Exploiting stellar surveys: the need for spectroscopy

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- European Galactic Plane Surveys (EGAPS)
- Stars in Nearby Galaxies – Massive stars

European Galactic Plane Surveys (EGAPS)

- **(EGAPS)**
  - **IPHAS** – 300 million point sources Hα, r' and i' in the northern galactic plane (INT); (70% passed data quality, 93% observed, DR1 coming soon) – www.iphas.org
  - **UVEX-N** - u', g', and HeI5876 in north GP (INT)
  - **VPHAS+** – 600 million point sources; southern plane counterparts of IPHAS & UVEX-N (awaits VST)
  - IR surveys: **UKIDSS-GPS** & **VVV** etc (UKIRT & VISTA)

- **Sloan** DR5 – 200 million sources
- **2MASS** – 500 million sources
- **GAIA, Pan-STARRS, LSST** …..etc – lots of imaging surveys needing spectroscopic support!!

Science drivers are many…

- Search and counts of all classes of Ha emitting stars/nebulae - short-lived but critical (birth, death, binarity, …) stages of stellar evolution: supergiants, LBVs, pre-MS, WR, Be stars, interacting binaries, PNe, HII regions, SNRs…
- Study of Galactic structure (stellar populations, reddening), variables,…
- Study of star-forming regions
- etc

(much of this is in the Science Vision draft document…but stellar **evolution** should be emphasized more strongly)

Most of these objectives will need spectroscopic follow-up

Spectroscopic requirements

- Isolated emission line sources: 13^{th} – 20^{th} magnitude, R-band or IR single source spectroscopy (expect ~10^4 in IPHAS alone!): A lot of time on 2-4m telescopes!
- Compact young clusters: (slit) MOS and AO assisted IFU spectroscopy in IR on 8m telescopes.
- Stellar populations tracing galactic structure: (fibre) MOS in Optical/R-band or IR on 4/8m telescopes.
- Resolution: a range - depends on object(s) & science

