# Measuring Correlations between Host Galaxies and Type Ia Supernovae at Redshift One

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Type Ia Supernovae (SNe Ia) are bright transients whose peak luminosity can be standardized via empirical models. Assuming the remaining luminosity scatter is redshift independent, SNe Ia become very precise cosmological distance measurements. However, it has been discovered that SNe Ia, as presently standardized for cosmology, have a correlation with host galaxy properties (e.g. Kelly et al. 2010). However, it is unknown if these corrections are redshift dependent, causing a greater systematic uncertainty. In the era of large surveys with LSST and WFRIST, our lack of understanding of these corrections will become a limiting systematic.

Several host galaxy-SN Ia correlations, and their redshift dependences, were investigated by Uddin et al. 2017. They analyzed 1330 SN Ia across 4 redshift bins. The local SN Ia can are then compared to the high redshift, $z > 0.5$, SN Ia. Since the uncertainties in the correlations are dominated by statistics, the 332 SN Ia per bin result in an uncertainty of $\sim 0.02$ mag. Though Uddin et al. have well constrained correlations, their highest redshift bin will be the lowest edge of a survey like WFIRST. Their work does not measure the relevant parameter space for the WFIRST SN Ia survey.

Since Uddin et al. 2017, there have been a number of new high redshift SN Ia surveys, dominated by recent Subaru and HST programs: See Change, SUSHI, the Hyper-SuprimeCam SN Ia survey. These three programs will add over 150 cosmologically useful SN Ia at a redshift greater than one. As apart of each program, they have multi-band images of the host galaxies. From these images, one can measure the same galaxy properties analyzed in Uddin et al. 2017. The addition of these observations will allow us to measure, to a high significance, any difference in correlations between host galaxies and Type Ia Supernovae at a redshift of $\sim$1.

Using archival data, we can extend our understanding of the high redshift correlations between host galaxies and SN Ia from $> 0.5$ to $> 1$. Since the needed host galaxy images are taken early in a survey, they are already available in public data archives. Via private communications, the SN Ia data is in preparation with a scheduled release later this year. Our small team of SN Ia standardization experts, with the analysis of this archival data, will be able to improve our understanding of host galaxy-SN Ia correlations at a redshift of $\sim$1.

## References

Kelly, P. L., Hicken, M., Burke, D. L., et al. 2010, AJ, 715, 743
Uddin, S. A., Mould, J., Lidman, C., et al. 2017, ApJ, 848, 56

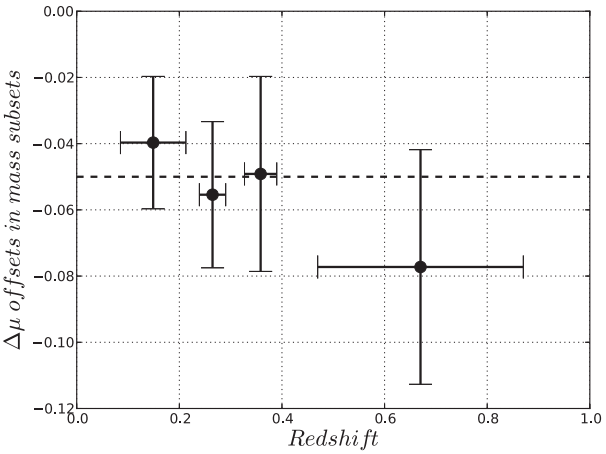


Figure 1: The redshift dependance of host stellar mass host galaxy-SN Ia correlation. This is consistent with no redshift evolution. However, the high redshift bin (z > 0.5) is the lowest redshift range of the future WFIRST survey. This high redshift bin could be closer to z > 1, if resent SNe Ia surveys were added to the analysis. Figure from Uddin et al. 2017.