



RSGs as Metallicity Tracers in External Galaxies

Lee Patrick

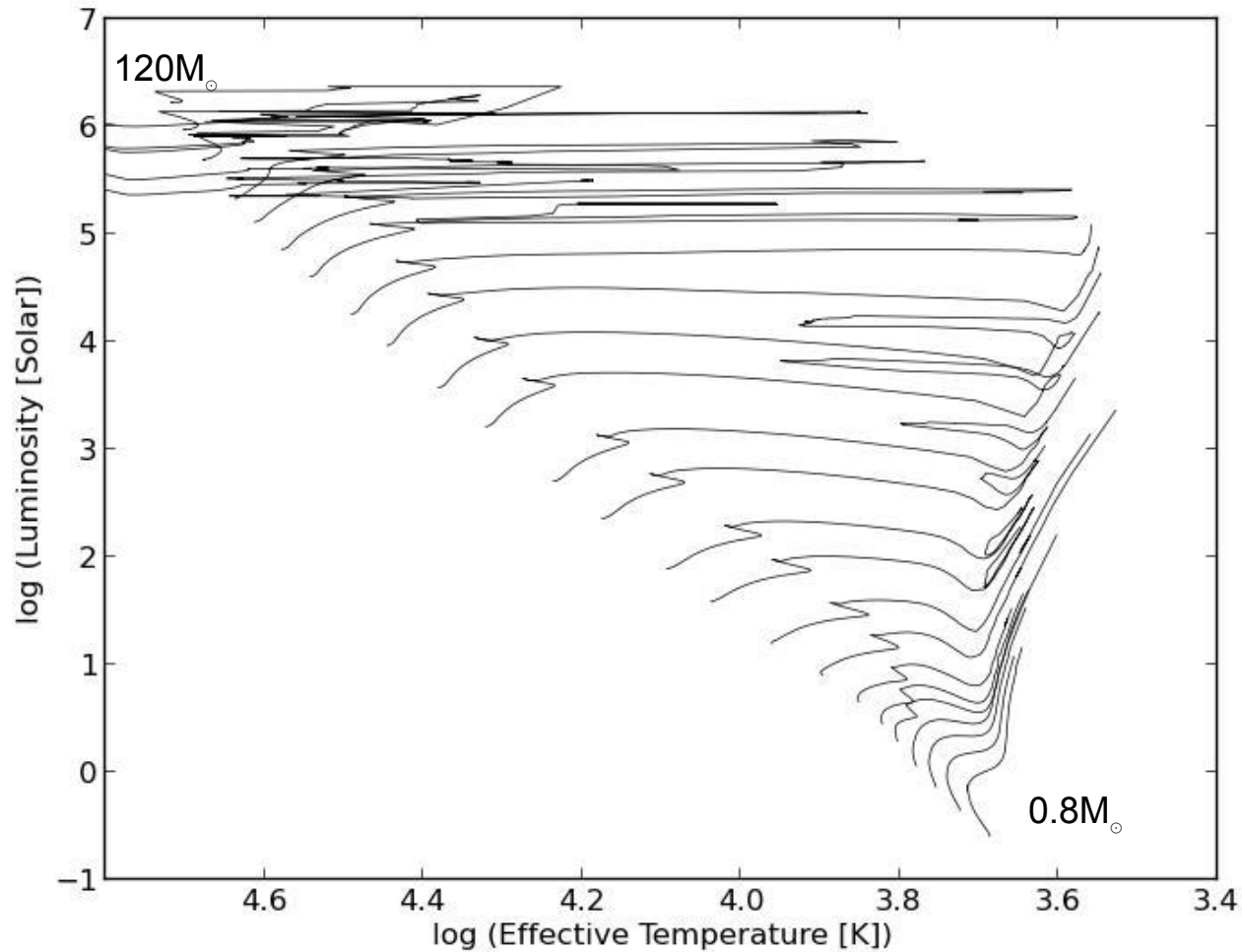
University of Edinburgh

Supervisors: Chris Evans, Annette Ferguson
Collaborators: B. Davies, R-P, Kudritzki,
Z. Gazak, N. Bastian

