Post-AGB Stars in the Magellanic Clouds

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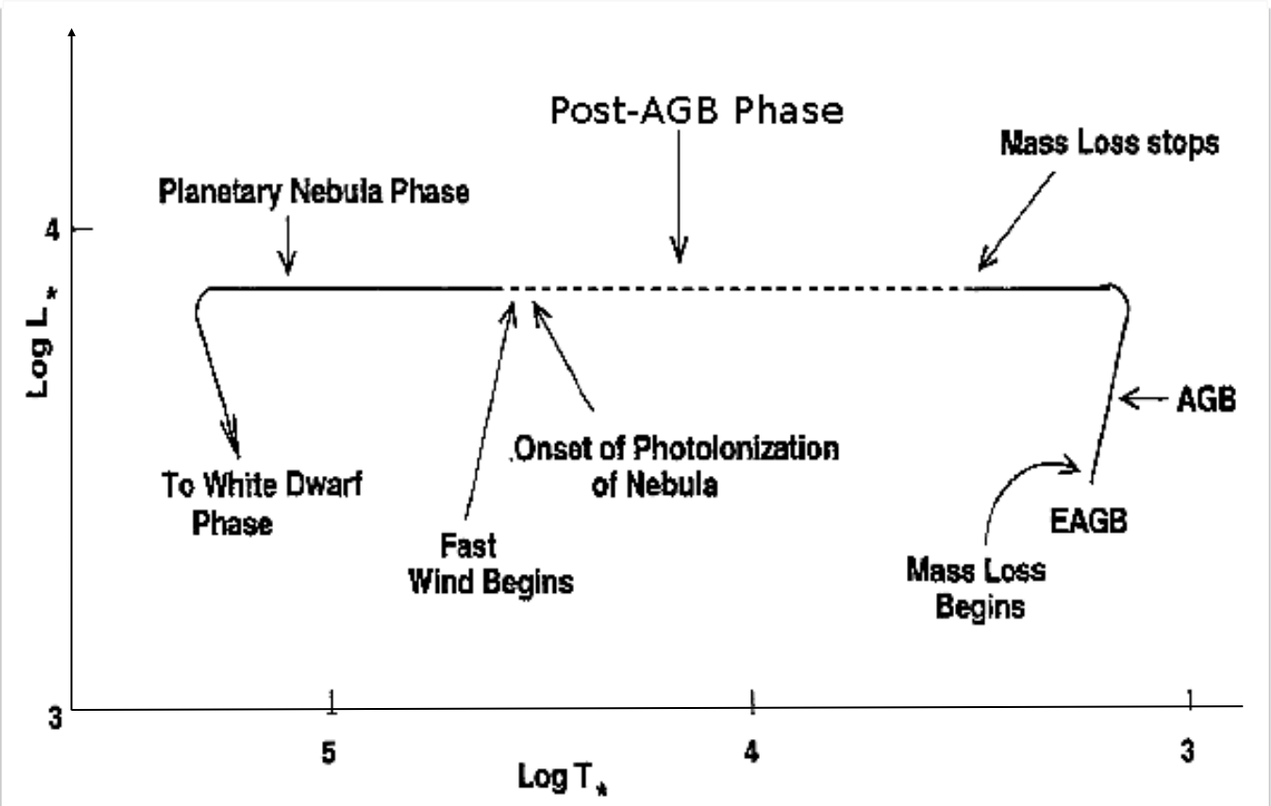
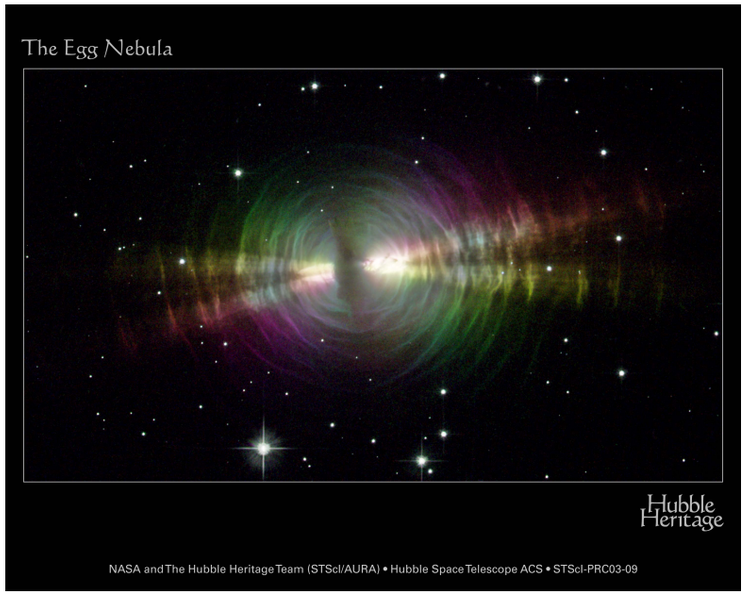
AGB → Post-AGB → PNe

- Transient phase ~1000 - 10000 years
- A - K Spectral Types
- Masses: 0.6 - 0.8 M_{sun}
- R* ~ 1 AU on the AGB to R_{WD}
- Variable (Pop II Ceph. Instability strip)
- Obscure to naked...



