Direct Oxygen Abundances for the Lowest Luminosity LVL Galaxies

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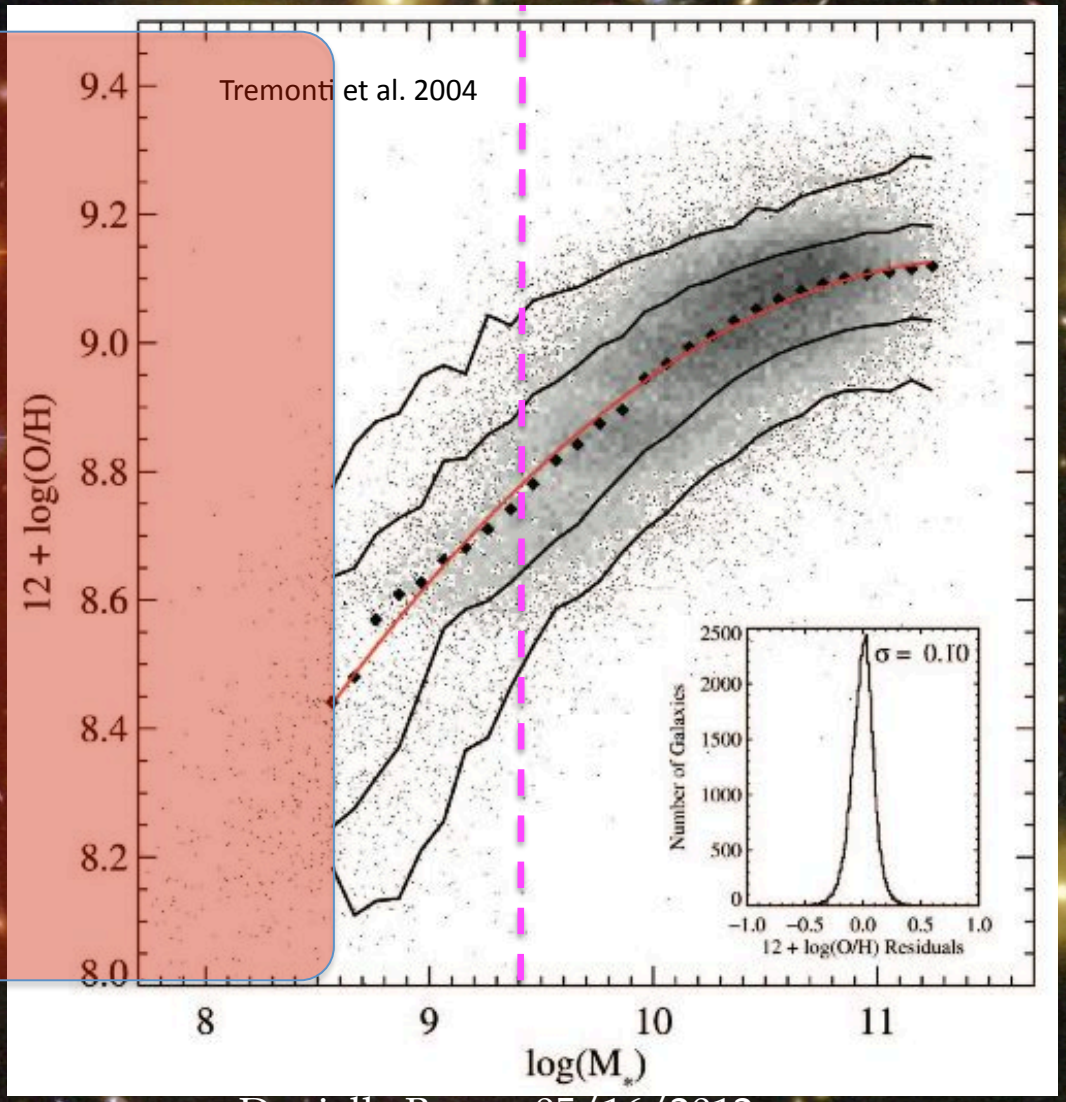
Mapping Oxygen in the Universe

