



Understanding the evolving Local Universe from a neutral gas perspective

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Astounding Stories of Super Science

Hobart, 20 April 2012

CSIRO Astronomy & Space science

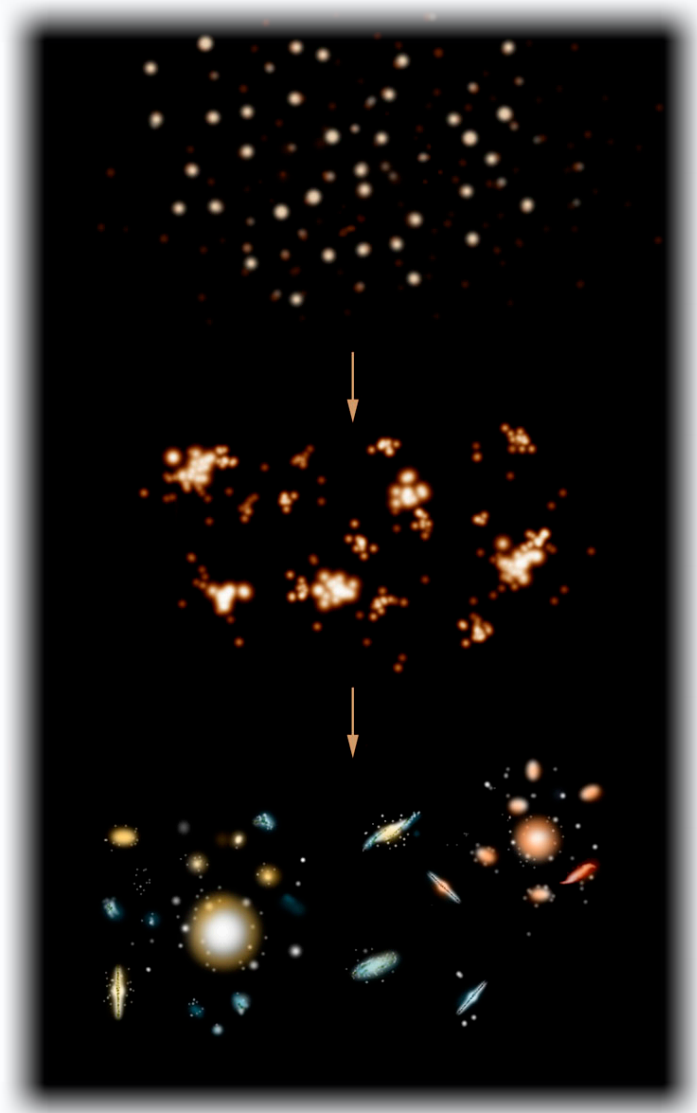
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Local Universe = useful benchmark for studying the processes of star formation & galaxy evolution



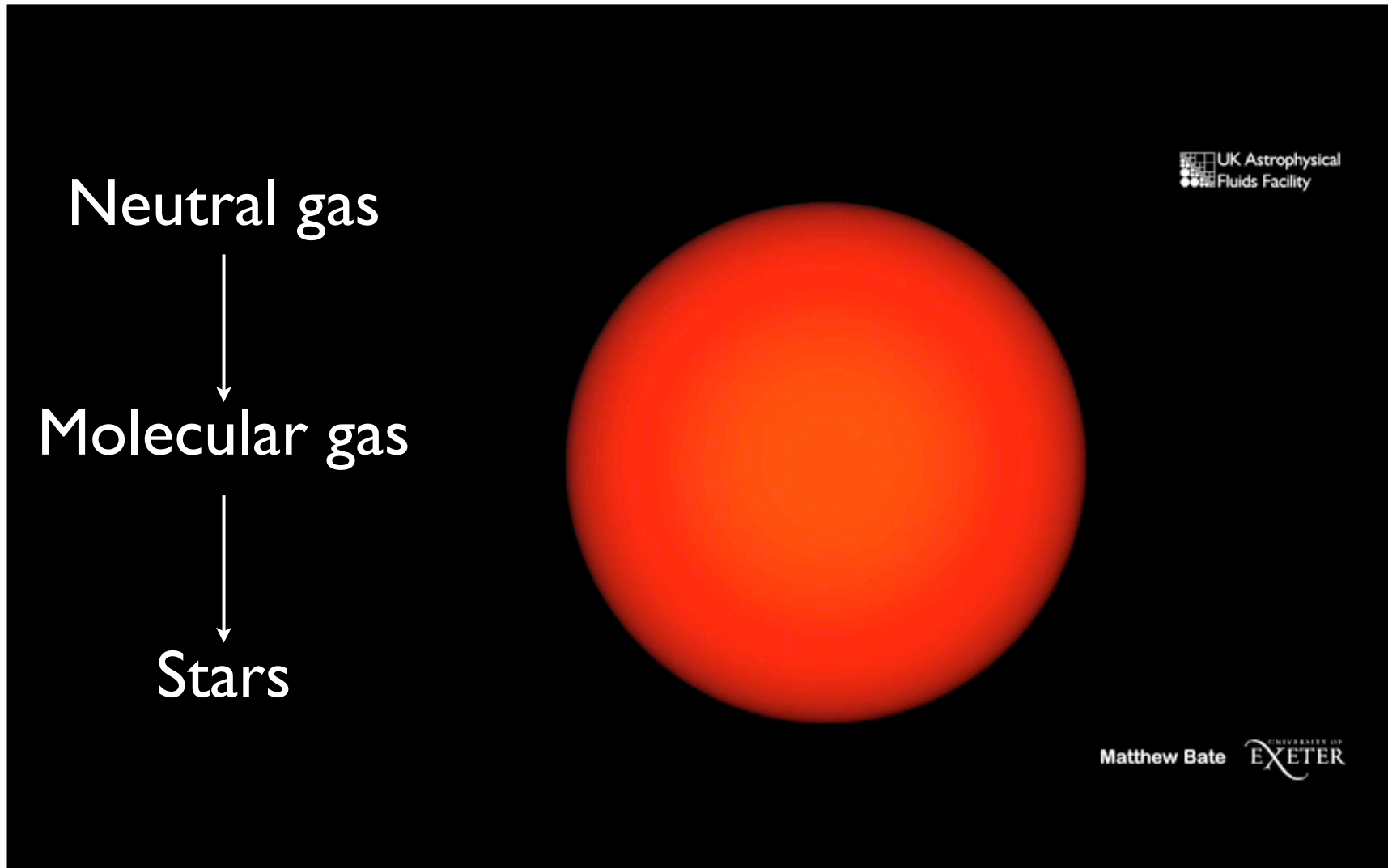
Motivation & context



- **Dark matter (DM) & galaxy formation models:**
 - DM growth through mergers of DM halos
 - However, simulated distribution of baryons & DM is not quite right yet
- ➔ **Observations are needed to further our understanding of the processes involved**