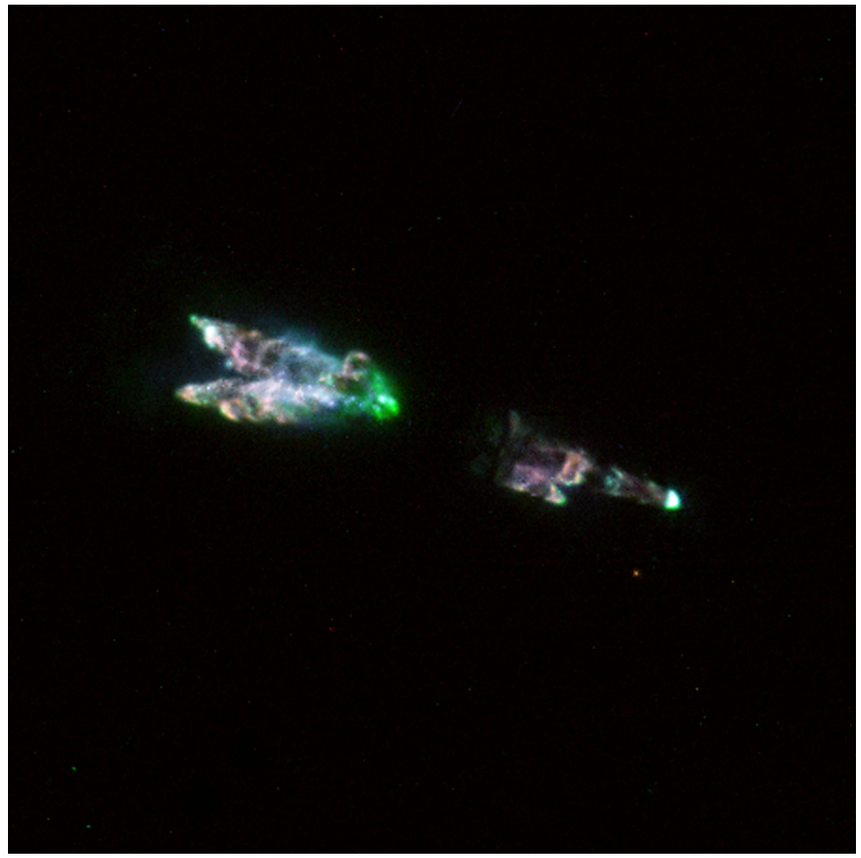
Post-AGB stars



Egg nebula
ADS: 727 ref (02/03/2010)

Calabash (OH231)
ADS: 403

AFGL 618
ADS: 702



No good statistical picture of
Post-AGB evolution

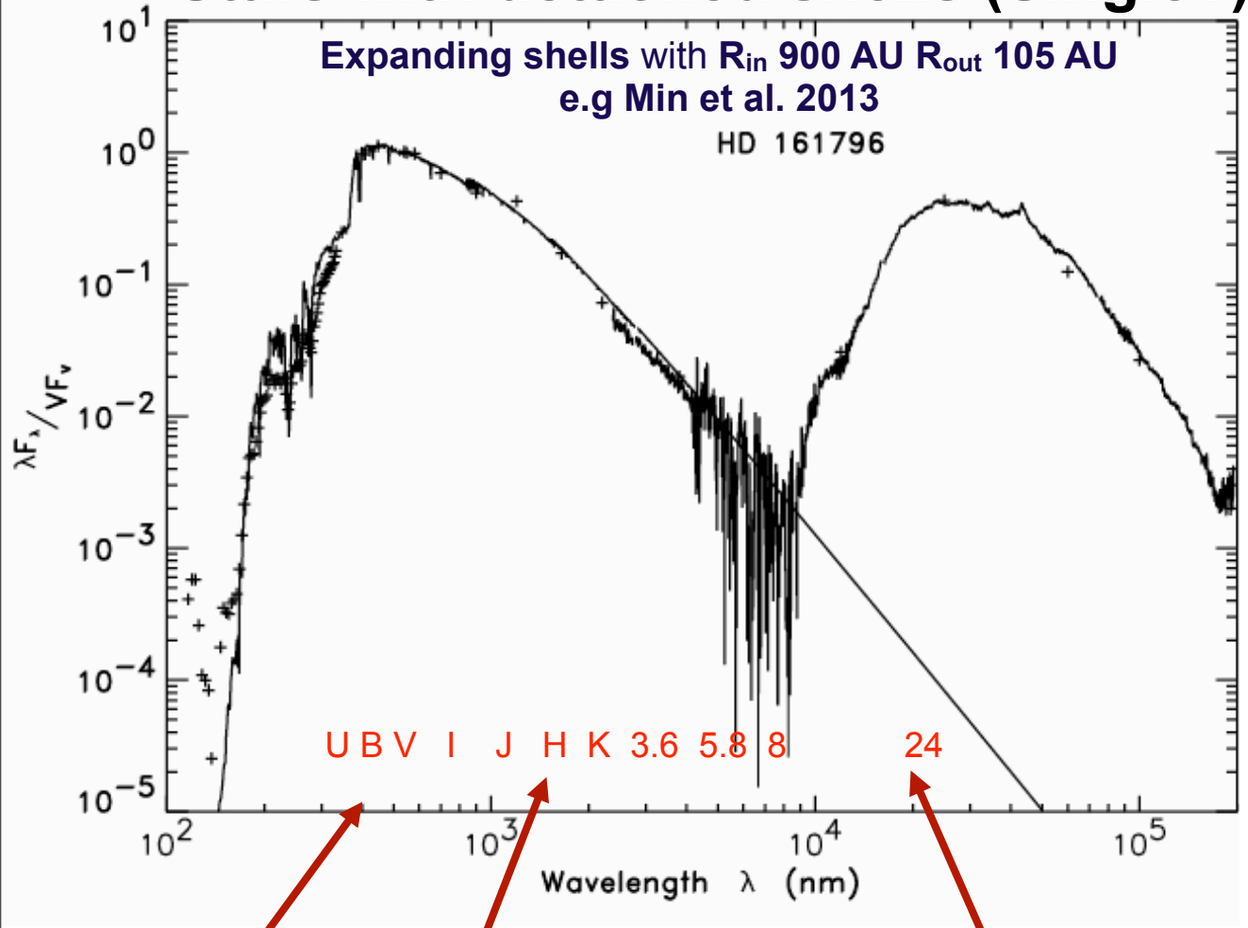
What are the evolutionary channels
connecting the individual objects ?

