

searching for the lowest metallicity galaxies

U.C. Santa Cruz

July 31, 2019

Small Galaxies,
Cosmic Questions

Tiffany Hsyu

Ryan Cooke

J. Xavier Prochaska

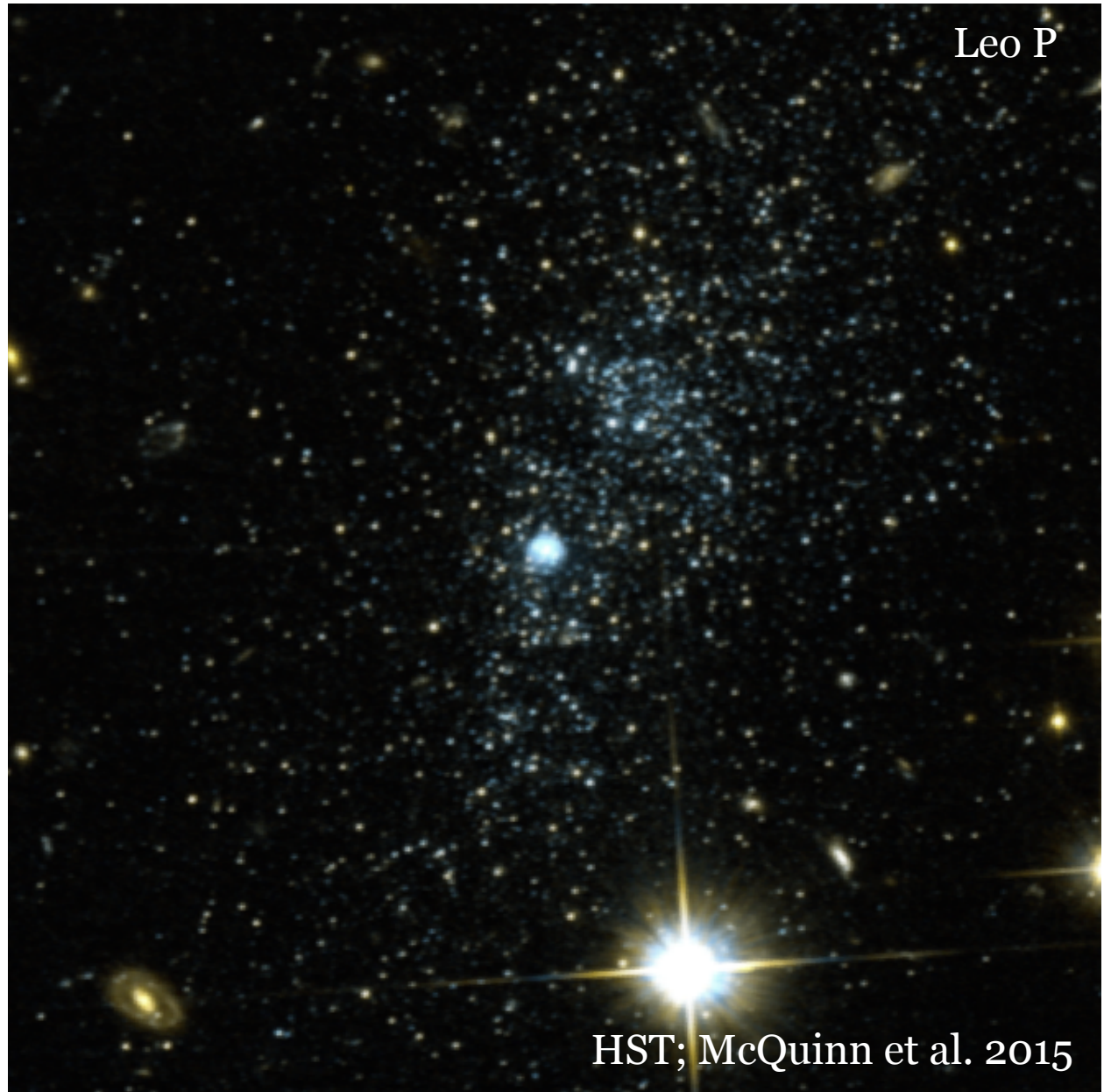
Mike Bolte

I Zwicky 18

- one of the few, near-pristine environments in our local Universe
- $12+\log(\text{O}/\text{H}) = 7.17$
 - $\sim 1/30^{\text{th}}$ solar
- enables studies of the very early Universe

low-metallicity galaxies in our local Universe

- detailed studies of physical conditions
- understanding of metal-poor environments
 - star formation
 - chemical evolution
- measurements of the primordial ^4He abundance



