

# Young, Blue, and Cold

A Blind Survey of Nearby Galaxies  
with *Herschel-ATLAS*

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Loretta Dunne

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Steve Maddox

(and the *H-ATLAS* team)

Accepted by MNRAS  
**arXiv:1502.03843**



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# Previous Surveys of Dust in Galaxies

**SLUGS**

SCUBA Local Universe Galaxy Survey

**SINGS**

*Spitzer* Infrared Nearby Galaxy Survey

**KINGFISH**

Key Insights on Nearby Galaxies Far-Infrared Survey with *Herschel*

**HRS**

*Herschel* Reference Survey

**IRAS**

InfraRed Astronomical Satellite

**Planck**

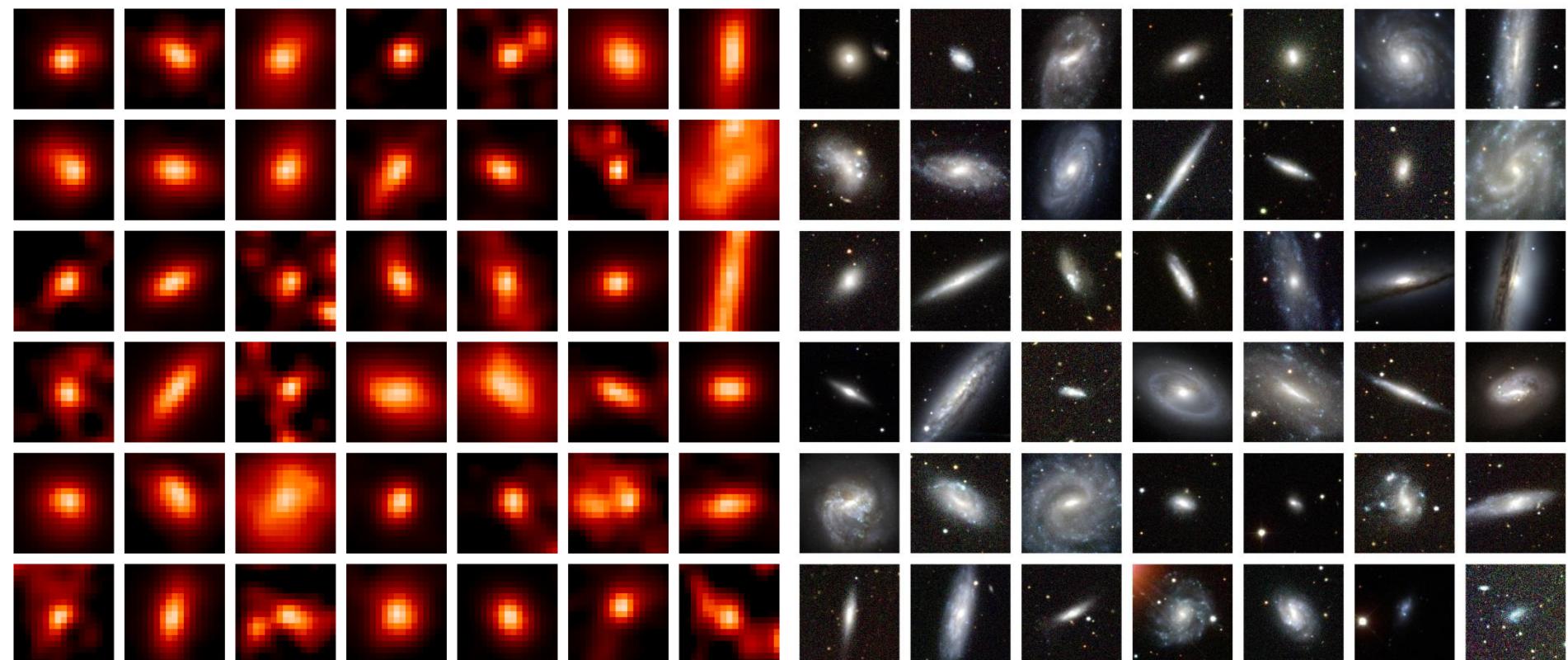
(Atypically, not an acronym)



# Herschel Astrophysical Terahertz Large-Area Survey

Principal Investigators: Steve Eales & Loretta Dunne

# A Dust-Selected Local Galaxy Sample



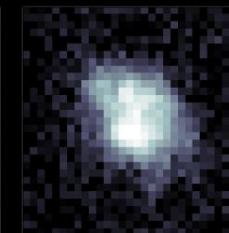
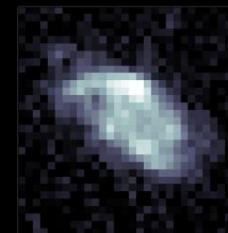
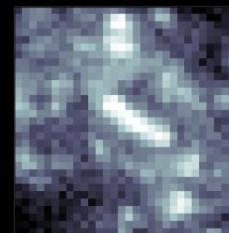
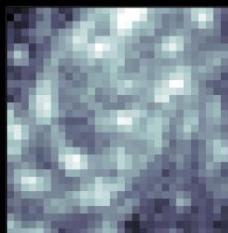
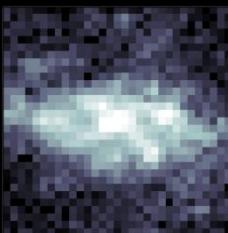
H-ATLAS 250  $\mu\text{m}$

SDSS *gri*-bands

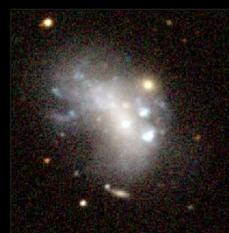
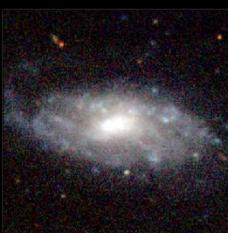
$15 < D < 46 \text{ Mpc}$

# BADGRS: Blue And Dusty Gas Rich Sources

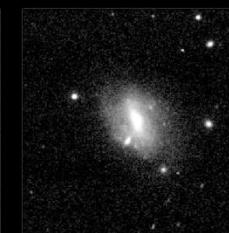
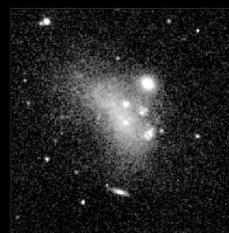
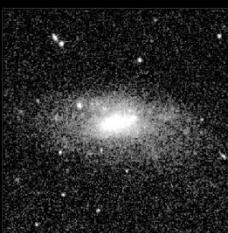
GALEX Far-UV



