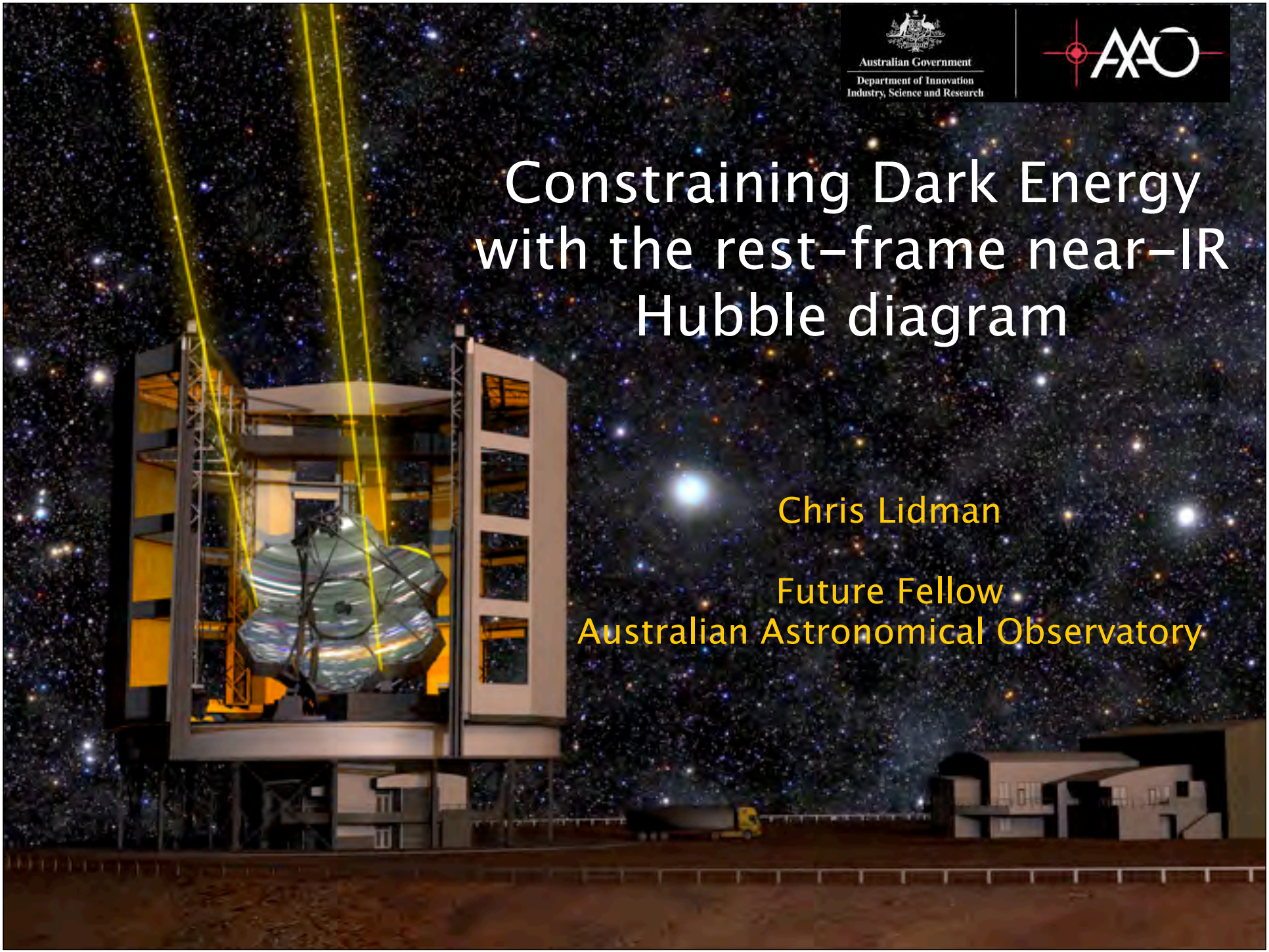


Australian Government
Department of Innovation
Industry, Science and Research

