Using the next generation of telescopes to measure supernova host galaxy masses

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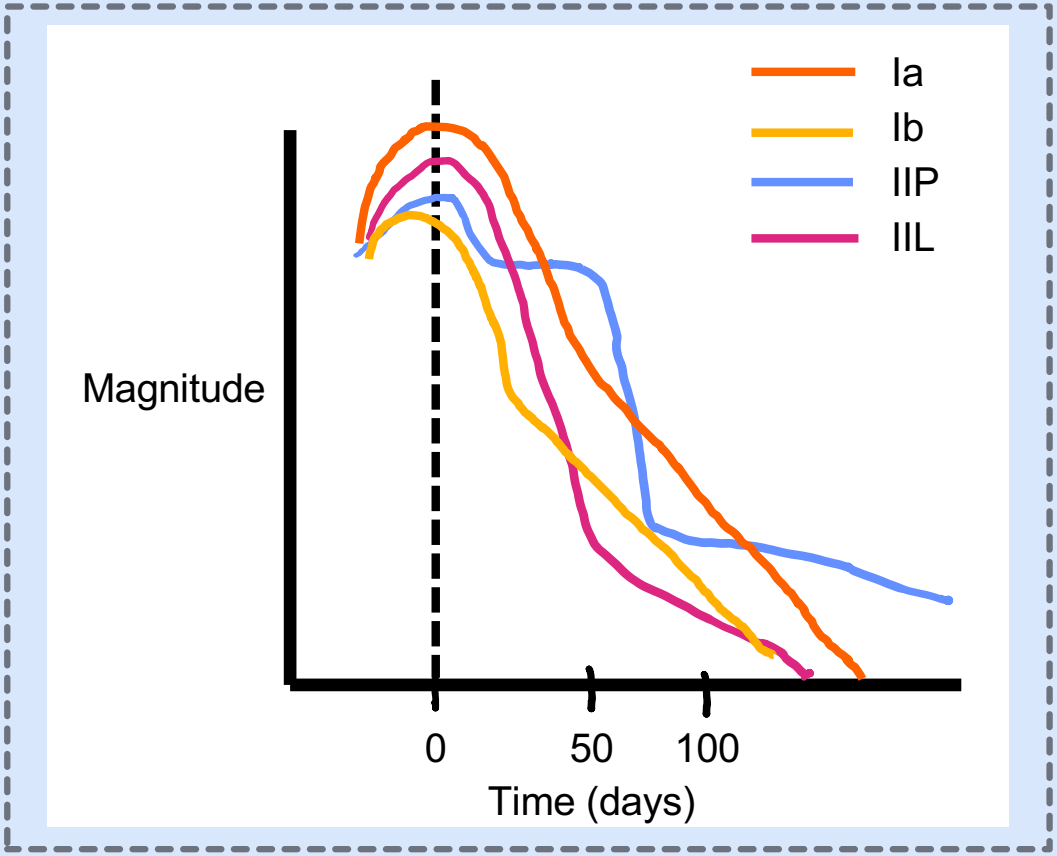
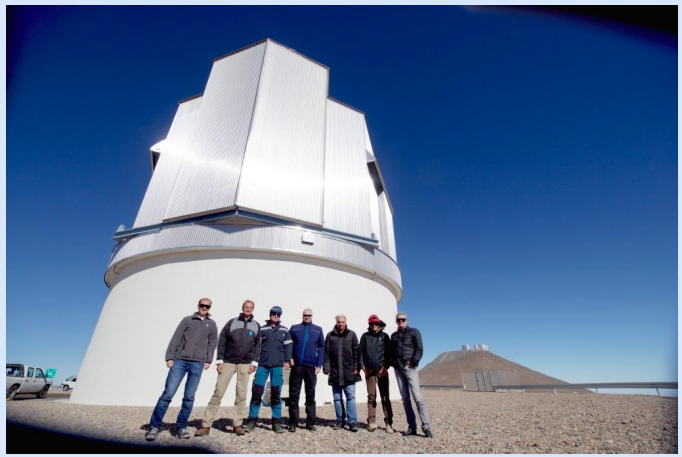
The Problem

- To measure the expansion of the universe we use type Ia supernovae.
- SNe observed by LSST will only have photometry and redshift data. Making classification harder.
- SNIa brightness correlates with host galaxy properties. Need good measurements to avoid biases in cosmological parameters



