International
Centre for
Radio
Astronomy
Research

THE UNIVERSITY OF
WESTERN AUSTRALIA
Achieving International Excellence

Curtin
University of Technology

ICRAR is a partnership between The University of Western Australia and Curtin University of Technology

WALLABY Local Universe …

Gerhardt Meurer

My viewpoint

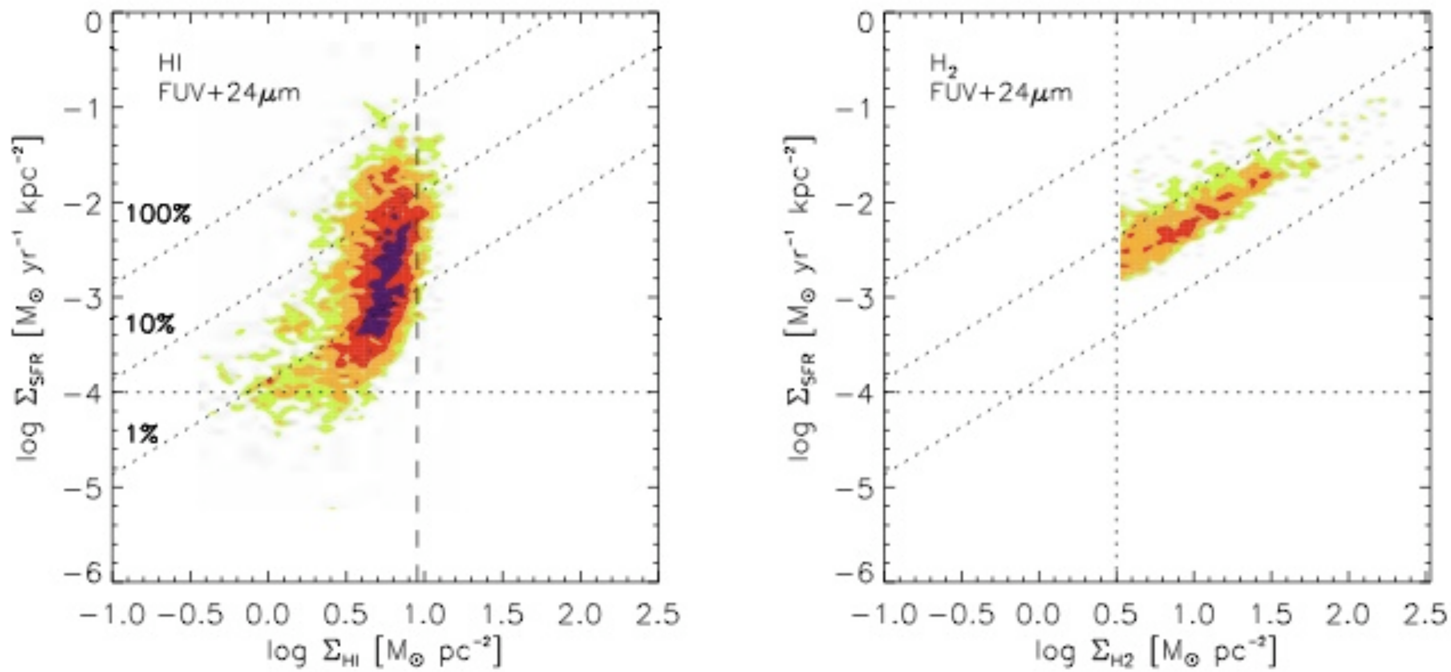
- SINGG: the Survey of Ionization in Neutral Gas Galaxies
  - Hα and R band survey
- SUNGG: the Survey of Ultraviolet emission in Neutral Gas Galaxies
  - Far and near ultraviolet (FUV, NUV) survey

- Parent sample of both is HIPASS the HI Parkes All Sky Survey

- Does star formation care about the *neutral* ISM?

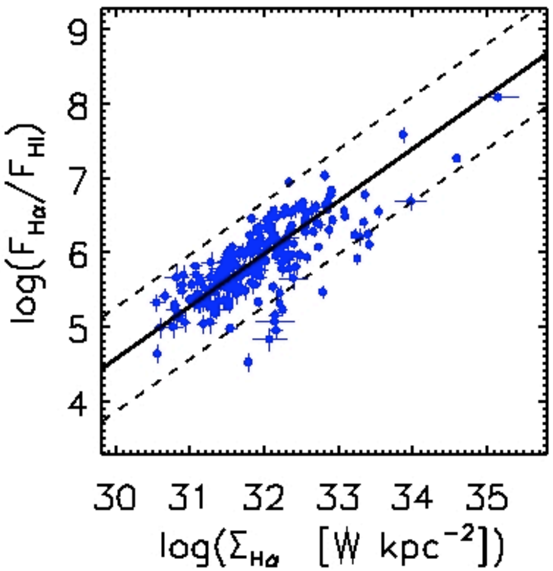
An HI – star-formation connection?

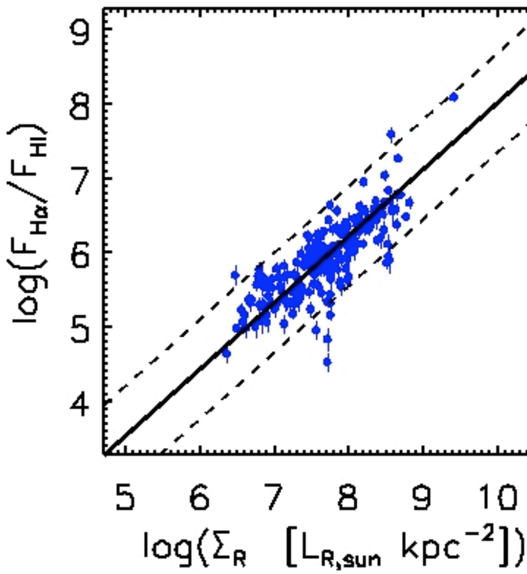
- Stars form out of the molecular ISM, not HI
- So why should there be ***any*** connection?



