Star Formation in Dwarf Galaxies
Flagstaff, June 19-22, 2012

The Dust-to-Gas Ratio in Dwarf Galaxies

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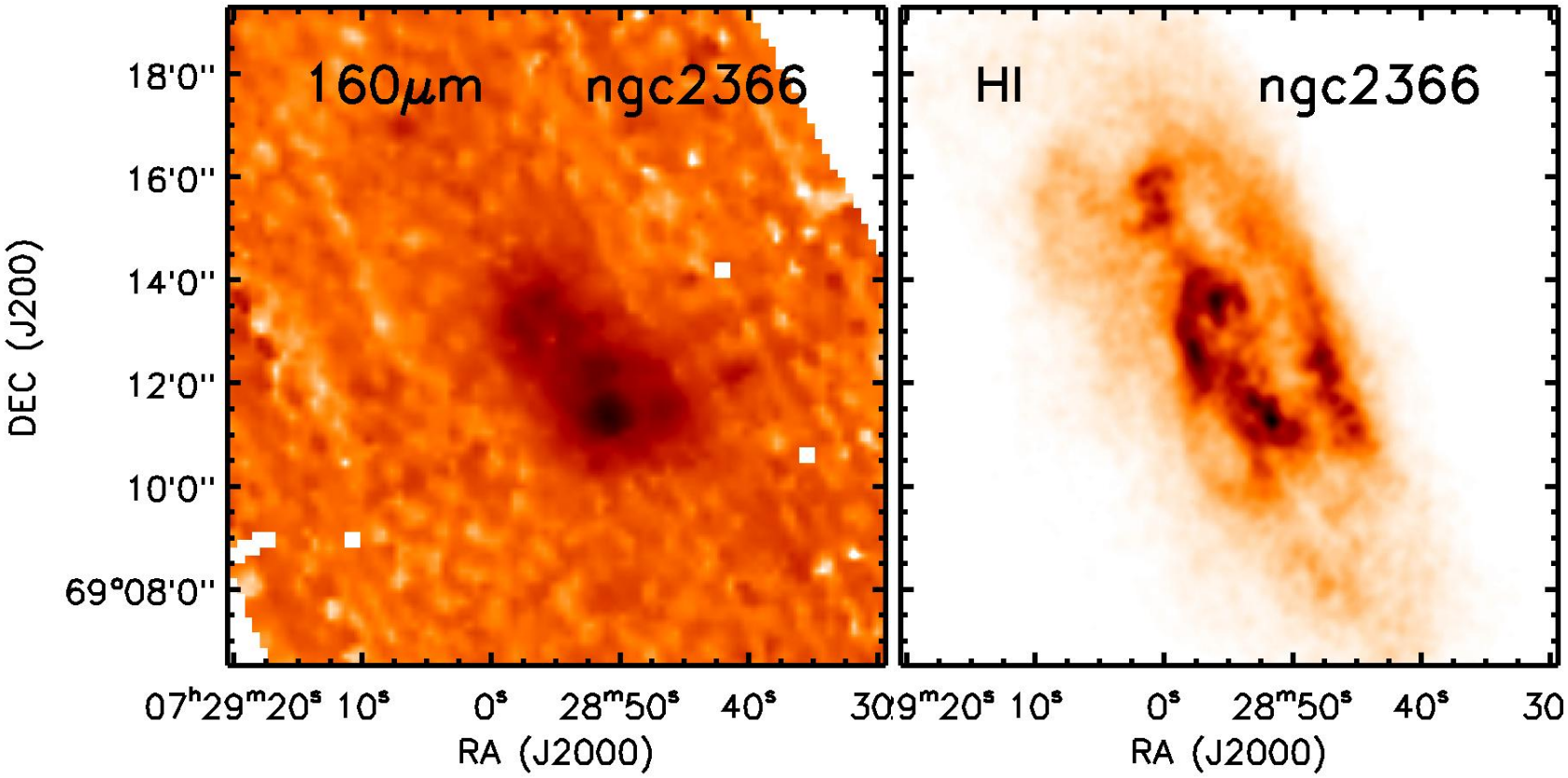
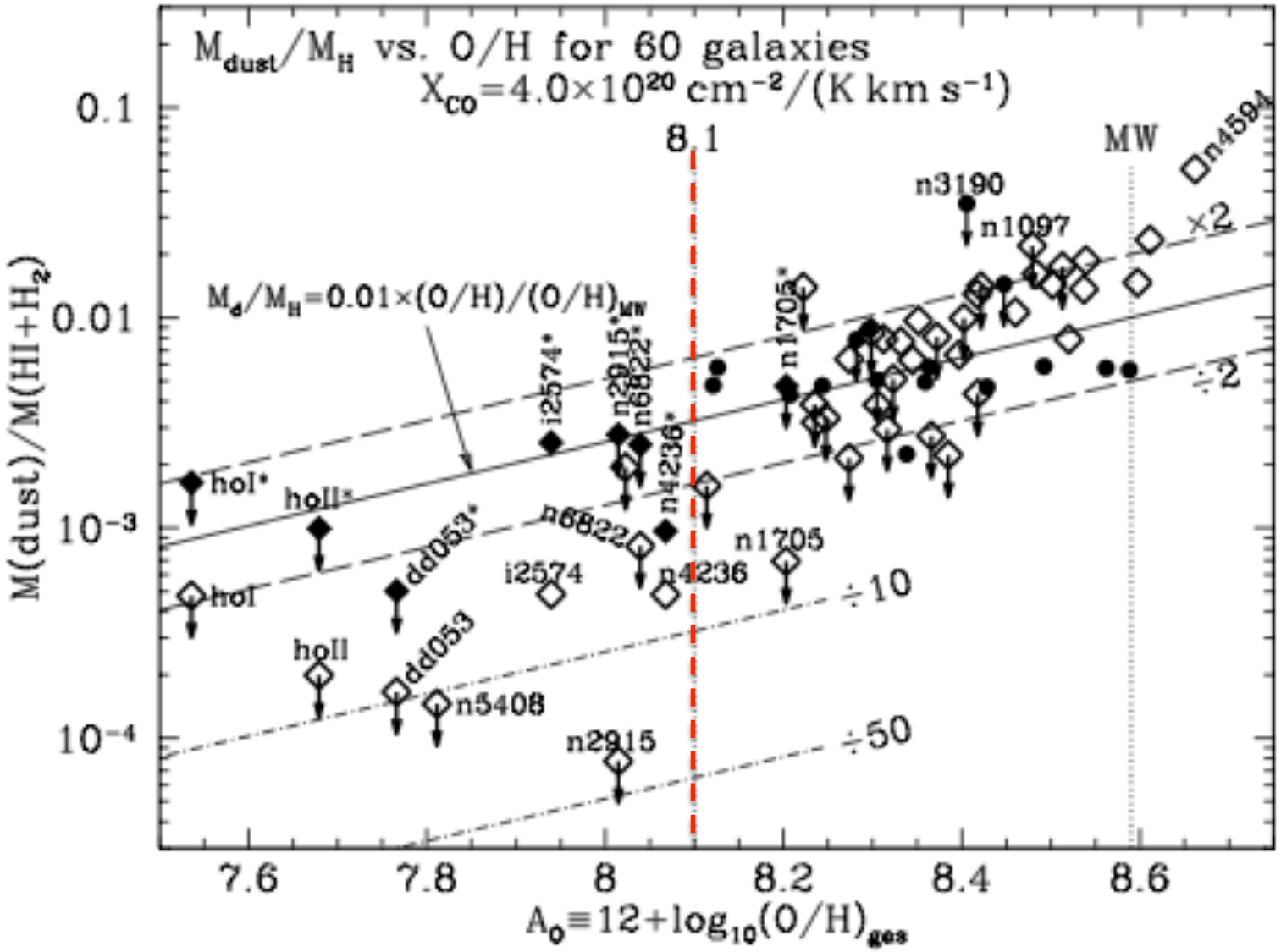
LITTLE THINGS, THINGS & VLA-ANGST teams

