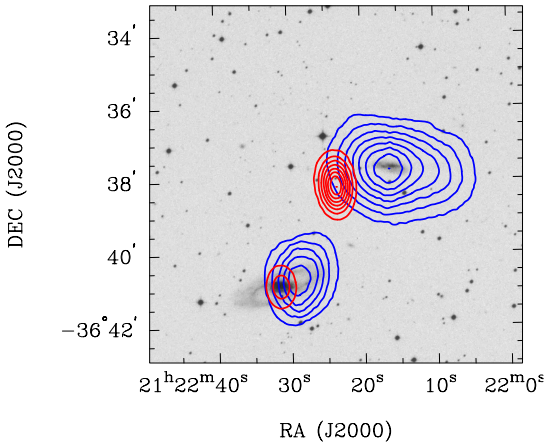
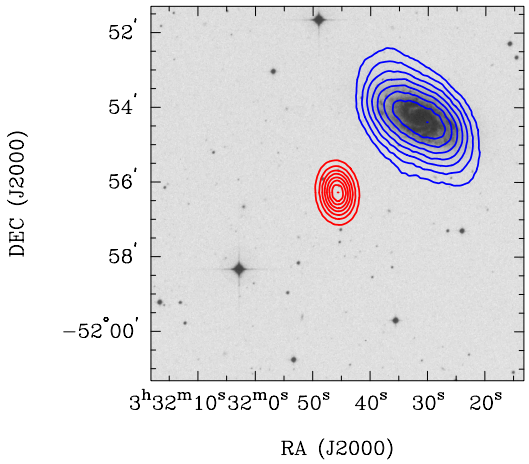
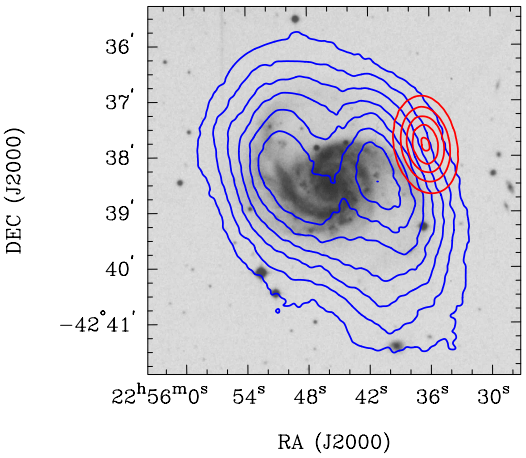
Results - HI emission