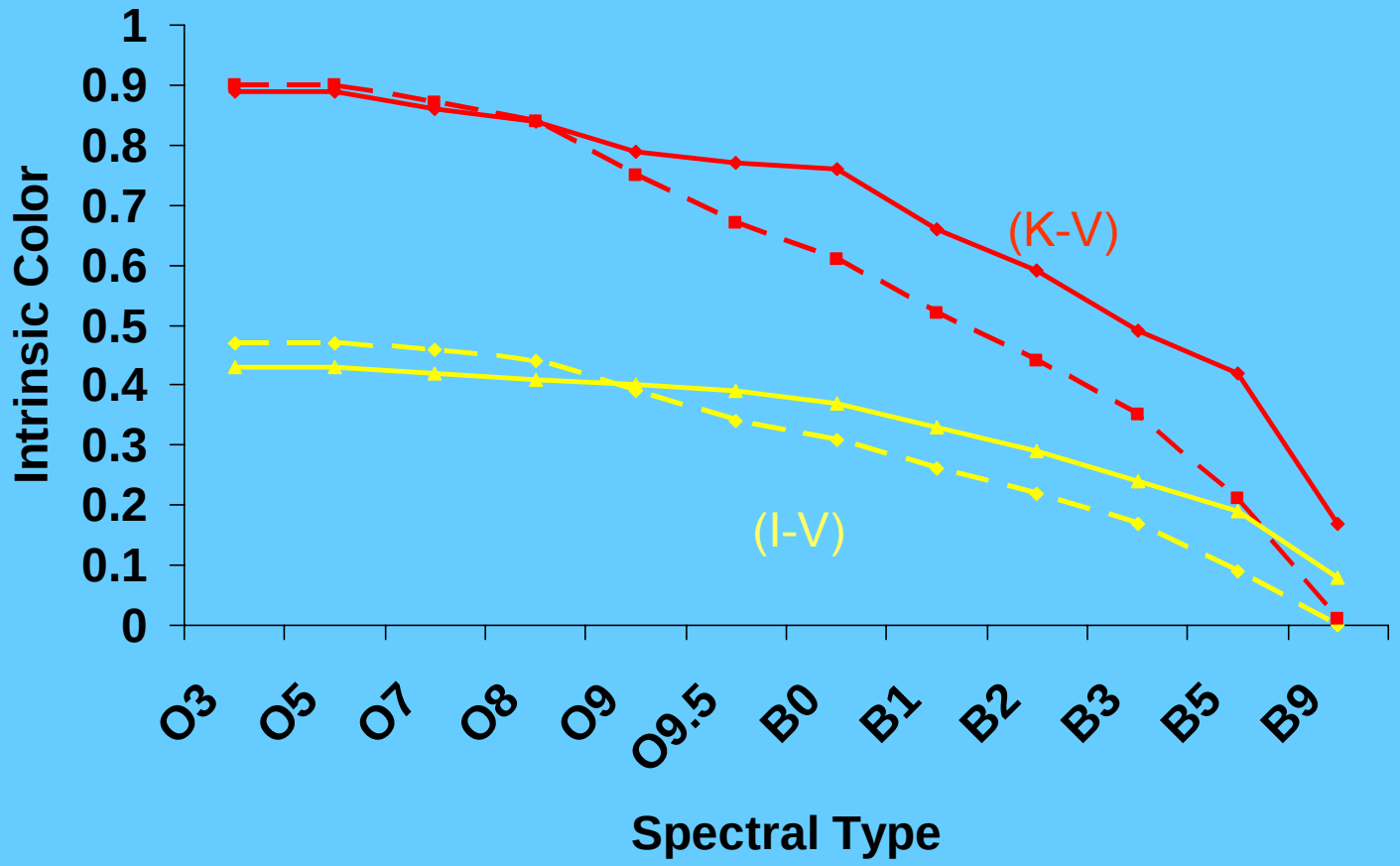
(Already have 14,000 spectra from IPHAS sample using HECTOSPEC on MMT plut several thousands more from 2/4m telescopes!)

(Hot) Massive stars - what are the problems?

- How do massive stars form? (Accretion or merger scenarios?)
- What is their IMF?
- Is there an upper mass cut-off?
- Multiplicity?
- Origin of X-rays? (Magnetic fields or winds? Is B-field fossil or generated?)
- What is the distribution of initial rotational velocities?
- Mass loss rates, clumping
- Why are there `weak winds´
- How does all this depend on metallicity (Z)?

Need to study stellar groups/populations – at different Z

Why photometry is no good for hot stars!