HD 56126: 218 ref.
HD 187885: 122 ref.
SAO 239853: 36 ref.

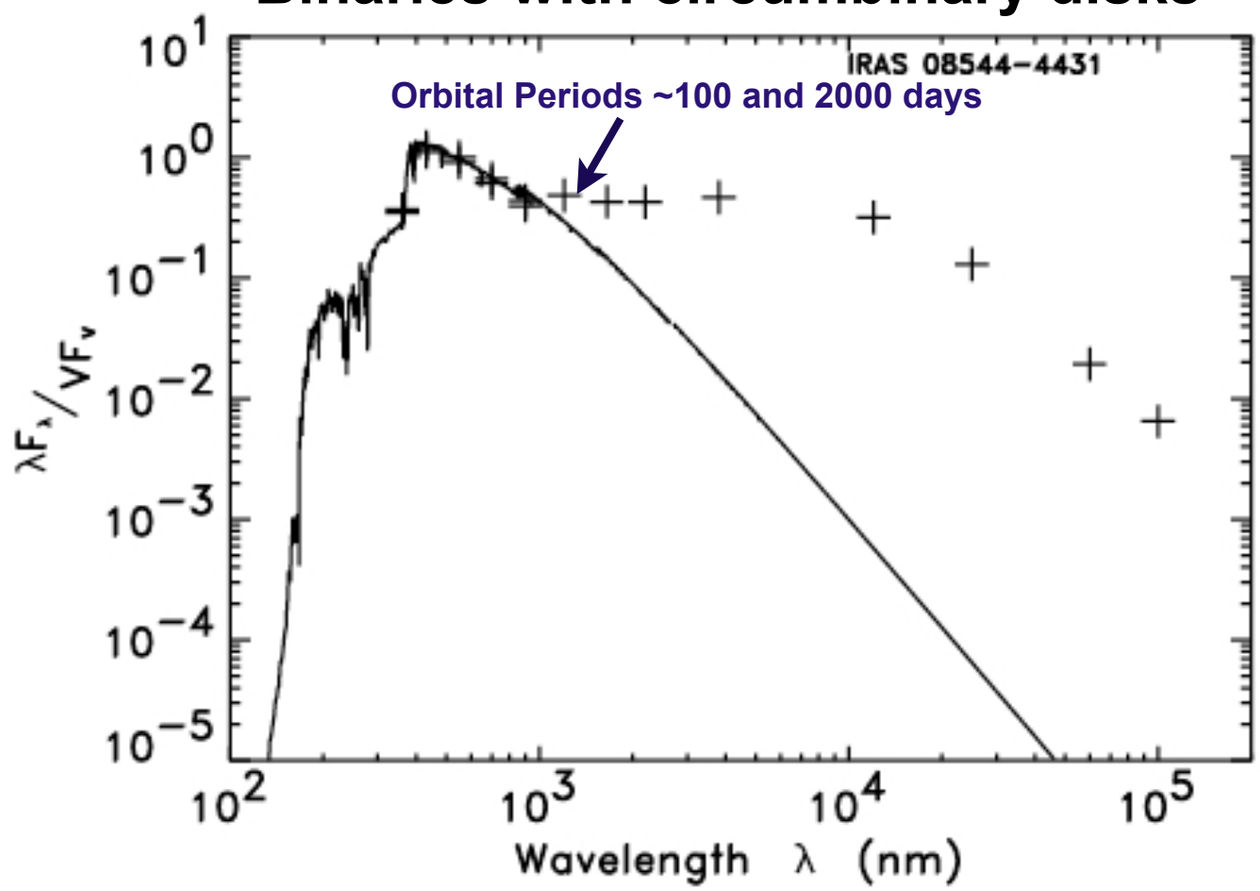
Optically Visible Galactic Post-AGB Stars

