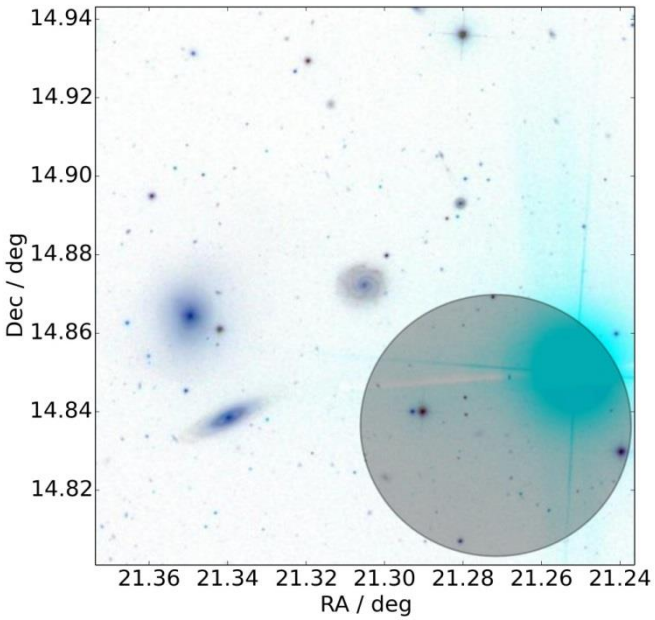
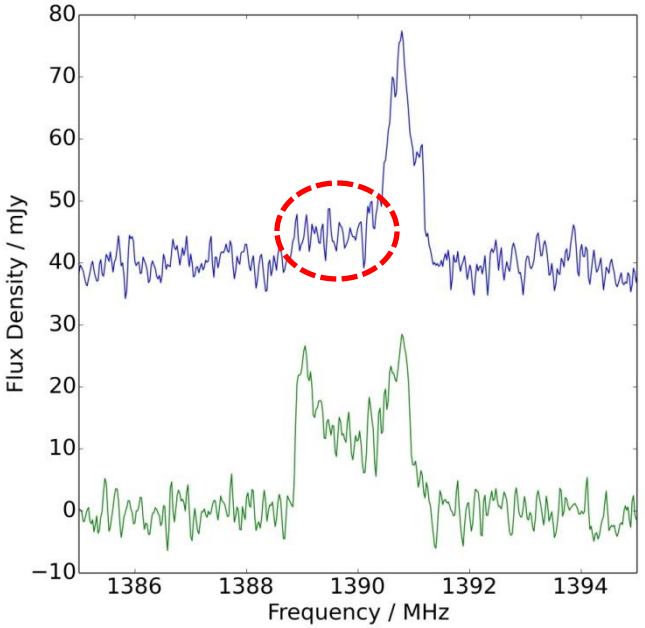
Spectroscopic Confusion: Its Impact on HI Surveys and Stacking