Why We Care: M-Z Relationship
Method
Results
Conclusions

Current State
Low Mass



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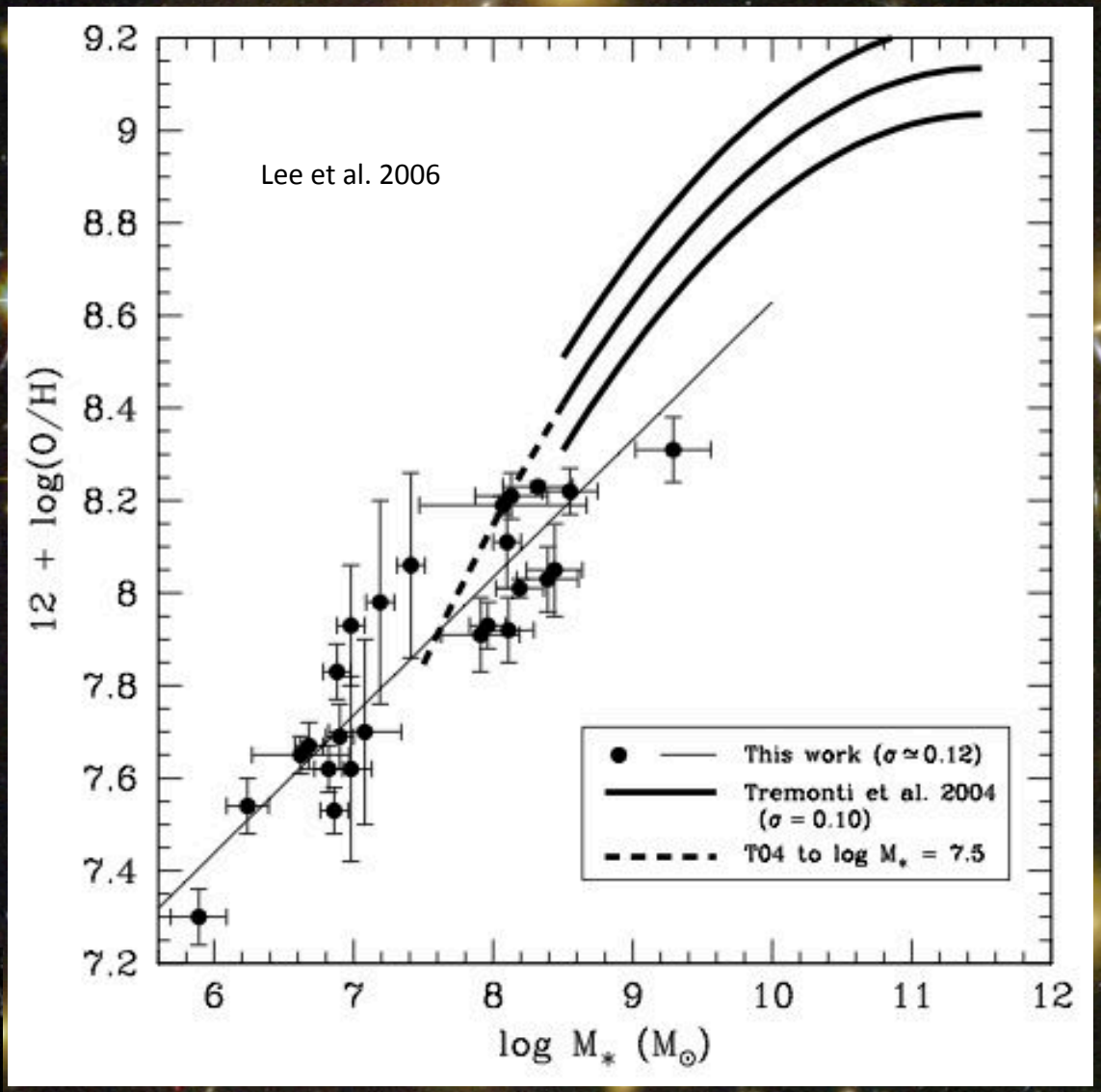
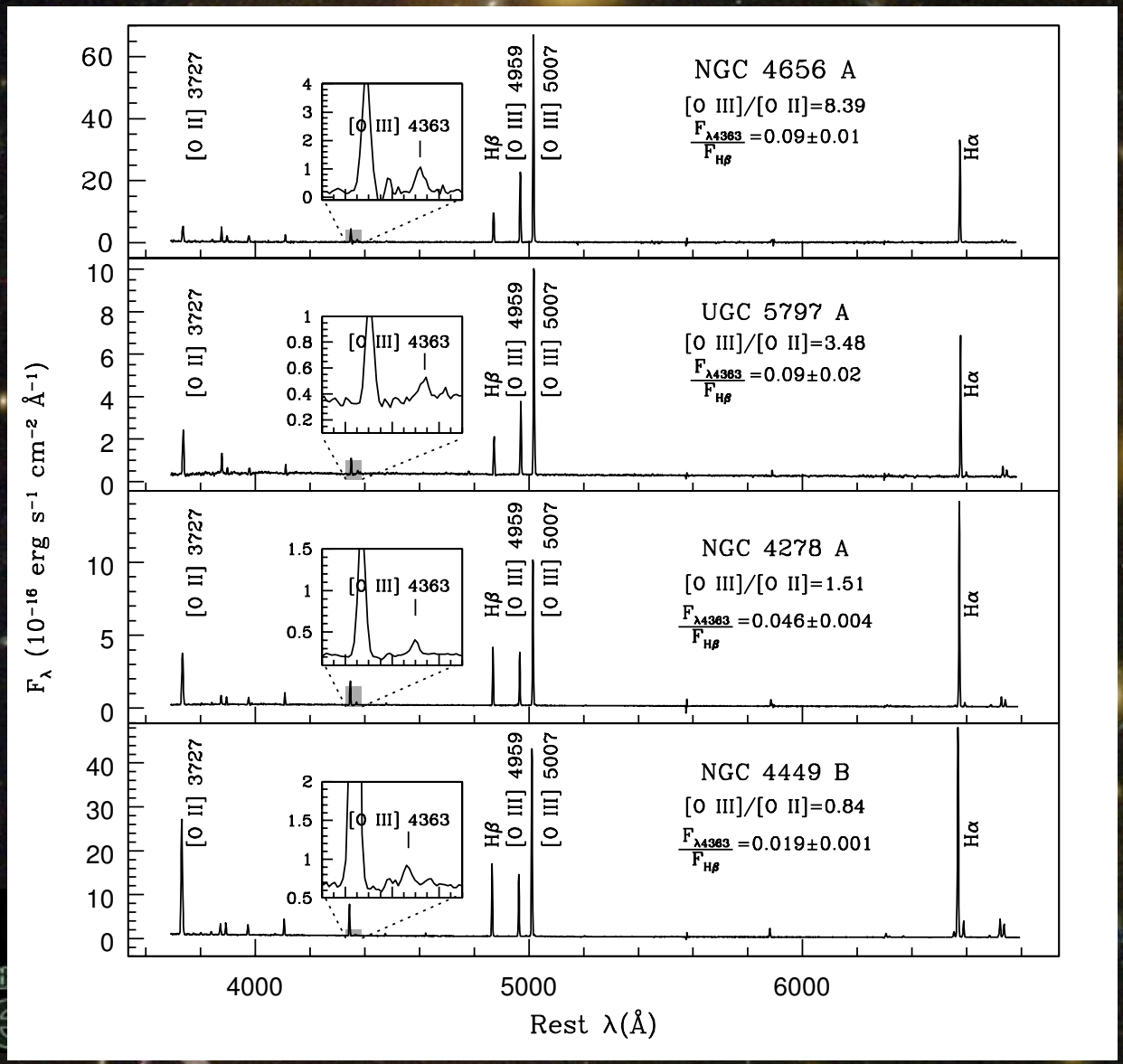