(Toruń Catalog - Szczerba et al. 2007)

Stars with detached shells (Single?)



Binaries with circumbinary disks



Studies by: Van Winckel 2003,2007, 2009; De Ruyter et al. 2006; Gielen et al. 2009; Dermine et al. 2012 ...

Optical + 2MASS + Spitzer bands allow us to distinguish between the two types - not always...

Mid-IR dust emission is characteristic of Post-AGB stars!

Optically Visible Post-AGB Stars in the SMC* and LMC**

**Kamath et al. 2013 MNRAS (Accepted)*
***Kamath et al. 2014 MNRAS (in prep)*

Mid-IR Spitzer Space Telescope Surveys

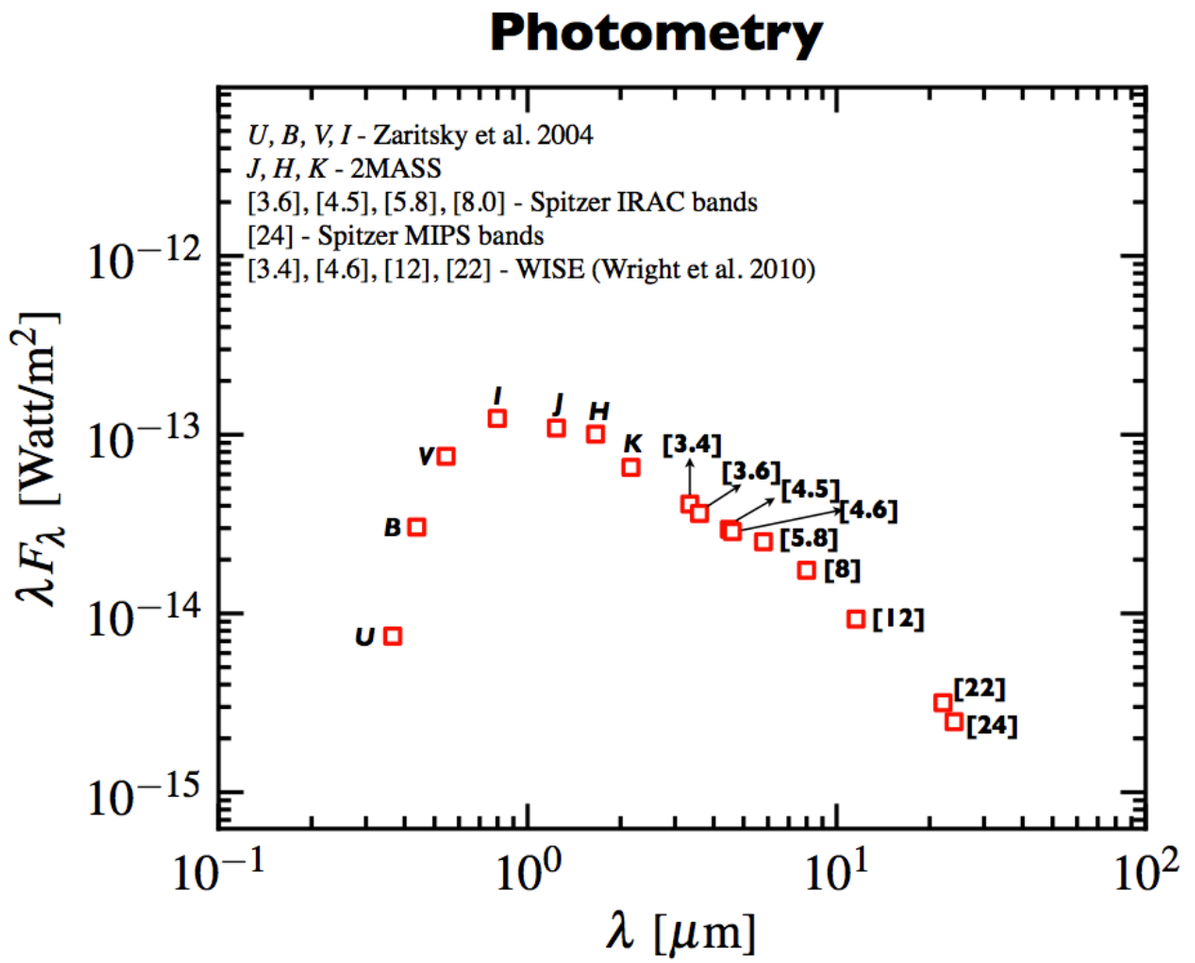
Candidates with Mid-IR excess selected from the Mid-IR SST survey