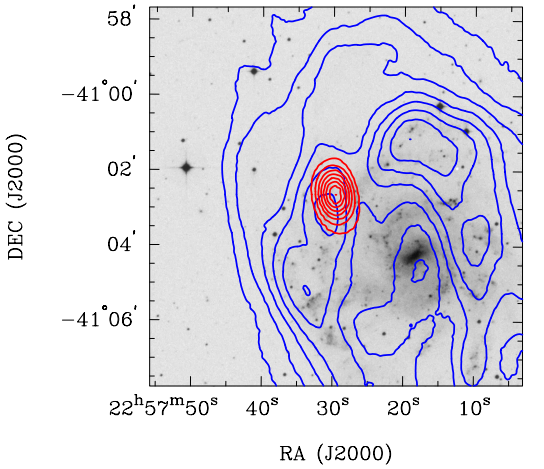












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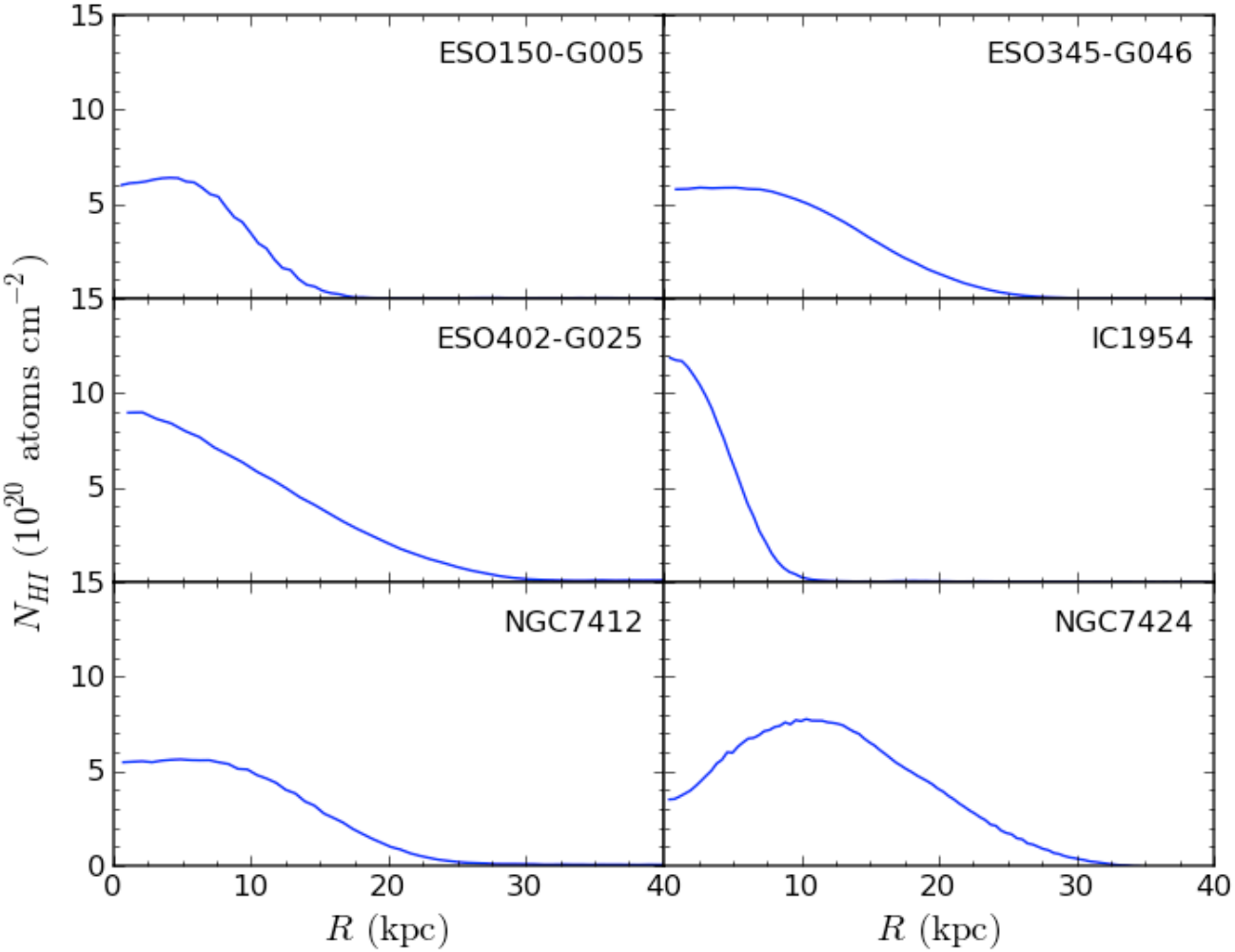
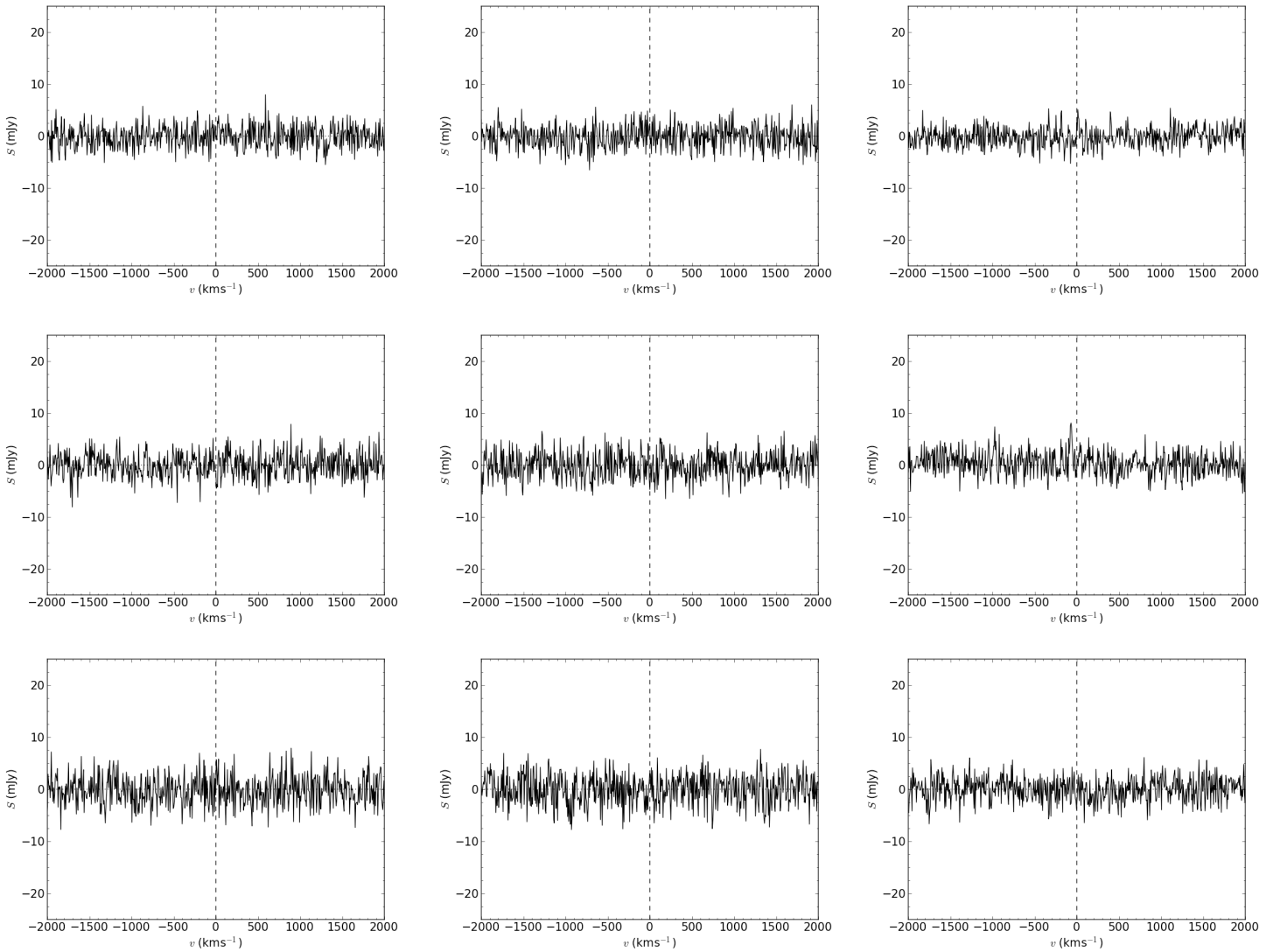
Radial HI Distribution