Mapping Oxygen in the Universe

- 258 galaxies in the nearest 11 Mpc:
  - IRAC and MIPS IR imaging for the complete sample

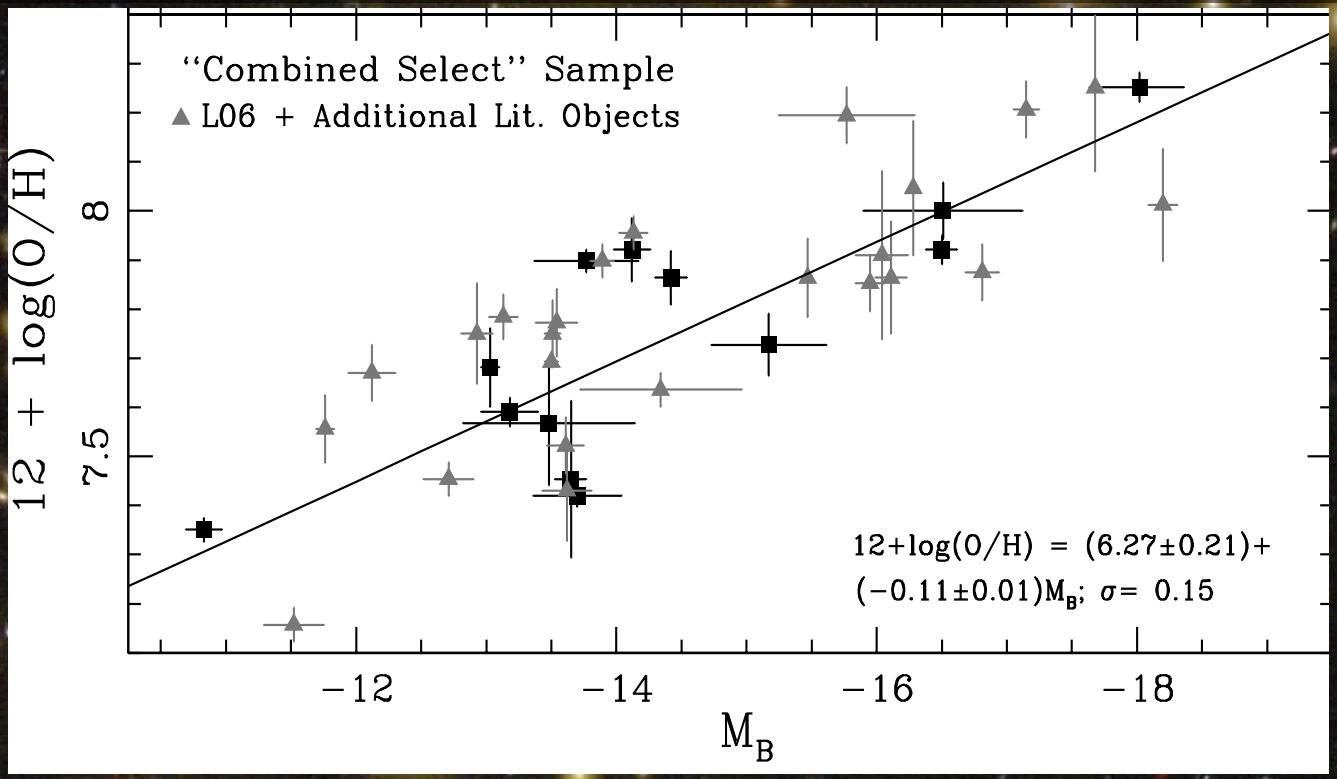
- Recent Local Volume galaxy surveys:
  - narrowband Hα (Kennicutt et al. 2008)
  - *GALEX* ultraviolet (Lee et al. 2011)
  - *HST* resolved stellar population imaging (Dalcanton et al. 2009)

