

Young, Blue, and Cold

Blind Surveys of Nearby Galaxies
with *Herschel-ATLAS*

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Steve Maddox

(and the *H-ATLAS* team)



CARDIFF
UNIVERSITY

PRIFYSGOL
CAERDYDD

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

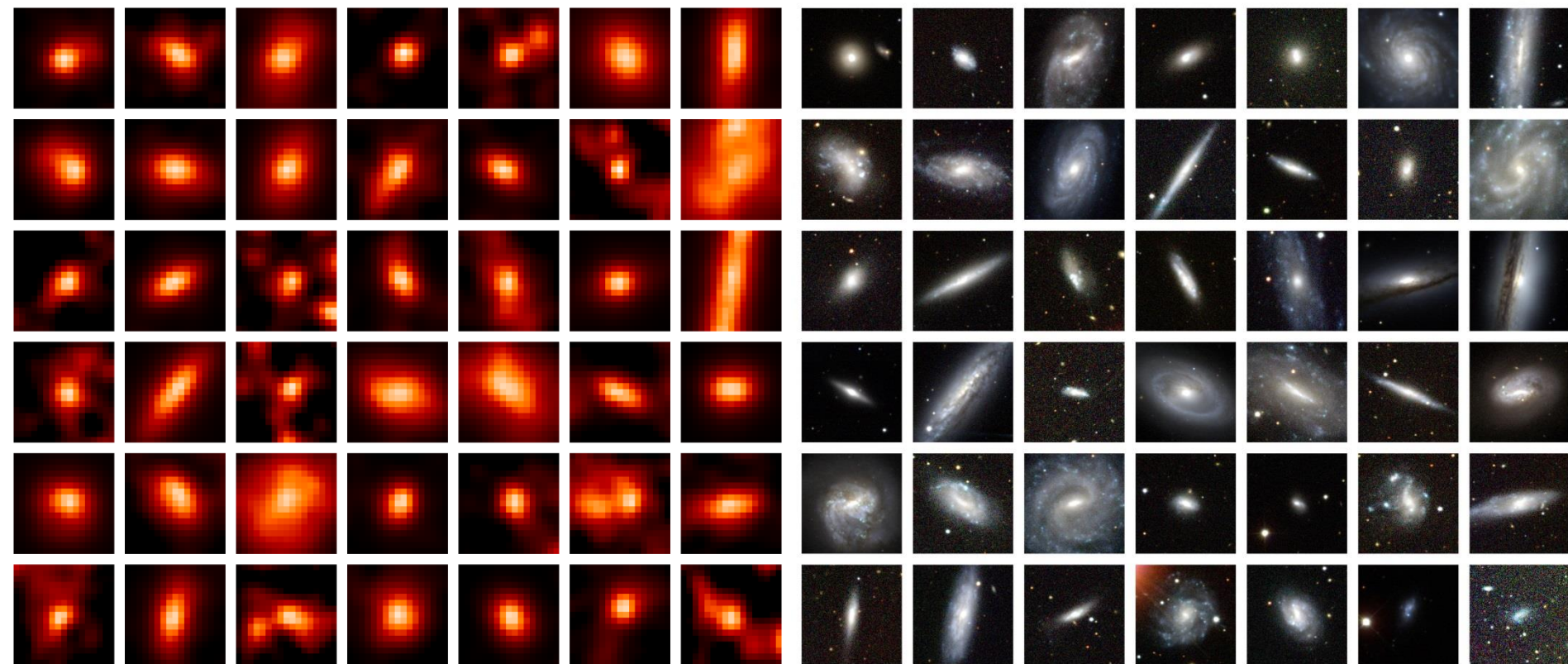
(Atypically, not an acronym)