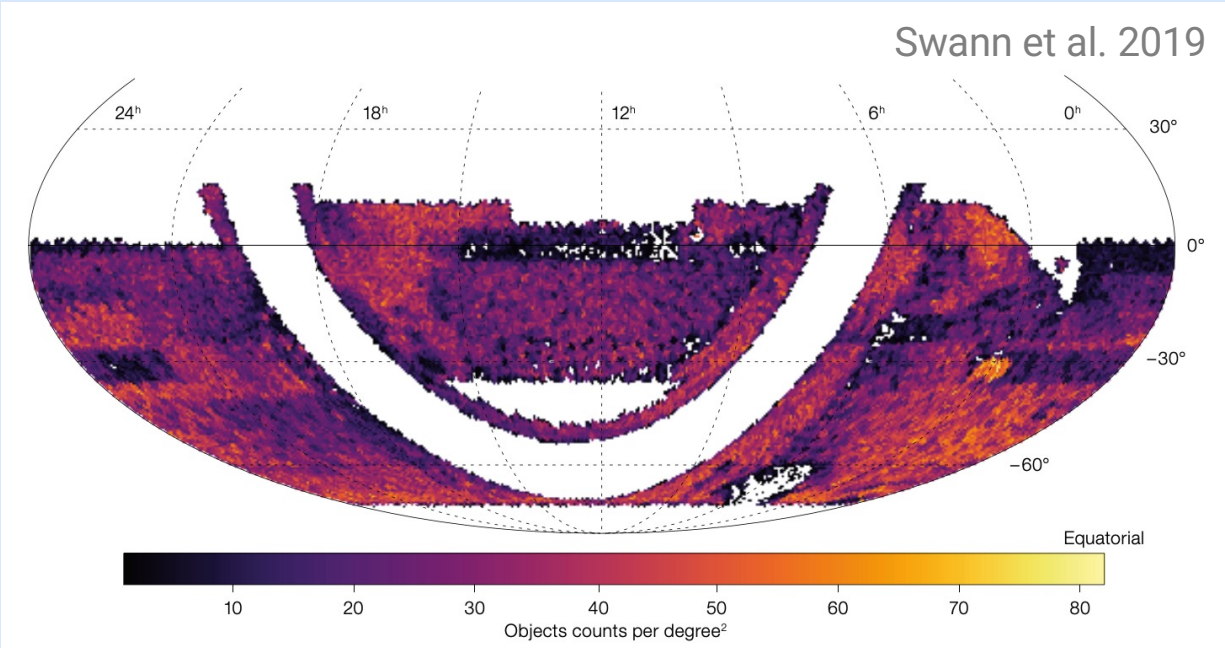
My Solution

- Use two next generation telescopes to study supernova host galaxies
- Improve measurements of galaxy masses, reducing uncertainty.
- In the future this will help to classify supernovae, as well as reducing bias in cosmological analysis.



4-metre Multi Object Spectrograph Telescope (4MOST)

- Aims to carry out spectroscopic follow up to satellite and ground-based observations
- Can study 2400 different objects at the same time.



