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Finding HI-rich Dwarf Galaxies in Existing and Future Surveys

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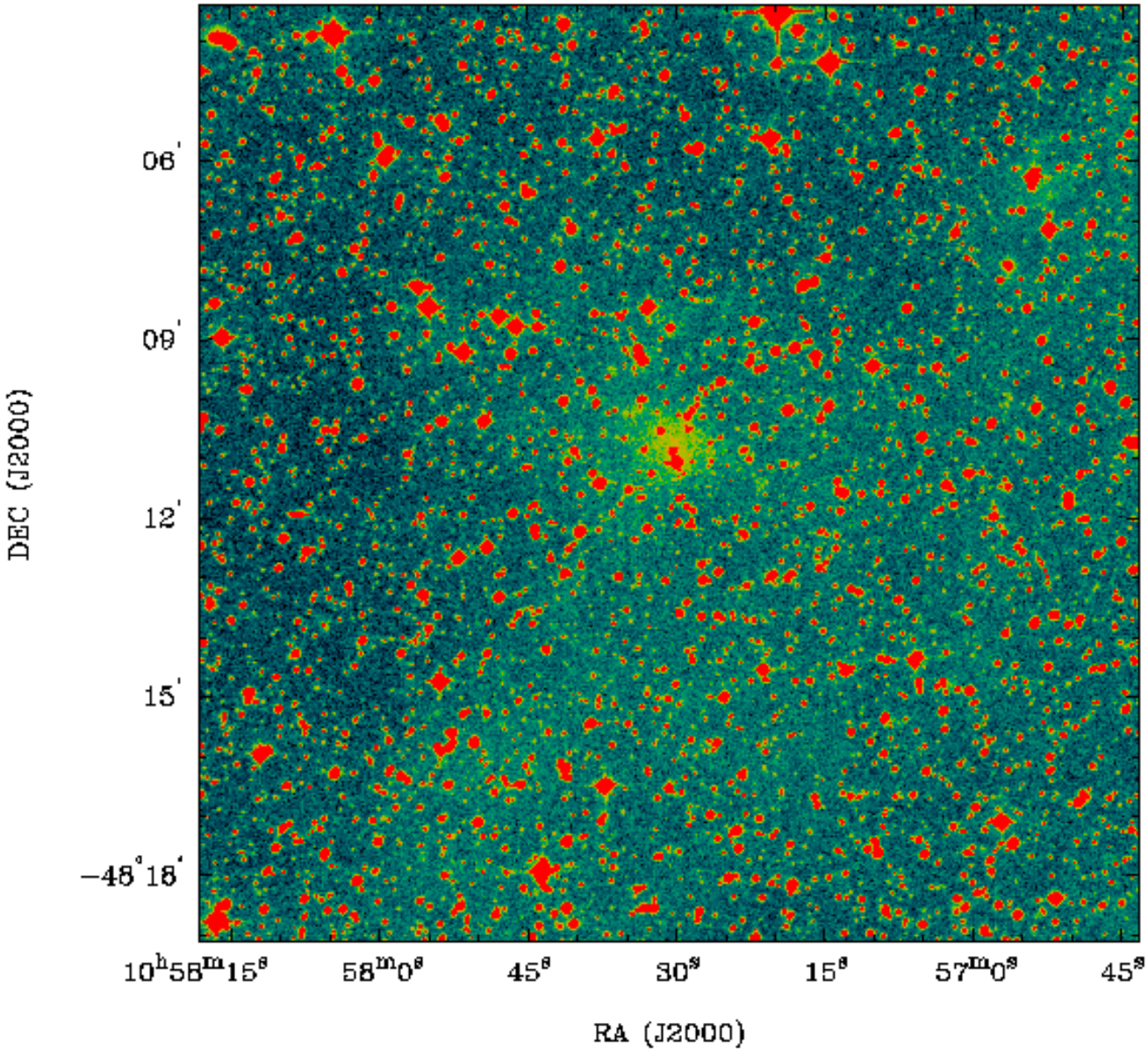
The HI Mass-to-Light Ratio

- Distance independent quantity:

$$\mathcal{M}_{HI}/L_B = 1.5\times10^{-7}\, F_{HI}\, 10^{0.4(m_B - A_B)} \quad \mathcal{M}_\odot/L_{\odot,B}$$

- Galactic extinction A_B is taken from the Schlegel et al. (1998) dust maps. Internal extinction is not taken into account currently.
- Typical values are $< 1\ \mathcal{M}_\odot/L_{\odot,B}$ for late-type galaxies (Roberts & Haynes, 1994).
- Galaxies have been found with significantly higher ratios, often with extended HI envelopes.