Star formation

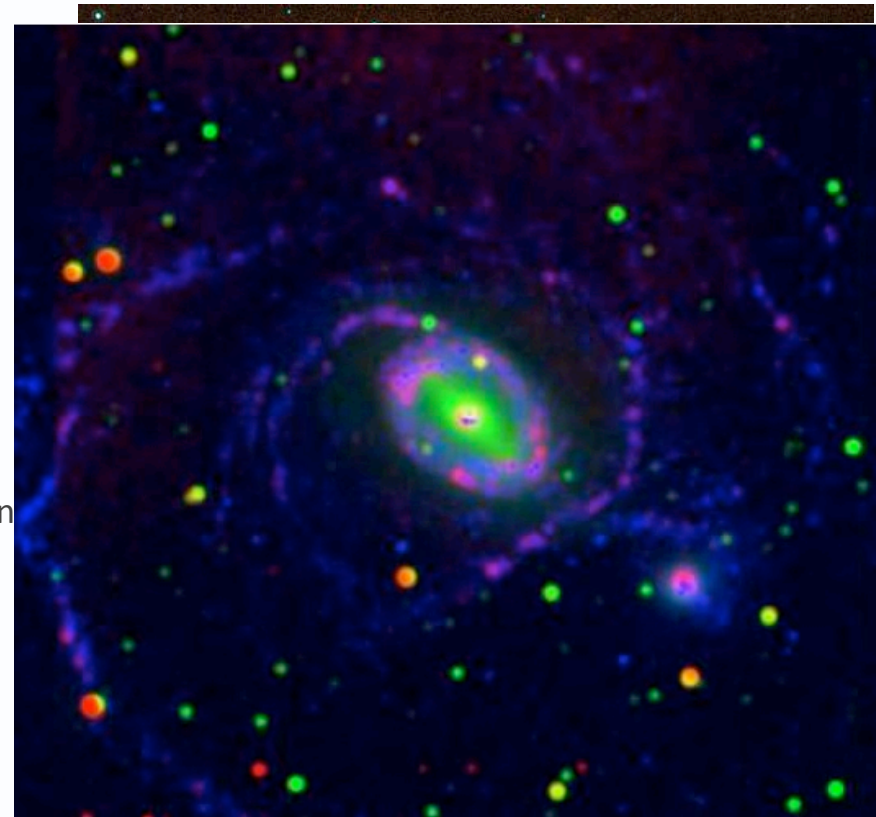


Tracing star formation

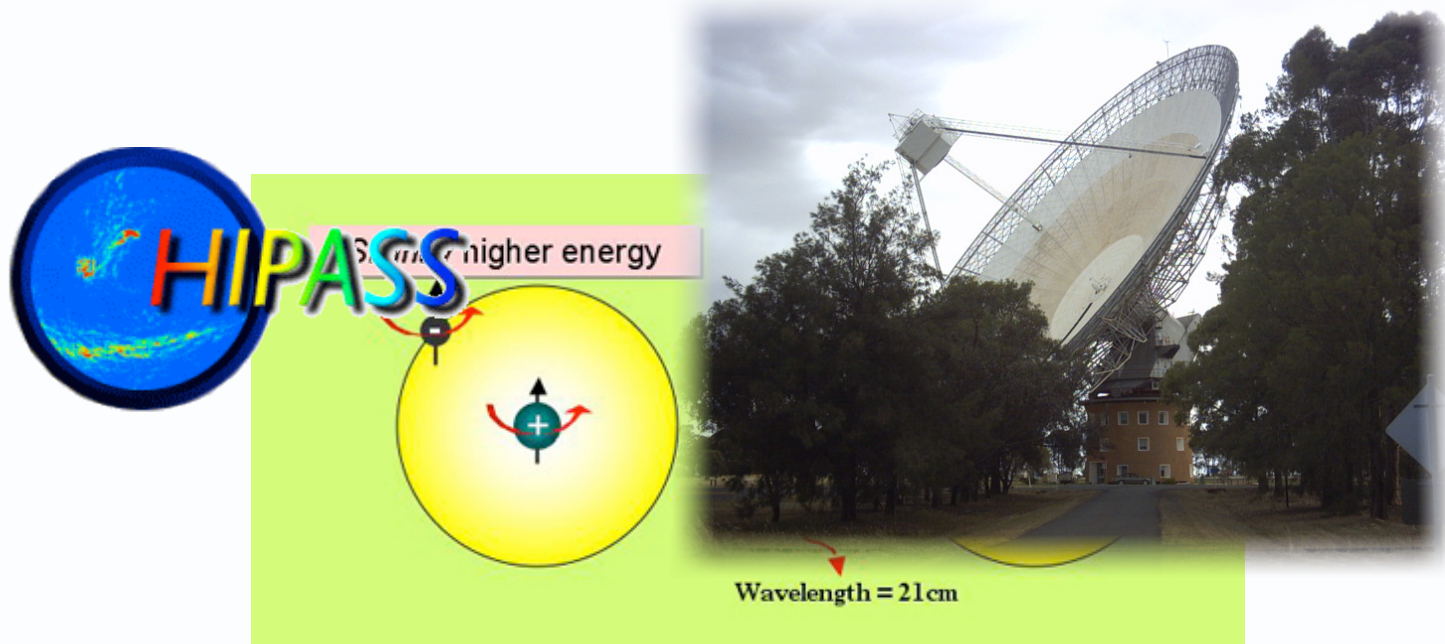
e.g. N1512

~~H α~~ Vacuum UV

- indirect tracer of star formation
 - direct tracer of photosphere
- emission from young O & B stars
- traces the HII regions ionized by the young O stars ($M_{\star} > 15M_{\odot}$)
 - dominates emitted SED of SF popⁿ
-
- sensitive to IMF
 - sensitive to dust extinction



Neutral Hydrogen (HI)



HI Parkes All-Sky Survey (HIPASS)

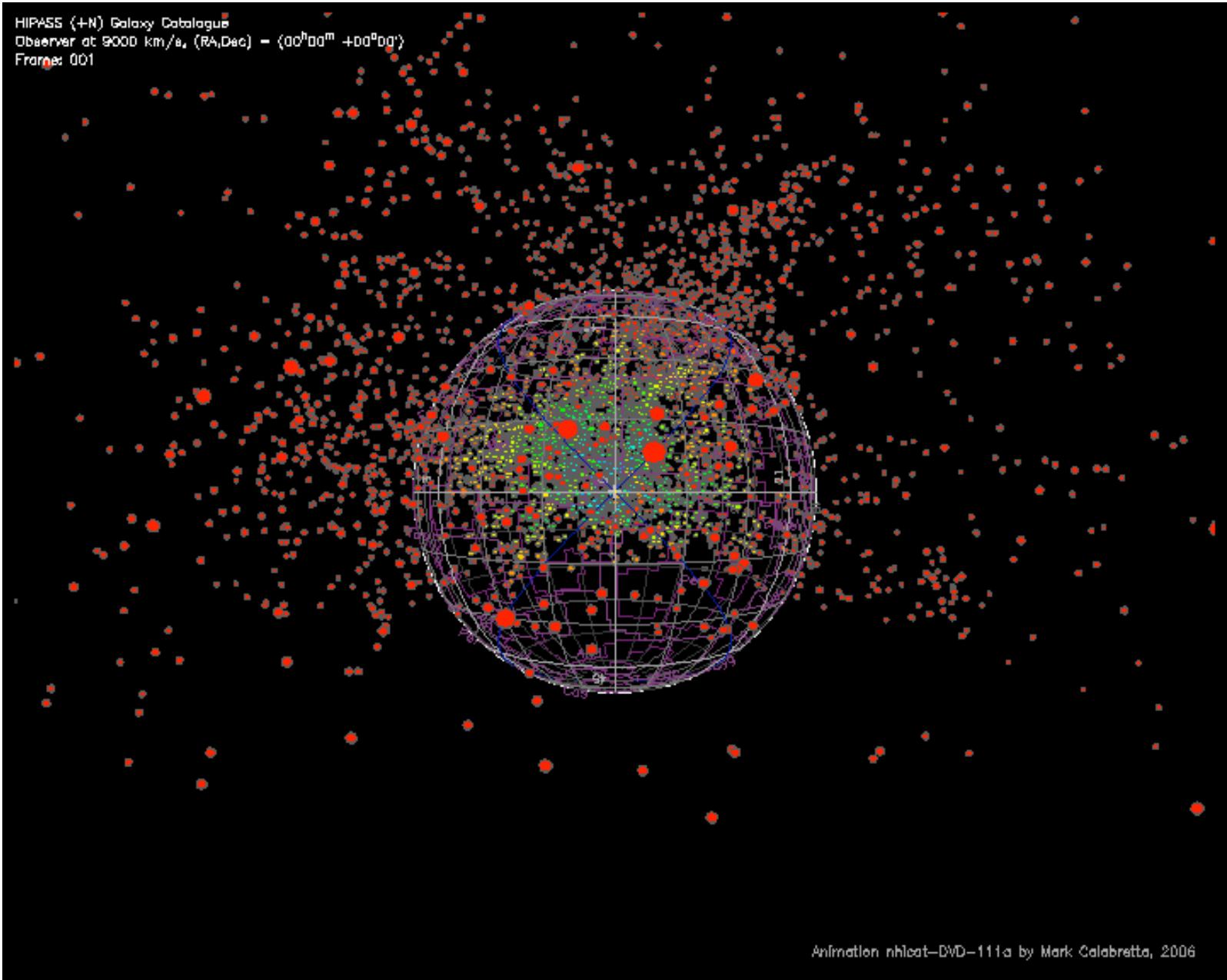
- largest neutral Hydrogen (HI) survey to-date covering >70% of sky
- ~5300 galaxies @ $z < 0.05$

Wong+06a; Meyer+04; Barnes+01;



HIPASS (+M) Galaxy Catalogue
Observer at 9000 km/s, (RA,Dec) = (00^h00^m +00°00')