Herschel **A**strophysical **T**erahertz **L**arge-**A**rea **S**urvey

Principal Investigators: Steve Eales & Loretta Dunne

A Dust-Selected Local Galaxy Sample



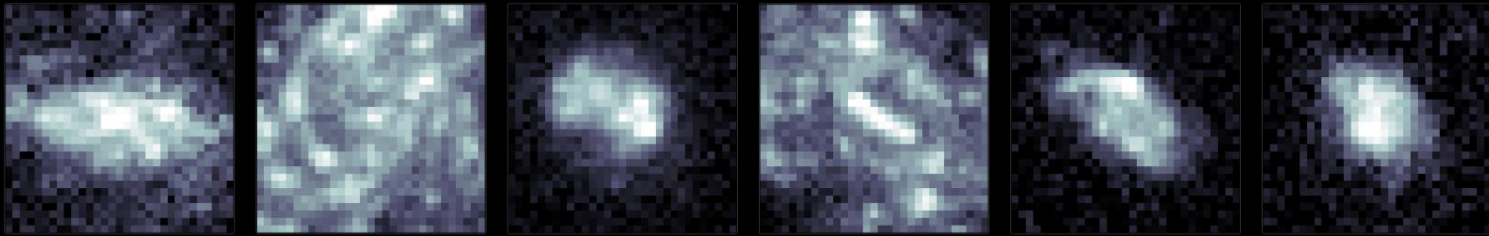
H-ATLAS 250 μm

SDSS *gri*-bands

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

BADGRS: Blue And Dusty Gas Rich Sources

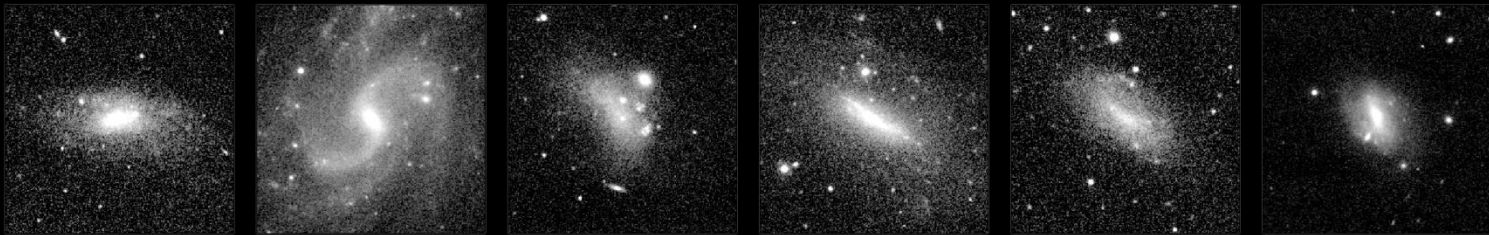
GALEX Far-UV



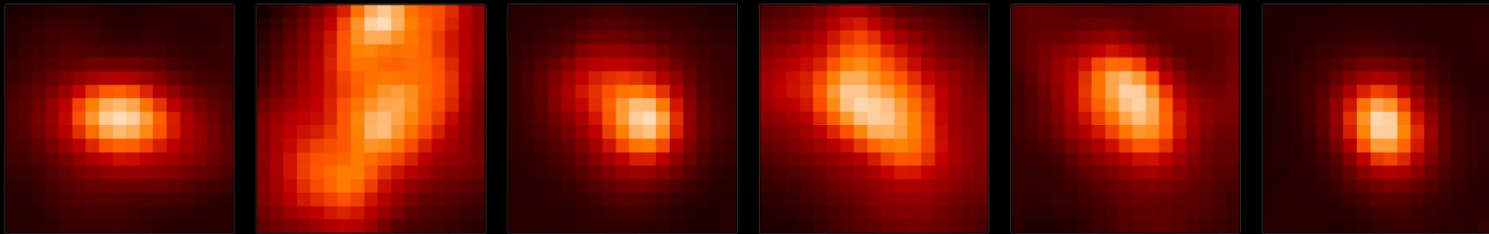
Optical SDSS *gri*



Near-IR VIKING K_s

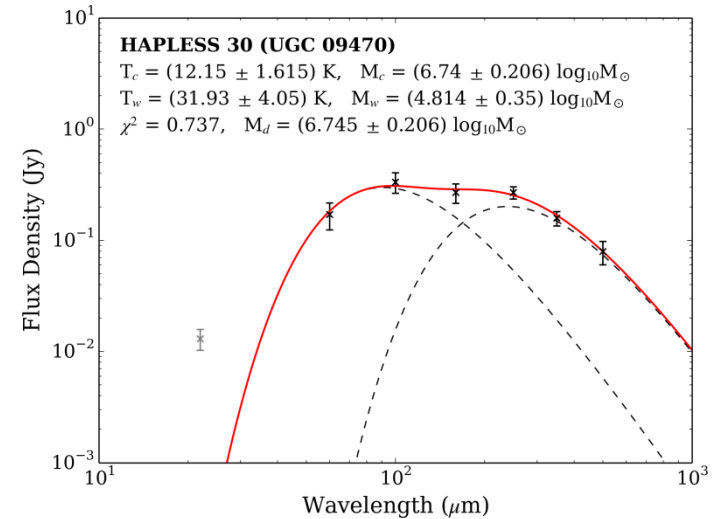
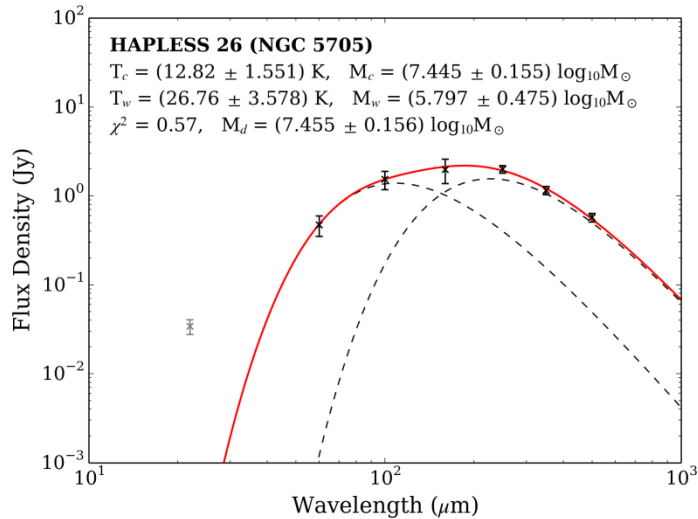
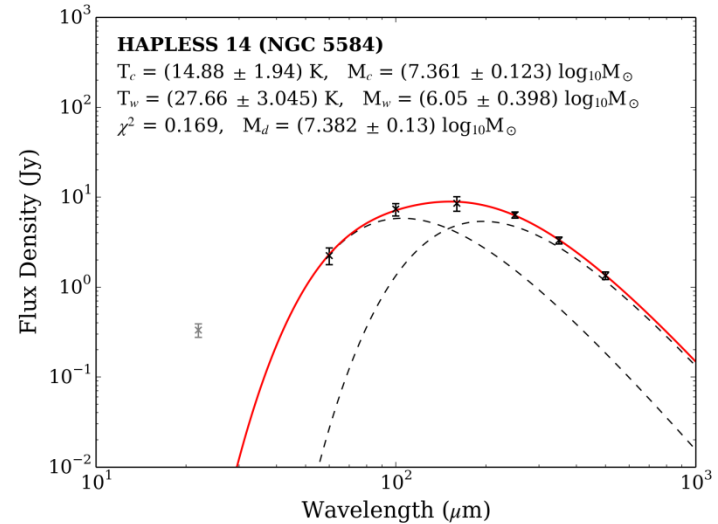
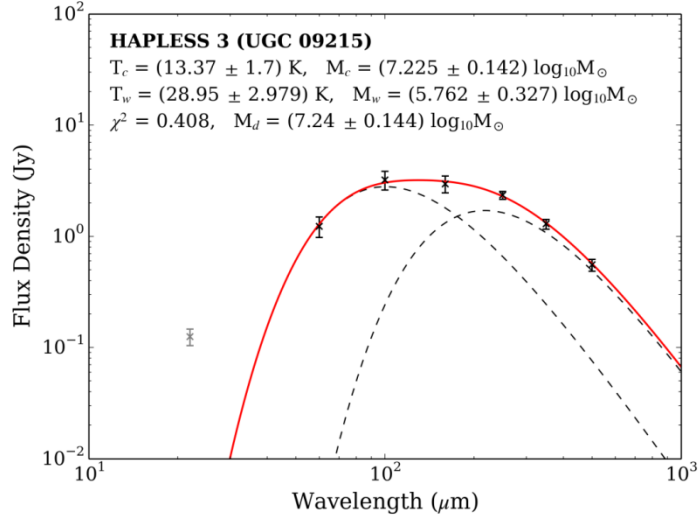