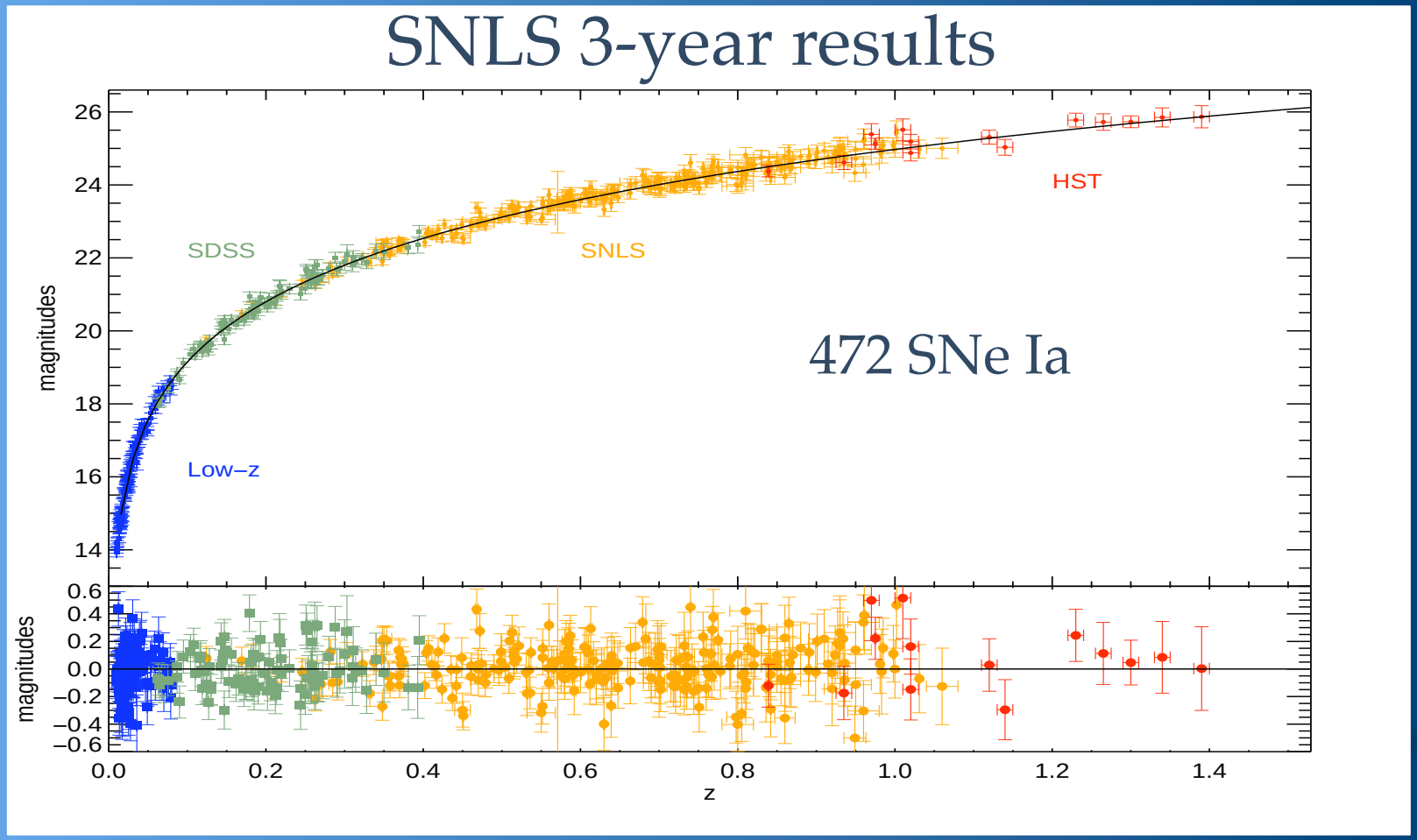
Constraining Dark Energy with the rest-frame near-IR Hubble diagram