- Sample of 42 galaxies:
  - $2.5 \leq D \leq 14.0$ Mpc
  - $-21.7 \leq M[4.5] \leq -13.1$
  - $-18.8 \leq MB \leq -10.7$
  - Low luminosity spirals and dwarf irregulars


NGC 4656 A
[O III]/[O II]=8.39
$\frac{F_{\lambda 4363}}{F_{H\beta}}$ =0.09±0.01
UGC 5797 A
[O III]/[O II]=3.48
$\frac{F_{\lambda 4363}}{F_{H\beta}}$ =0.09±0.02
NGC 4278 A
[O III]/[O II]=1.51
$\frac{F_{\lambda 4363}}{F_{H\beta}}$ =0.046±0.004
NGC 4449 B
[O III]/[O II]=0.84
$\frac{F_{\lambda 4363}}{F_{H\beta}}$ =0.019±0.001
[O II] 3727
[O III] 4363
Hβ
[O III] 4959
[O III] 5007
Hα
F_λ (10^{-16} erg s^{-1} cm^{-2} Å^{-1})
Rest λ(Å)
4000
5000
6000

- "Select" = [O III] λ4363 > 4σ
  + Secure distance (TRGB or Ceph)

- 13 of 31 objects with "direct" abundances
- 14 updated objects from Lee et al. 2006
- 11 objects from van Zee & Haynes 2006 and Marble et al. 2010



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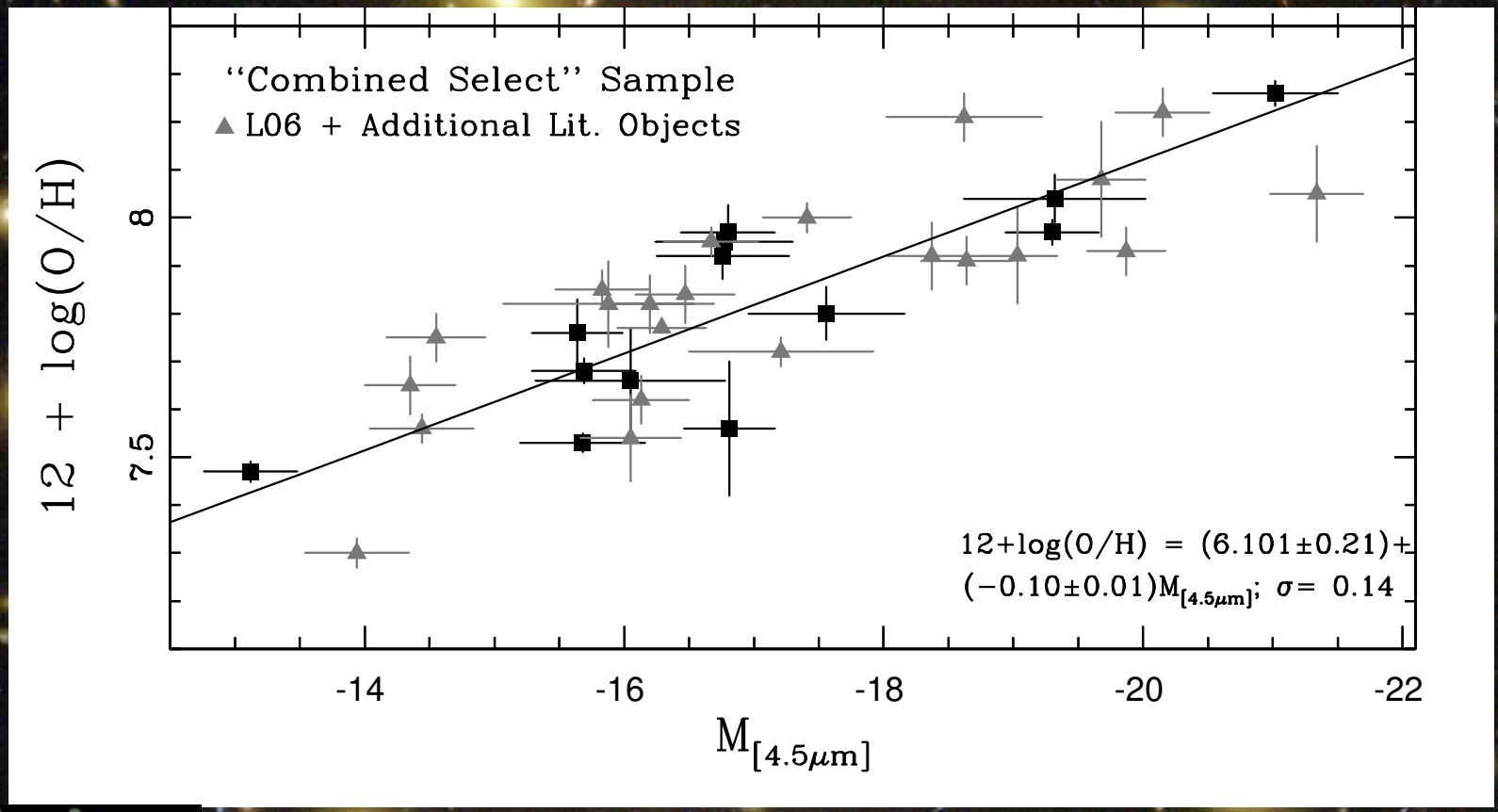