Frame: 001



Animation nhicat-DVD-111a by Mark Calabretta, 2006



Nearby galaxy surveys



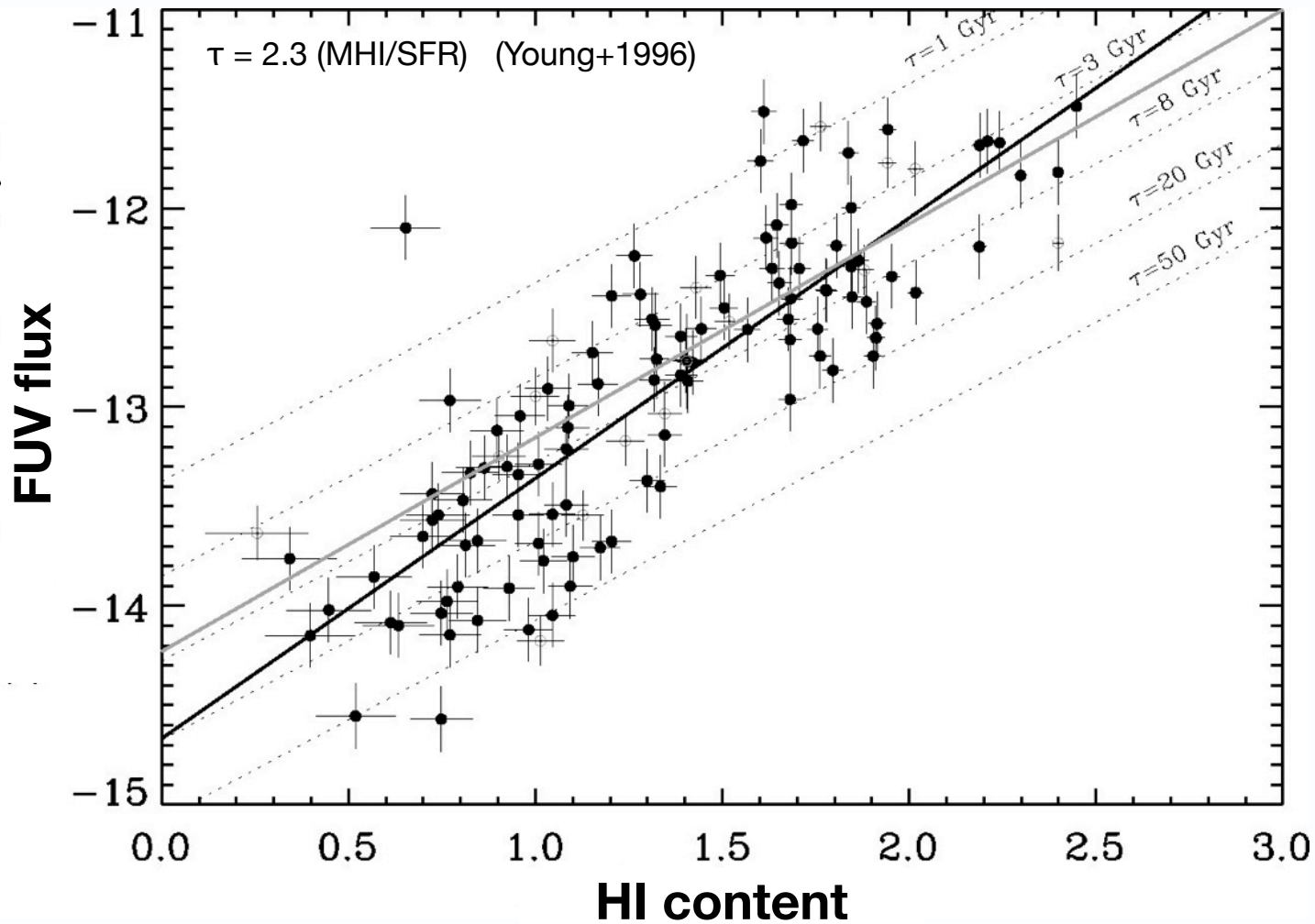
Multiwavelength surveys of Neutral Gas Galaxies

- sampled evenly across HI mass bins
- imaged ~300 galaxies in FUV & NUV using GALEX
- imaged ~400 galaxies in the optical R-band & H α

Wong+12 (in prep); Wong07; Meurer+06



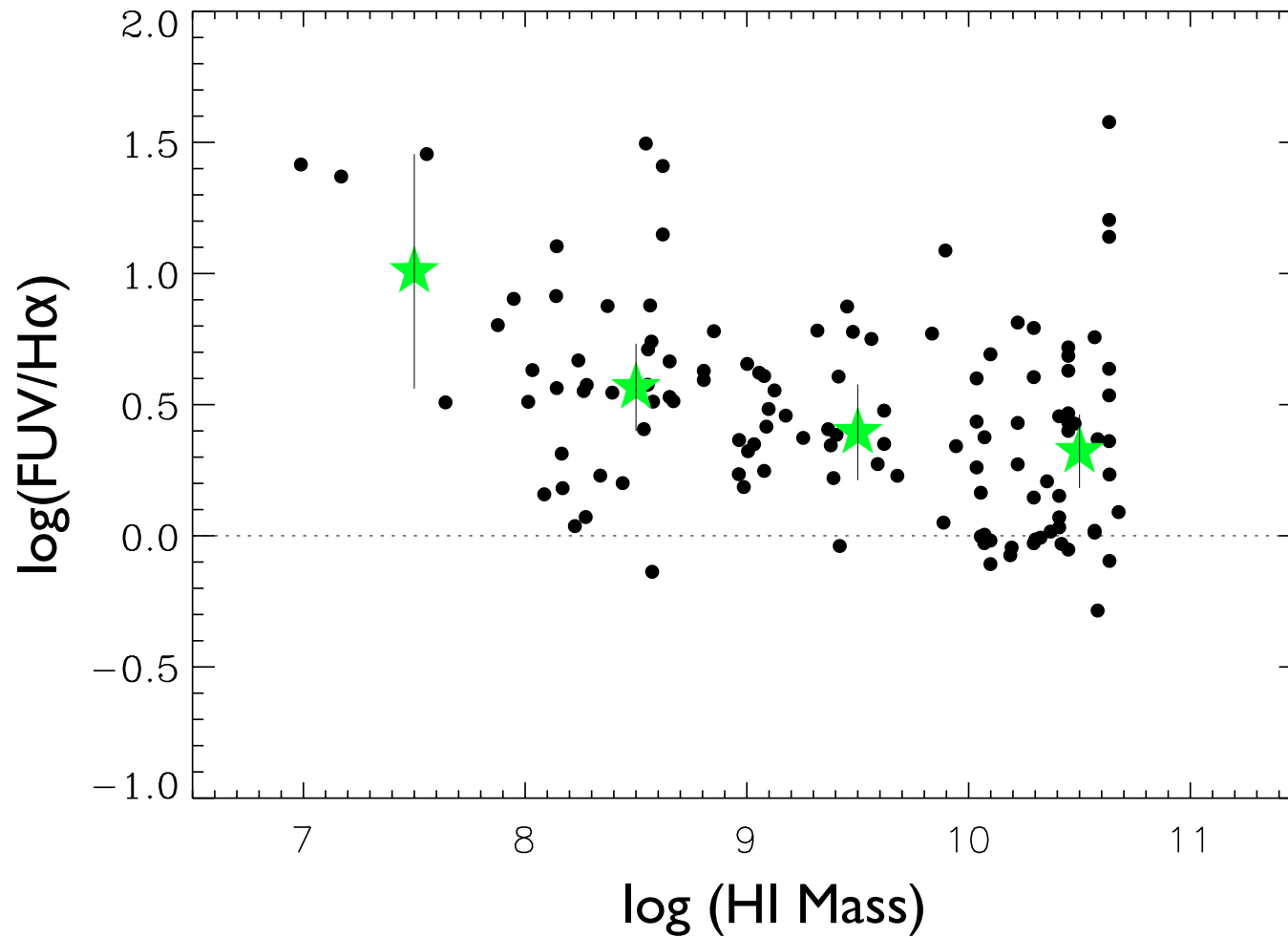
Every HI-selected galaxy is star-forming



Wong+ 2012 (in prep); Wong07



Galaxies with less HI has fewer O-type stars (?)



Wong07

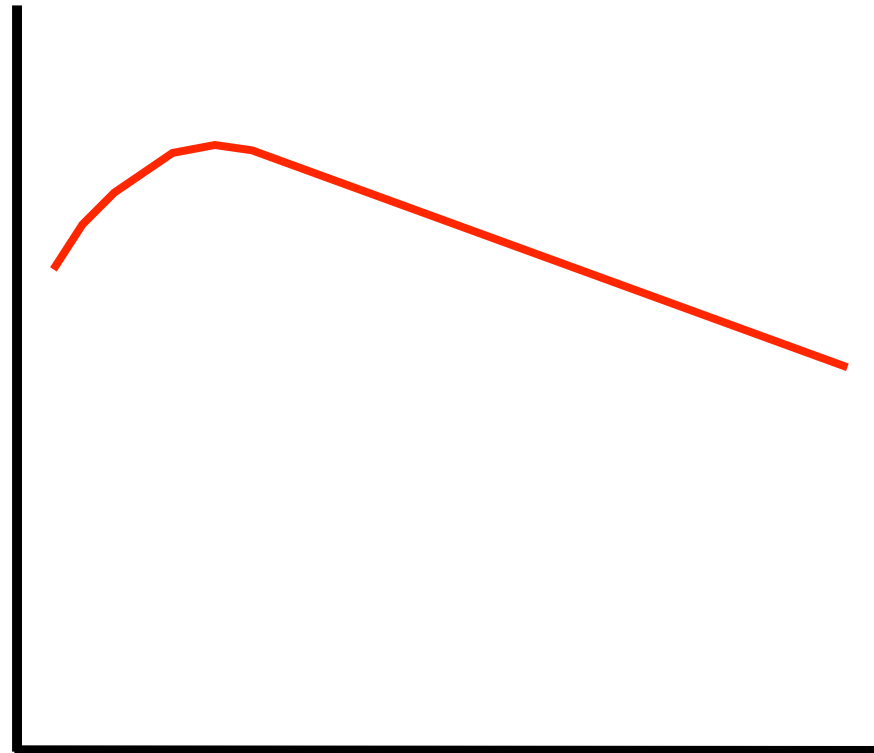


Initial mass function (IMF)