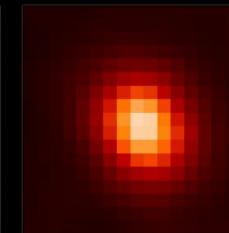
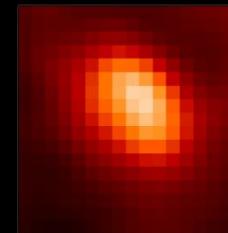
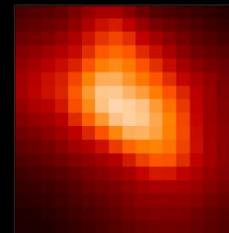
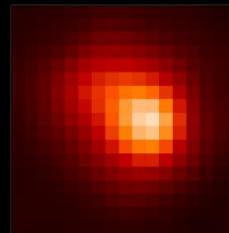
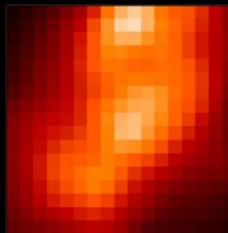
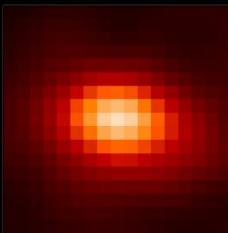
Optical SDSS *gri*



Near-IR VIKING  $K_s$

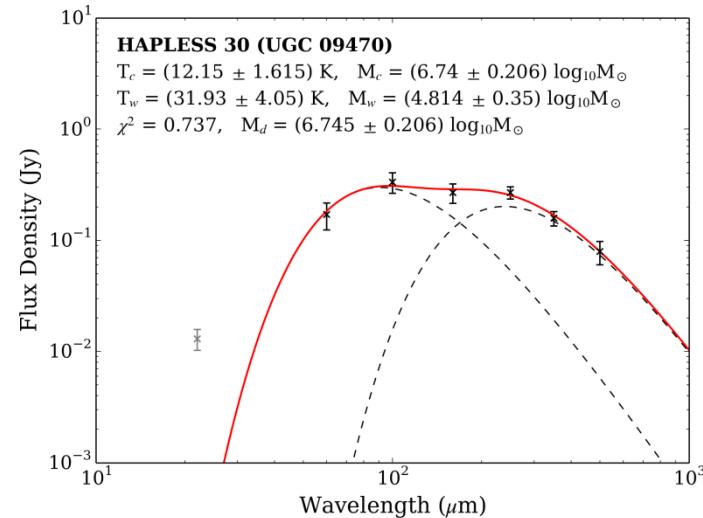
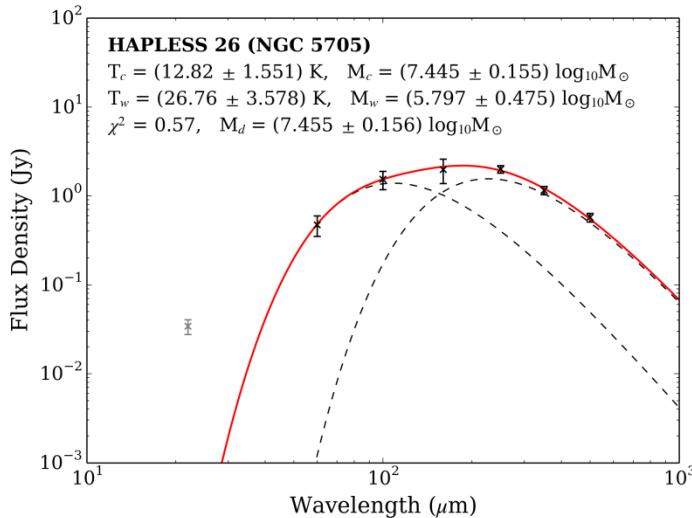
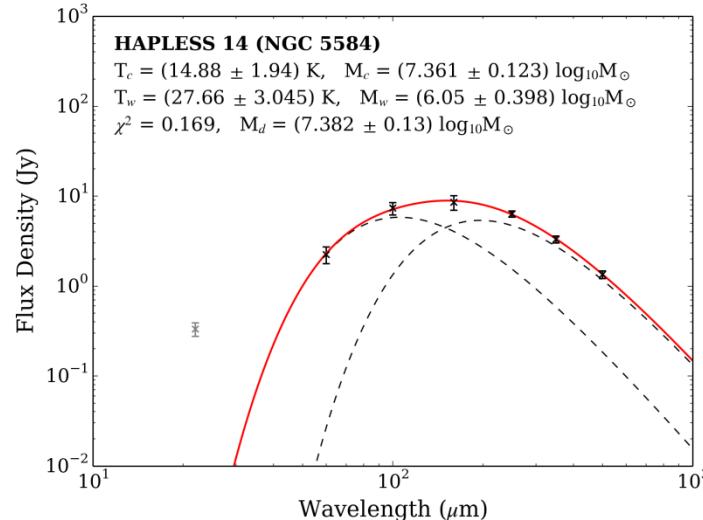
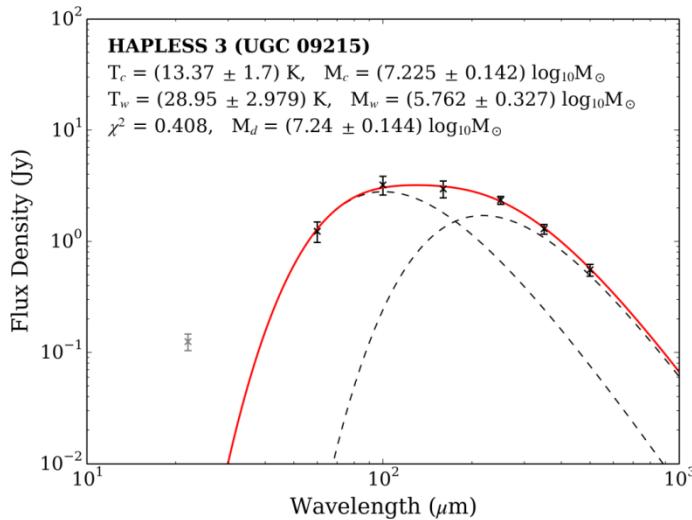