Mike Jones - Cornell University - PHISCC 2015

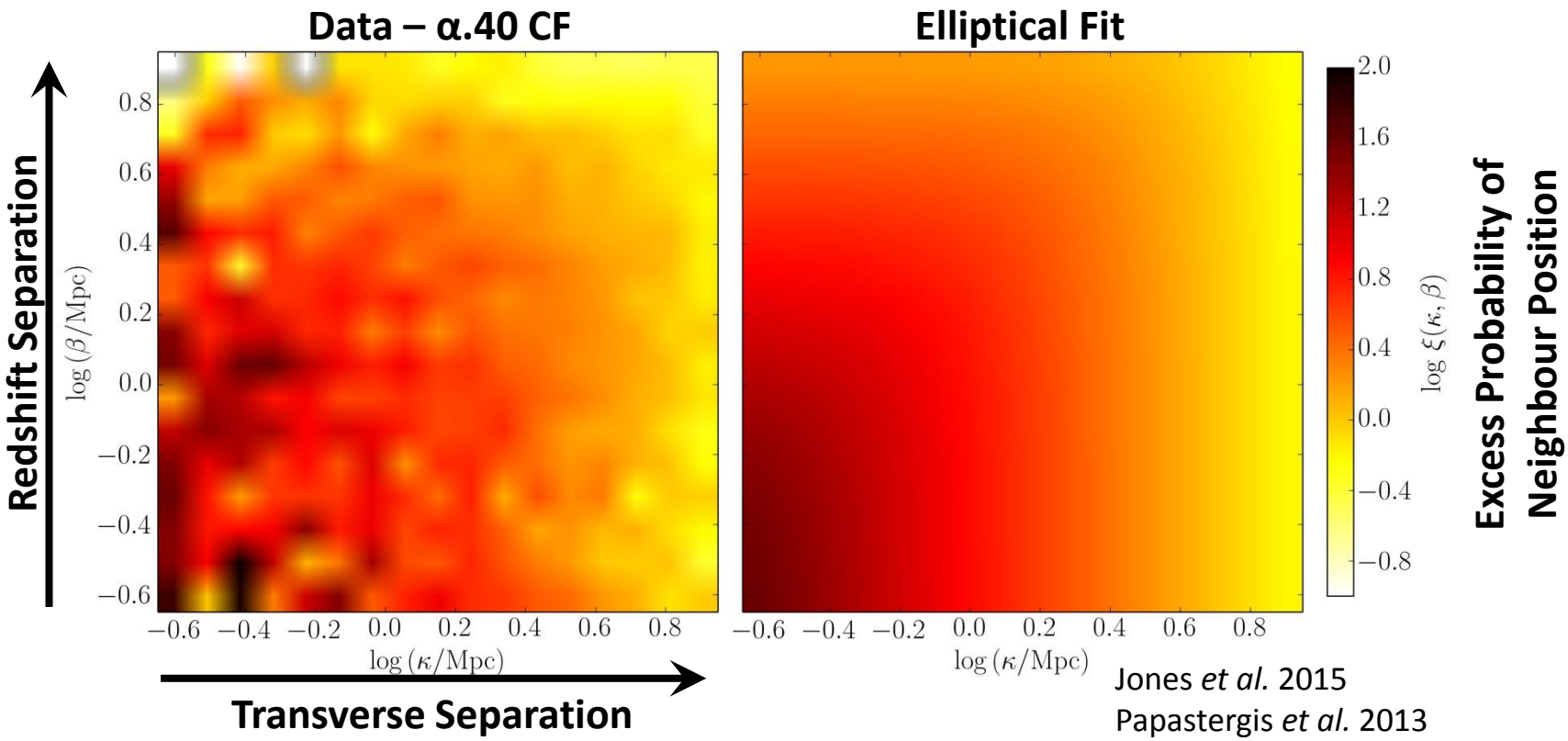
Based on: Jones *et al.* 2015 and Jones *et al.* (in prep)

Outline

- How to predict confusion from ALFALFA dataset.
- What impact does confusion have on observed HIMFs?
- How much will confusion contribute to stacks of non-detections in deep surveys.