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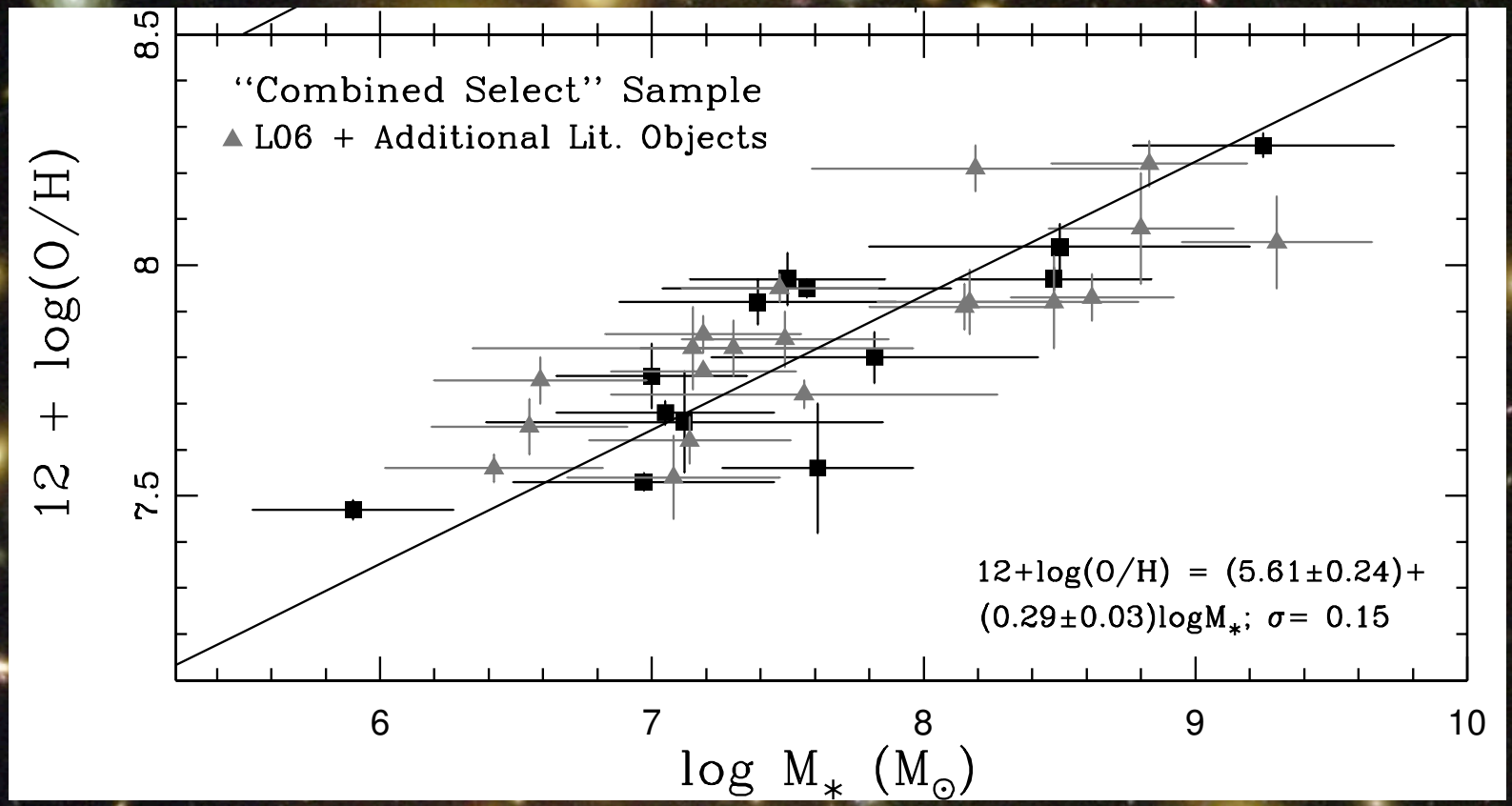
Danielle Berg 05/16/2012