H-ATLAS 250 μm



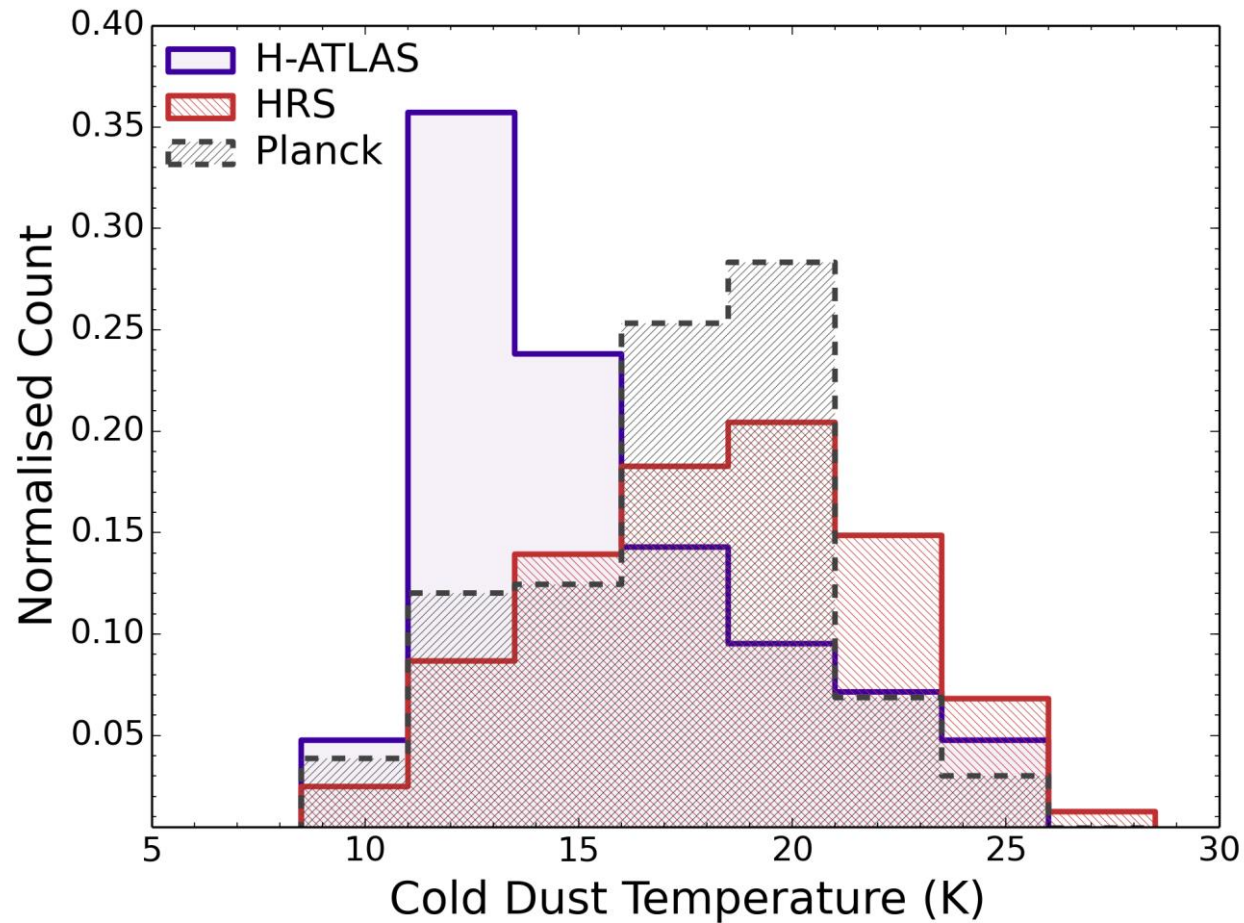
$$\text{FUV-}K_s < 3.5$$

Dust SED Fitting



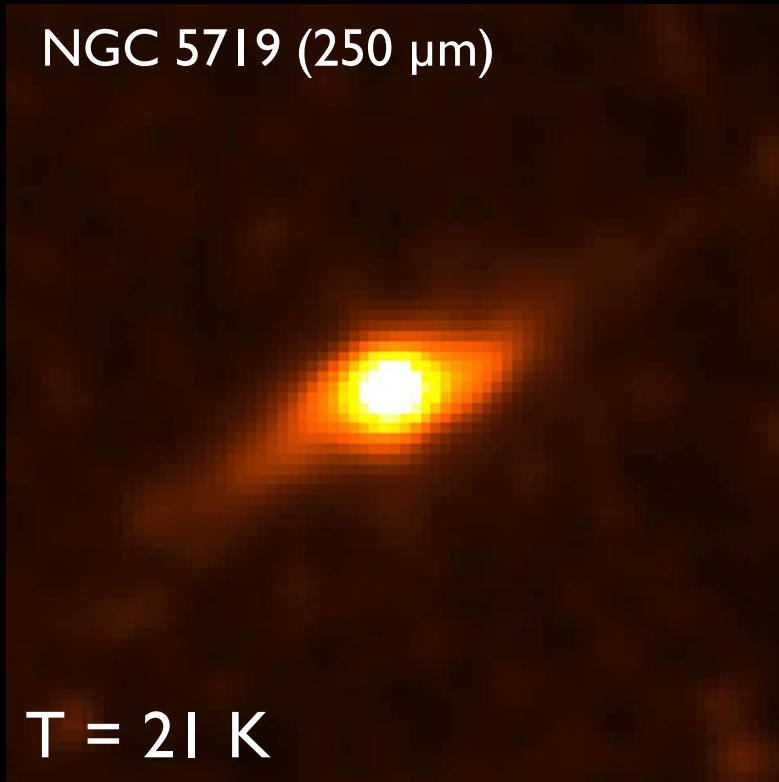
BADGR dust temperatures typically 11–16 K

Previously Overlooked Cold Dust



Cold & Very Faint

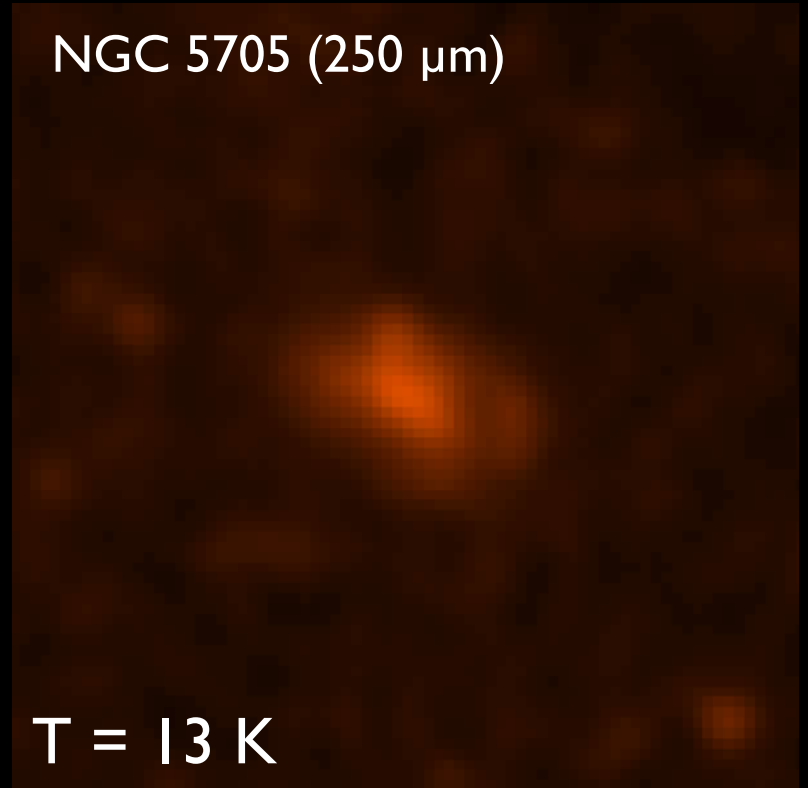
NGC 5719 (250 μm)



$T = 21 \text{ K}$

“Normal” galaxy

NGC 5705 (250 μm)

