

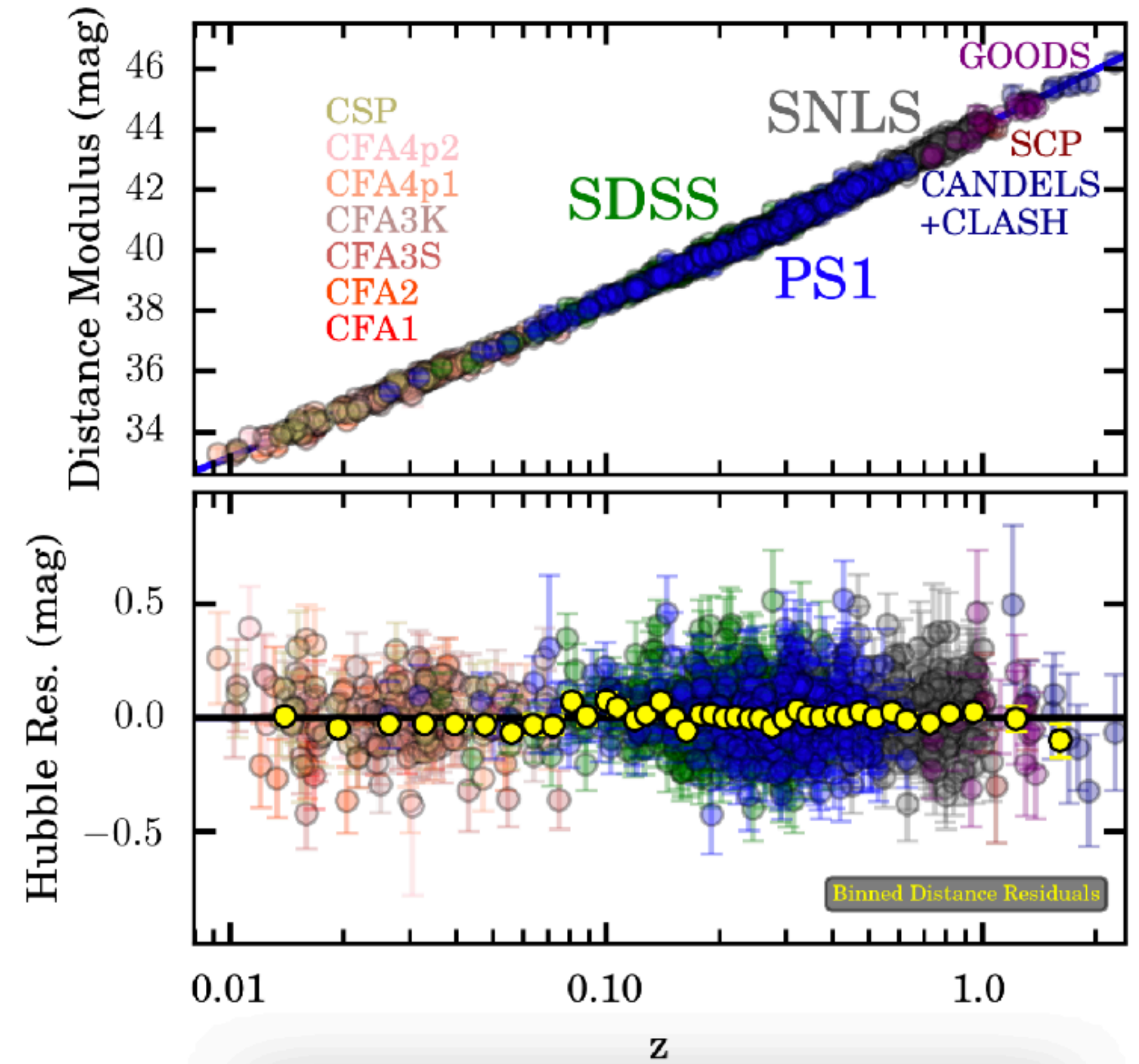
# **SN Ia Cosmology and Core-Collapse Science with the Roman Space Telescope**

**Helen Qu  
(University of Pennsylvania)**

**Cosmology with the Roman Space Telescope Virtual Seminar, 1/27/2022**

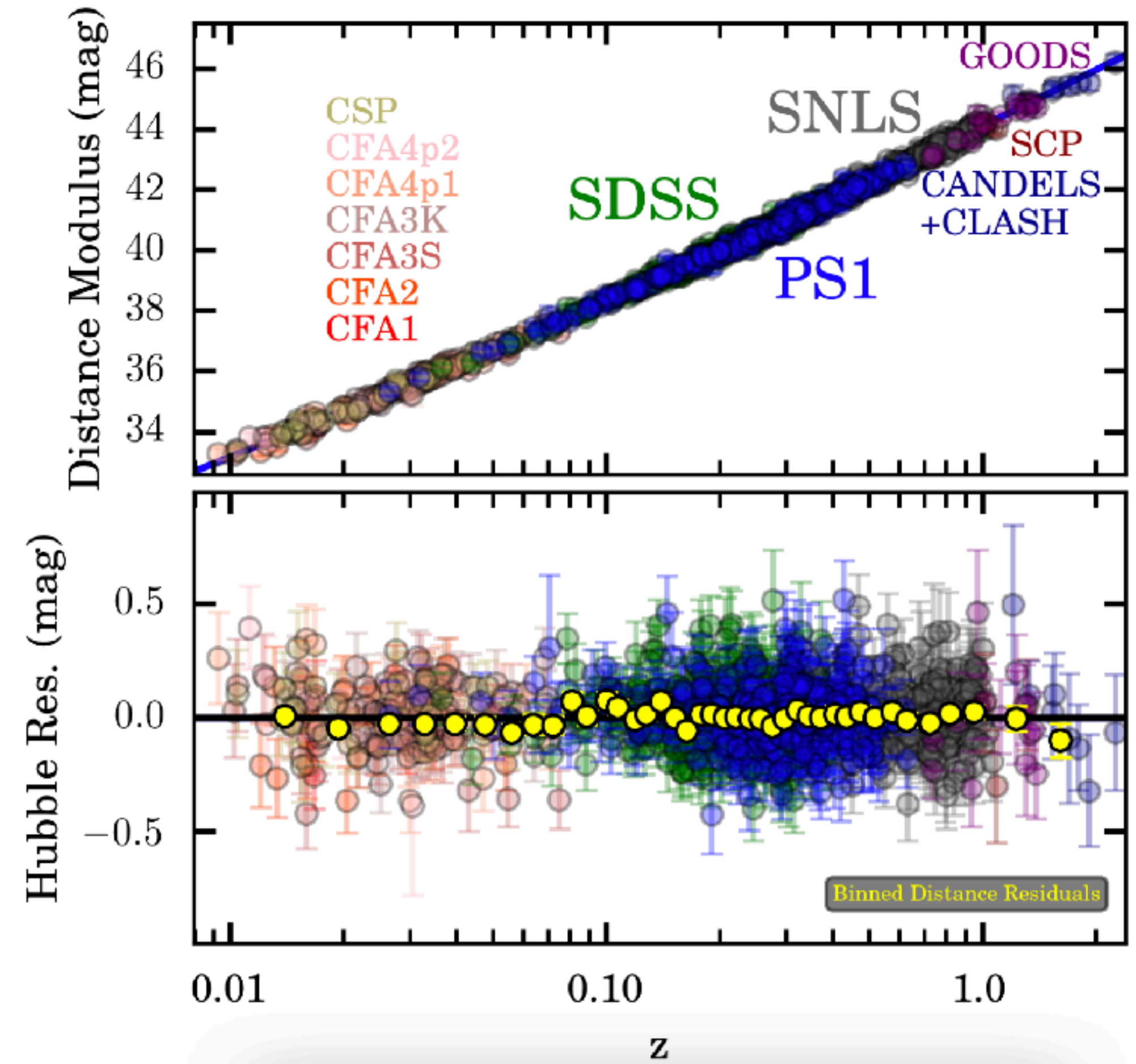
# Standard Candle Cosmology

- **Input:** Redshift  $z$ , luminosity distance  $d_L$
- **Output:** cosmological parameters ( $\Omega_m, \Omega_\Lambda, w$ )



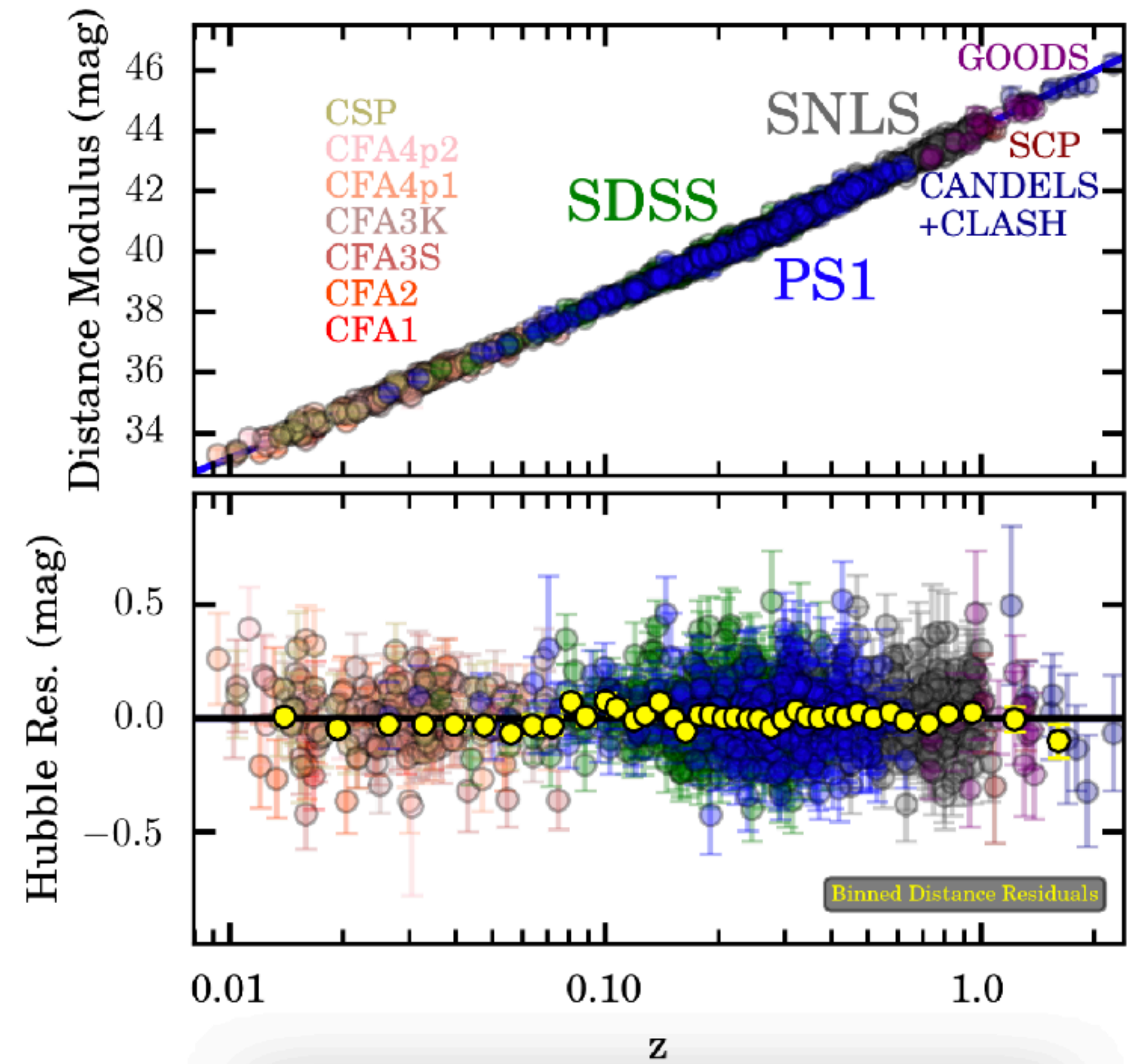
# Why Type Ia Supernovae (SNe Ia)?

