



Australian
National
University

Research School
of Astronomy &
Astrophysics

From OzDES to TiDES

Losing half the galaxies?

host-dependent redshift recovery bias in shallow spectroscopic follow-up for SNe Ia cosmology



EQUUS



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DARK ENERGY IS STILL THE BIG PROBLEM

We can observe acceleration

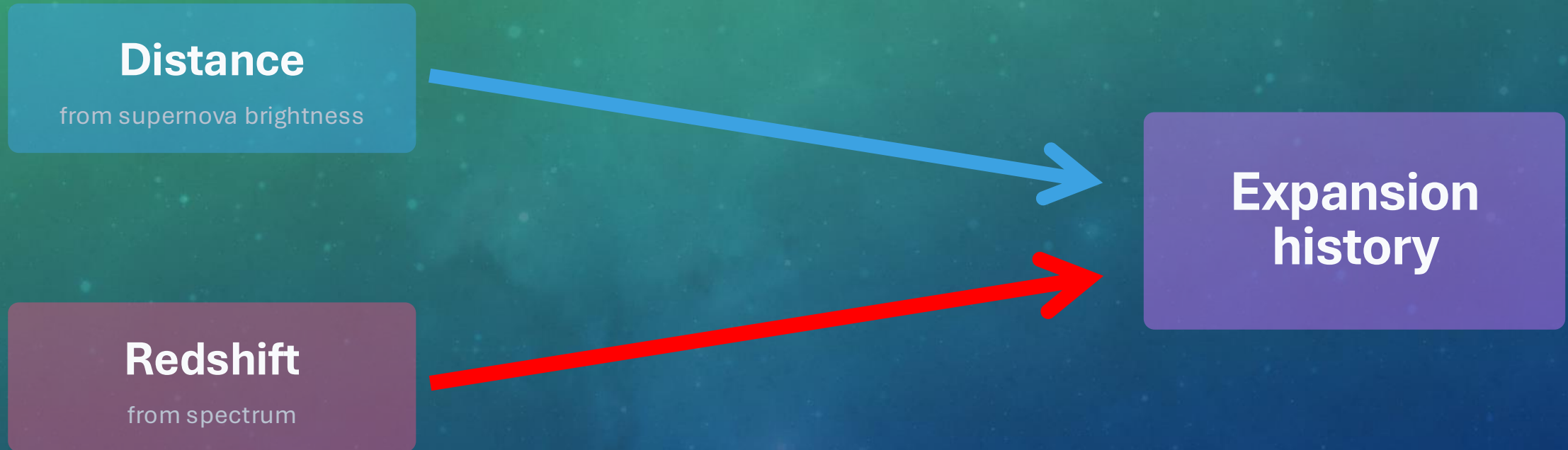
But the physical cause is still open:

cosmological constant? Λ
evolving dark energy? $\omega \neq -1$
modified gravity?
something else?

The task: measure expansion history precisely enough to test the physics.

BBC Sky at Night

WHAT DO WE ACTUALLY MEASURE?



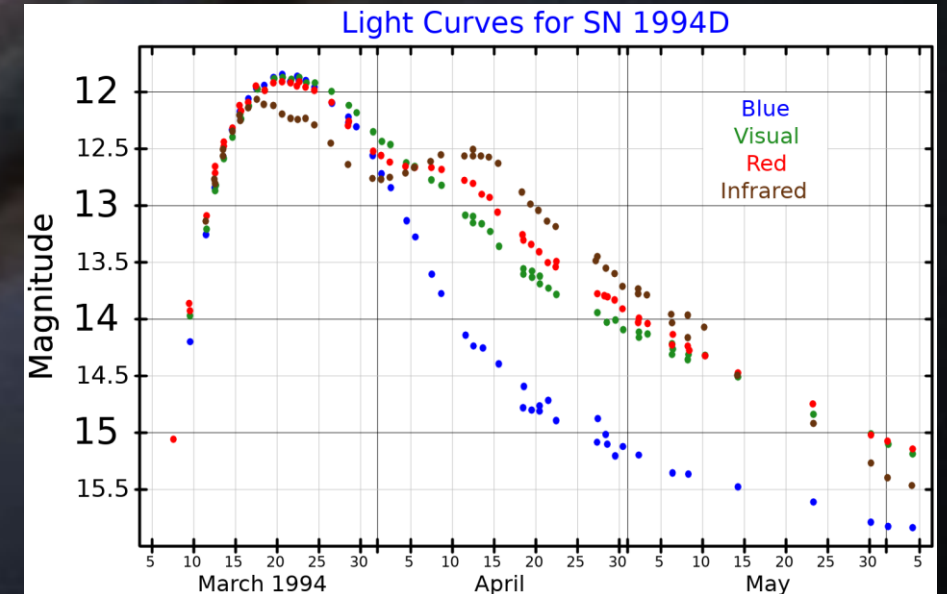
Different dark-energy models predict slightly different relationships between distance and redshift.