$H$ -ATLAS 250  $\mu$ m



$FUV-K_s < 3.5$

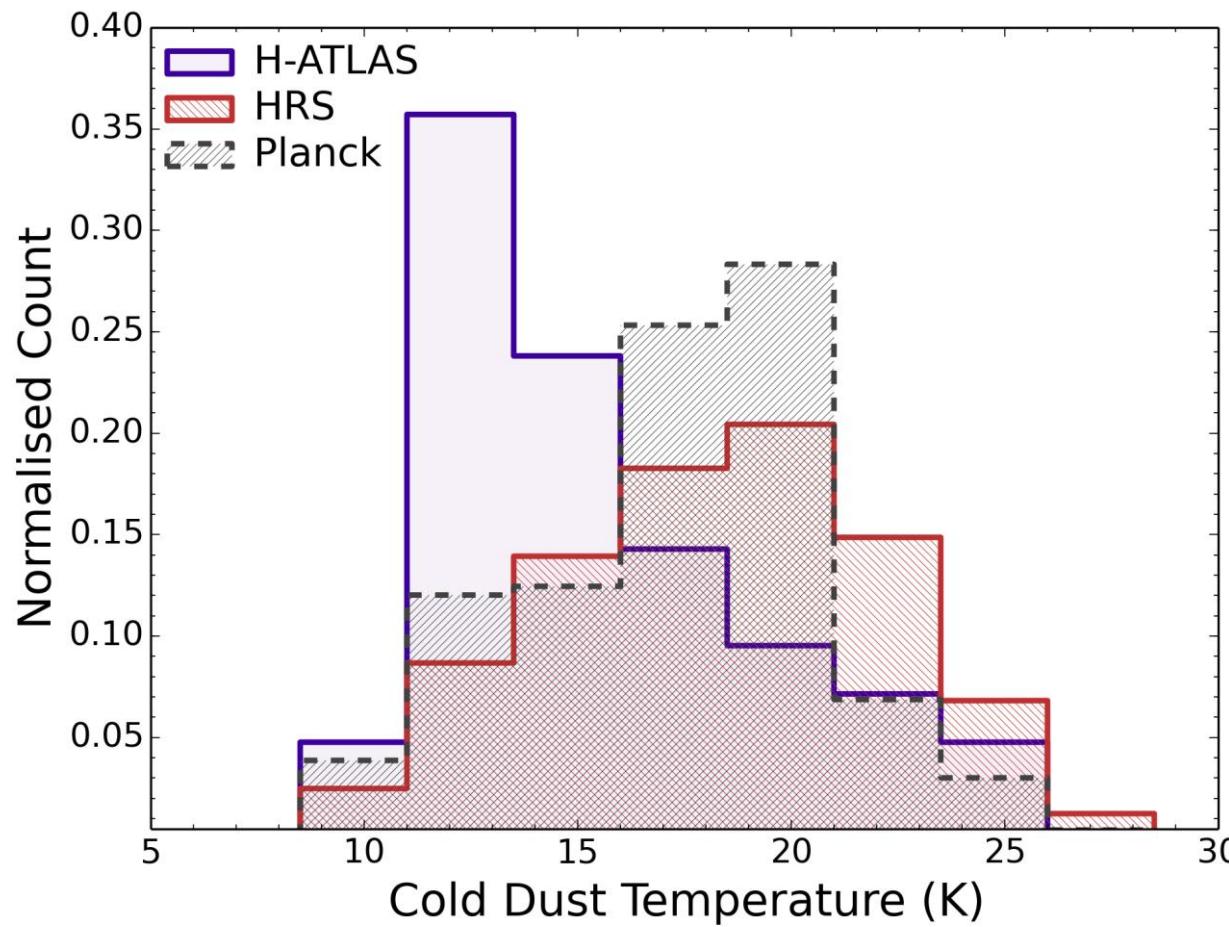
# Dust SED Fitting



BADGR dust temperatures typically 11–16 K

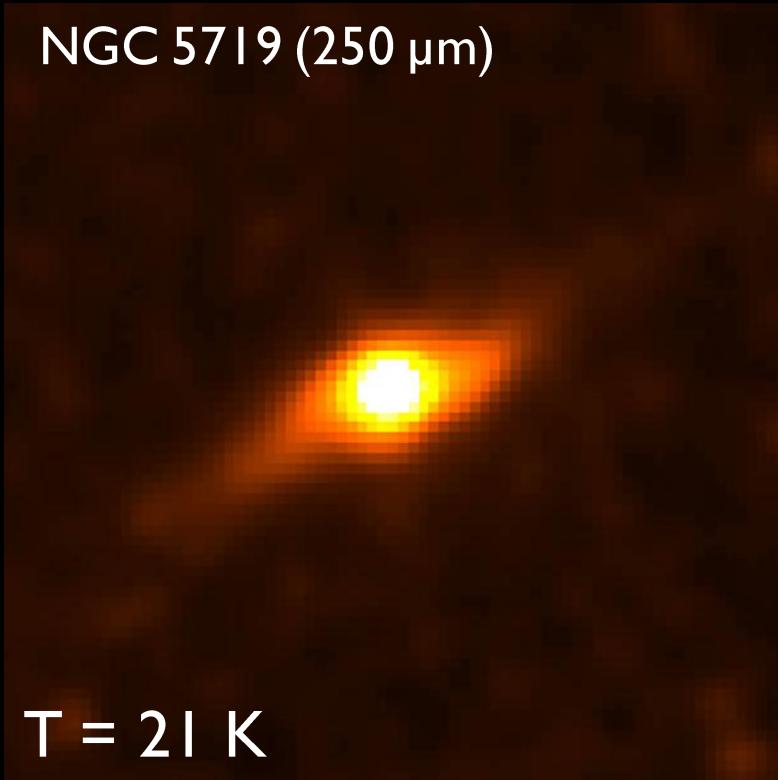
Chris Clark