- SNe Ia are:
  - **highly luminous:** observable out to  $z \sim 1 - 2$
  - **standardizable candles:** brightness  $\rightarrow$  distance



# What do we need for cosmology?

- accurate distance modulus estimates of SNe Ia
- accurate redshift estimates of SNe Ia
- pure sample of SNe Ia



# How do we get $z$ , SN type?

## **Spectroscopy:**

- + accurate redshift measurement
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## **Photometry:**

- less accurate redshift measurement
- SN type not confirmed
- + available for all observed objects

# Agenda

- SN Ia Cosmology with Roman
  - **Spectroscopy** — redshift measurement, classification
  - **Photometry** — classification

# Agenda

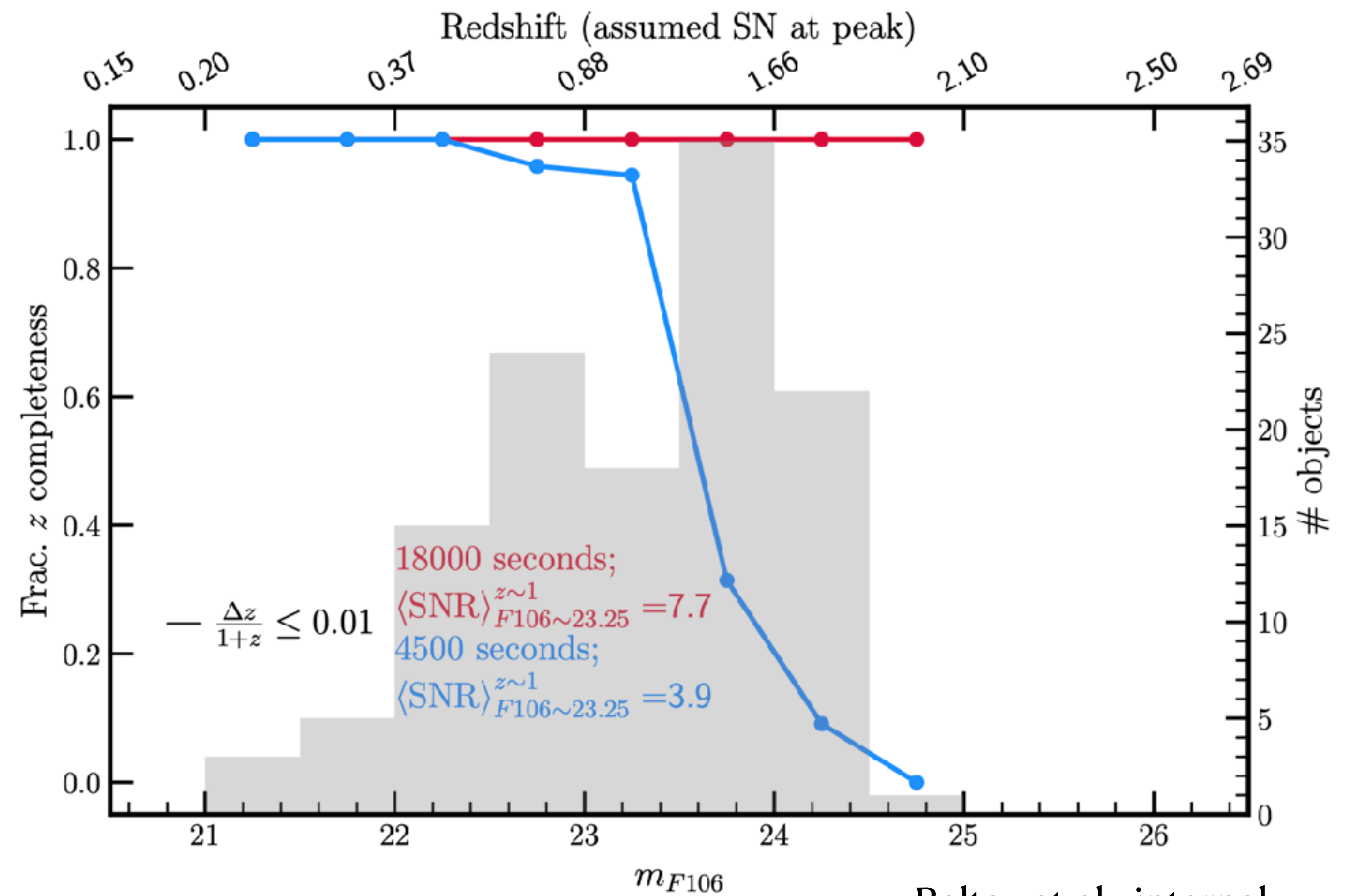
- SN Ia Cosmology with Roman
  - **Spectroscopy** — redshift measurement, classification
  - **Photometry** — classification
- Applications to Non-Ia SN Science
  - early-time photometric typing



# Redshift Recovery

## Prism Spectroscopy of Live SN Ia

- Redshift recovery efficiency for simulated prism spectroscopy in Roman's **shallow** and **deep** surveys