A ‘Conti’ diagram

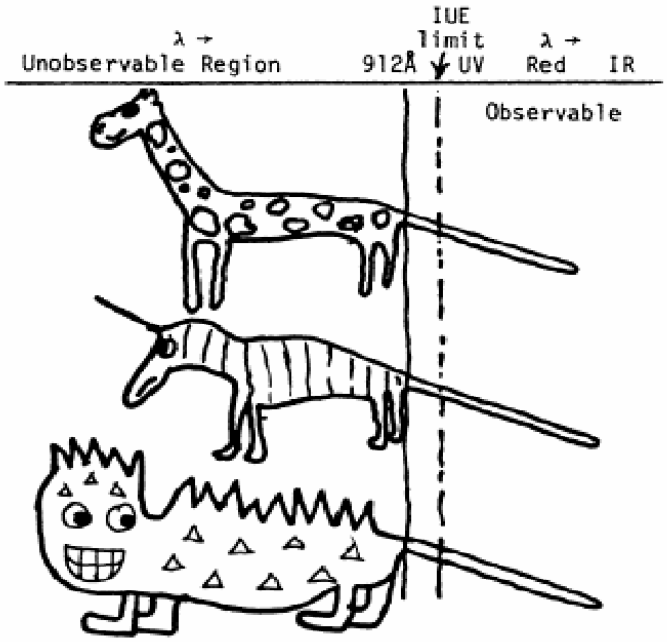
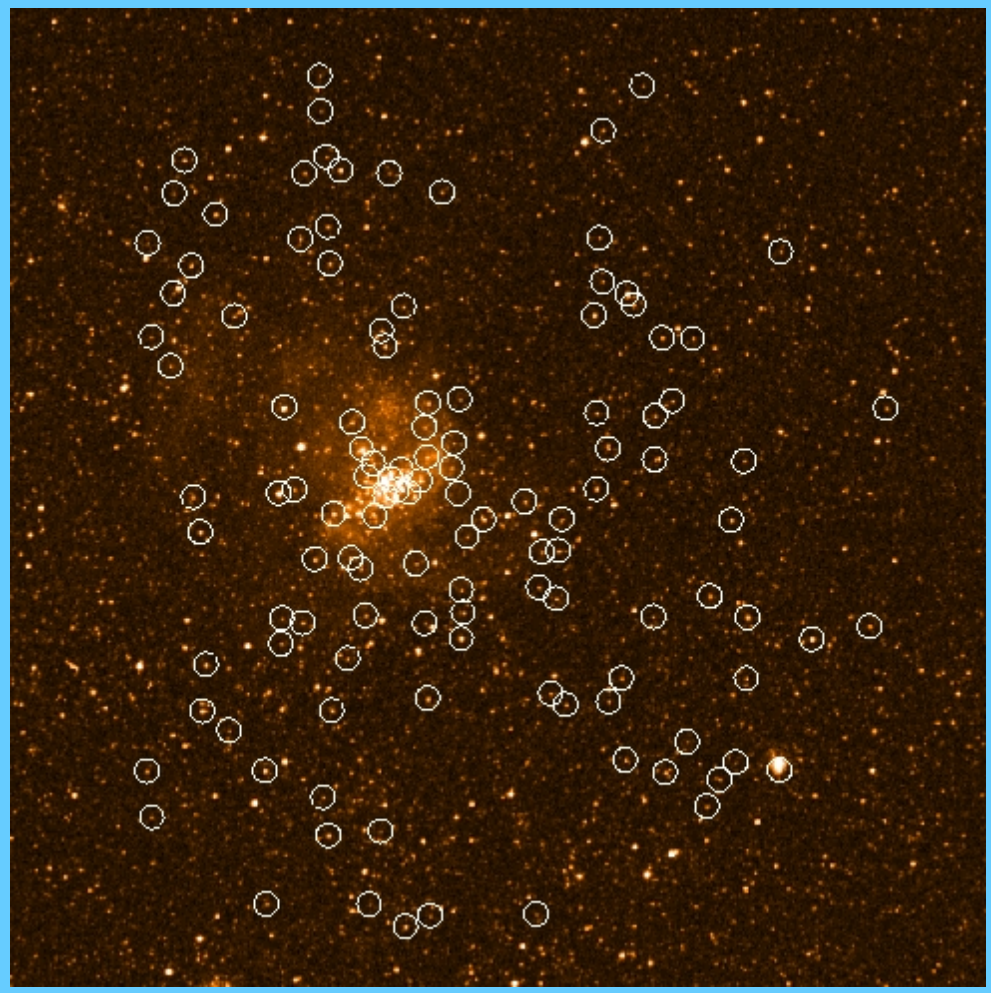


Fig. 2. Cartoon showing difficulty in discerning the nature of the "beast" existing below λ912 Å, the Lyman limit, if one only has the "tail" of the distribution to observe in the UV, optical, and IR wavelengths.