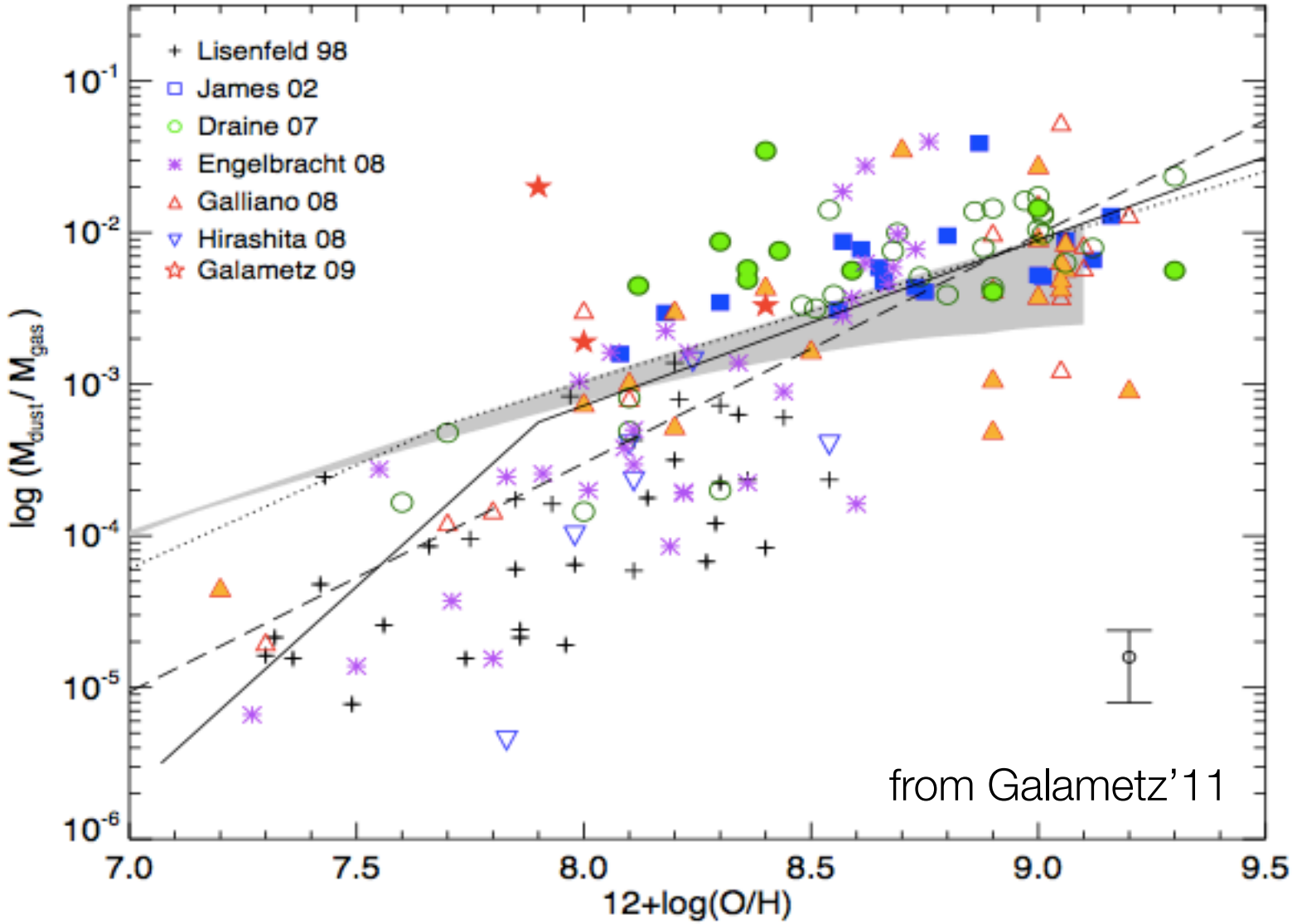
Dust in Galaxies



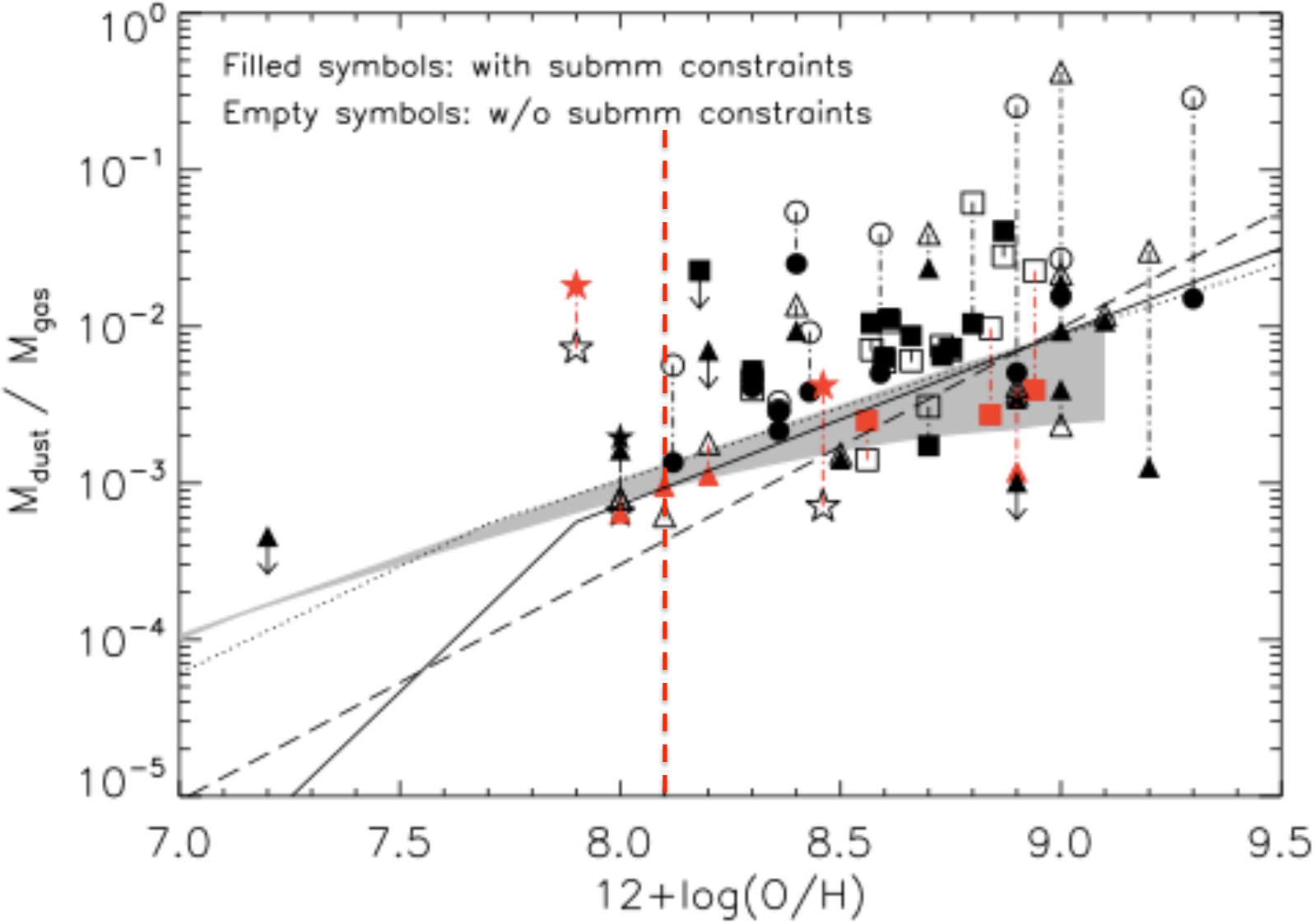
Draine'07


M_{dust}/M_H vs. O/H for 60 galaxies
$X_{CO}=4.0\times10^{20}$ cm^{-2}/(K km s^{-1})
$M_d/M_H=0.01\times(O/H)/(O/H)_{MW}$
8.1
MW
n4594
n3190
n1097
n1705*
i2574*
n2915*
n6822*
n4236*
hoI*
hoII*
dd053*
n6822
n1705
i2574
n4236
hoI
hoII
dd053
n5408
n2915
×2
÷2
÷10
÷50
0.1
0.01
10^{-3}
10^{-4}
M(dust)/M(HI+H_2)
7.6
7.8
8
8.2
8.4
8.6
$A_O\equiv12+\log_{10}(O/H)_{gas}$

Dust-to-Gas Ratio from Literature



Galametz'11


Filled symbols: with submm constraints
Empty symbols: w/o submm constraints
M_{dust} / M_{gas}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
7.0
7.5
8.0
8.5
9.0
9.5
12+log(O/H)

