Constraining GRB and SLSN progenitors using a large, unbiased sample of nearby core-collapse supernovae

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MOTIVATION

Almost all low-z LGRBs (Vergani+2015) and SLSNe-I have been in dwarf galaxies with low stellar masses
(Lunnan+2014,Perley+2016,Schulze+2016)

- Preference for dwarfs -> metallicity limit

Many SLSNe are found in starburst dwarf galaxies (Leloudas+2015,Perley+2016) and LGRBs are common in strongly star-forming regions also (Fruchter+2006,Kelly+2014)

How significant are these trends? Is it unique to LGRBs/ SLSNe?

If real, what is physical cause (and what is the progenitor)?

OUR STUDY

Aim: Gather a control sample of core-collapse supernova host galaxies to make quantitative comparisons to the hosts of LGRBs and SLSN

This will help determine the importance of the starburst phase to SN production in dwarf galaxies

Previous control samples are limited due to: biases (targeting and follow-up), low number statistics

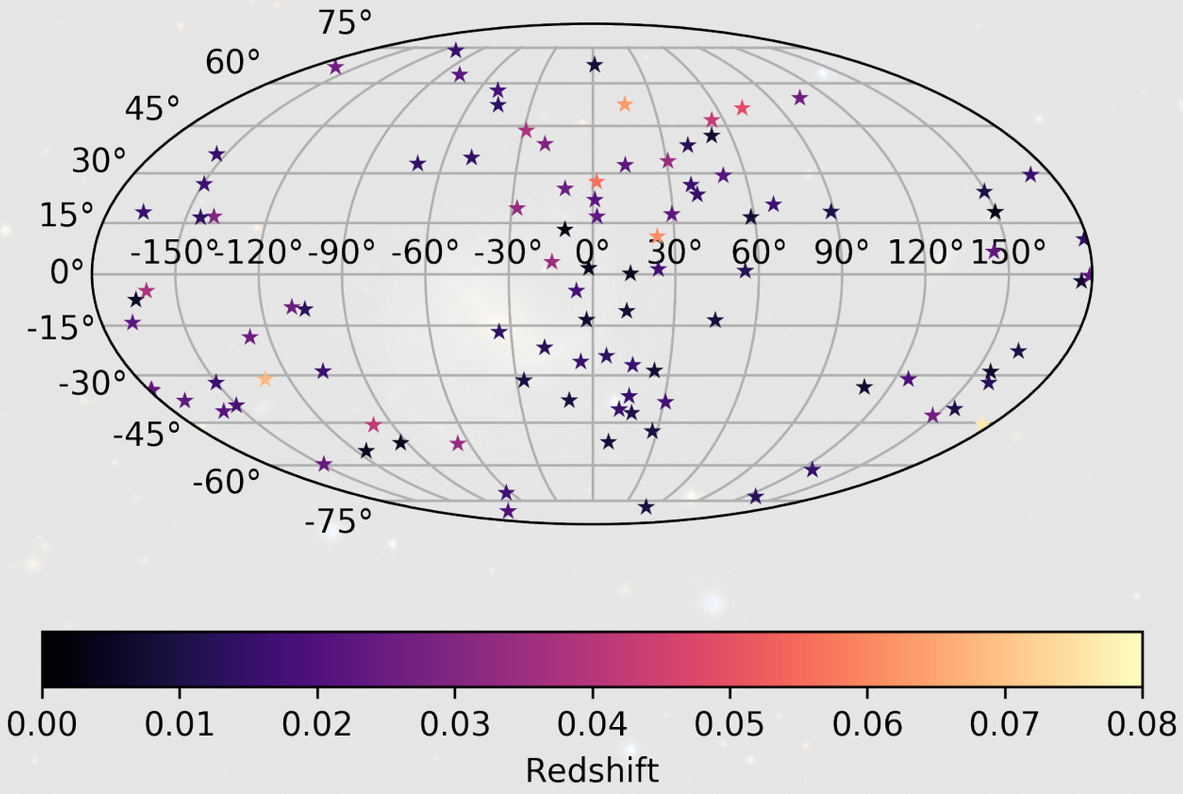
SAMPLE SELECTION

Survey: "All-Sky Automated Survey for Supernovae" (ASAS-SN).

Untargeted, Unbiased and spectroscopically complete (Shappee+2014)

Sample size: 100 CCSN host galaxies (2013-March 2017)

69 host galaxies above -30° δ

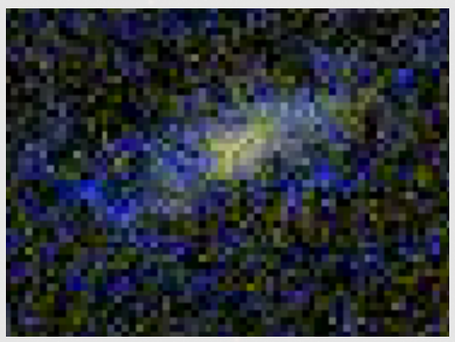


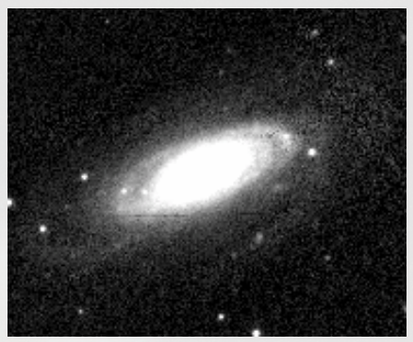
METHODOLOGY

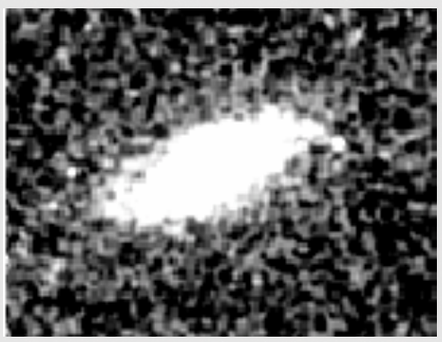
Photometry of galaxies from UV to near IR:

- GALEX, Nasa Sloan Atlas, Pan-STARRS, and 2MASS

Use identical aperture sizes to measure the brightness of a galaxy in each band





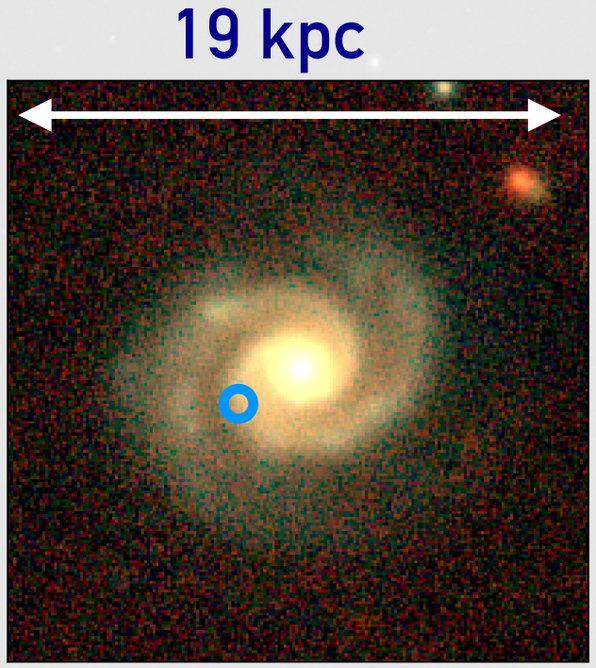


SEDs of galaxies fitted using Le Phare (Arnouts+1999,Ilbert+2006) to derive the stellar mass and an approximate SFR

NGC 5227

Supernova: ASAS-SN 15fz (type II)

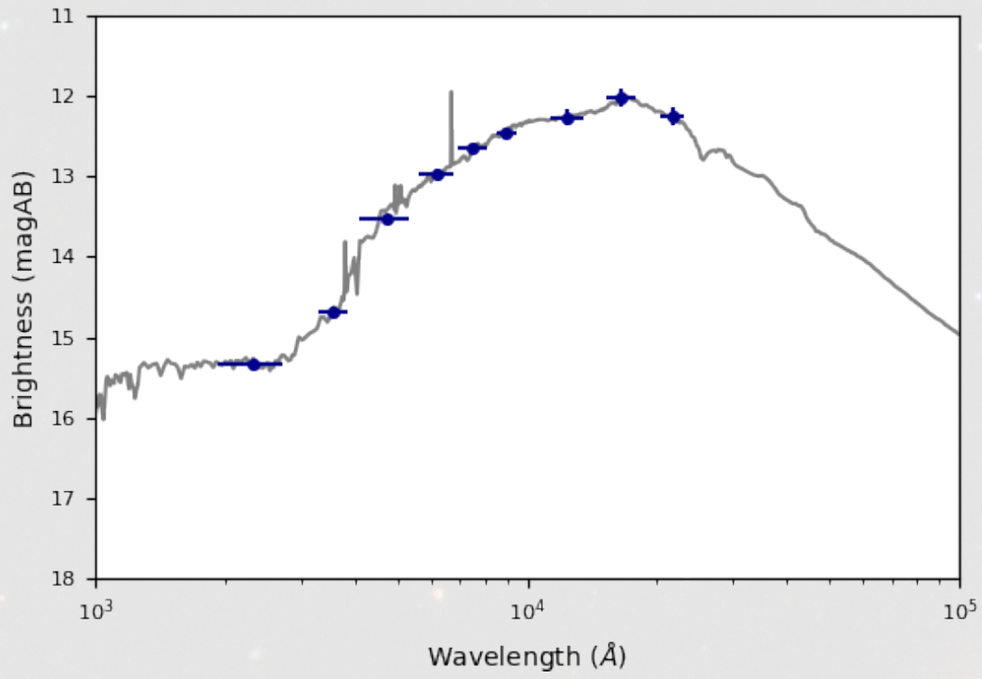
Morphology: Barred spiral galaxy



Mass: 2.8×10^{10} $M_\odot$

(~1/2 mass of MW)