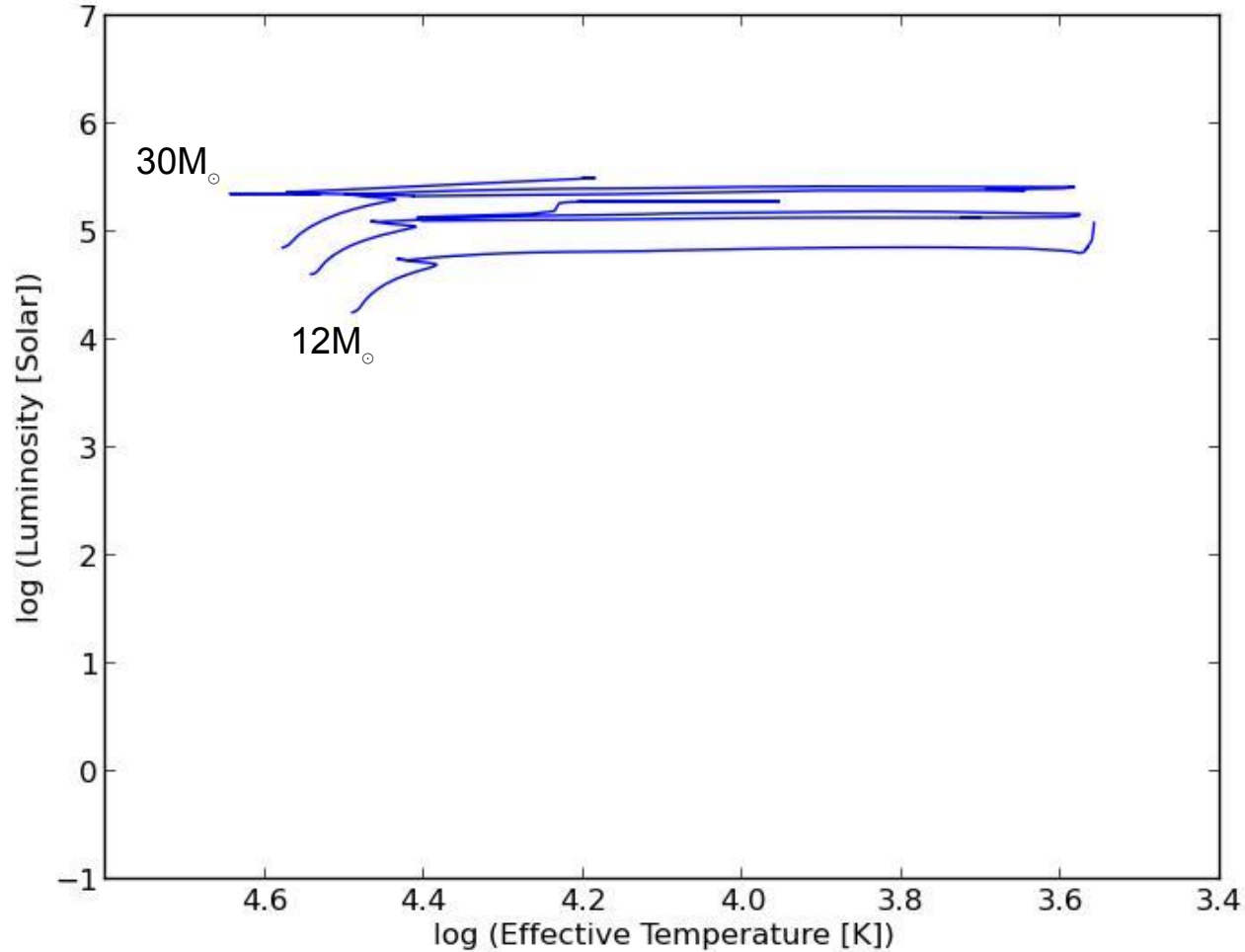
Outline

- Why red supergiants?
- KMOS observations
- Results so far: NGC 6822
- Future work
- Conclusions