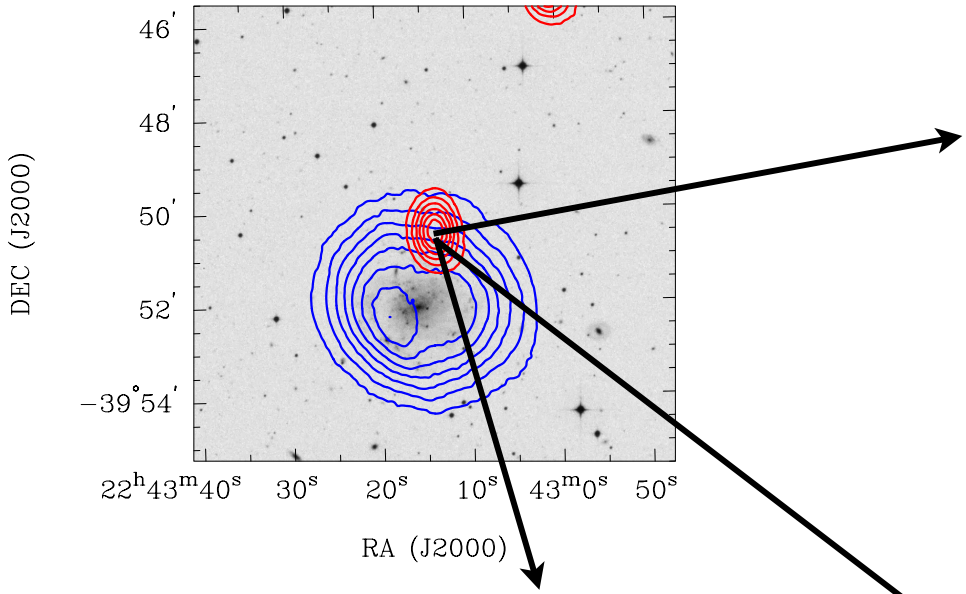
Results - HI Absorption

Uniform

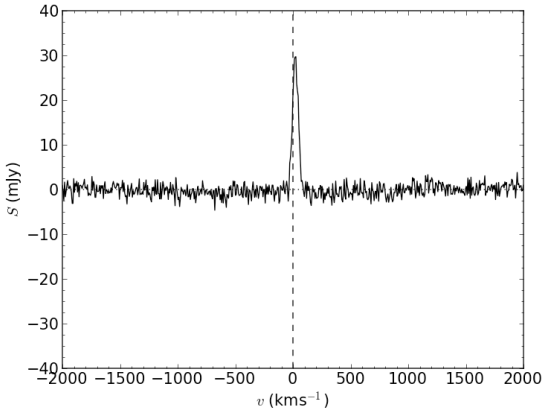


Use Bayesian line-finder - developed by James Allison to search spectra for absorption-lines