ALFALFA

Estimating Rates of Confusion:
2D Correlation Function

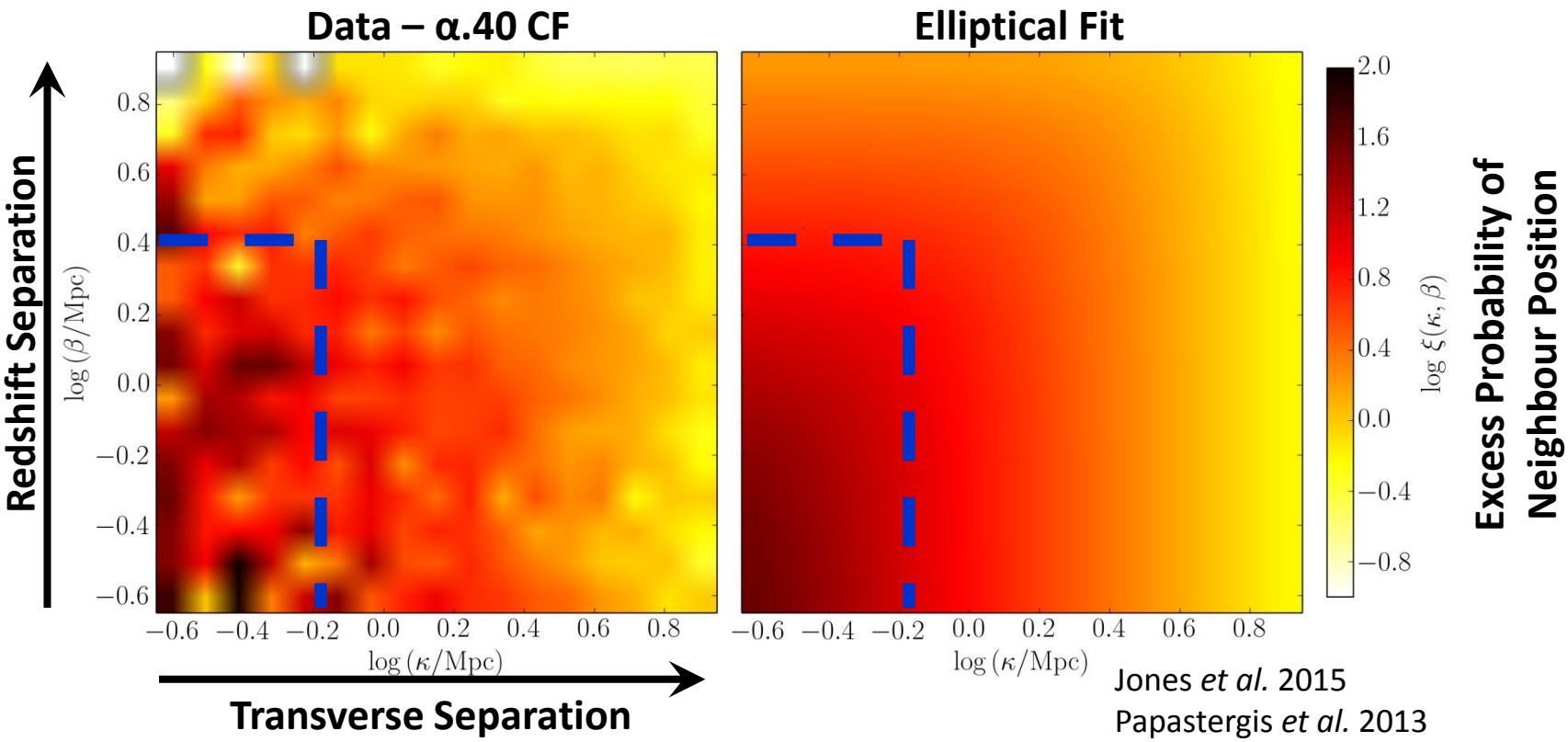


Jones *et al.* 2015
Papastergis *et al.* 2013

Can predict the probability of confusion with a neighbour, based on the telescope beam width and the velocity widths of the sources.

Reproduces observed confusion rates in both ALFALFA and HIPASS.