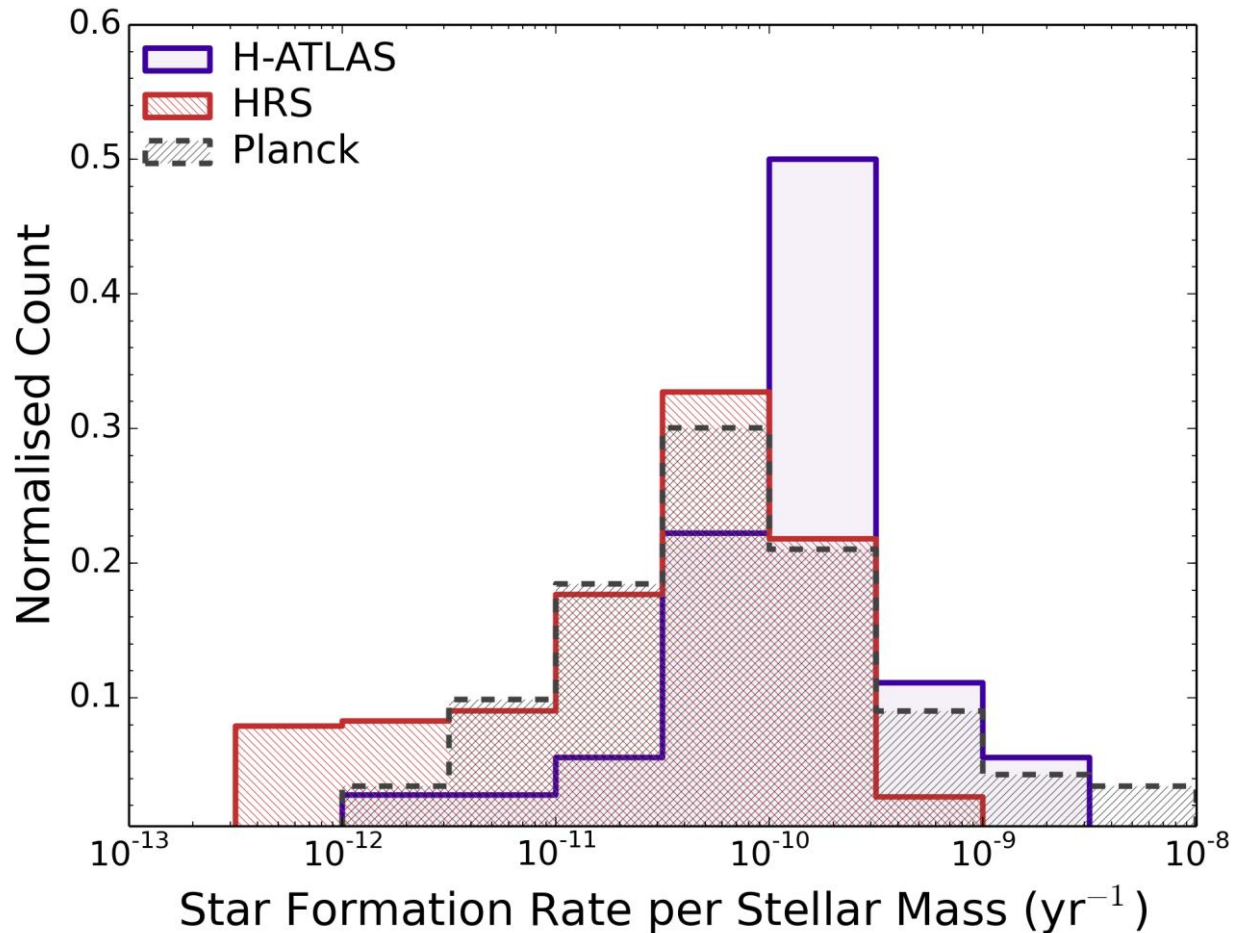


$T = 13 \text{ K}$

BADGR

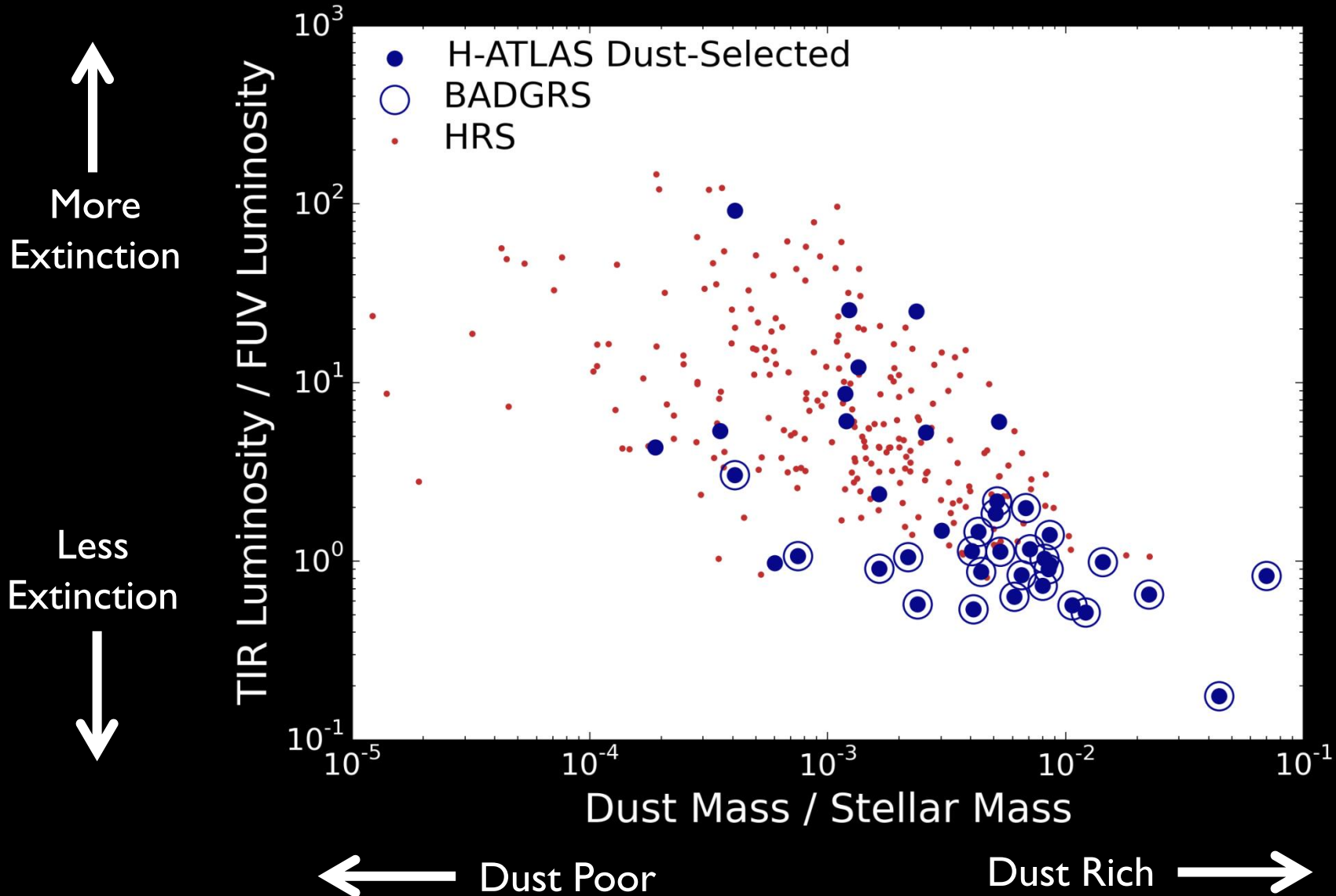
Blue And Dusty Gas Rich source

Cold Dust, But Lots Of Heating...?

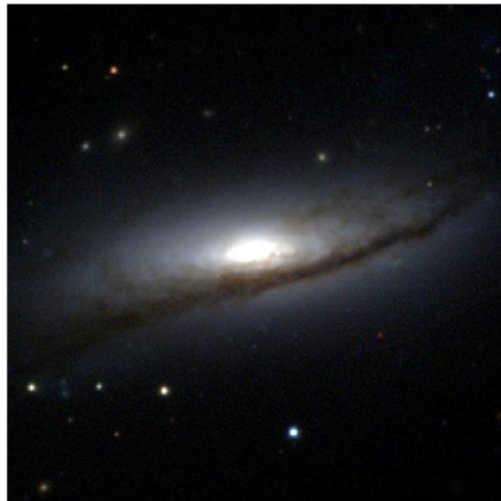
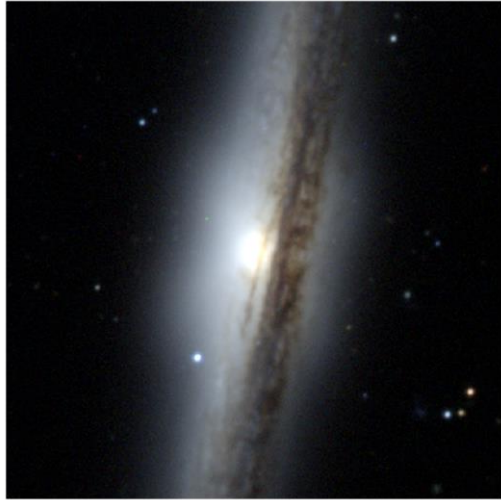