Simplest Dust Model

- single-temperature modified black body
  - only two free parameters (T_{Dust} and intensity)
  - use Spitzer 70 & 160μm data
  - fix emissivity index $\beta = 1.5$ and dust absorption coefficient to XXX
  - cannot constrain dust with $T_{Dust} < 15$ K
  - potential to underestimate dust mass by factor ~2-4 as compared to Draine'07 using Spitzer & Herschel & submm data

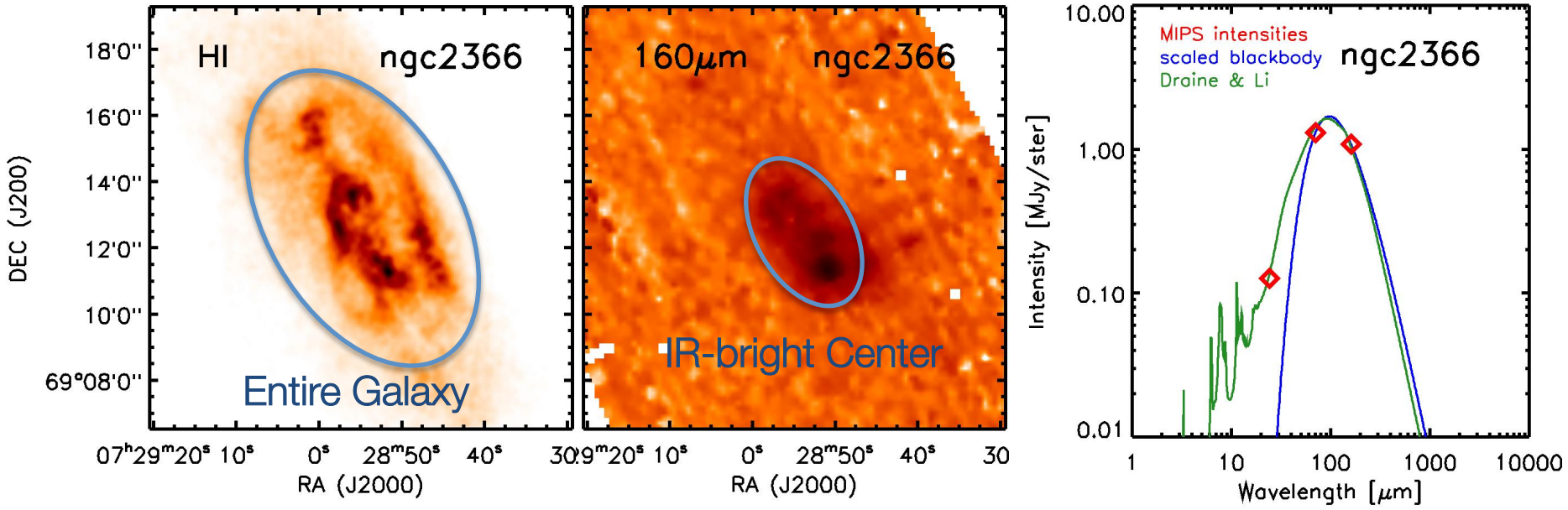
Our Data

- HI: from VLA surveys LITTLE THINGS, ANGST, and THINGS
- IR: from Spitzer surveys SINGS and LVL; large map coverage; background variations
- Metallicities: various methods (T_e or strong line) and sources using empirical PT05 calibration
- FUV: from Galex NGS and Little Things team