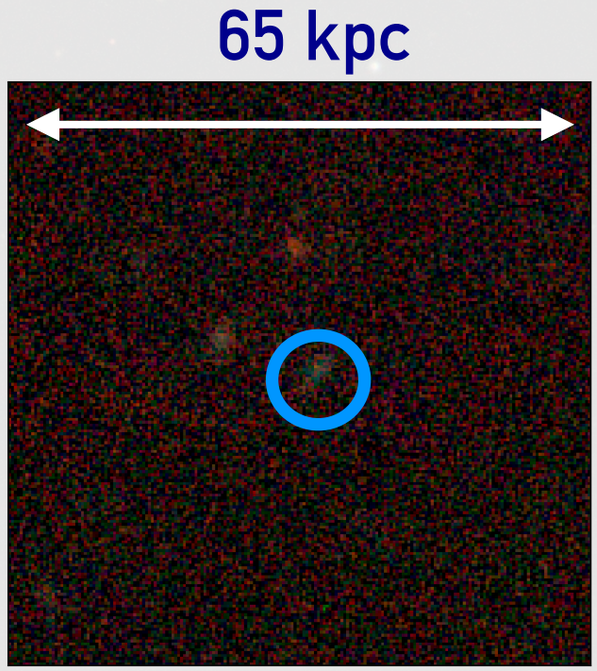
SFR: 3.2 $M_\odot$/Year



SDSS J130408.54+521846.4

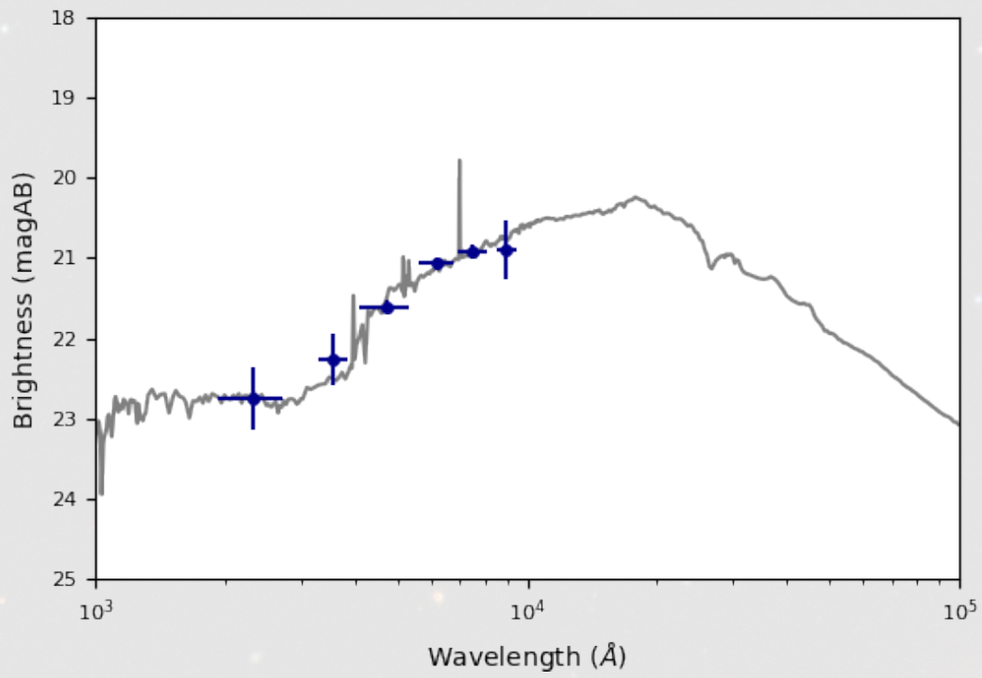
Supernova: ASAS-SN 14ms (type Ib)

Morphology: Dwarf galaxy



Mass: 1.2×10^8 $M_\odot$

SFR: 0.03 $M_\odot$/Year

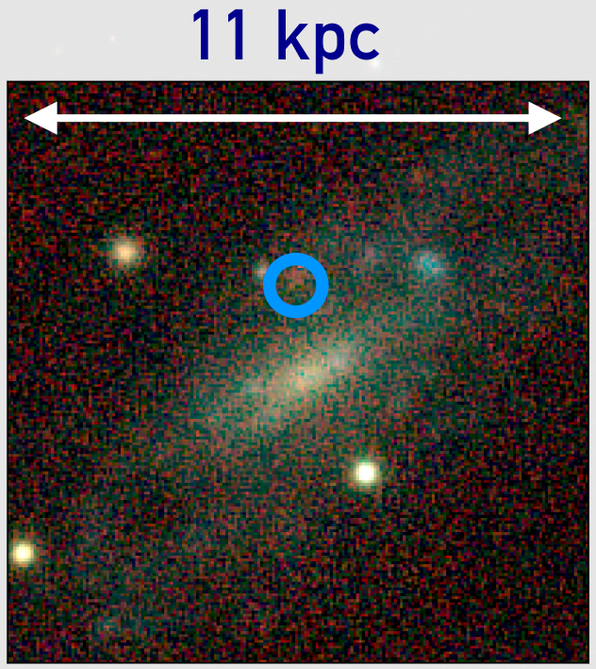


UGC11860

Supernova: ASAS-SN 14dq (type II)

Morphology: Starburst dwarf galaxy?/

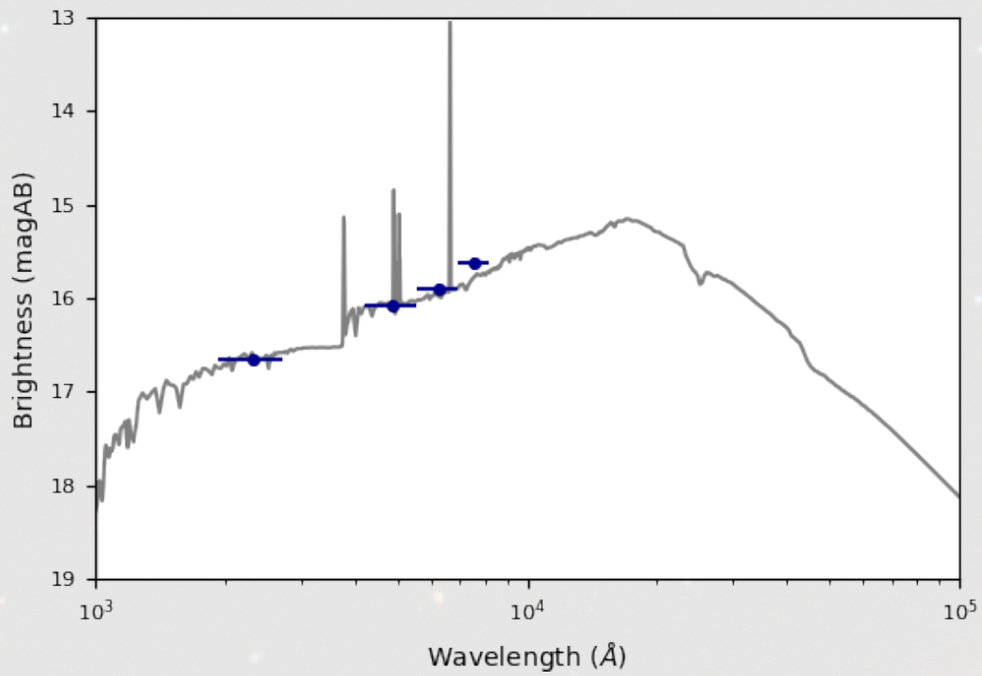
Low surface brightness galaxy?