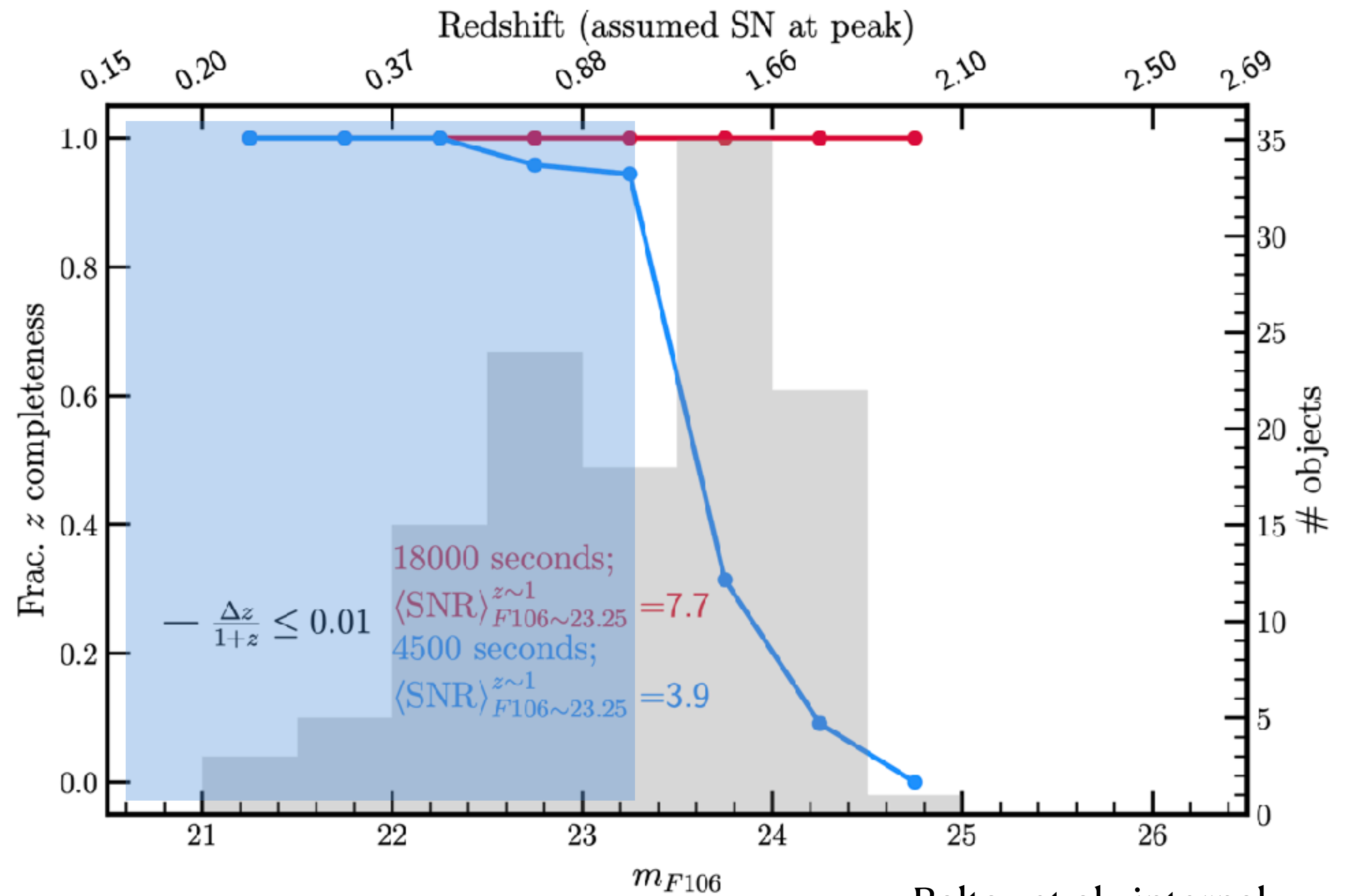


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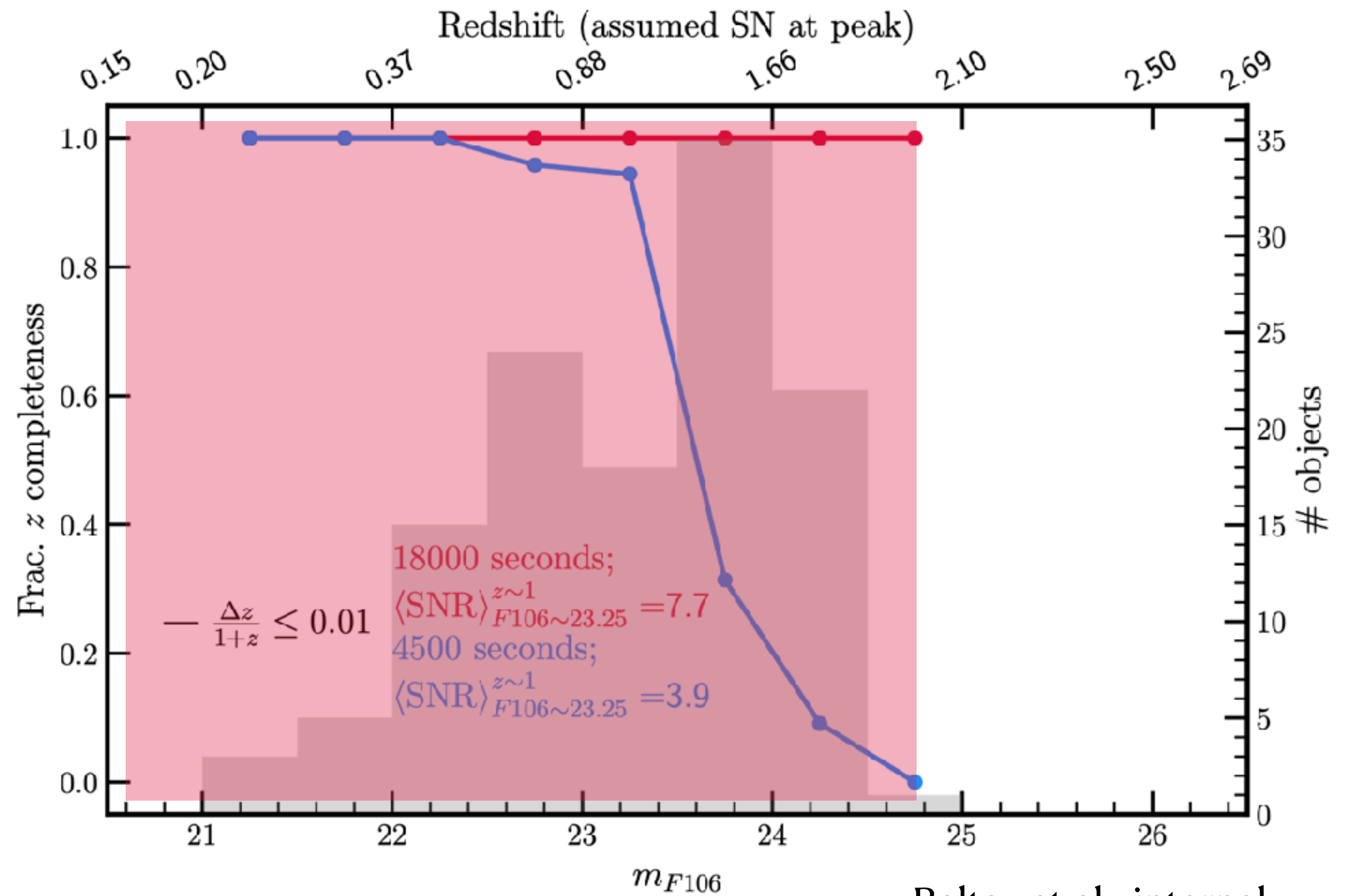