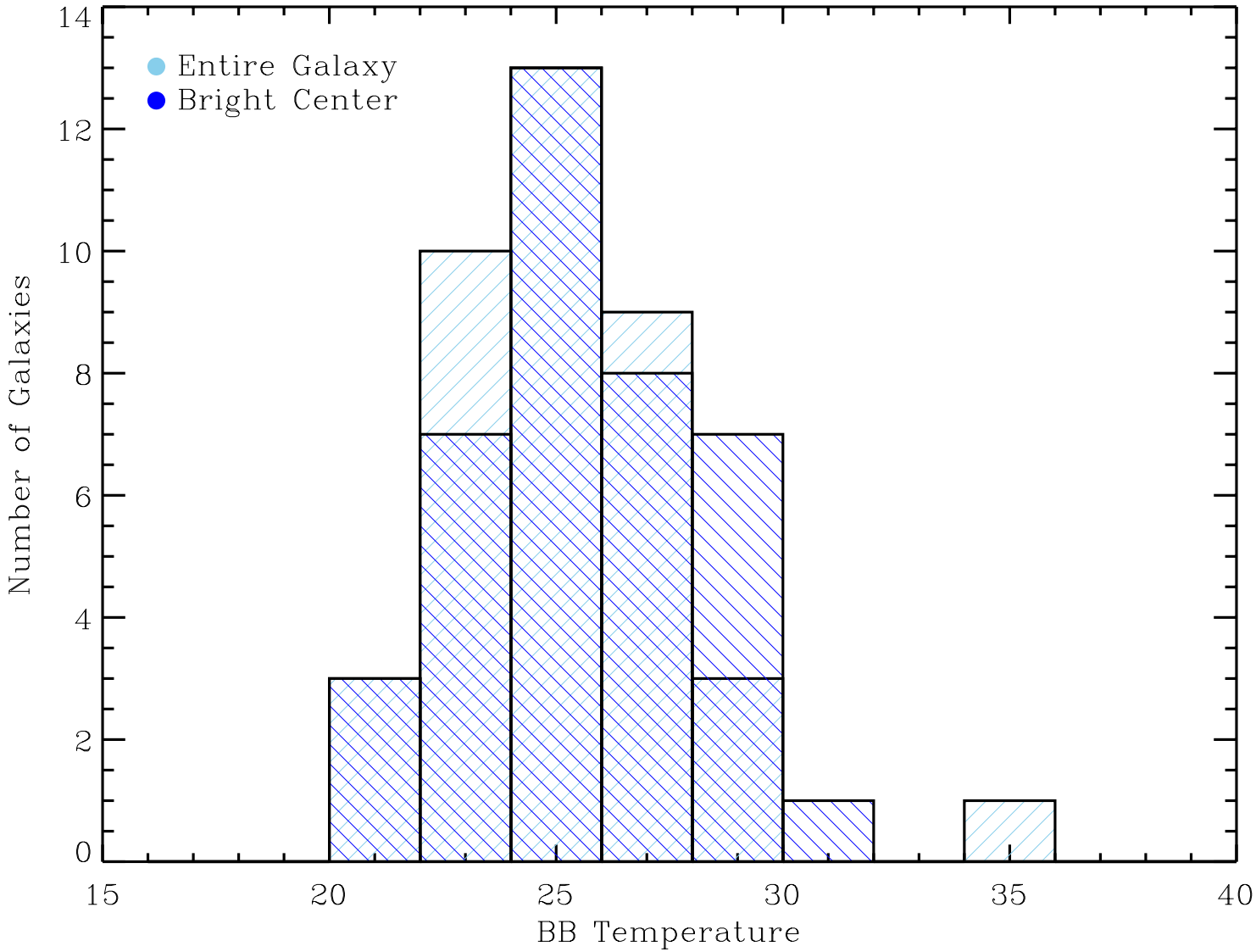
⇒ sufficient IR signal in 40 (of ~60) dwarf galaxies we have HI data on

Our Analysis

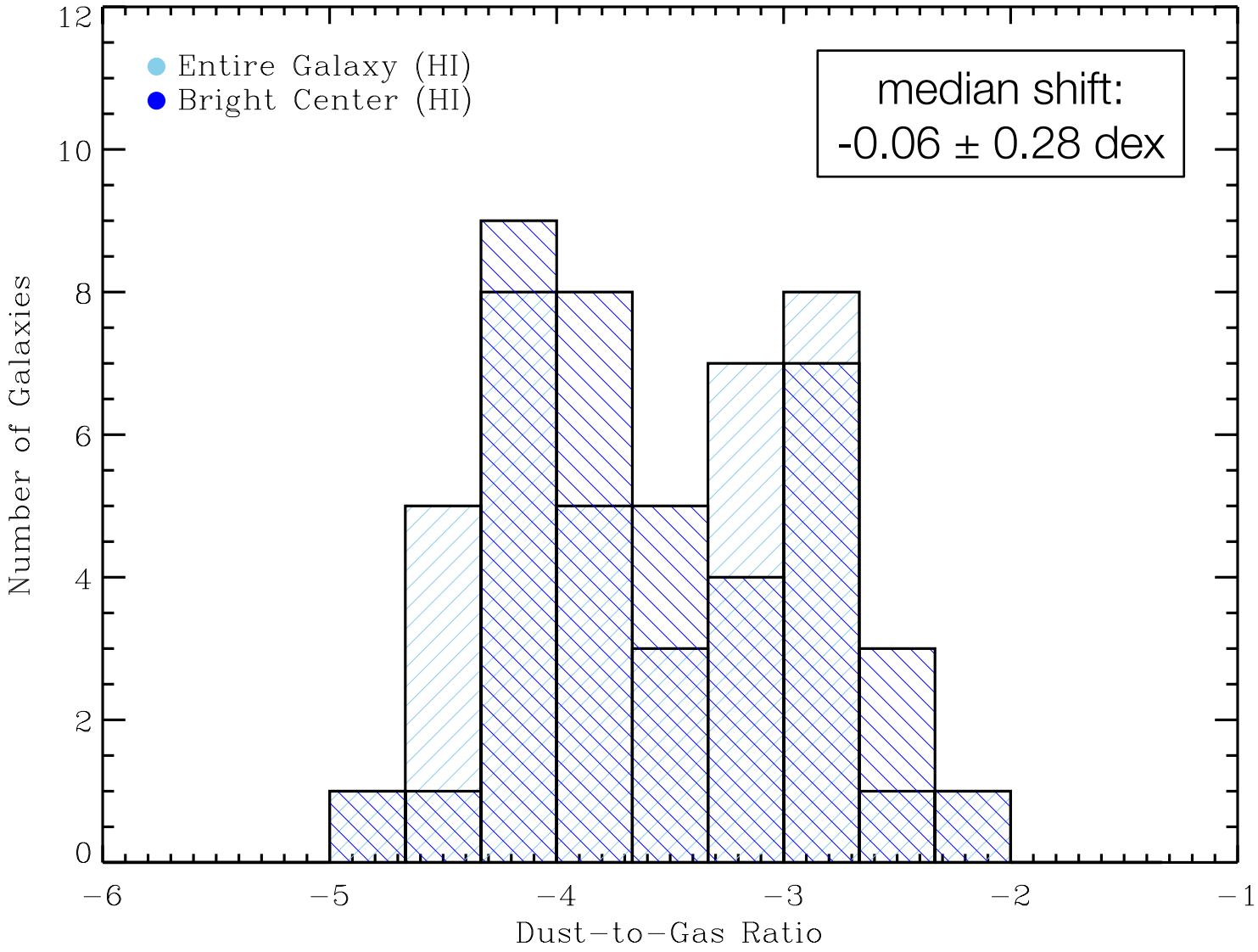
- divide galaxies into two regions: entire / center
- average data and Monte-Carlo uncertainties
- fit mod black body and propagate uncertainties