# Previously Overlooked Cold Dust



# Cold & Very Faint

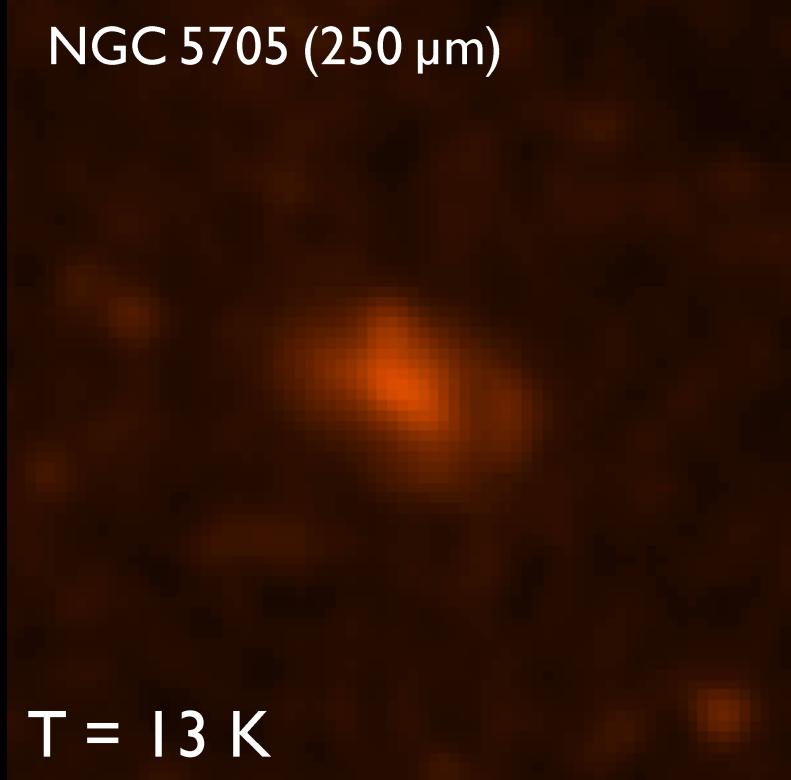
NGC 5719 (250  $\mu\text{m}$ )



$T = 21 \text{ K}$

“Normal” galaxy

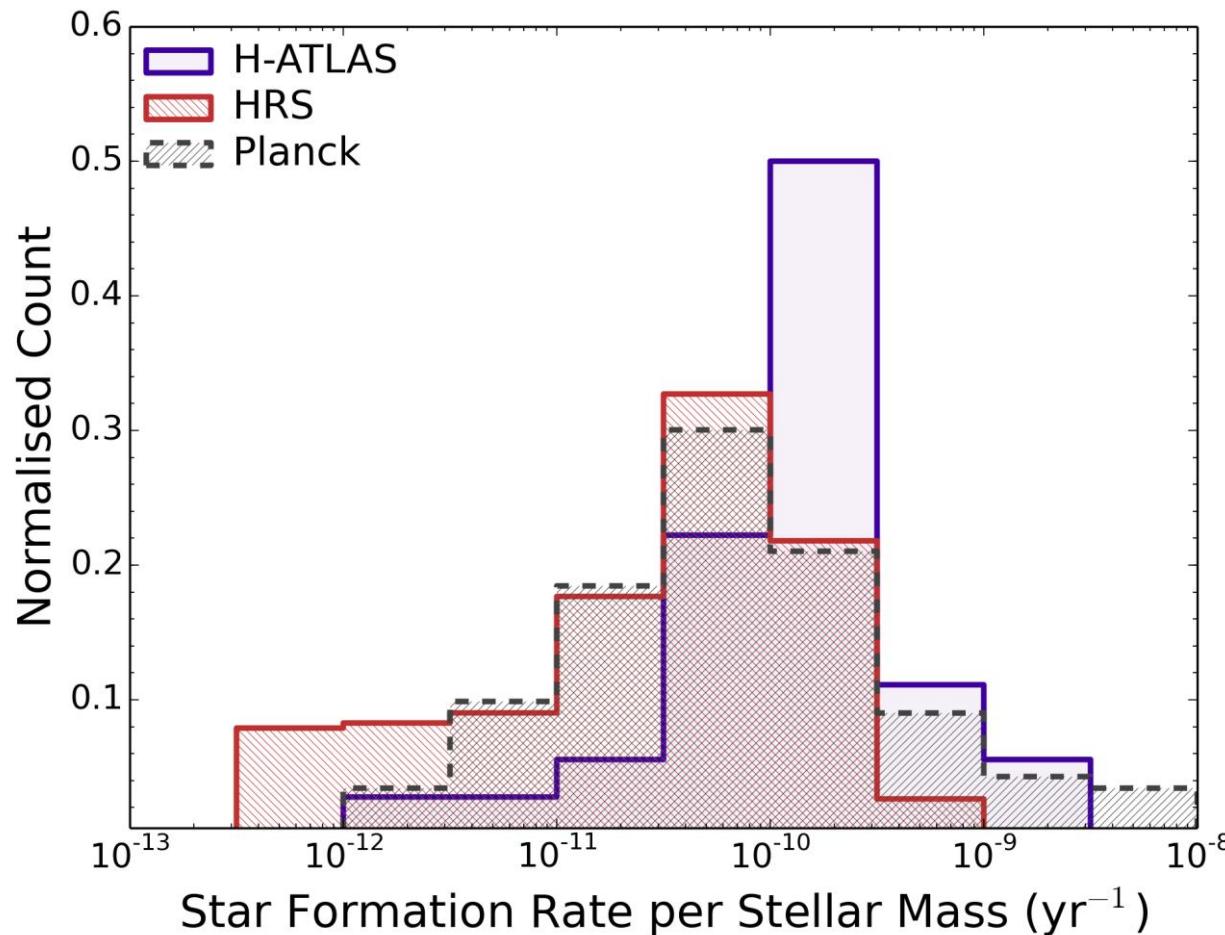
NGC 5705 (250  $\mu\text{m}$ )



