

### Stellar Evolution & Star Formation A fewuthings you haven't heard about



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#### Introduction



La Palma MOS Conf. - Chris Evans - March 2015

#### Large samples for population studies



#### As tracers for galaxy evolution / SF history



# Timeline



KMOS: Multi-IFU, near-IR

2020



2015





MOSFIRE: Multi-slit, near-IR





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2025

#### KMOS: Stellar Evolution around the GC



### New windows for stellar studies



AO correction better in J-band, and stars are intrinsically red (I-J) = 0.5-1.0

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#### Spectroscopy of Red Supergiants

#### Refining the atomic data: nLTE effects



Bergemann et al. (2012, 2013, 2015)

J-band method now tested for RSGs - tests for RGB stars to come

Huge potential for observations with 8-10m & ELTs

#### Timeline

HUGE surveys, >10<sup>6</sup> stars

- Inner MW
- MW disk, halo
- Magellanic Clouds
- LG dwarfs/Irrs

2015





2025

### Star-formation - Always Clustered?



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No apparent evidence for one past cluster

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### Timeline



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### **Current Limits**



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#### Image Credits: David Radburn-Smith

#### ELT Spectroscopy Beyond the Local Group



#### Even more extreme environments







Leo P Giovanelli et al. (2013)

Rhode et al. (2013): 1.5-2Mpc

Skillman et al. (2013): 12+log(O/H)=7.14



### **E-ELT Enters Construction Phase**

ESO Council gives green light for E-ELT construction



### E-ELT Instrumentation: ESO Roadmap

Two 1<sup>st</sup>-light instruments

#### Future decision points mapped out

Year	ELT-IF U + LTAO	ELT-CAM + MCAO	ELT-MIR	FLT-MOS	ELT-HIRES	ELT-6	ELT-PCS
2012	HARMONI	MICADO	METIS	MOS	HIRES	+	EPICS
2014			VISIR start on -sky. Detector check.	Call for proposals Start Ph A	Call for proposals Start Ph A		
2015				Consortium selection for construction	Consortium selection for construction		Start ETD
2016						Call for Proposals	
2017						Start Ph A	
2018							
2019						Consortium ælection for construction	TRL check – start when ready
2020							
2021							
2022							
2023							





### **MOS Requirements**





\* Minimum size is 1"×1" if on/off sky subtraction is used.

arXiv:1501.04726

### **MOS Requirements**

- High multiplex: Integrated-light (GLAO) spectrosco
- High definition: Tens of channels using high-perform











### Technical Challenges: AO





#### Technical Challenges: AO











### Technical Challenges: Design





#### Design work ongoing: one possible focal-plane architecture:



Good alloc. efficiencies for high-z & stellar targets Avoids need for multiple plates/carousel Potentially quicker target allocation

Phase A to start late 2015

### Summary

- MOS instruments are workhorses of current large telescopes
- MOS instruments early-on in GMT and TMT plans
- Huge potential for stellar spectroscopy with E-ELT + MOSAIC
- White Paper presenting top-level cases
- Phase A study coming soon...





#### Science with MOS: Towards the ELT Era



### Cefalu, Sicily - 7-11 Sept. 2015

## Thanks!

#### HARMONI



#### 1<sup>st</sup>-light spectrograph (PI: N. Thatte, Oxford)



Final specs now converging for PDR phase

### Technical Challenges: Design



Avoids need for multiple plates/carousel 🗸 Potentially quicker target allocation 🗸

Phase A to start late 2015

#### Spectroscopy of Red Supergiants



#### **MOSFIRE**







Bressert et al. (2012)

#### Star-formation - Isolated?

- Apparently single stars & with RVs within  $1\sigma$  of mean RVs
- Associated with molecular filaments
- HST images: no obvious clusters, proper motion
- Proper motion studies with HST underway





#### See also Lamb et al. (2010) in SMC

Star-formation - clustered? Isolated?



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### **Current Limits**



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science & Technology Facilities Council UK Astronomy Technology Centre Star-formation - clustered? Isolated?



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### **Current Limits**

#### Tramper et al. (2011)



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See: Garcia & Herrero (2013); Garcia et al. (2013); Tramper et al. (2014)

#### Pitch: Red Supergiants as probes of metallicity