Chris Lidman

Future Fellow
Australian Astronomical Observatory

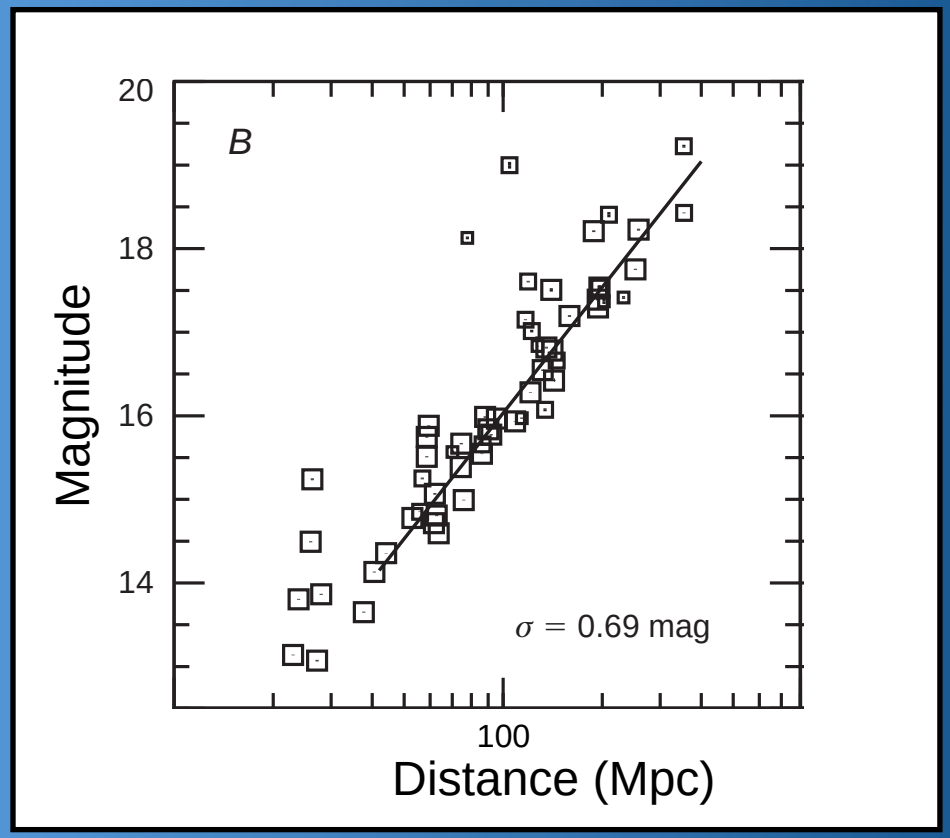
The B-band Hubble diagram

Conley et al. 2011



A 0.05 change in w ~ 1% distance (2% flux) change at z~1

SNe Ia are not perfect standard candles



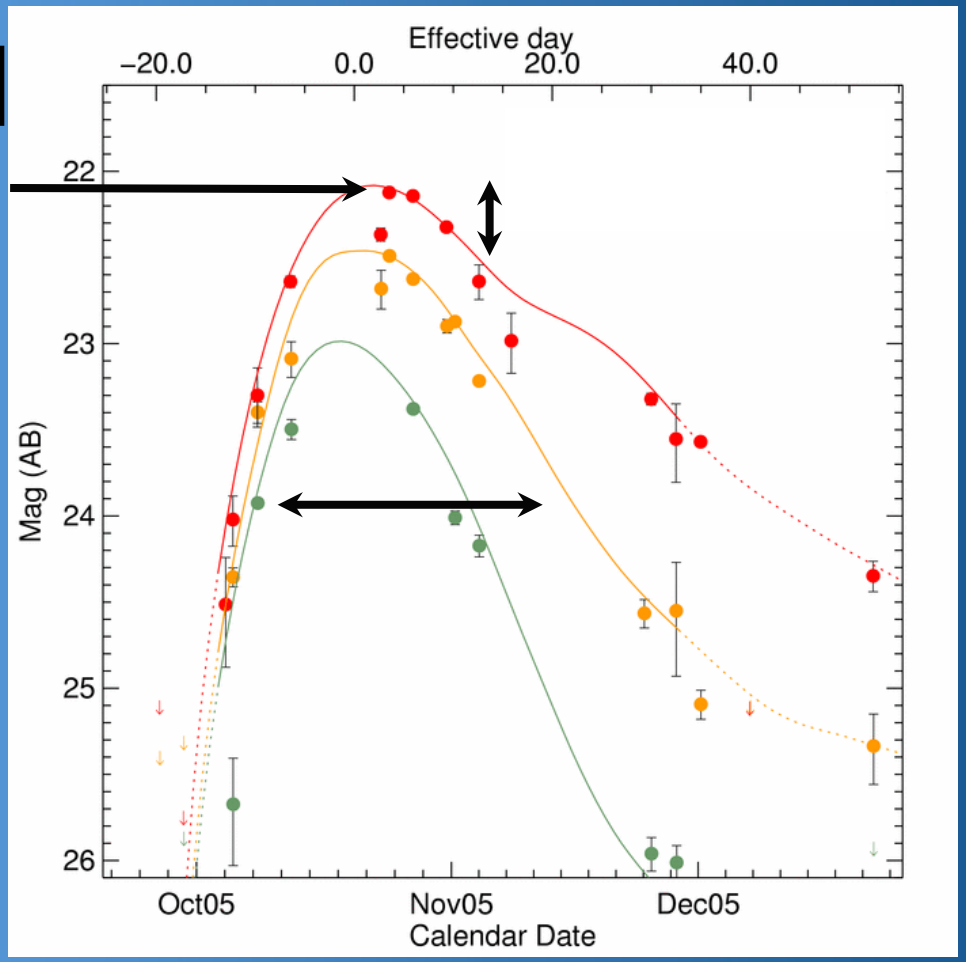
Phillips 2012

Corrections for light curve width and colour

Peak brightness

Colour (c)