our program

- increase sample size of low metallicity galaxies through SDSS photometry

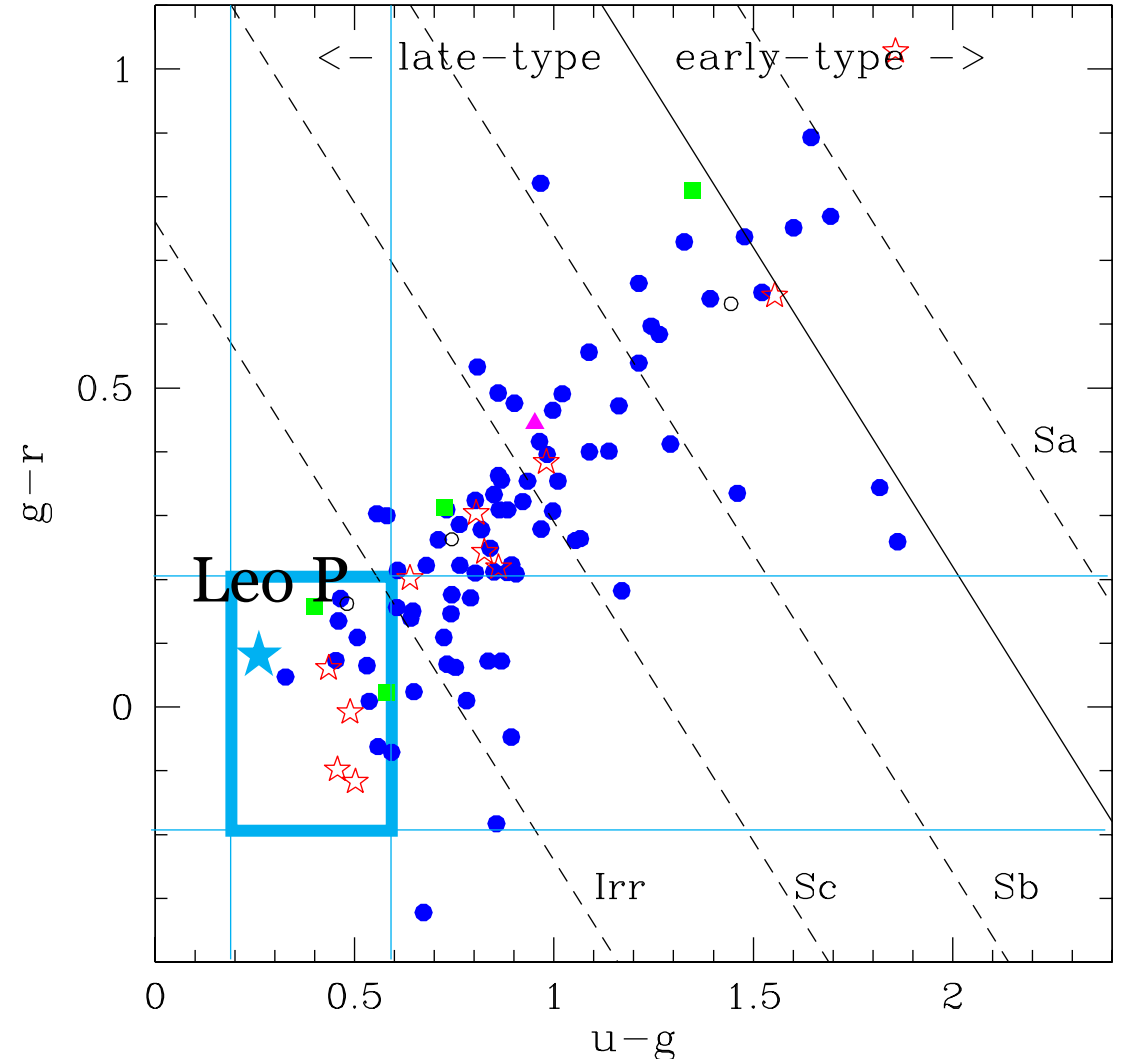
$$0.2 < u-g < 0.6$$

$$-0.2 < g-r < 0.2$$

$$-0.7 < r-i < -0.1$$


$$-0.4 - 2 * Z_{\text{error}} < i-z < 0.1$$

$$r < 21.5$$

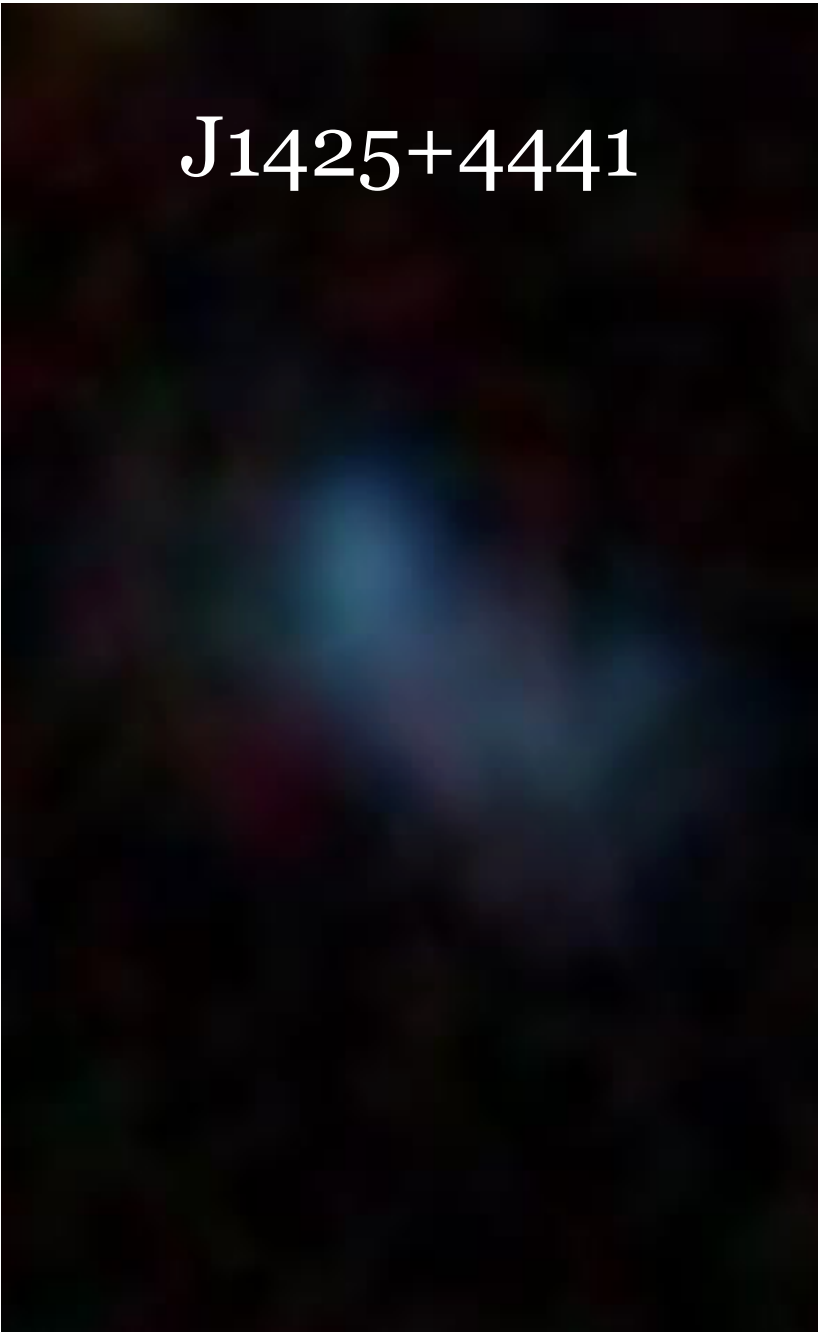


Lamareille et al. 2005

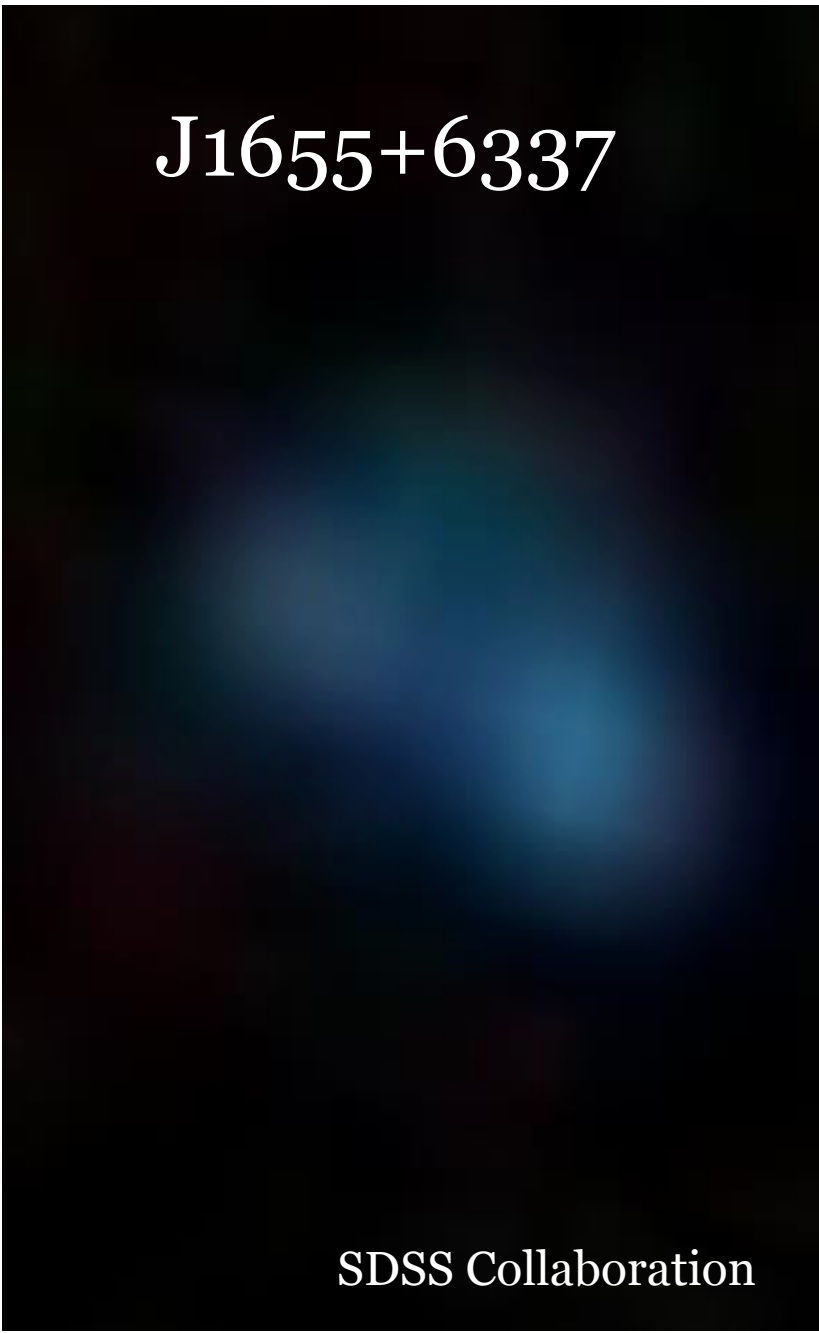
J1044+6306

Astronomical image of J1044+6306, showing a faint, diffuse blueish-white glow against a dark background.

J1425+4441

Astronomical image of J1425+4441, showing a faint, diffuse blueish-white glow against a dark background.