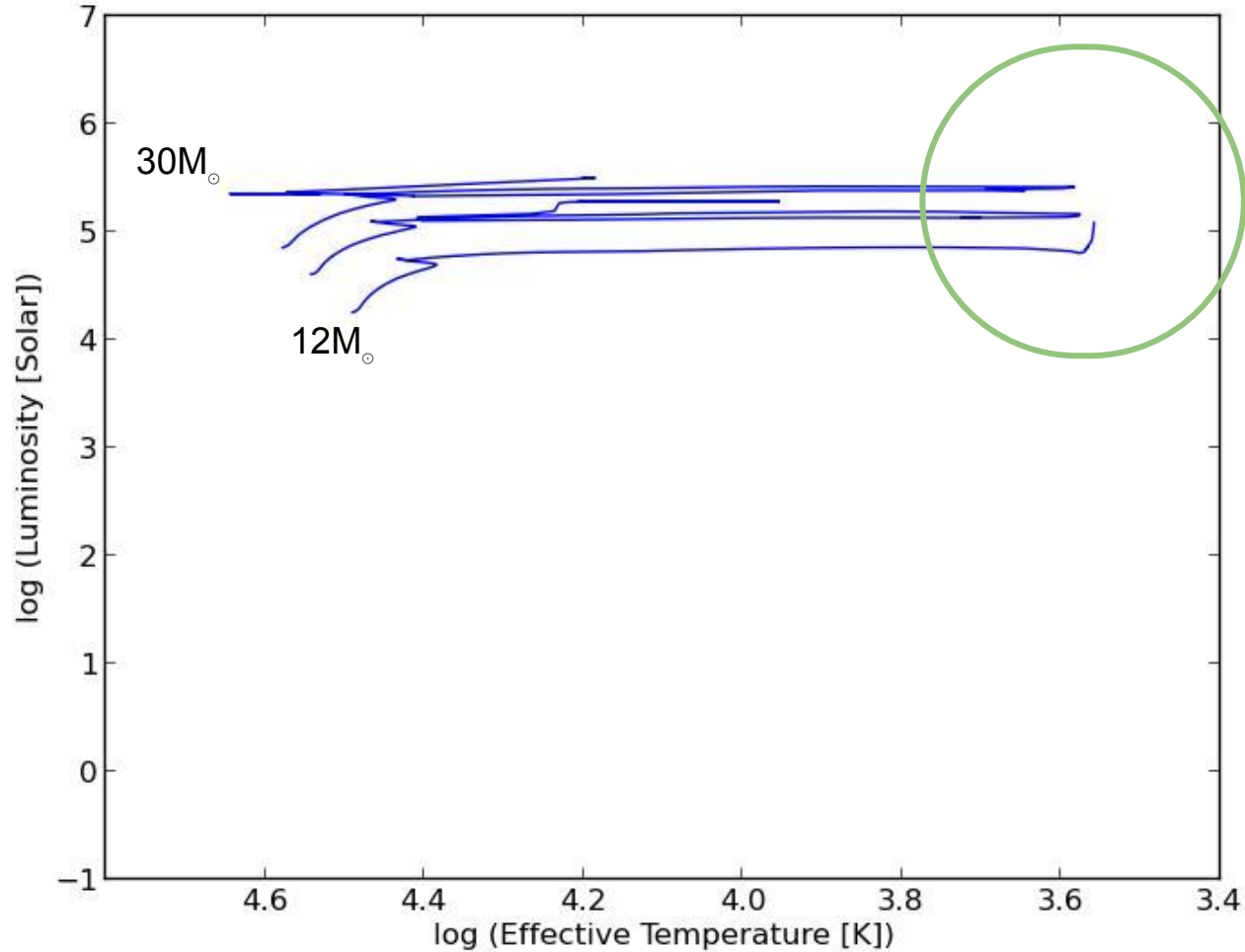
RSG Background



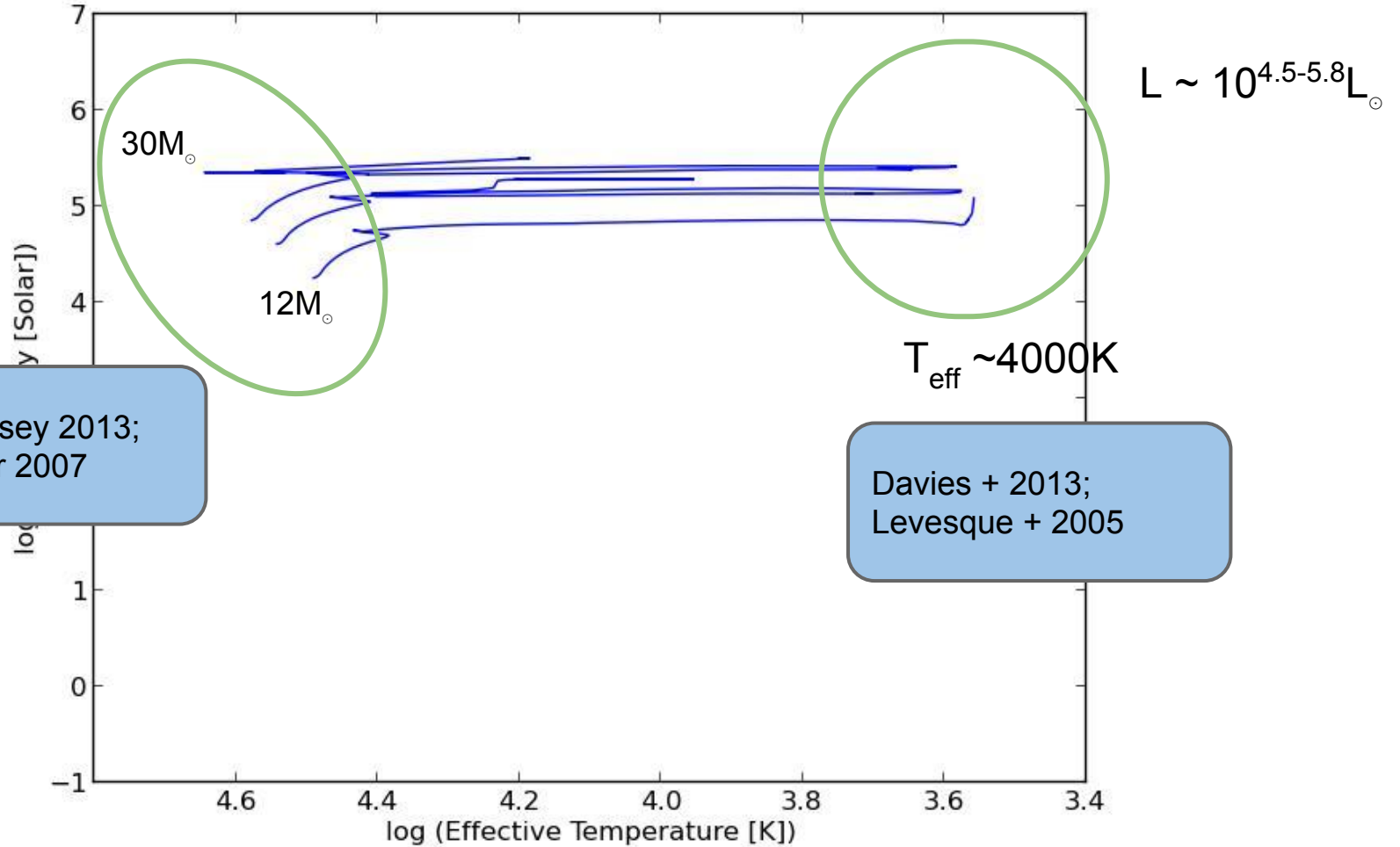
RSG Background



RSG Background



RSG Background

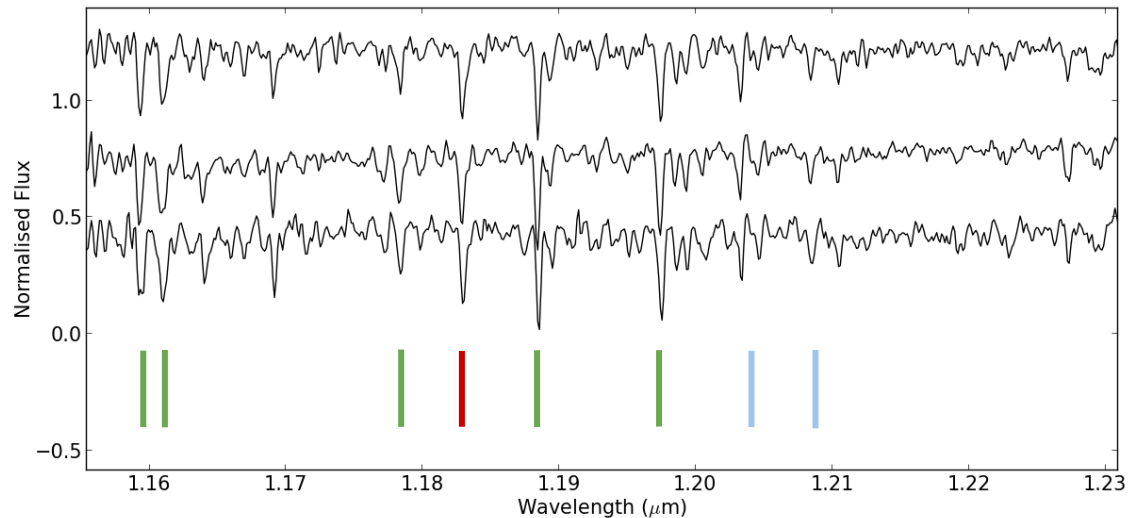


e.g. Massey 2013;