Bigiel et al. (2008, AJ, 136, 2846)

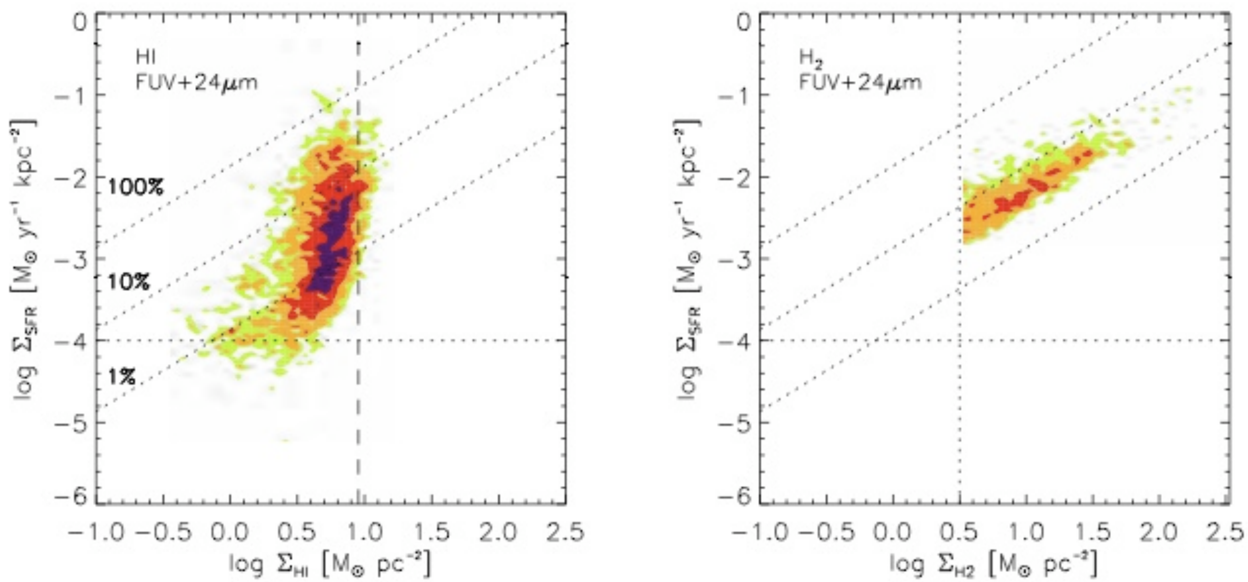
Correlations from SINGG





X-axis	Σ_{SFR}	Σ_R
r_{xy}	0.76	0.80
Slope	0.71	0.89
σ_y	0.28	0.27
σ_x	0.40	0.30

The THINGS SFL



1. $\Sigma_{SFR} \sim \Sigma_{H2}$ (N = 1.0) → Linear relation between molecular gas and SFR
2. $R_{mol} = \Sigma_{H2}/\Sigma_{HI} \sim \Sigma_{R}$ → molecular fraction set by hydrostatic pressure
3. Q(2 Fluids) = constant → ISM disks maintained at constant stability

Leroy et al. (2008, AJ, 136, 2782) , Bigiel et al. (2008, AJ, 136, 2846)

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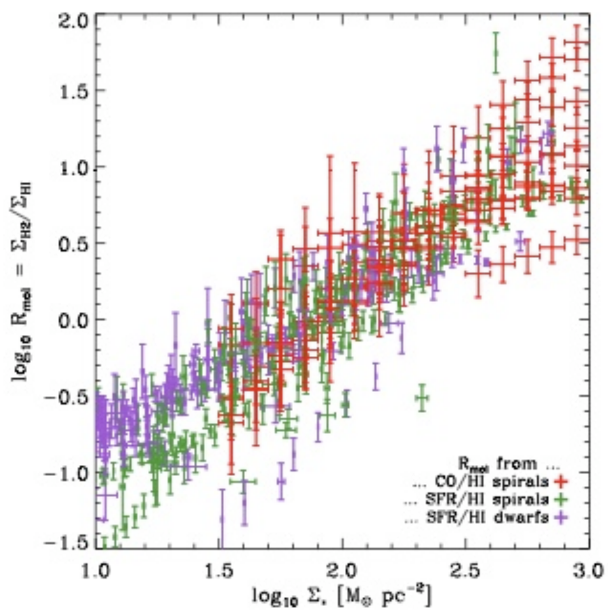