TYPE IA SUPERNOVAE GIVE DISTANCES

Light curve
+ colour
+ calibration

→ Distance

One half of the cosmology point.



$$H^2(z) = H_0^2 \left[\Omega_m (1+z)^3 + \Omega_{DarkEnergy} f(z, w) + \dots \right]$$

NASA/ESA, The Hubble Key Project Team and The High-Z Supernova Search Team

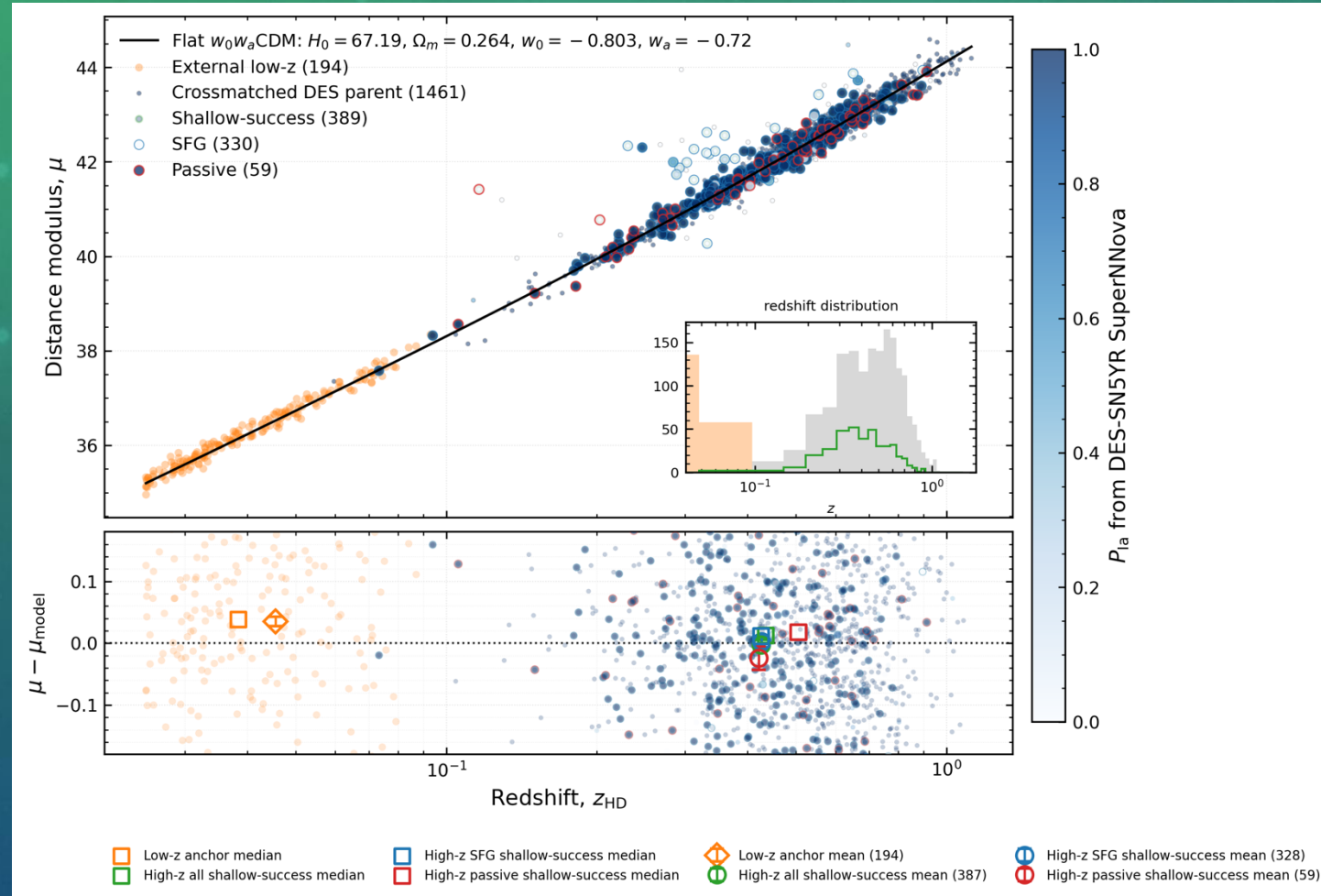
TYPE IA SUPERNOVAE: STANDARDISABLE CANDLES

How far away did the supernova appear to be?



DISTANCE ALONE ISN'T ENOUGH

A.Chan + C. Lidman In Prep (2026)