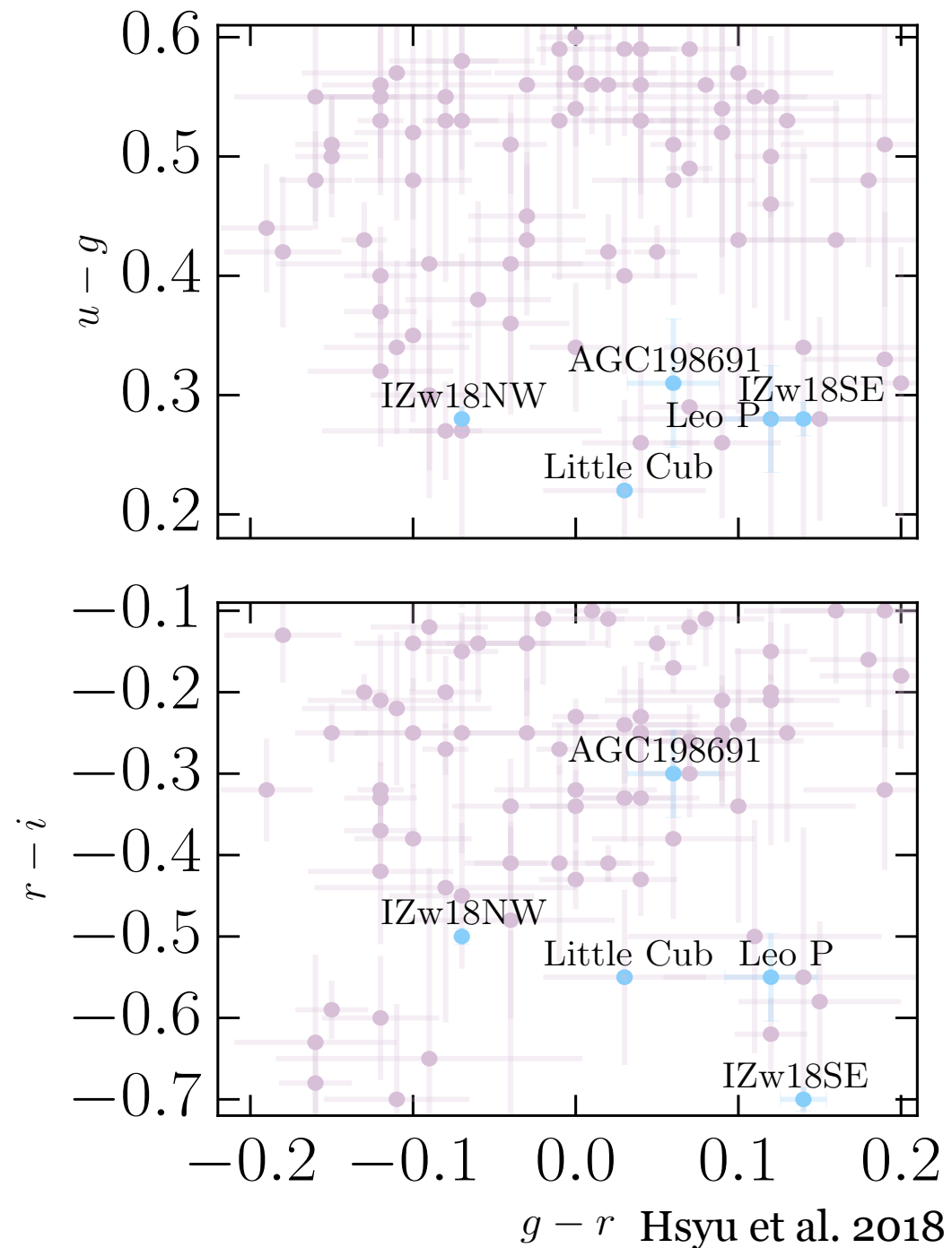
J1655+6337

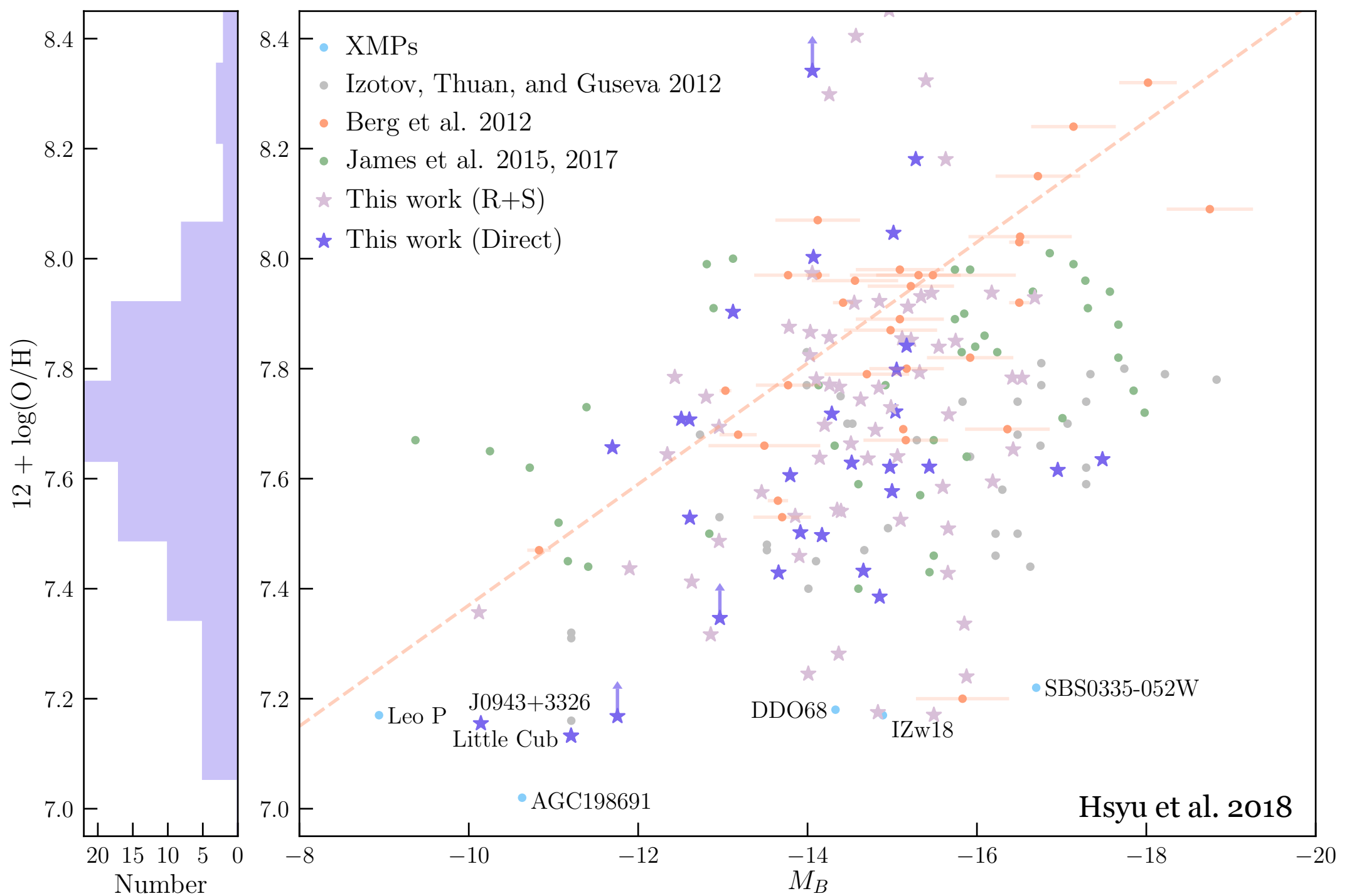
Astronomical image of J1655+6337, showing a faint, diffuse blueish-white glow against a dark background.

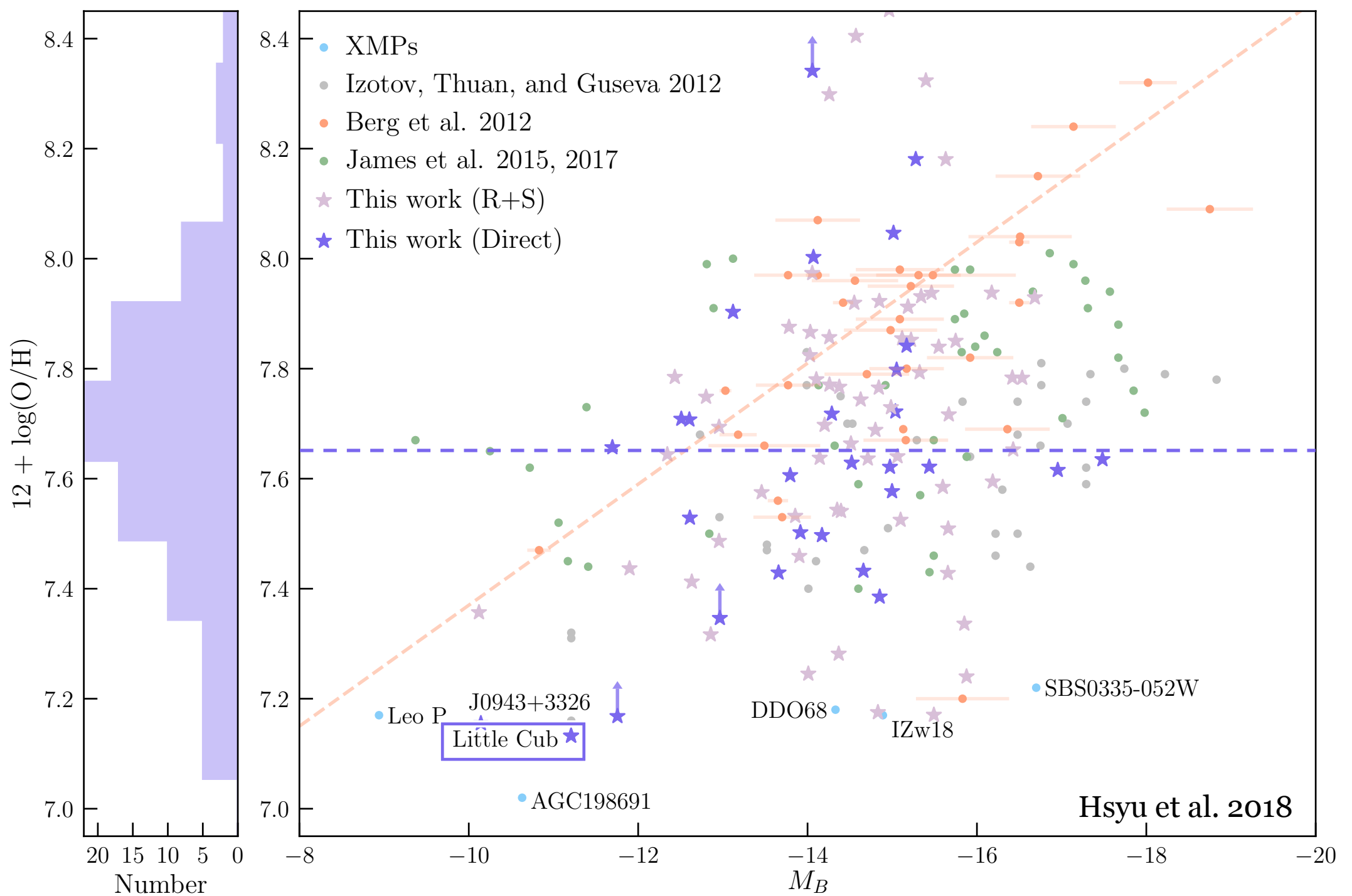
SDSS Collaboration

our results

- observed 158 candidate XMPs
 - initial observations using Kast at Lick Observatory
 - follow up spectroscopy using LRIS at Keck Observatory