Estimating Rates of Confusion:
2D Correlation Function

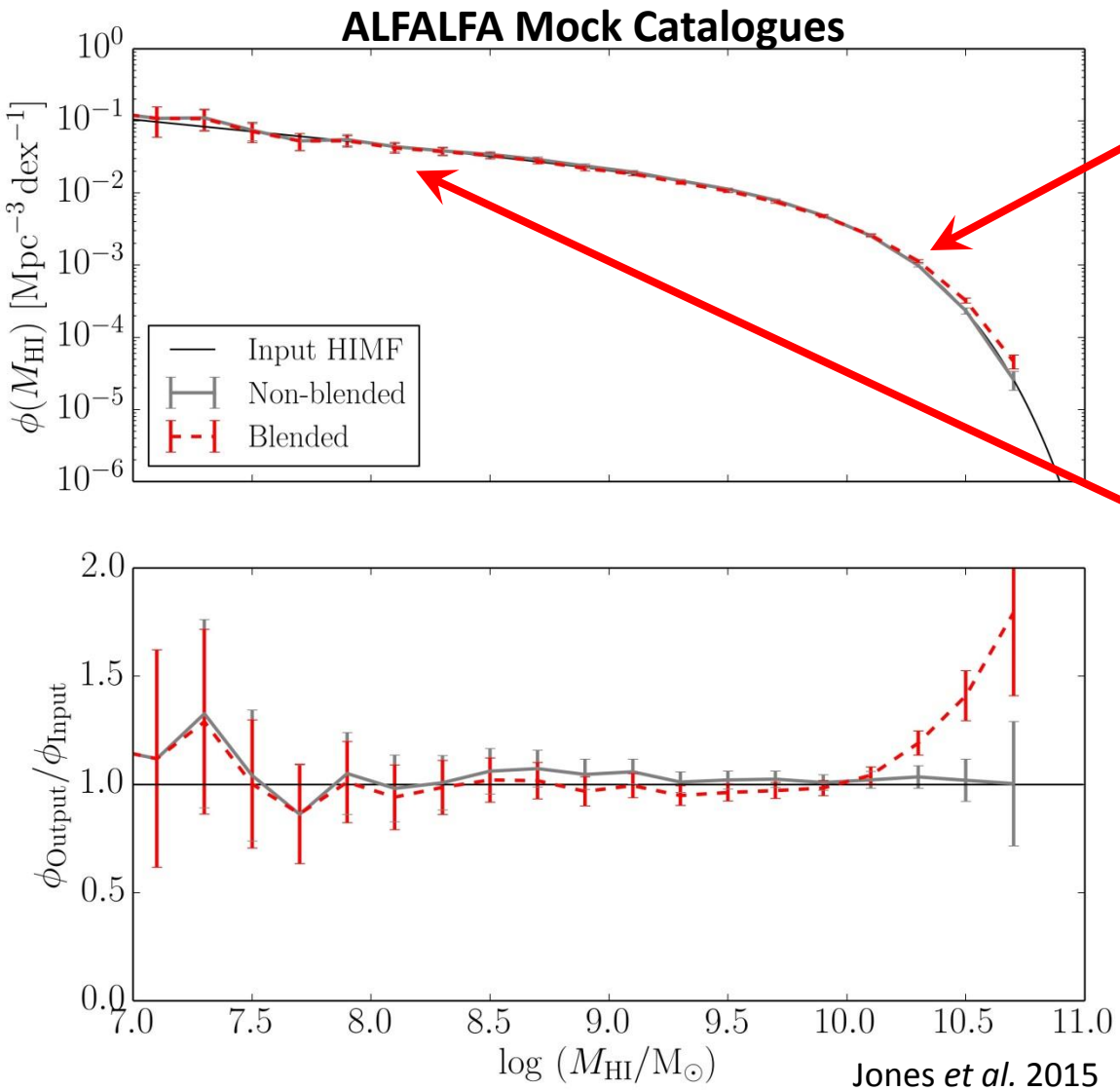


Can predict the probability of confusion with a neighbour, based on the telescope beam width and the velocity widths of the sources.

Reproduces observed confusion rates in both ALFALFA and HIPASS.

Impact on the HIMF:

Worst Case Scenario



M_* Increased

α Steepened (marginally)

Jones *et al.* 2015

Confusion in Next Generation Medium Depth Surveys

Survey	z_{max}	Beam	Peak Confusion†	ΔM_*/dex	$\Delta\alpha$
HIPASS	0.04	15.5'	40%	0.07	-0.04
ALFALFA	0.06	4'	19%	0.06	-0.03
WALLABY‡	0.26	30"	2%	0.003	-0.002
DINGO‡	0.26	30"	7%	0.02	-0.007

†between a detection and another object greater than a tenth of its own HI mass.
‡predicted survey parameters from Duffy *et al.* 2012.

