

Testing Lens Models of PLCK G165.7+67.0 Using Lensed SN H0pe

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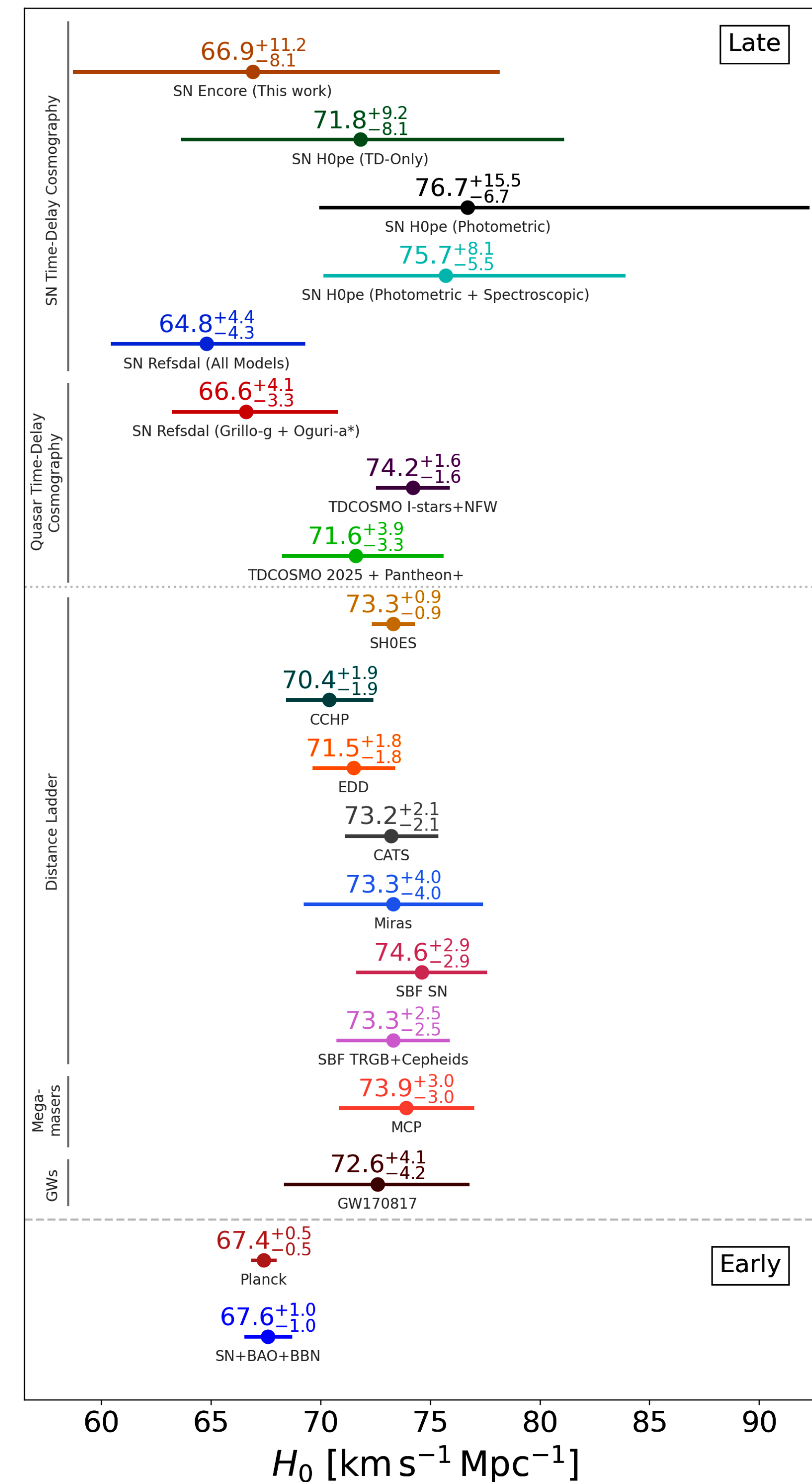
January 5th, 2026

Hubble Tension

The Hubble constant (H_0) quantifies the current expansion rate of the universe.

$\approx 5\sigma$ tension exists between early and late time probes.

Figure: H_0 measurements from SN Encore compared to other independent methods, broadly divided into late- and early time measurements. Figure 9 from Pierel (incl. Agrawal) et al. 2025