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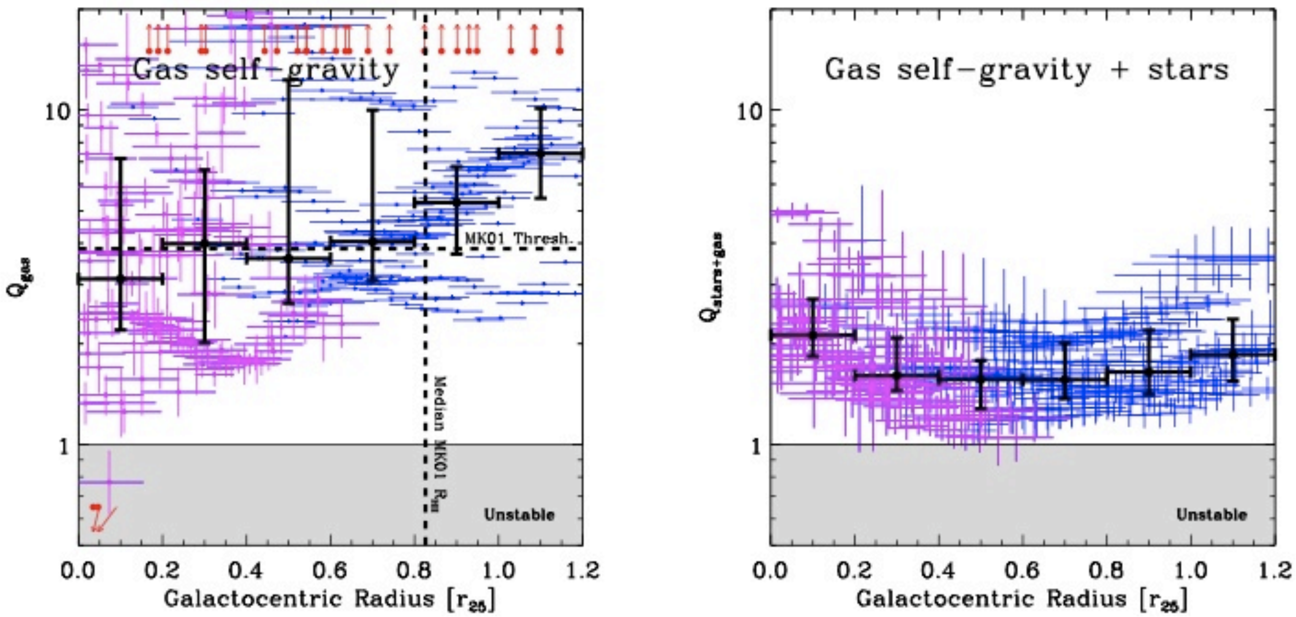

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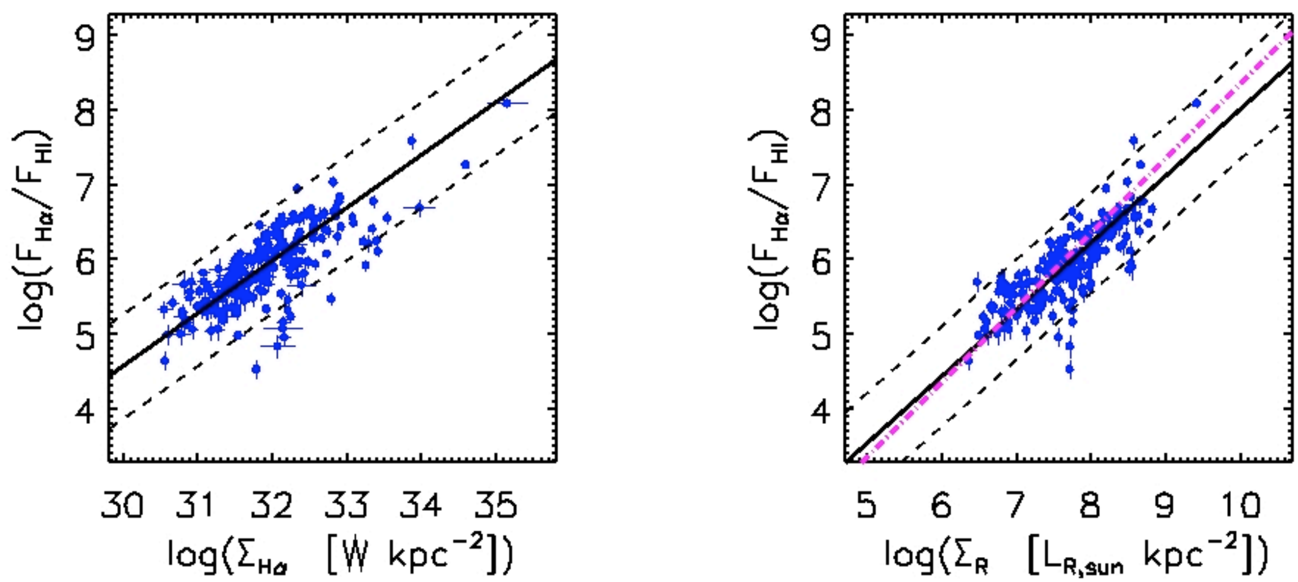
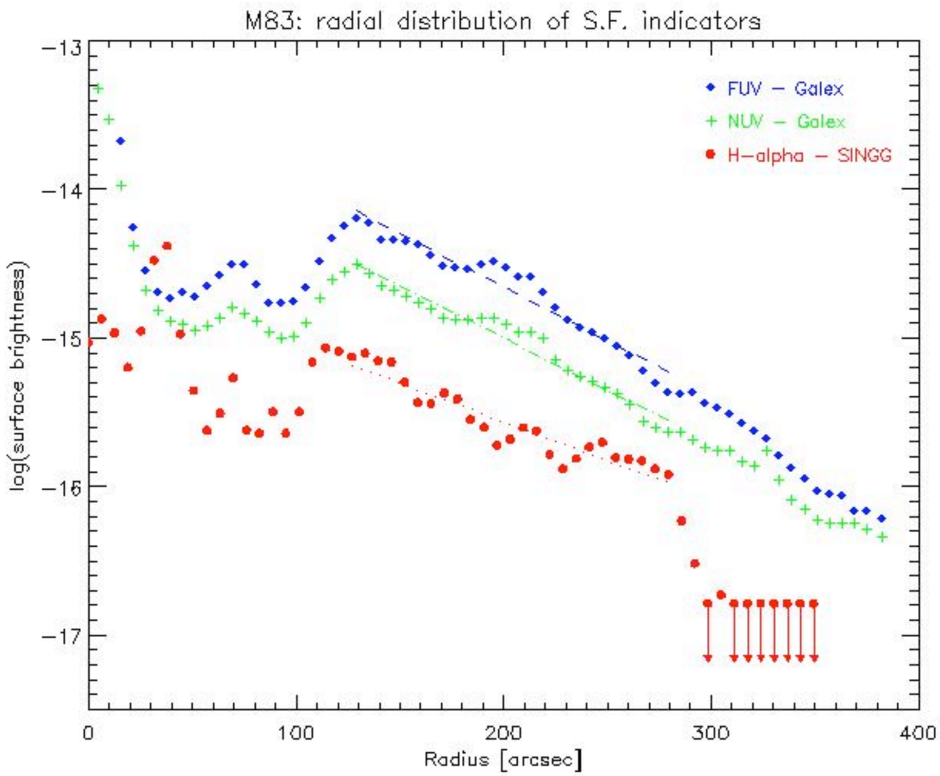
Test with SINGG global properties



- $H\alpha$/HI→SFR/HI→H_2/HI→R_{mol}→P(!)
- Expect 1:1 correlation with Σ_R

Explanation for $\rho_{SFR}(z)$ vs $\rho_{HI}(z)$?