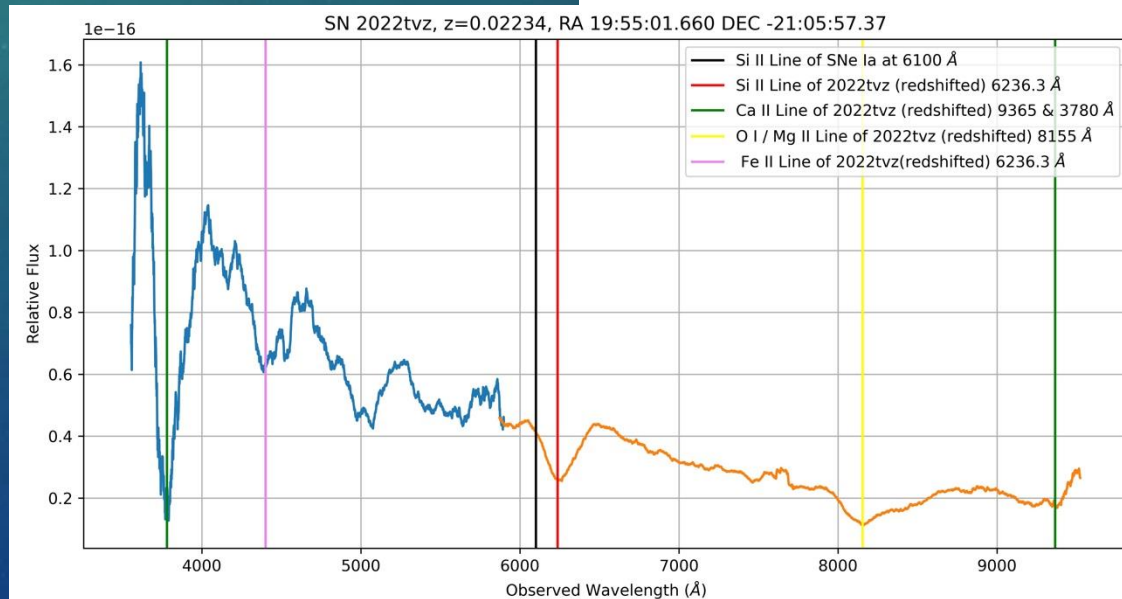
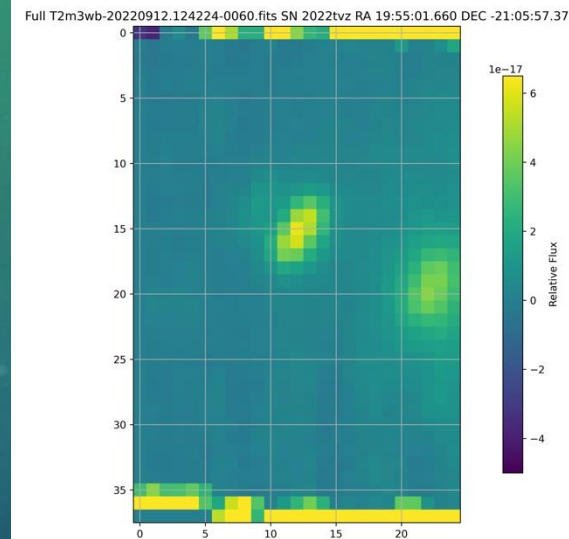
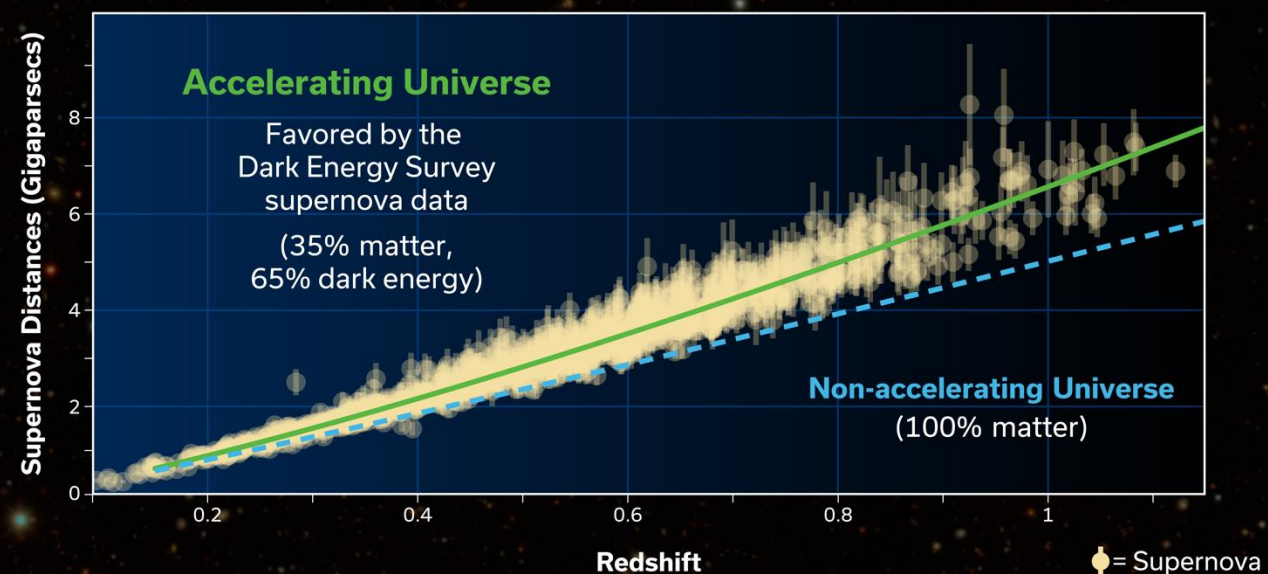
Supernova brightness + redshift = Hubble diagram

WHERE DO THE REDSHIFTS COME FROM?