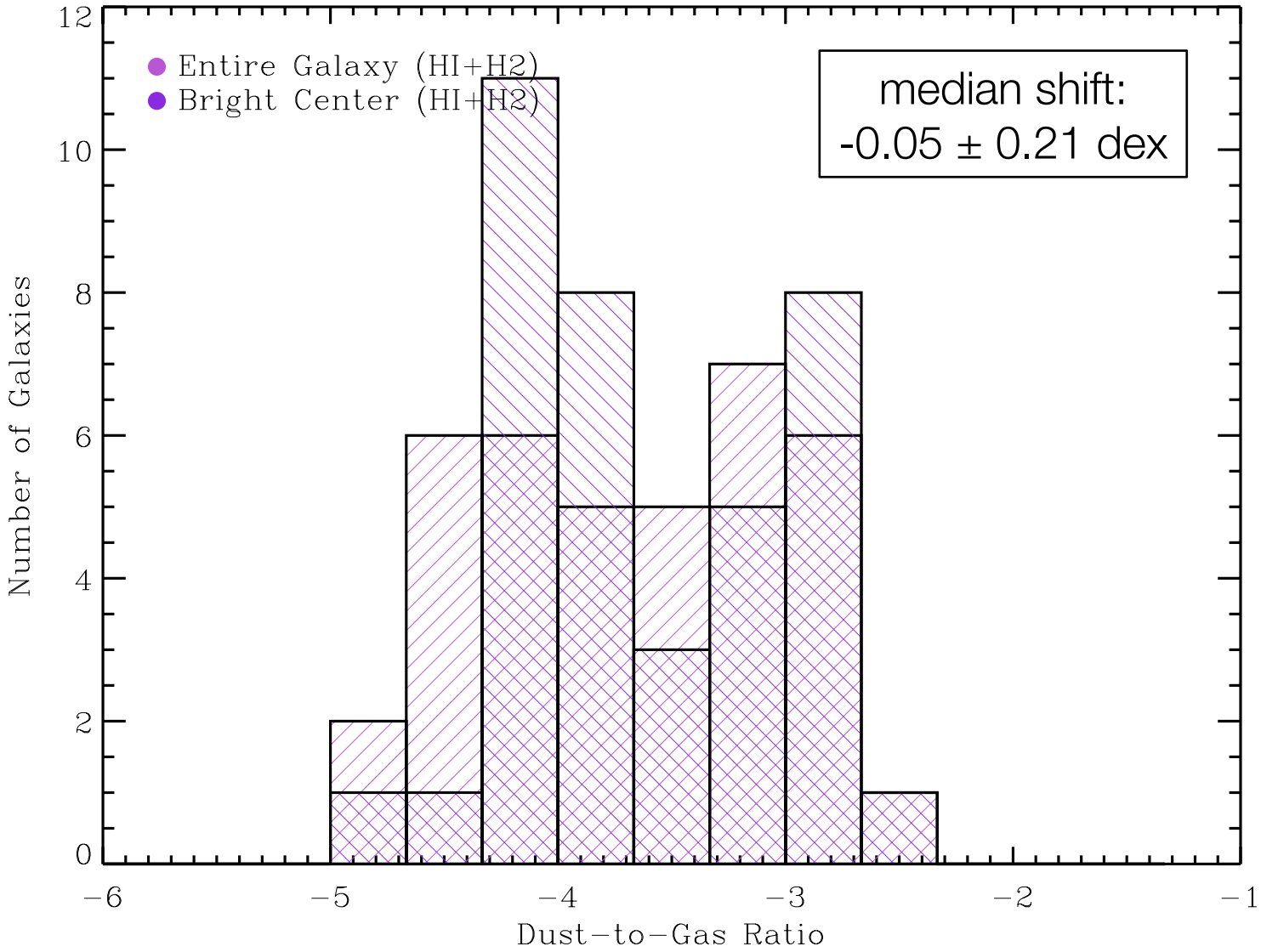
BB Temperatures



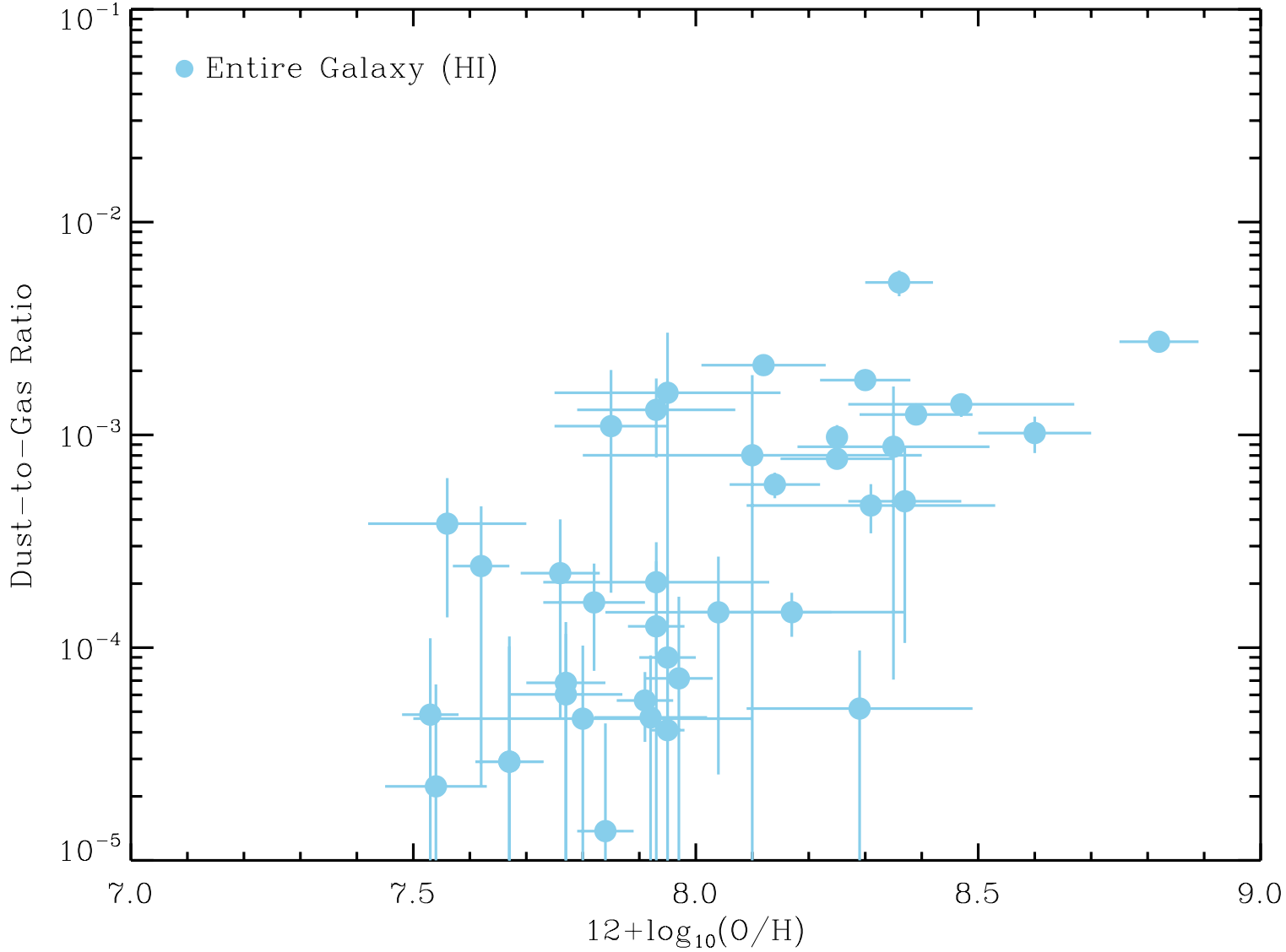
Dust-to-Gas Ratios