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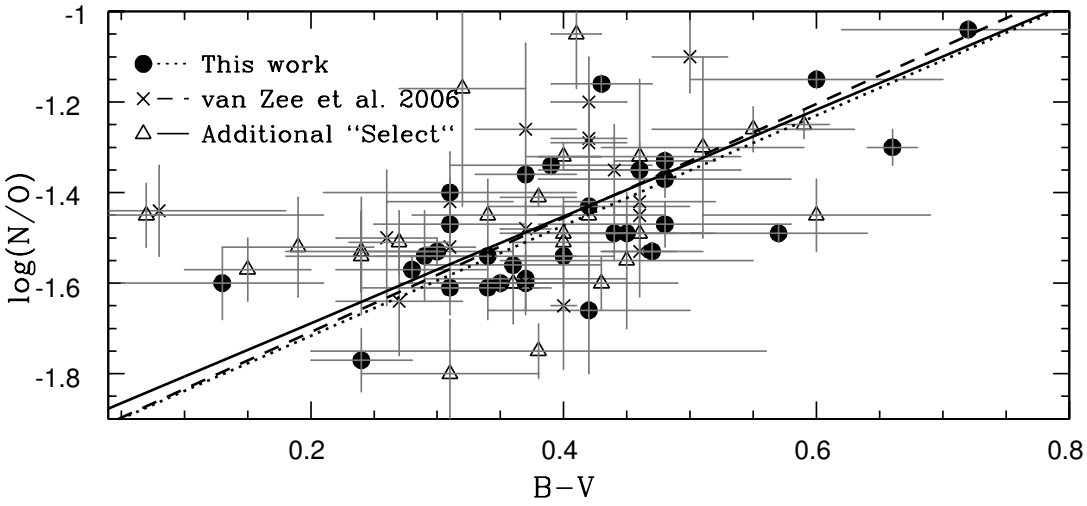
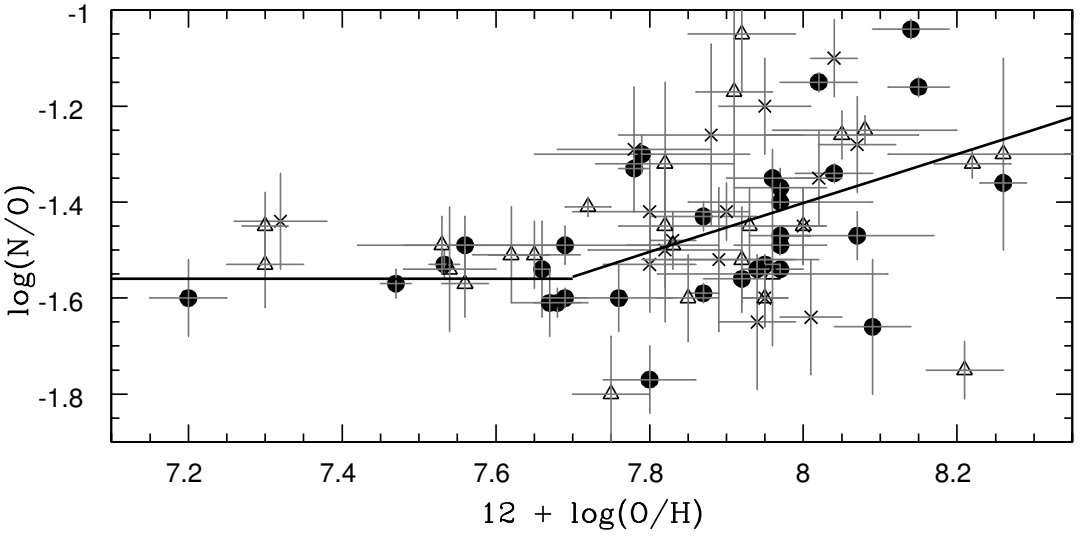
Positive correlation for
0.05 < B-V < 0.75

Constant N/O common for dwarf star-forming galaxies
→Not just those undergoing a current burst

Definitive explanation for plateau not yet resolved





Mapping Oxygen in the Universe

- Our new measurements allowed us to better characterize the L-Z and M-Z relationships, which suffer from small number statistics in the low luminosity regime.

- In creating a "Combined Select" sample of objects that have both reliable "direct" oxygen abundance determinations and distances (TRGB or ceph), both the L-Z and M-Z relationships agree well with previous relations defined at low luminosities.

- Our findings confirm that the near-IR relation has lower scatter than in the optical.
  - But to a smaller degree suggesting that AGB stars do not play a large role.

- The dispersions found suggest that, given a reliable distance measurement and appropriate photometry, either luminosity or mass may be used to estimate metallicity of a low-luminosity dwarf with just as much confidence.

- In agreement with previous studies, we find a positive correlation between N/O ratio and B-V color. As found in observations of blue compact galaxies, there are no objects with high N/O ratio below 12+log(O/H)=7.7.