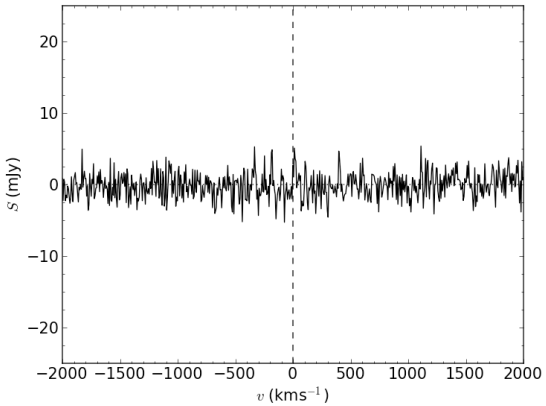
Gas...but no absorption



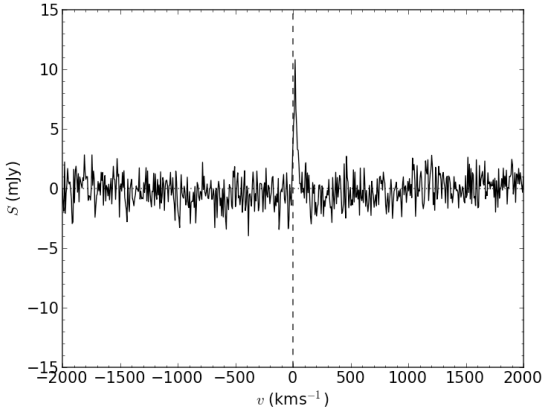
noCA06



Uniform

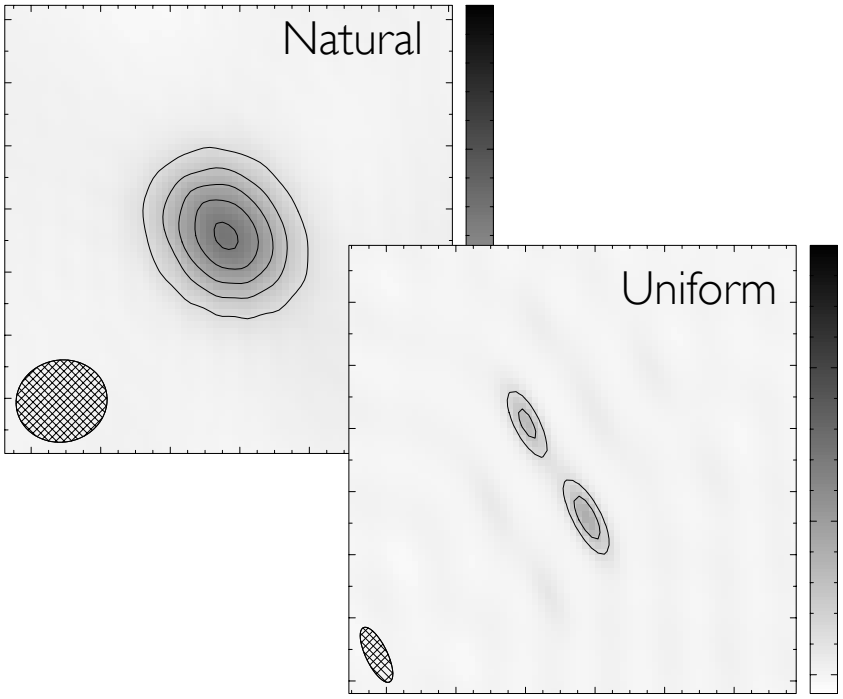


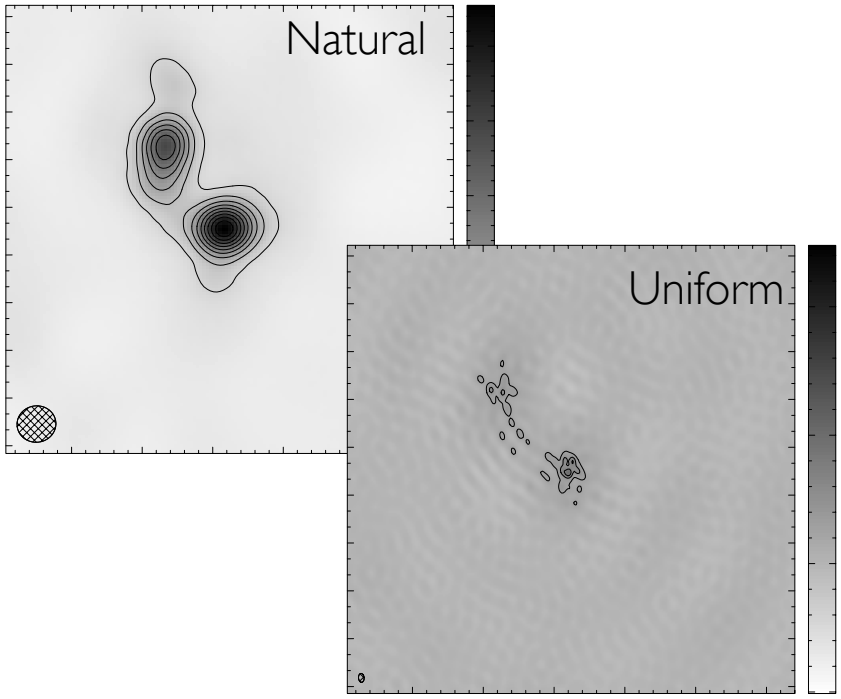
Natural



Low detection-rate

- 3/6 of the background sources become resolved
- Reduces flux against which to search for absorption - implications for FLASH