Target spectrum

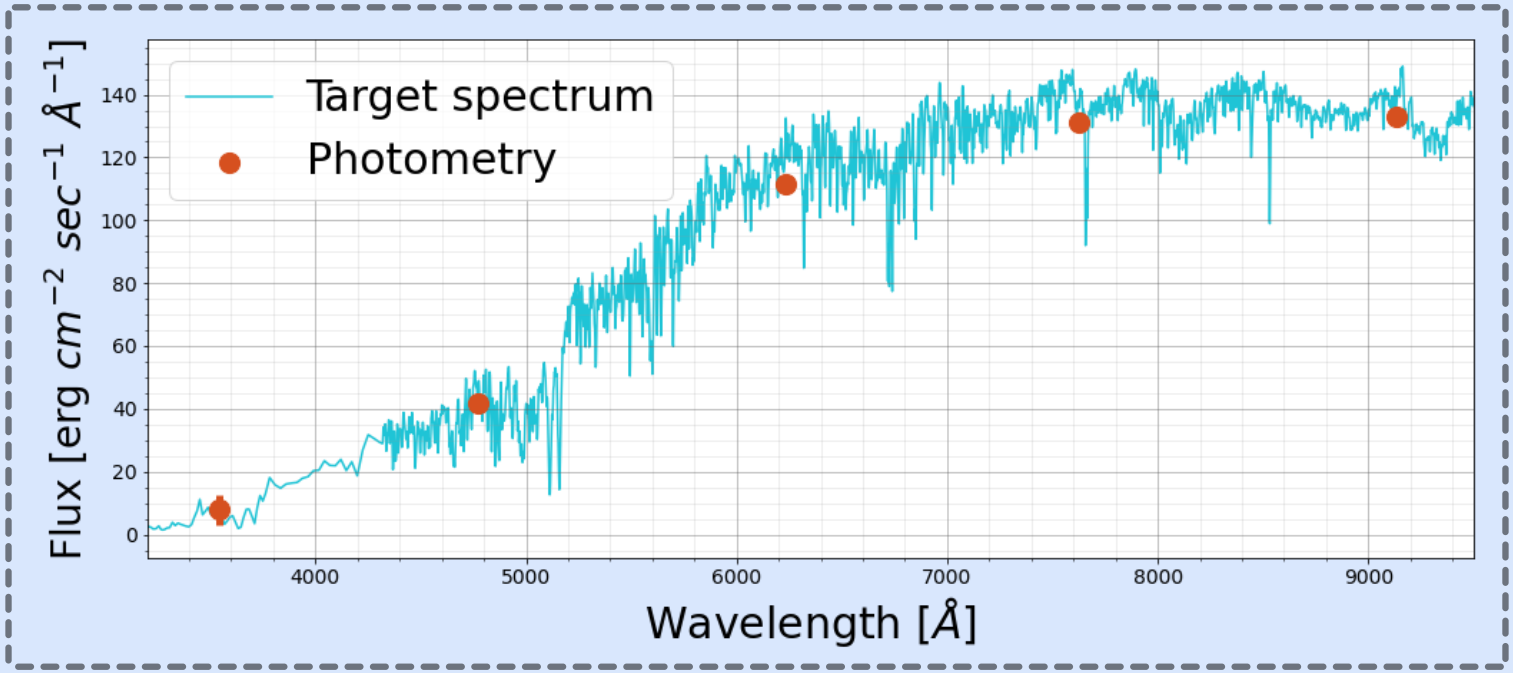
Start with a galaxy spectrum with known properties.

See how well we can recover these target properties.

Creating synthetic photometry

Take target spectrum, redshift and normalise it to various values

For each one, calculated fluxes through SDSS filters (u, g, r, i, z) with depth from LSST



Creating the 4MOST spectrum

Use the 4MOST Exposure Time Calculator (4FS ETC) to create a spectrum and a noise spectrum.