SMC: **S^{3}MC** (Bolatto et al. 2007) & **SAGE-SMC** (Gordon et al. 2010)

LMC: **SAGE** (Meixner et al. 2006) & (Blum et al. 2006)

- ☑ Candidate Selection
- ☑ Spectroscopic Examination
- ☑ SED Analysis
- ☑ Variability Analysis
- ☑ Spectroscopically verified

Catalogues of Post-AGB/RGBs and other interesting objects

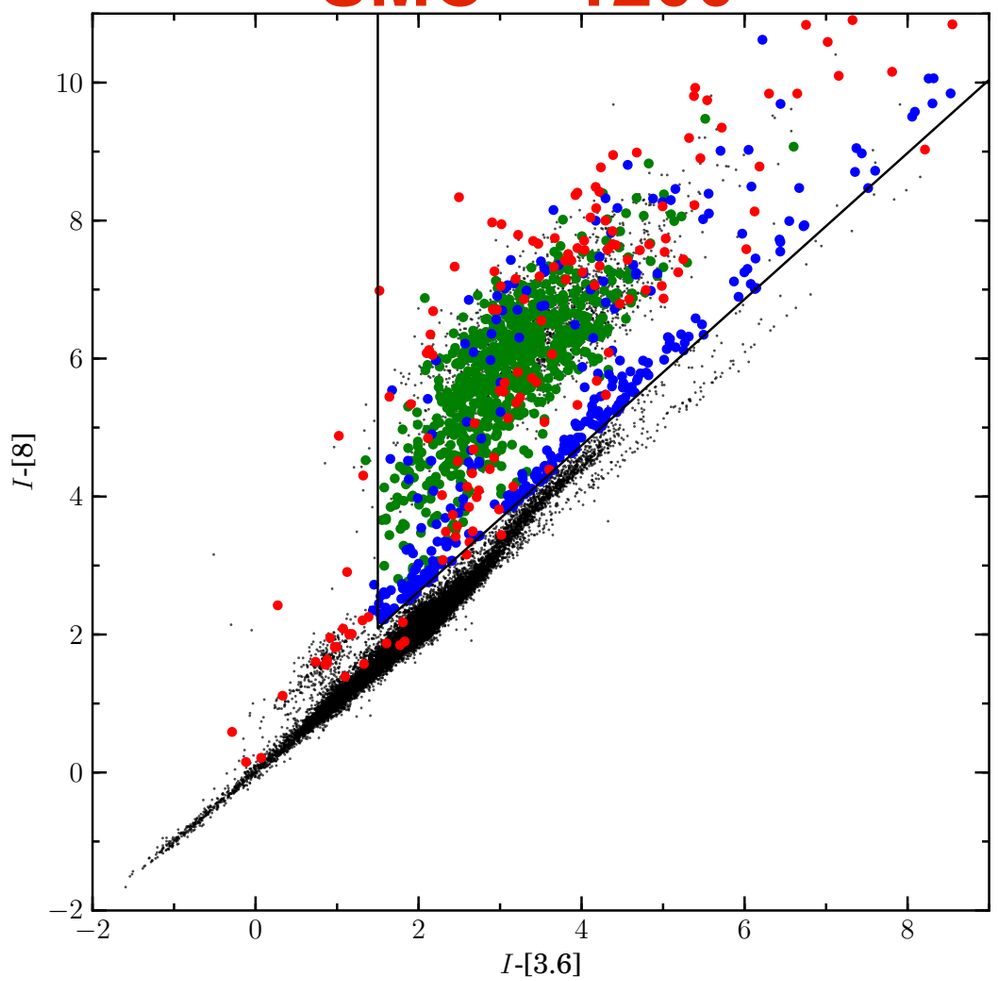


Selection Criteria

Colour Criteria: V < 20; [24] or [8] micron

Luminosity Criteria: 500 < L/Lsun < 35000 (rejects YSOs and Supergiants)