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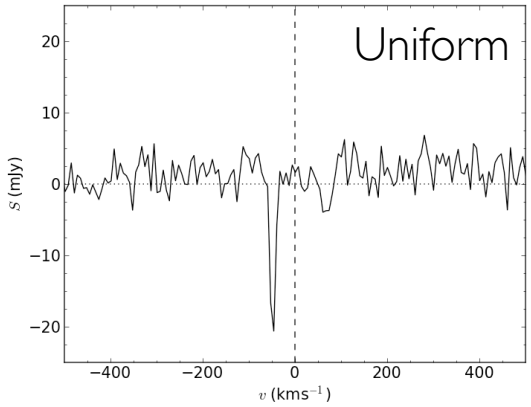
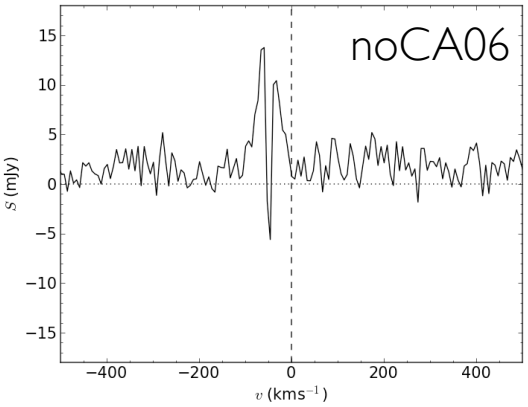
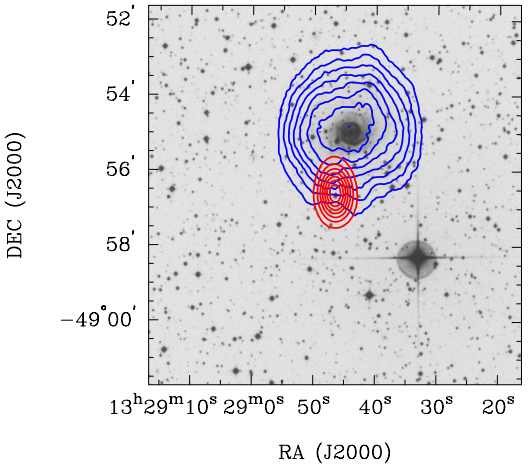
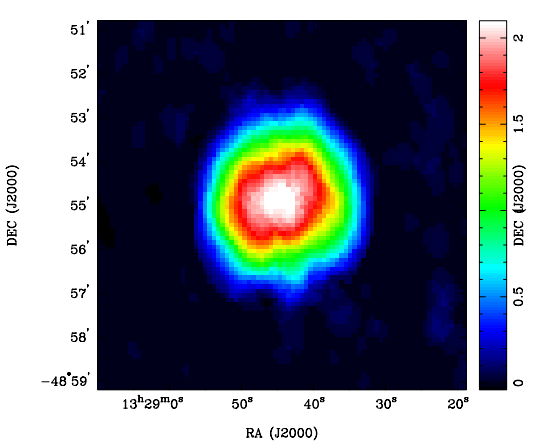
Detection!