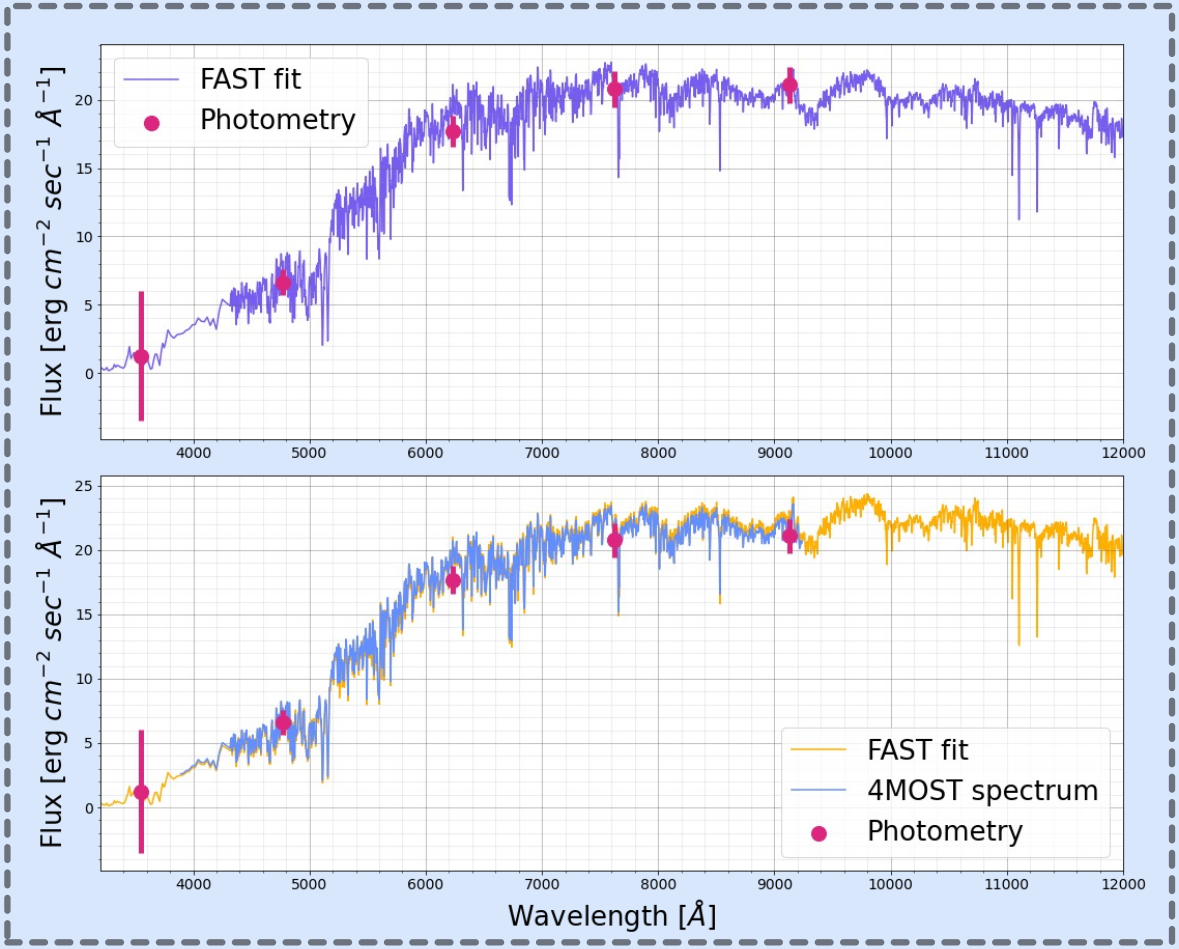
Need to format the output to prepare for SED fitting.

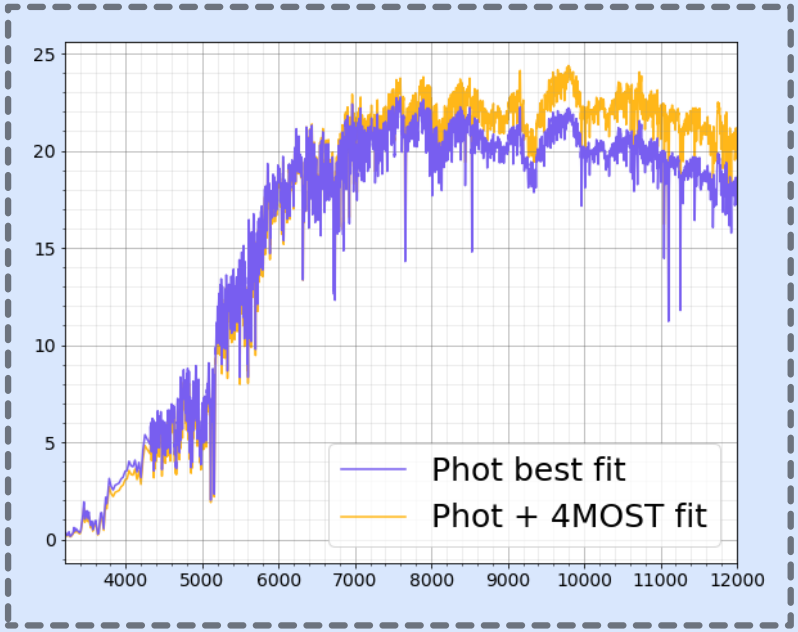
Finding a galaxy's properties

Fitting and Assessment of Synthetic Templates (FAST) is a SED fitting software. Fits stellar population synthesis templates to a spectrum and/or broadband photometry

Ran FAST with just photometry and again with photometry and a spectrum.