$T = 13 \text{ K}$

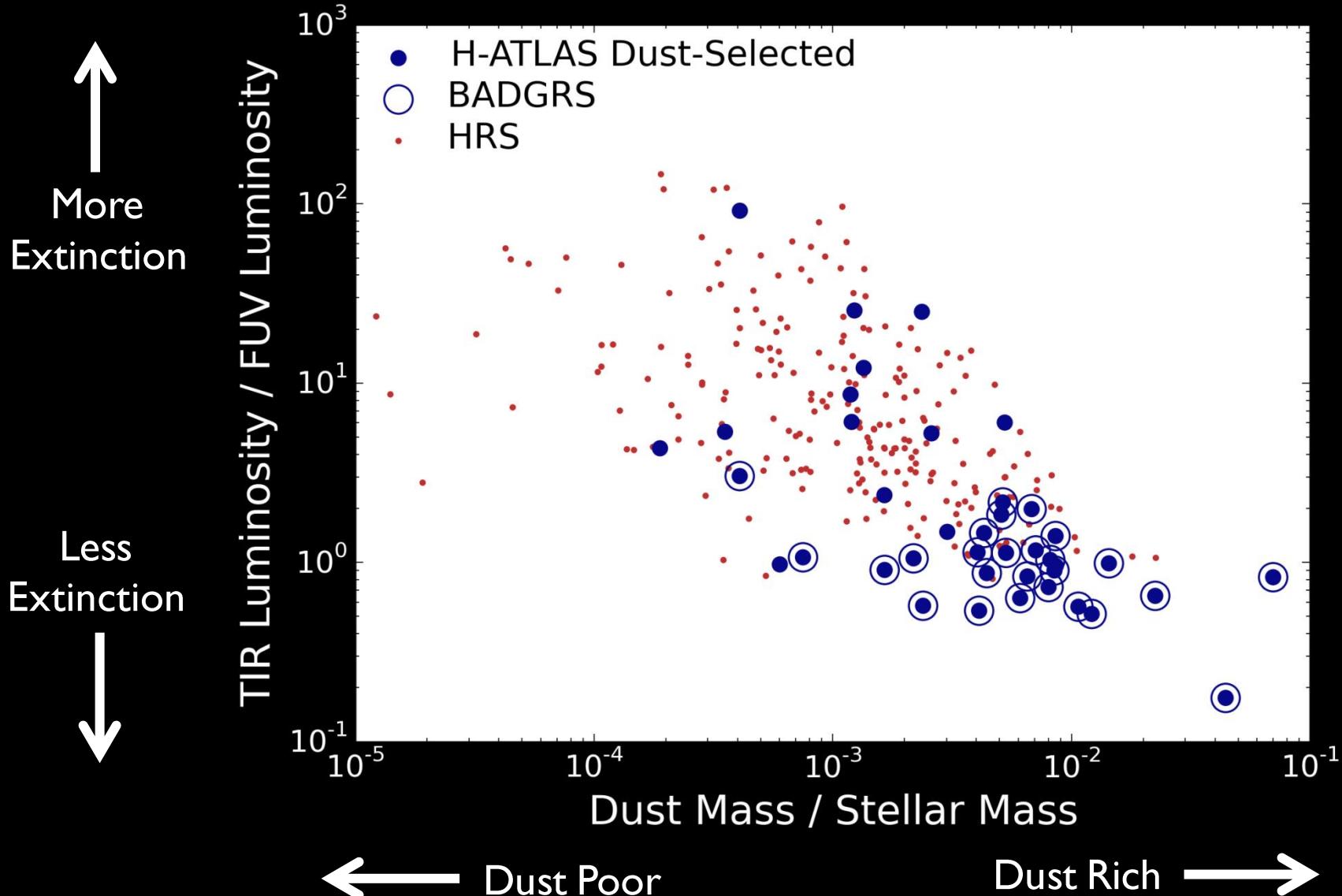
BADGR  
Blue And Dusty Gas Rich source

# Cold Dust, But Lots Of Heating...?



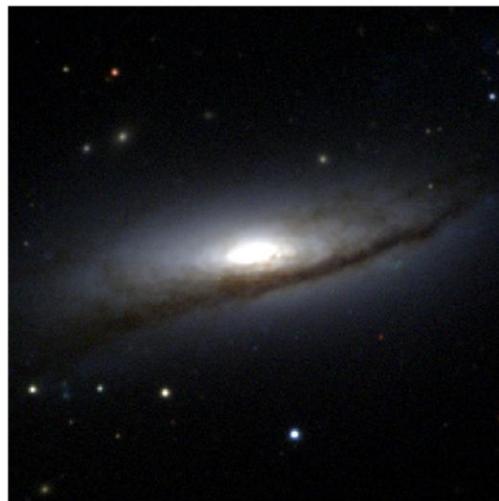
Average SSFR of dust-selected *H-ATLAS* sample is 4–5 times higher than average of *HRS* or *Planck* samples

# Lots of Dust, Little Extinction

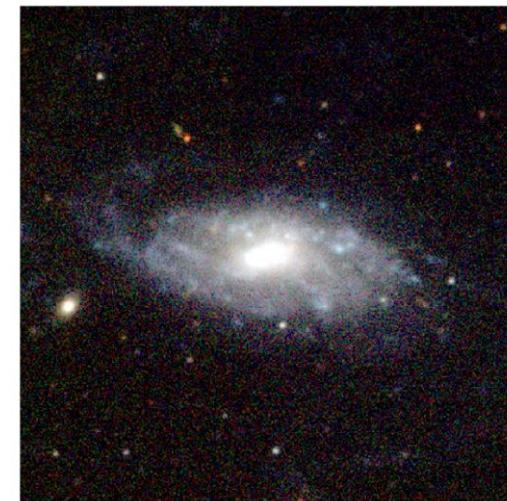
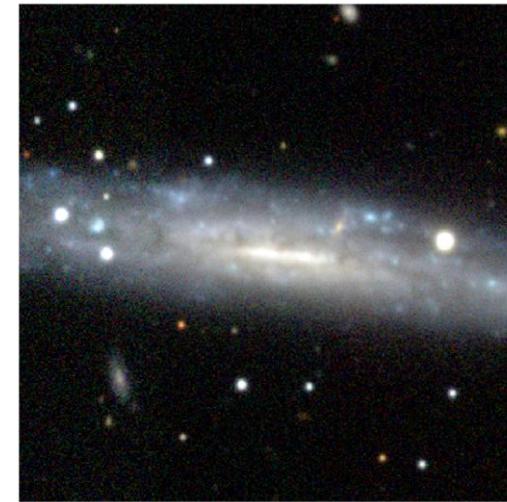


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# Dust Lanes $\neq$ Dust Rich