Total Objects Selected in SMC ≈ 1200

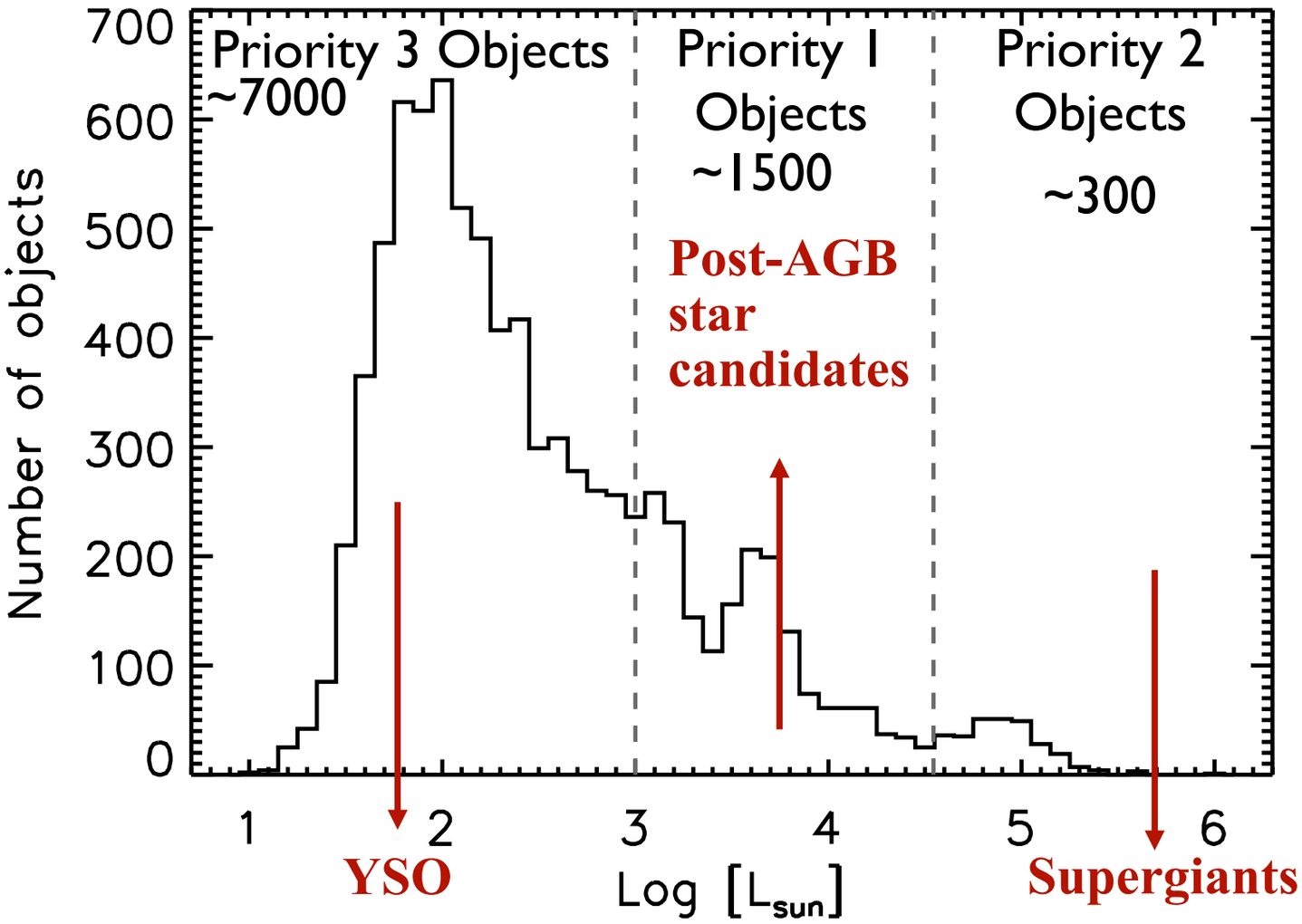


Priority 1 Objects ≈ 150

Priority 2 Objects ≈ 300

Priority 3 Objects ≈ 700

Total Objects Selected in LMC ≈ 9000