Average SSFR of dust-selected *H-ATLAS* sample is 4–5 times higher than average of HRS or *Planck* samples

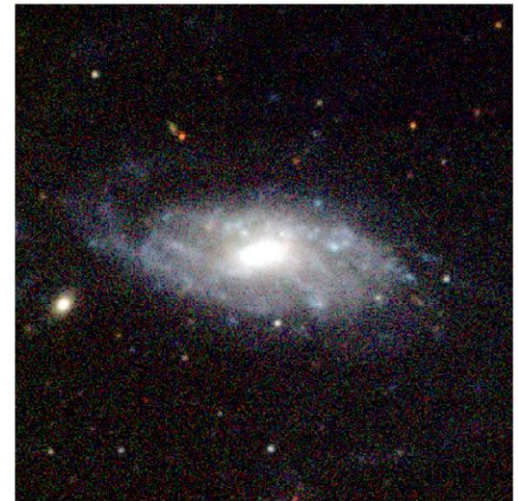
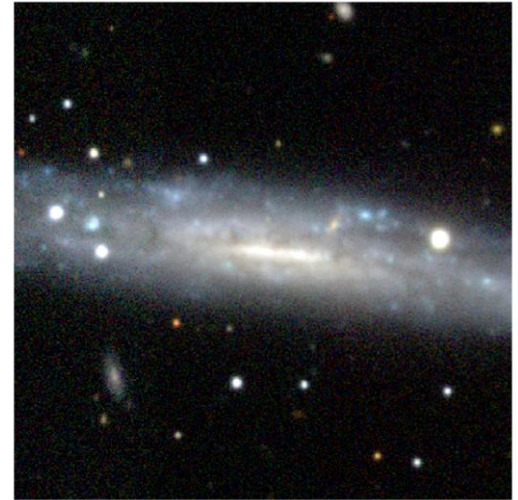
Lots of Dust, Little Extinction



Dust Lanes \neq Dust Rich



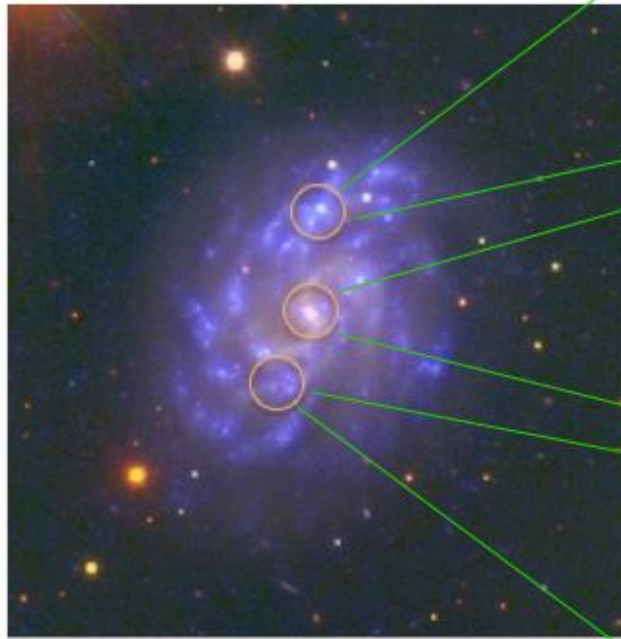
$M_D/M_S \sim 0.0005$



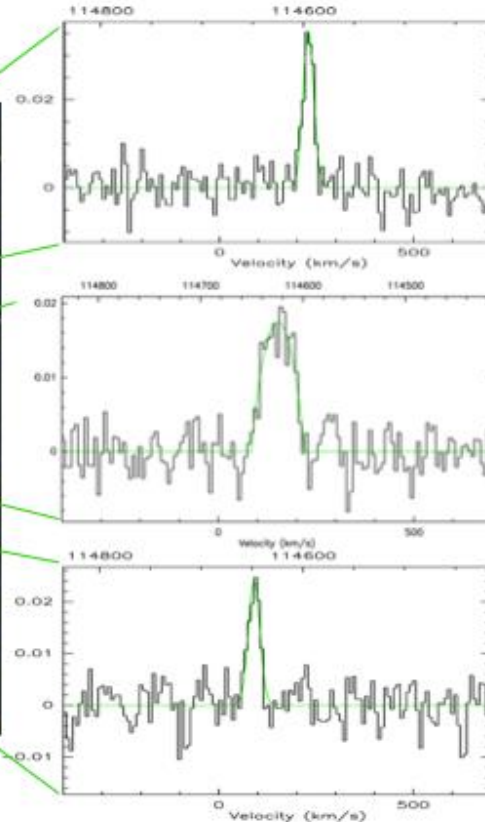
$M_D/M_S \sim 0.01$

The Highly Unusual ISM of BADGRS

Blue And Dusty
Gas Rich Sources



frZ-bands



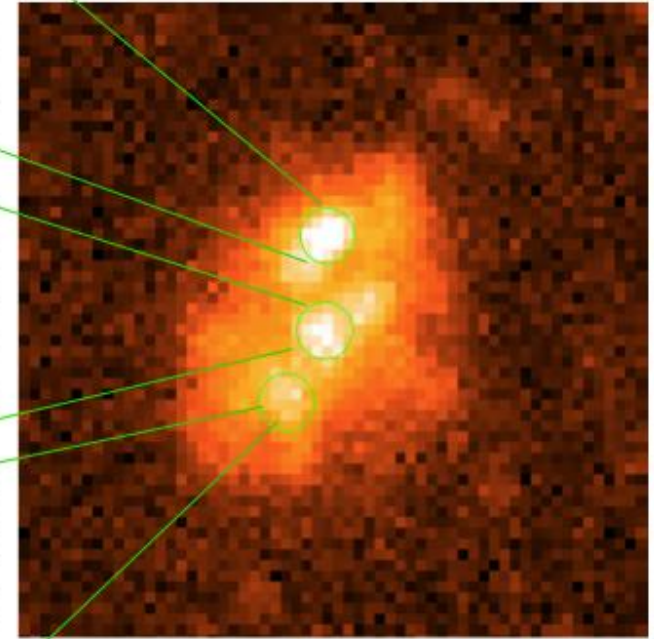
IRAM CO(1-0)