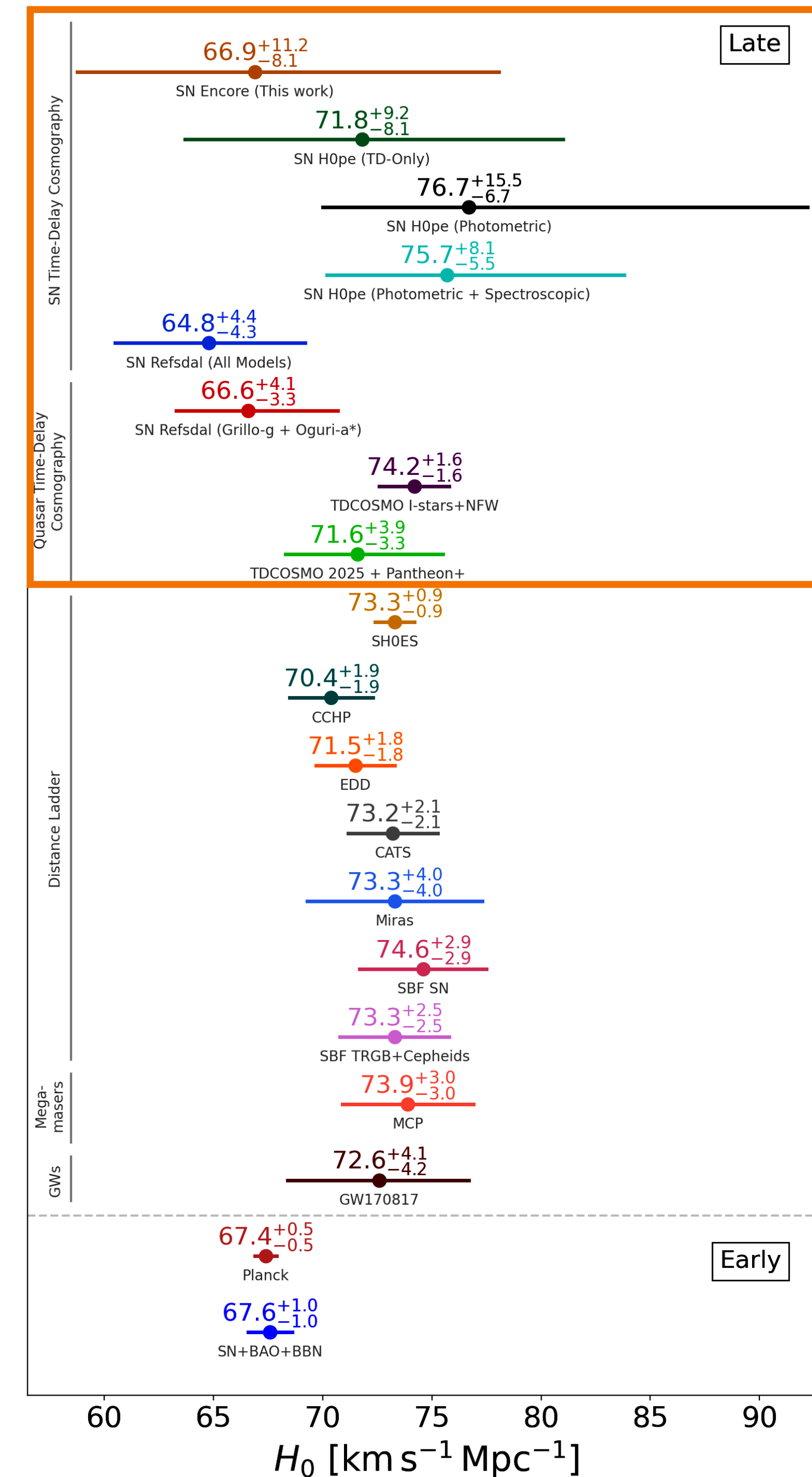
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$\approx 5\sigma$ tension exists between early and late time probes.

Time Delay Cosmography (TDC) provides a unique opportunity to address this tension!

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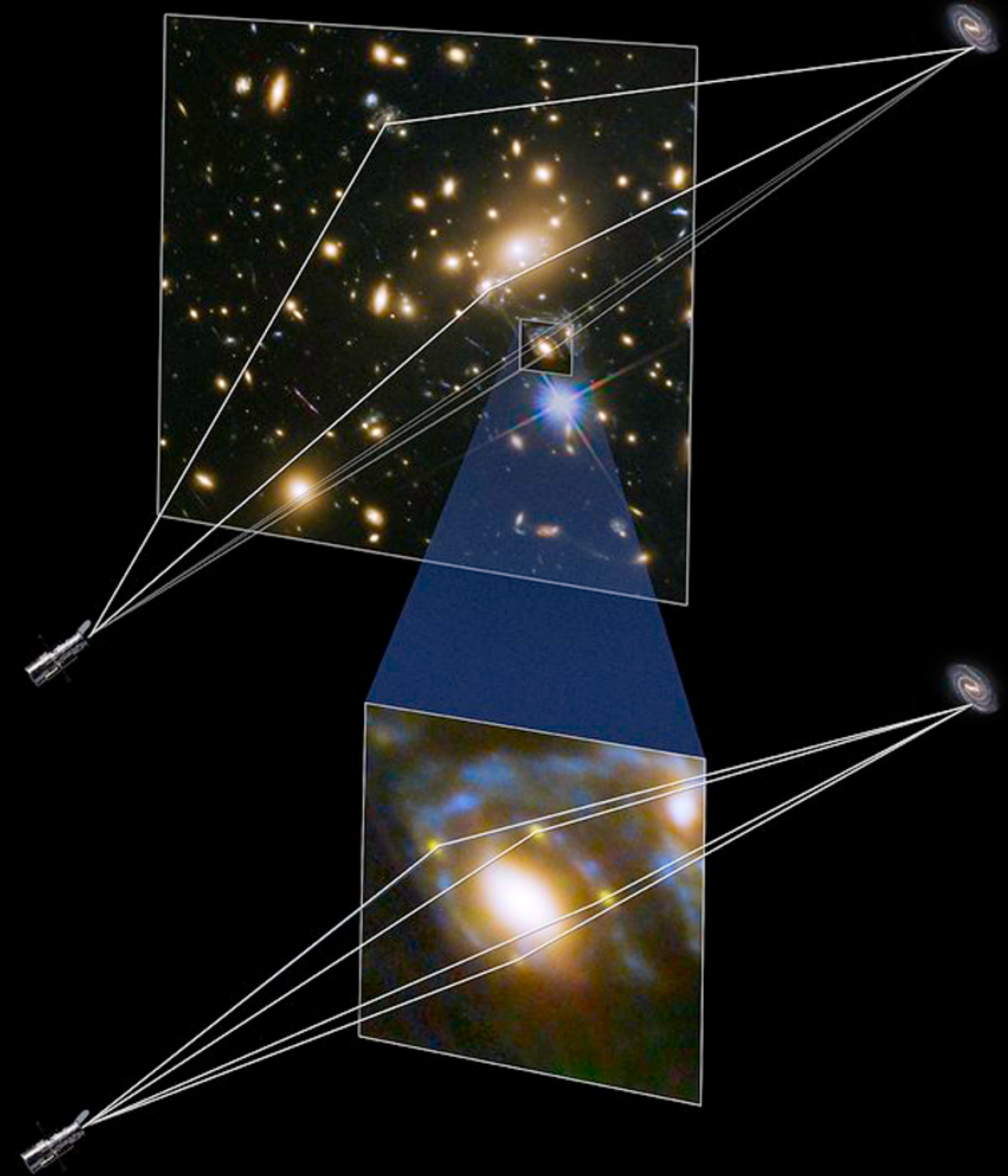


H_0 and glSNe

Time Delay between images is a one-step probe of H_0 .