SNe light curve $\rightarrow$ distance

Host spectrum $\rightarrow$ redshift

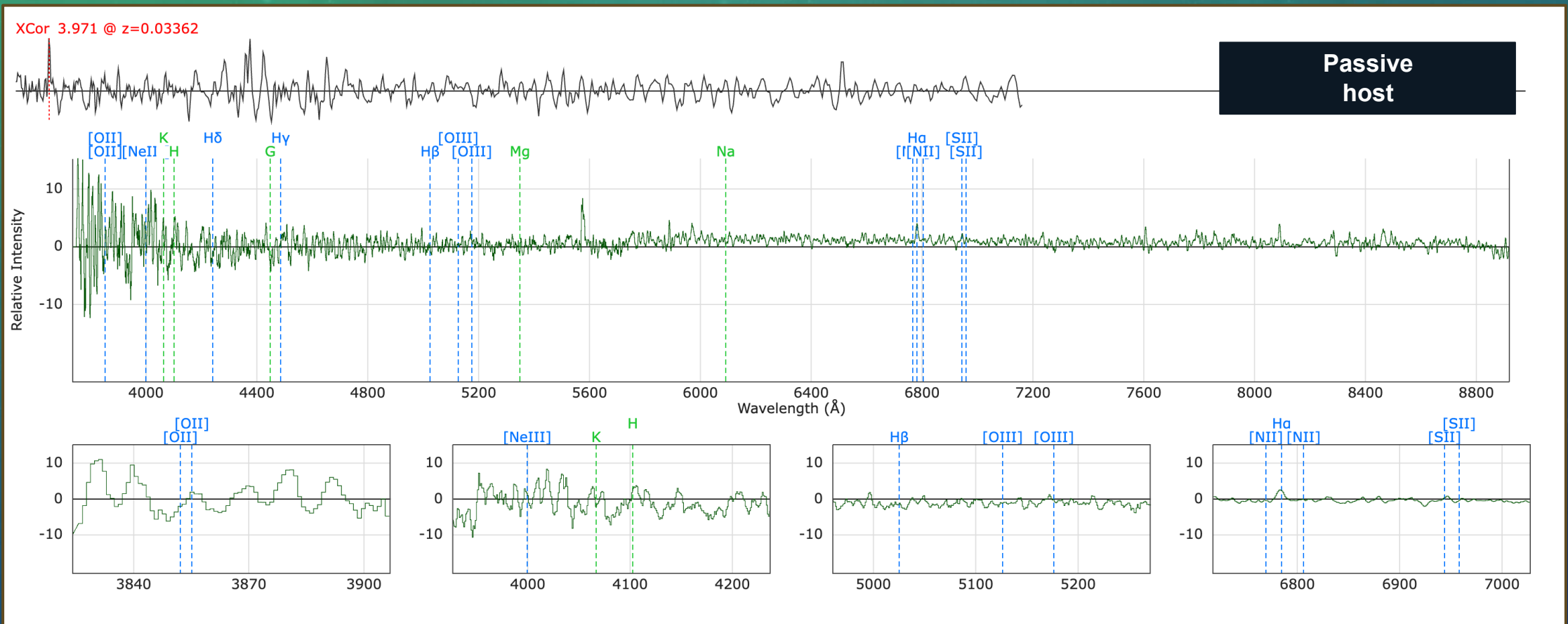
SUPERNOVA HUBBLE DIAGRAM



A. Chan et. al. (2022)

THE OBSERVATIONAL PROBLEM: NOT ALL GALAXIES ARE EQUALLY COOPERATIVE

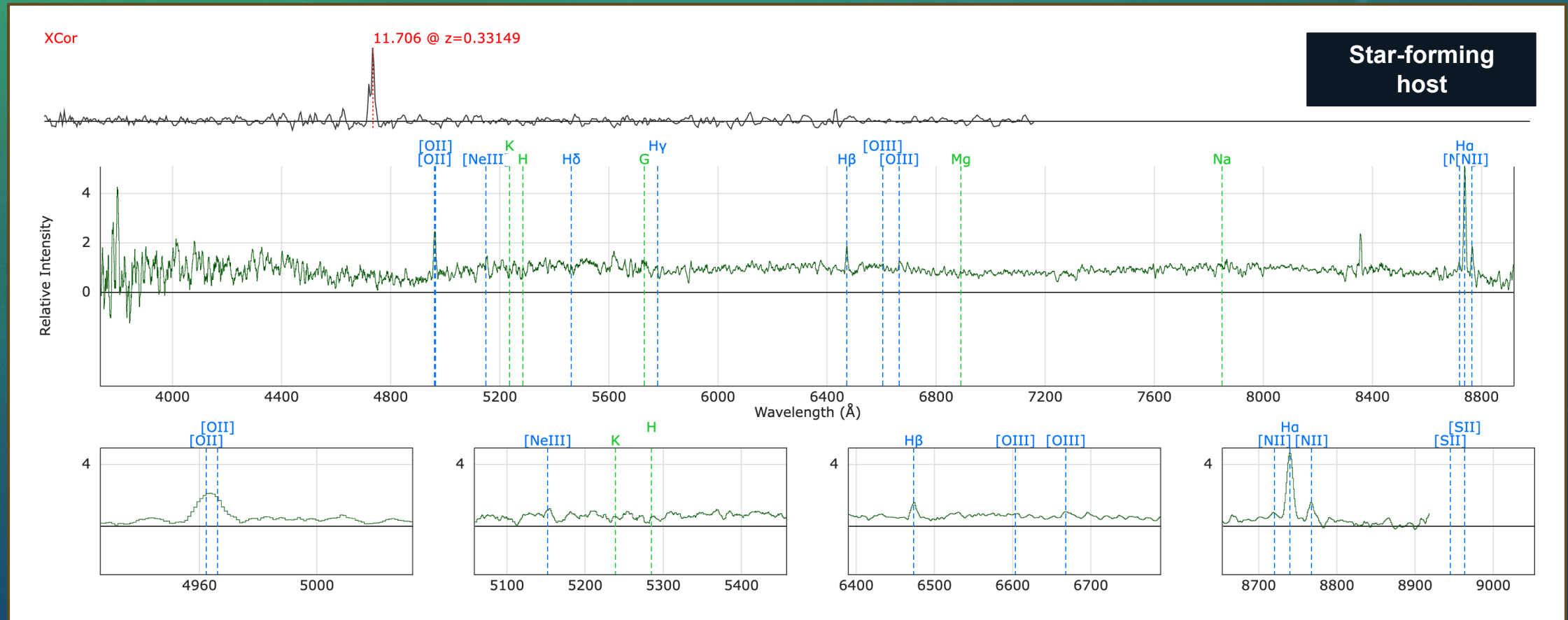
Broad/weak spectral features → harder redshift recovery at low S/N



