ID: S000 **PI: Marie Wingyee Lau** **Inst.: Kast** **Req.: 17 nights**

Spectroscopic Redshifts for Massive Galaxies Catalogs

1 Scientific Justification

This is the text for scientific justification. 2 pages maximum.

Significance of spec-z for building cluster catalogs...

Currently, the total number of galaxies in the cluster catalogs with spectroscopic redshifts is XX. With Kast observations, we will eventually add 61 galaxies in three different GAMA fields that currently only have photometric redshifts in the catalogs. We cut this target sample at stellar mass $M_* > 10^{11.5}\,\mathrm{M}_\odot$, with nearby pair at $< 1\,\mathrm{Mpc}$, and at $0.25 < z_{\mathrm{phot}} < 0.55$. We make a generous cut on photometric redshifts to ensure that all $0.3 < z < 0.5$ objects are covered.

Our major analysis work is to fit the Kast spectra with independent component stellar templates using pPXF (Cappellari & Emsellem 2004), with emphasis on the 4000 Å break. We were granted director's discretionary time in 2017 July for a trial Kast run. We observed four galaxies that have spectroscopic redshifts already determined in SDSS, to determine the signal-to-noise required for deriving reliable spectroscopic redshifts using Kast, and the brightness limit of the galaxies. We observed four galaxies of SDSS magnitude $r = 20.0$, $r = 19.3$, $r = 18.4$, and $r = 18.8$, each with exposure time 3600—7200 s. We performed preliminary data reduction using PYPIT. Figure 1 shows the Kast spectra smoothed for clarity, the SDSS spectra, and the models. While proper fluxing and cosmic ray rejection are still in progress, we demonstrated that signal-to-noise of ≈ 5 is sufficient for measuring redshift with precision of $XX\,\mathrm{km\,s^{-1}}$. In turn, this implies our program is feasible for galaxies with $r < 20.0$.

References

Last name First name, year, journal

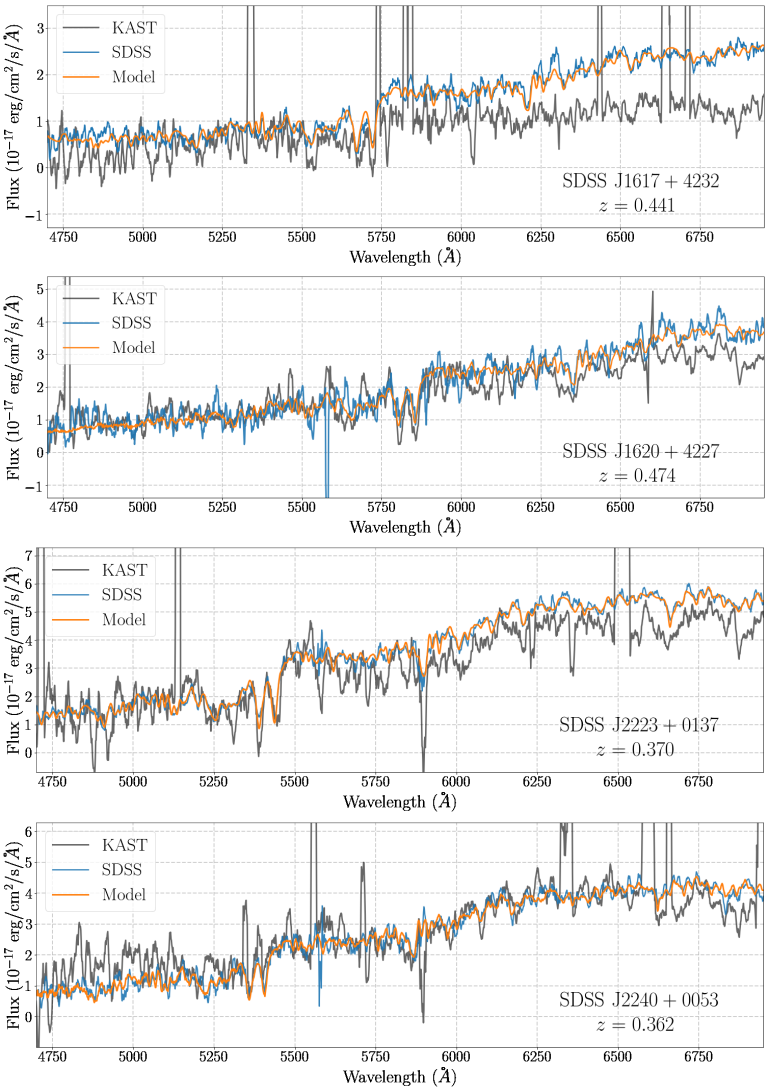

Figure 1: Preliminarily reduced and smoothed Kast spectra of four massive galaxies taken in our trial run in 2017 July, SDSS spectra of the same galaxies, and the galaxy stellar continuum models generated by pPXF. With signal-to-noise of ≈ 5, redshift can be determined with a precision of $XX\,\mathrm{km\,s^{-1}}$.