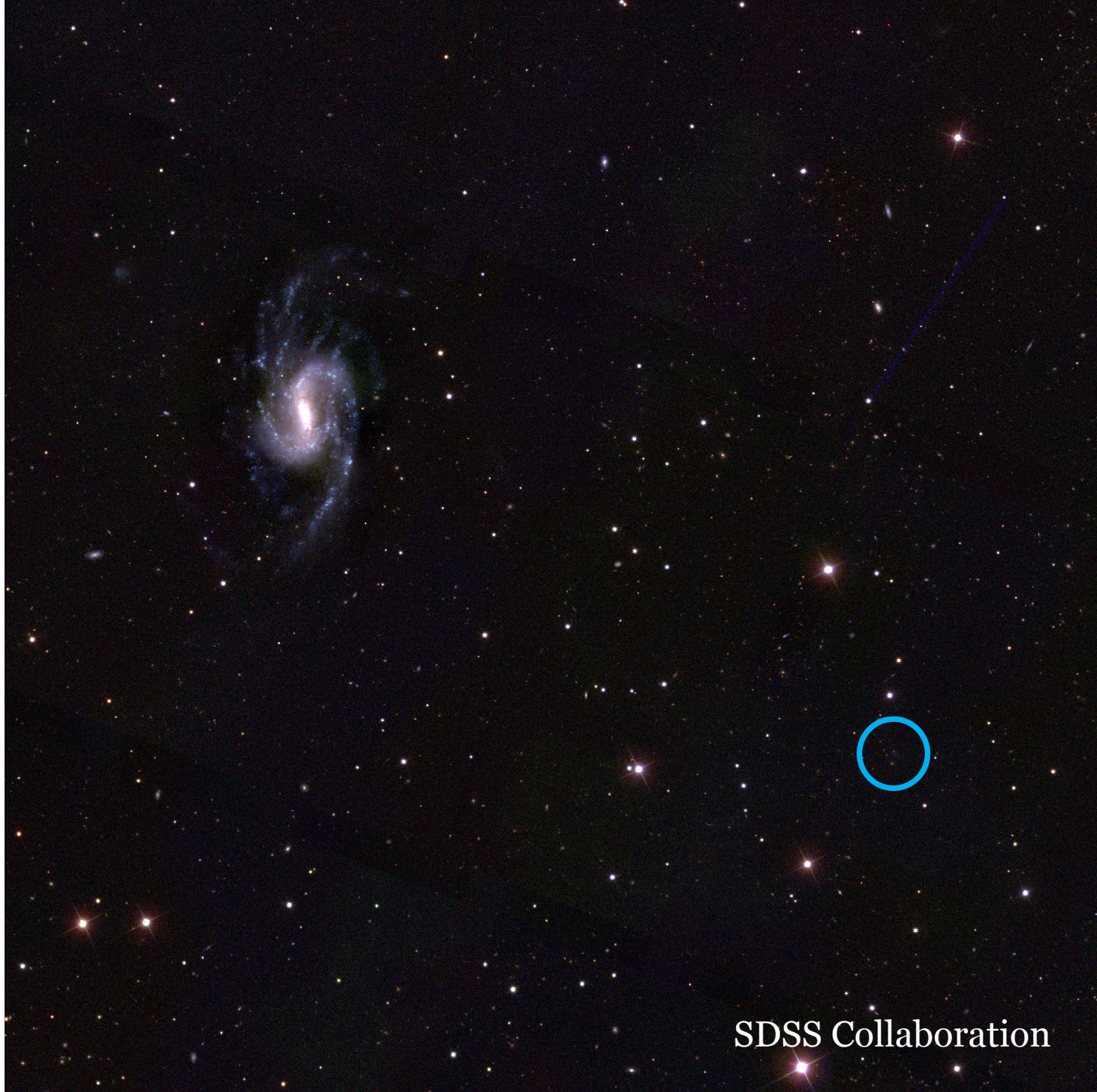






the little cub

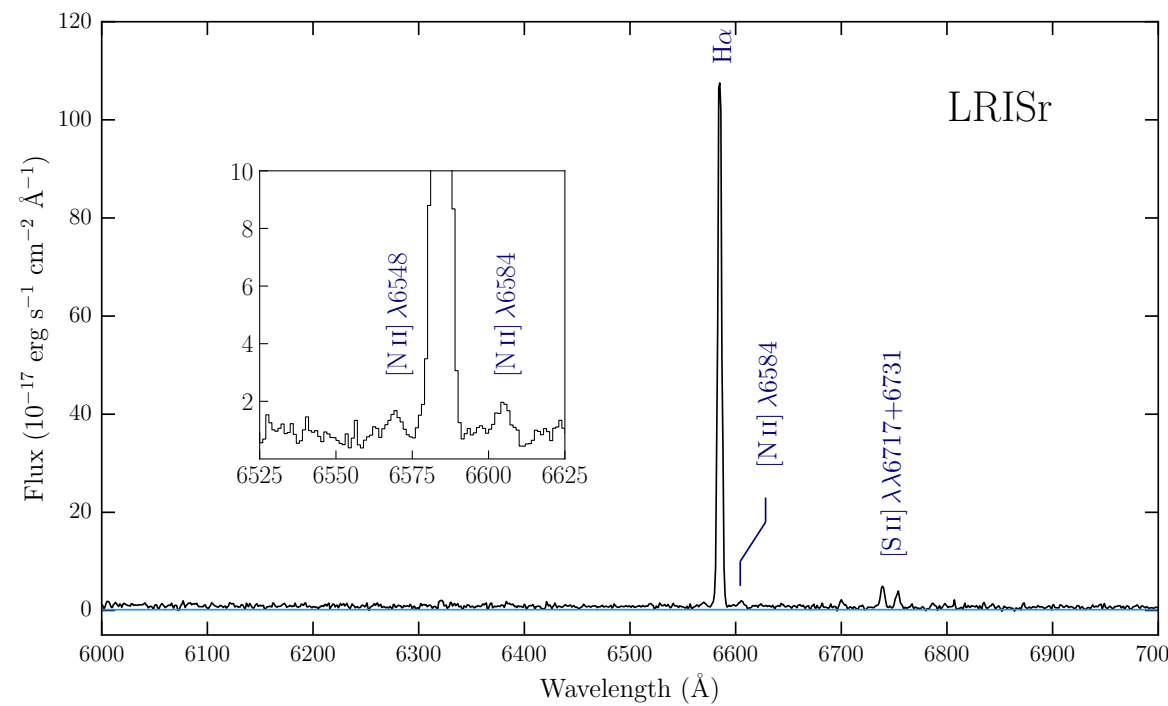
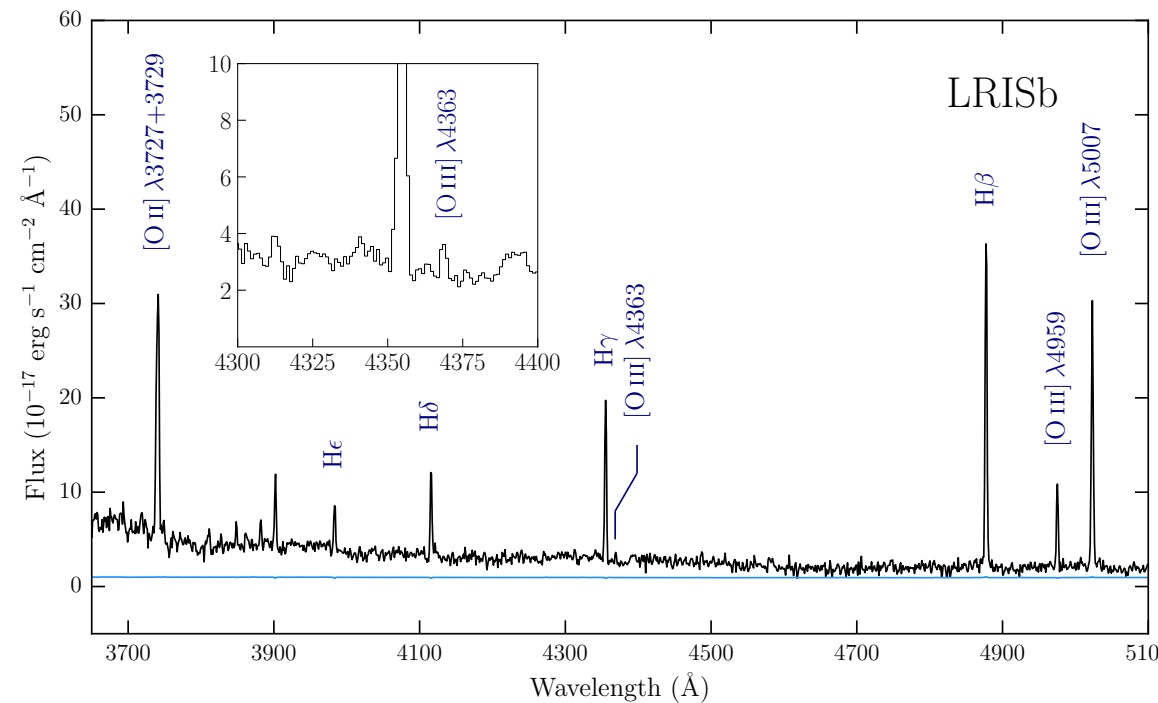
- selected through SDSS photometry
- one of the lowest metallicity star-forming galaxies currently known



