Science Case: IFU spectroscopy

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Type Ia supernovae are exceptional distance indicators for measurement of cosmological parameters. Their use as 'standardized' candles led to the discovery of dark energy. This was possible, by calibrating the peak lumniosity using strong correlations with the post-peak decline rate and the optical colour. The width-luminosity relation is shown to be a result of different amounts of ^{56}Ni synthesized by different SNIa. However, the scatter in the width-luminosity relation has evoked the need for a secondary parameter to explain SNIa light curves. One possibility for this is the metallicity of the progenitor, and as a result, the environment of the SN in the host.

Studies in the past have found correlations between properties of the SN host galaxy (eg. stellar mass) and supernova peak luminosities and optical colour (Sullivan et al. [2010]). With the SNfactory sample have demonstrated a correlation between the host $M_{stellar}$, $sSFR$, gas-phase metallicities and the SNIa hubble residual (Childress et al. [2013]). This indicates that bluer, brighter SN occur more frequently in younger stellar populations. Theoretical efforts (eg. Timmes et al. [2003]) have shown that higher metallicity in the environments leads to more neutron rich nuclear species and hence a lower production of ^{56}Ni, which qualitatively explains the observed trend between the SN intrinsic brightness and the metallicity of the host. Such a correlation has been used in recent cosmological studies to provide extremely precise constraints on the equation of state parameter of dark energy (Sullivan et al. [2011], Betoule et al. [2014]).

In this project, we aim to measure the metallicities for SN hosts with more than one SN. The targets host both 'normal' Ia's as well as peculiar, subluminous objects. A comparison of the different regions in these hosts will allow us to link the properties of different SN subclasses to the environments in which they explode.

Candidate objects in our sample have excellent complementary datasets for the hosts, as well as the SNe. NGC 1309 has precise distance measurements from Cepheids (Riess et al. [2011]). It hosted two SNe, a well studied, normal SN, 2002fk and an interesting, peculiar Type Iax explosion SN2012Z. These are characteristically subluminous explosions, with very little production of ^{56}Ni . From HST pre-explosion imaging, Mccully et al. [2014] have, for the first time identified the progenitor star of such an explosion. Hence, NGC 1309 presents the ideal opportunity to study the difference between the environments

of normal SNIa and more peculiar Iax SNe.

1 Immediate Objective

We would like to use the MUSE IFU data to measure the metallicity in the host galaxy using the [N II] and H α lines in the regions around the SNe. We would like to compare the metallicities in the sites for SN2012Z, a faint, peculiar Iax SNe to the measurement for a normal SNIa 2002fk in the same galaxy. Since both SNe have detailed photometric and spectroscopic datasets, we would like to relate the properties of the SN to the host metallicity.

References

[1] Sullivan M., et al., 2011, ApJ, 737, 102

[2] Sullivan M., et al., 2010, MNRAS, 406, 782