HI and SF in M83



- Thilker et al. (2005) showed that M83, the paradigm case for a star formation edge (Martin & Kennicutt, 2001) has no UV edge.
- Now Bigiel et al (2010, ApJL) have shown that FUV traces HI at very low surface brightnesses.

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L34 BIGIEL ET AL. Vol. 720

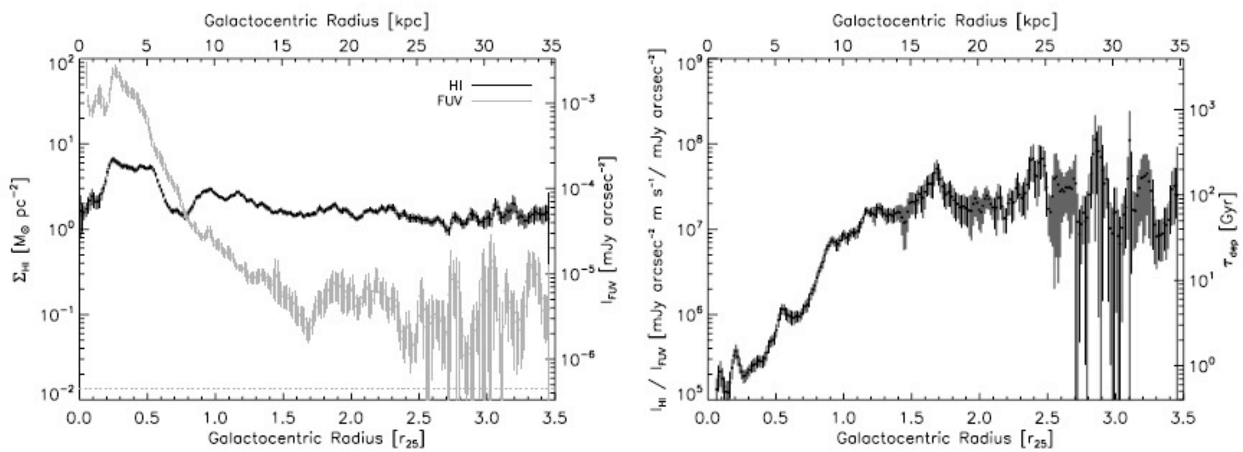
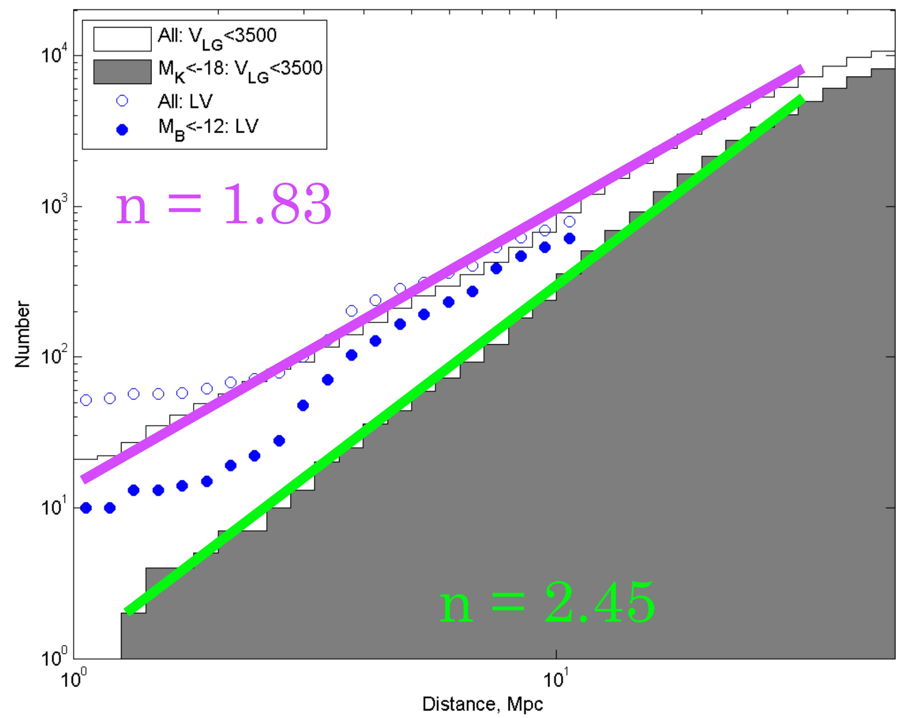