Crowther 2007

Davies + 2013;
Levesque + 2005

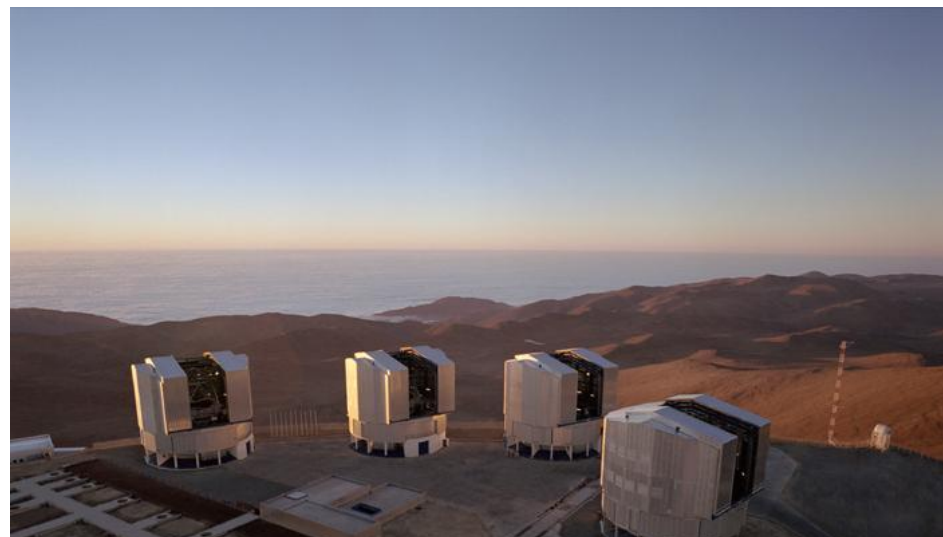
Deriving Metallicities

- J-band provides relatively clean spectral window
- Region dominated by features of iron and alpha elements