Mapping
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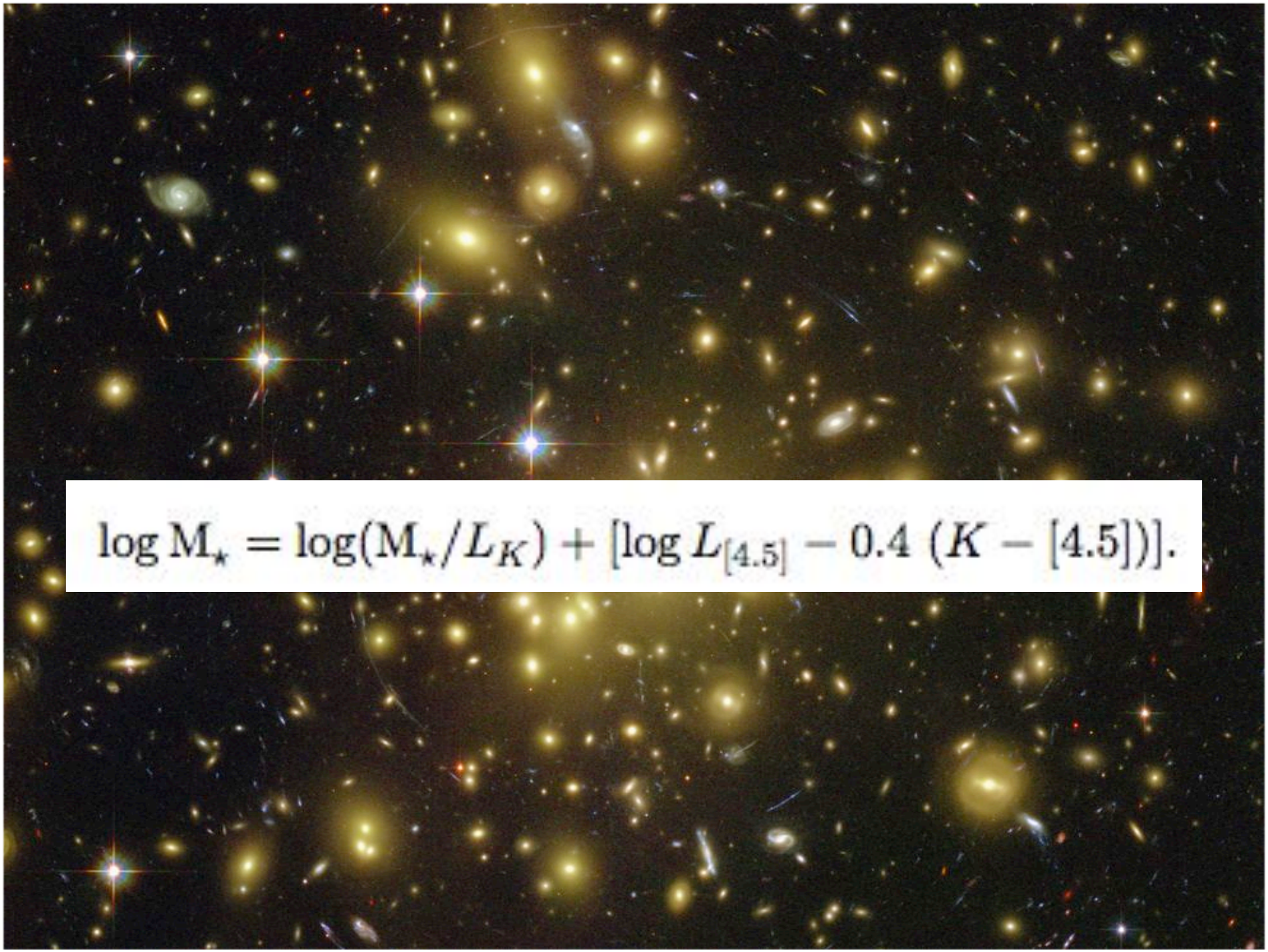
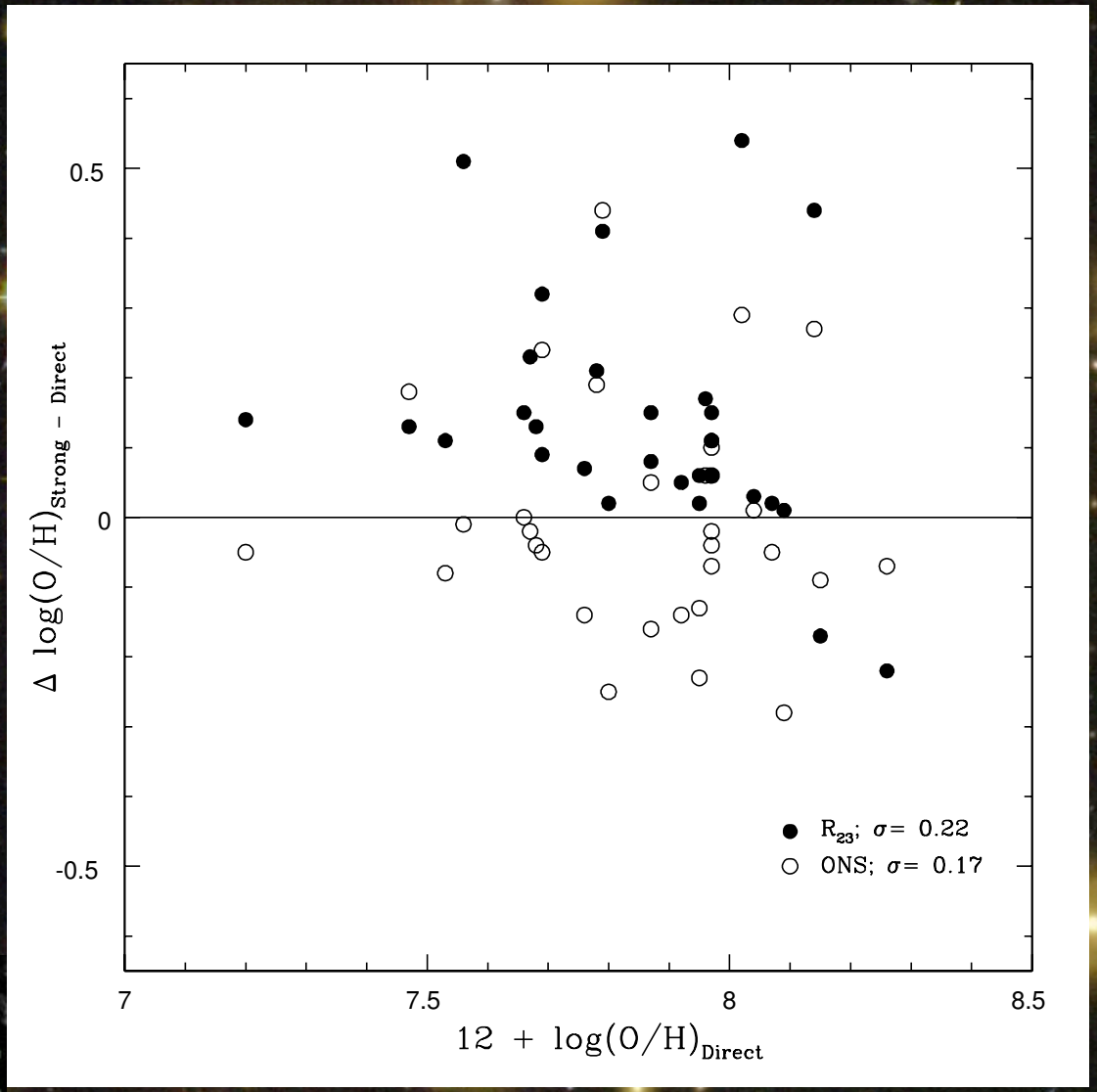
Universe