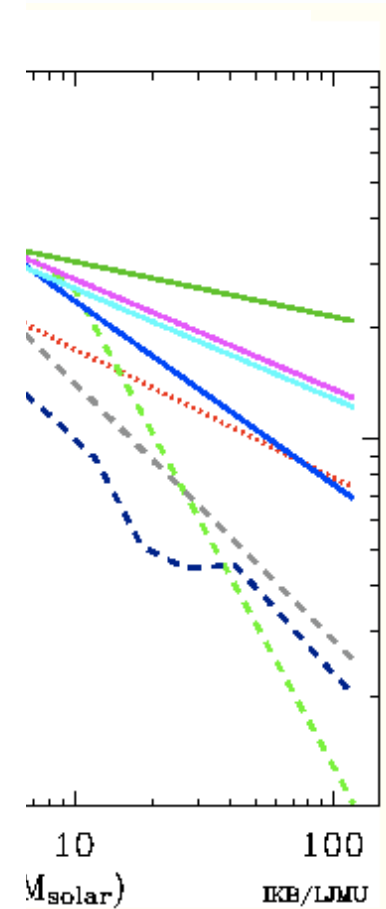
- *statistical distribution of stellar masses that form in a single episode of SF*

IMPORTANT: Interpretation of observable galaxy models of stellar chemical evolution

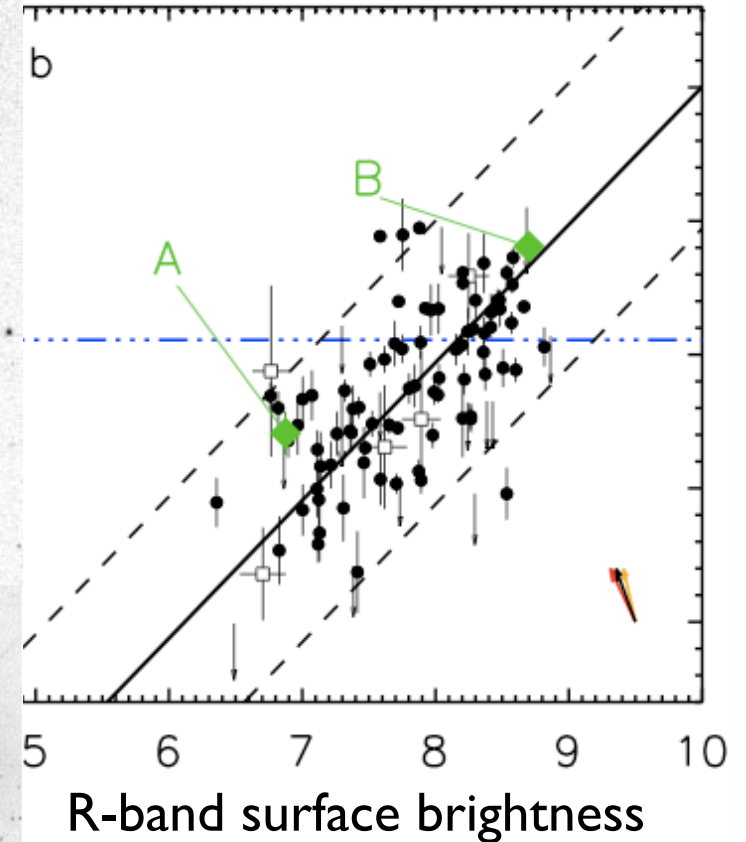
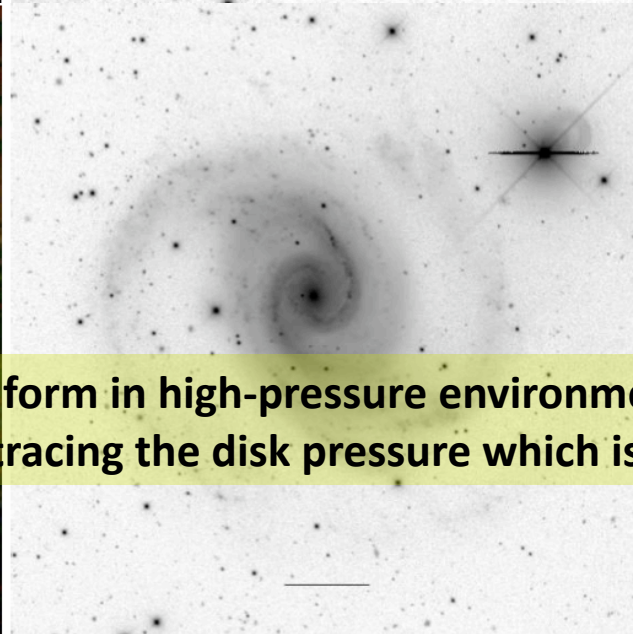
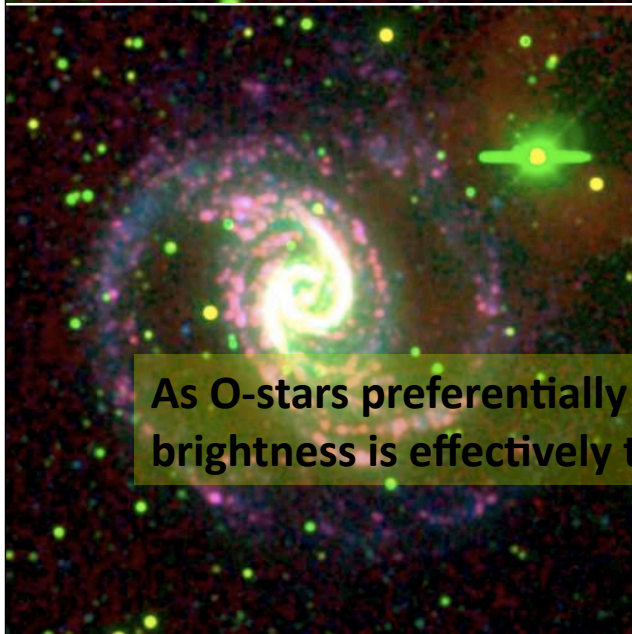
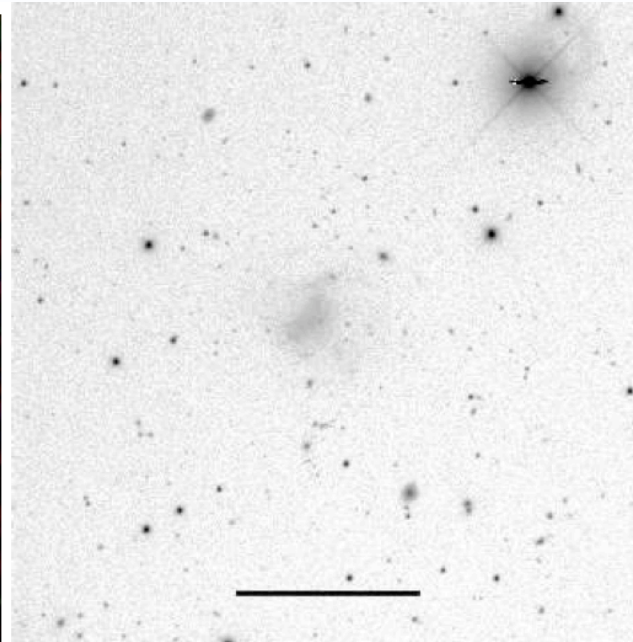
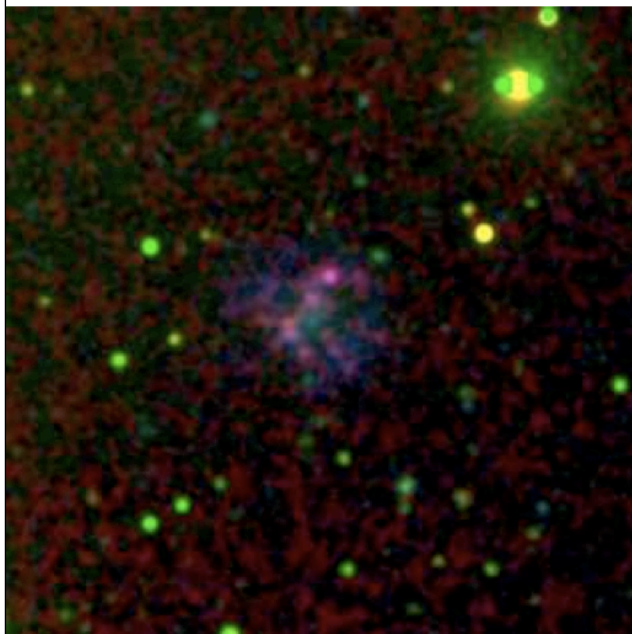
Mass fraction per dex



log (mass)