- $R \sim 3000$



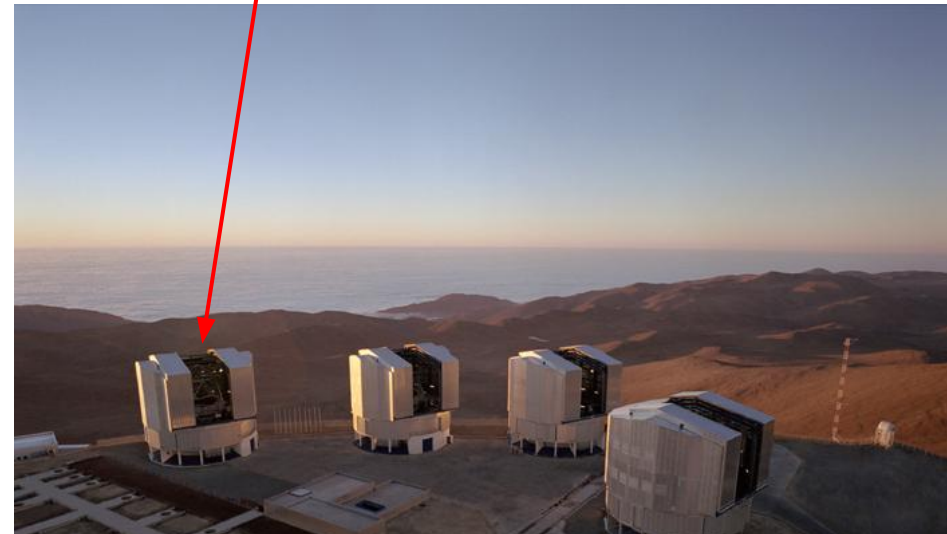
KMOS Observations

- IFU multi-object spectrograph
- 24 configurable arms
- Wavelength coverage: 0.8-2.0 μm
- Resolution at 1.2 μm : ~3500