the little cub

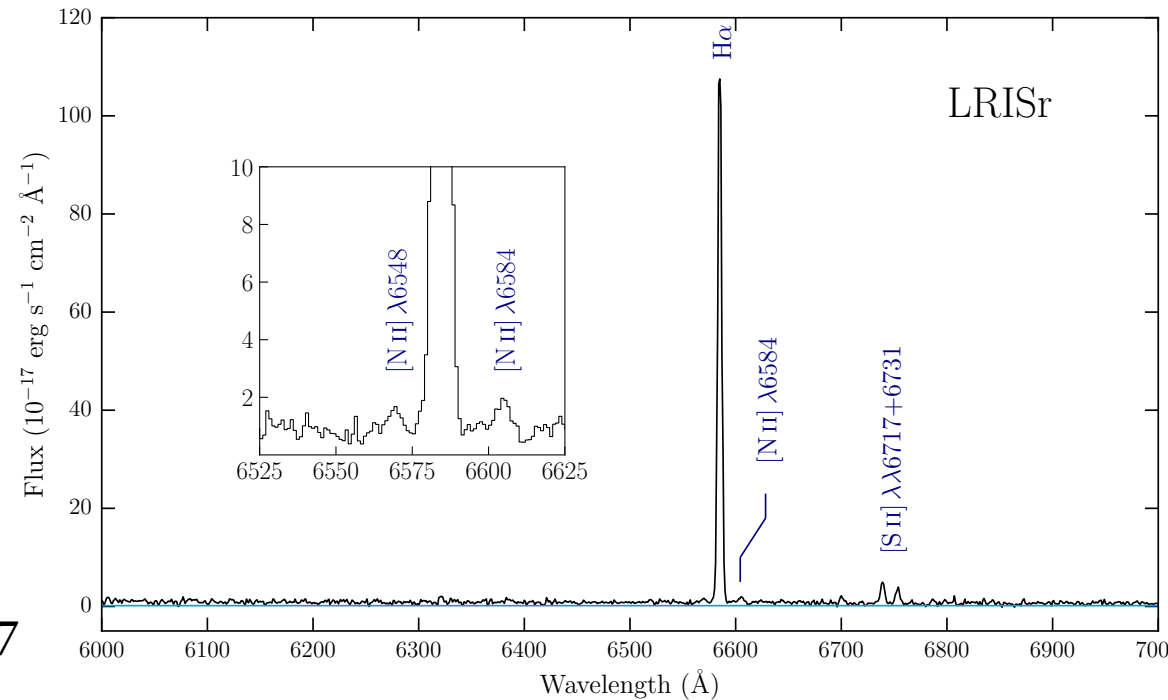
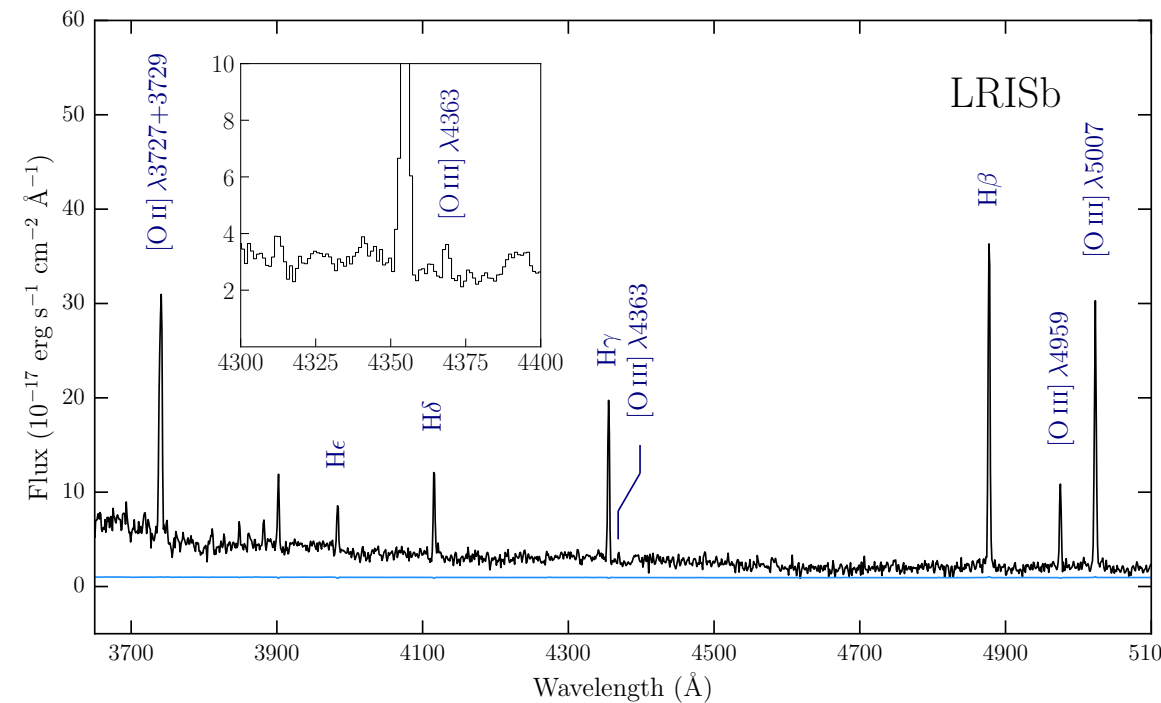


Hsyu et al. 2017



the little cub

- $12+\log(\text{O}/\text{H}) = 7.13 \pm 0.08$
 - $\sim 0.03 Z_{\odot}$
- redshift, $z = 0.0032$
 - $d_{\text{LC}} \sim 15.8 - 20.6 \text{ Mpc}$
- $\text{SFR} \sim 0.63 - 1.1 \times 10^{-3} M_{\odot} \text{ yr}^{-1}$