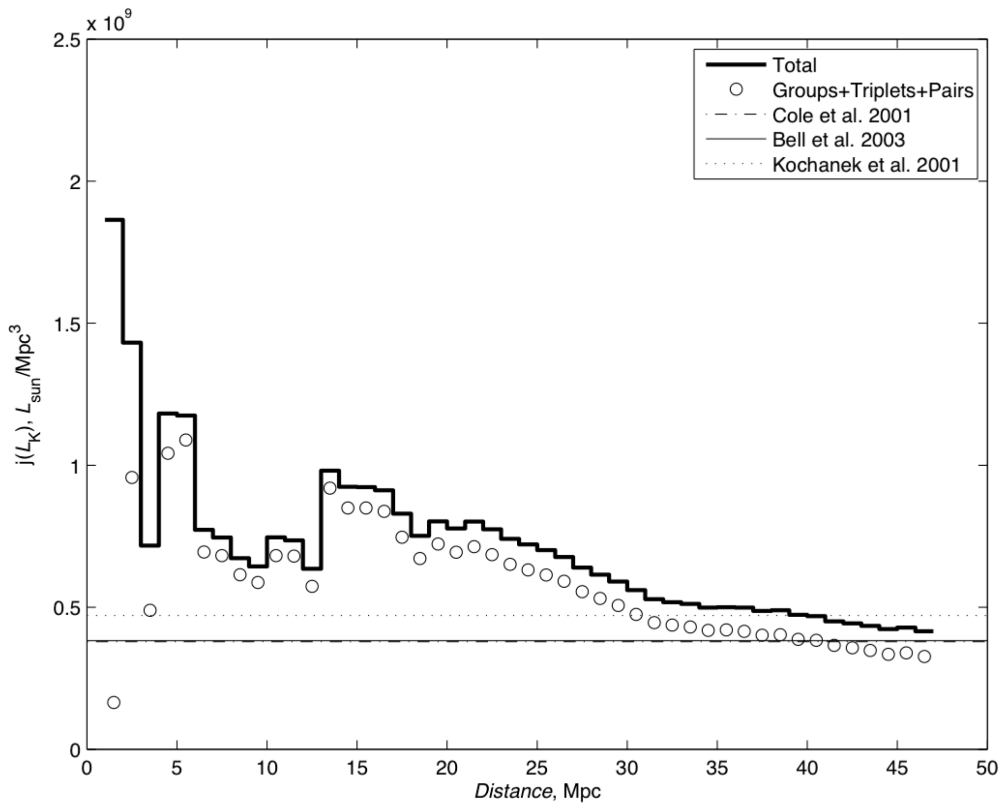
Figure 4. Left: H I (black) and FUV (gray) emission averaged in 6″.5 wide azimuthal rings (deprojected radial profiles) in regions of significant H I emission, i.e., along the arms in the extended disk of M83 (see the text). The error bars show the (1σ) uncertainty in the mean in each annulus. The left axis provides the mass surface density scale for the H I profile, and the right axis the intensity scale for the FUV profile (we note that in order to convert the FUV intensity scale—in units of mJy arcsec^{-2}—into SFR surface densities Σ_{SFR}—in units of $M_\odot$ yr^{-1} kpc^{-2}—one needs to multiply I_{FUV} by ~3.46; compare to Bigiel et al. 2010). The gray dotted line indicates the typical 5σ sensitivity for the (averaged) FUV emission in an (outer disk) annulus. The respective H I sensitivity is below the lower plot limit. H I and FUV emission show quite distinct radial trends: whereas average H I surface densities remain relatively constant along the filaments in the outer disk, the mean FUV intensity continues to drop before leveling off at 1.7 r_{25}. Right: intensity ratio of H I and FUV radial profiles. Converting FUV intensity into Σ_{SFR}, this ratio yields the H I depletion time (right axis). At large radii, this depletion time remains relatively constant at about 100 Gyr, i.e., many Hubble times.

Incompleteness

- Catalogue of Nearby Galaxies (Karachentsev et al. 2008)
  - Updated to 750+ galaxies with D < 10 Mpc
  - Aims to be complete to D = 8 Mpc
  - Missing ~1K galaxies out to D = 8 Mpc
- Compilation of 10K+ galaxies with V_r < 3500 km/s
  - Difference in (eye) fitted lines suggests that ~21K galaxies are missing to D = 30 Mpc
  - (but most of these we probably couldn't see with WALLABY)



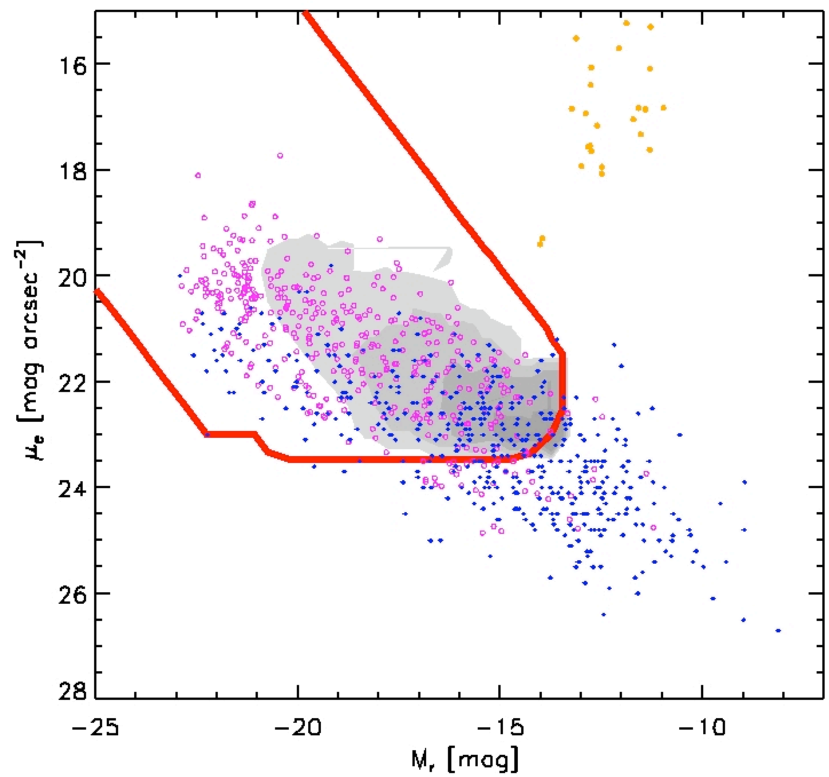
Local density enhancement?