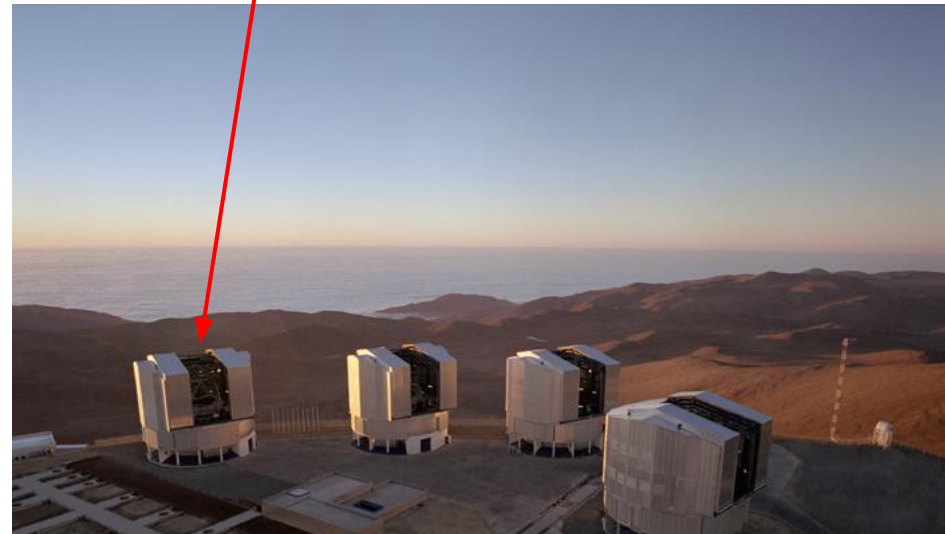
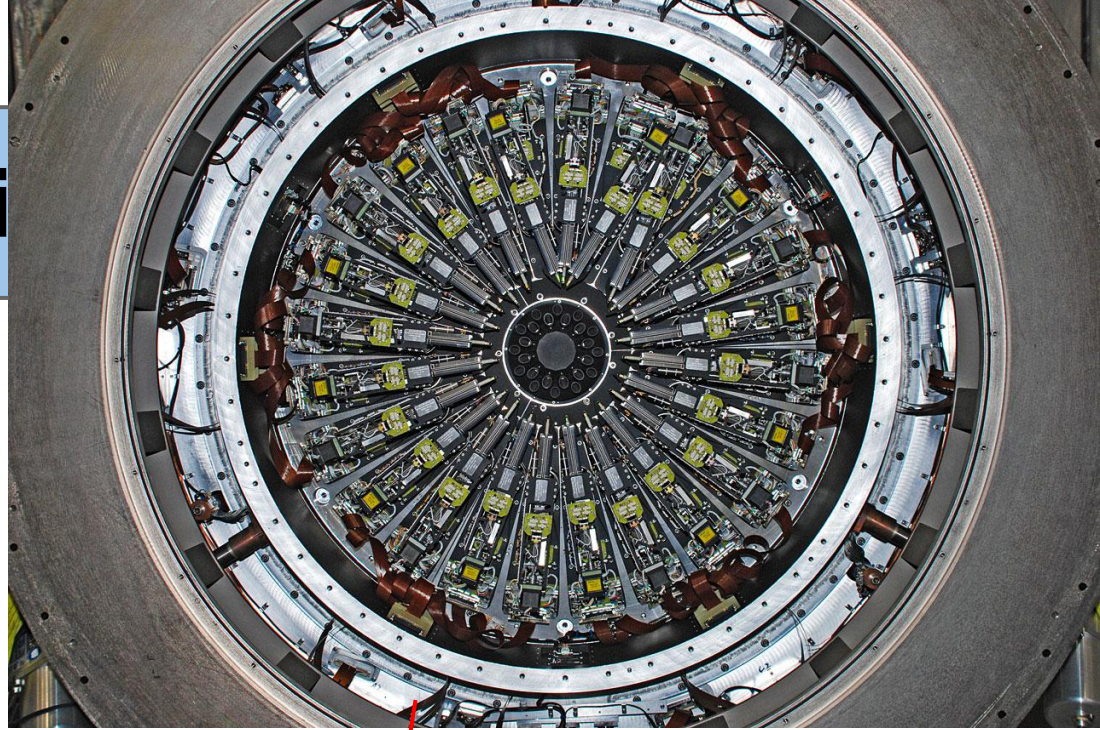
KMOS Observations

- IFU multi-object spectrograph
- 24 configurable arms
- Wavelength coverage: 0.8-2.0 μm
- Resolution at 1.0 μm : ~3500



KMOS Observati

- IFU multi-object spectrograph
- 24 configurable arms
- Wavelength coverage: 0.8-2.0 μm
- Resolution at 1.1 μm : ~3500



KMOS Observations

- Commissioning data:

- NGC 3109, M83

~ 4.5 Mpc

- Science Verification data:

- NGC 6822

~ 0.5 Mpc

- Guaranteed Time Observations:

- NGC 55, NGC 300,

~ 2 Mpc

WLM, NGC 3109

~ 1.5 Mpc

~ 2 Mpc

~ 0.5 Mpc

NGC 6822

- Irregular galaxy
- $d \sim 500$ kpc
- $\log(O/H) + 12 = 8.4$

Venn + 2001



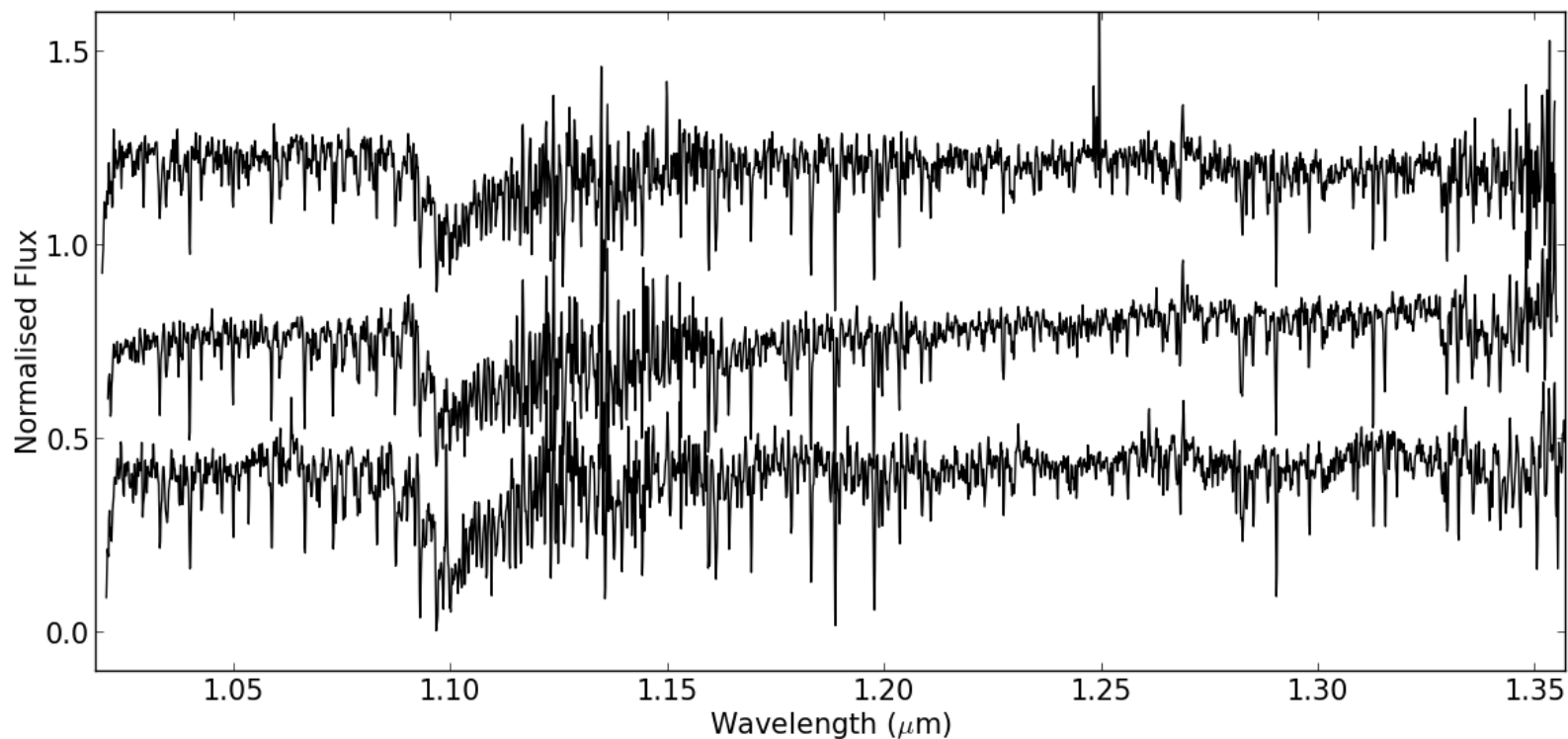
Credit: S. Leshin

NGC 6822

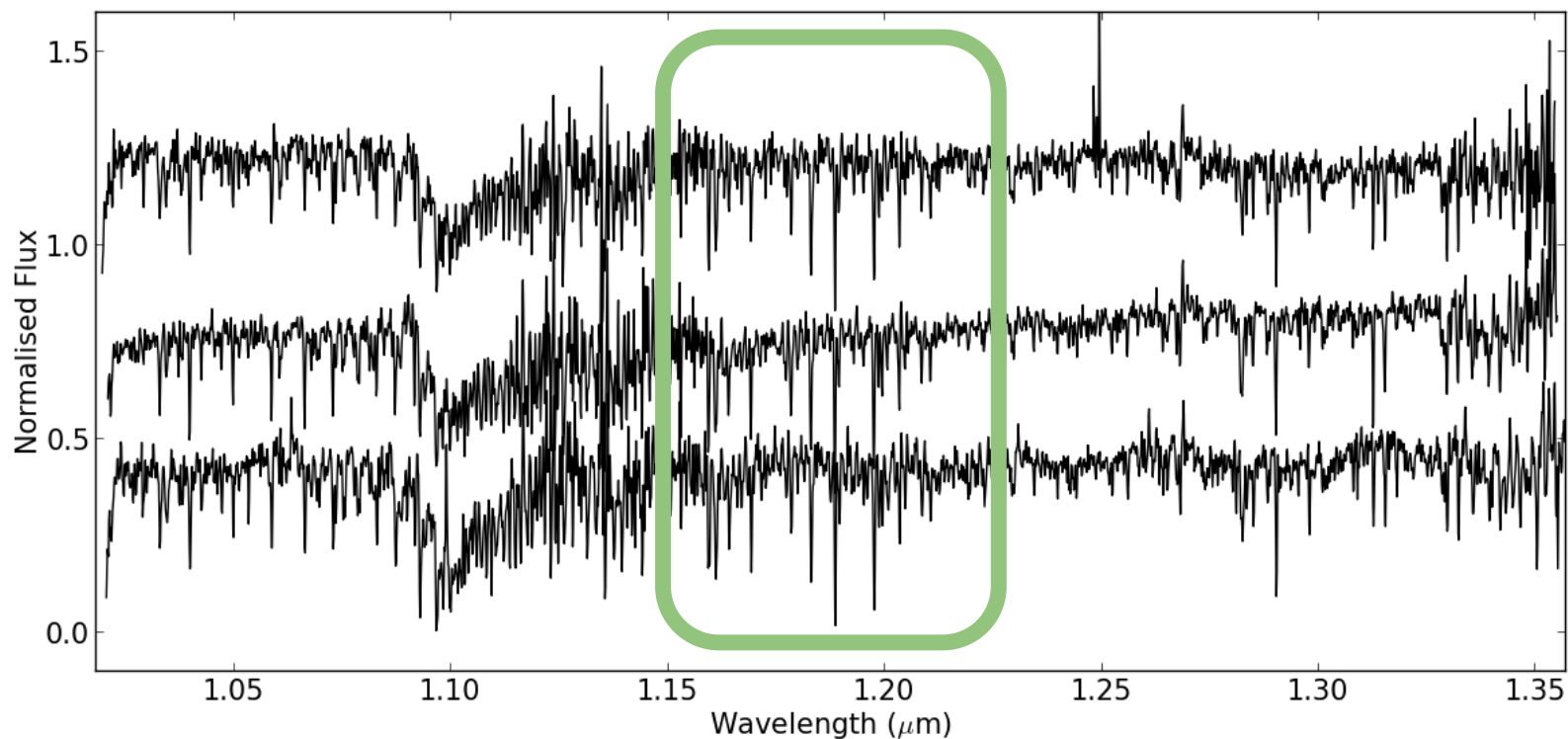
- 19 RSGs observed
- Spatially extended sample