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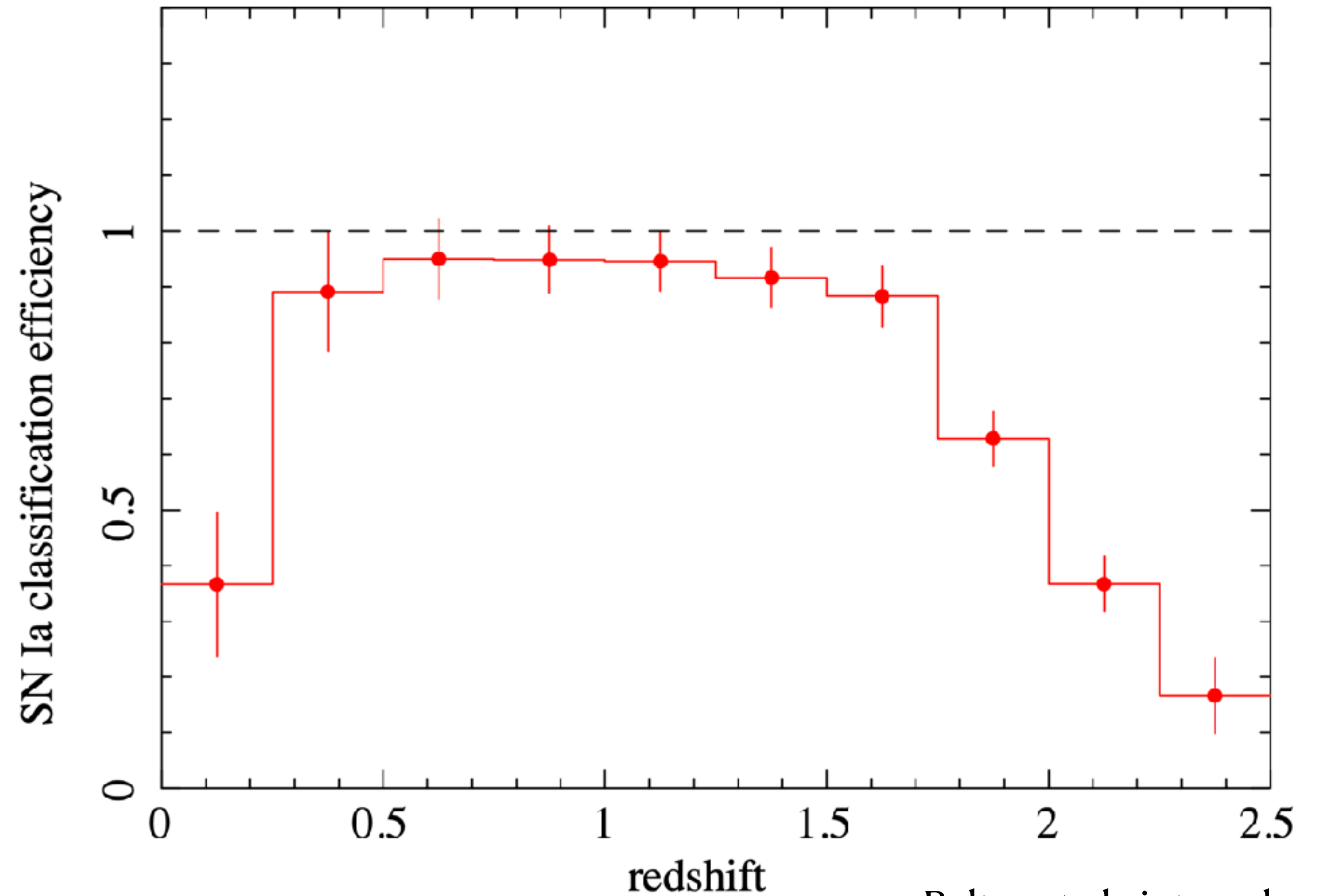
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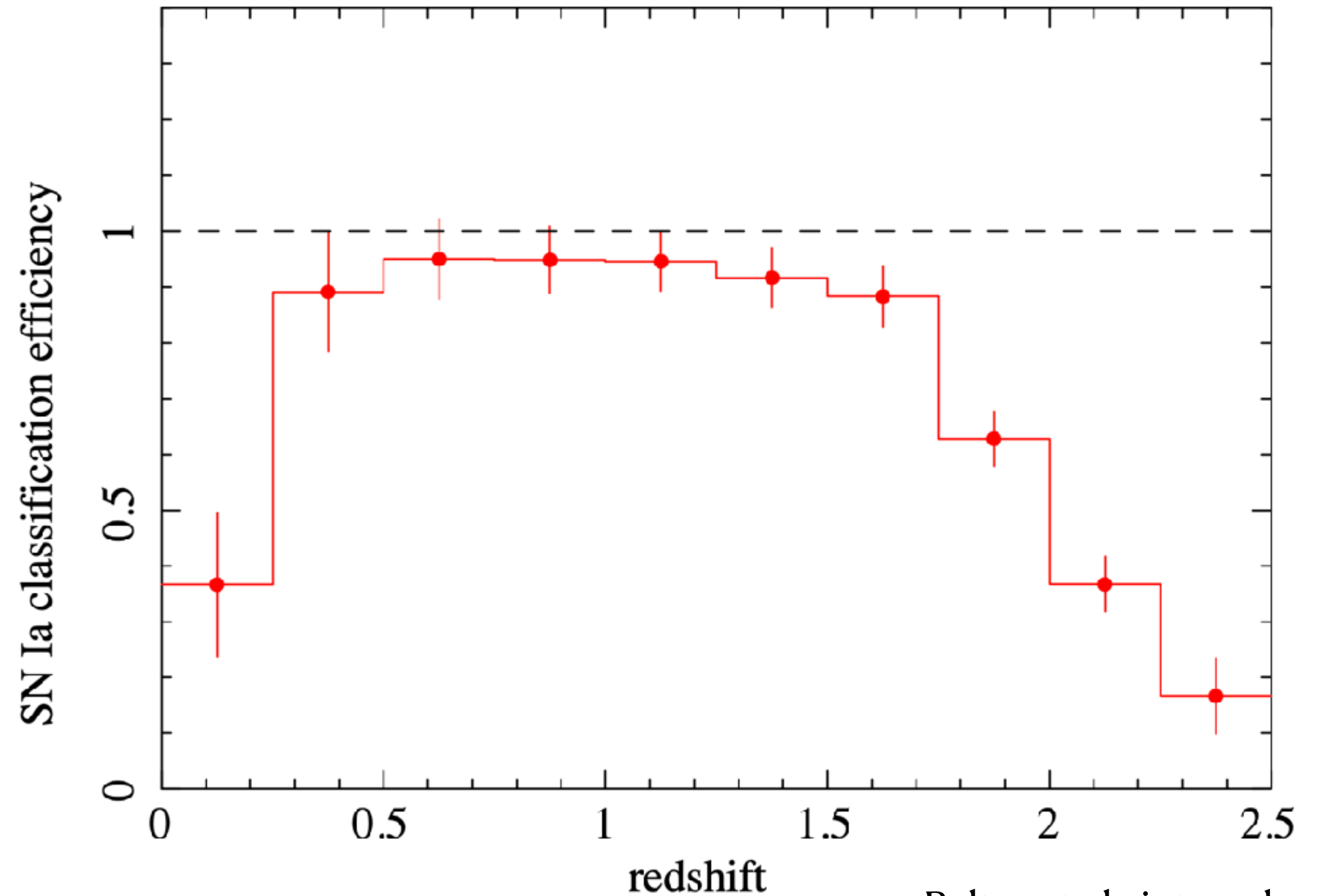
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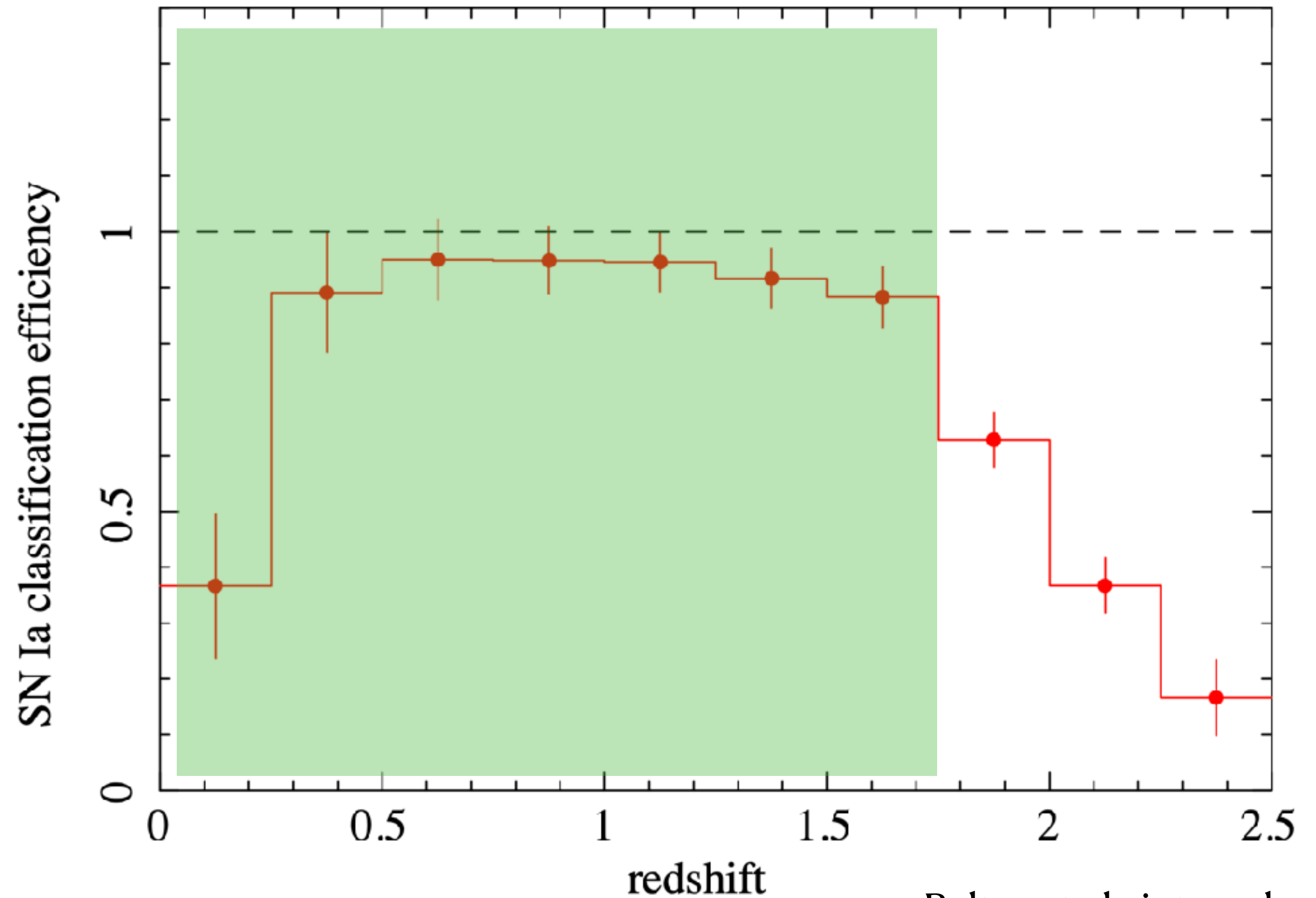
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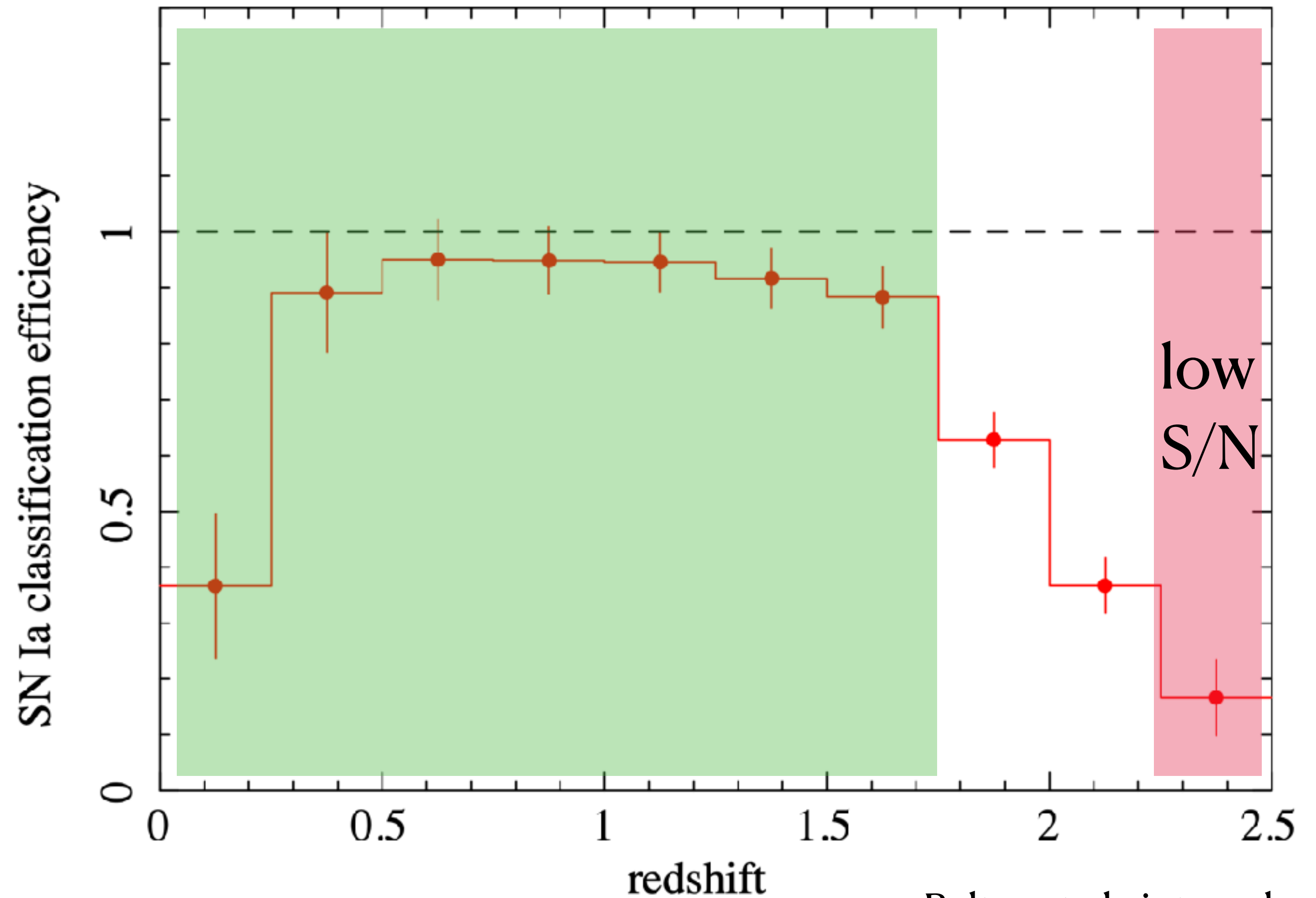
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- S/N too low for SN Ia candidates at  $z > 2.2$