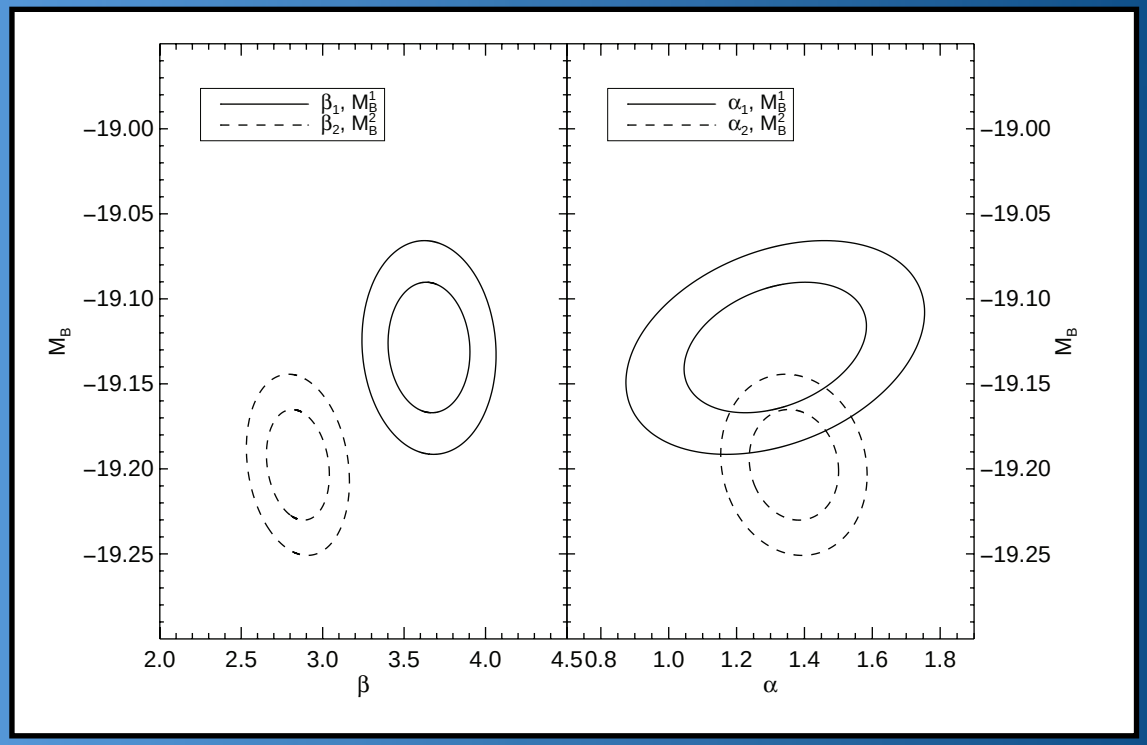
Lightcurve width (s)



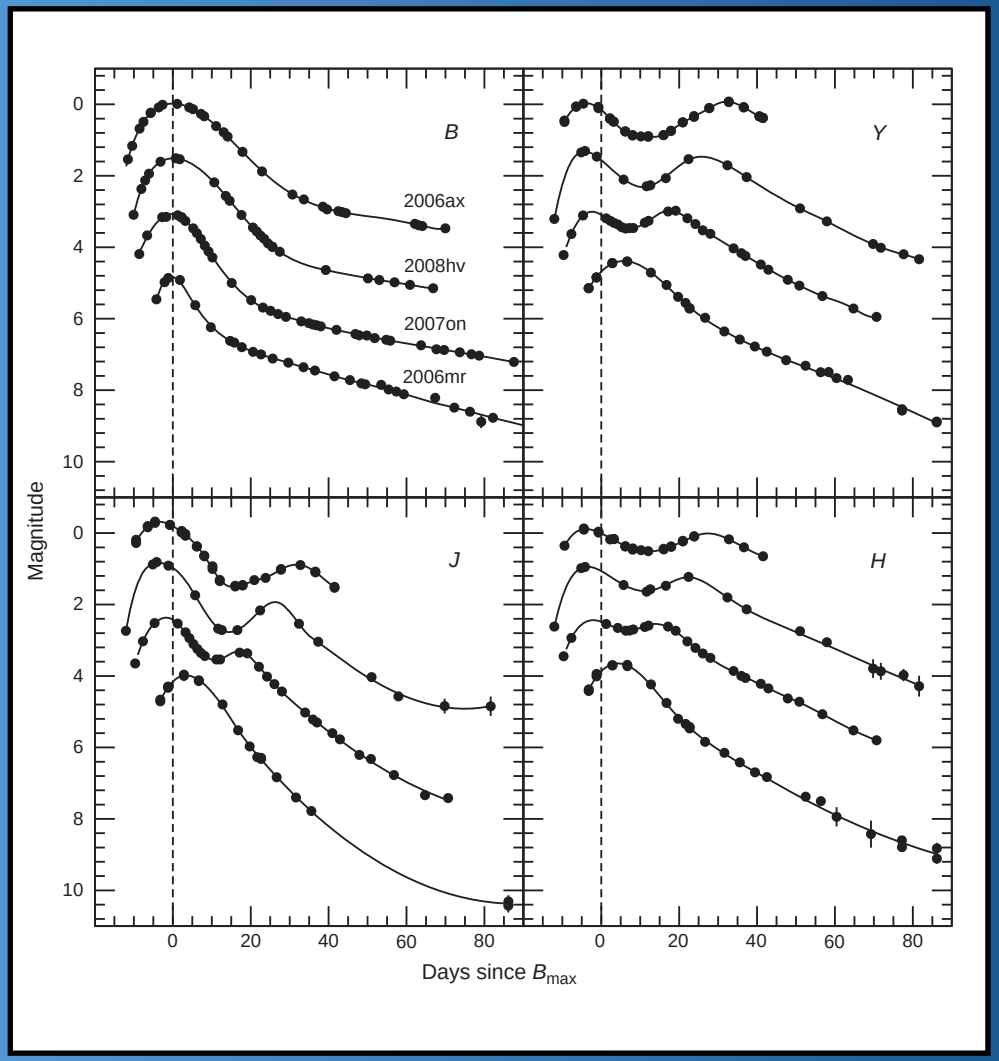
$$m_B = 5\log_{10} D_L + M_B - \alpha(s-1) + \beta c$$