TD depends on:

1. The positions of the observed images with respect to the source
2. The local lensing potential
3. The assumed cosmological model



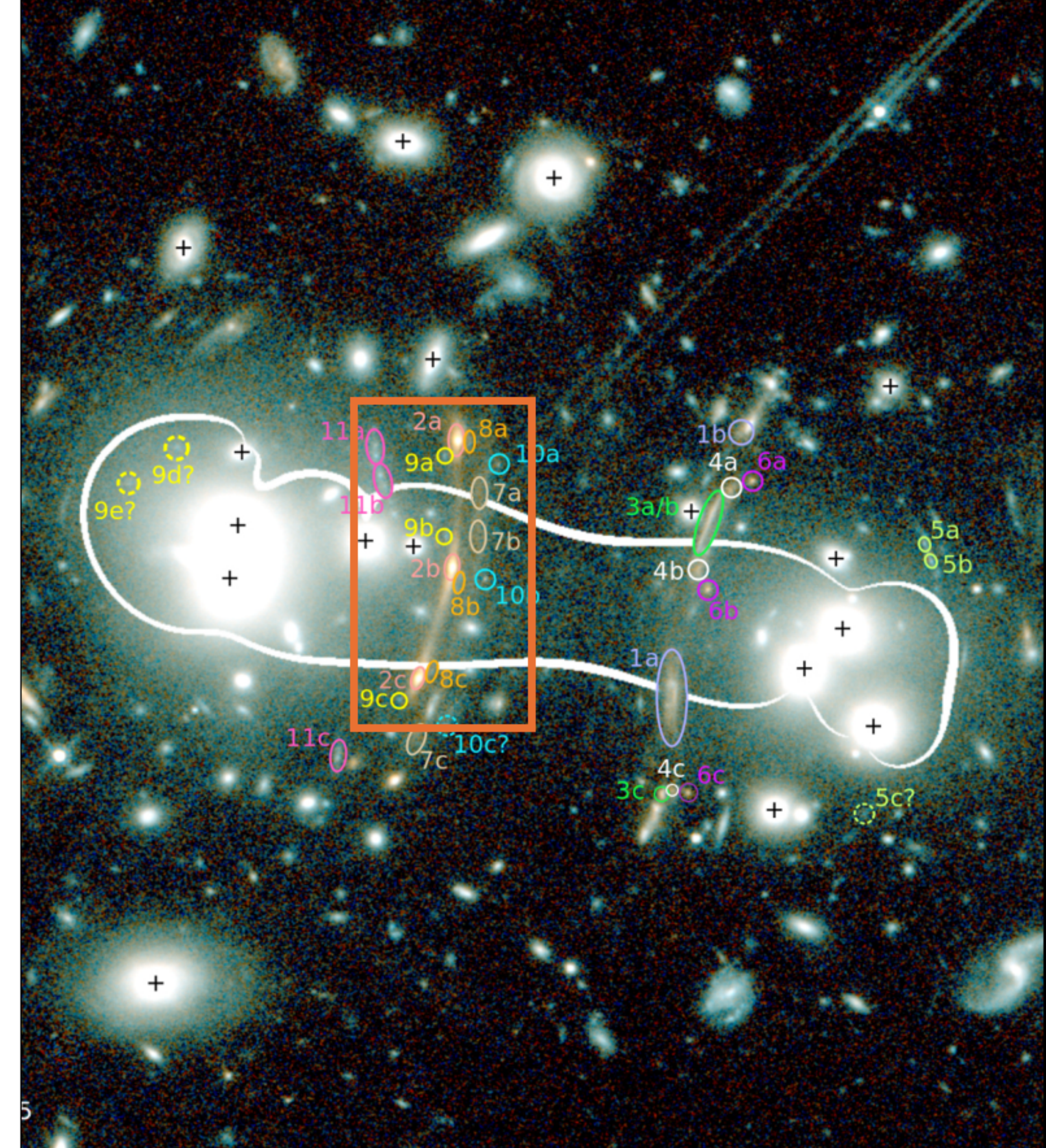
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Lens Models critical to H_0 measurement!



HST color image of galaxy cluster PLCK G165.7+67.0 with critical curve predicted by a lens model with the different arclet families labeled. Figure 8 from Frye+19.