06'
09'
12'
15'
−48°18'
DEC (J2000)
10h58m15s
58m0s
45s
30s
15s
57m0s
45s
RA (J2000)

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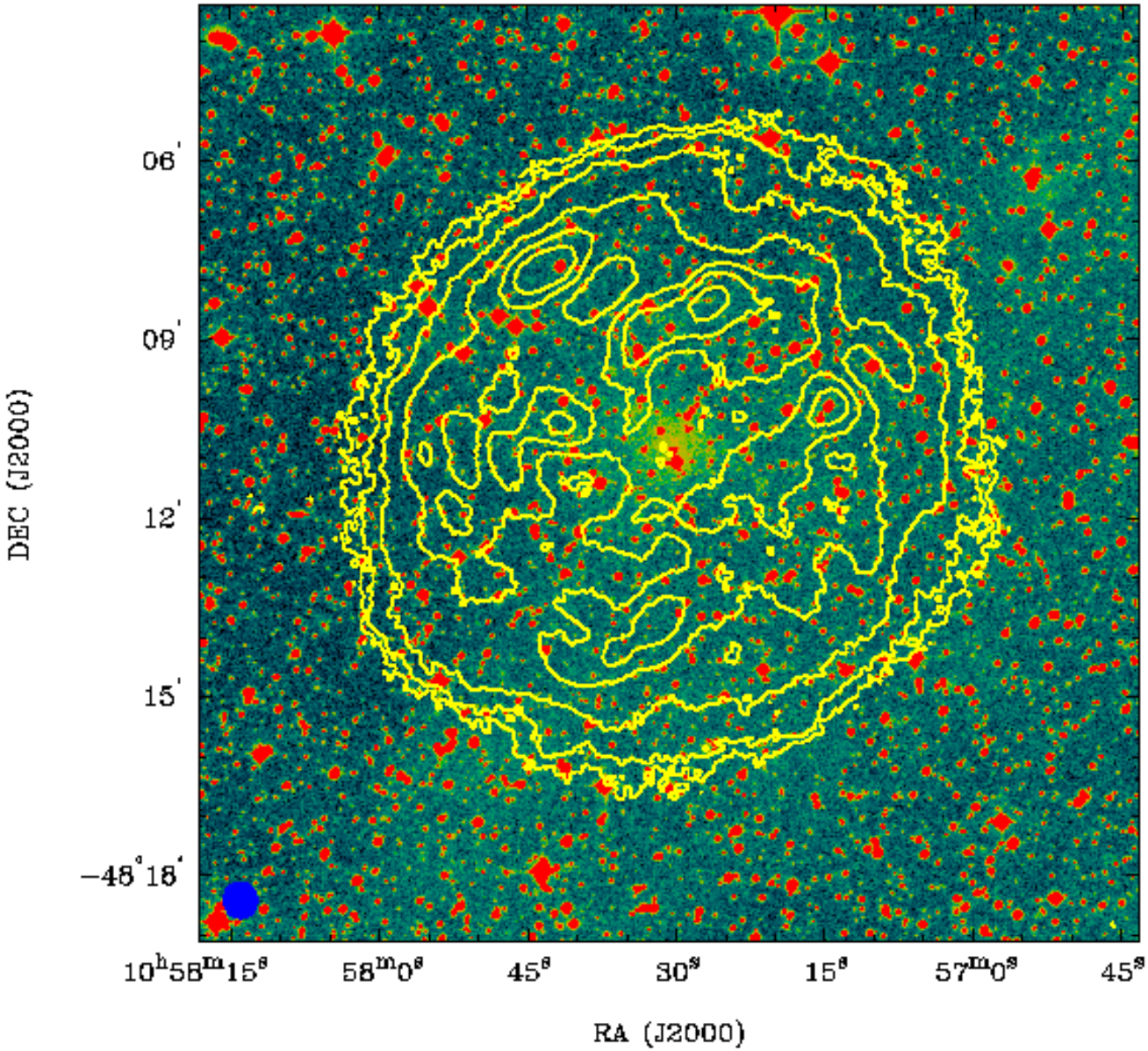
ESO 215-G?009



ESO 215-G?009 (Warren et al. 2004)

- $\mathcal{M}_{\rm HI}/{\rm L_B} = 22 \pm 4\ \mathcal{M}_\odot/{\rm L}_{\odot,{\rm B}}$.
- One of the highest (if not the highest) $\mathcal{M}_{\rm HI}/{\rm L_B}$ to be confirmed by accurate measurement.
- H I extends 6.4 ± 0.4 times the optical radius.
- Velocity field shows a regular rotating disc.
- $SFR_{20cm} < \sim 2.5 \times 10^{-3}\ \mathcal{M}_\odot yr^{-1}$.
- $\langle SFR \rangle_{past} \sim 2.7 \times 10^{-3}\ \mathcal{M}_\odot yr^{-1}$.
- Appears isolated (nearest galaxies ~2 Mpc away).