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

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

$$M_{\text{H}_2}/M_{\text{d}} = 2\text{--}27 \text{ (MW } X_{\text{CO}})$$

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

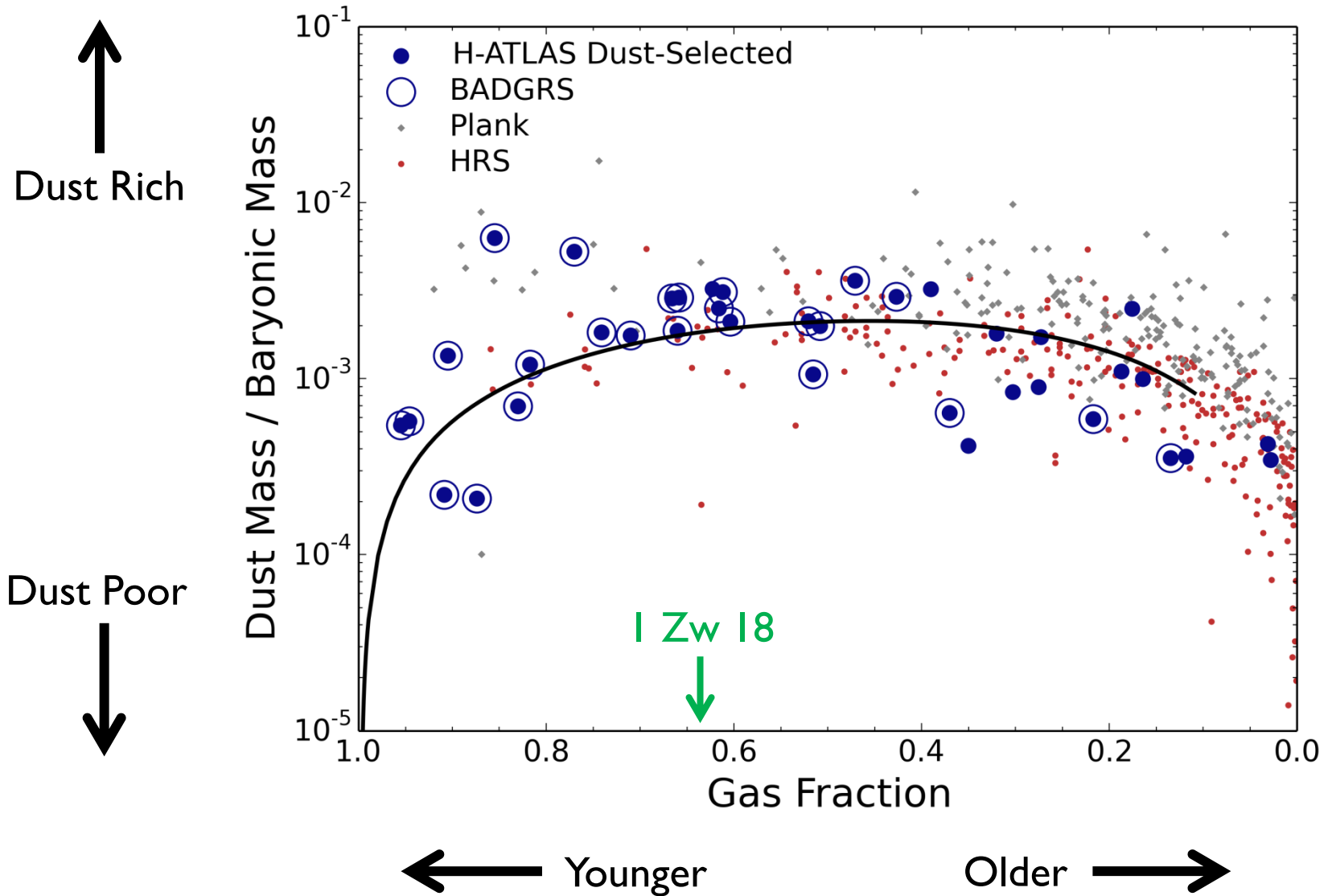


H-ATLAS 250 μm

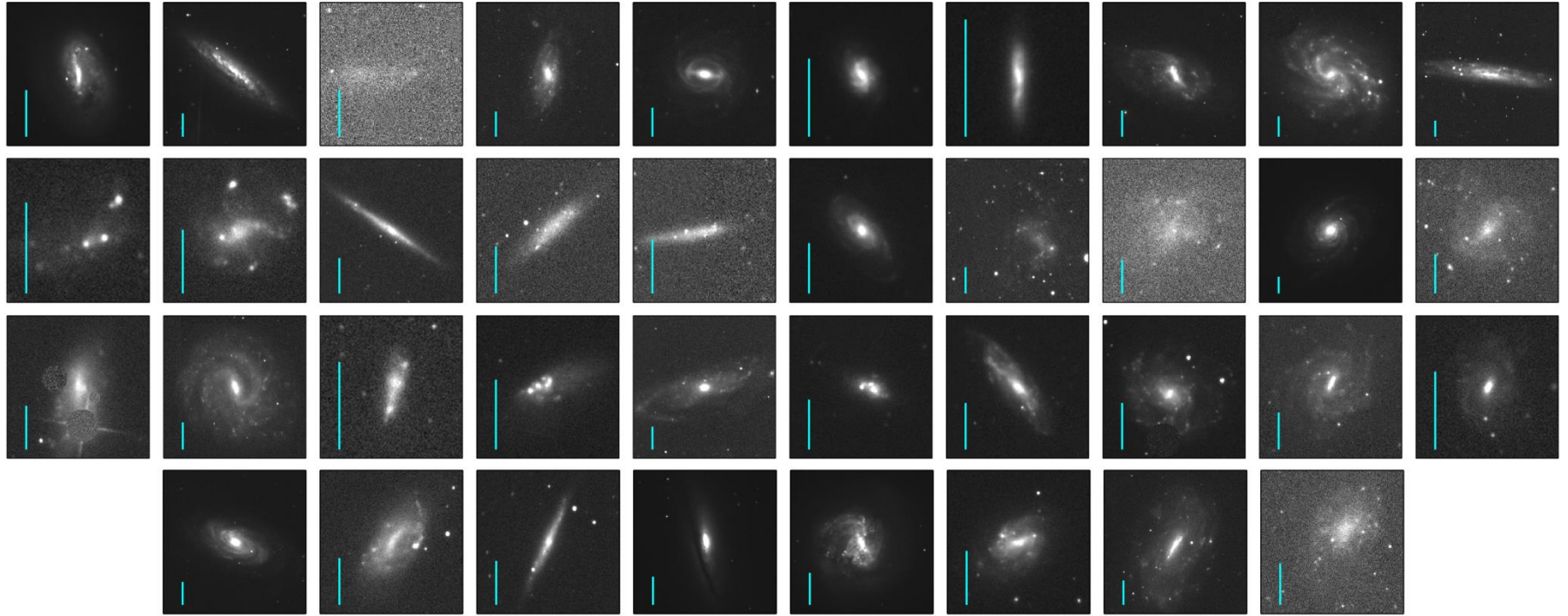