FAST

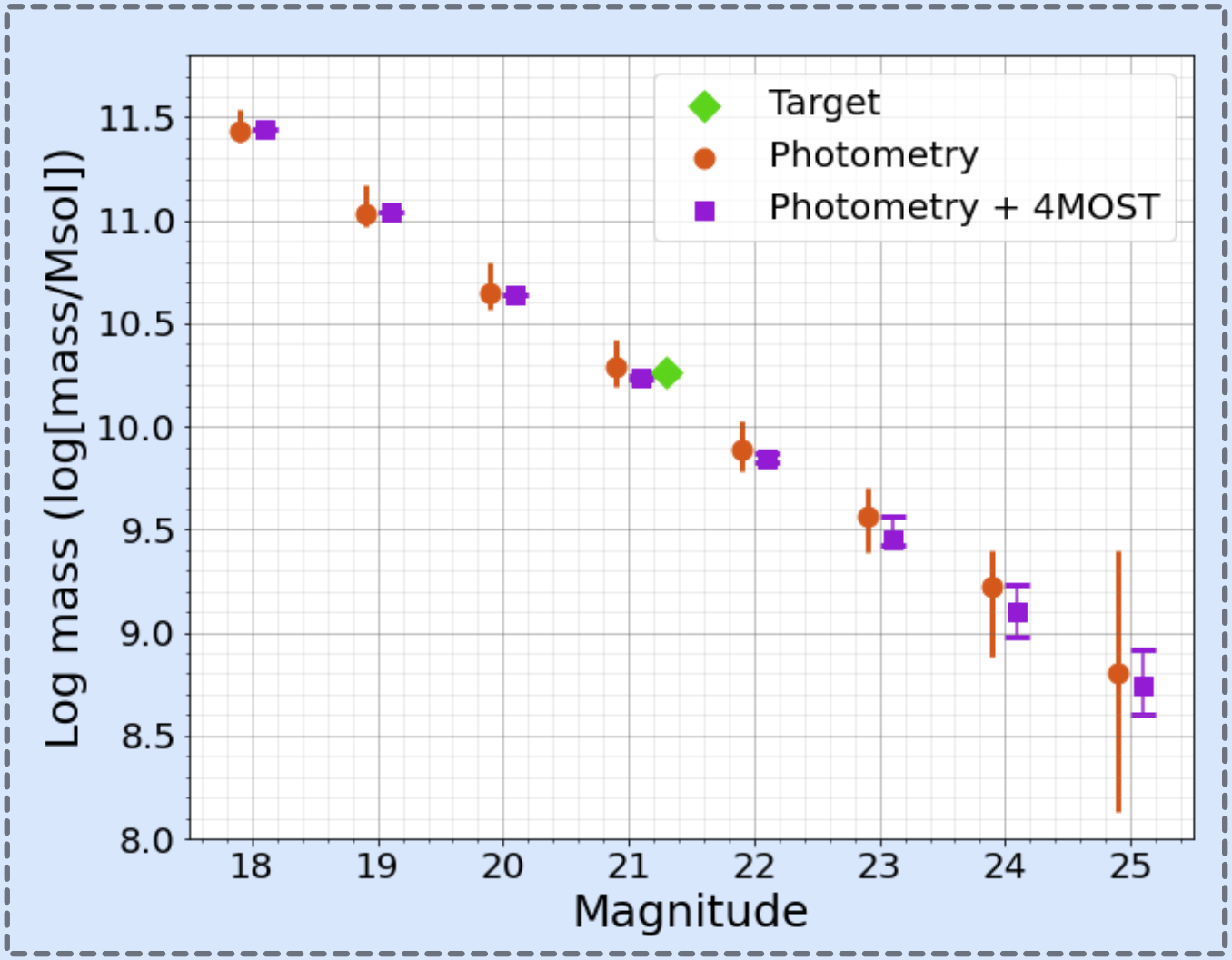

FAST fit
Photometry
Flux [erg cm^{-2} sec^{-1} $Å^{-1}$]
FAST fit
4MOST spectrum
Photometry
Wavelength [$Å$]


Phot best fit
Phot + 4MOST fit

Results

With 4MOST and photometry working together, uncertainty is smaller.