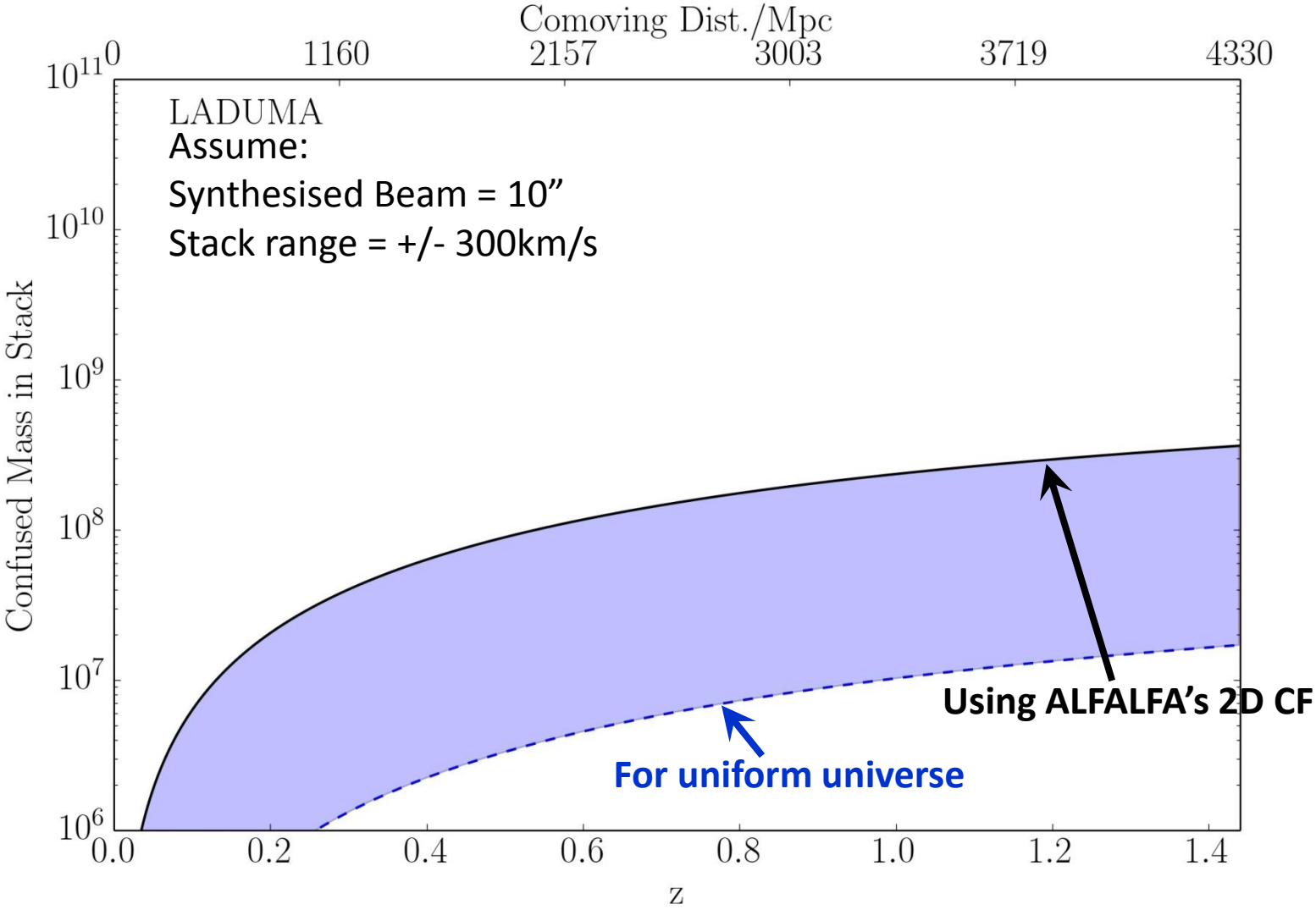
- **WALLABY** & **WNSHS** have sufficient resolution that **confusion bias** in the HIMF will be **smaller than the random errors**.
- **DINGO** will be between WALLABY and ALFALFA.
- May be a **concern** for probing **z-evolution** of the **HIMF**.

Stacking

- Deep surveys like CHILES and LADUMA will stack non-detections to probe “normal” HI galaxies to the highest possible z.