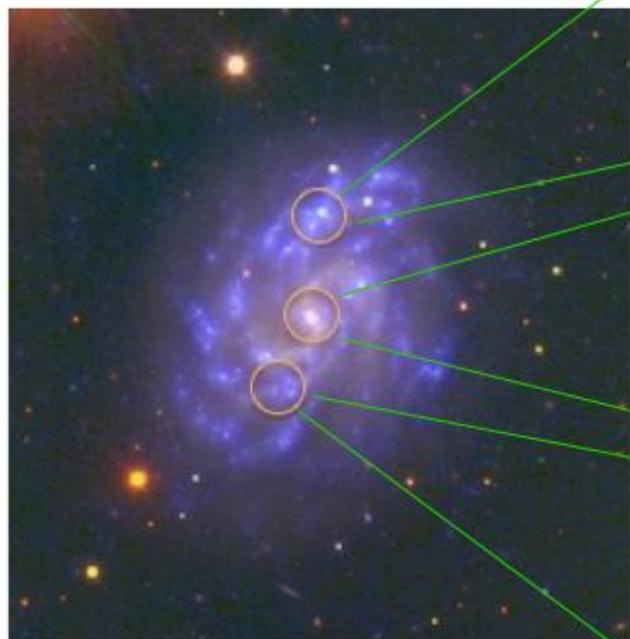
$M_D/M_S \sim 0.0005$



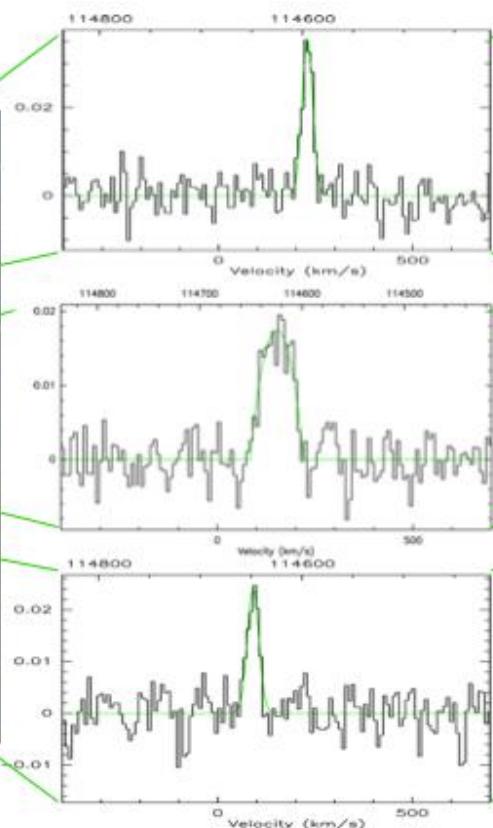
$M_D/M_S \sim 0.01$

# The Highly Unusual ISM of BADGRS

Blue And Dusty  
Gas Rich Sources



frZ-bands



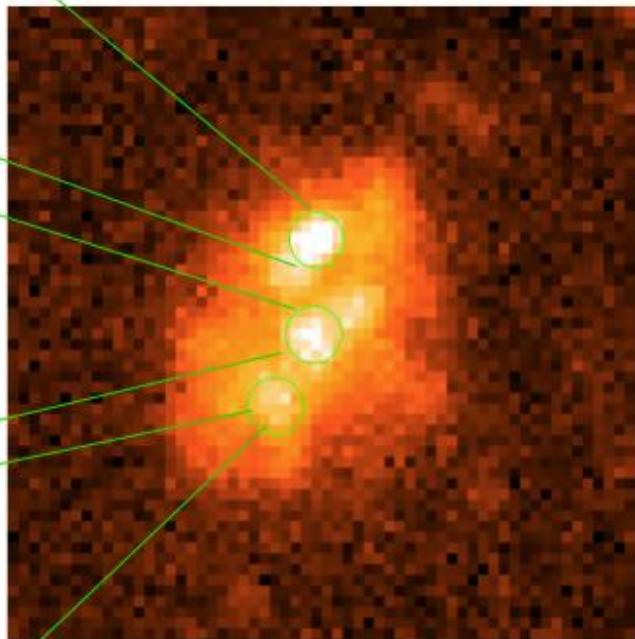
IRAM CO(1-0)