More complex picture

Sullivan et al. 2011

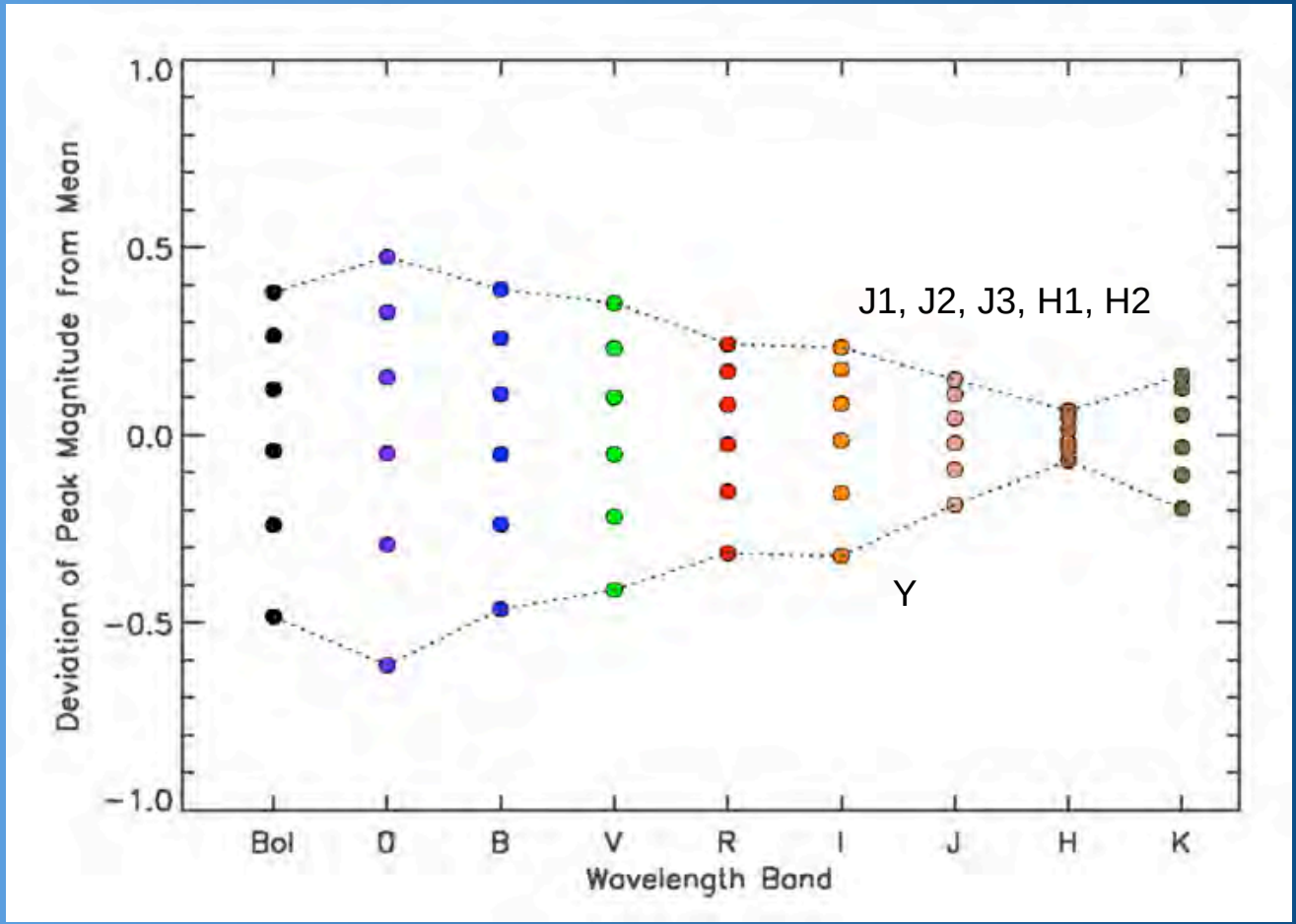


SNe Ia Light curves



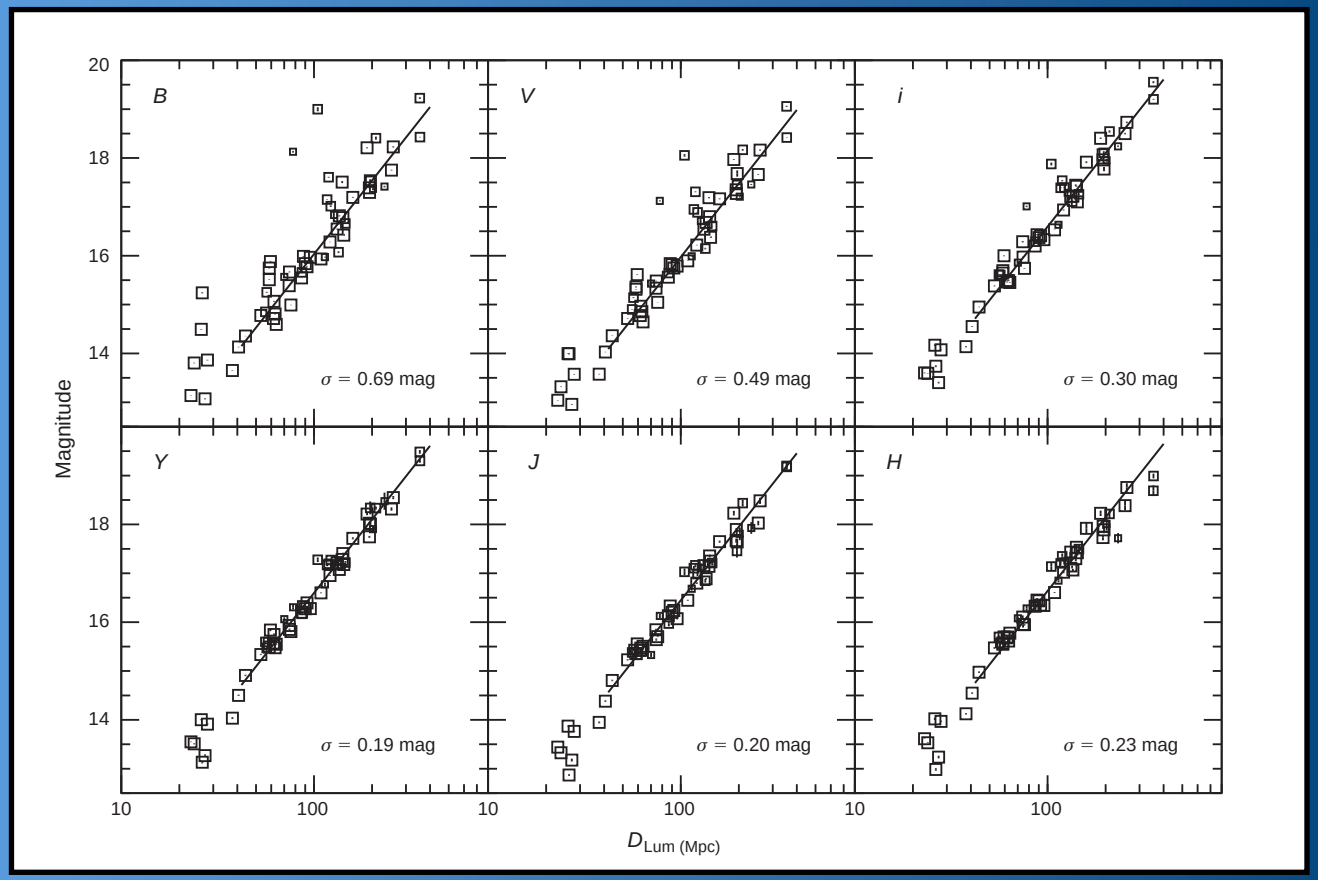
Phillips 2012

Theoretical expectation



Kasen 2006

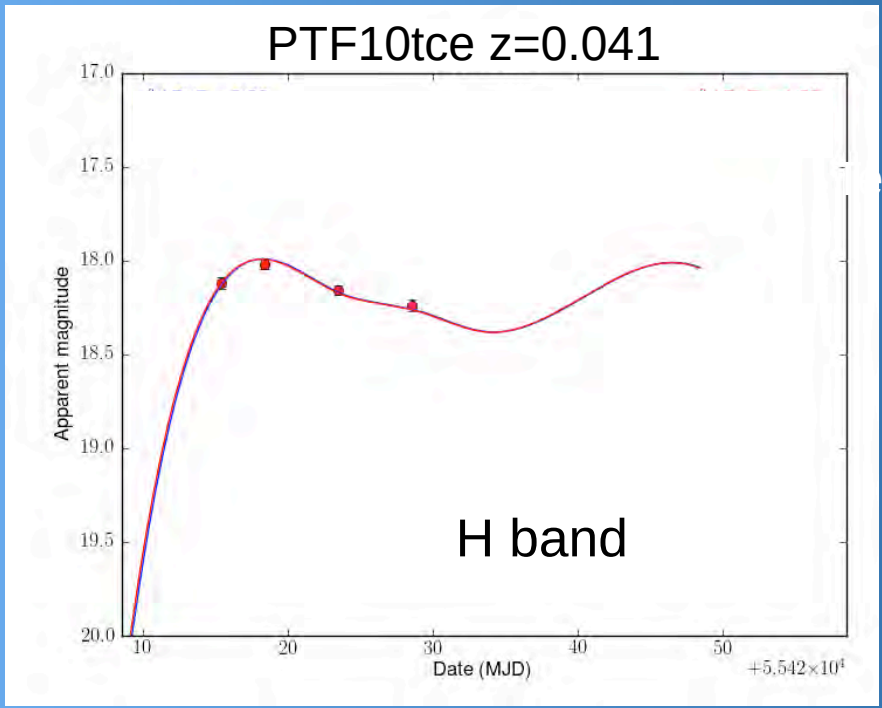
SNe in the near-IR

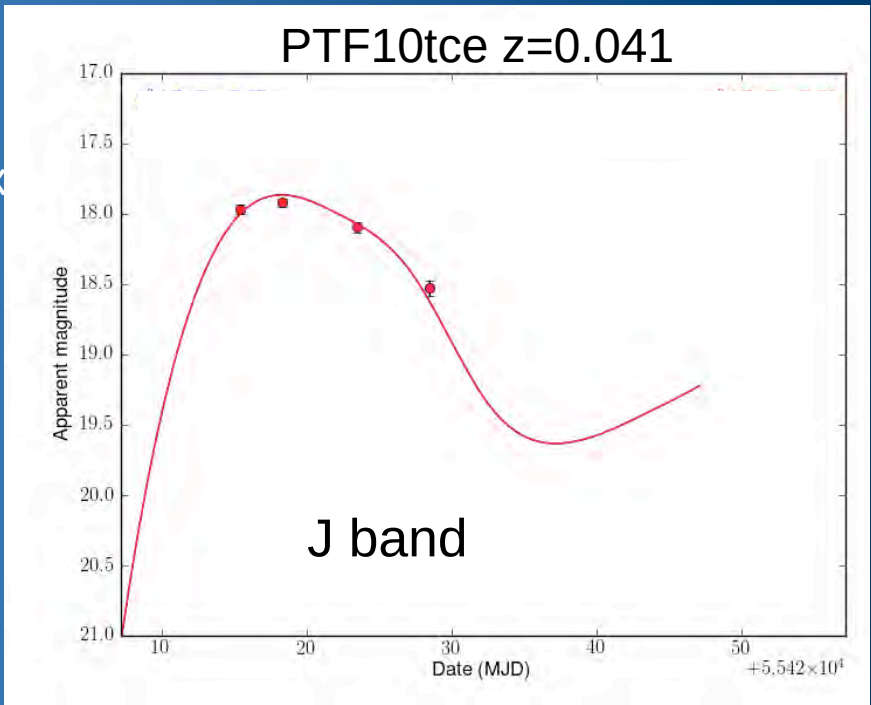


Phillips 2012

NIRI follow-up of PTF SNe Ia

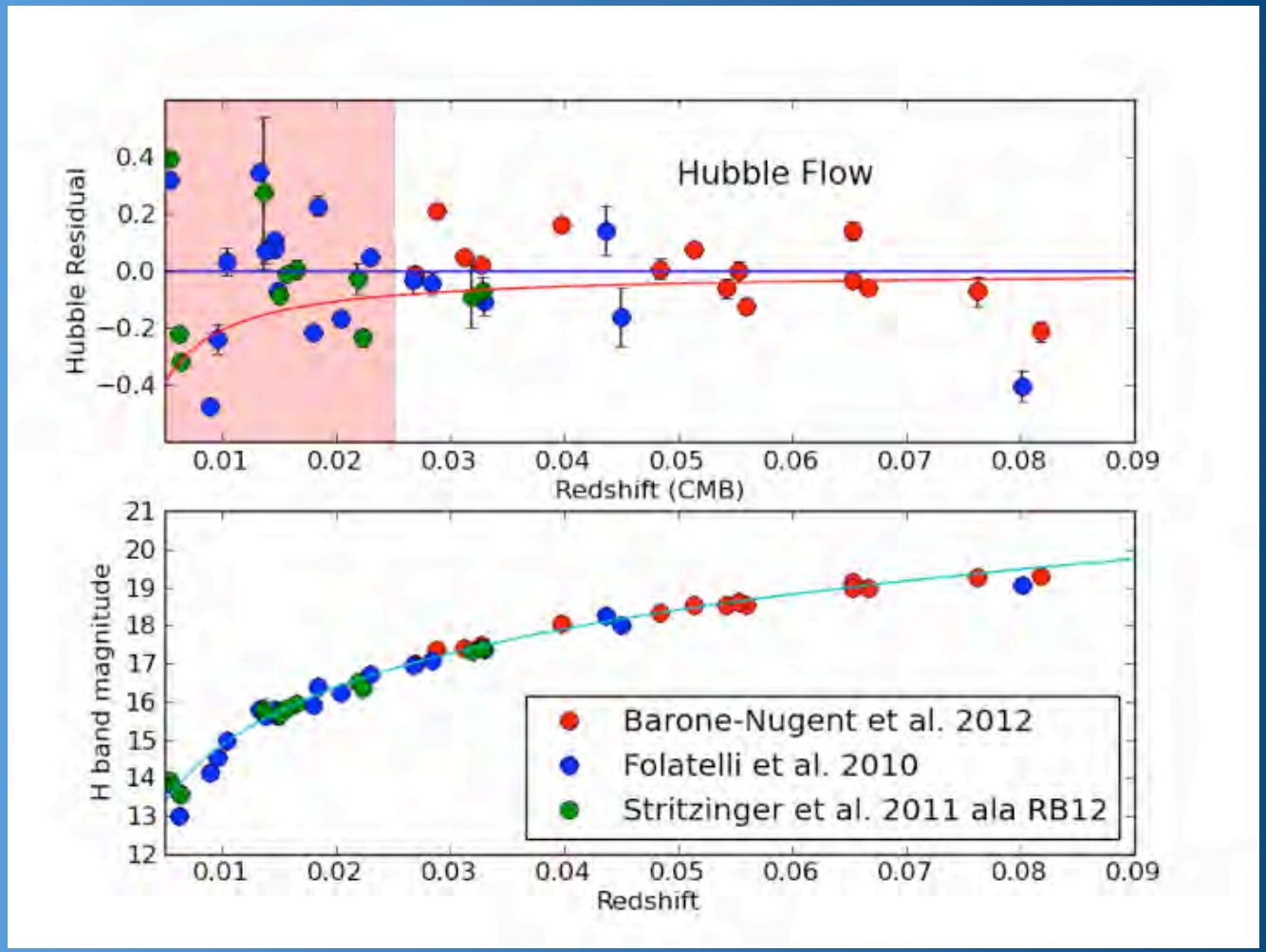
- Discovered with the Palomar Transient Factory
- Very early spectroscopy (2 weeks before maximum light)