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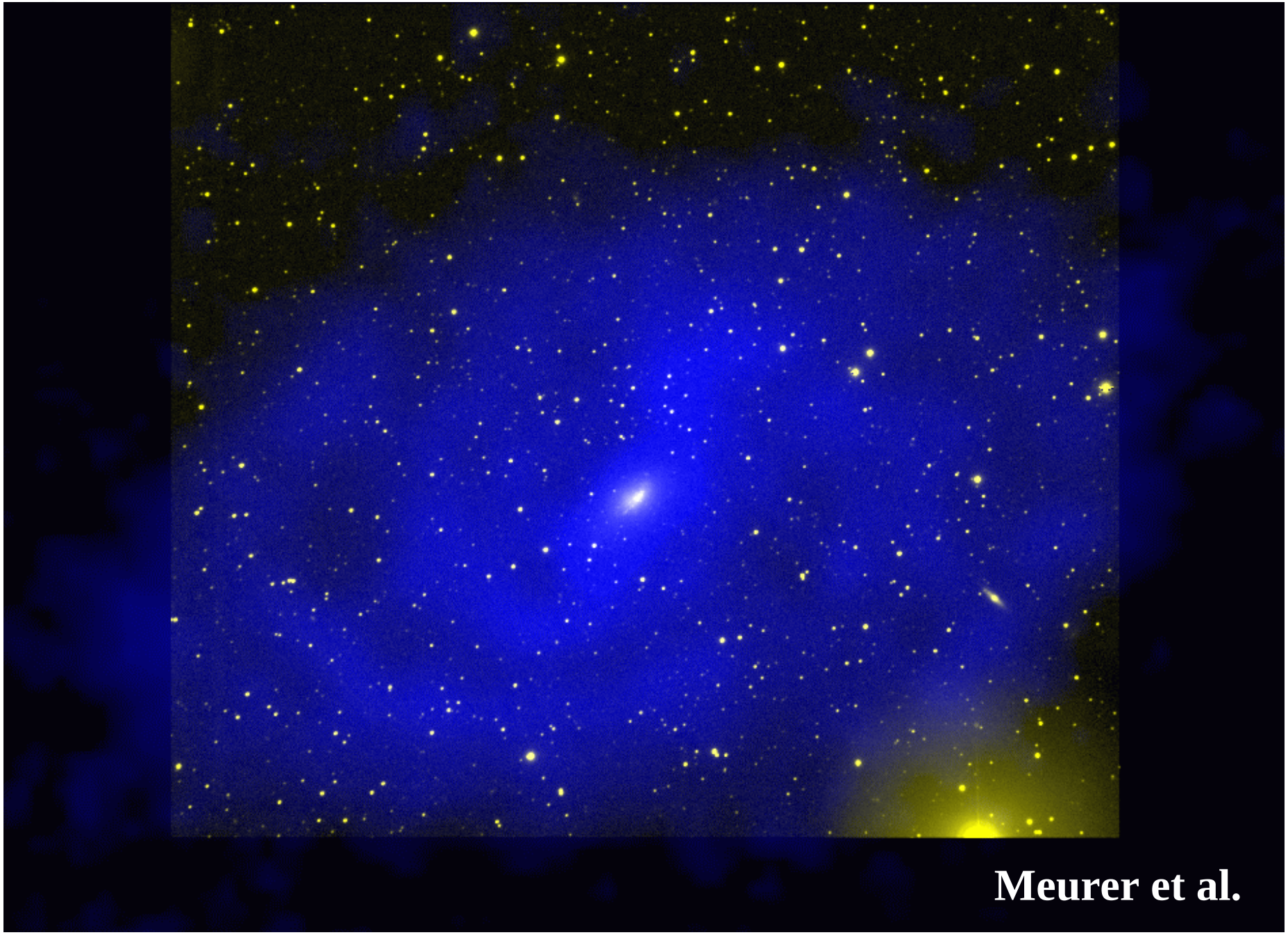