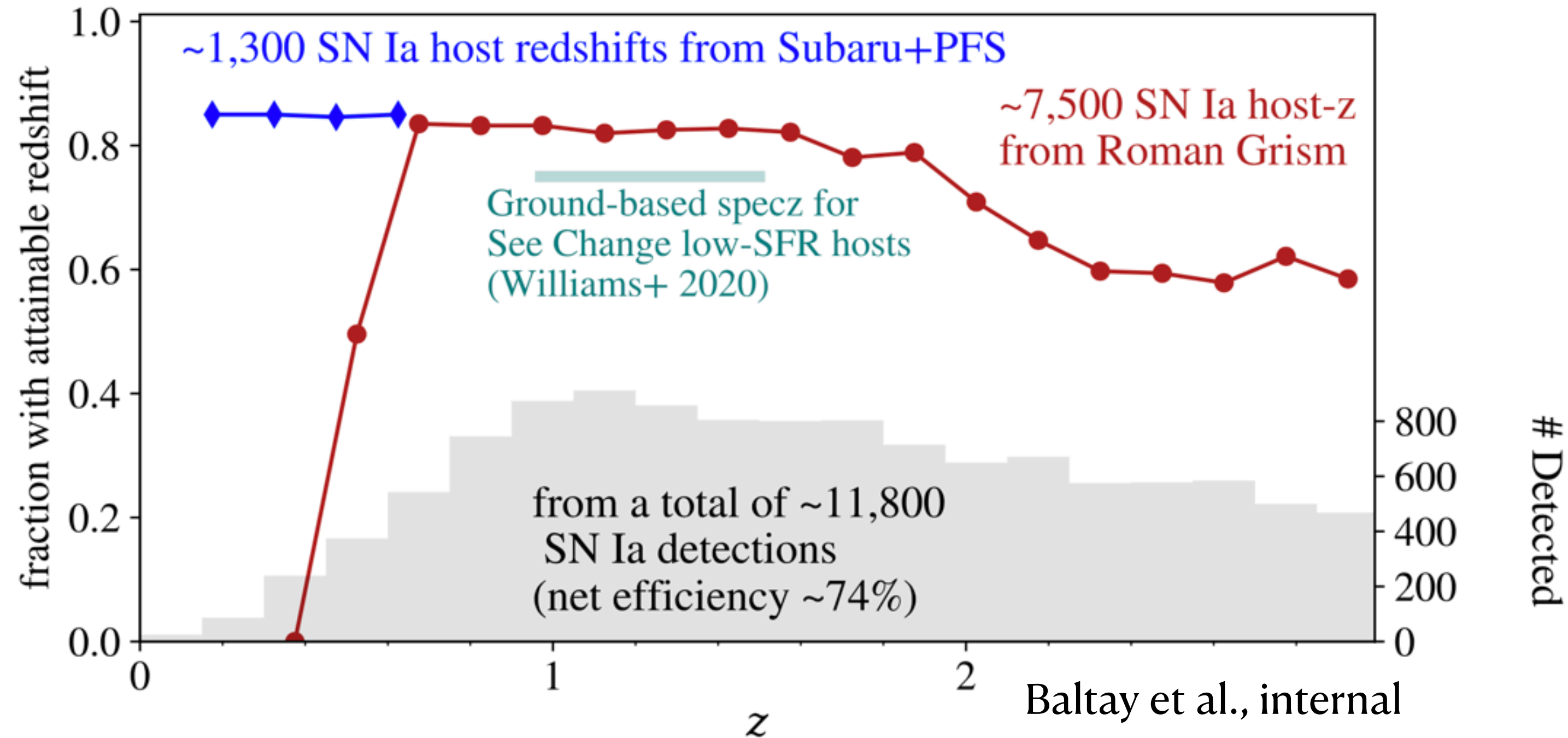


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# Redshift Recovery

## Host Galaxy Spectroscopy

- Redshift recovery efficiency from **Subaru+PFS** and **Roman grism** in a simulated Roman HLS deep field



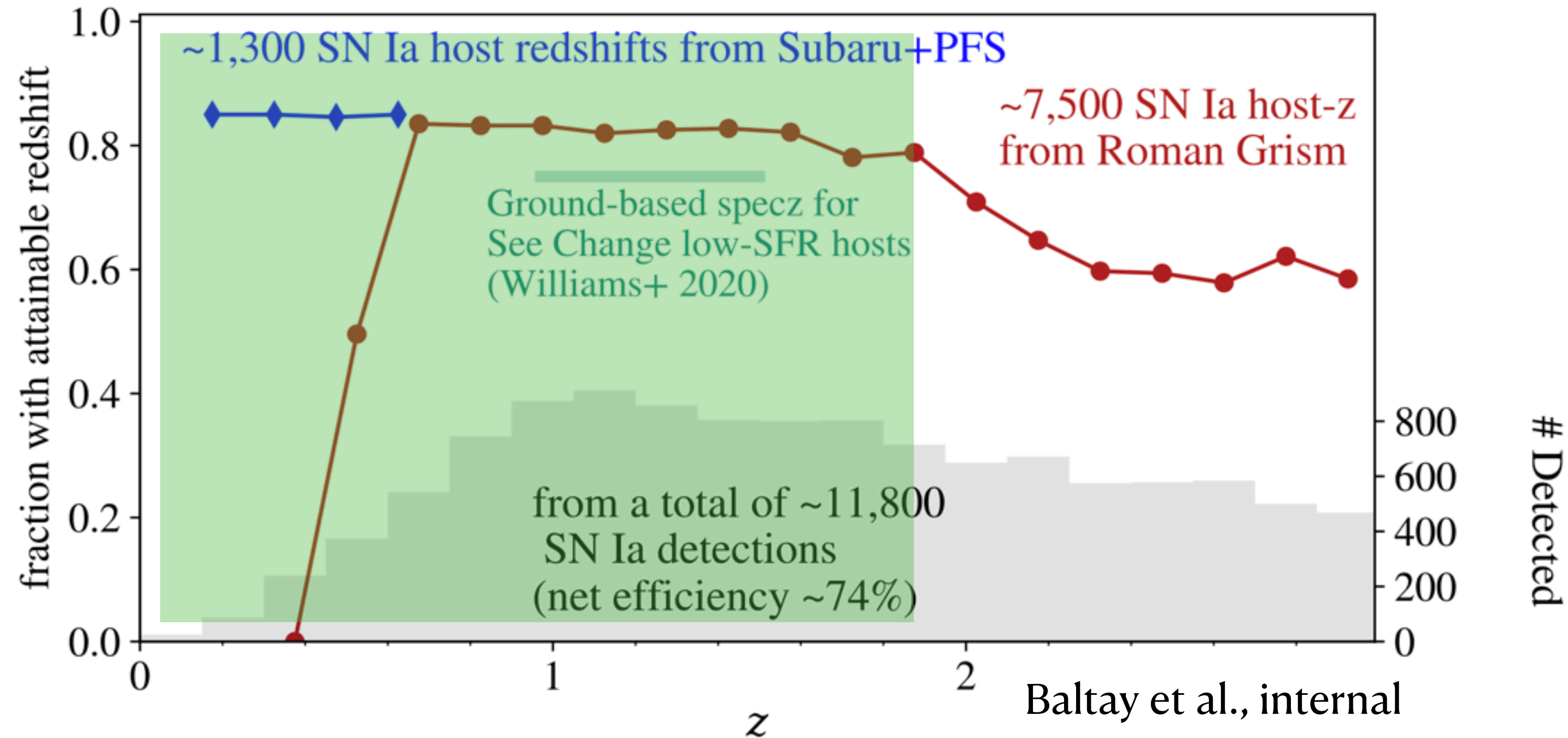
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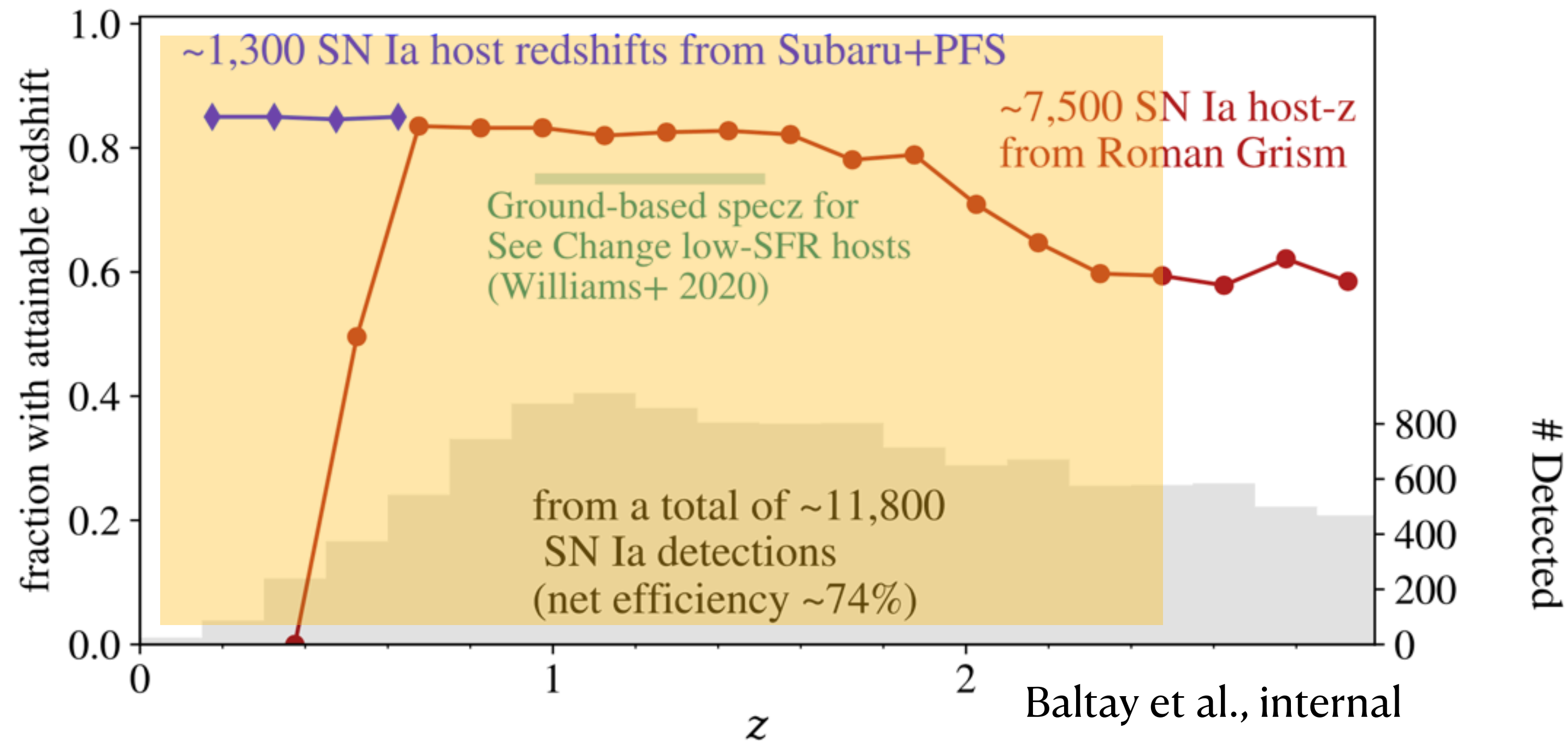
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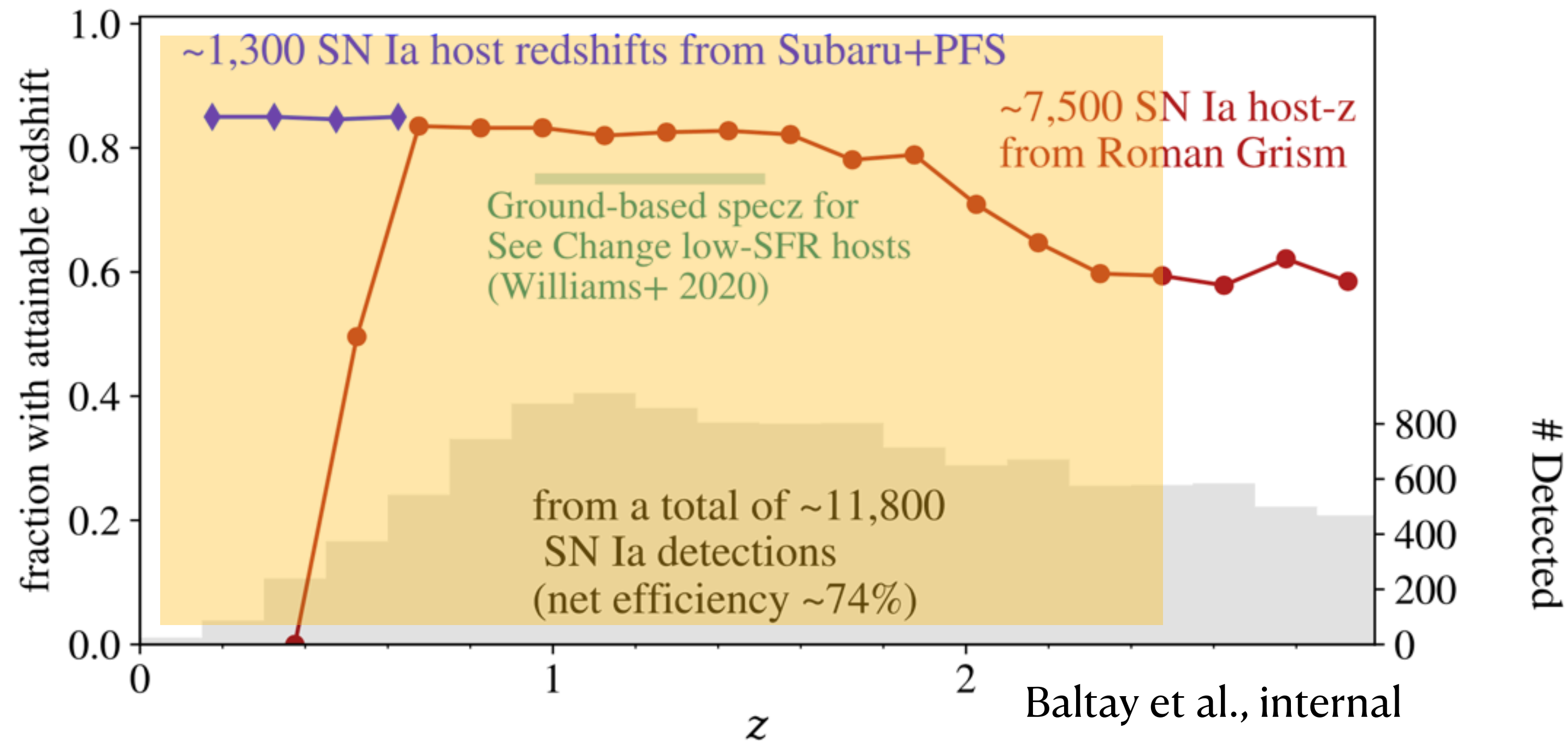
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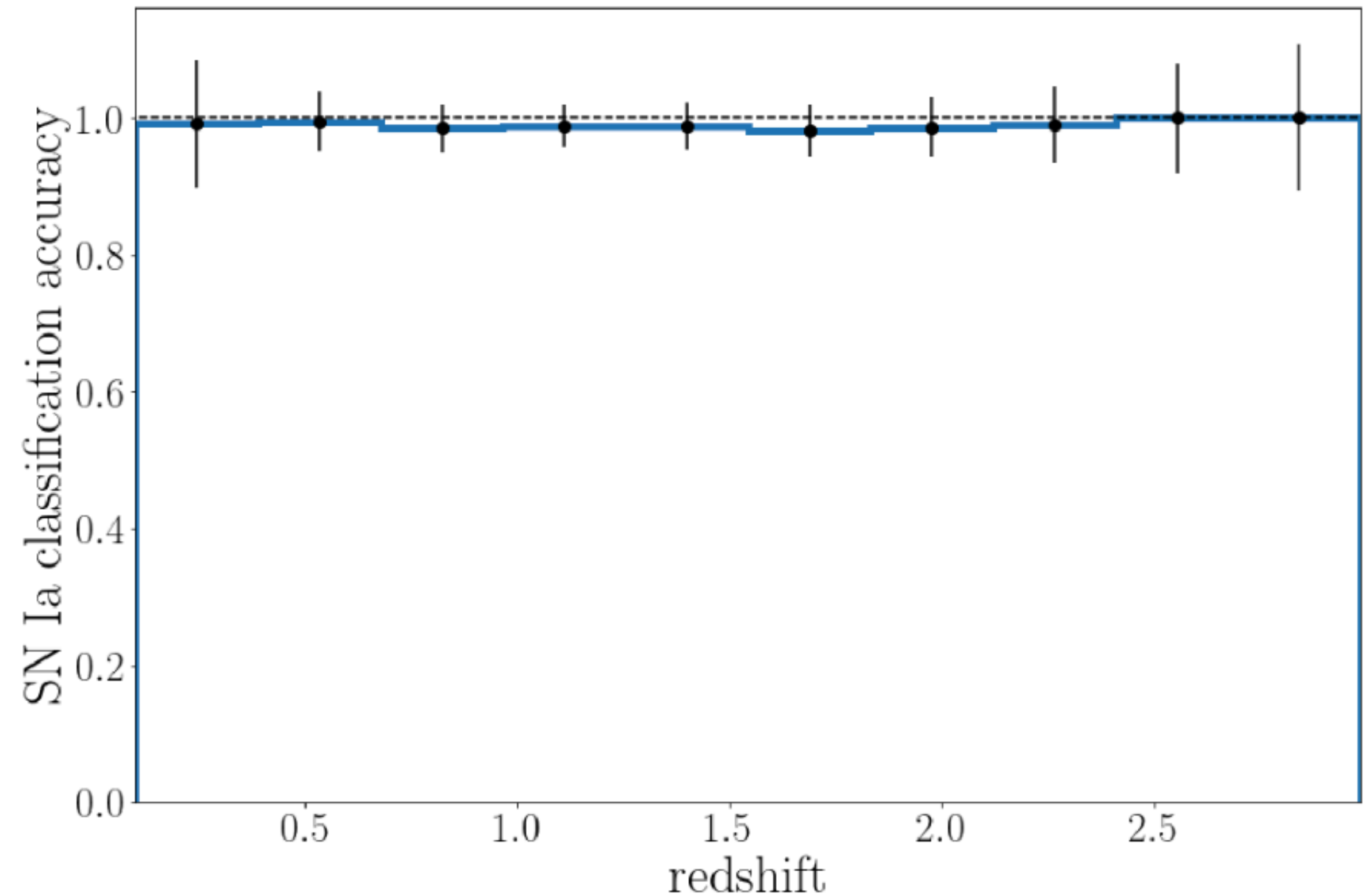
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- 8800 host galaxy redshifts / 11,800 SN Ia detections = 74% efficiency