MARZ

THE OBSERVATIONAL PROBLEM: NOT ALL GALAXIES ARE EQUALLY COOPERATIVE

Strong narrow spectral features → easier redshift recovery at low S/N

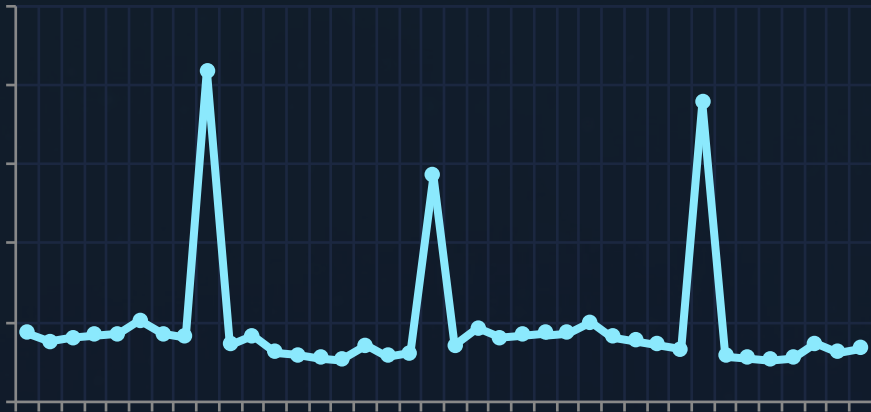


MARZ

THE OBSERVATIONAL PROBLEM: NOT ALL GALAXIES ARE EQUALLY COOPERATIVE

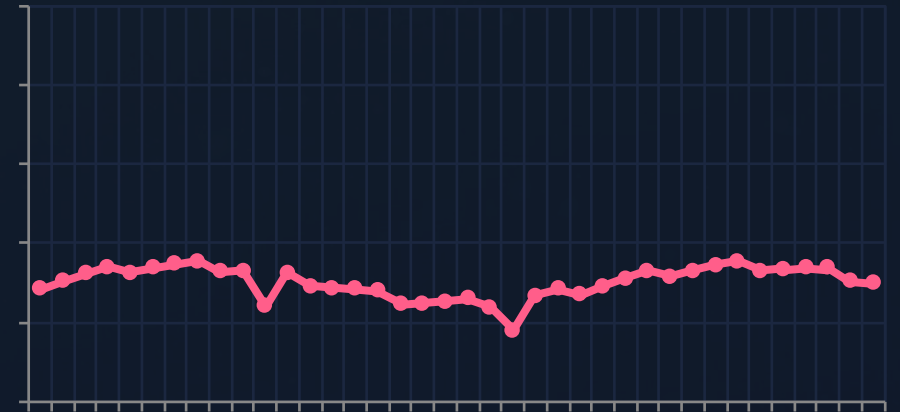
Strong narrow features

Often easier to redshift with limited exposure

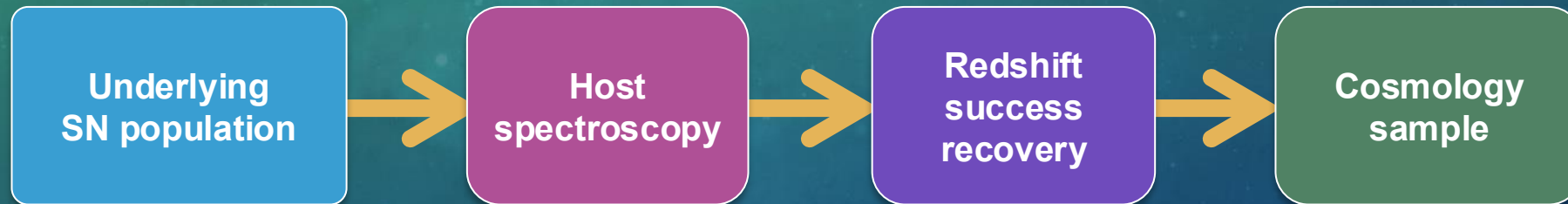


Weak / broad features

More likely to wash out as exposure is limited



THE SELECTION-FUNCTION QUESTION: ARE WE SELECTING THE COSMOLOGY SAMPLE BEFORE DOING COSMOLOGY?