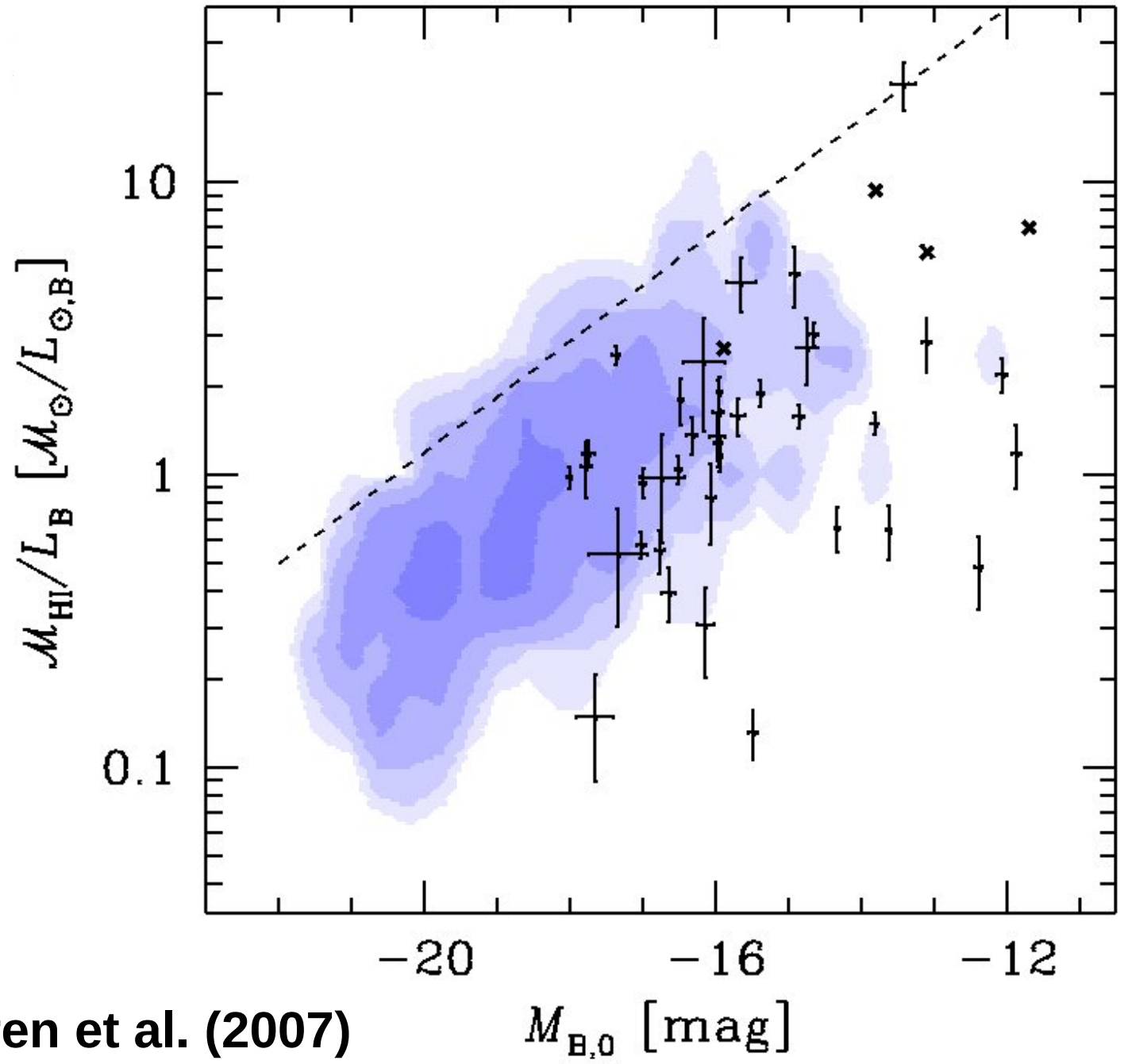
Other Gas Rich Dwarfs