$$I_{CO} = 0.2\text{--}2 \text{ K km s}^{-1}$$

$$\text{FWHM} = 30\text{--}100 \text{ km s}^{-1}$$

$$M_{H_2}/M_d = 2\text{--}27 (\text{MW } X_{CO})$$

$$Z = 0.5\text{--}1 Z_\odot$$

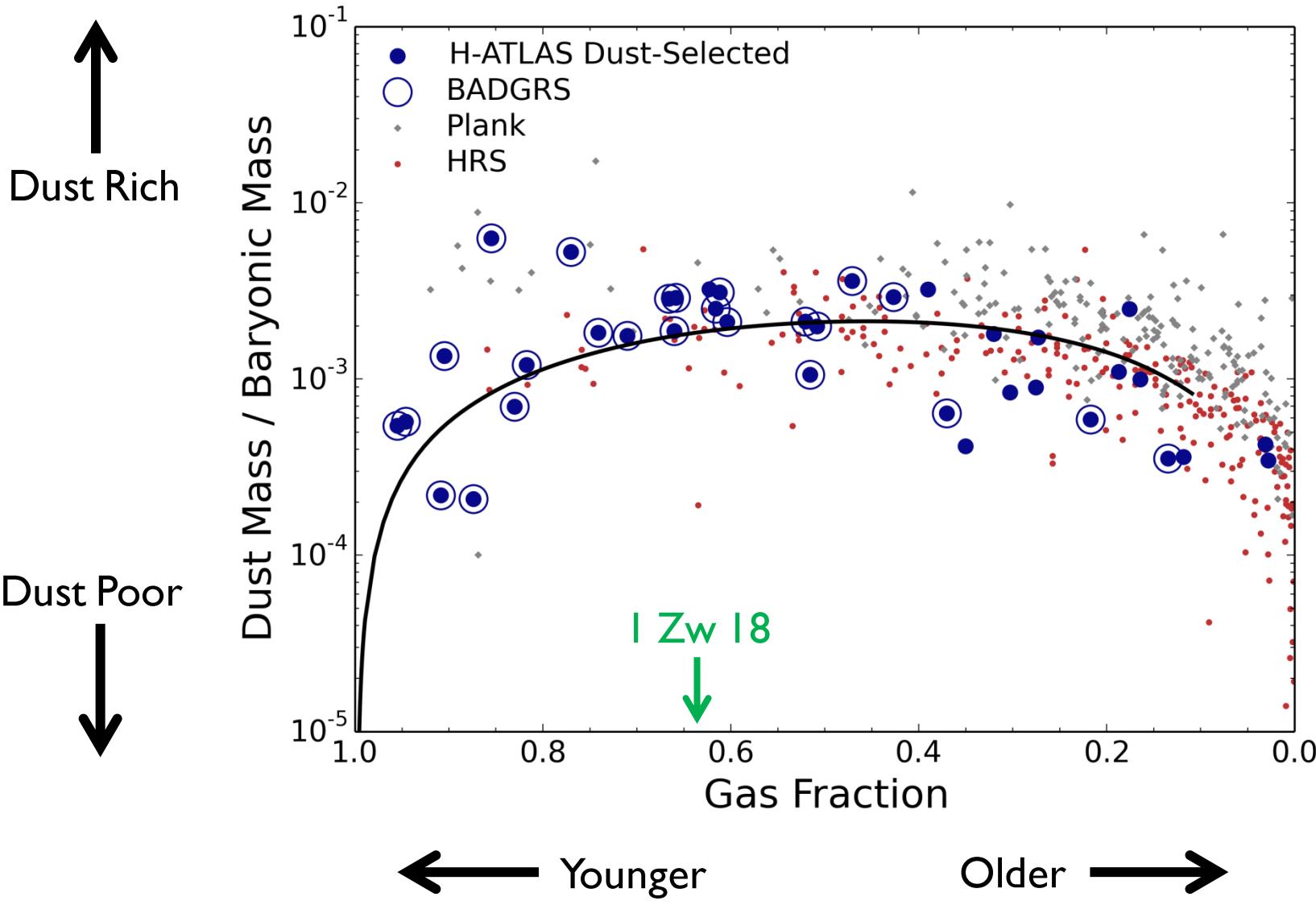


H-ATLAS 250  $\mu\text{m}$

IRAM data by  
Ivan Oteo and  
Zhiyu Zhang

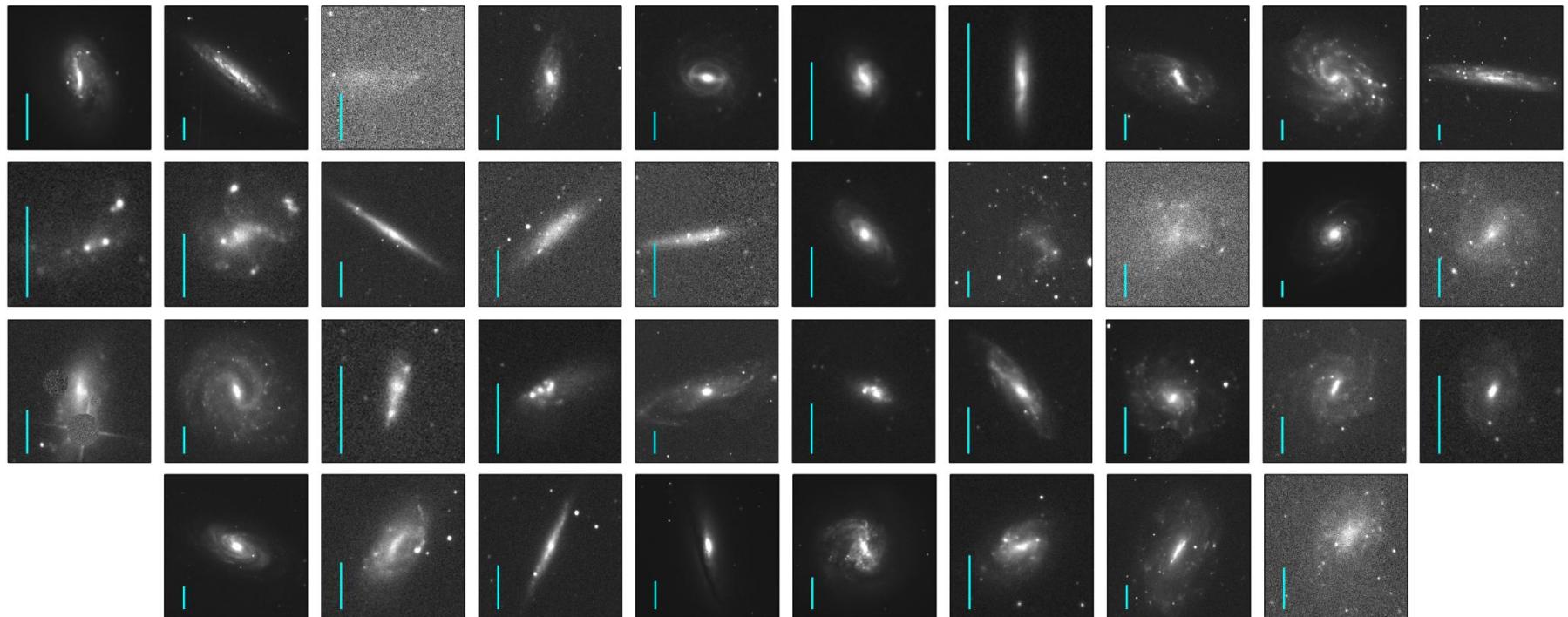
Chris Clark

# A Dusty Window On Young Galaxies



Chris Clark

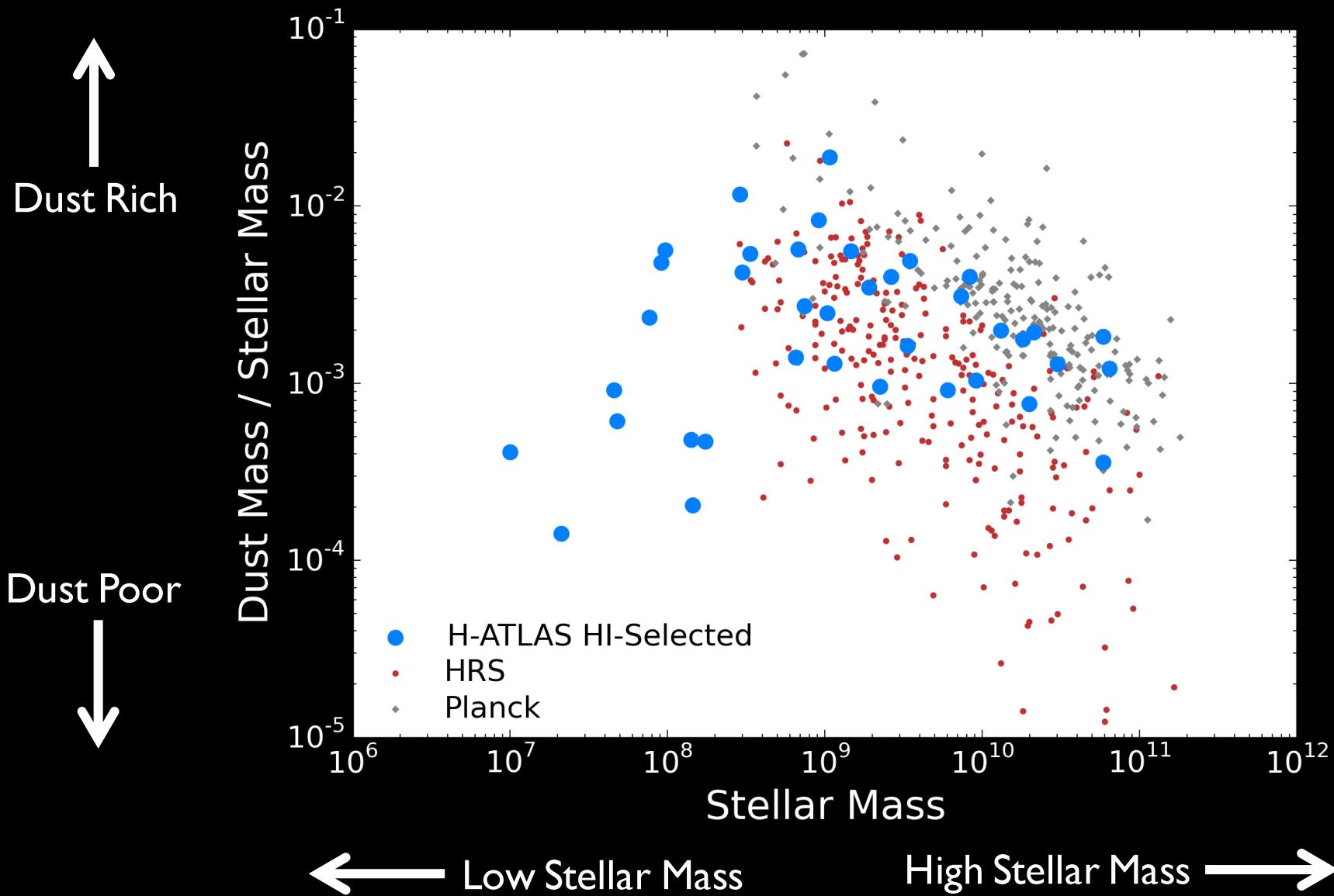
# An H<sub>I</sub>-Selected Galaxy Sample in H-ATLAS