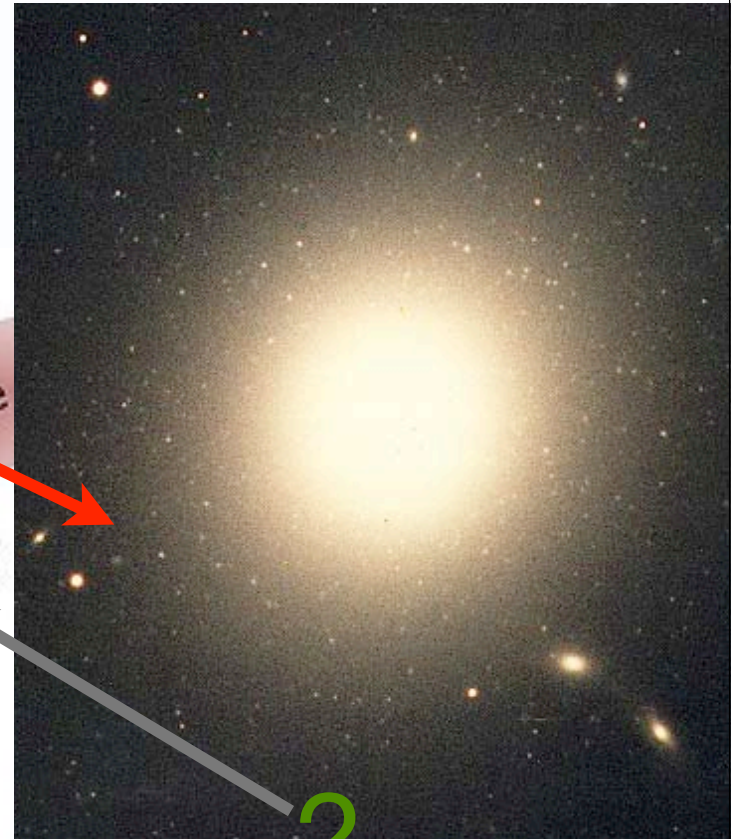
Smaller stellar density \rightarrow fewer O stars



As O-stars preferentially form in high-pressure environments, the stellar surface brightness is effectively tracing the disk pressure which is regulating the O/B ratio



Galaxies



red sequence

green valley

blue cloud

BLUE

Low luminosity

High luminosity

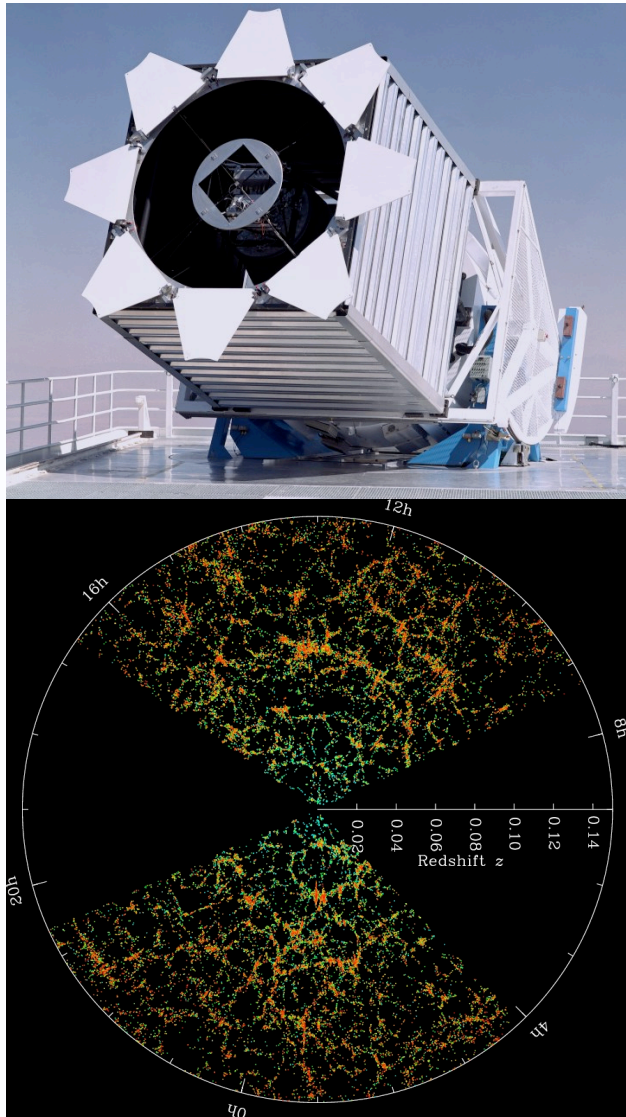


?

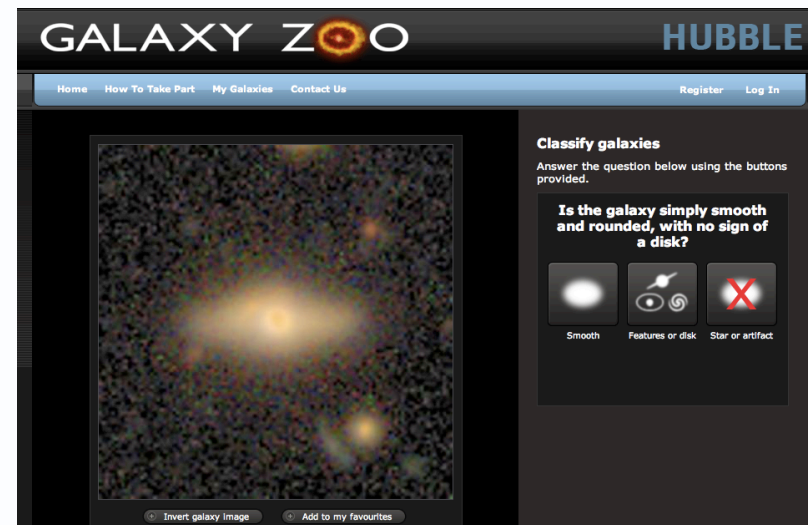
Nature **or** Nurture ?



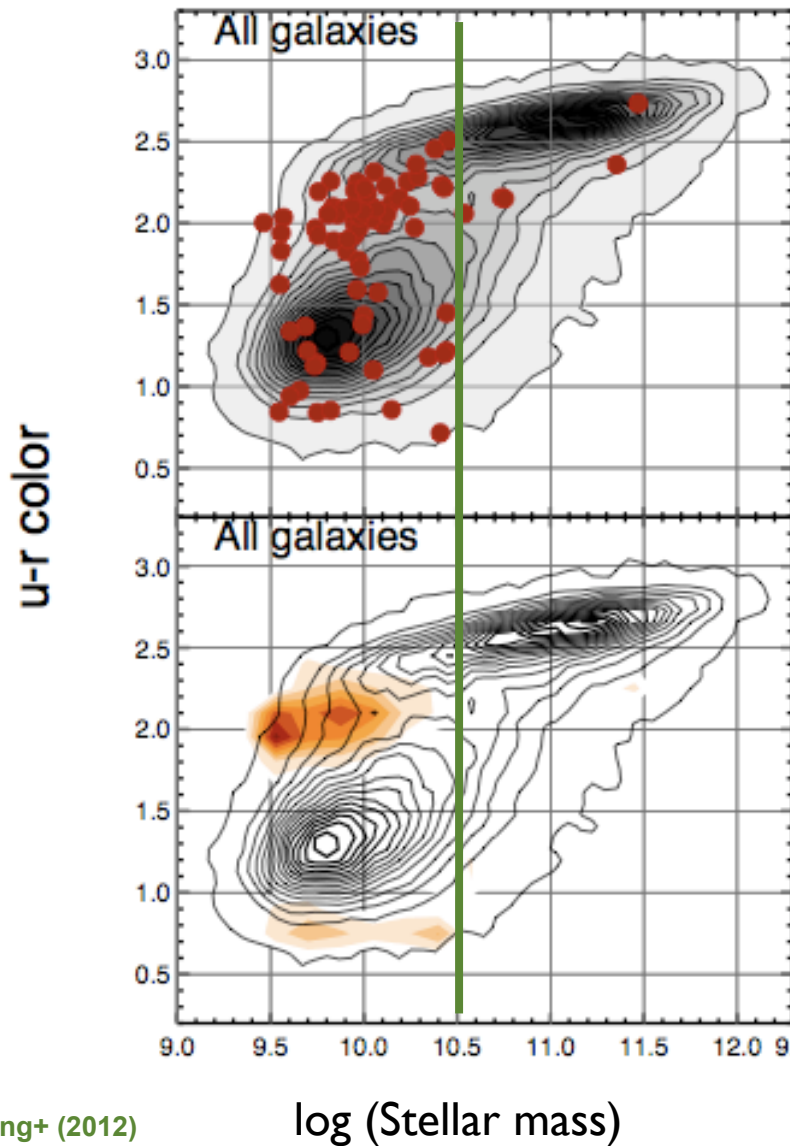
SDSS



www.galaxyzoo.org



Local post-starburst galaxies



Wong+ (2012)

log (Stellar mass)