IRAM data by
Ivan Oteo and
Zhiyu Zhang

Chris Clark

A Dusty Window On Young Galaxies



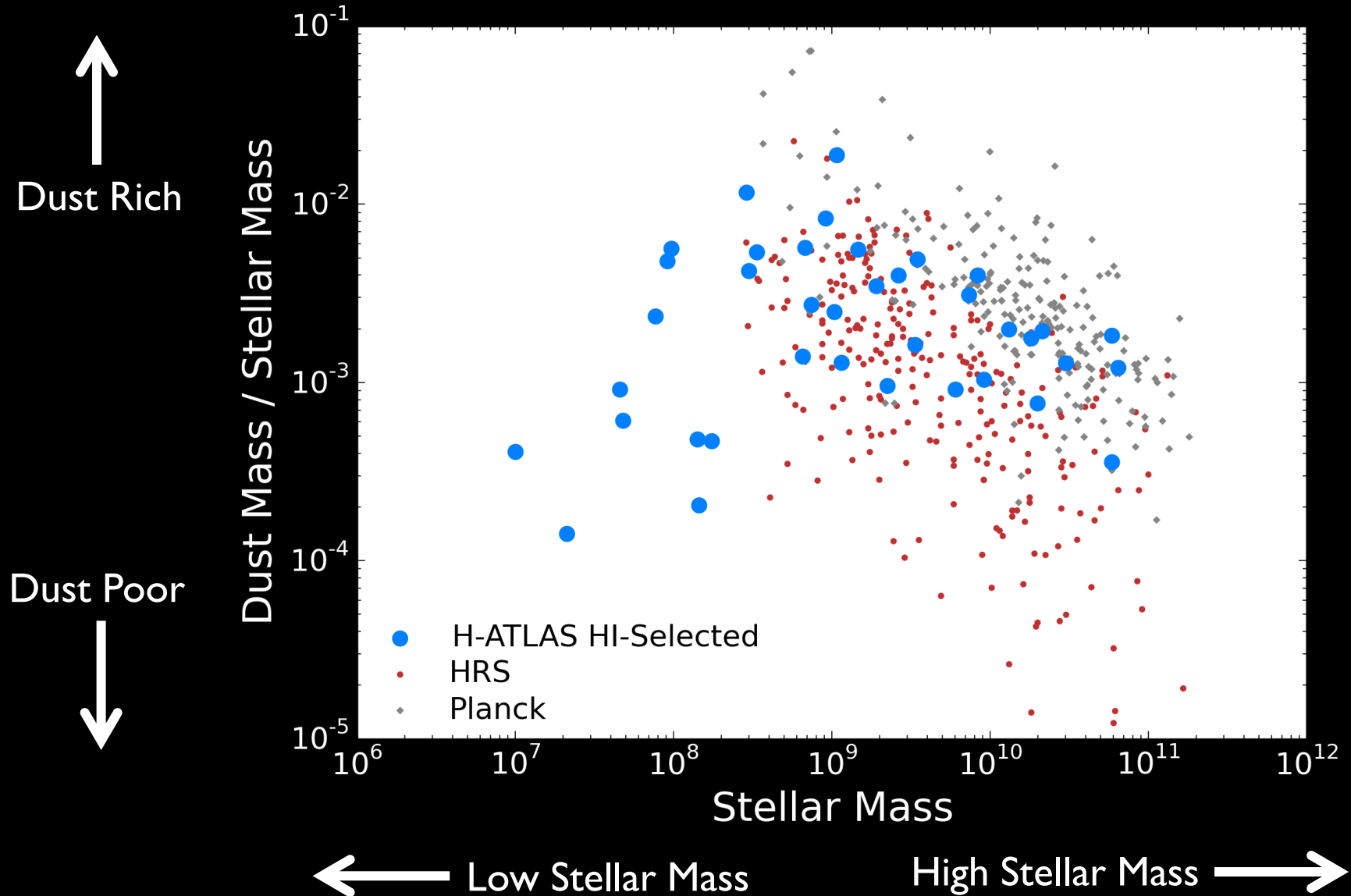
An HI-Selected Galaxy Sample in *H*-ATLAS



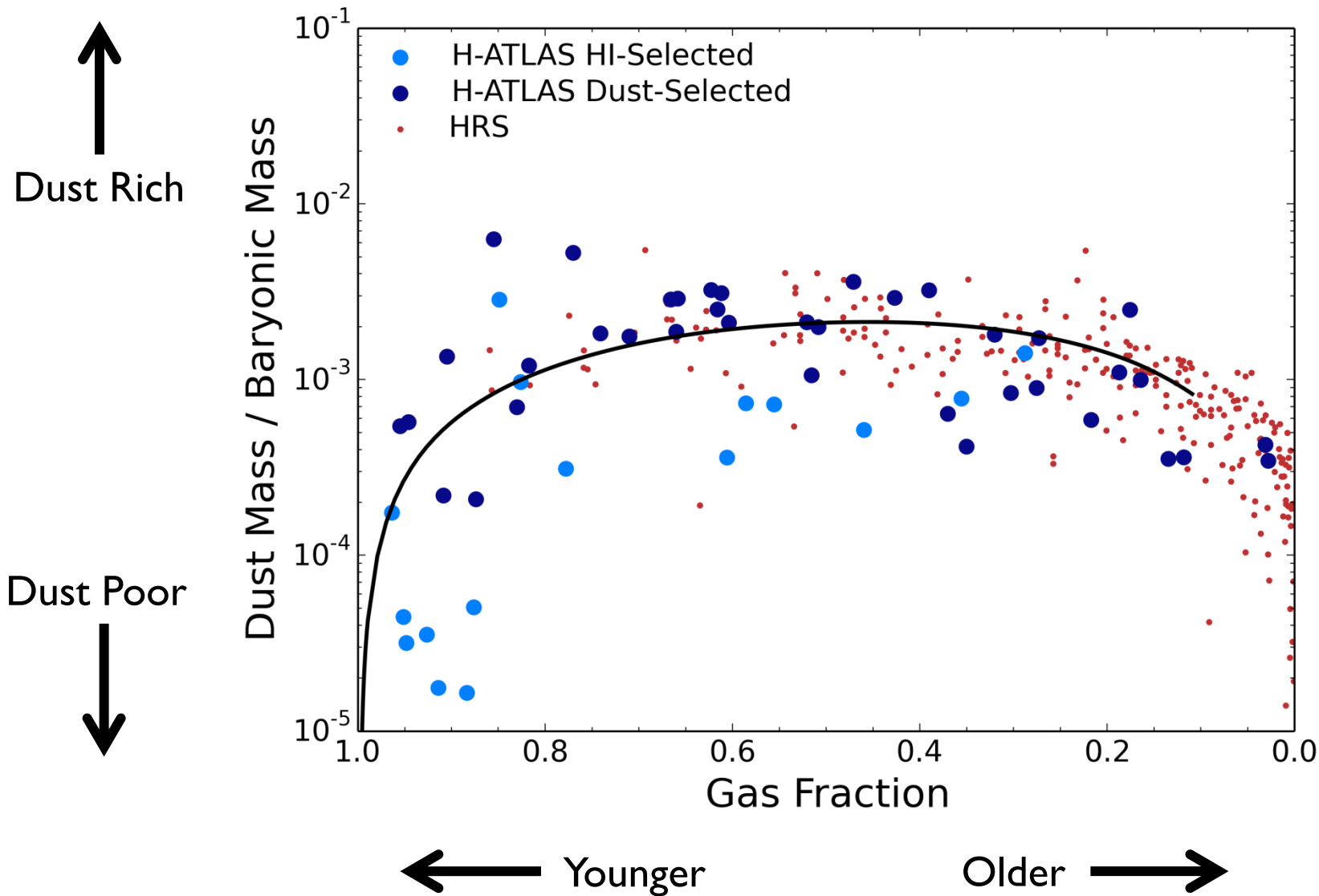
38 HIPASS-detected galaxies in *H*-ATLAS equatorial fields
(Pieter de Vis, Loretta Dunne, et al; in prep)