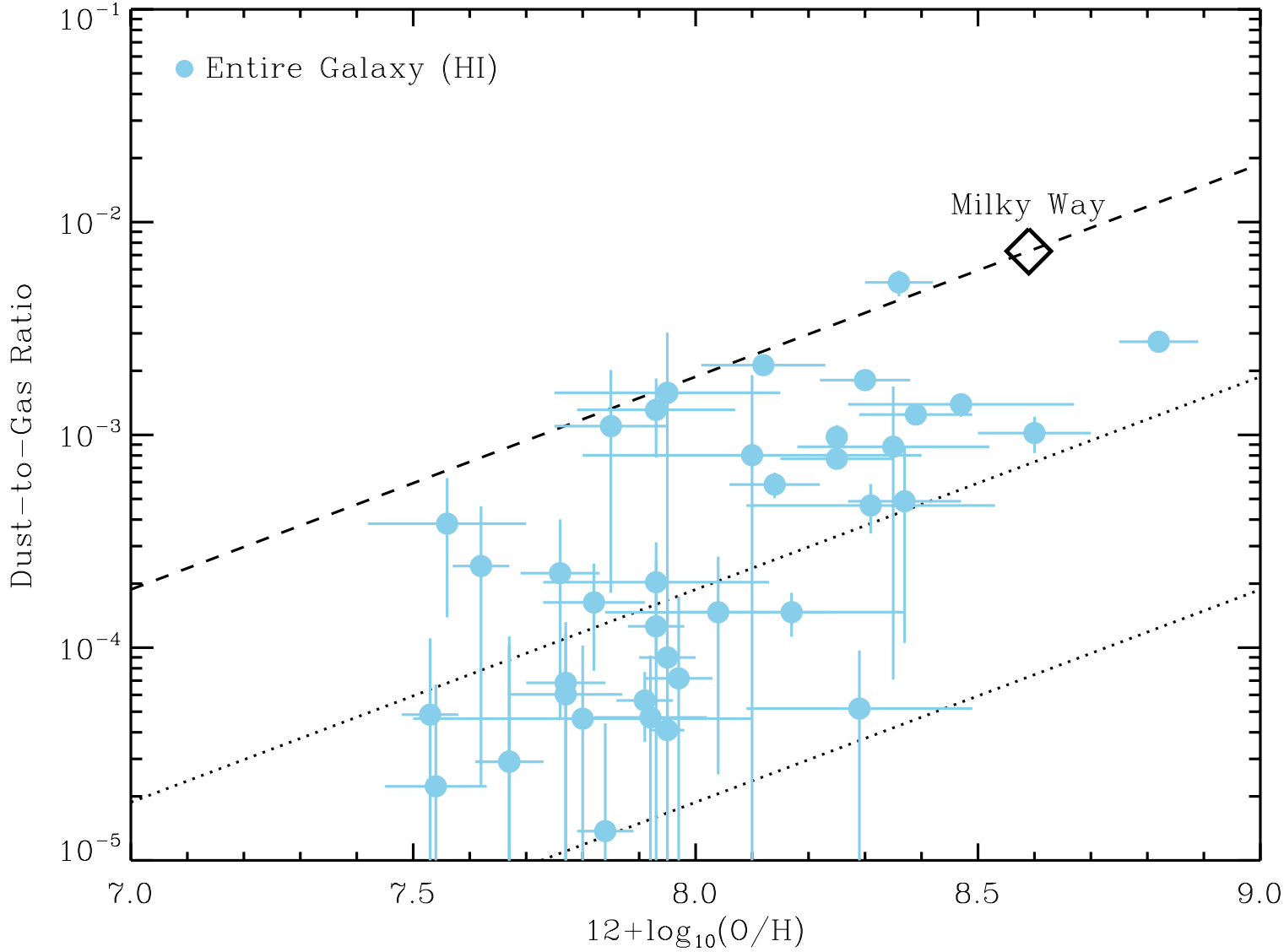
Dust-to-Gas Ratios



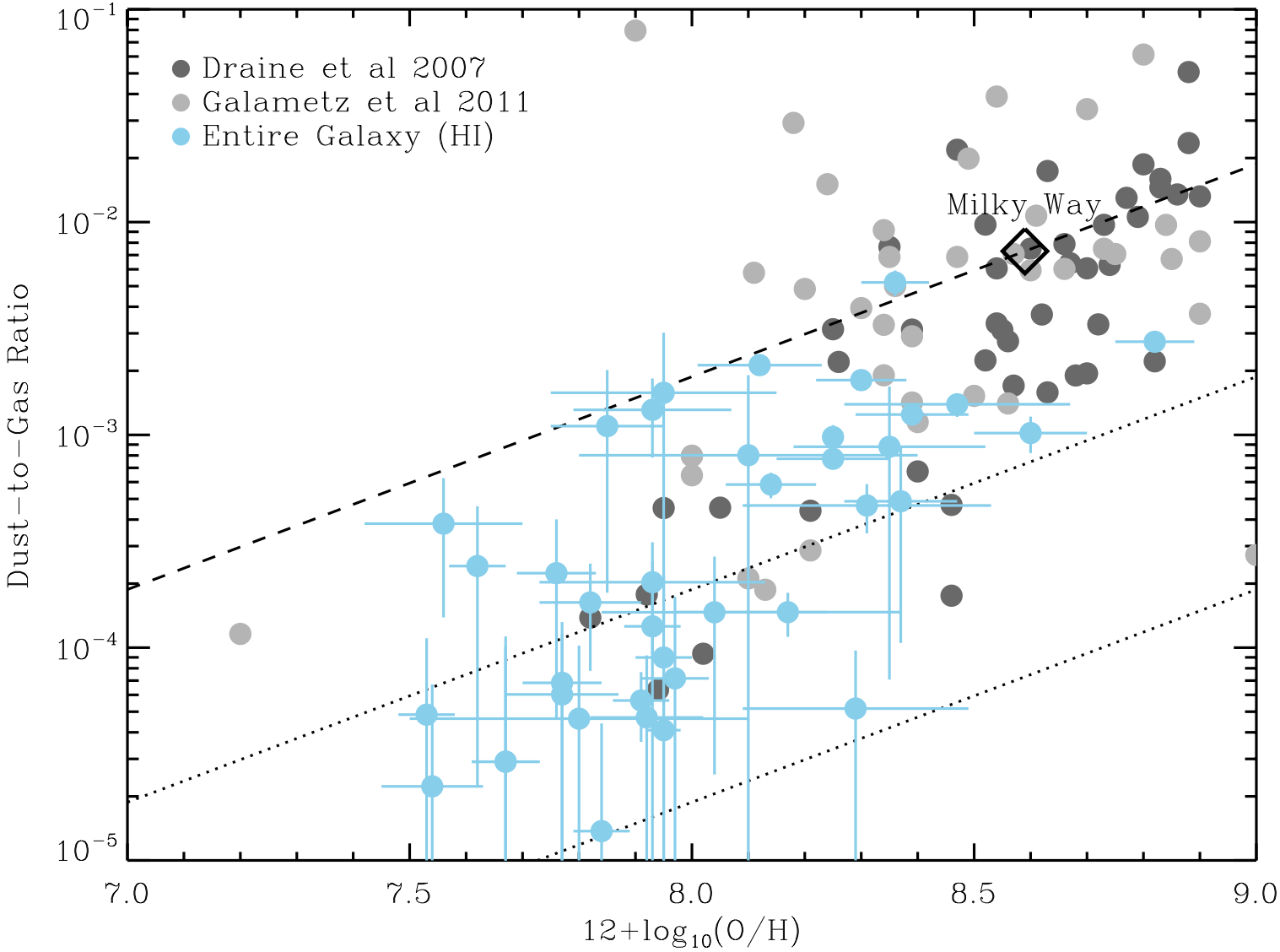
Dust-to-Gas Ratio