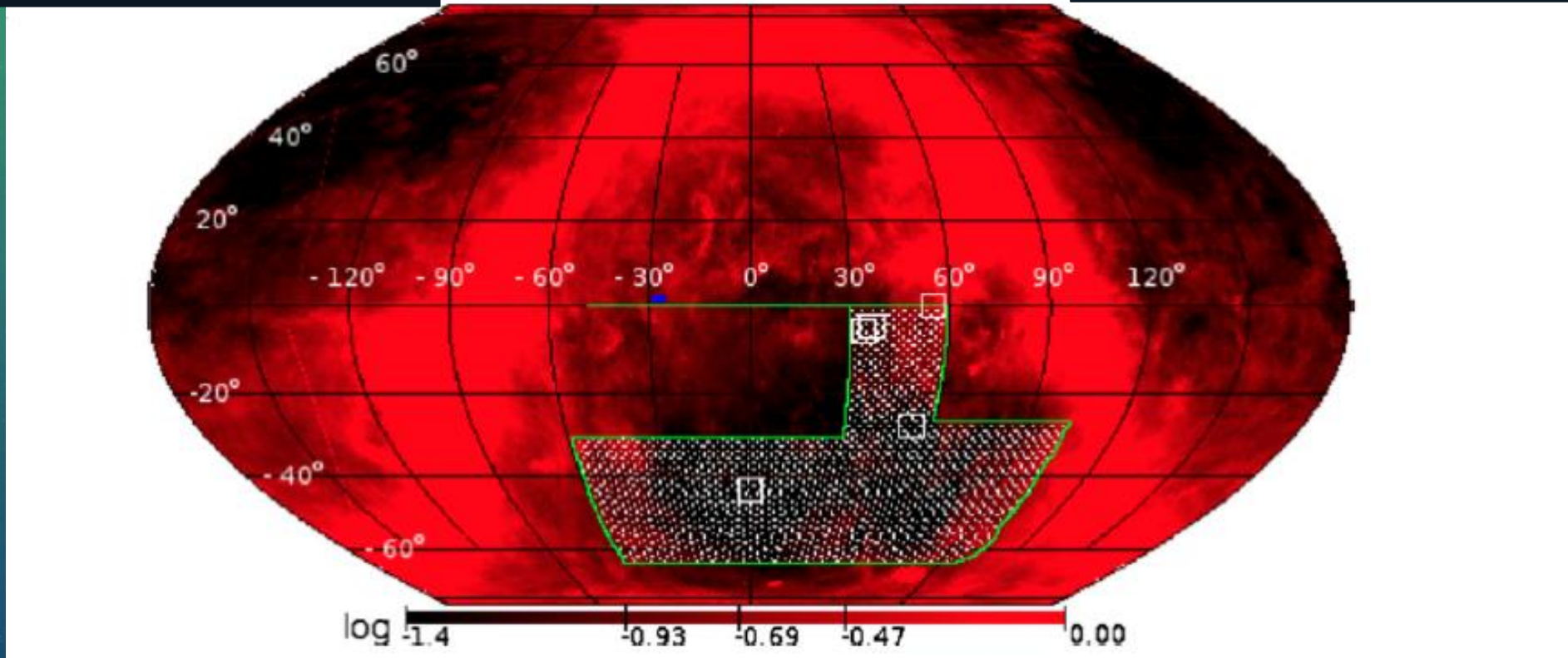


The redshift requirement acts like a reconstruction / selection efficiency.

WHAT IF OZDES HAD STOPPED AFTER THREE EXPOSURES?

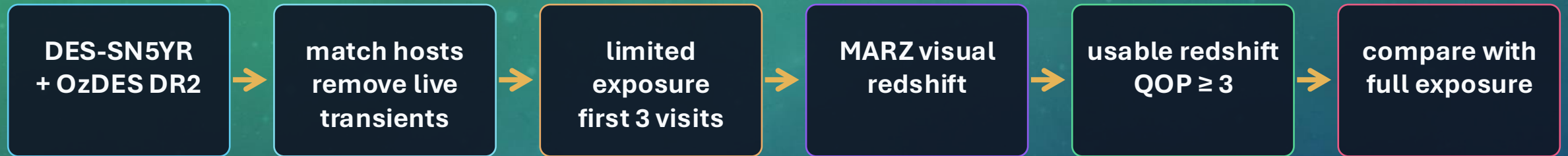
Full exposure = reference redshift

Limited exposure = first 3 visits



Would we recover the same host-galaxy redshift?

HOW WE TESTED IT



1,280

full exposure reference hosts

920

strong-feature / star-forming
hosts

360

weak/broad-feature passive hosts

Success criterion: limited-exposure redshift matches full-exposure reference within $|\Delta z| \leq 0.001$