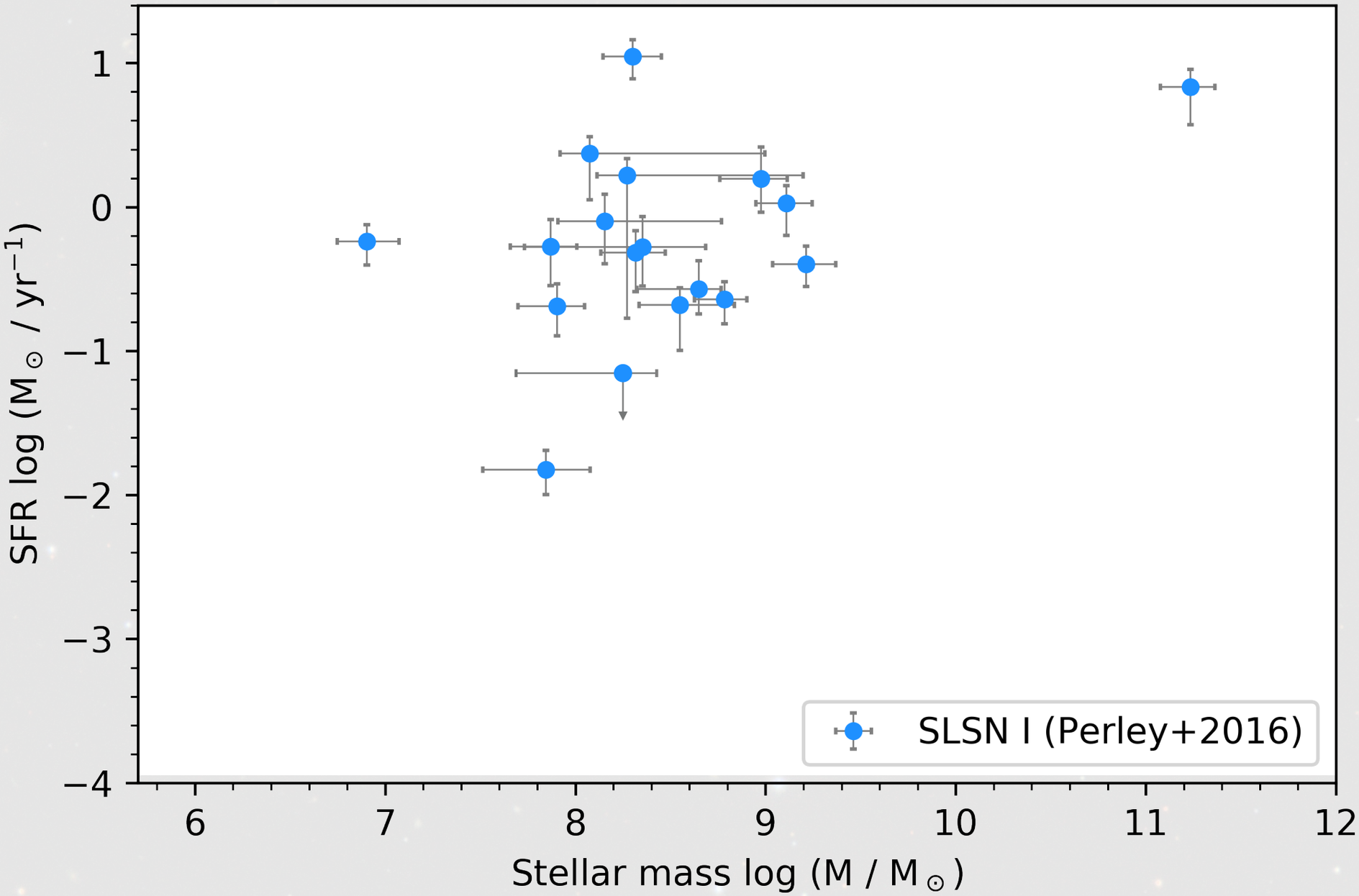
Mass: 8.2×10^7 $M_\odot$

SFR: 0.8 $M_\odot yr^{-1}$

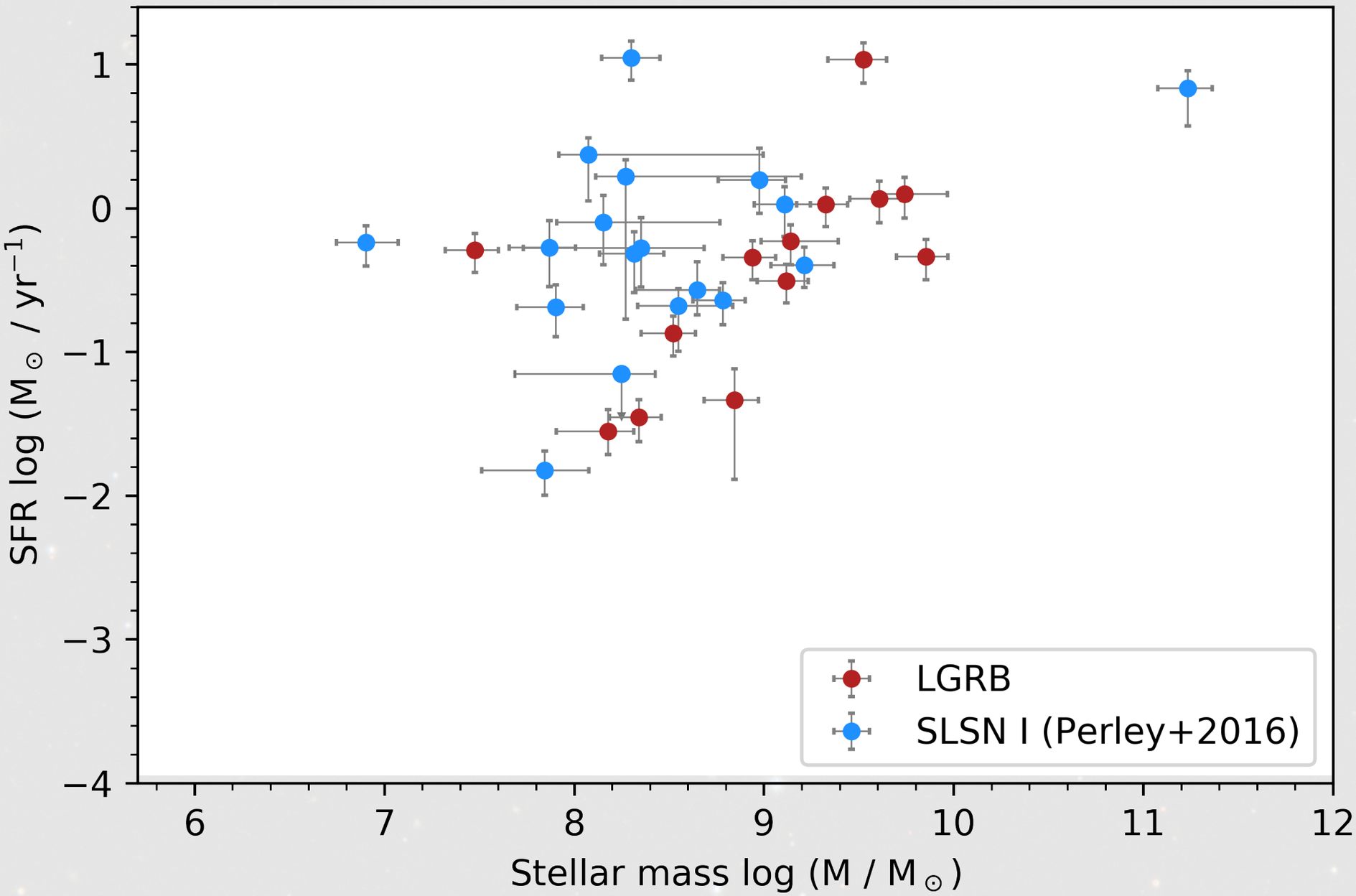