The VLT-FLAMES survey of Massive Stars: Targets in NGC 346

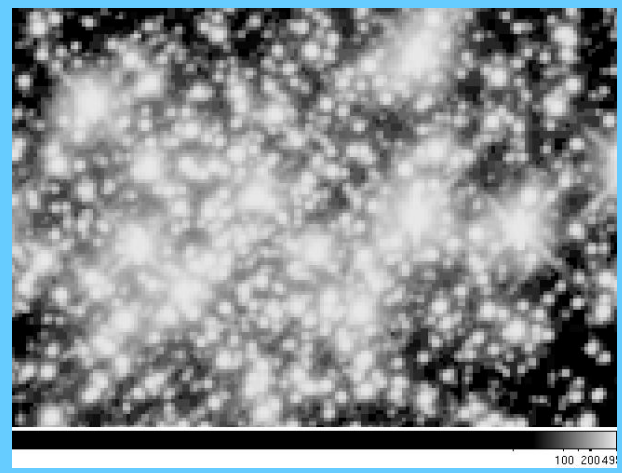
~1000 OB stars at R=20,000 in LMC, and MW. NGC346 is one of 7 fields.



Courtesy: Chris Evans

The need for AO assisted IFU spectroscopy….

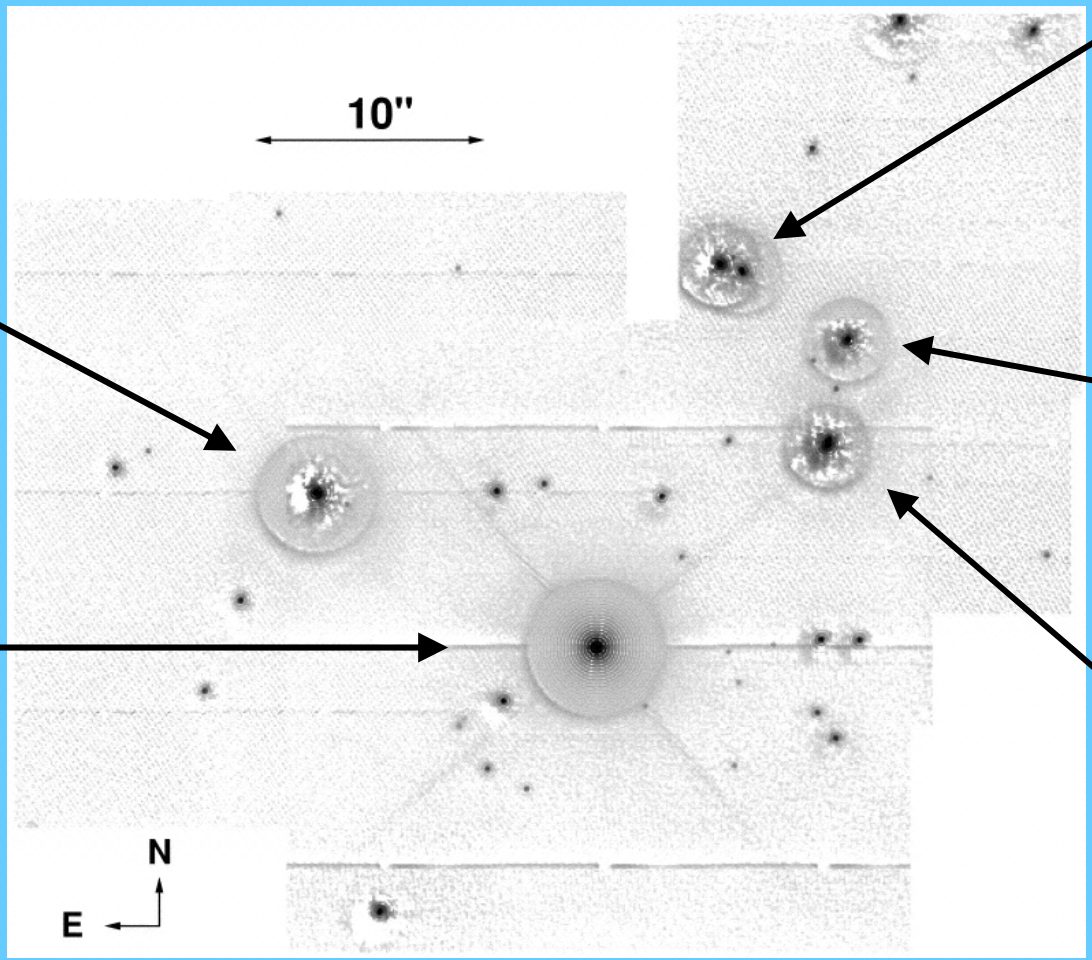
- Top panel: a cluster core in the SMC taken with HST/PC