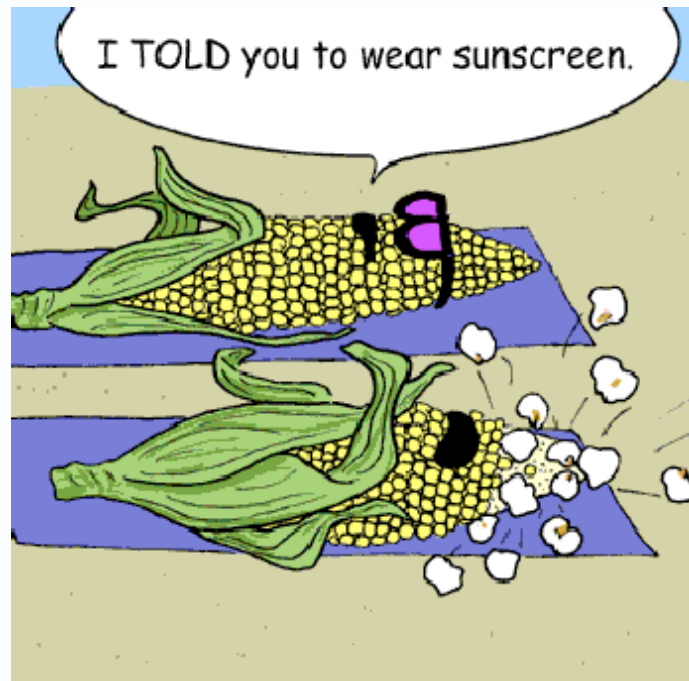
- low-mass end of the green valley, below the Kauffmann transition mass (Kauffmann+03)

- structurally, local green valley PSG are similar to early-types (KS probability = 0.7)

- *however, no unique environments !*

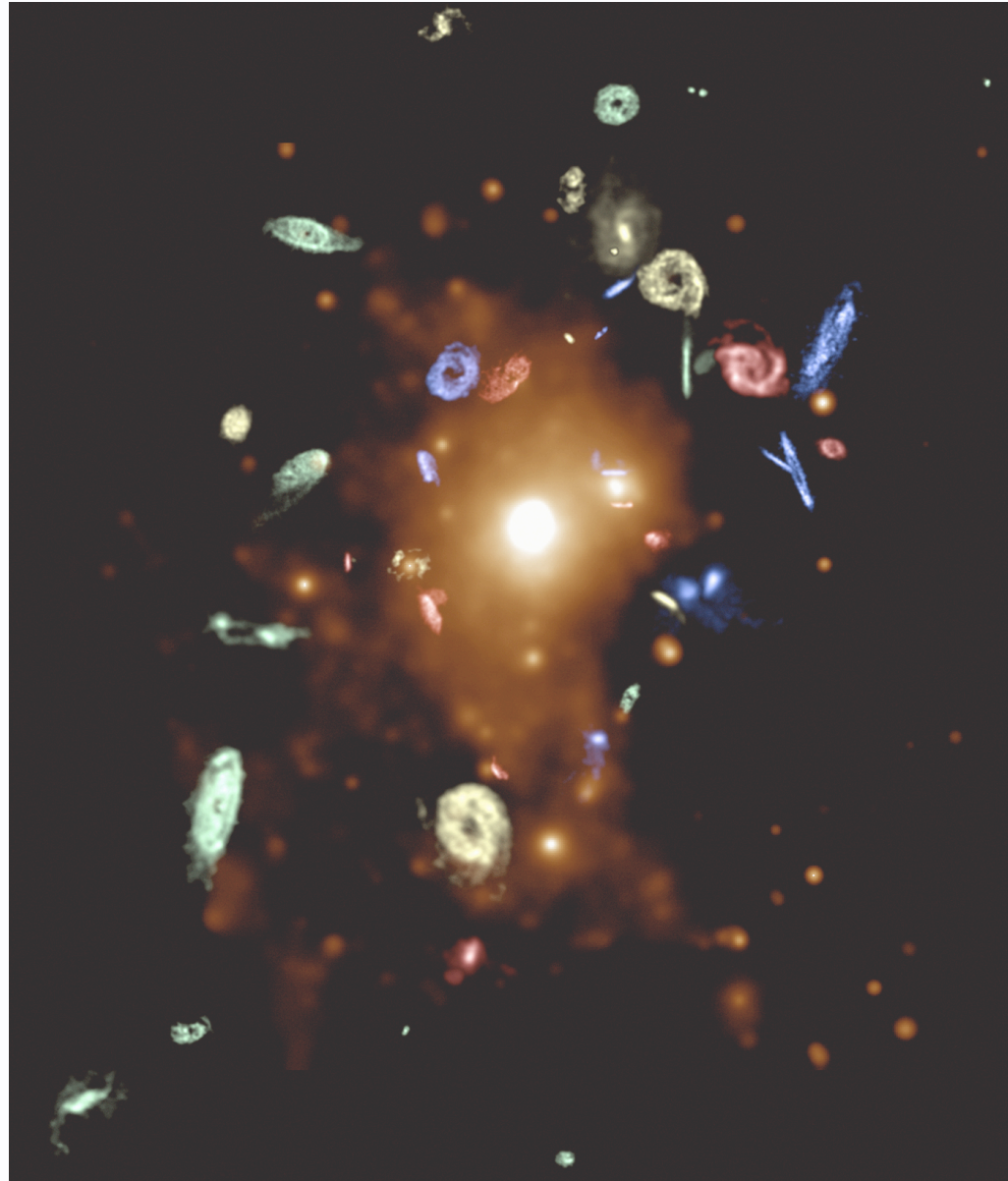


Environmental effects ?



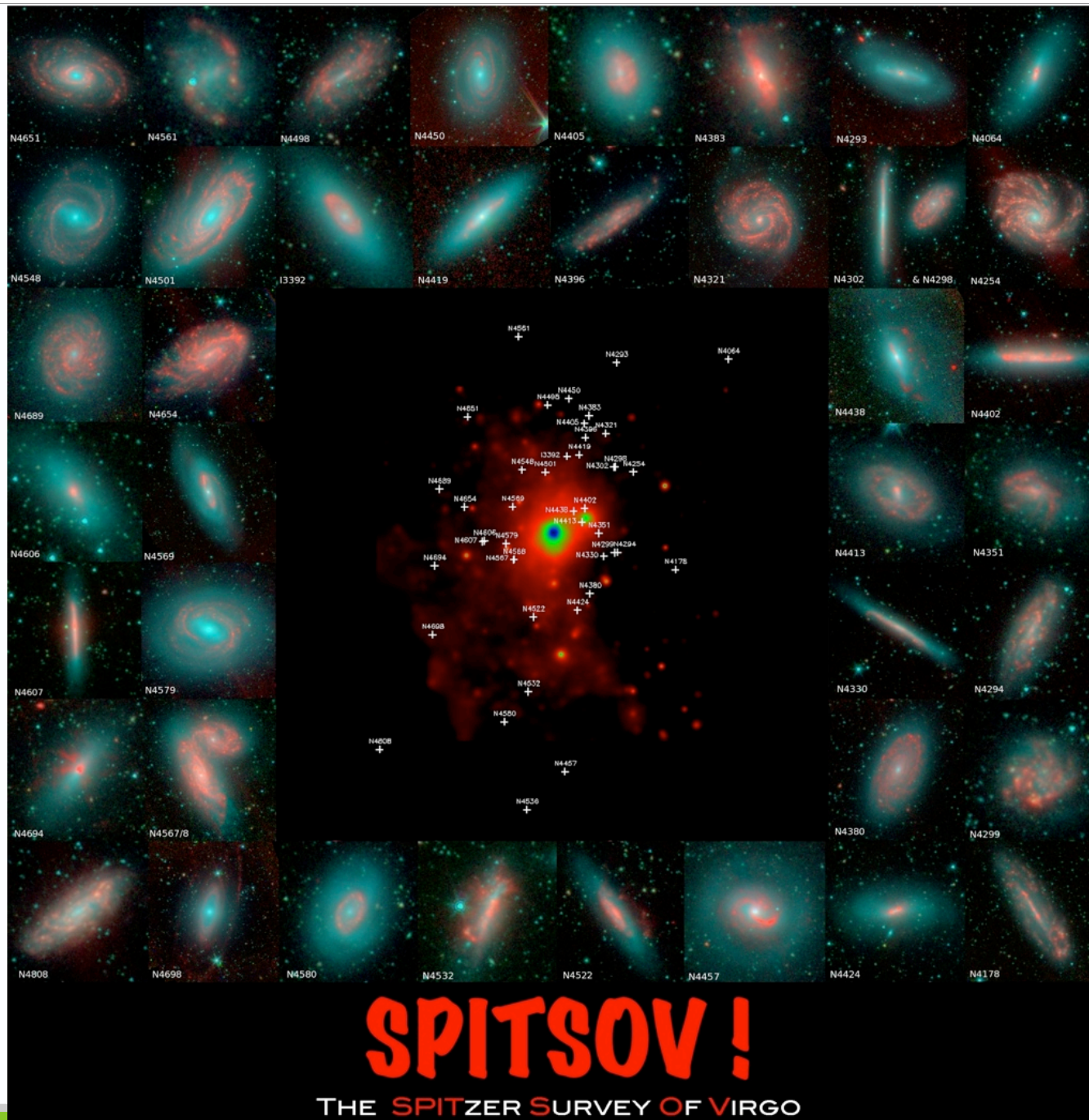
HI is an excellent environmental impact tracer

- gravitational interactions (galaxy harassment, mergers)
- hydrodynamical (ram pressure stripping of ISM by ICM)



Chung+ (2009);





SPITSOV!