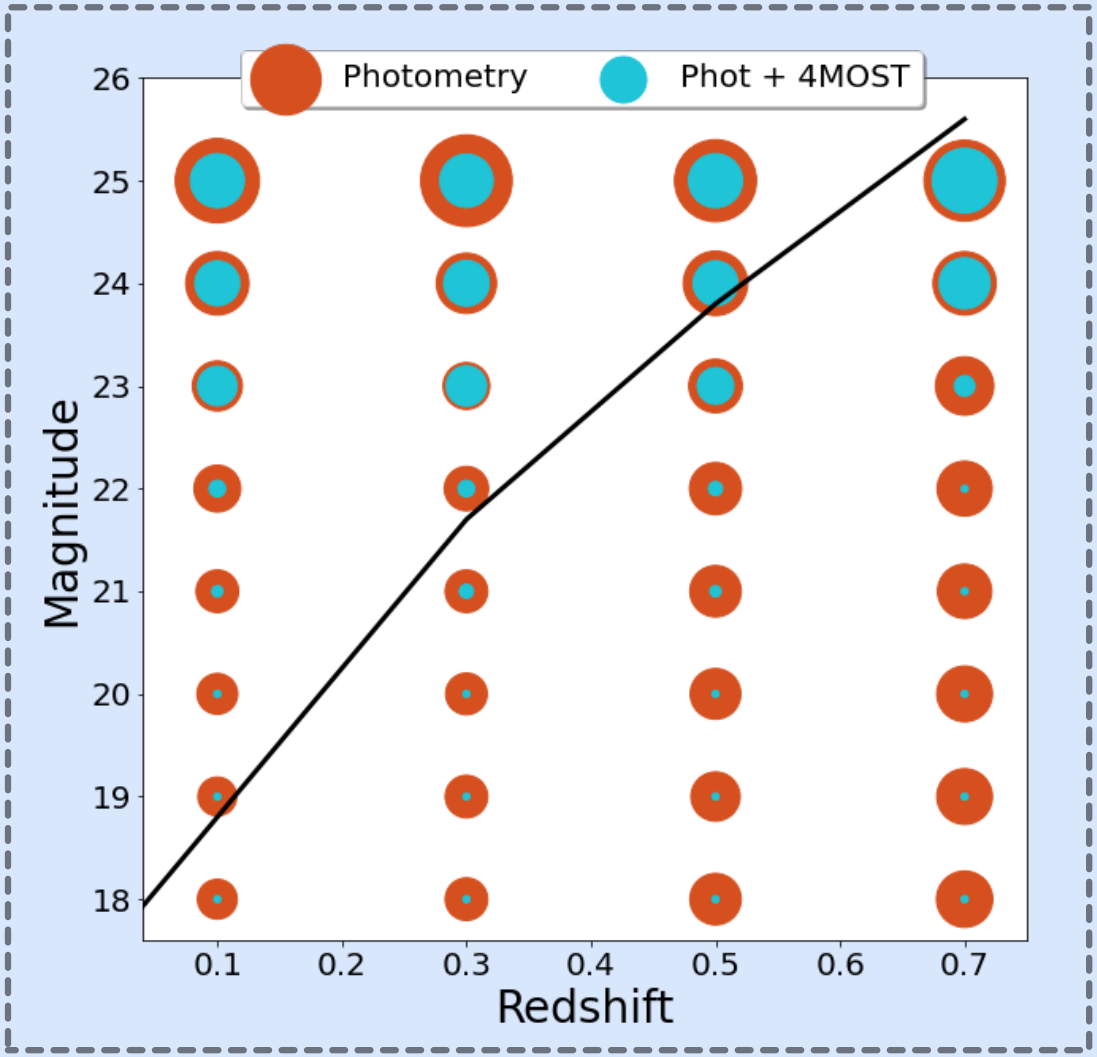
Reduced uncertainty at all tested magnitudes ($18 < r < 25$) and redshifts ($0.1 < z < 0.7$).



Results

The area of the circle is proportional to the size of the mass uncertainty at each magnitude and redshift.

Photometry alone is in orange, whilst photometry with 4MOST is in blue. The black line represents the divide for the mass step.



What's Next?

Will apply the improved mass measurement to a simulated catalogue of transient light curves and associated host galaxies.

Classification will be carried out with machine learning to see whether the improved mass measurement improves transient classification.