Dust-to-Gas Ratio



Dust-to-Gas Ratio



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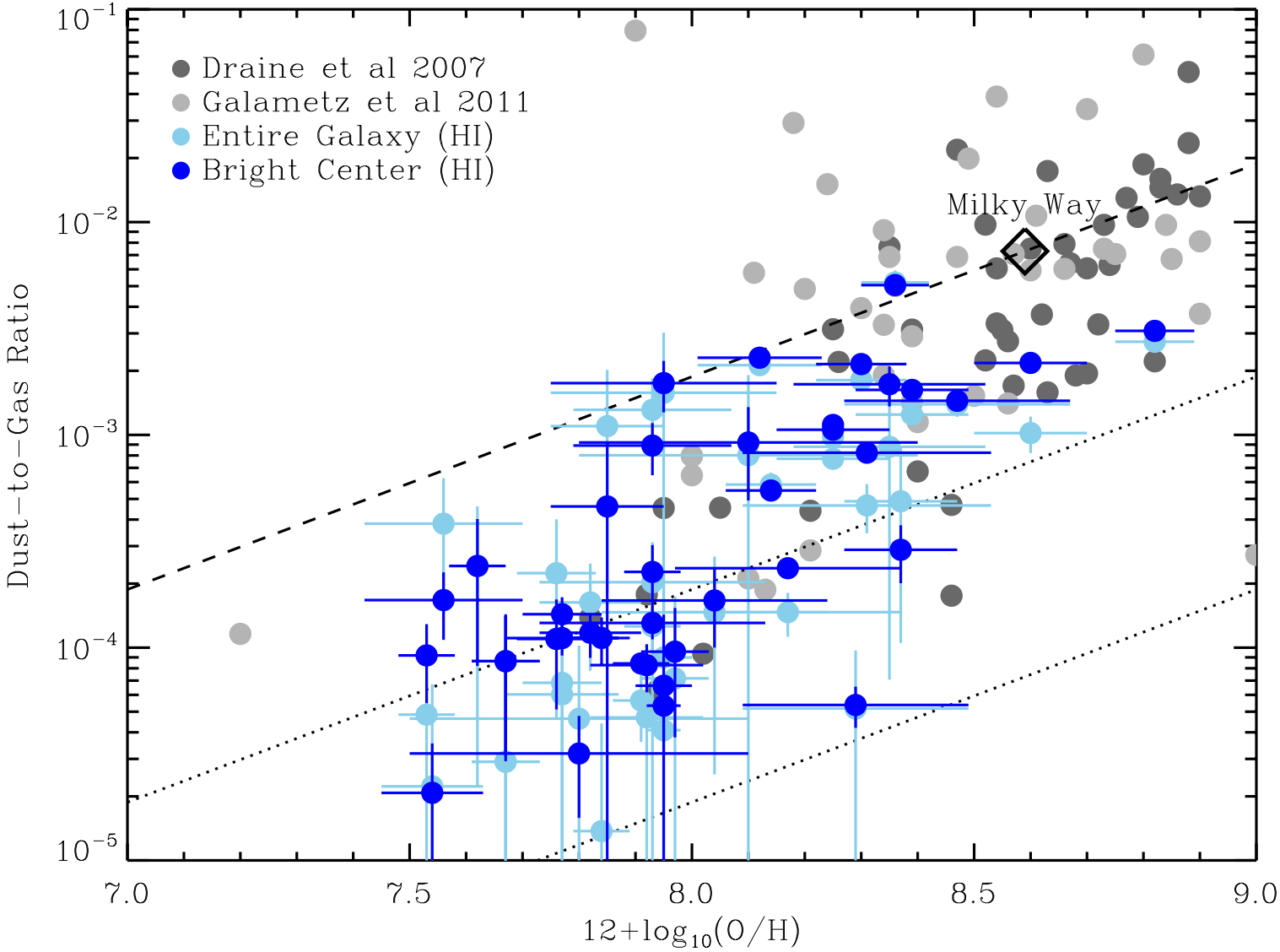