- From Karachentsev et al.
- K band luminosity within D < 30 Mpc larger than derived from large area surveys
- Drop-off in j_K with D ould explain why n = 2.45 in last slide
- Or maybe large area surveys are incomplete…?

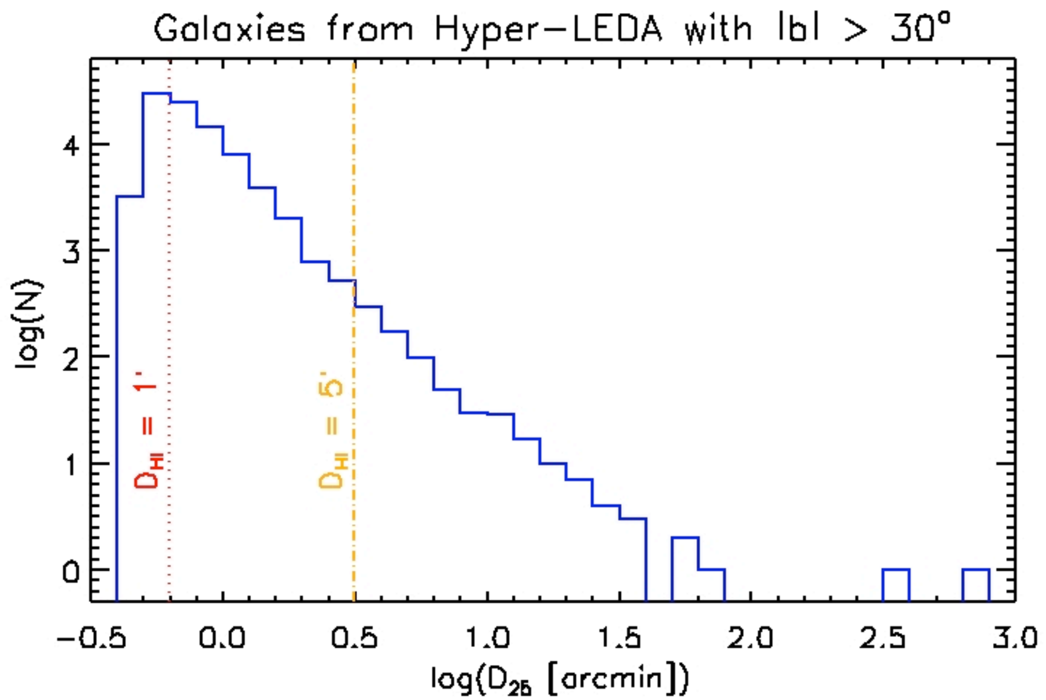
What types of galaxies are being missed?

- Big surveys miss low surface brightness, low luminosity galaxies
- We will not be getting optical spectroscopy for most of these…
- compact HSB galaxies could also be missed (HI rich UCDs?)



grayscale: GAMA (sel limits)
○ SINGG
• Local universe (Jerjen)
• UCDs (Evstigneeva et al. 2008, AJ 136, 461)

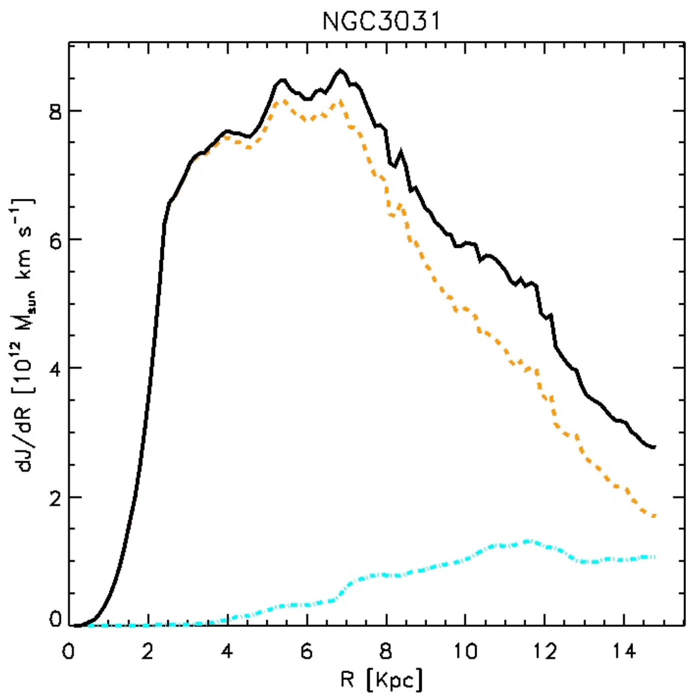
How many big galaxies?

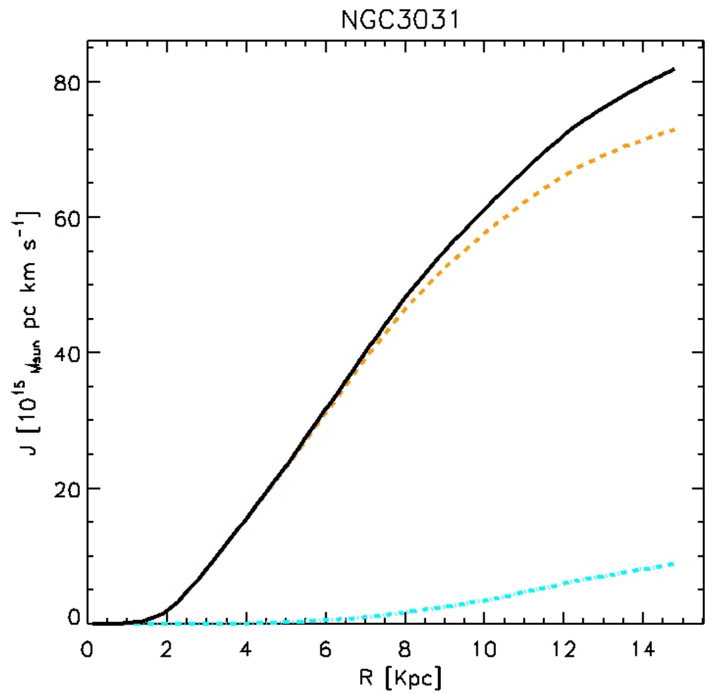


- Start with GALEX Large Galaxy Atlas input catalog: 170k galaxies (Seibert…)
- Assume $D_{HI}/D_{25} \sim 1.6$
- Consider galaxies with $|b| > 30^o$
- Scale to 3π area of WALLABY, 4π of WALLABY + WNSHS