- Bottom panel: same convolved with a seeing of 0.6”

Courtesy: Ian Hunter (QUB/ING), Dan Bramich (ING)

Orion Trapezium Cluster: θ^1 Ori A-E



B: B1 V/B3
Mult. B poss.

D: B0.5 Vp

E: B0.5
B yes.

C: O6.5 Vp
Mult. B yes.

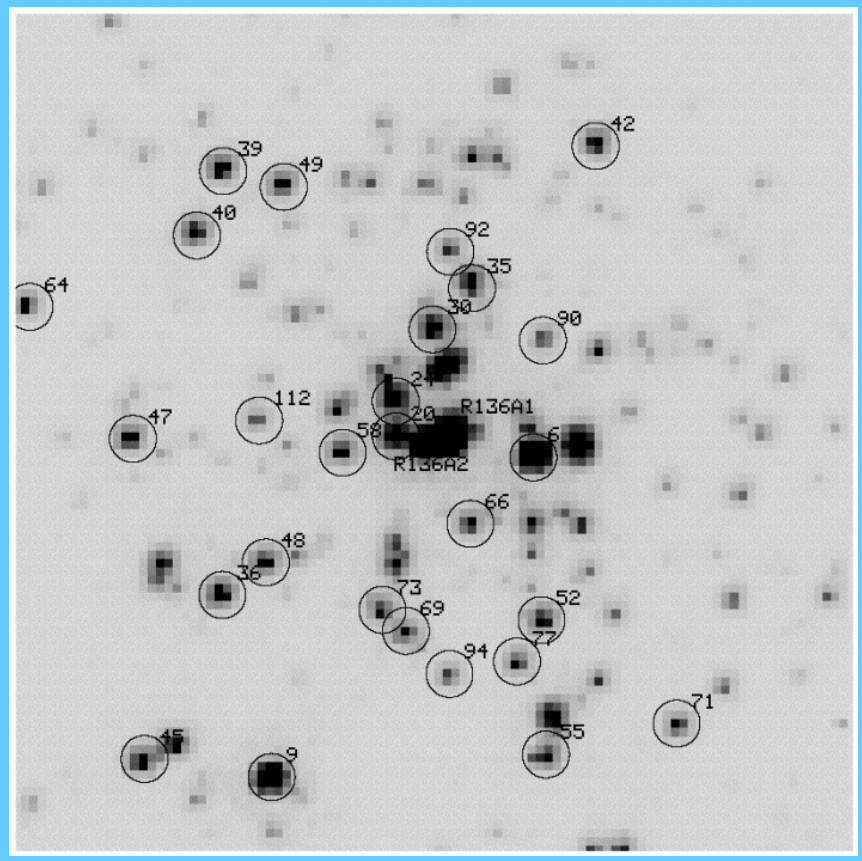
A: B0.5 V
Mult. B yes.