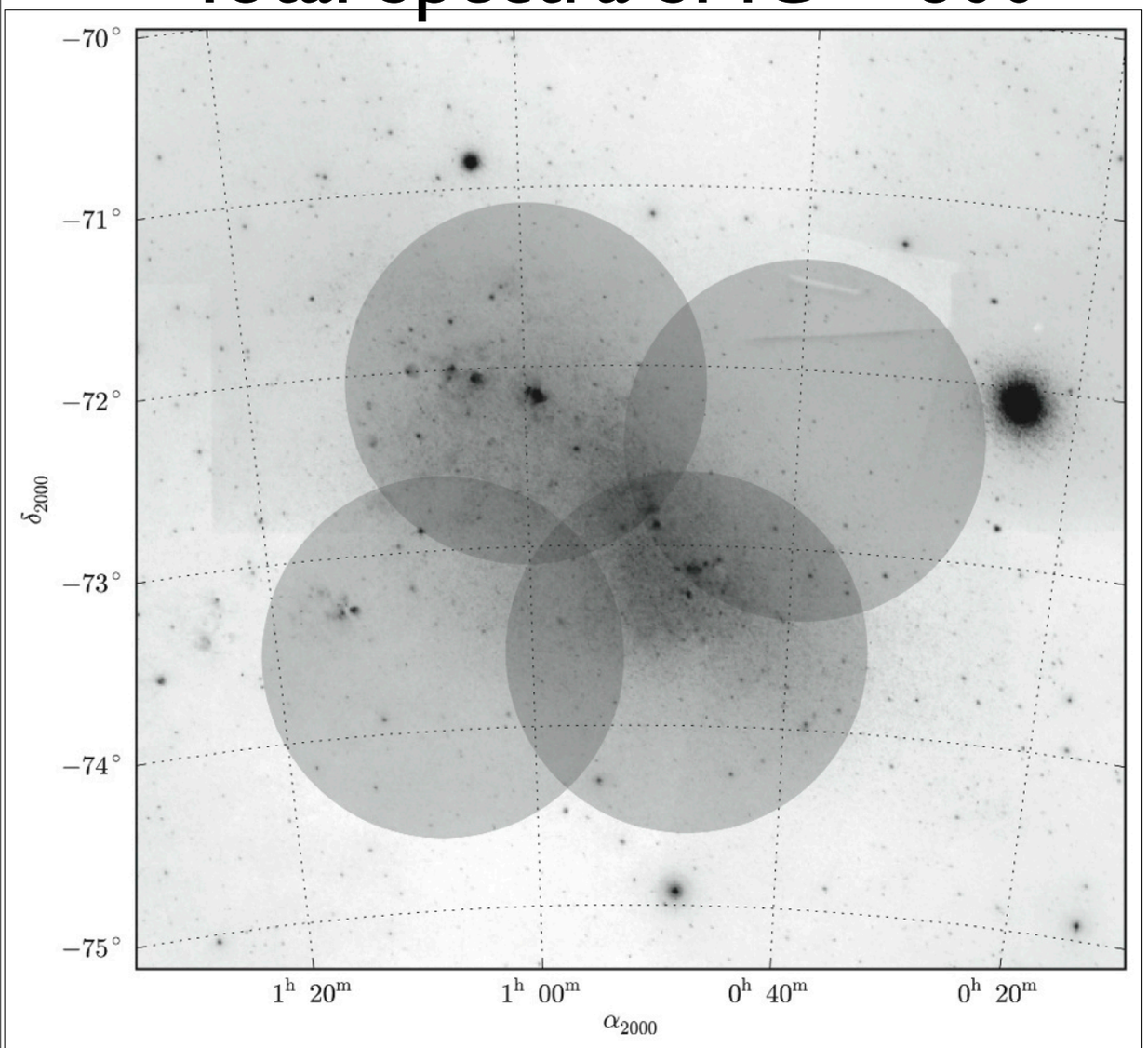
E.Van Aarle et al. 2011

Spectroscopic Observations

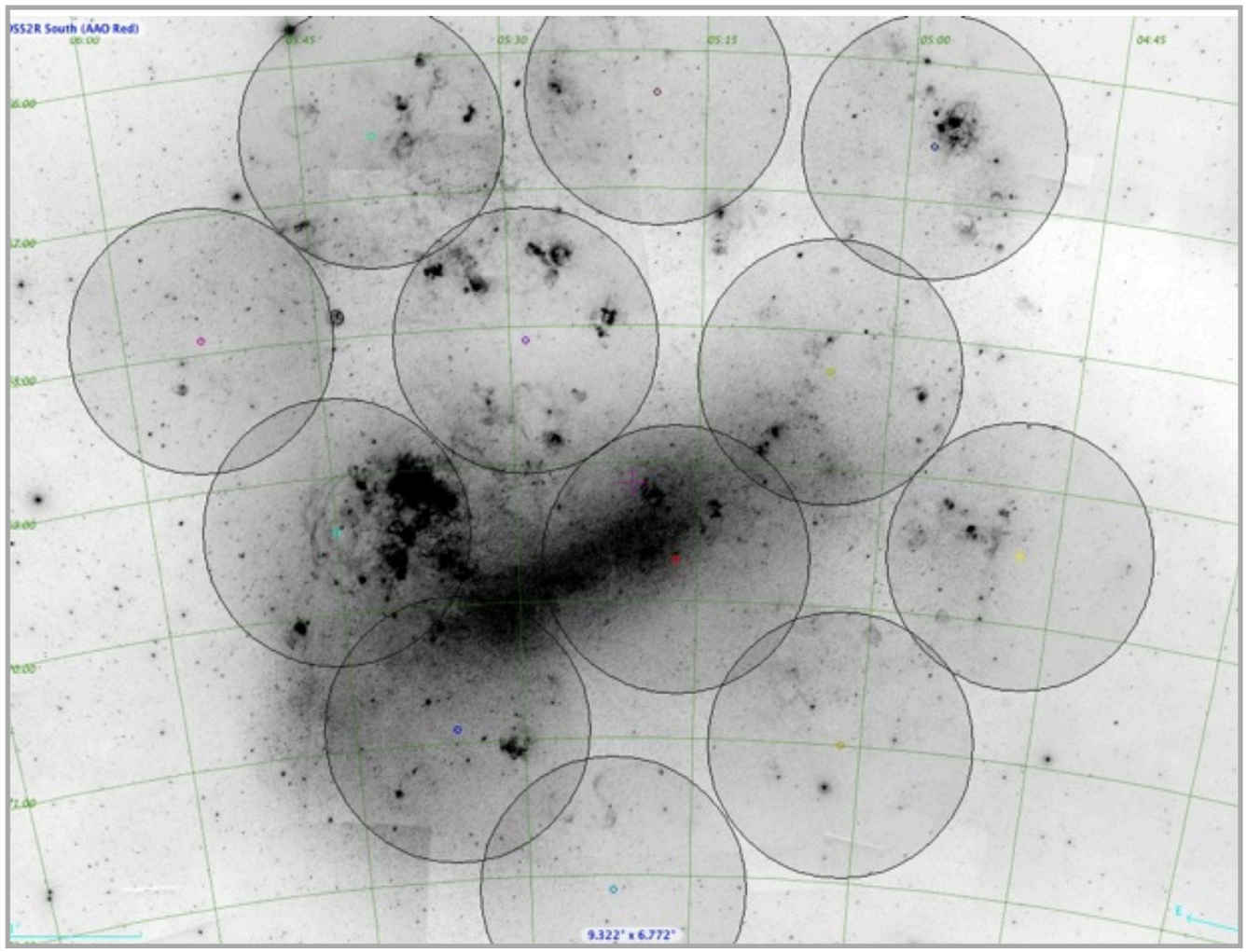
AAOmega Multi-fibre Spectrograph (400 Fibres) on the 3.9m AAT