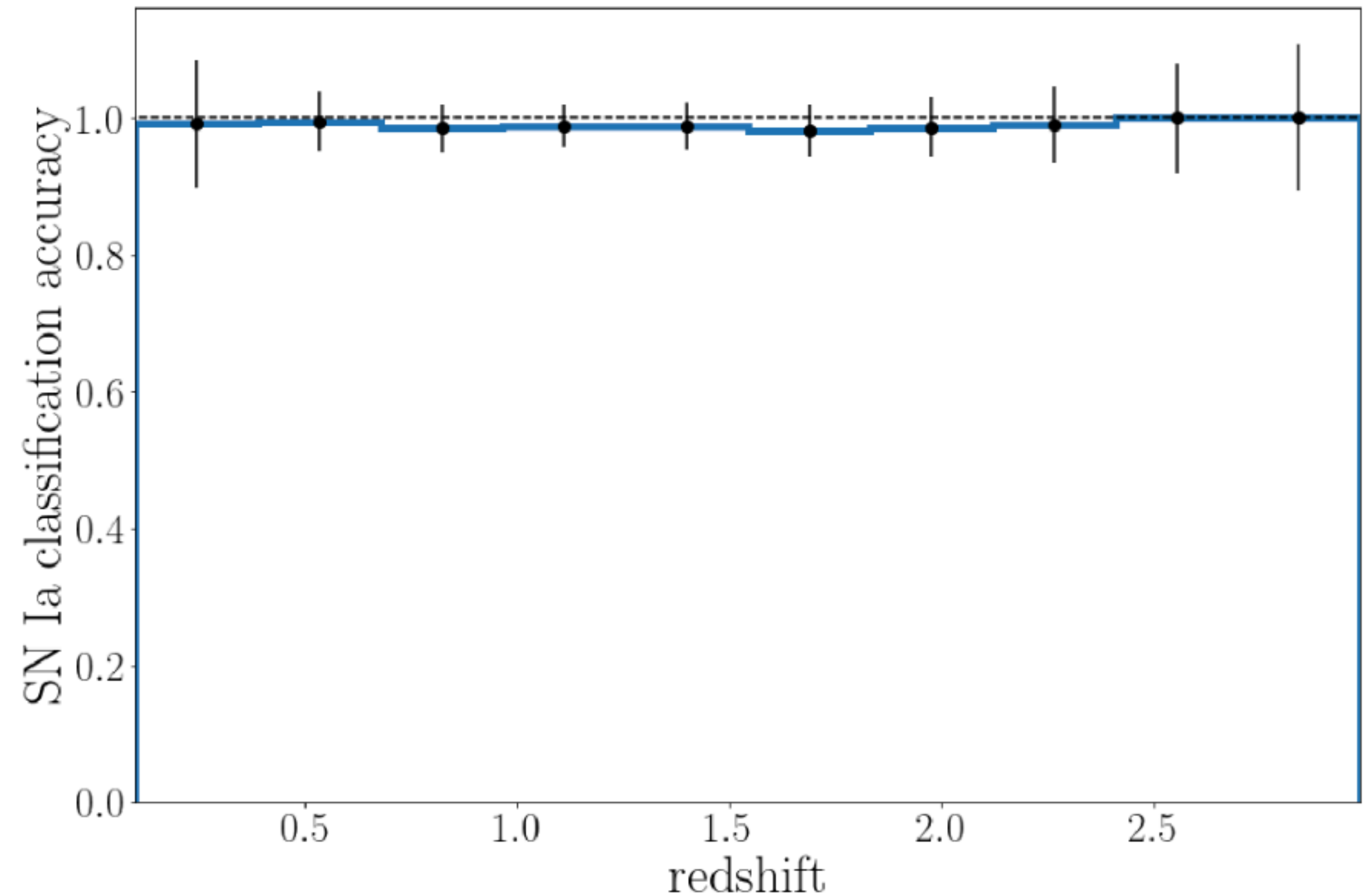
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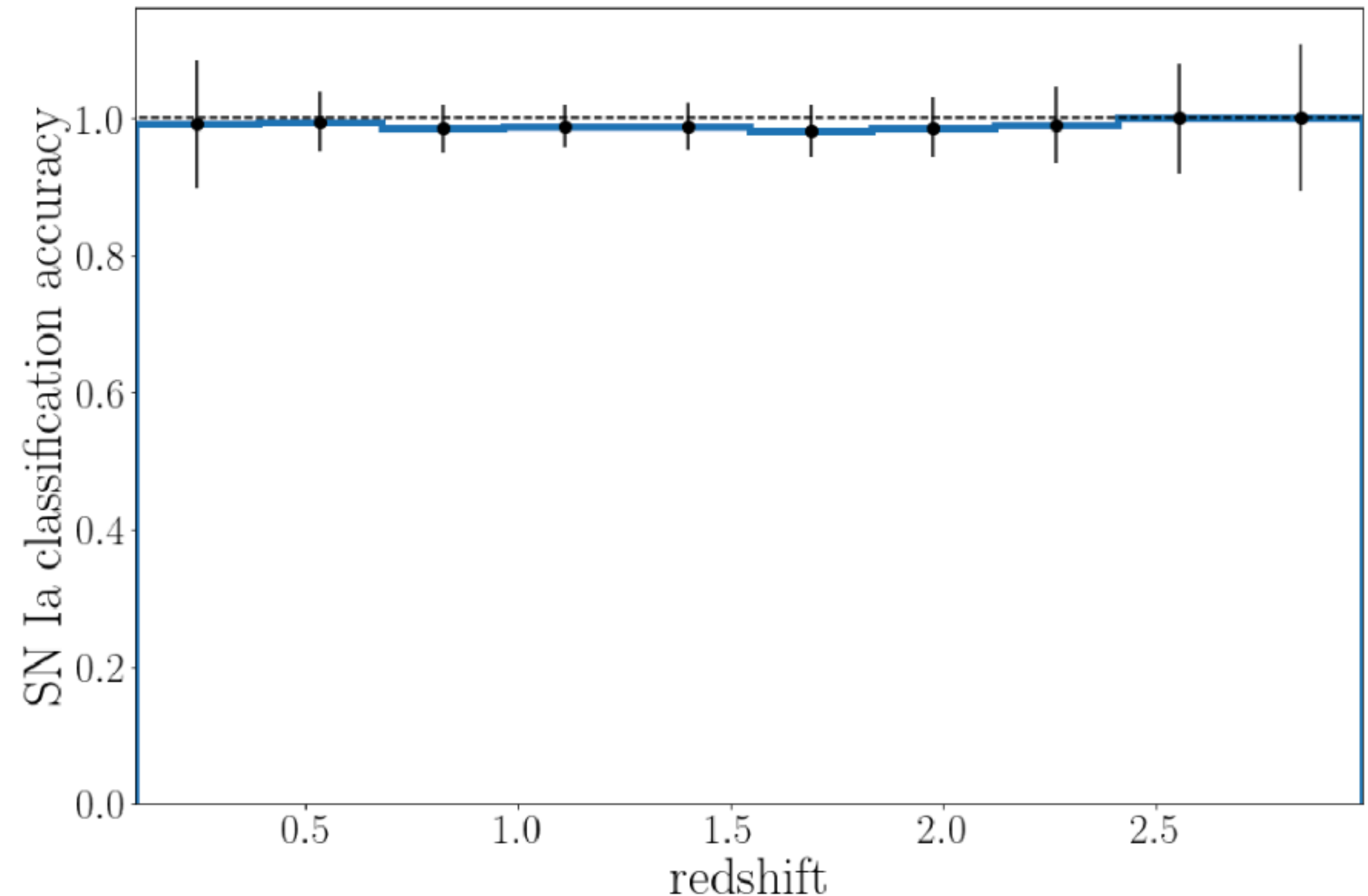
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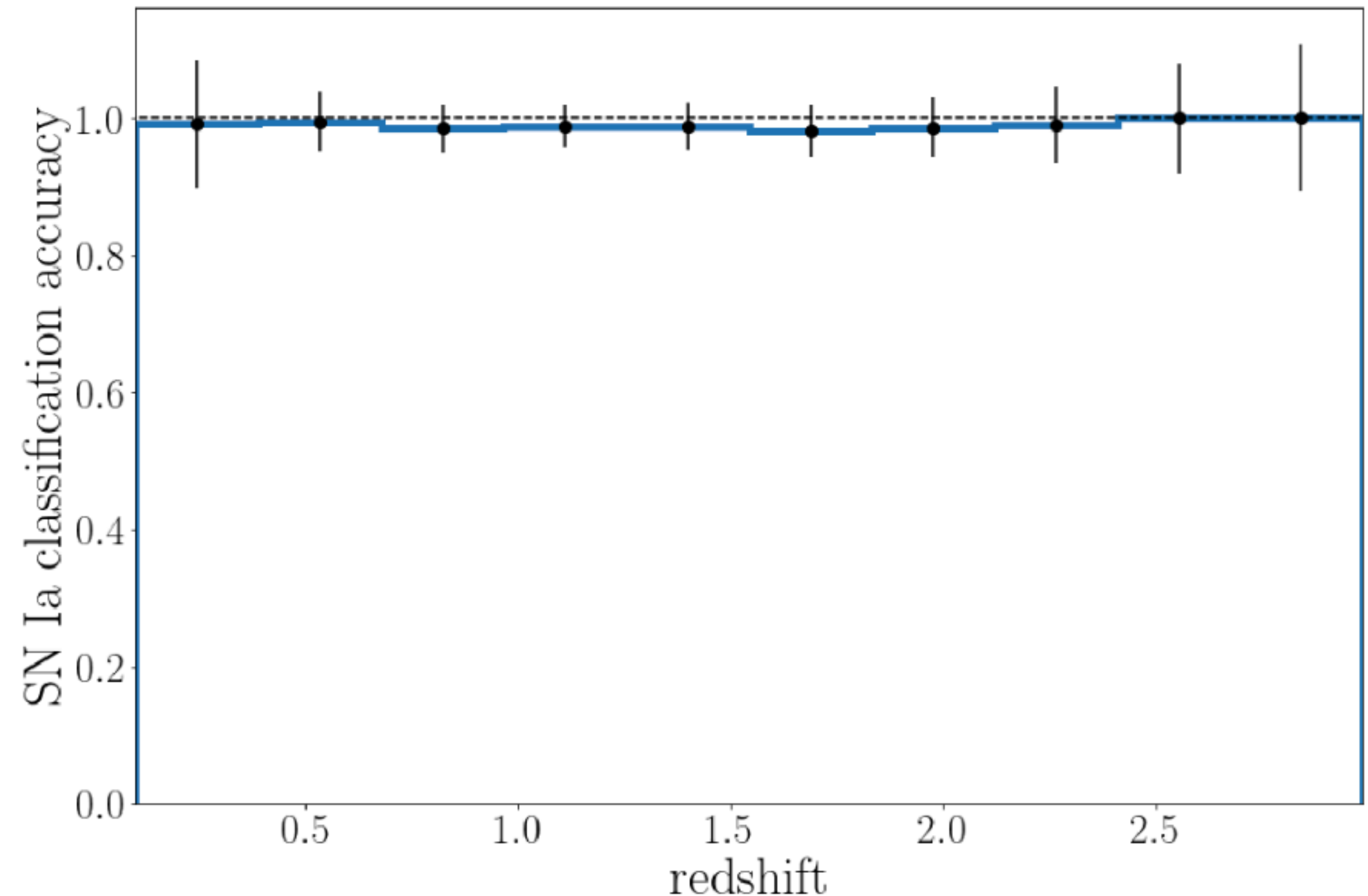
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- Caveat: results on simulations may not translate exactly to real data