the little cub

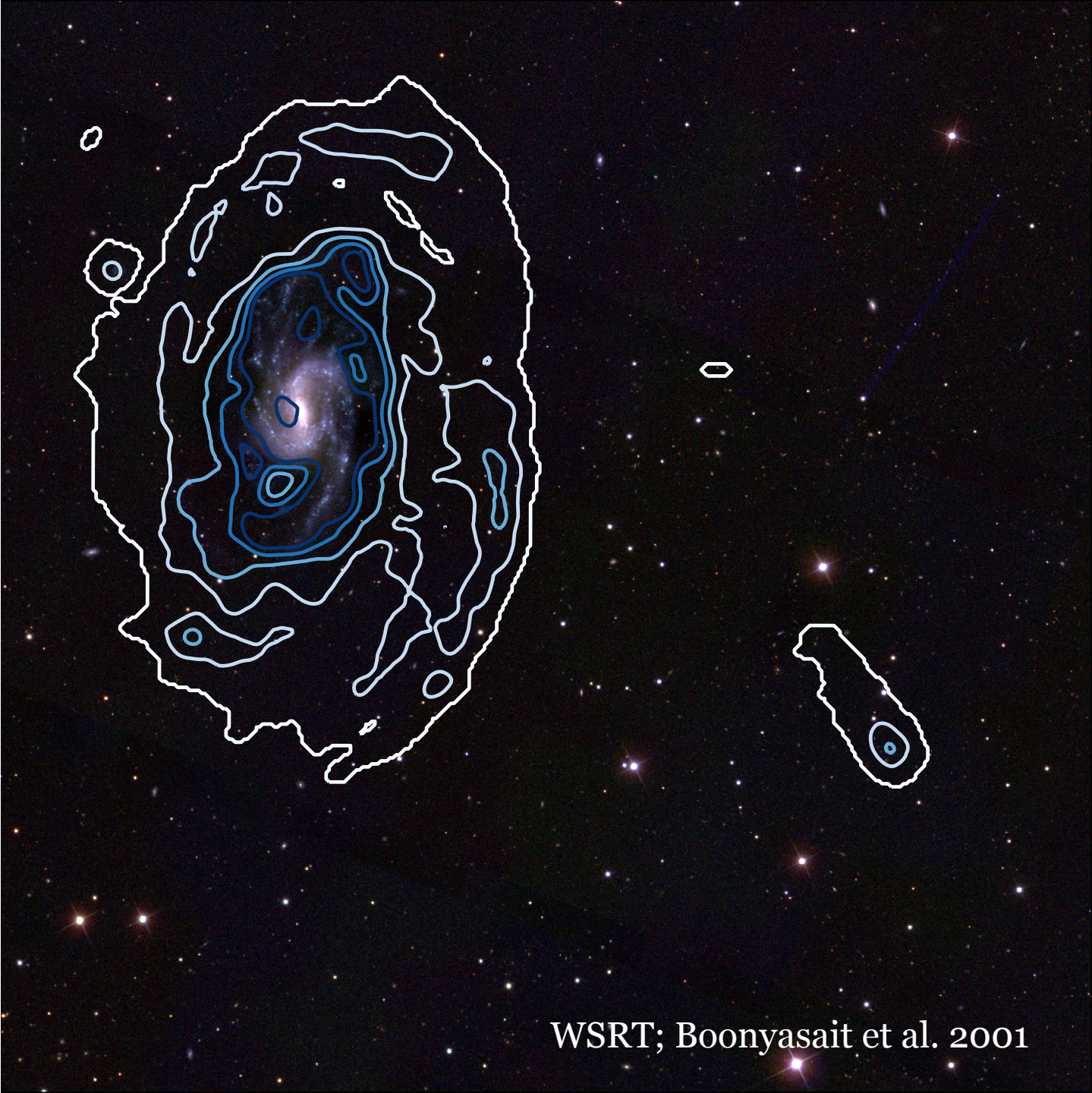
Hsyu et al. 2017



SDSS Collaboration

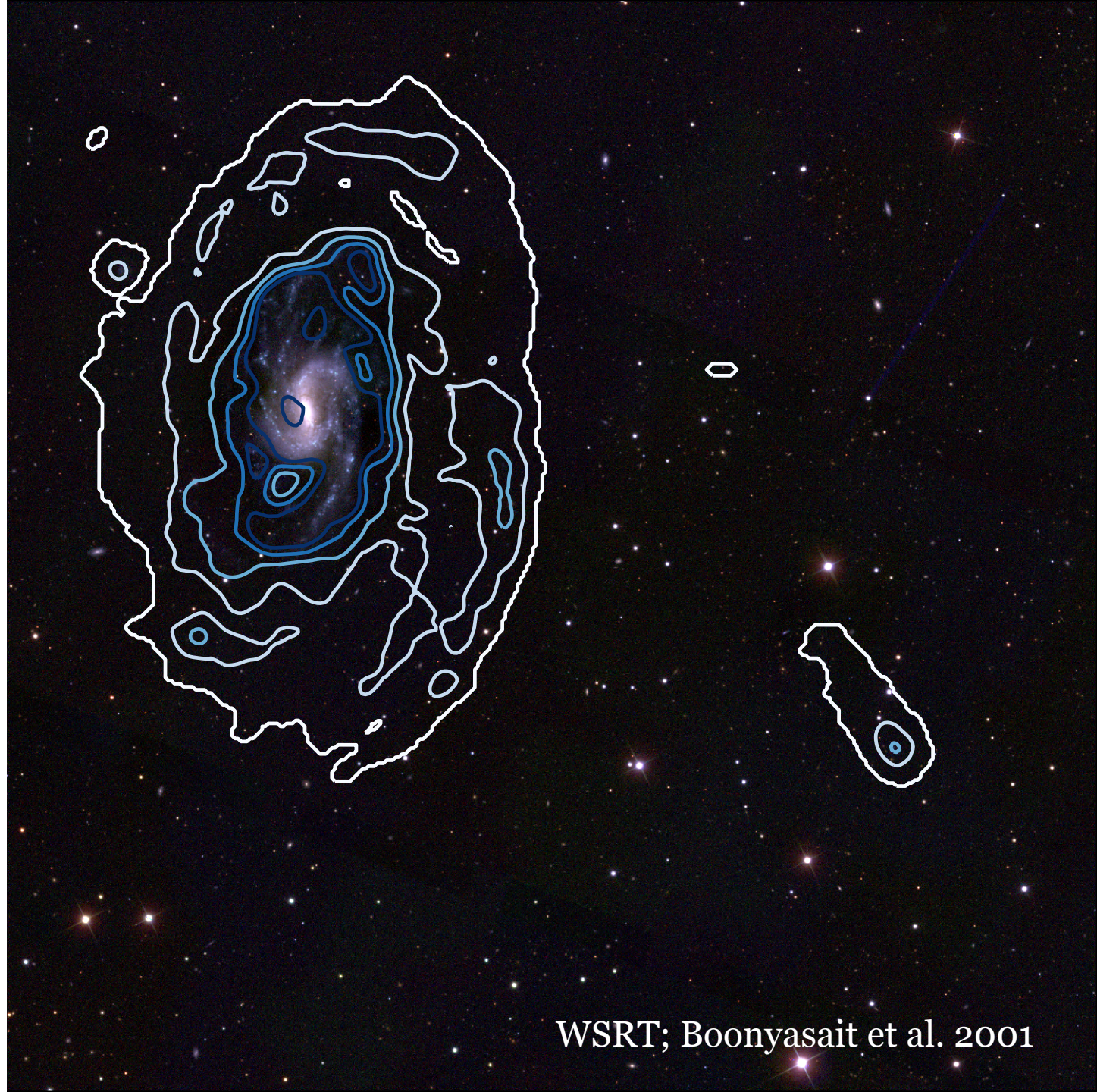
the little cub

- gas rich
 - $M_{\text{HI}} = 4.7\text{-}8.2 \times 10^7 M_{\odot}$
 - $M_{*} \sim 10^5\text{-}10^6 M_{\odot}$



the little cub

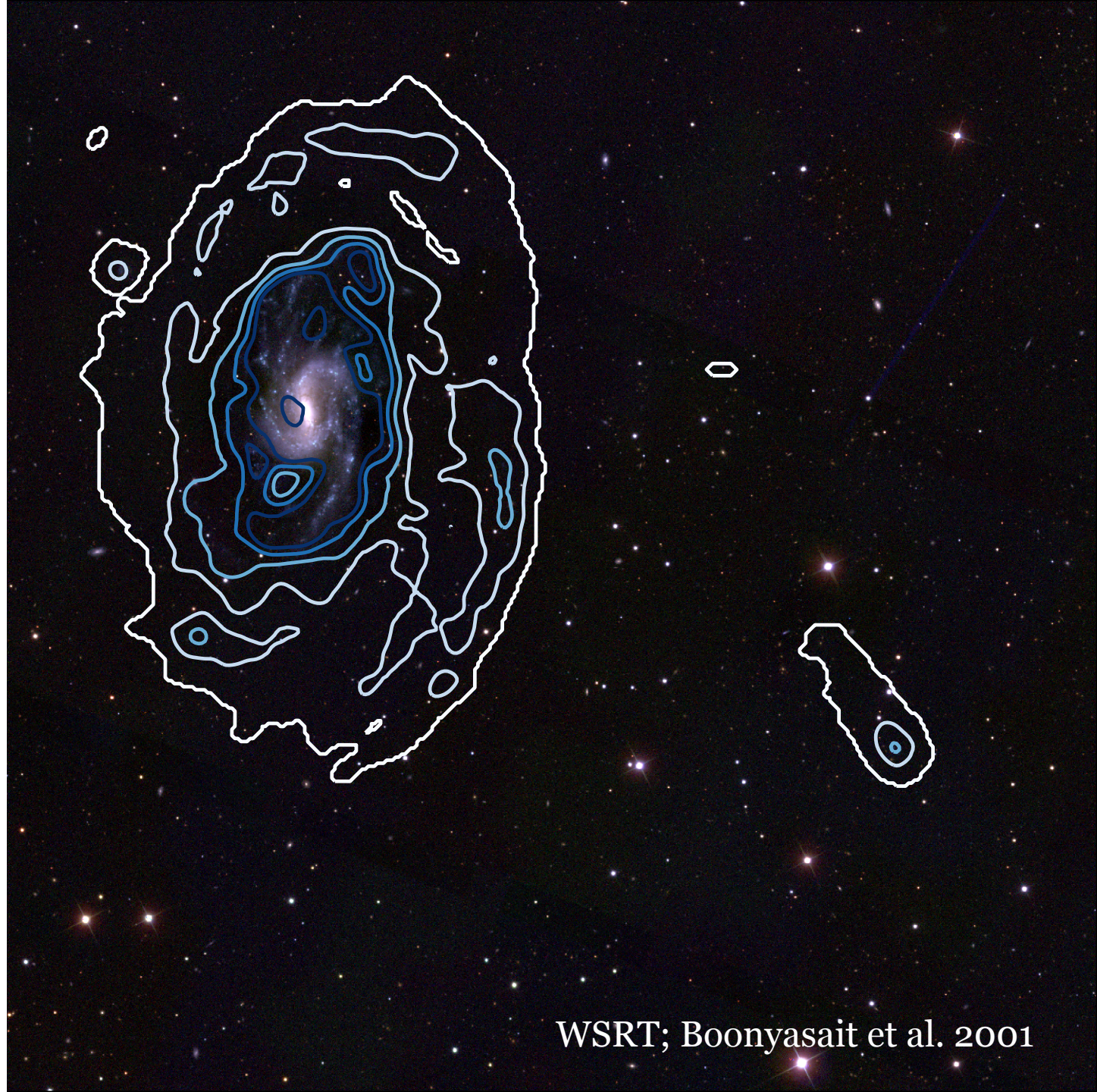
- gas rich
 - $M_{\text{HI}} = 4.7\text{-}8.2 \times 10^7 M_{\odot}$
 - $M_{*} \sim 10^5\text{-}10^6 M_{\odot}$
- interacting with nearby spiral NGC 3359?
 - $d_{\text{NGC3359}} = 20.8 \text{ Mpc}$
(Tully et al. 2013)
 - $v_{\text{offset}} = 53 \text{ km/s}$
 - $d_{\text{projected}} = 70\text{-}90 \text{ kpc}$



the little cub

- gas rich satellite?
 - unusual to find low mass, gas rich satellites in LG
 - are LG satellites atypical? (Geha et al. 2017)