D_{HI}	3π	4π
1'	83,000	110,000
2'	11,800	15,800
3'	3,700	4,900
5'	1,100	1,400
10'	240	320

Angular momentum (J) content





- Typically J assumed to follow stellar (exponential disk; e.g. Mo, Mao, & White 1998)

- However HI disks are very extended and contain much of the actual J
- Σ_{HI} drops off slowly, so actual J depends on how far out disk can be traced

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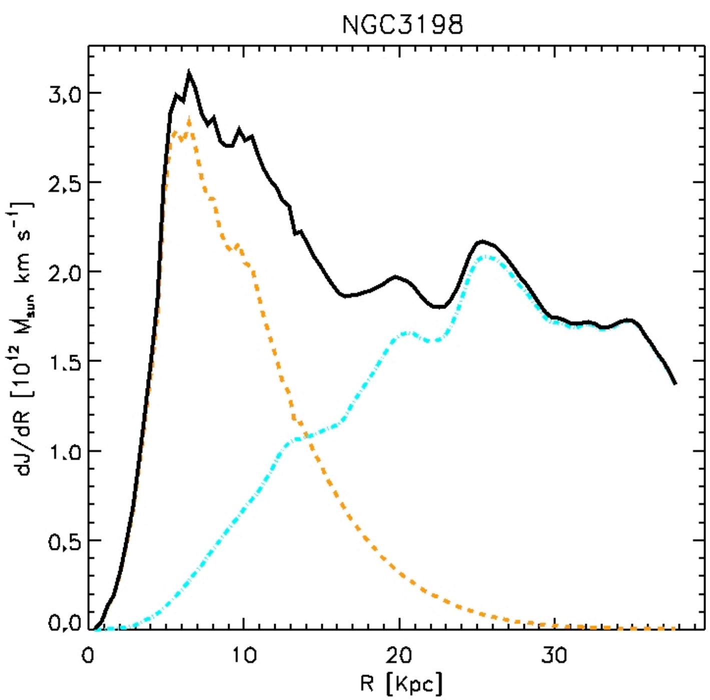

