

# Red Supergiant Stars within the Local Group

Lee. R. Patrick



Doctor of Philosophy  
The University of Edinburgh  
March 2016

# Chapter 1

## Red Supergiants in NGC 55

### 1.1 Opening remarks

Owen has kindly helped reconstruct and combine the data sets

### 1.2 Introduction

- What is NGC 55?
- Why is it important?
- What other studies of abundances are present in NGC 55
- Any controversies? e.g. its distance, association to Sculptor group etc.

### 1.3 Observations

The observations for this study were taken using three nights of KMOS guaranteed time observations (GTO) containing xx RSG candidates, the first of which was taken in October 2013 as part of the observations which led to the publication of Gazak et al. (2015). These data consisted of six science exposures (S) of 600s with sky offset exposures (S) interleaved in an O, S, O observing

pattern. Seeing conditions for these data were good at  $0''.8$ – $1''.2$  throughout the course of the observing block (OB).

The second data set which is made use of in this chapter comes from two nights in September 2014 where the OB used in 2013 was used as backup observations for a programme which required excellent seeing ( $< 0''.6$ ). The seeing limits on our observations are more relaxed ( $< 1''.5$ ) which gave us an opportunity to make use of some slightly poorer quality KMOS data.

On the first in September 2014 where this OB was observed, the seeing conditions varied widely ( $> 1''.6$ ) prompting one observer to comment that “this is the worst recorded seeing at Paranal!”. However, there are 24 science exposures where the seeing conditions were better than  $2''.2$ , which are (potentially) useful. The final night of observing consisted of 12 exposures with seeing conditions varying between  $1''.1$ – $1''.6$ .

In addition to the science exposures obtained, on each night a standard set of KMOS calibration files were obtained as well as standard star observations on each night. The standard star observing block for each night is slightly different where in October 2013 HIP 3820 (Houk, 1978, B8 V;) was observed using the 24-arm telluric template (KMOS\_spec\_acq\_stdstarscipatt). However, in September 2014 only the three-arm telluric template was observed (KMOS\_spec\_cal\_stdstar), this time with HIP 18926 (Houk & Smith-Moore, 1988, B3 V;) and HIP 3820 on both nights.

**interestingly both with radial velocity measurements. Could do some nice calibration of the RV measurements? or update their measurements ... remember, we’ve chosen them to be featureless in this region**

### 1.3.1 Target Selection

- Why were these targets selected?
- Something to do with HST photometry?

**Table 1.1** *Measured velocity resolution and resolving power across each detector.*

Date	Det.	IFUs	Ne $\lambda 1.17700 \mu\text{m}$		Ar $\lambda 1.21430 \mu\text{m}$	
			FWHM ( $\text{km s}^{-1}$ )	$R$	FWHM ( $\text{km s}^{-1}$ )	$R$
16-10-2013	1	1-8	$95.48 \pm 2.46$	$3140 \pm 81$	$90.78 \pm 2.12$	$3302 \pm 77$
	2	9-16	$88.91 \pm 1.66$	$3371 \pm 63$	$86.30 \pm 1.85$	$3473 \pm 74$
	3	17-24	$82.96 \pm 2.14$	$3612 \pm 76$	$80.77 \pm 2.14$	$3712 \pm 98$
14-09-2015	1	1-8	$84.18 \pm 1.93$	$3561 \pm 82$	$90.78 \pm 2.12$	$3302 \pm 77$
	2	9-16	$87.00 \pm 1.69$	$3446 \pm 67$	$84.67 \pm 1.93$	$3541 \pm 81$
	3	17-24	$97.14 \pm 1.88$	$3086 \pm 60$	$94.85 \pm 2.01$	$3161 \pm 67$
15-09-2014	1	1-8	$82.55 \pm 1.96$	$3632 \pm 86$	$80.41 \pm 2.30$	$3728 \pm 106$
	2	9-16	$88.08 \pm 1.78$	$3404 \pm 69$	$86.03 \pm 1.96$	$3485 \pm 80$
	3	17-24	$98.04 \pm 1.91$	$3058 \pm 59$	$96.74 \pm 2.05$	$3099 \pm 66$

## 1.4 Data Reduction

- Describe the steps Owen has taken ...
- Bin reductions into seeing bins
- Telluric correct etc.

## 1.5 Results

### 1.5.1 Radial Velocities

- Association with NGC 55
- Does this deserve a subsection of its own?

### 1.5.2 Stellar Parameters

- Comparison to previous results

## **1.6 Discussion**

- Orientation of NGC 55

## **1.7 Conclusions**

# Bibliography

Gazak J. Z. et al., 2015, ApJ, 805, 182

Houk N., 1978, Michigan catalogue of two-dimensional spectral types for the HD stars

Houk N., Smith-Moore M., 1988, Michigan Catalogue of Two-dimensional Spectral Types for the HD Stars. Volume 4, Declinations  $-26^{\circ}$  to  $-12^{\circ}$ .