Hsyu et al. 2017



WSRT; Boonyasait et al. 2001

NGC 3359

From Wikipedia, the free encyclopedia

Coordinates:  10°46′36.8″S﻿, ﻿63°13′25″

NGC 3359 is a **galaxy** located 49 million light years from Earth.^[1] The central bar is approximately 500 million years old.^[2]

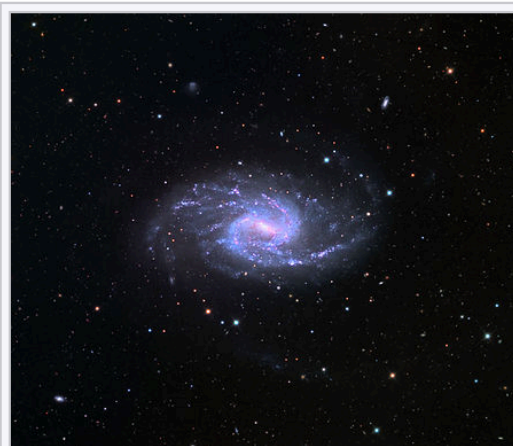
NGC is "devouring" the much smaller galaxy, nicknamed the **Little Cub**.^[3]

References [edit]

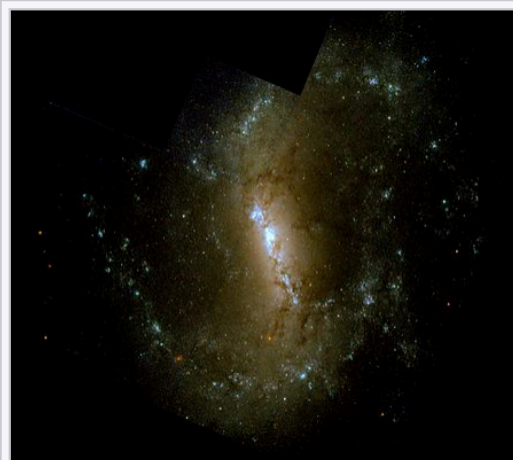
- ↑ "NGC 3359" . *u-strasbg.fr*.
- ↑ "Best of AOP: NGC 3359" . *noao.edu*.
- ↑ "'Little Cub' giving astronomers a rare chance" .



*This galaxy-related article is a **stub**. You can help Wikipedia by **expanding it**.*



NGC 3359 in 32 inch telescope



Galaxy NGC 3359 in Ursa Major (HST)

NGC 3359



NGC 3359

Observation data (J2000.0 epoch)

Right ascension 10^h 46^m 36.8^s

Declination +63° 13′ 25″

Redshift 0.003373

Characteristics

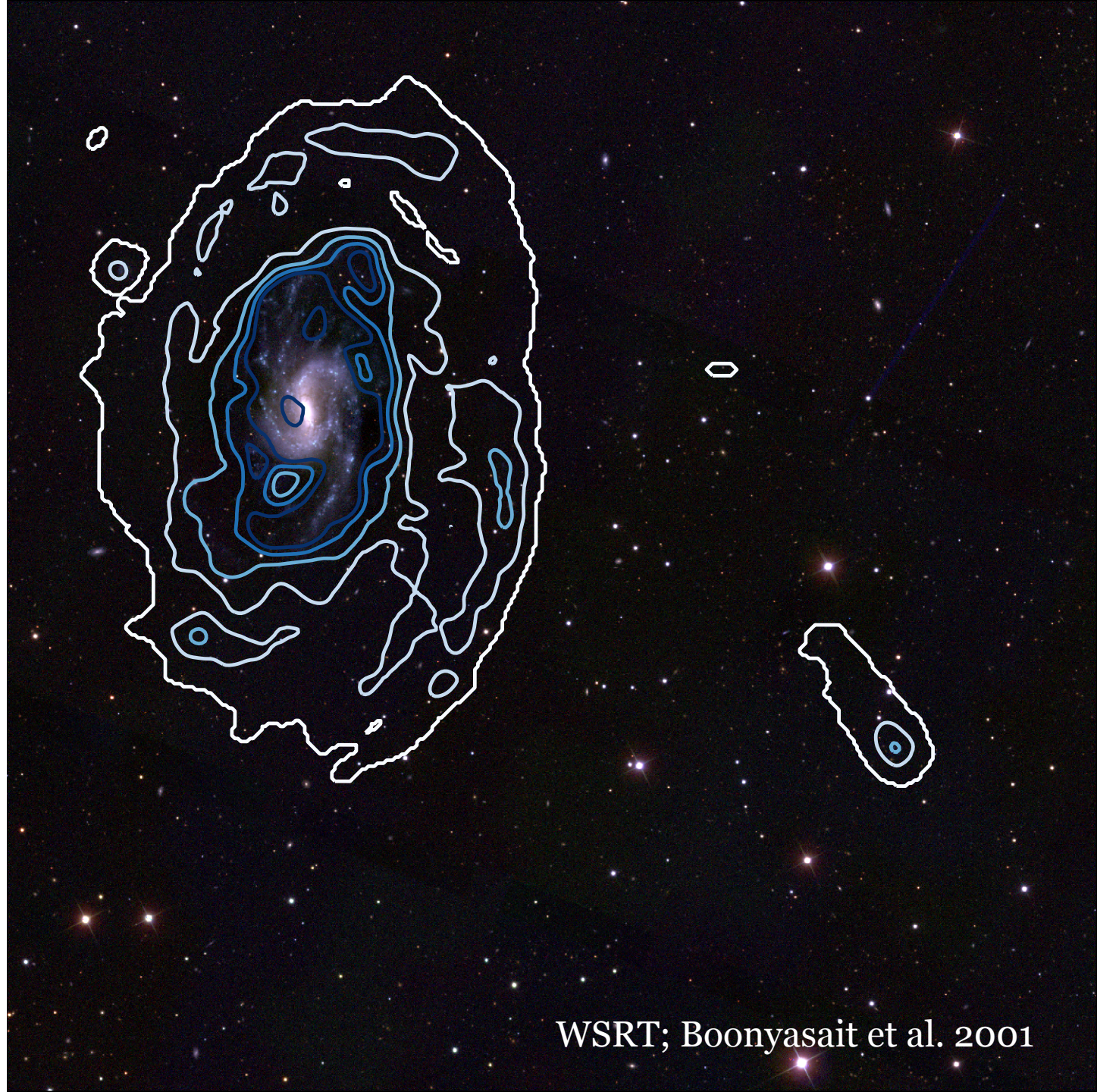
Apparent size (v) 4.683 × 1.920 arcmin

See also: [Galaxy](#), [List of galaxies](#)

the little cub

- gas rich satellite?
 - unusual to find low mass, gas rich satellites in LG
 - are LG satellites atypical? (Geha et al. 2017)
 - laboratory to study dwarf galaxy evolution, satellite quenching due to massive host galaxy