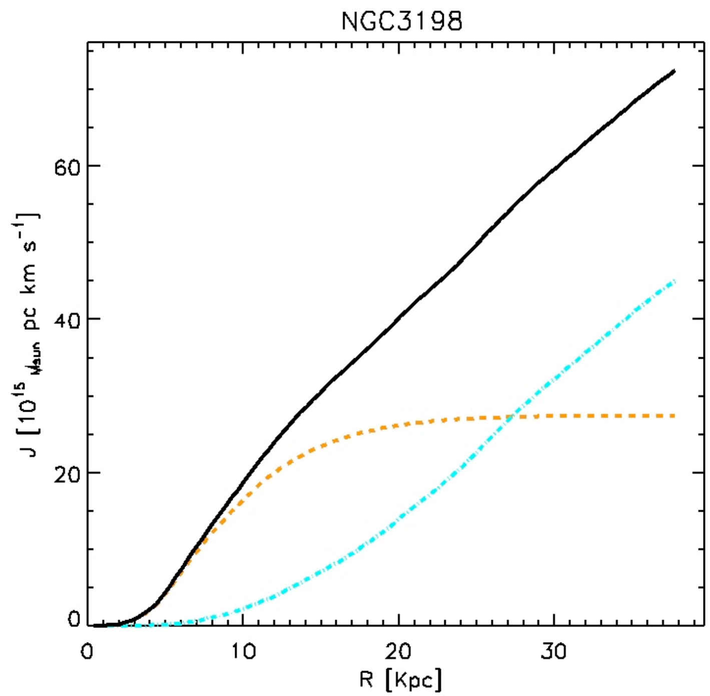

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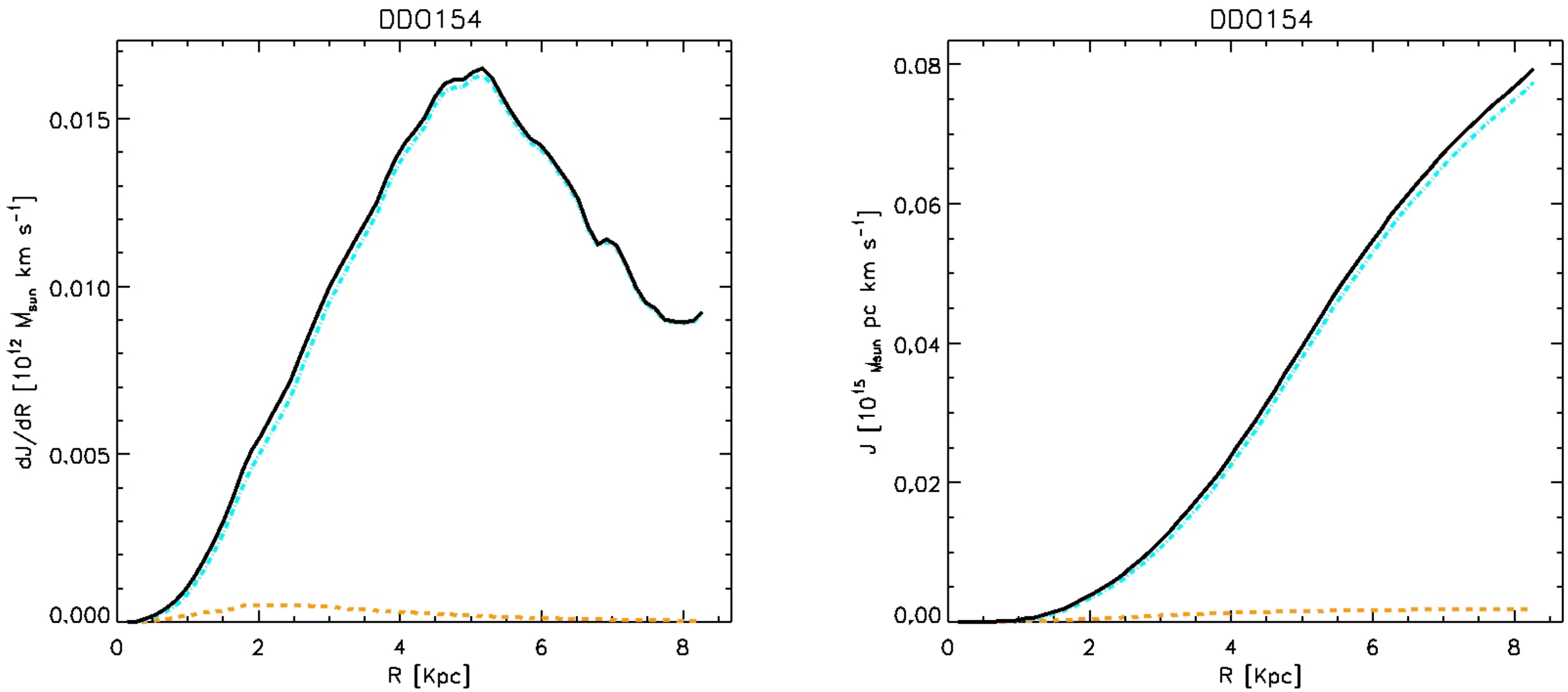

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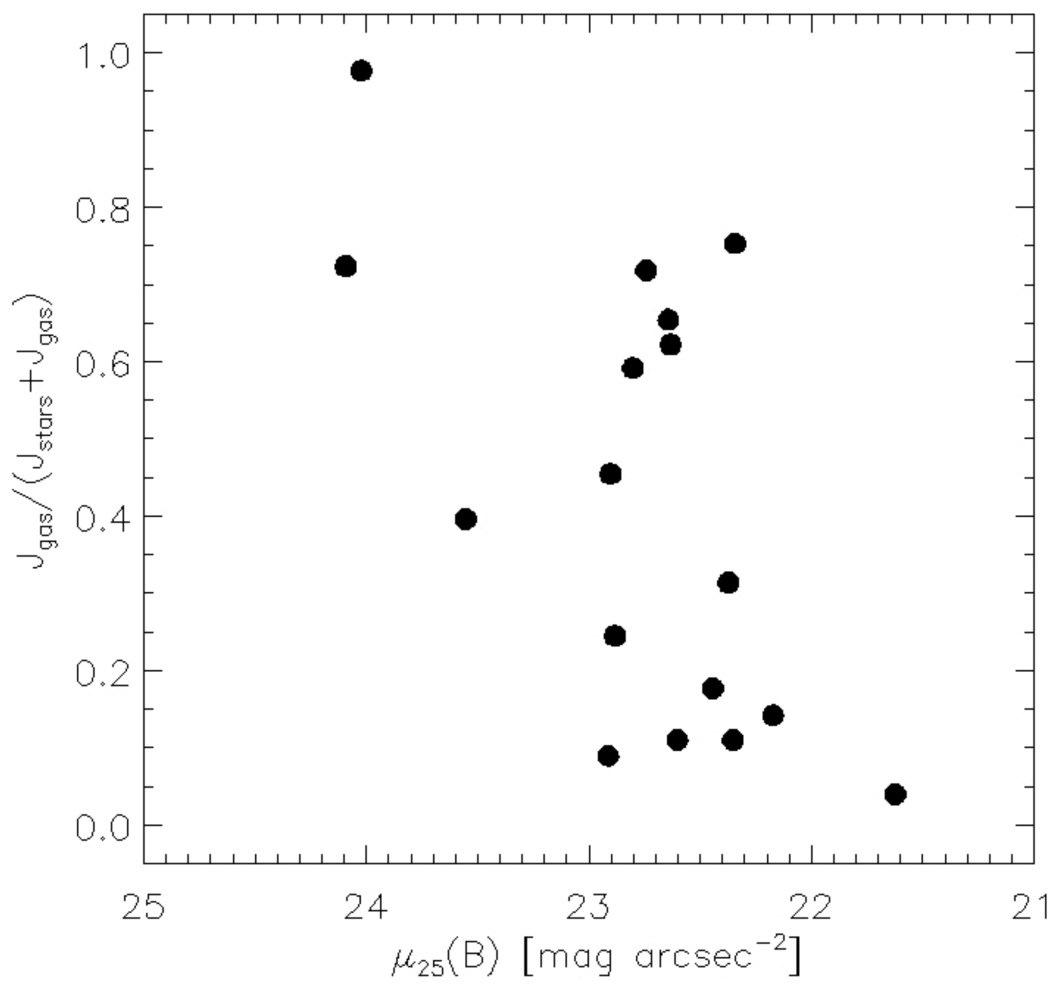
J in gas correlates with SB?



Wish list for WALLABY results

- SFL (& IMF) on kpc scales
  - Hα imaging
  - UV imaging
- Gas-rich ultra-faint dwarfs out to 10 Mpc (if they exist)
  - Optical imaging
- Rotation curves, spin parameters and mass models for hundreds of galaxies in an HI selected sample
  - Optical RCs
  - Optical imaging
  - NIR imaging

New constraints on the nature of Dark Matter