- DDO 154 (Carignan & Beaulieu, 1989)
  - $\mathcal{M}_{\rm HI}/{\rm L_B} = 9.4\ \mathcal{M}_{\odot}/{\rm L}_{\odot,{\rm B}}$
- NGC 3741 (Begum et al., 2005)
  - $\mathcal{M}_{\rm HI}/{\rm L_B} = 5.8\ \mathcal{M}_{\odot}/{\rm L}_{\odot,{\rm B}}$
- NGC 2915 (Meurer et al., 1994, 1996)
  - $\mathcal{M}_{\rm HI}/{\rm L_B} = 2.7\ \mathcal{M}_{\odot}/{\rm L}_{\odot,{\rm B}}$
- UGCA 292 (Young et al., 2003)
  - $\mathcal{M}_{\rm HI}/{\rm L_B} = 7.0\ \mathcal{M}_{\odot}/{\rm L}_{\odot,{\rm B}}$


Meurer et al.



Warren et al. (2007)

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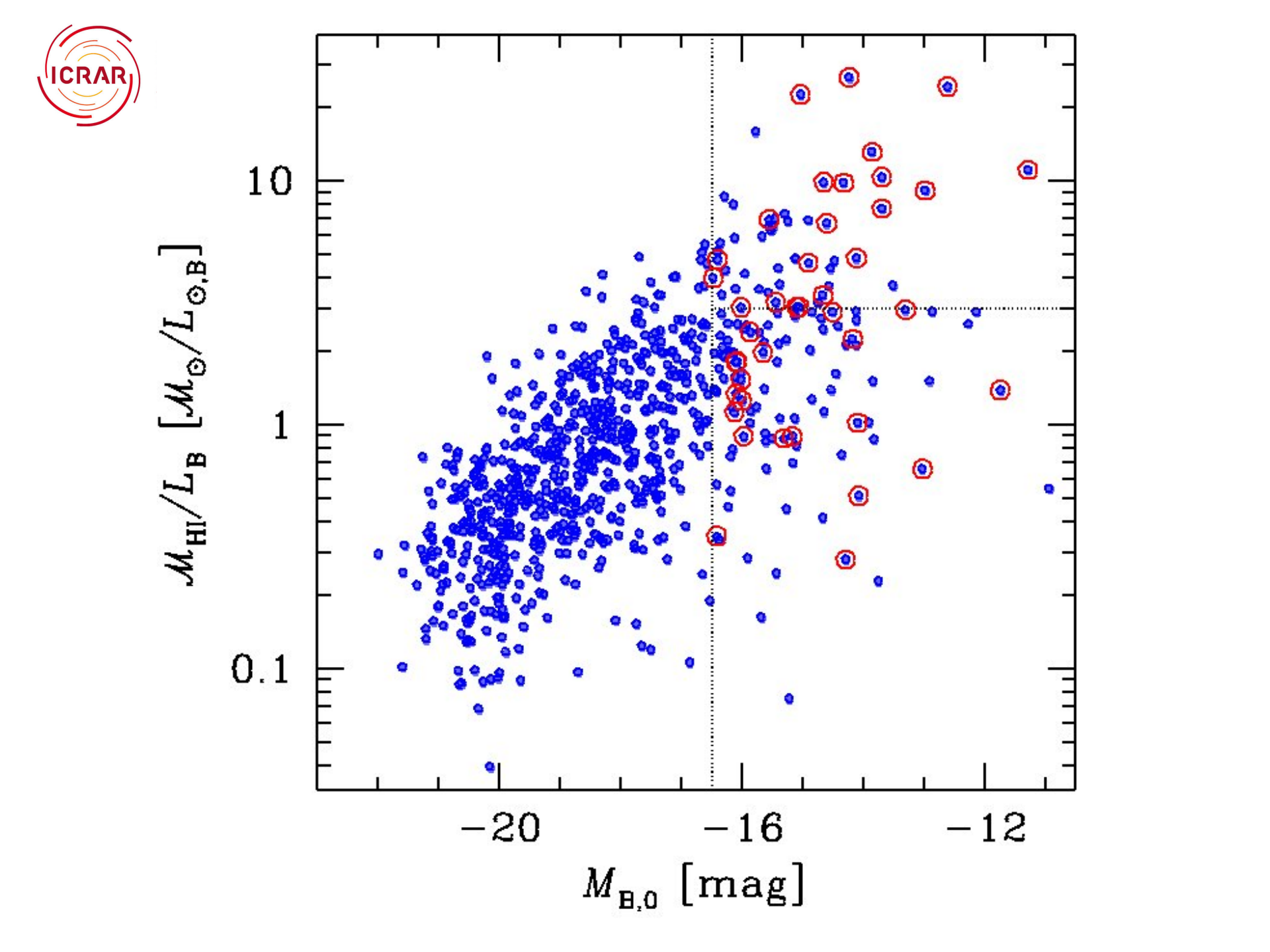
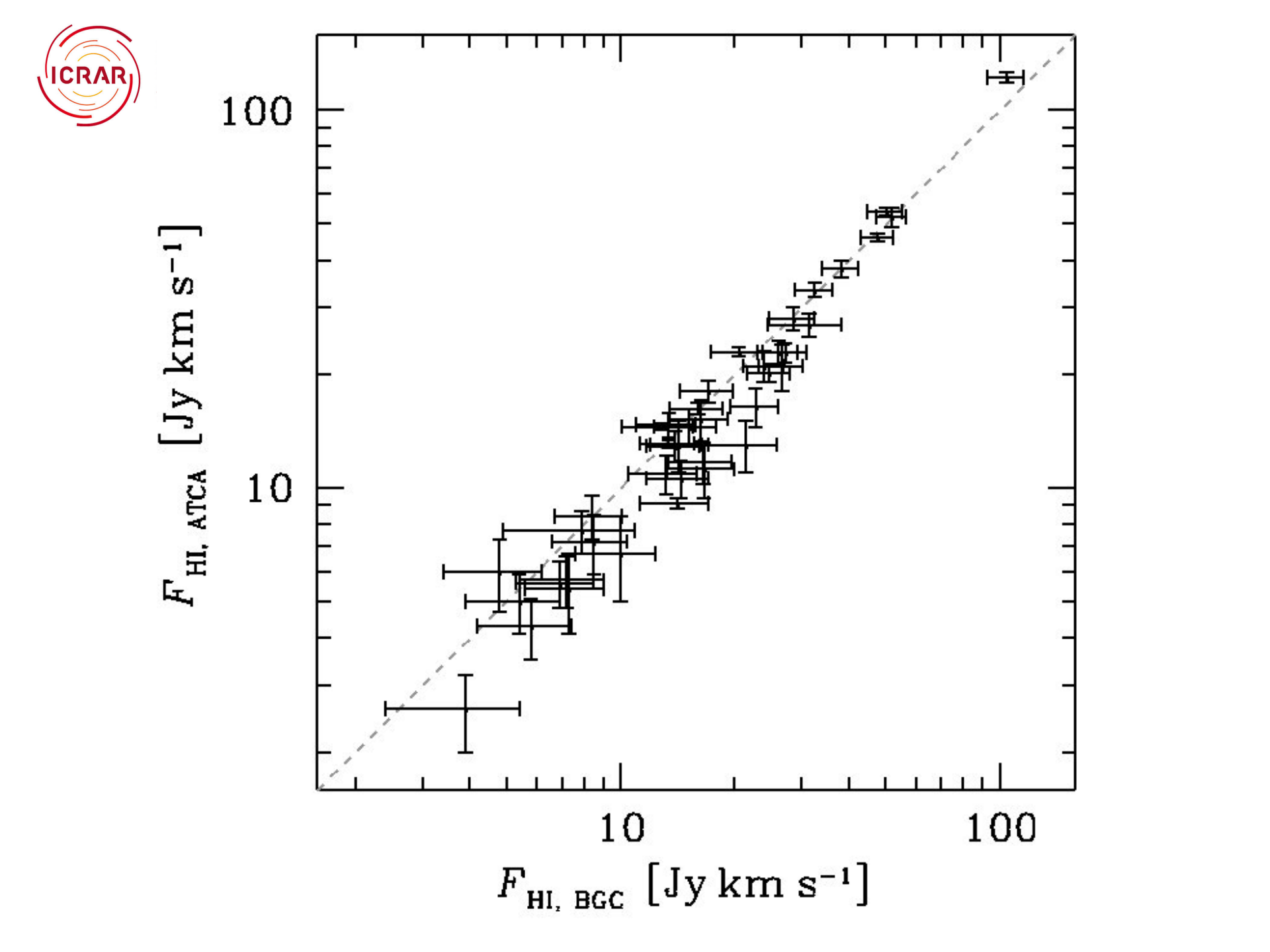
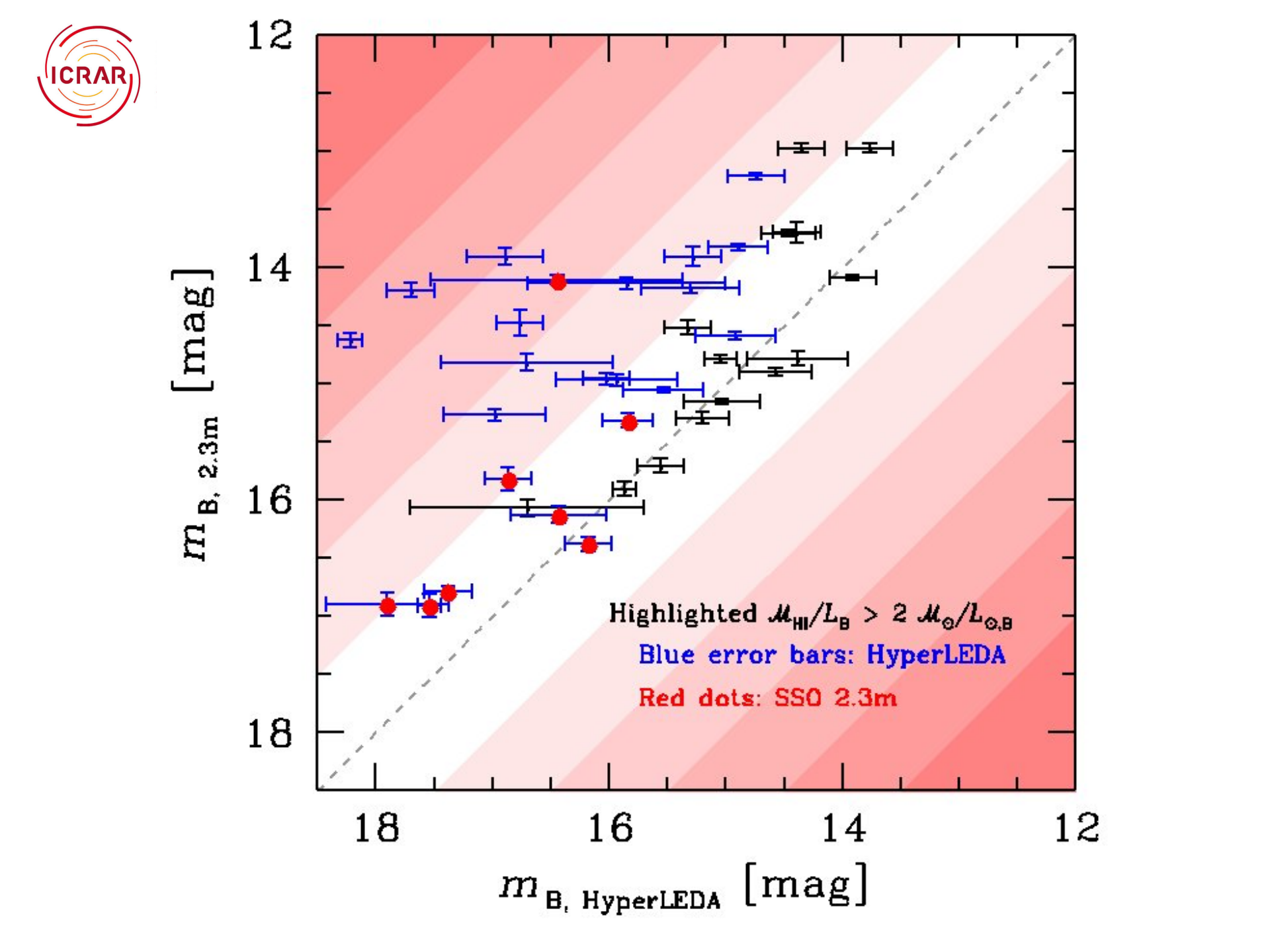
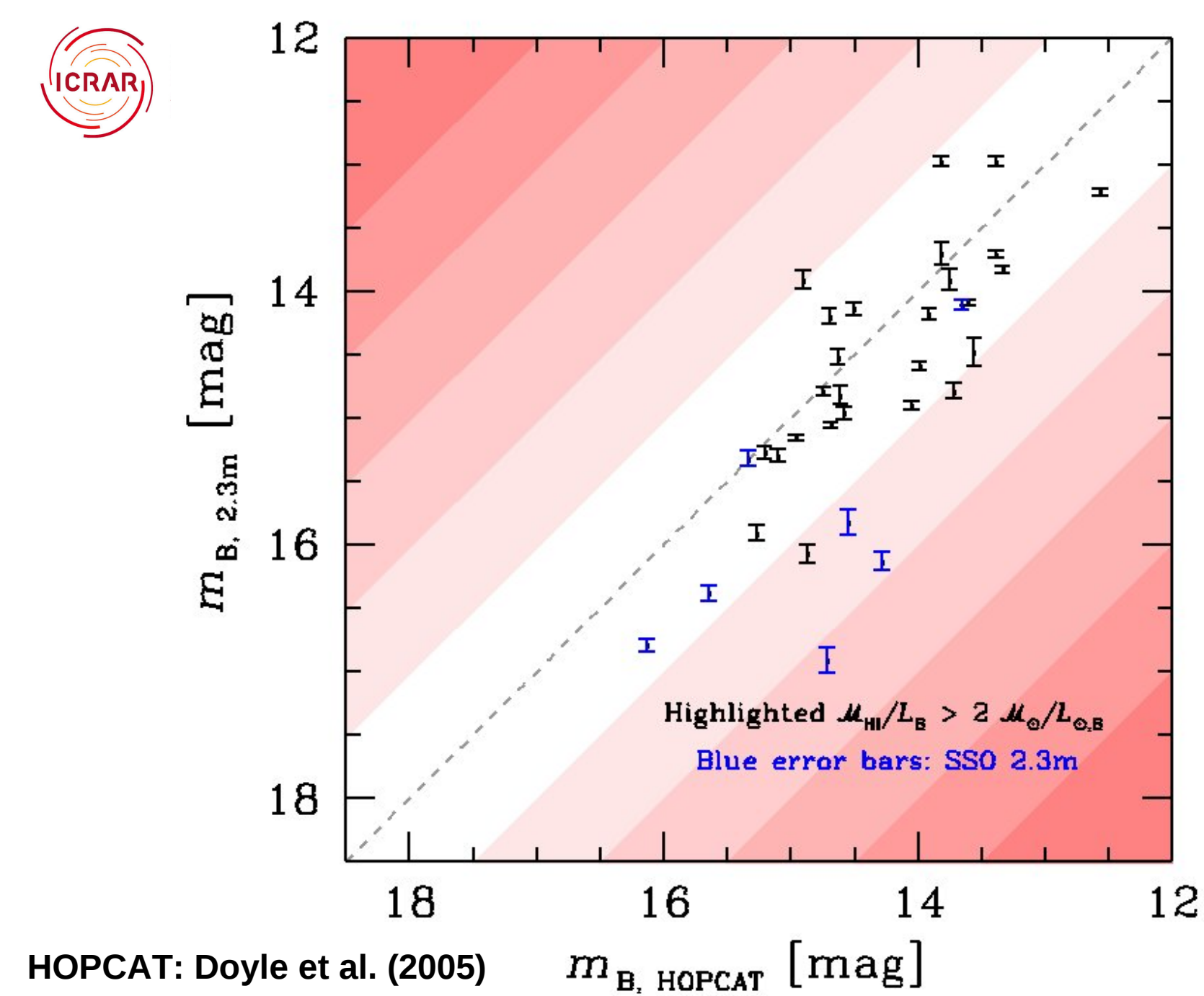
Finding More Gas-Rich Dwarfs