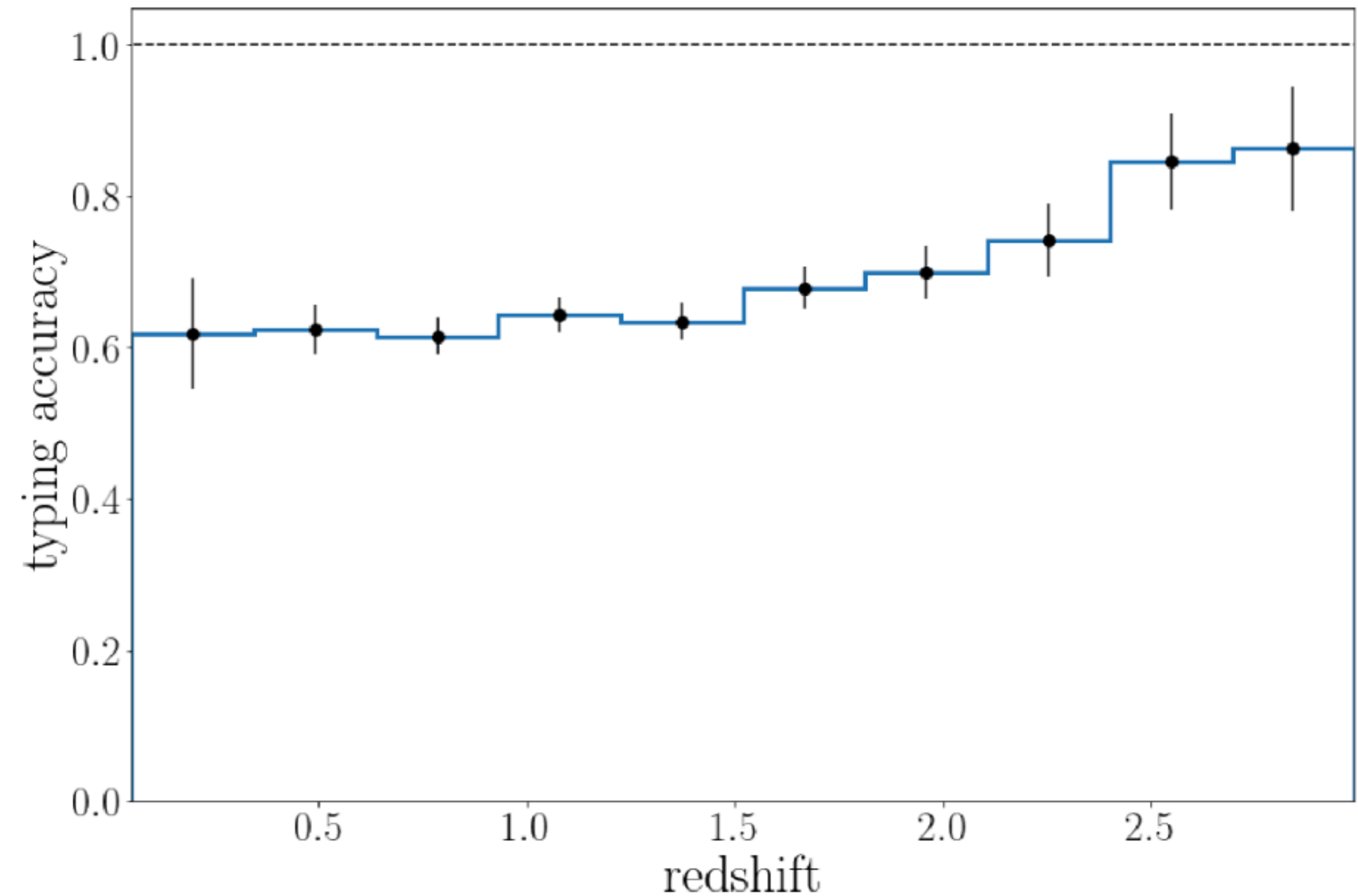
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- Early identification guides an optimal strategy for follow-up observation