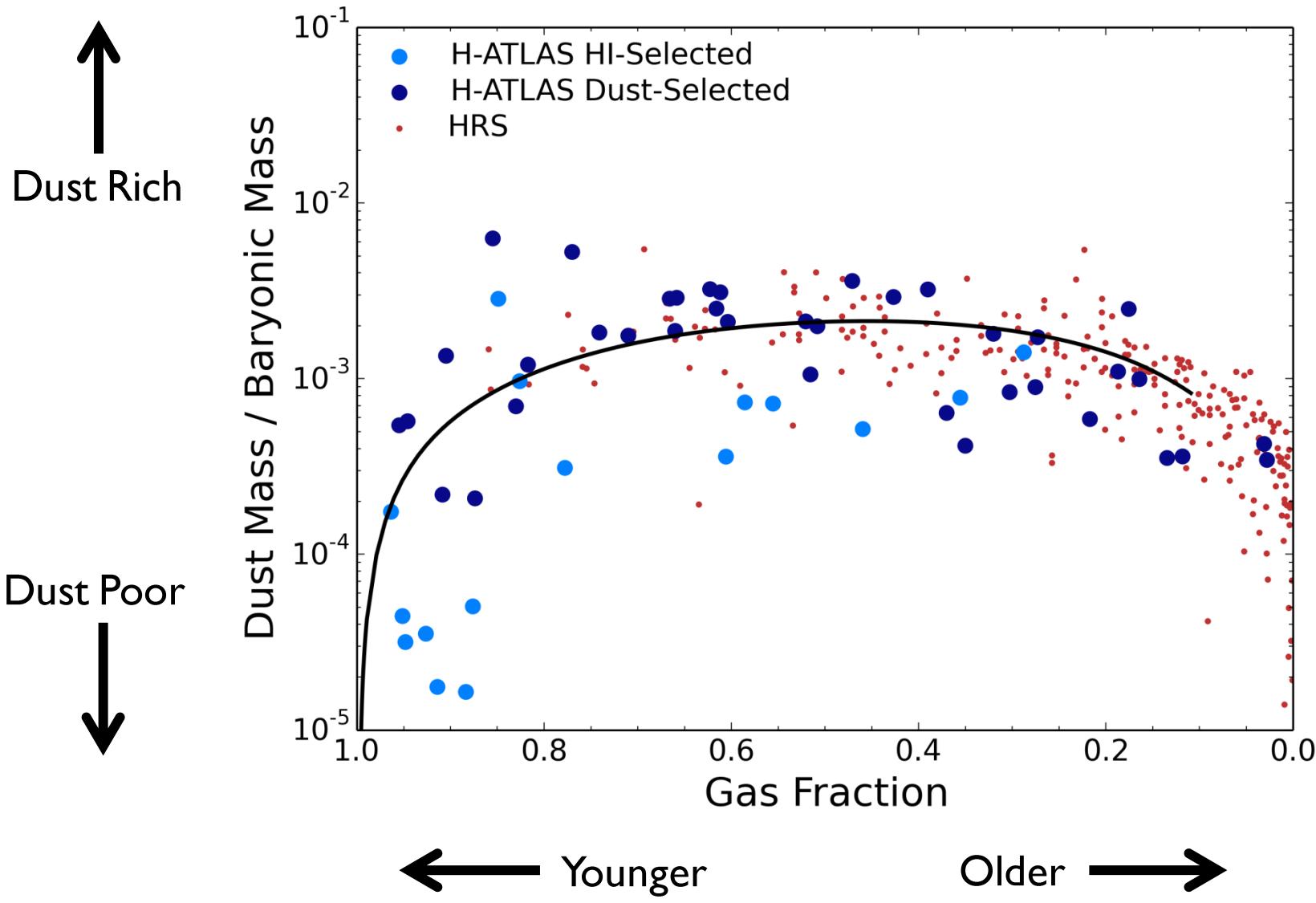
38 HIPASS-detected galaxies in H-ATLAS equatorial fields  
(Pieter de Vis, Loretta Dunne, et al; in prep)

20 in common with the H-ATLAS-detected dust-selected sample

# The Turnover in Dust Evolution



# Extremely Young, Dust-Poor Galaxies



# Key Results

- A dust-selected nearby galaxy survey with *Herschel-ATLAS* reveals that very blue ( $\text{FUV-K}_S < 3.5$ ) irregular/flocculent galaxies dominate the local dusty universe.
- These **Blue And Dusty Gas Rich Sources** – **BADGRS** – have been severely under-sampled by previous surveys. They account for 5% of the stellar mass, 35% of the dust mass, and 50% of the HI mass in our dust-selected sample.
- The more dust-rich a galaxy, the less UV extinction occurs; hence the BADGRS have very cold dust temperatures of 11–16 K.
- The BADGRS appear to be in an intermediate stage of evolution; they contain more HI than stars, but have processed a lot of raw material into dust very quickly.
- Additionally, an HI-selected sample of galaxies in the *Herschel-ATLAS* fields reveals very young gas-dominated galaxies (atomic gas fractions  $> 0.8$ ) that have not yet built up large masses of dust.
- See Simon Schofield's poster (Nº 23) on the chemical evolution of the BADGRS.