THE SPITZER SURVEY OF VIRGO

Wong+12b (in prep);

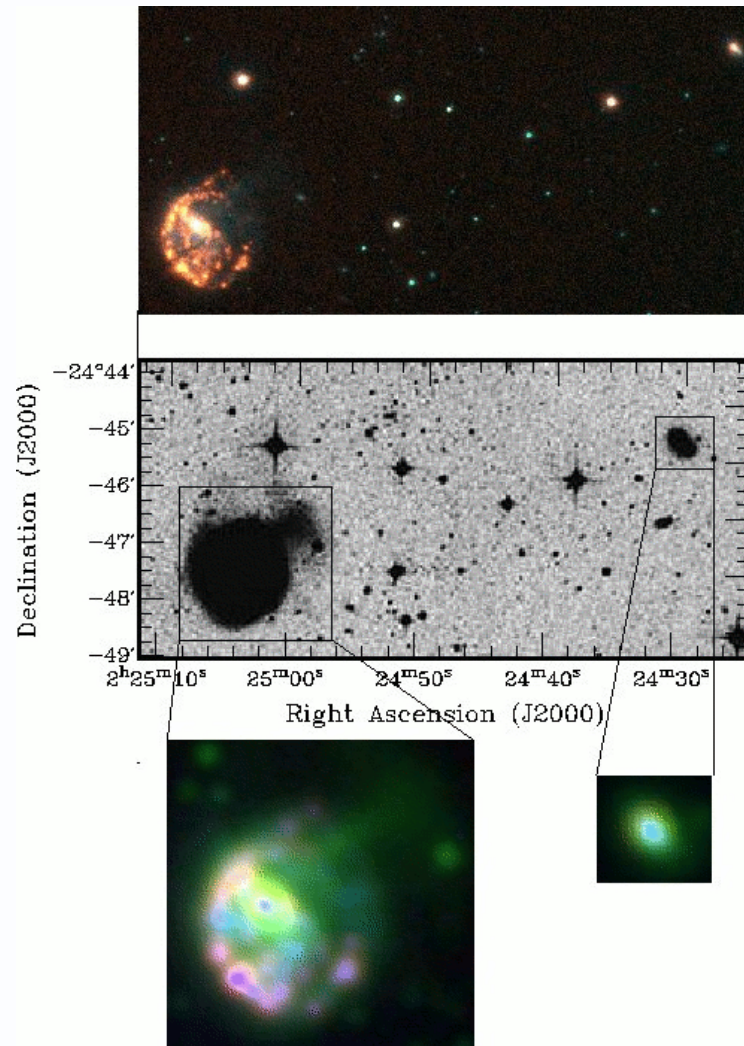


Gravitational interaction

3 color:
 $H\alpha_{\text{rsub}}$, $H\alpha$ & R-band

digitally-stacked
photographic plates
(courtesy David Malin)

3 color::
 $H\alpha$, R-band & FUV



Wong+ (2006b);



Most recent paper on ram pressure stripping ...

How does ram pressure affect the star formation law?

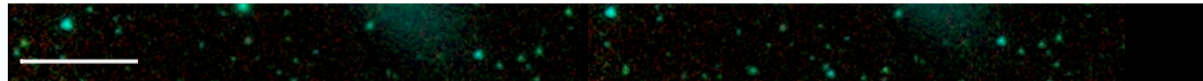
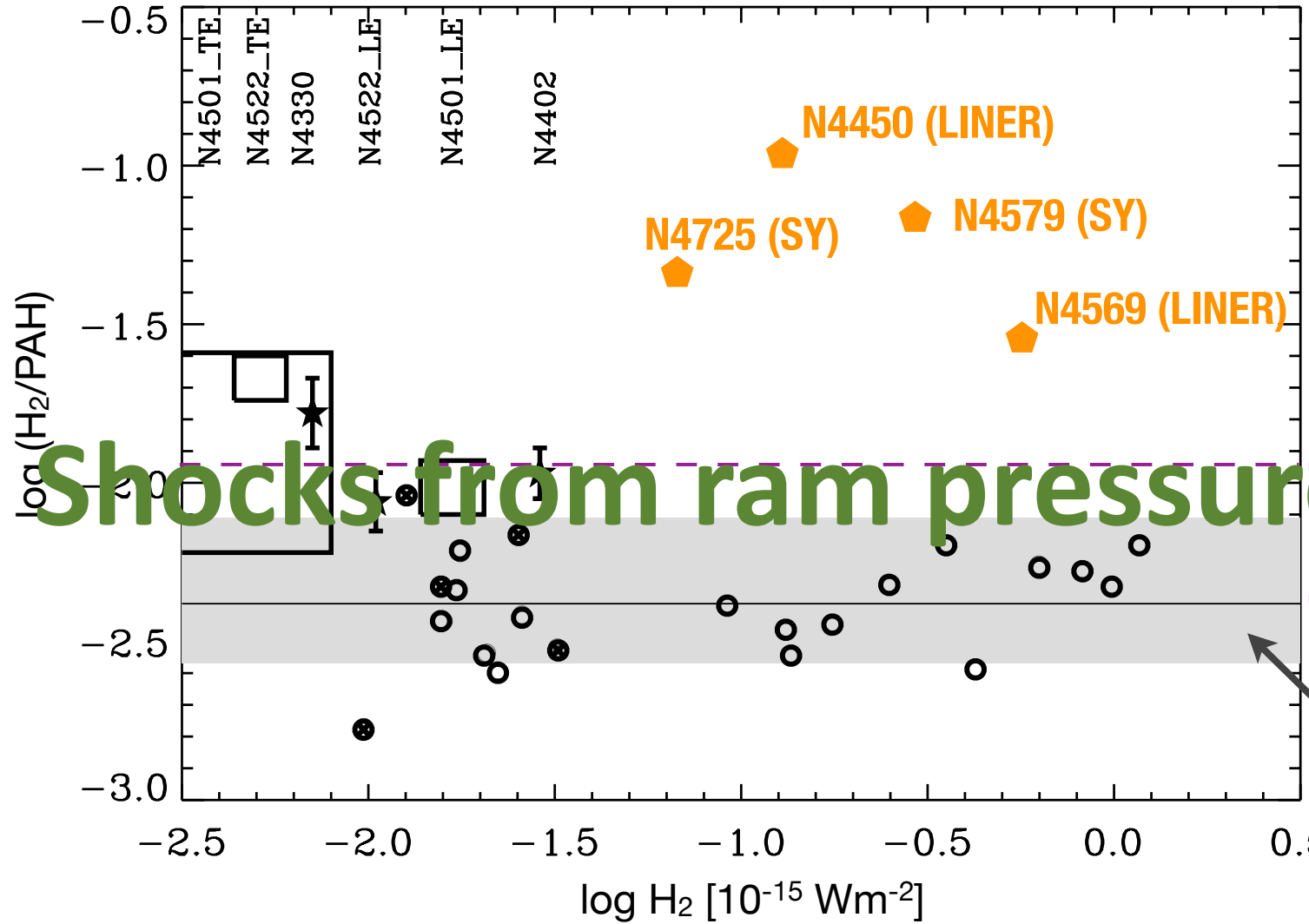
- Galaxies with symmetric gas distributions show tightness of SFR- Σ_{gas} correlation to be similar to that of SFR- Σ_{stars}

The influence of the cluster environment on the star formation law: SFR & Σ_{gas}
star formation efficiency of 12 Virgo spiral galaxies

- star formation efficiency: $\text{SFE} \sim \text{SFR} / \Sigma_{(\text{HI}+\text{H}_2)}$
B. Vollmer¹, O.I. Wong², J. Braine^{3,4}, A. Chung⁵, and J.D.P. Kenney⁶