- Follow-up with NIRI on Gemini North – 4 epochs in J and H
- Observed 15 SNe Ia (0.025 < z < 0.08)





Barone-Nugent et al. 2012

H-band Hubble diagram



Scatter in H = 0.10 mag - in J, about 0.12 mag

(Almost) perfect standard candle

There's no (or perhaps only a very weak) correlation between Hubble residuals and

- colour
- light curve width

But, samples are small

How many points are enough?

Only one point within 10 days of B max is enough,
if the date of B max is known.

Rest frame near-IR Hubble diagram

Rest frame J band at z=0.7 lands in the K band

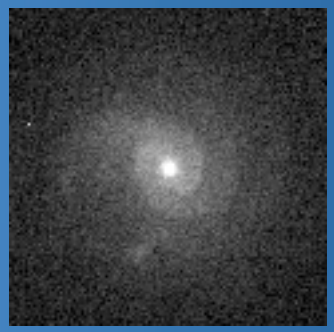
Technically feasible with MCAO on Gemini South (2 hour exposure)

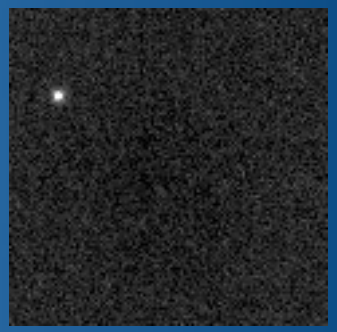
But one needs of the order of 100 SNe Ia. There are too few asterisms.

An obvious choice is JWST (can also do rest frame H-band at z=1)

GMT?

PTF10tce z=0.041





Supernova + Host - Host = Supernova

GMTIFS - Imager with a 20” field of view

NGSAO and LTAO - Spatially variable PSF

GLAO - 0.3” (longish exposures)

Choose SNe near brightish stars (WFS and/or PSF)

Summary

1. SNe in the near-IR are very good (almost perfect) standard candles

2. Samples are still small and we'd like to explore other wavelengths (Y, H1, H2?)

3. A rest frame near-IR Hubble diagram containing ~200 SNe Ia with GMTIFS seems feasible if issues with spatially variable PSFs can be overcome.