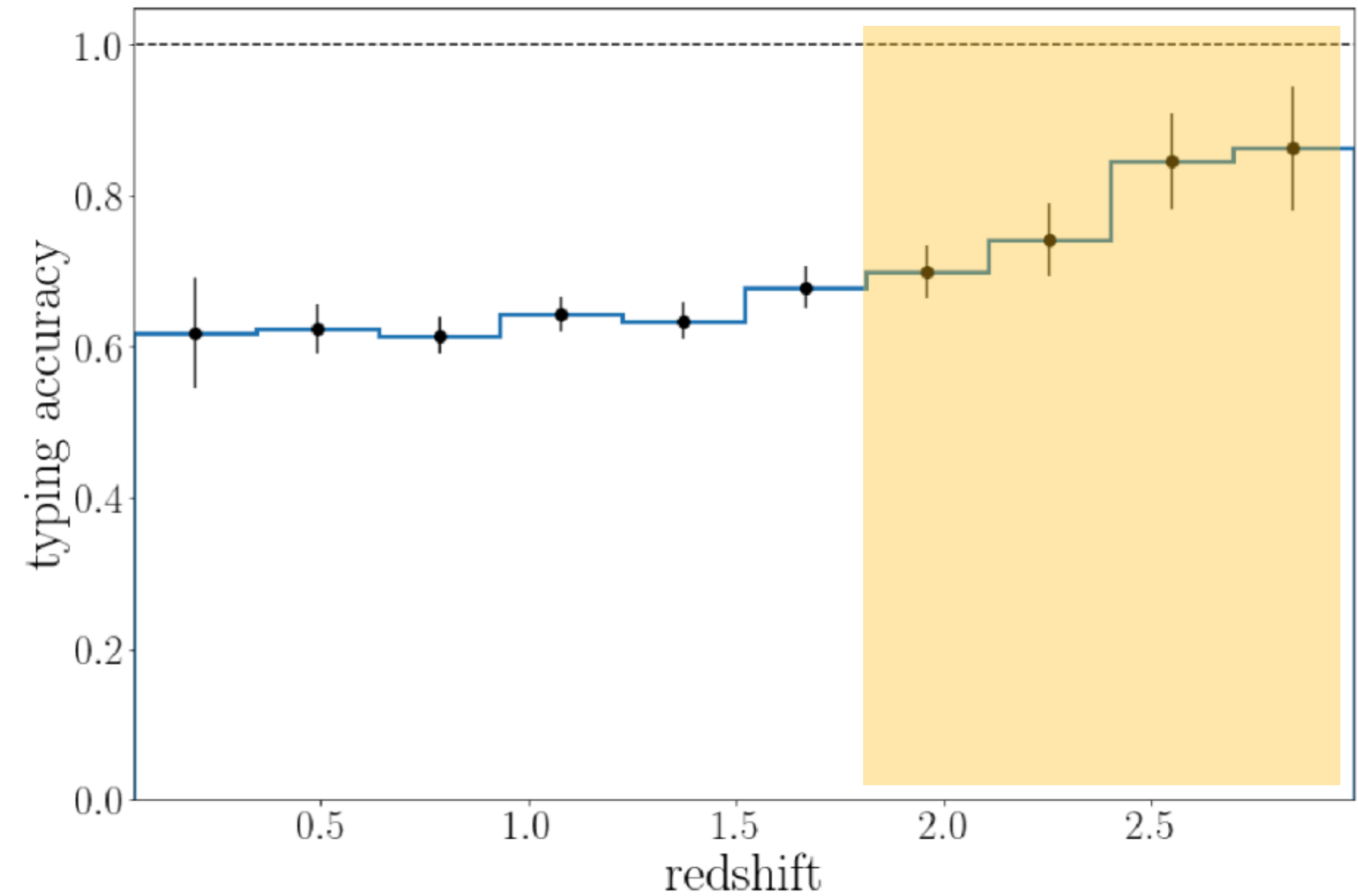
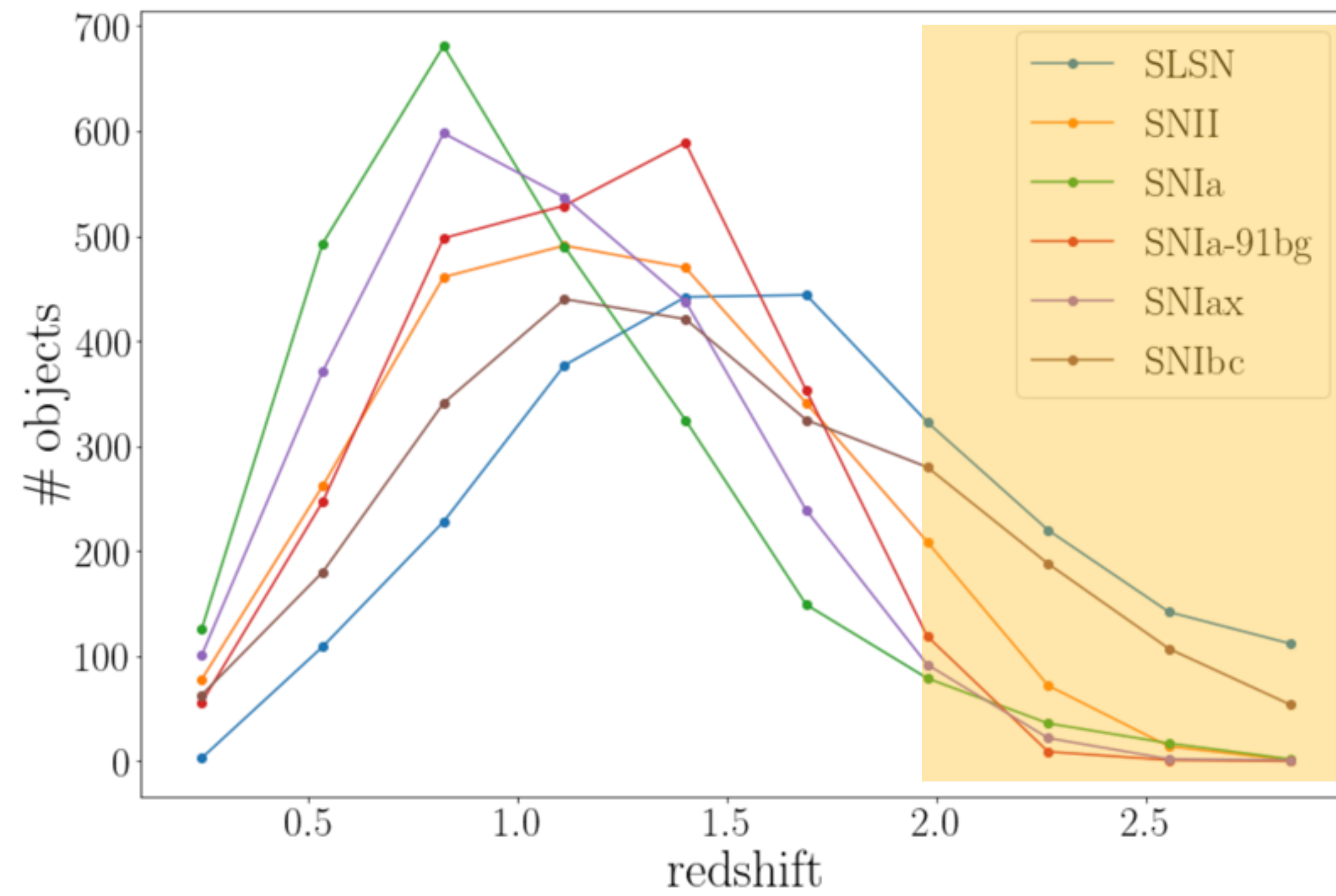
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# Summary

- 2 options for **redshift measurement**:
  - Live SNIa spectroscopy — high completeness up to  $z \sim 1$  (shallow),  $z \sim 2$  (deep)
  - Host galaxy spectroscopy — high completeness up to  $z \sim 1.8$
- **Spectroscopic SN Ia classification**: high efficiency up to  $z \approx 1.75$
- **Photometric SN Ia classification**: high efficiency (on simulations)
- **Early-time photometric SN typing**: good typing accuracy close to initial detection