SN H0pe

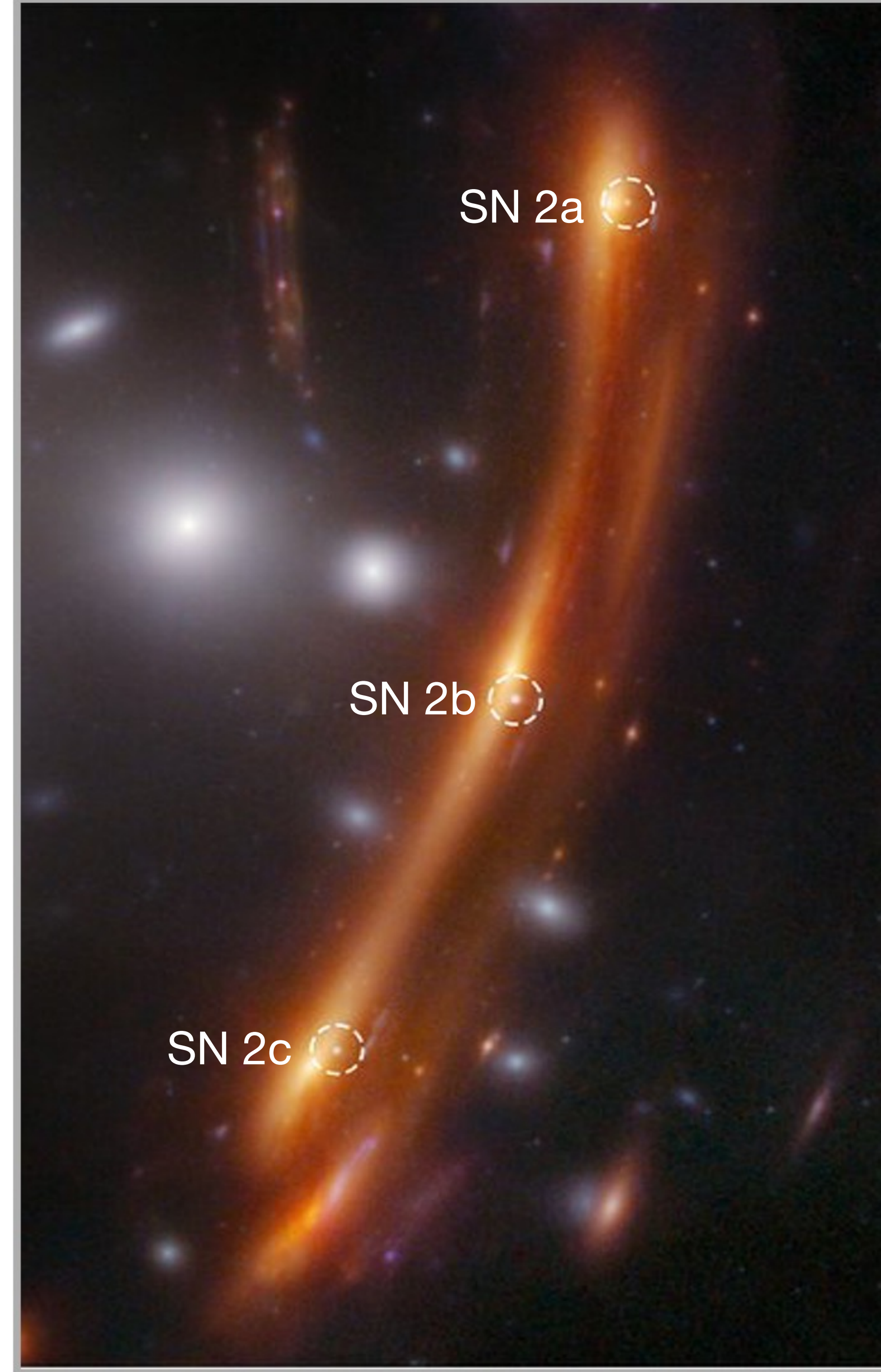
A Triply-Lensed SN Ia

- In Arc 2 of PLCK G165.7+67.0
- $z = 1.7834 \pm 0.0005$
- First H_0 measurement from a gI SN Ia!
(Pascale et al 2025)

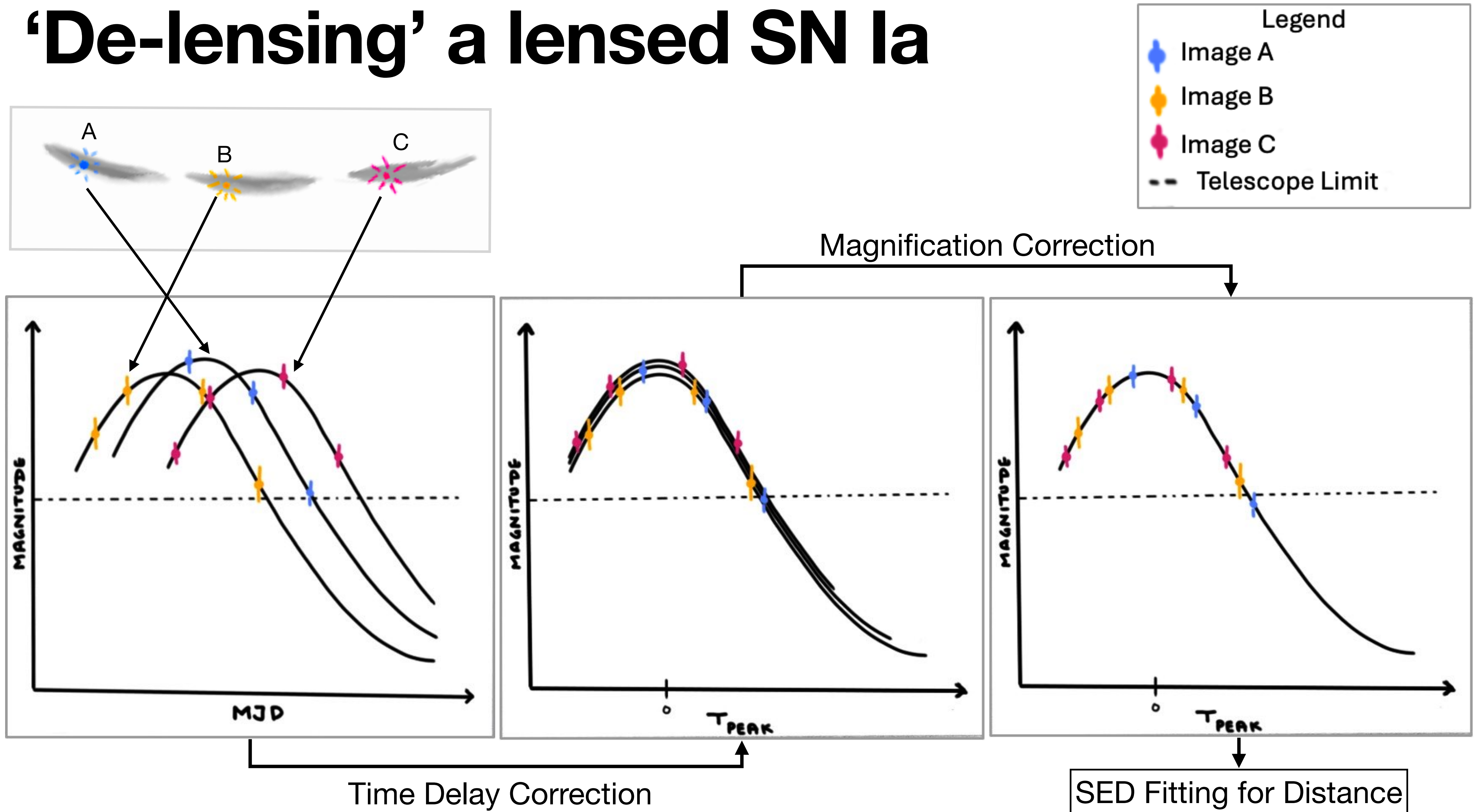
$$H_0 = 75.7^{+8.1}_{-5.5} \text{ km s}^{-1} \text{ Mpc}^{-1}$$