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

The Turnover in Dust Evolution



Extremely Young, Dust-Poor Galaxies

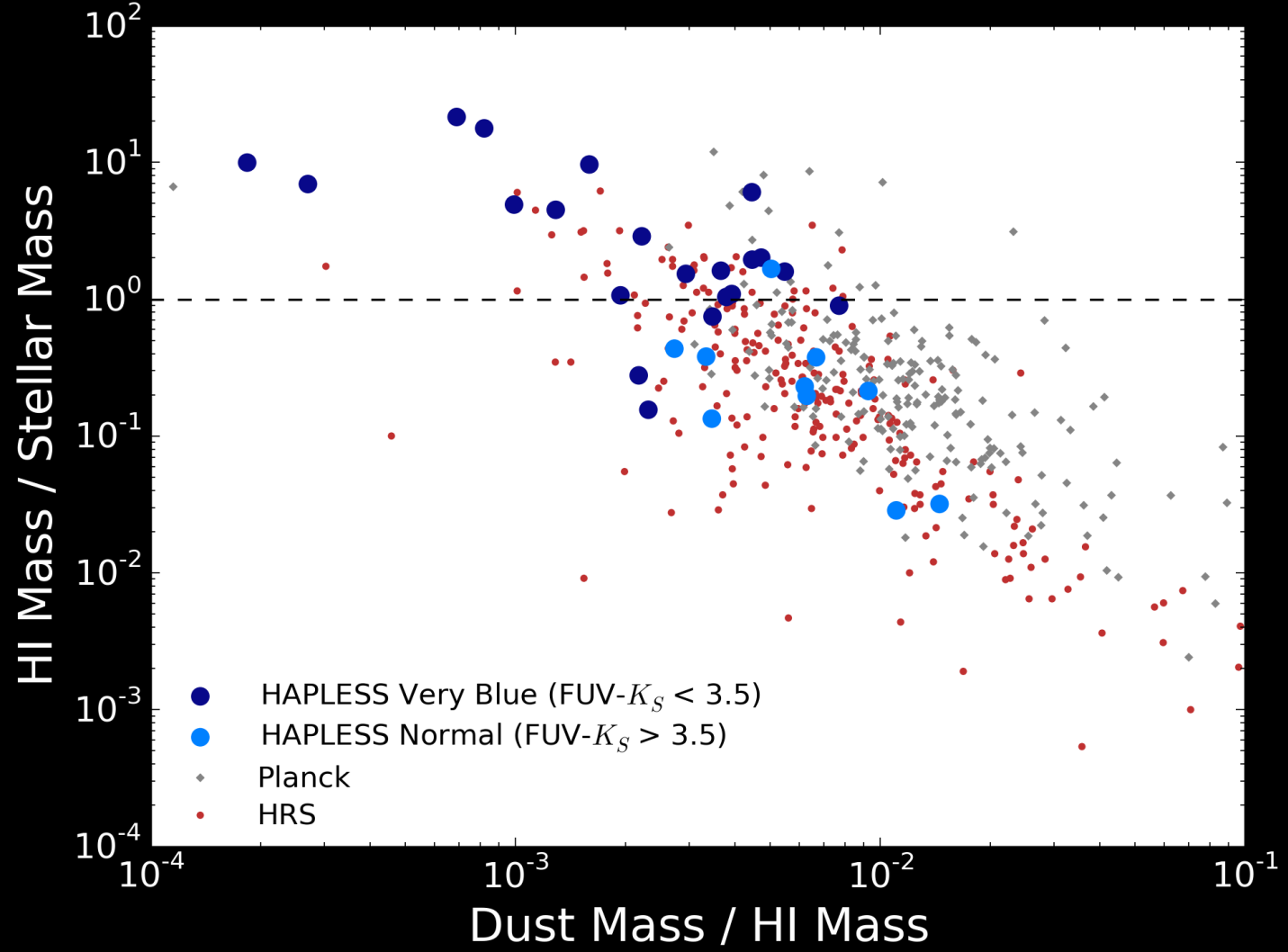


Key Results

- A dust-selected nearby galaxy survey with *Herschel*-ATLAS reveals that very blue ($FUV-K_s < 3.5$) 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.

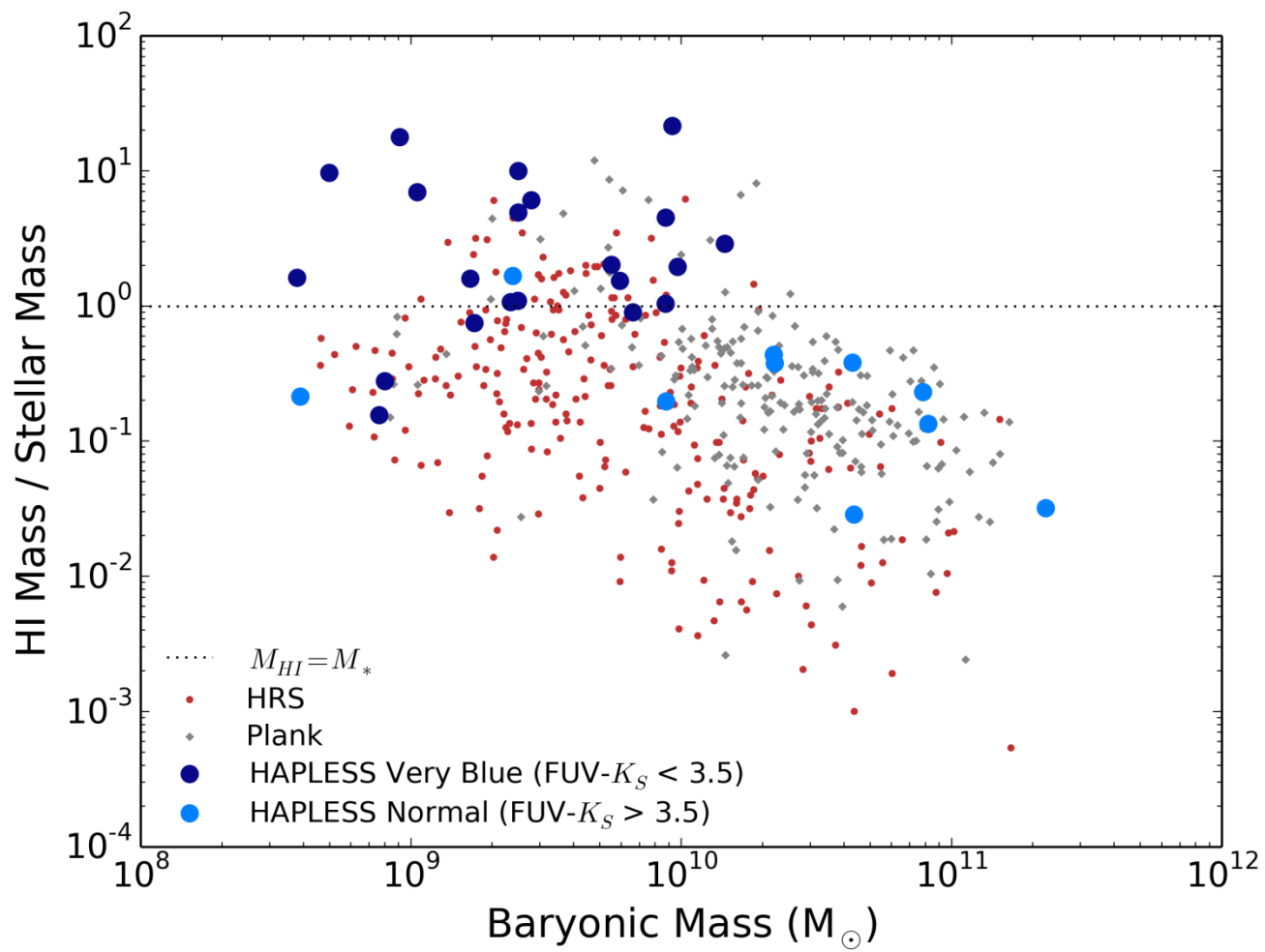
↑
Atomic Gas
Rich

↓
Atomic Gas
Poor



← Low Dust-to-Gas

High Dust-to-Gas →



- HAPLESS GAMA09
- HAPLESS GAMA12
- HAPLESS GAMA15
- All NED Optical