sSFR: 1×10^{-8} yr^{-1}



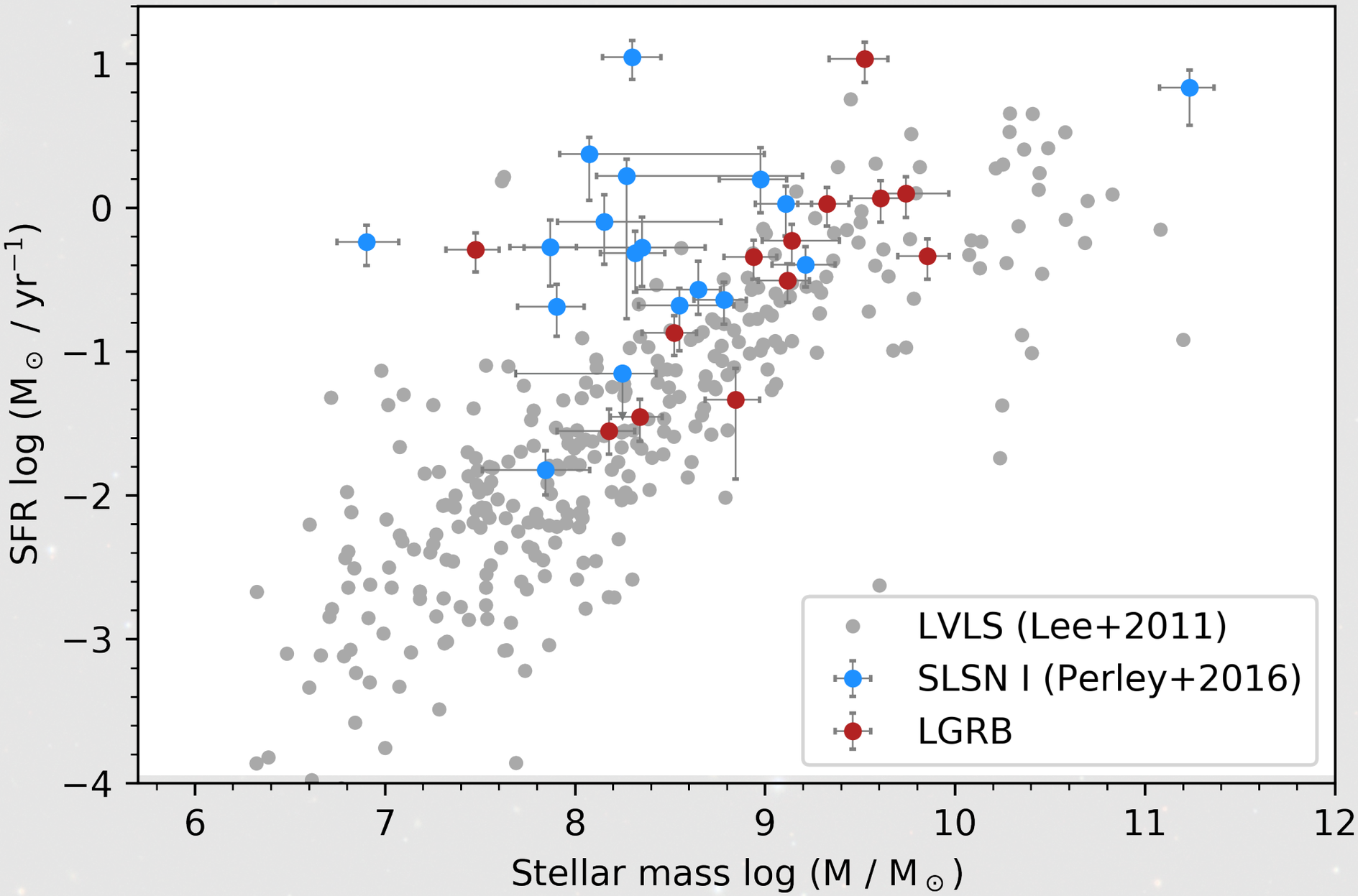
HOST GALAXY MASS VS SFR



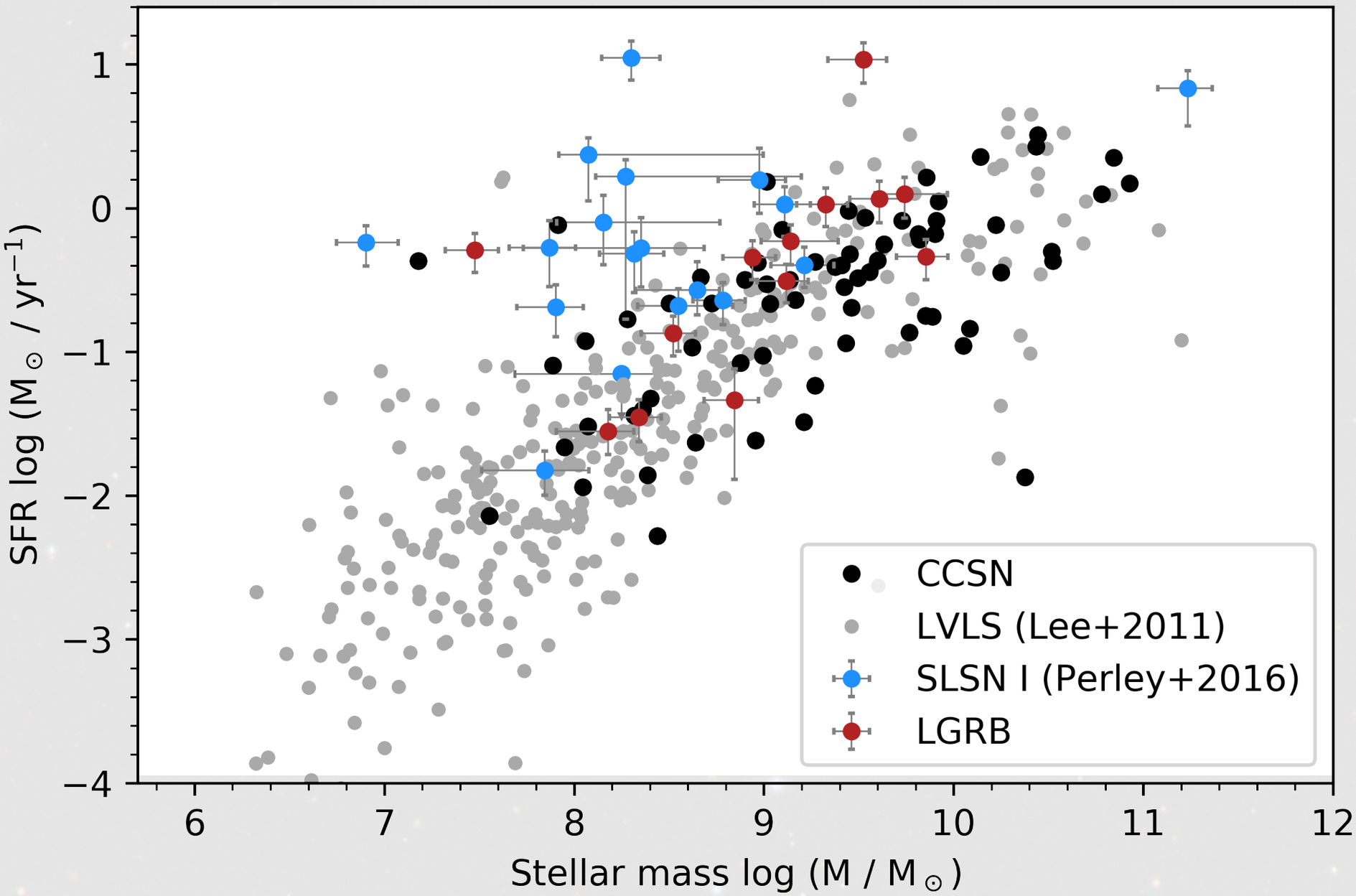
HOST GALAXY MASS VS SFR