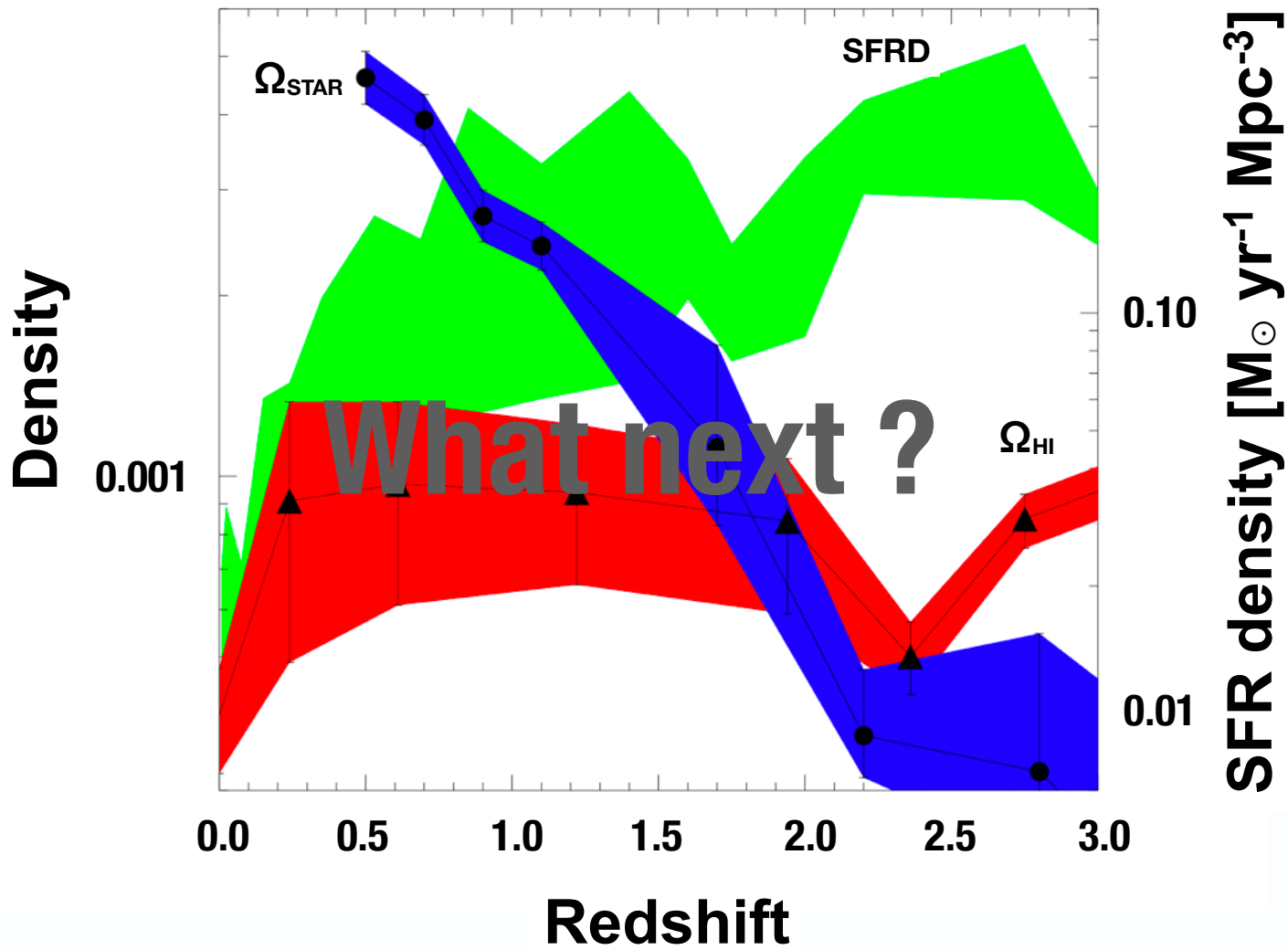
No evidence for a strongly increased SFE due to ram pressure
BUT a strongly decreased SFE is observed in the stripped gas

→ **IMPORTANT** because this means the vast majority of the stripped gas will either be heated or join the general cluster medium



Wong+ '12c (in prep)

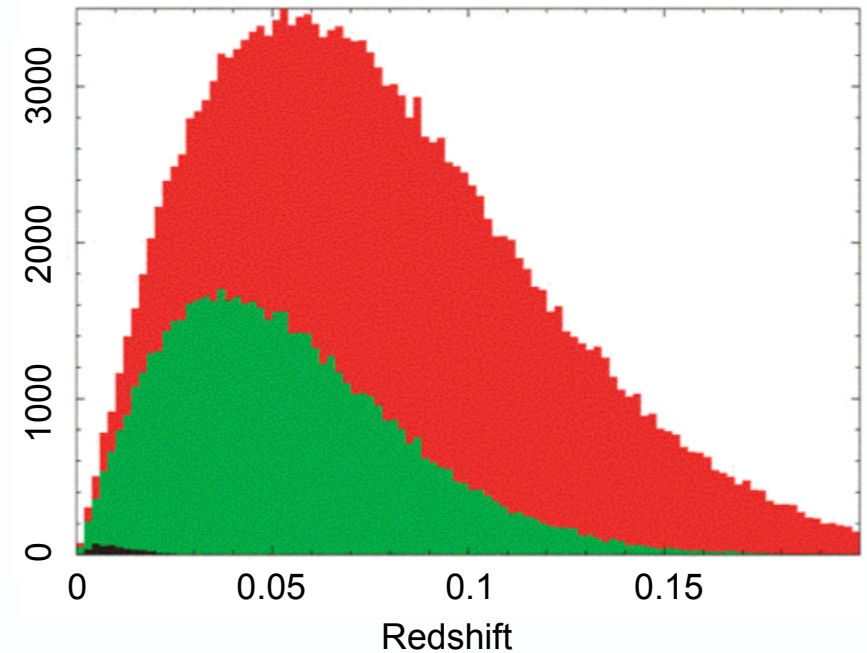




WALLABY - the ASKAP HI all-sky survey

- the next generation HI survey
- survey 2/3 of sky out to $z \sim 0.2$
- expect 500,000 sources

- will have the spatial resolution and sensitivity to resolve filaments and tidal HI features within the nearby Universe



various observations

Thank you

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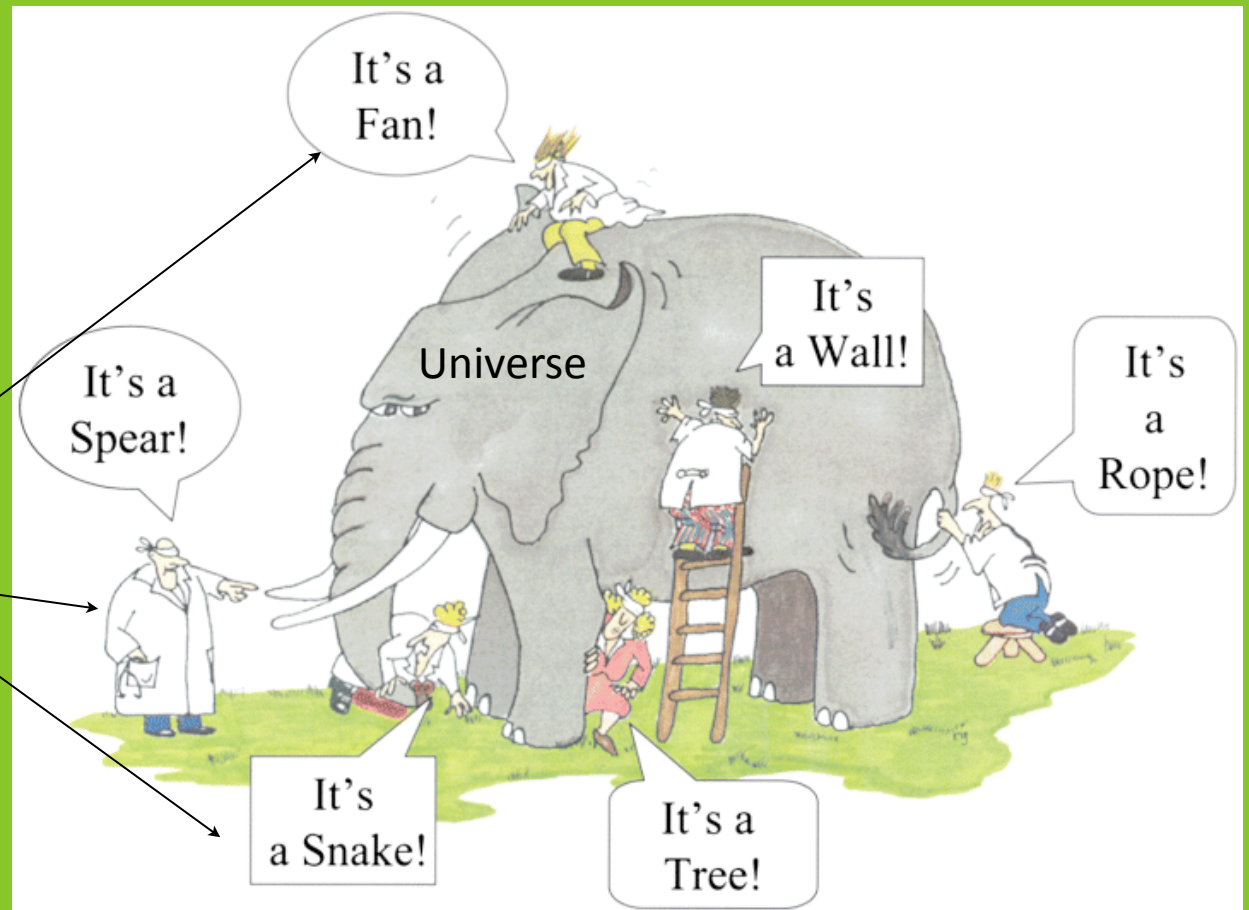
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