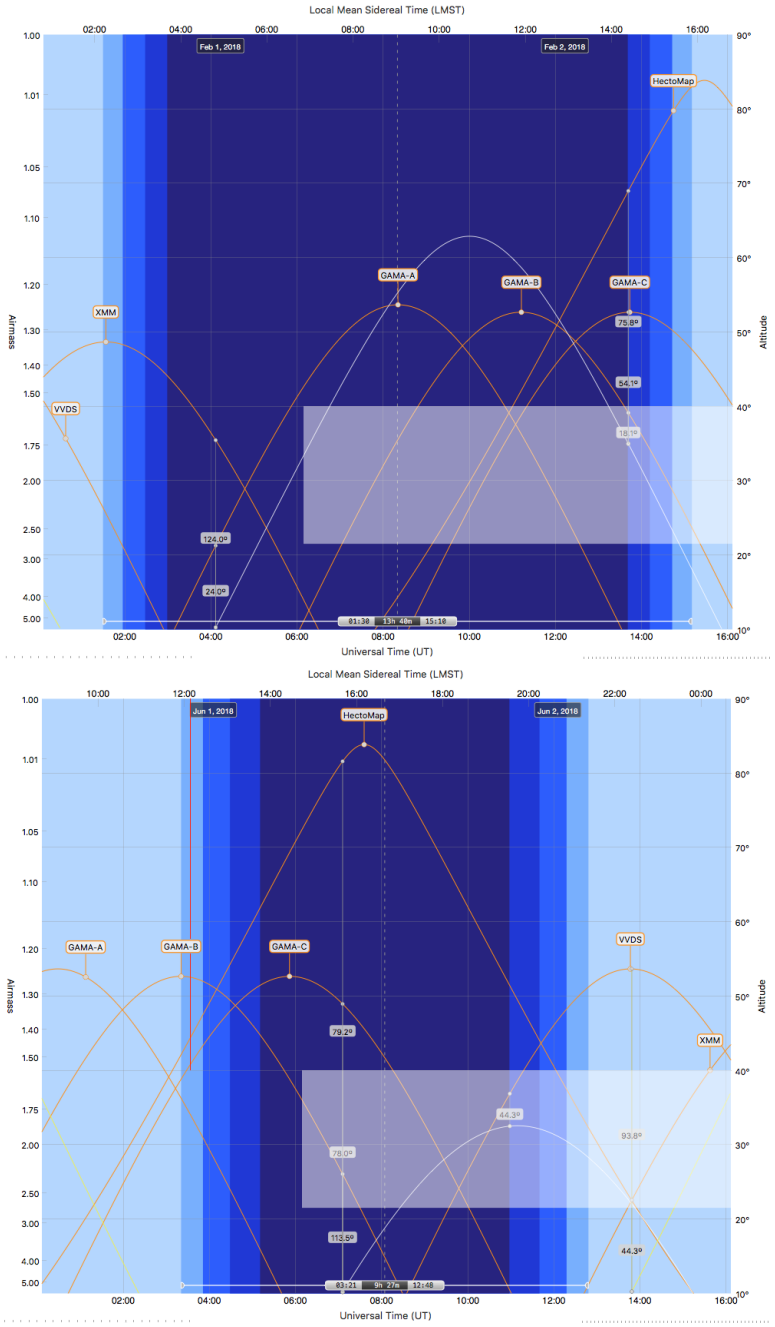

Figure 2: (Top) visibility curves of the GAMA-A, GAMA-B, and GAMA-C fields on 2018 February 1. (Bottom) visibility curves on 2018 June 1.

Table 1: List of targets.

Name	RA (J2000)	Dec (J2000)	SDSS r-mag	photo-z	Exposure
JXXXX+XXXX	XX:XX:XX.XX	XX:XX:XX.X	XX.X	X.X	XXXX s

2 Targets and Exposures

We will use the Shane 3m telescope and the Kast spectrograph to observe a sample of 39 early-type galaxies that currently have photometric redshifts, in three different fields covered by GAMA, named GAMA-A, GAMA-B, and GAMA-C. Given the faintness of our targets, dark time is preferred.

The SDSS r-band magnitudes for our targets range between XX and XX. Our science goal will require $\sim$ 7200 s of exposure to obtain sufficient signal-to-noise. These long exposures will be broken into 1800 s exposures as a compromise between CCD read noise and cosmic ray accumulation. With overhead we expect we can observe $\approx$ 3 targets per night. To observe a total of 39 targets, 13 nights are required at minimum. If available, this program could use an additional 4 nights to account for unfavorable observing conditions and possibly observe additional galaxies in the whole Hyper Suprime-Cam footprint. Figure 2 shows the visibility curves of the four fields to be observed on 2018 February 1 and 2018 June 1. Because of the low declination, our targets are only observable in a relatively narrow range of time in a semester. We request time allocation in March and April when more of our targets are within the telescope pointing limit.

We will setup to resolve the 4000 Å break and other major spectroscopic features such as the Ca II H and K lines, while simultaneously cover a sufficiently broad wavelength range for full SED fitting (Figure 1). As a compromise of the above two requirements, we will use the 600/5000 grating on the red side.

Table 1 lists all the galaxies in the targeted fields. We will observe additional targets in the Hyper Suprime-Cam footprint if we run out of targets.

In poor observing conditions we will increase exposure time and give preference to bright targets.

3 Supplementary Observations Required from other Observatories

Our full cluster catalogs include spectroscopic redshift catalogs from the GAMA team.

4 Technical Remarks

We have none.

4.1 Status of Previously Approved 3-m Programs

This program obtained director's discretionary time of one night in 2017A.

PI Lau is a graduate student at UCSC, who has been awarded a total of 22 nights in 2015A, 2016A, and 2017A for the program Late-time Optical Spectral Signatures of Tidal Disruption Candidates. The observing program is completed and the path to publication is active.

Co-I Leauthaud and co-I Huang have extensive experience with optical spectroscopy and are experts in assive galaxies.

Co-I Greg Sallaberry is an aspiring undergraduate researcher at UCSC, who will lead the observing and data reduction effort.