- The number of know high HI mass-to-light ratio dwarf galaxies is very small.
- A few dozen with $> 2\ \mathcal{M}_{\odot}/\mathrm{L}_{\odot,\mathrm{B}}$, only a handful $> 5\ \mathcal{M}_{\odot}/\mathrm{L}_{\odot,\mathrm{B}}$.
- Strong HI line emission, but hard to detect at optical wavelengths.
- How can we increase these numbers?
- Best to start with blind HI surveys and combine with available optical photometry.

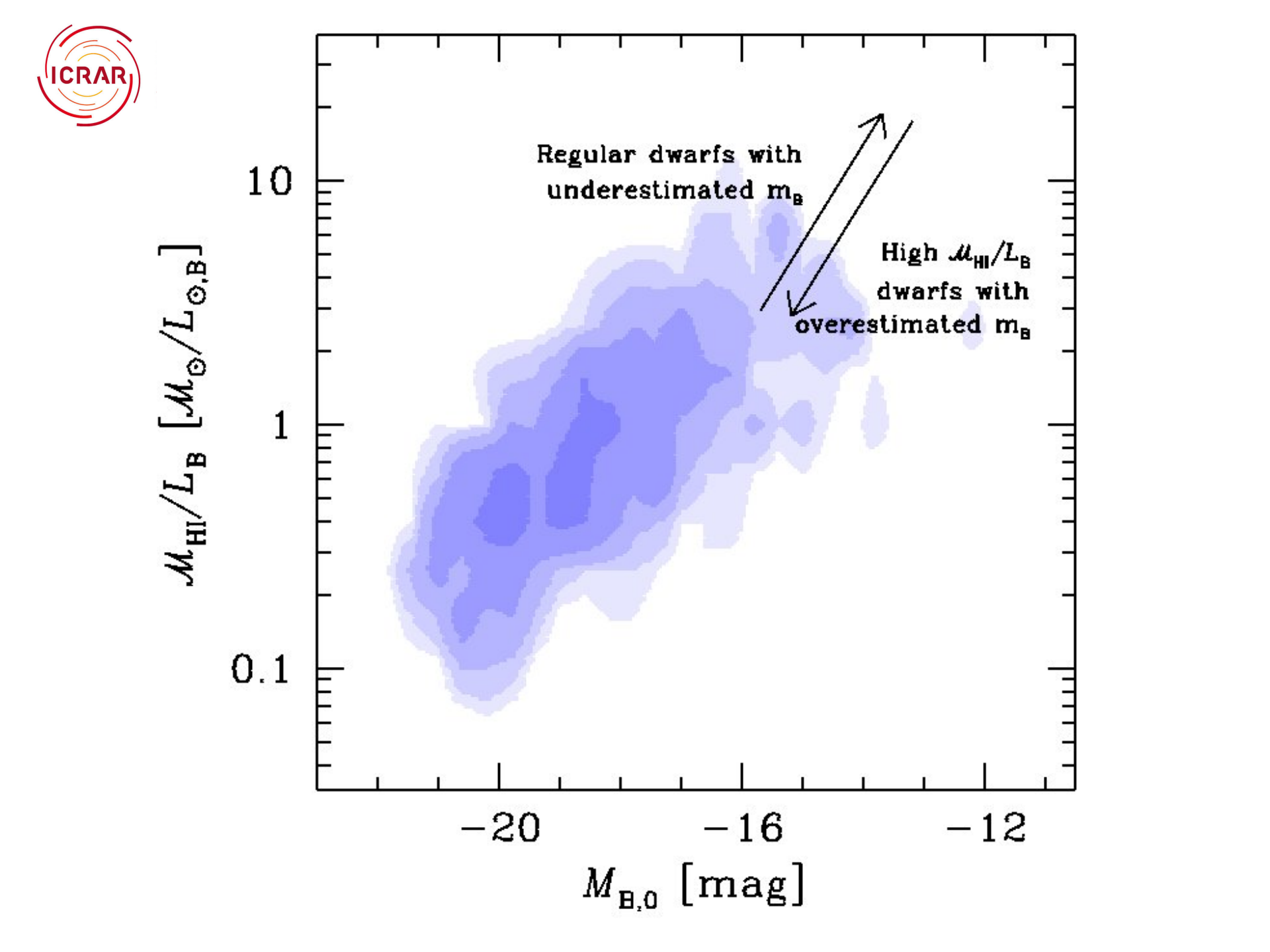

10
1
0.1
$\mathcal{M}_{\rm HI}/L_{\rm B}$ $[\mathcal{M}_\odot/L_{\odot,\rm B}]$
−20
−16
−12
$M_{\rm B,0}$ [mag]


100
10
10
100
$F_{\rm HI,\ ATCA}$ [Jy km s^{-1}]
$F_{\rm HI,\ BGC}$ [Jy km s^{-1}]


12
14
16
18
$m_{B,\ 2.3m}$ [mag]
18
16
14
12
$m_{B,\ HyperLEDA}$ [mag]
Highlighted $\mathcal{M}_{HI}/L_B > 2\ \mathcal{M}_\odot/L_{\odot,B}$
Blue error bars: HyperLEDA
Red dots: SSO 2.3m



HOPCAT: Doyle et al. (2005)


Regular dwarfs with
underestimated m_B
High $\mathcal{M}_{HI}/L_B$
dwarfs with
overestimated m_B
10
1
0.1
$\mathcal{M}_{HI}/L_B$ $[\mathcal{M}_\odot/L_{\odot,B}]$
−20
−16
−12
$M_{B,0}$ [mag]

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HIPASS and other existing surveys

- More of these galaxies may have been detected in HIPASS but gone unnoticed.
- Several galaxies may have wrong magnitudes.
- HIPASS sources with no know optical counterpart (or one that has not been imaged).
- We need to have good optical follow-up dwarf galaxies, preferably more than just B band.
- Can Skymapper give us the the accurate magnitudes we need?

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MeerKAT and WALLABY

- MeerKAT will be crucial for following-up know gas-rich dwarfs.
- Source confirmation, velocity fields, full extent of HI discs.

- WALLABY will likely detect many more of these galaxies.
- But unless we have good optical follow-up they will go unnoticed in the catalogues.


Thank You