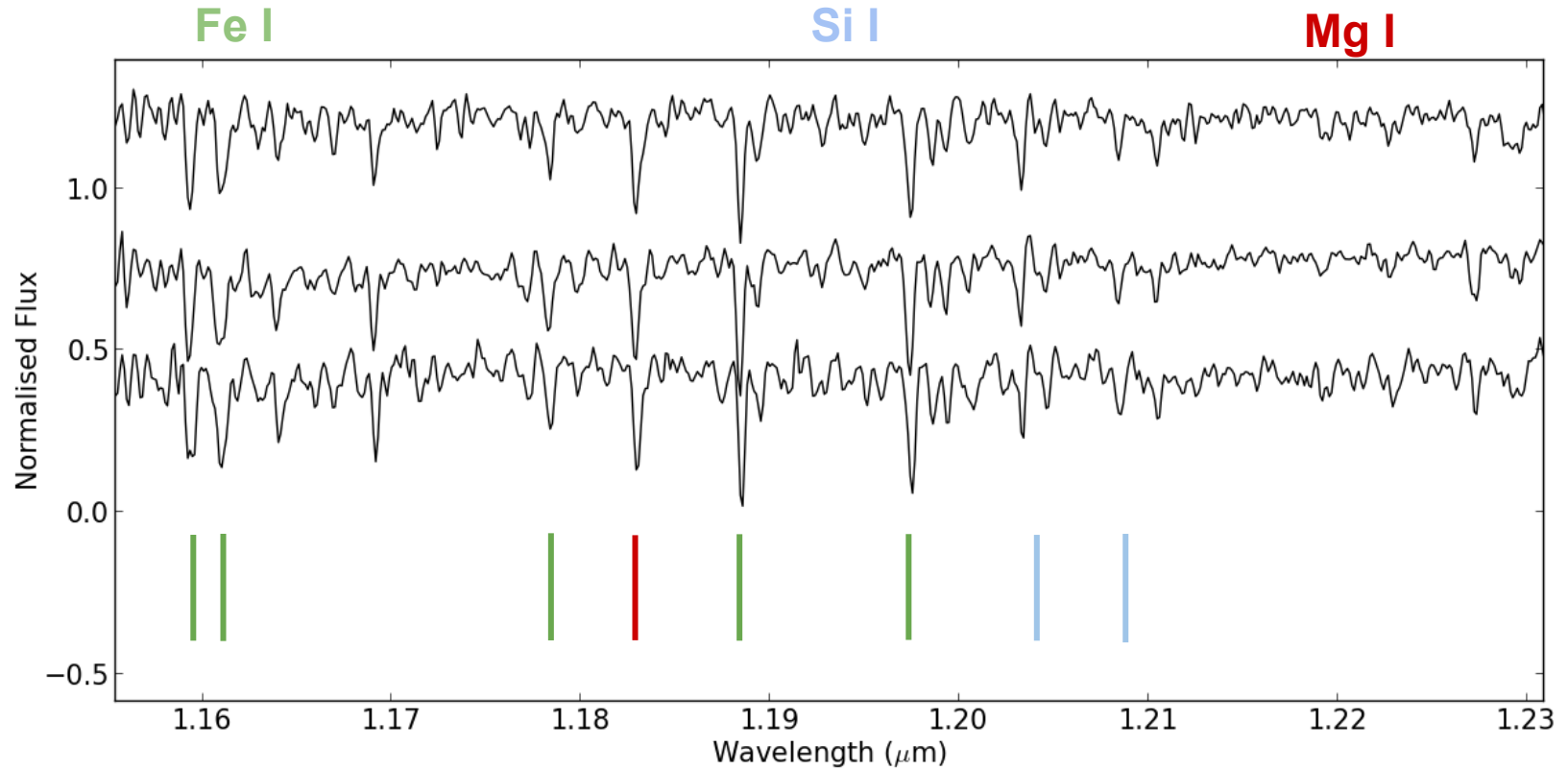
KMOS Observations



KMOS Observations



KMOS Observations



Future Work

- Quantify abundance gradient (or lack of) in NGC 6822
- Begin work on NGC 300, 55, 3109
- Provide independent calibration of mass-metallicity relation in local universe

Future Work: ELT era

- With an E-ELT metallicities of individual stars could be measured out to 10's of Mpc
- Using Young Massive Clusters we can get to 300 Mpc ($z = 0.1$)

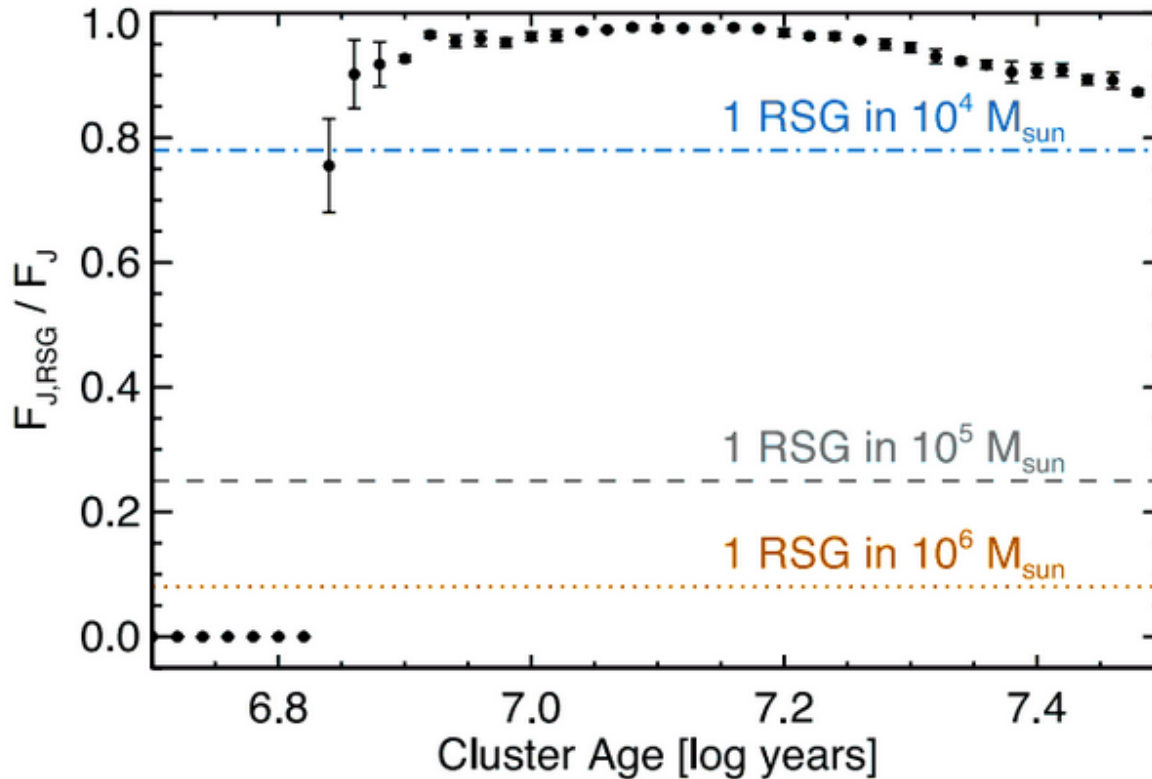
Evans + 2011

Conclusions

- Direct stellar metallicities can currently be derived at distances of around ~ 5 Mpc with individual RSGs
- Our first results in NGC 6822 will be published soon ...
- With an ELT direct metallicities can be measured out to ~ 100 Mpc

Deriving Metallicities: YMCs

- This method is also applicable to clusters of stars



Gazak + 2013