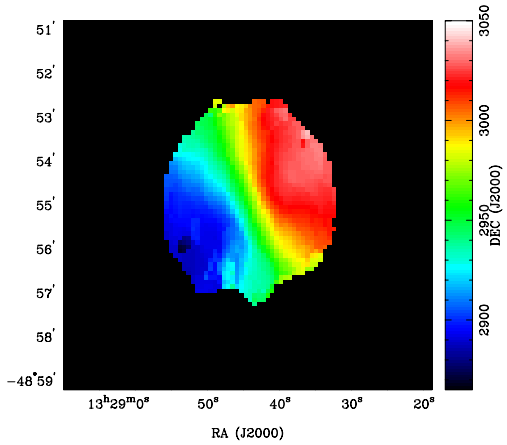


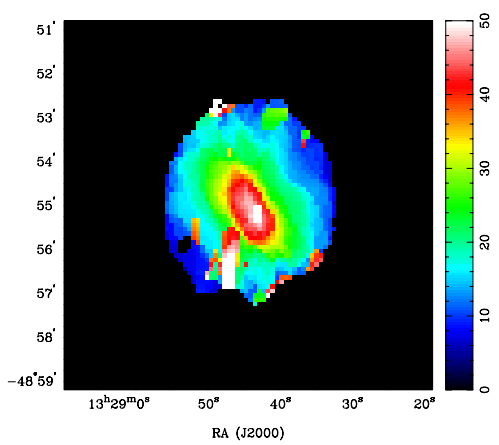


NGC5156





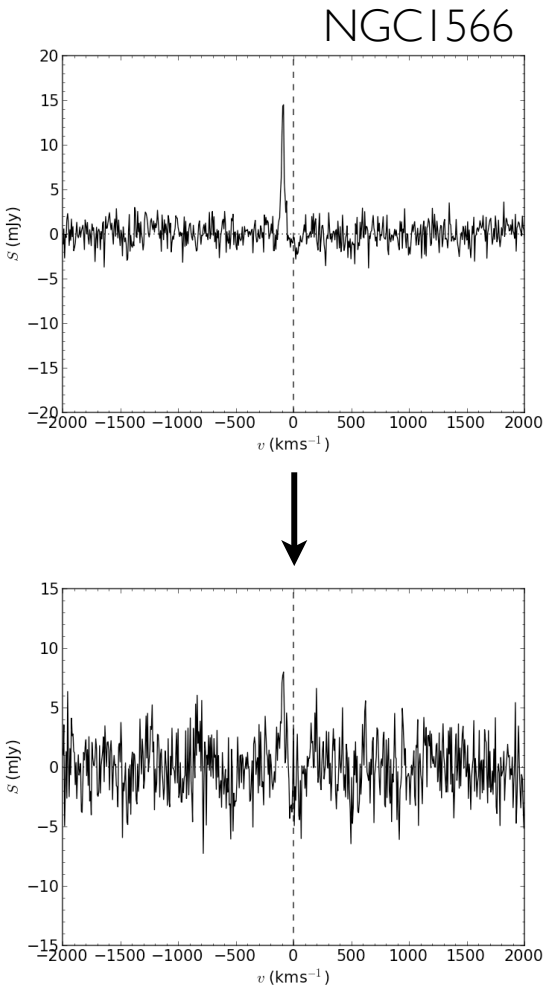




- τ_{peak} ~ 0.06
- Calculate T_s ~160K (f=1)
- Follow-up observations planned

Findings and Issues

- DLA-like column densities out to ~10-20 kpc
- Properties of background sources found to be important
- Emission both helps and hinders:
  - Gives us information to help understand absorption-line data (especially for non-detections)
  - But could 'hide' - or even masquerade as absorption
  - Implications for WALLABY-FLASH piggyback