HOST GALAXY MASS VS SFR

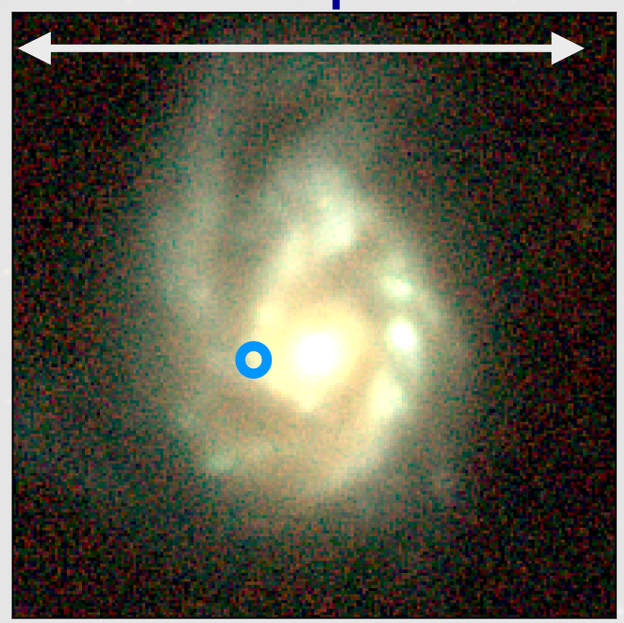


HOST GALAXY MASS VS SFR



NGC 3191

Supernova type: SN 2017egm (SLSN I)