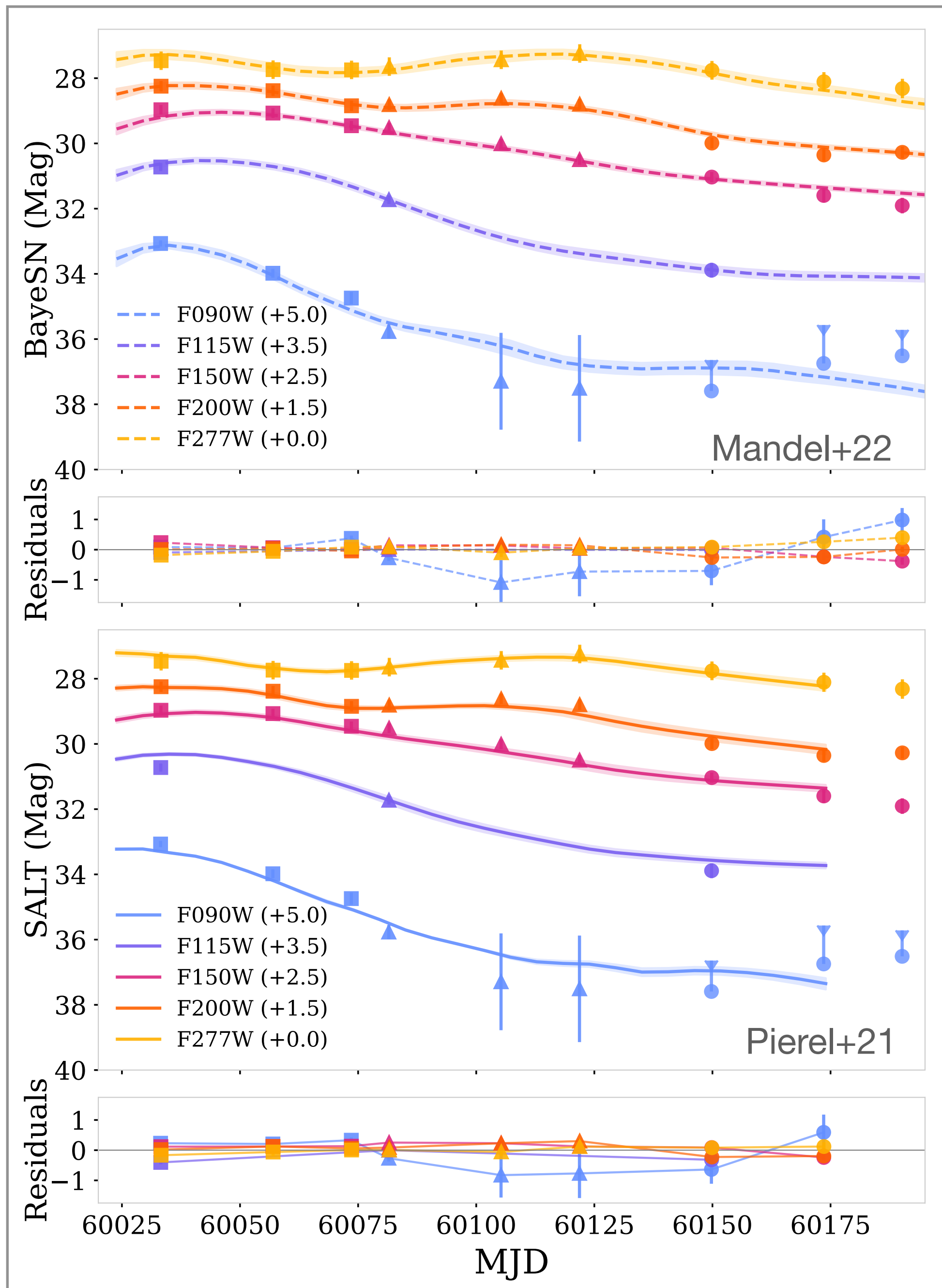
- Successful template obtained in JWST
Cycle 3 program in May 25 (PID: 4744, PI:
Frye)