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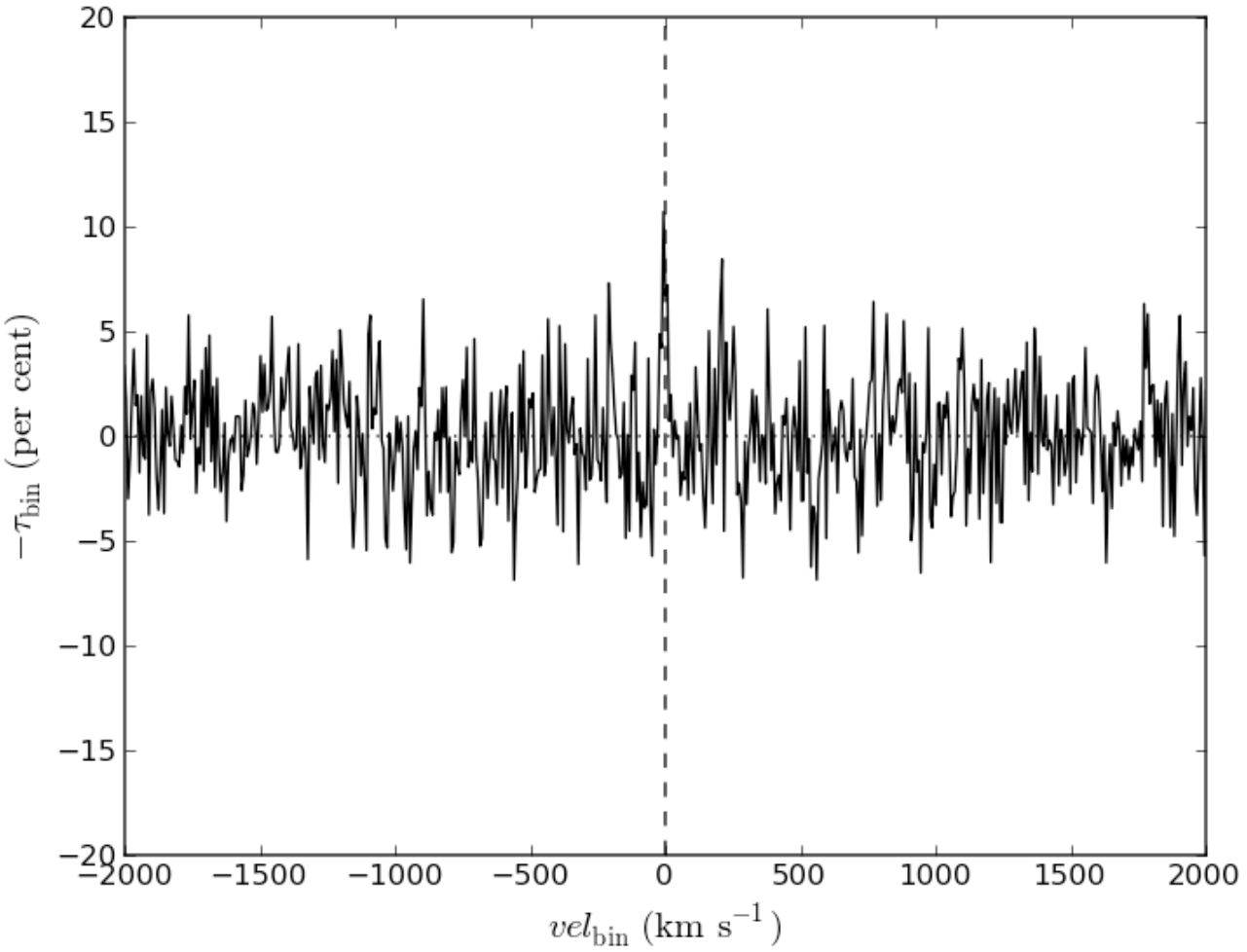
Stacked Spectrum



Next Steps

- Publish results of pilot sample (Reeves et al., in prep)
- Reduce new data - will improve statistics
- Search in archival data
- Follow-up observations of selected sources

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Conclusions

- We have conducted a search for intervening HI absorption in nearby, gas-rich galaxies
- Detected one likely absorption line, which we now intent to follow-up
- Successfully mapped the HI distribution, which helps us understand the absorption-line detection rate
- Have encountered several issues relevant for future absorption-line surveys
- Find that loss of continuum source flux is at least partially responsible for our low detection rate
- Emission is a double-edged sword:
    - Gives us additional information to understand absorption-line data
    - Can present difficulties in trying to detect an absorption-line