Morphology: Spiral galaxy

Mass: $2.4 \times 10^{10}\ M_{\odot}$

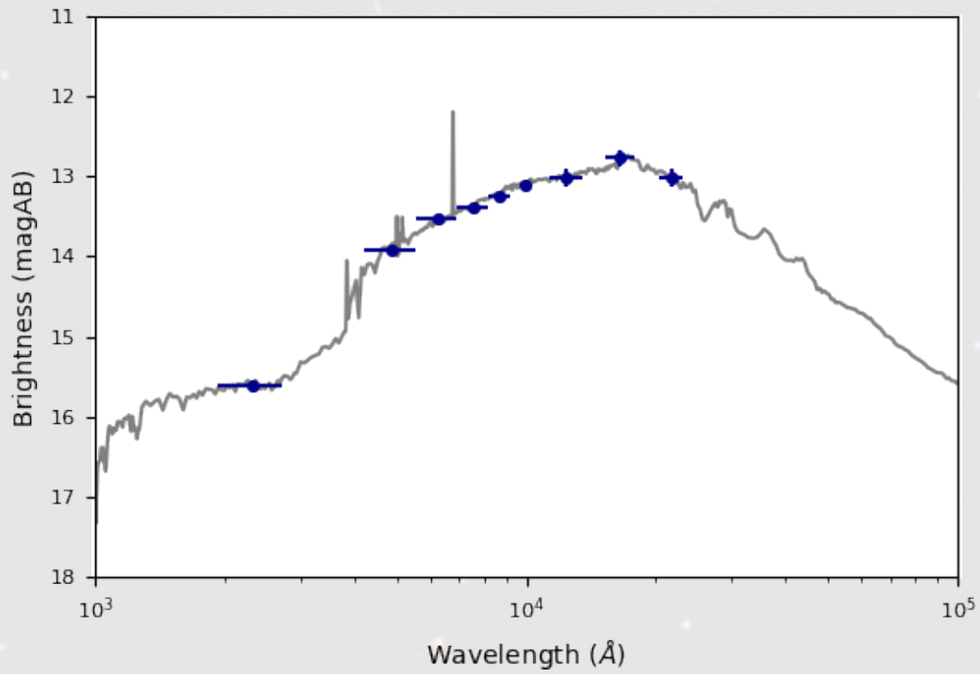
SFR: $13\ M_{\odot} yr^{-1}$

Closest SLSN-I

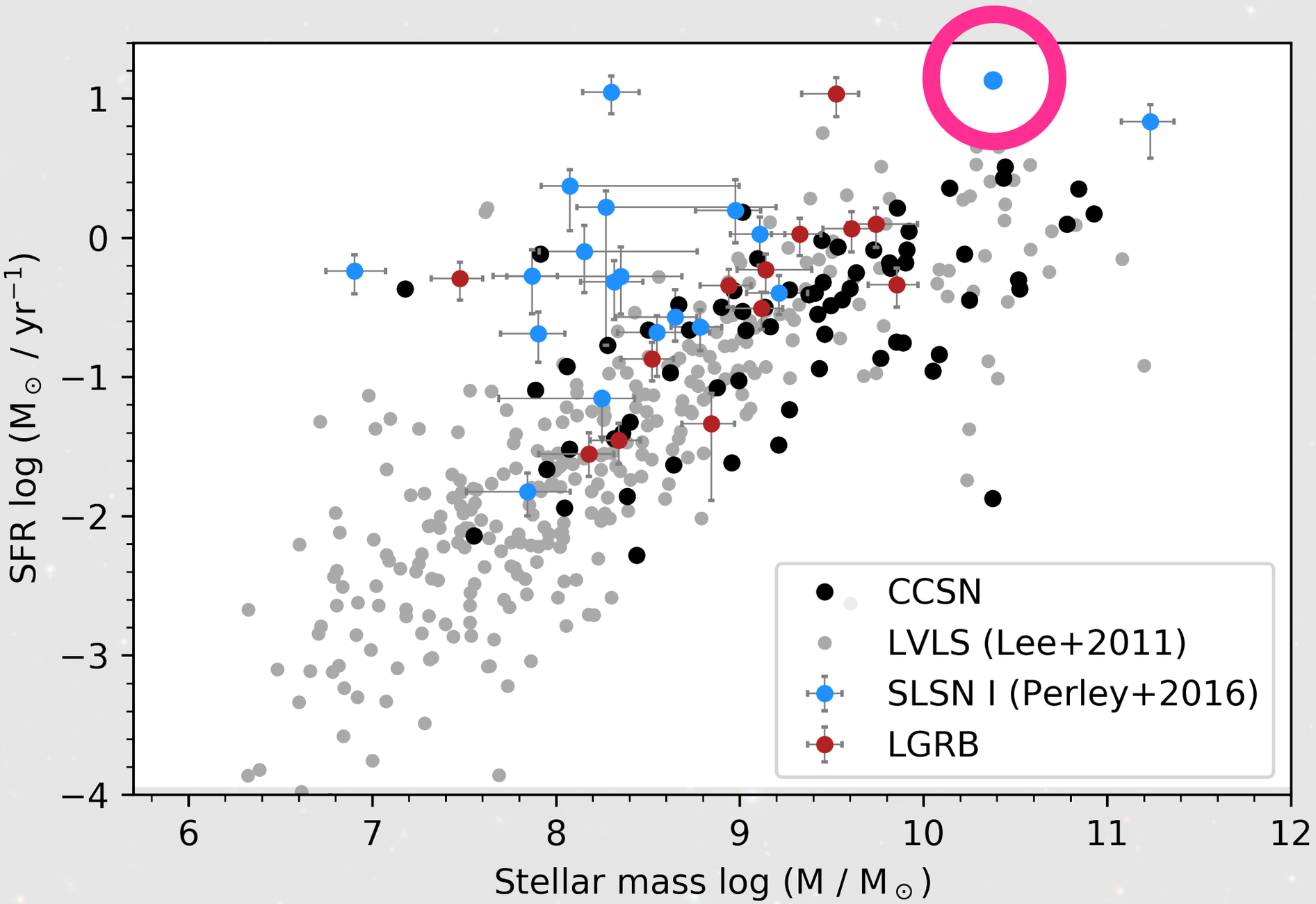
z=0.03087 (~130 Mpc)

PTF11hrq

z=0.057 (~243 Mpc)



HOST GALAXY MASS VS SFR



CONCLUSIONS

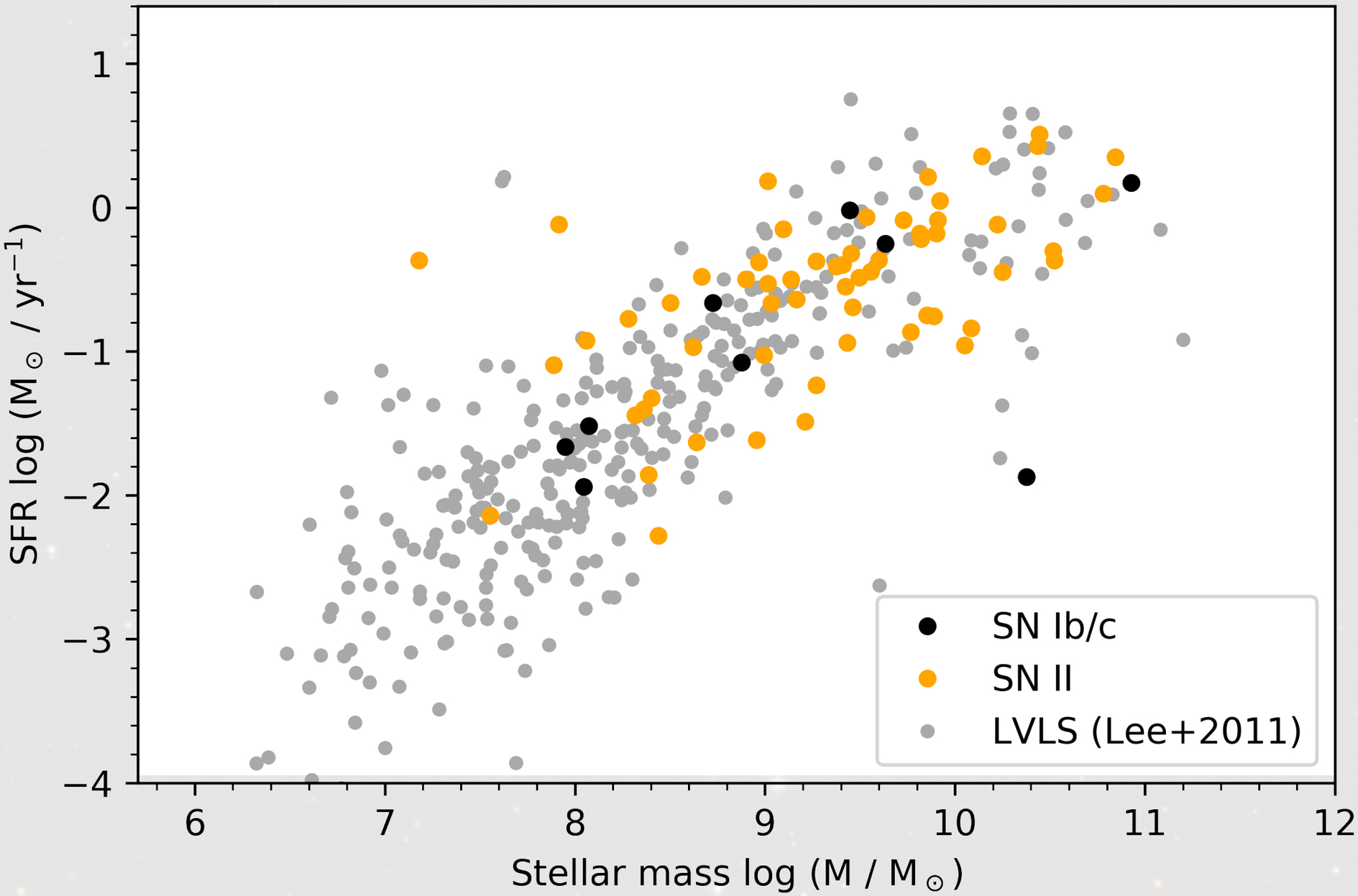
Most core-collapse supernovae found in high mass galaxies