30 Doradus and R136a

18 O3 stars, 3 WN stars, 1 Of/WN star

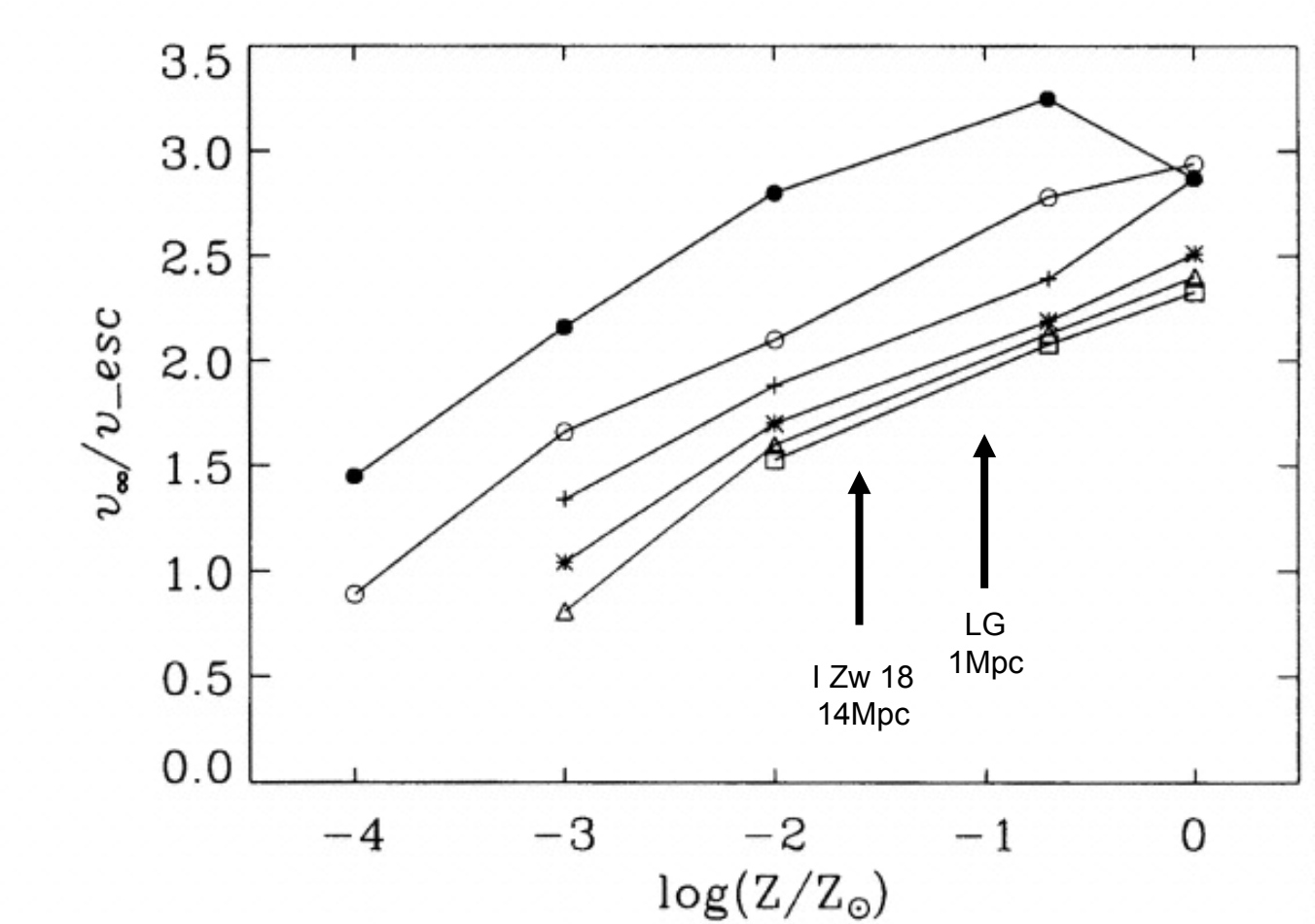
Circles are HST/FOS 0.26 arcsec aperture.

Image size is 4.55x4.55”.



The need for low Z,and where to look…

Needs milliarcsec resolution …but only supergiants are realistic targets!



Kudritzki (2001)

Summary

- Continuing trend towards spectroscopy of larger stellar samples – prompted by imaging surveys
- Facilities need to be matched to appropriate scales, (e.g. IFUs offer great potential for multi-object spectroscopy of compact groups), spatial and spectral resolutions, and telescope apertures.
- Dealing with these data is a problem! How to interface with theory? (Genetic Algorithms?)
- Spectroscopic databases may not be large in size, but their information content is huge!
- The UV is essential!