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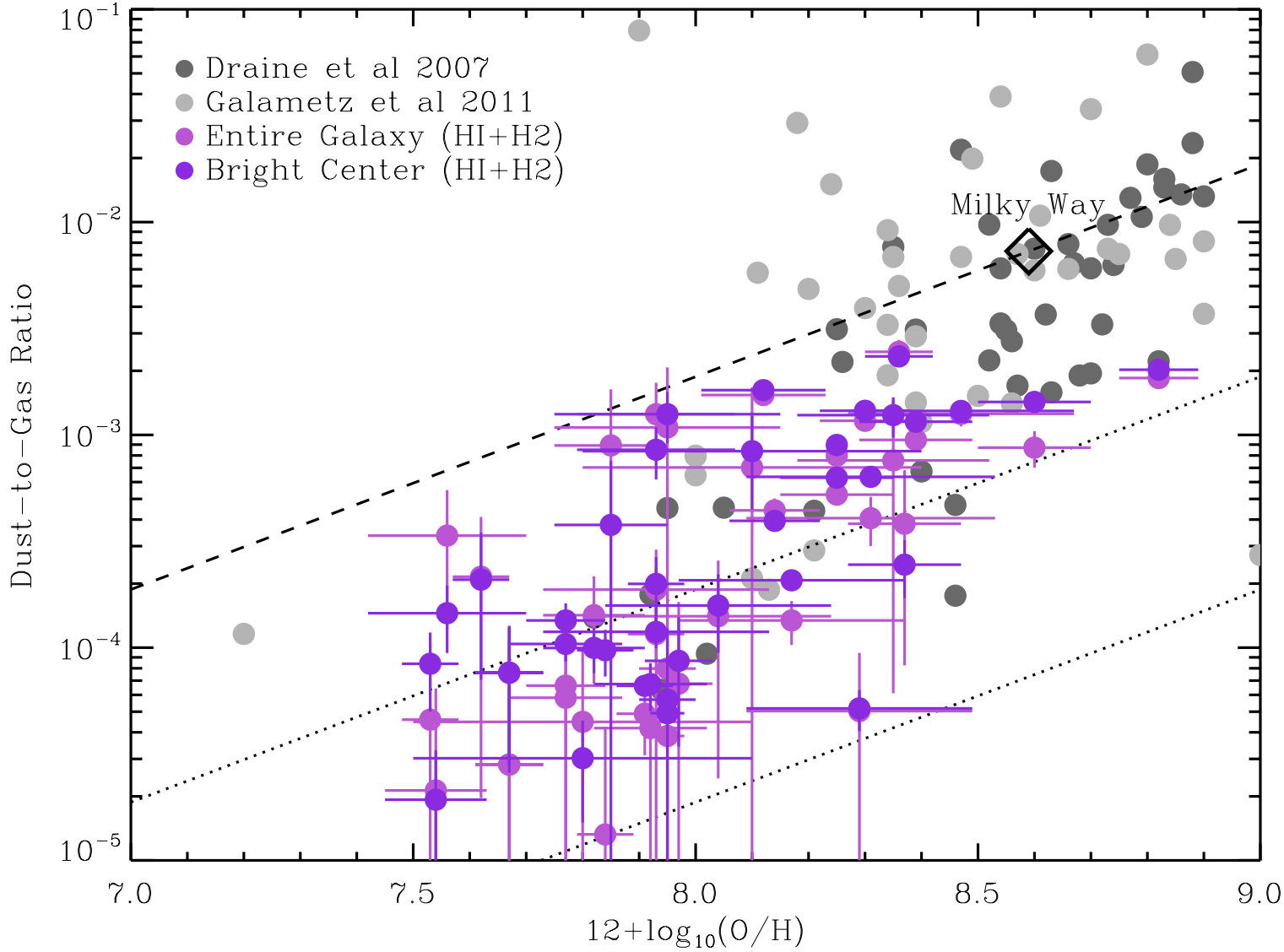
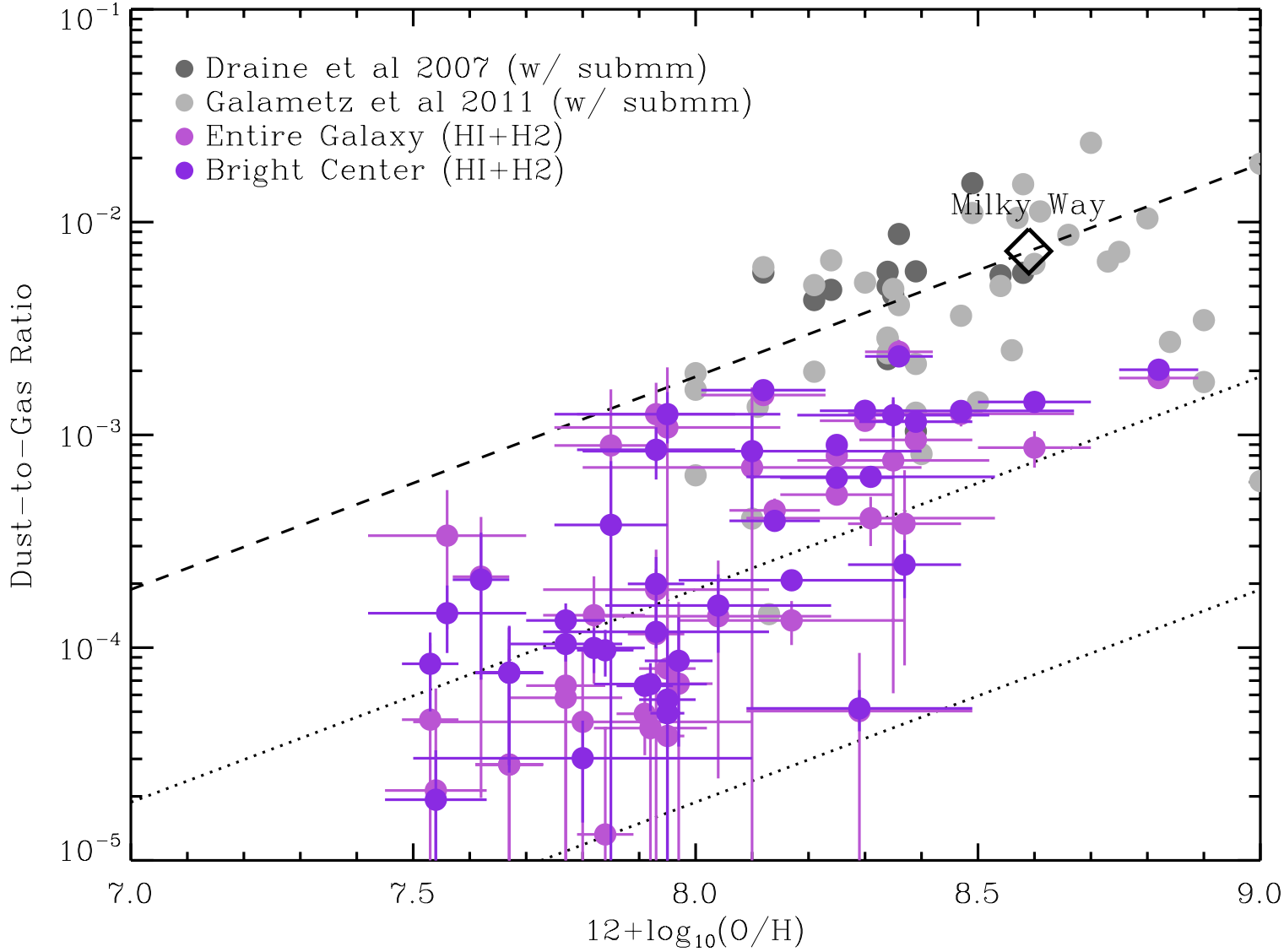


Dust-to-Gas Ratio



Summary

- $M_{Dust,\ BB}$ from single-temp modified black body fit to MIPS 70 & 160μm
- DGR_{BB} with updated metallicities and M_{H2} from SFR
- DGR_{BB} similar in entire galaxy and IR-bright center
- DGR_{BB} factor ~100 lower at 12+logO/H < 8.0 then DGR_{REF} at 12+logO/H ~ 8.5
- $M_{Dust,\ BB}$ likely underestimates M_{Dust} by factor ≤ 2-4 as compared to modeling of 70-500 / 850μm SED