$$\log \mathrm{M}_\star = \log(\mathrm{M}_\star / L_K) + [\log L_{[4.5]} - 0.4\ (K - [4.5])].$$

Results: Strong vs. Direct Abundances



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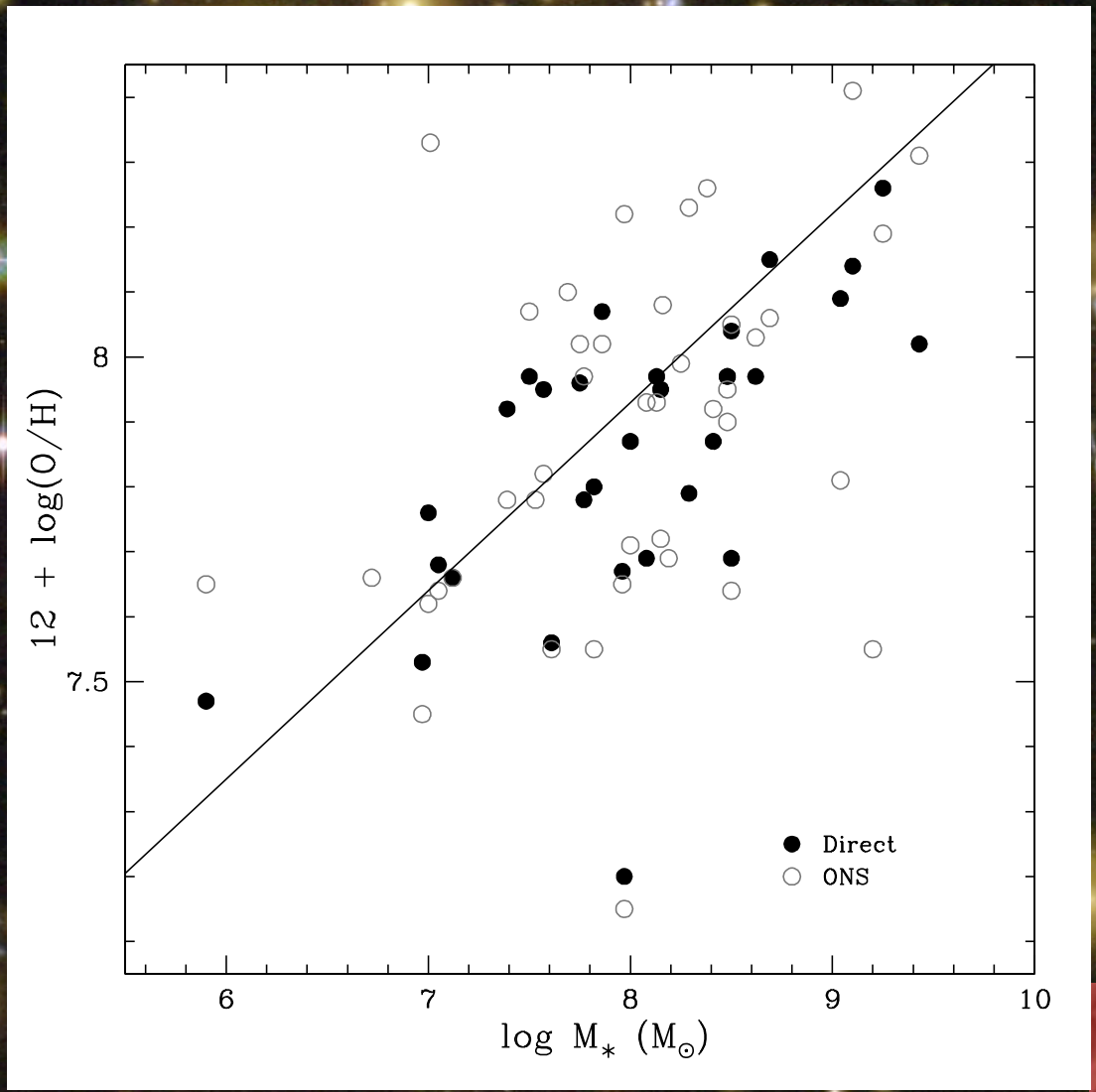
Results: Strong vs. Direct Abundances



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