JWST NIRCcam color image of SN H0pe.
Credits: NASA, ESA, CSA, STScI

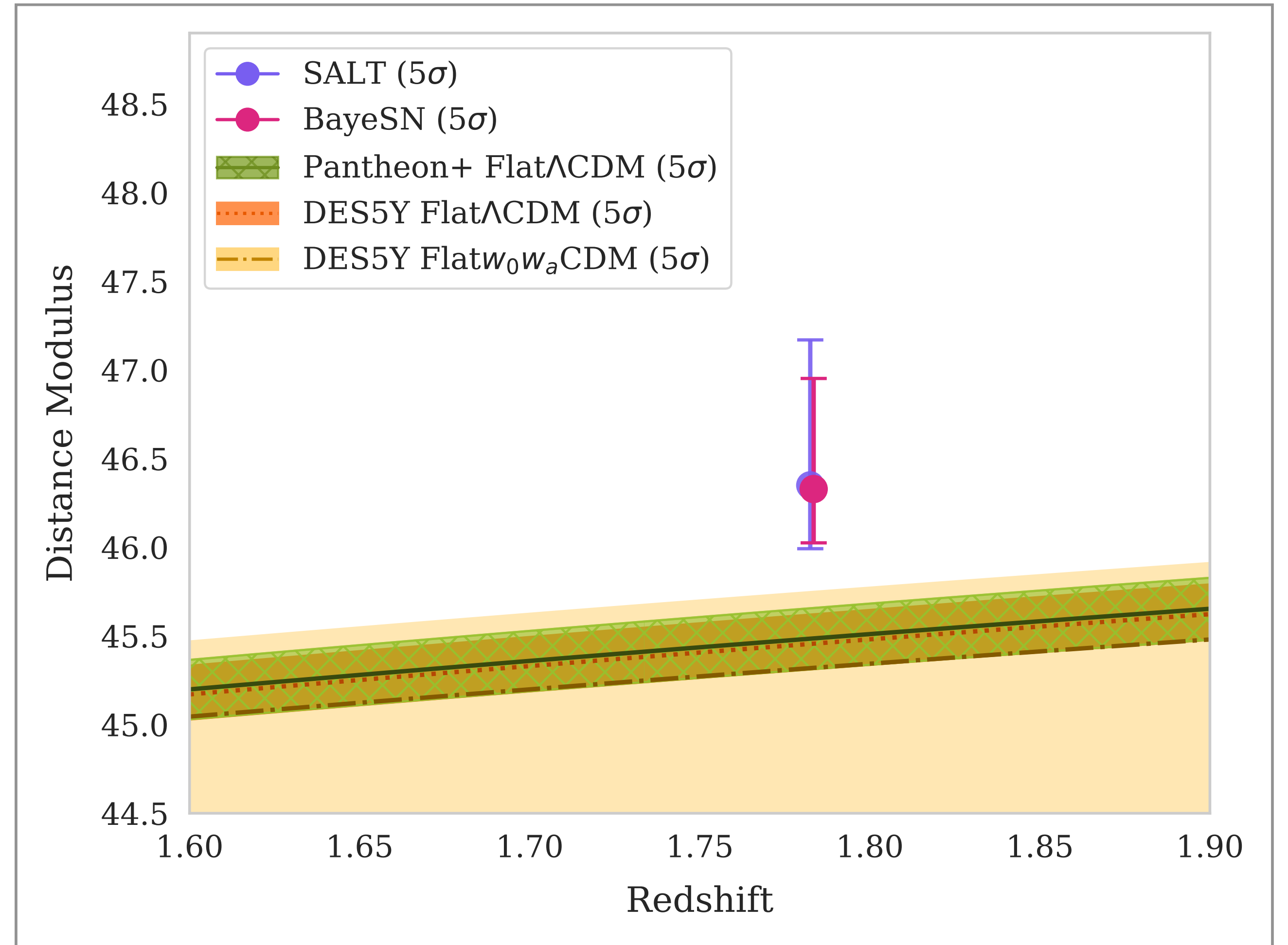


'De-lensing' a lensed SN Ia



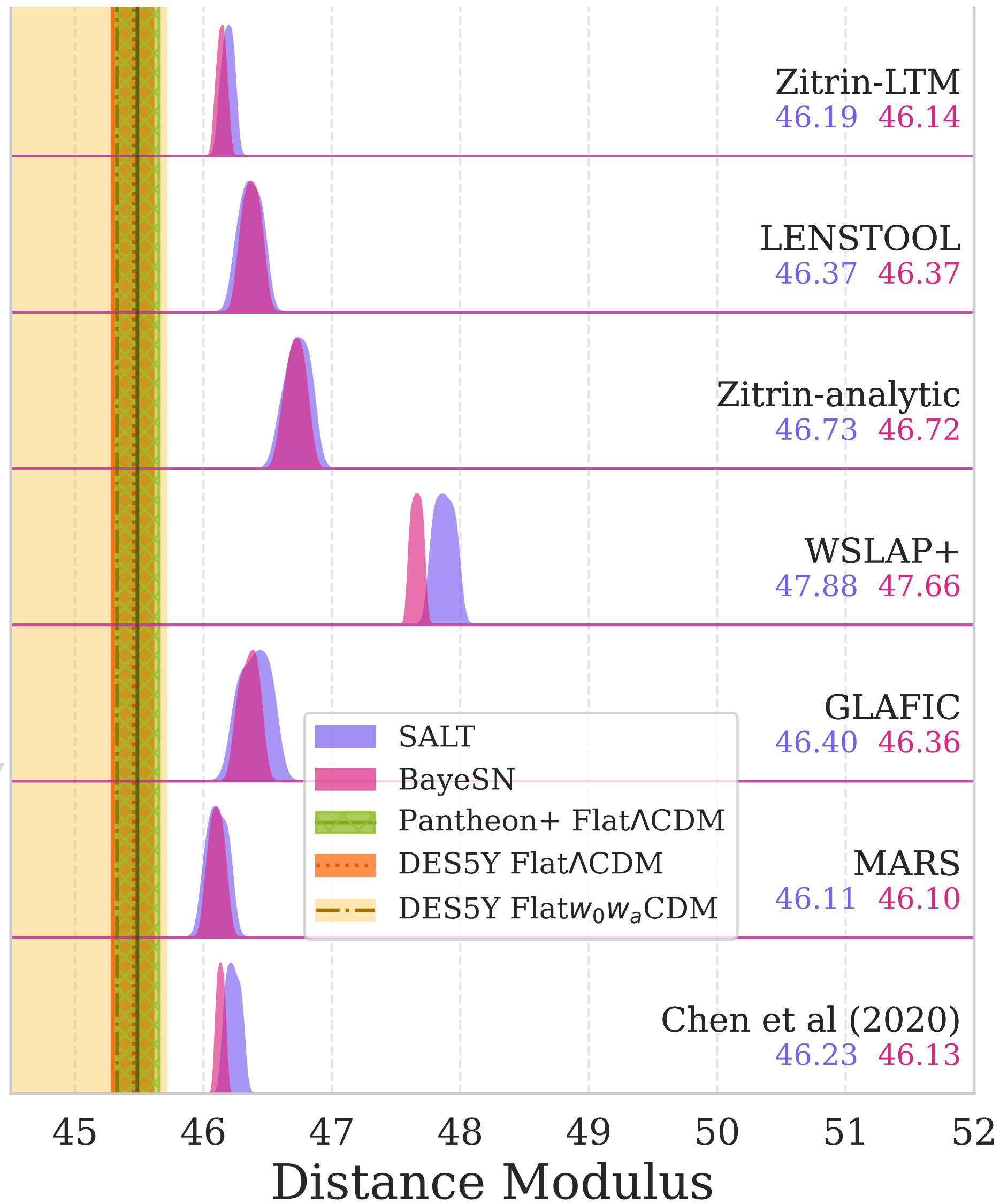


Lens models over predict μ at $z = 1.783$

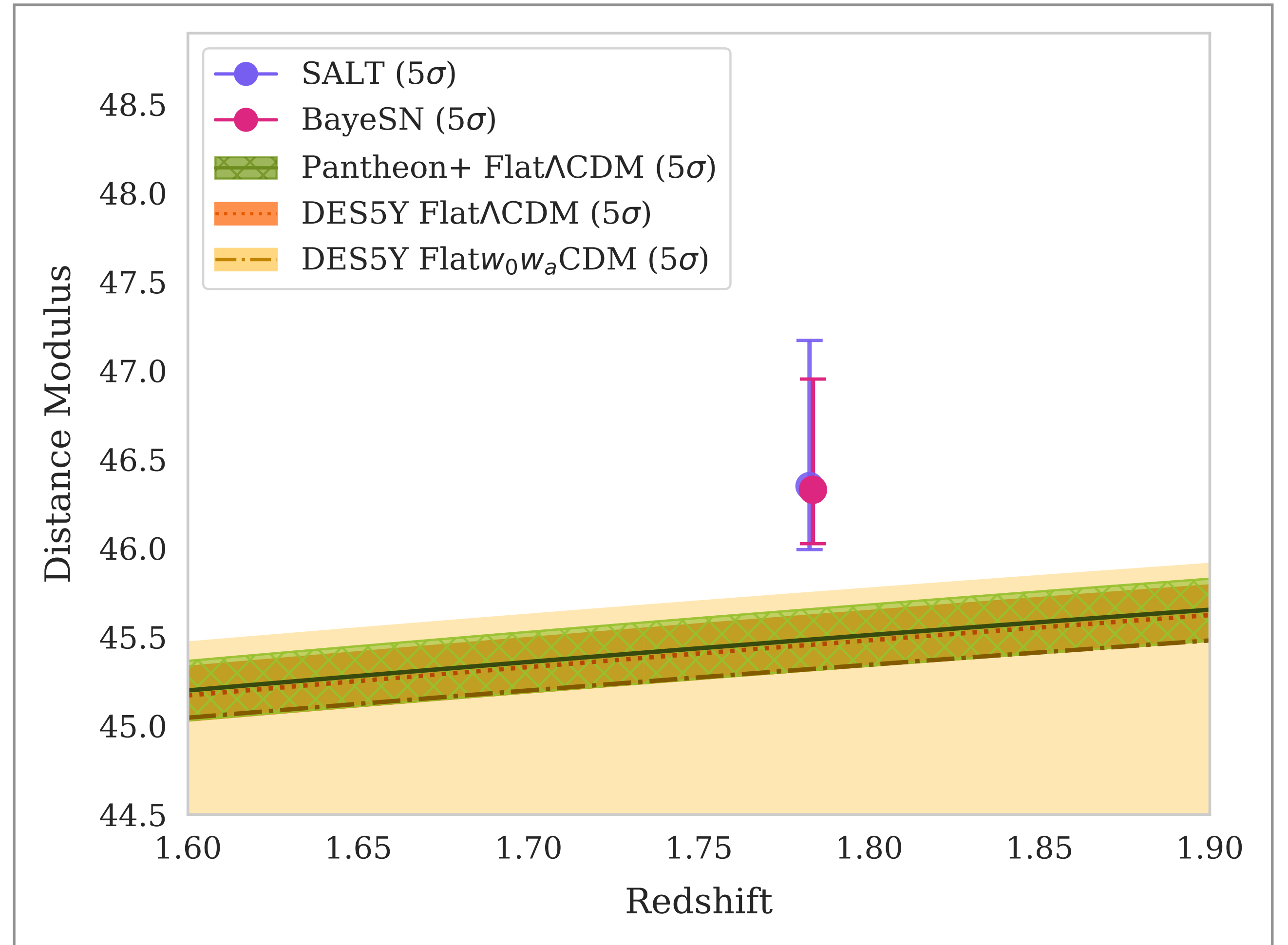


Weighted avg. distance moduli compared to cosmological constraints from Pantheon+ and DES (Fig. 5 Agrawal+25)

Increasing TD prediction accuracy



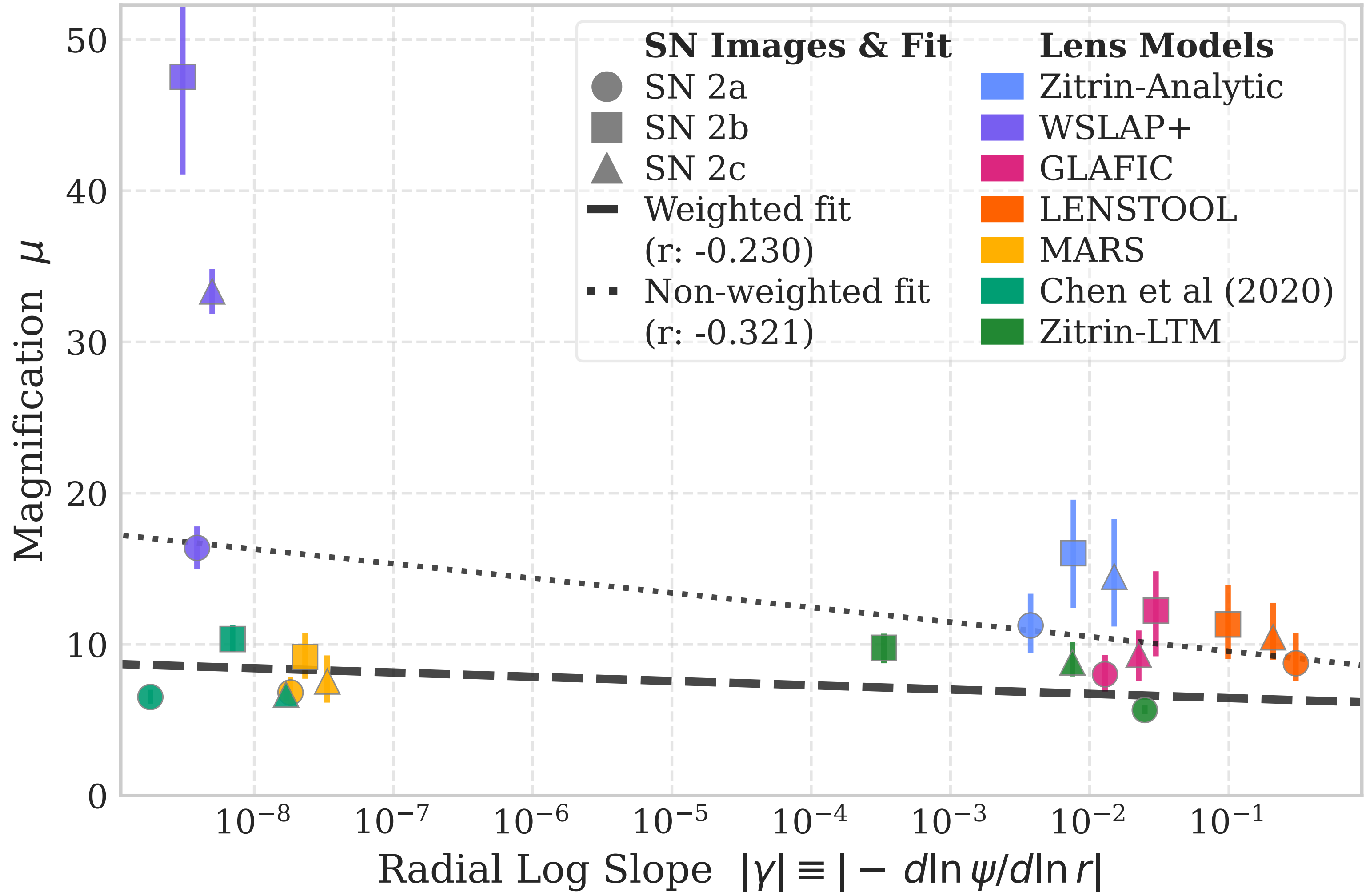
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Weighted avg. distance moduli compared to cosmological constraints from Pantheon+ and DES (Fig. 5 Agrawal+25)

Shallow potentials predict higher magnifications

Magnification vs Radial Log Slope at SN image positions



➡ The true potential of the cluster is even steeper than the current lens models predict! (Figure 6 from Agrawal+25)

Lensed SNe can function as a test of lens modeling showing hidden systematics!

Key Results

1. All G165 Lens Models over predict magnification.
 - ➡ There is a underlying assumption/modeling choice being made.
 - ➡ Magnifications must be used as priors for inference.
2. There is significant difference among the lens models
 - ➡ Having multiple lens models for scientific inference is crucial.
3. A negative correlation exists between the radial slope and magnifications
 - ➡ The true slope of the cluster is steeper than current models