MAIN RESULT

Recovered with limited exposure

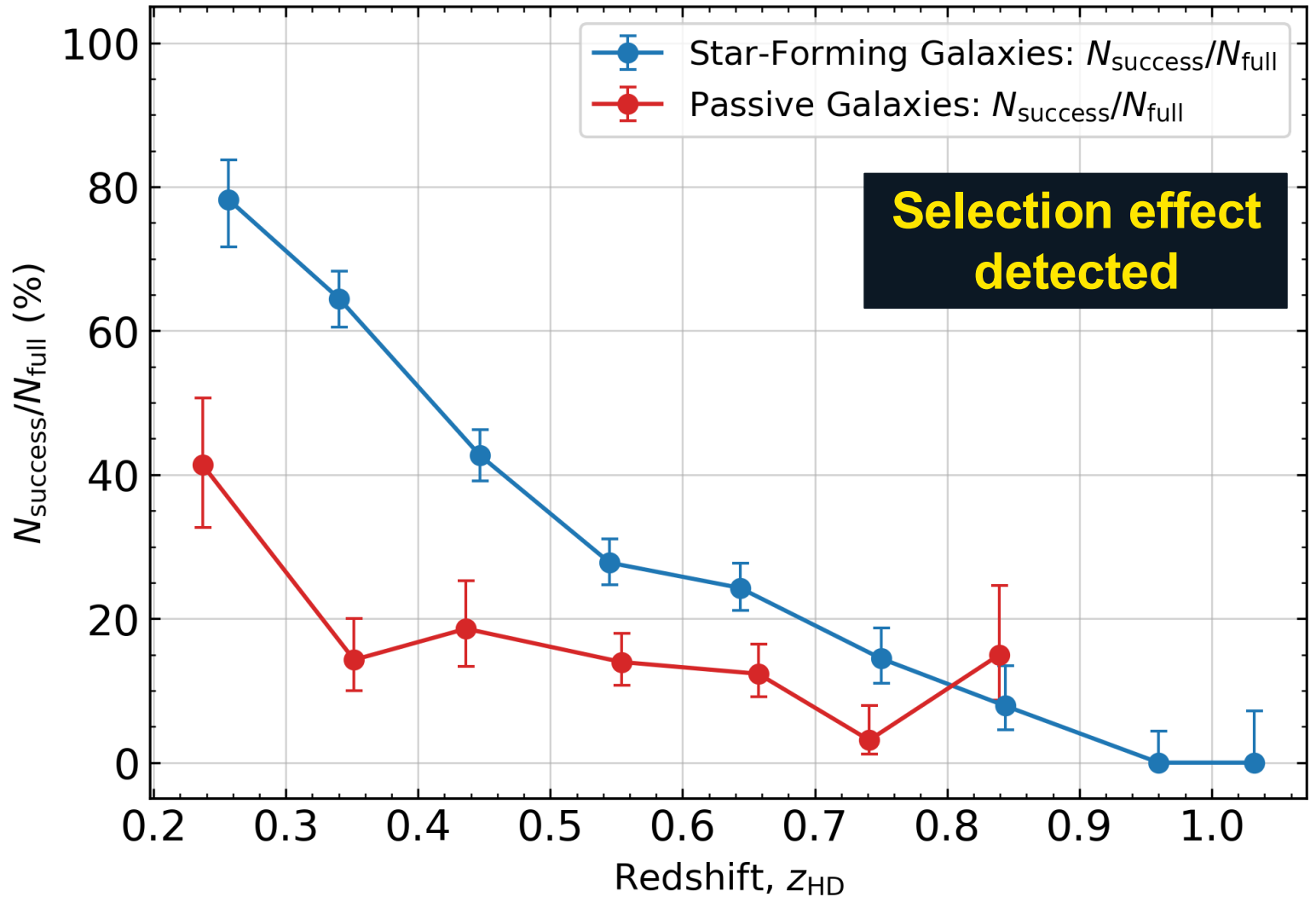
35.9%

Star-forming

16.4%

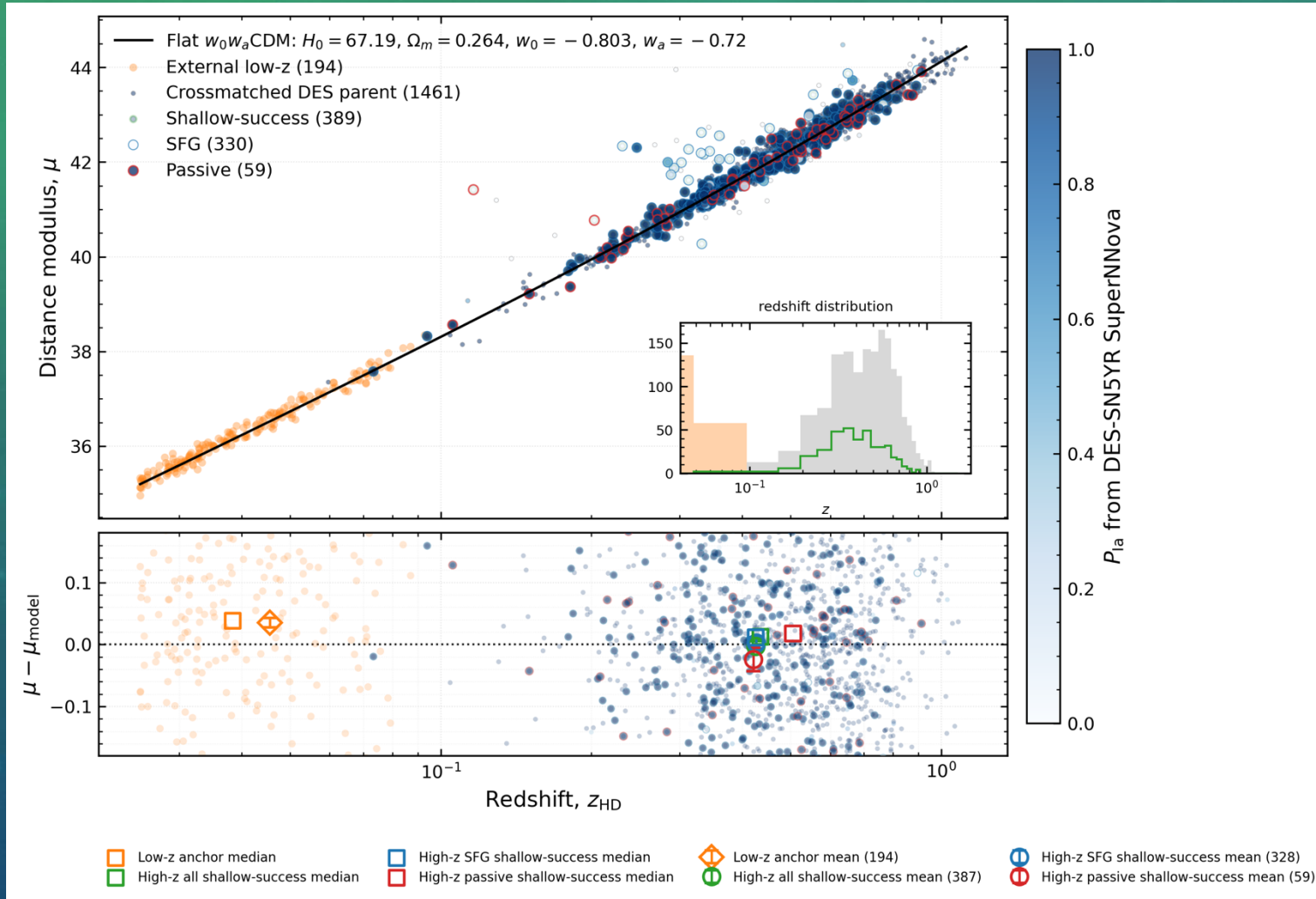
Passive

Accepted redshifts are mostly correct:
389 / 410 recovered redshifts match
→ 5.1% failure rate



A.Chan + C. Lidman In Prep (2026)

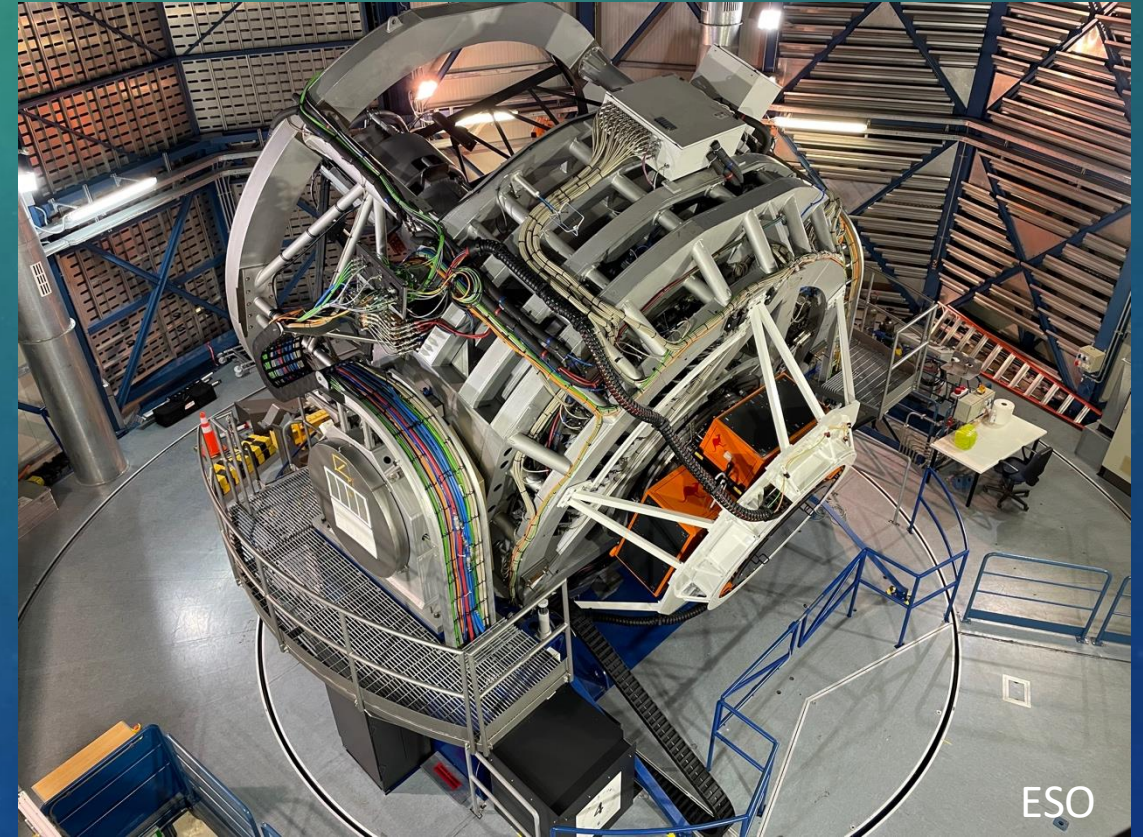
DOES THIS MATTER FOR COSMOLOGY?



No significant
Hubble-residual
difference yet

A.Chan + C. Lidman In Prep (2026)

OZDES→TIDES / 4MOST→RUBIN- ERA TRANSIENT COSMOLOGY



Bigger samples make spectroscopic selection functions harder to ignore.

TAKE-HOME

1. Limited-exposure spectroscopy produces a host-dependent redshift selection function.
2. Star-forming hosts are recovered much more efficiently than passive hosts.
3. Future precision cosmology needs to model that selection function.

SUPERNOVAE NEAR AND FAR

CELEBRATING THE ACHIEVEMENTS OF BRIAN SCHMIDT AND THE 40TH ANNIVERSARY OF SN1987A

22 - 26th Feb 2027

Canberra, Australia



<https://www.mso.anu.edu.au/supernovae-near-and-far/>
September 30th - Submission of abstracts and early-bird registration close



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Thanks!



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