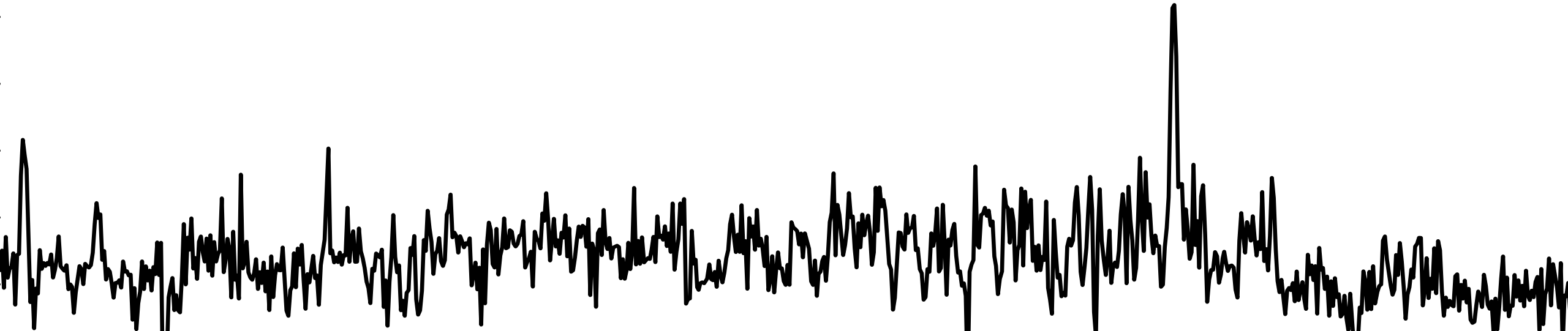
Hsyu et al. 2017



WSRT; Boonyasait et al. 2001

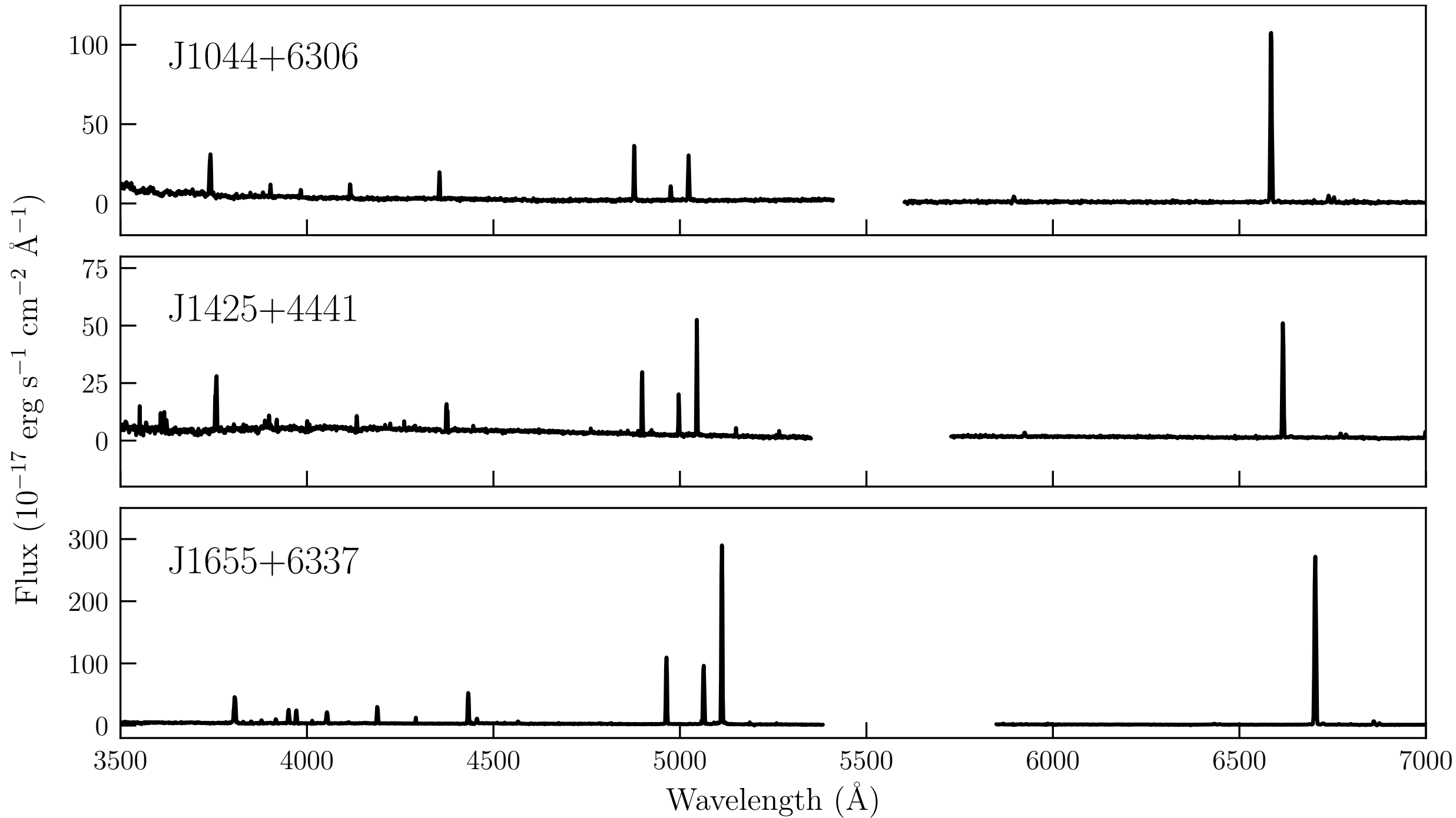
a new, low-metallicity sample set

- obtained follow-up, complementary optical+near-infrared spectroscopy on a subset of our XMP sample
 - more than doubles the current number of systems used in latest primordial ^4He measurements



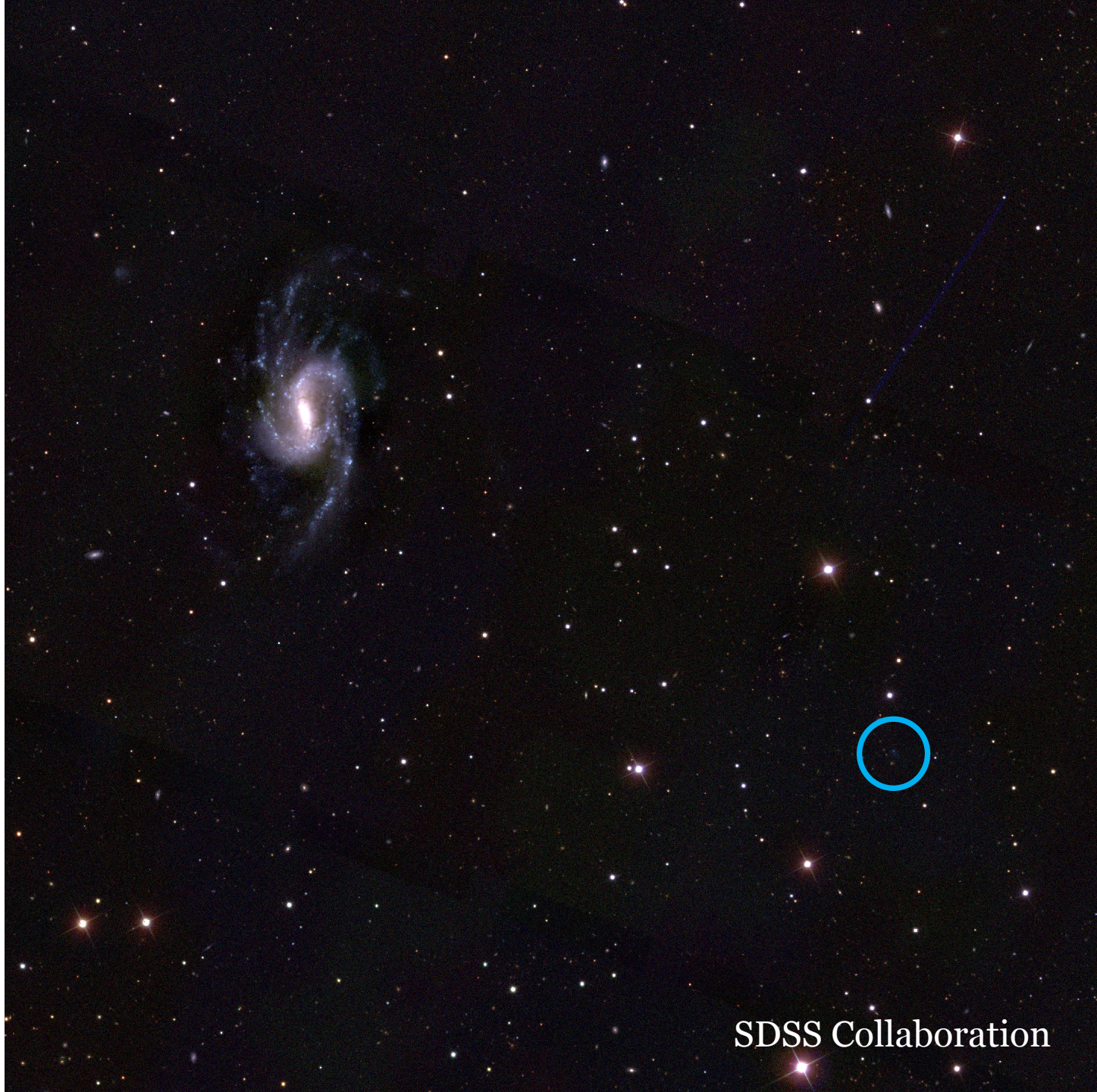
summary

- new survey to identify the most metal-poor galaxies in our cosmic neighborhood based on SDSS photometry
- report the discovery of ~100 new systems
- extremely successful at identifying new, low-metallicity systems
 - almost half having $12+\log(\text{O}/\text{H}) \leq 0.1 Z_{\odot}$
- report the discovery of one of the most metal-poor star-forming galaxies currently known – the Little Cub
- stay tuned for a measurement of the primordial ${}^4\text{He}$ abundance!



the little cub

- selected through SDSS photometry
- one of the lowest metallicity star-forming galaxies currently known



the little cub

- selected through SDSS photometry
- one of the lowest metallicity star-forming galaxies currently known