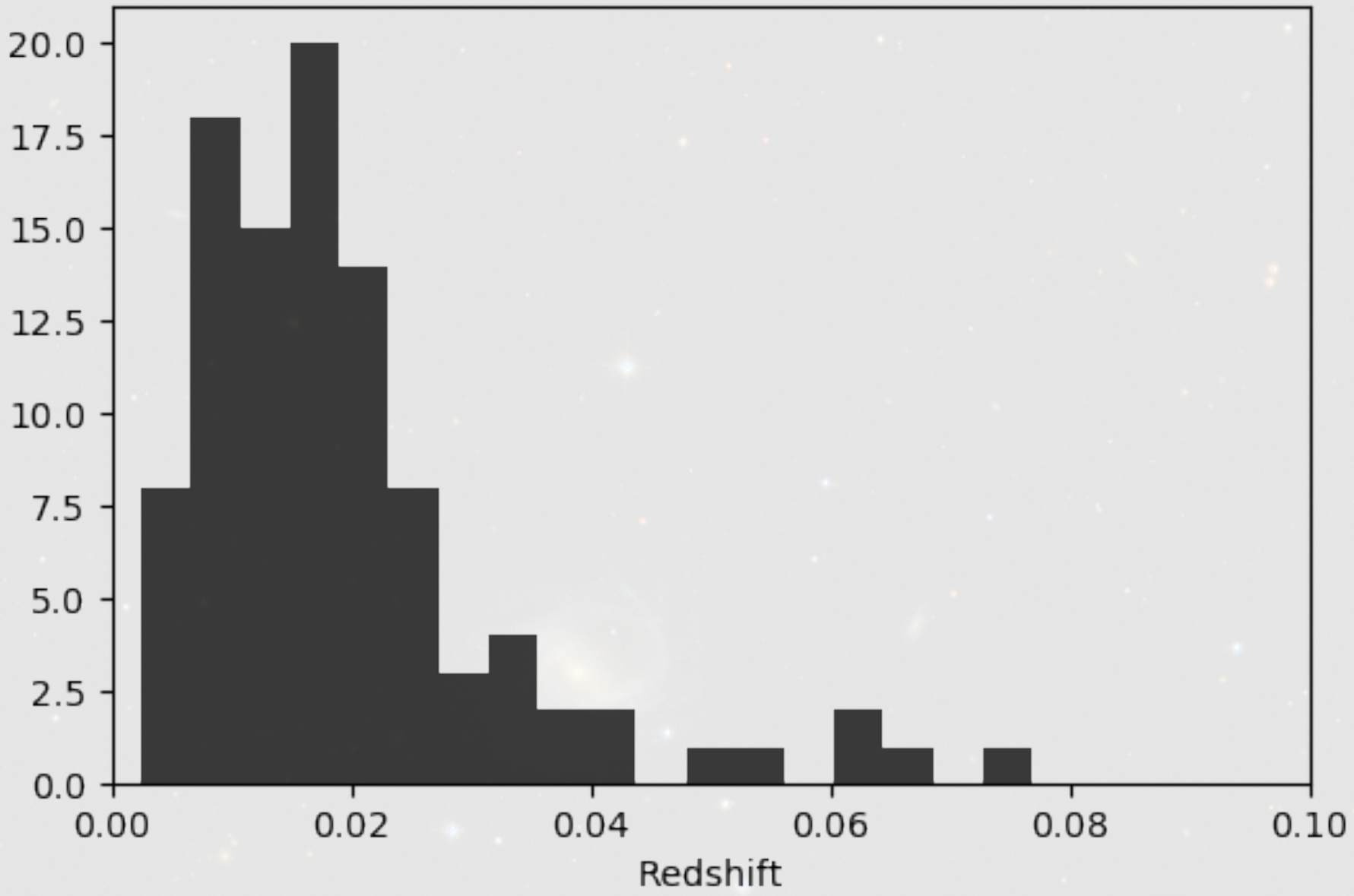
	Quartile mass log ($M/M_\odot$)		
	Lower	Median	Upper
LGRB	8.5	9.1	9.5
SLSN	8.1	8.3	8.8
CCSN	8.7	9.4	9.9

Even at low masses there seems to be a difference between SLSN and core-collapse supernova hosts

Few candidate starburst galaxies, but photometry checks ongoing, additional observations planned

HOST GALAXY MASS VS SFR

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17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0.00
0.02
0.04
0.06
0.08
0.10
Redshift