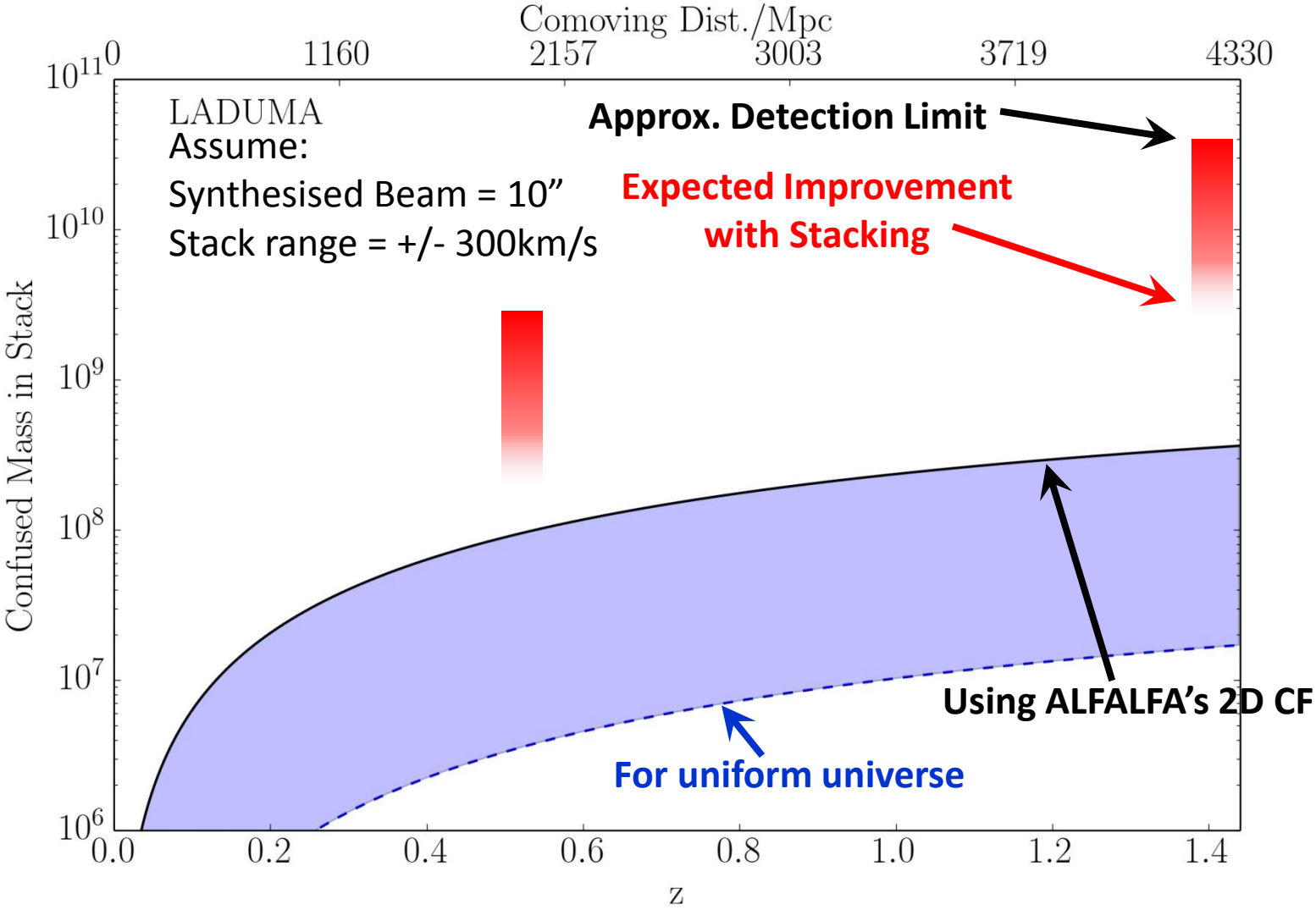
- How much of the mass in such stacks will be contributed by confusion?

How much HI mass does confusion contribute to a stacked spectrum?



Jones *et al.* (in prep)

How much HI mass does confusion contribute to a stacked spectrum?



Jones *et al.* (in prep)

Conclusions

- Confusion rates of upcoming surveys can be predicted based on existing datasets.
- Generic impact of confusion on the HIMF:
  - M_* increases
  - α steepens (but only slightly)
- WALLABY and WNSHS will be negligibly effected
- DINGO's z-dependence of the HIMF may be impacted by confusion.
- Confusion can contribute a significant amount of HI mass to a stacked spectrum.
- CHILES and LADUMA should be relatively unaffected by confusion provided they both reach 5-10" resolution.
- The **impact of confusion**, and where it is most severe is often **counter-intuitive**.