Optical Low Resolution Spectra (3700 Å - 8700 Å)

Total Spectra SMC ~ 800

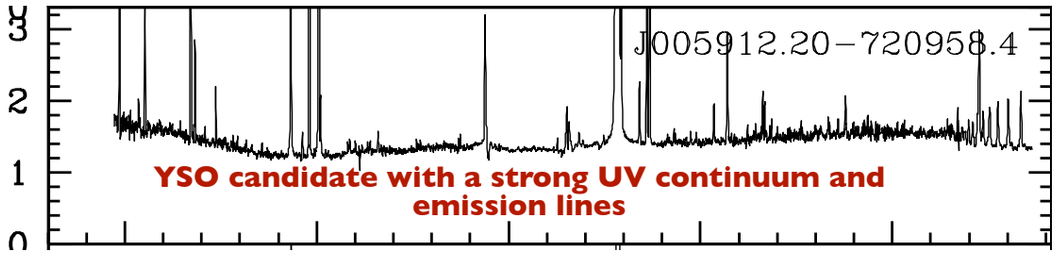


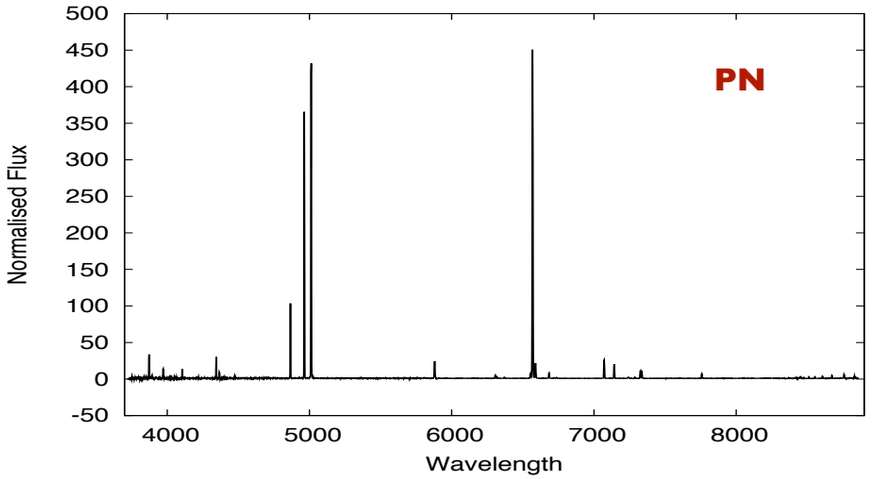
Total Spectra LMC ~ 2000

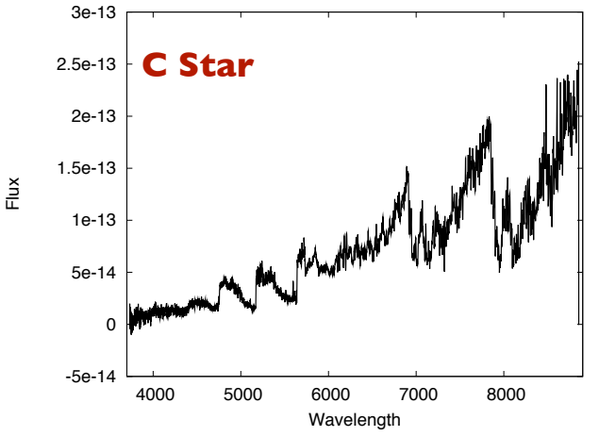


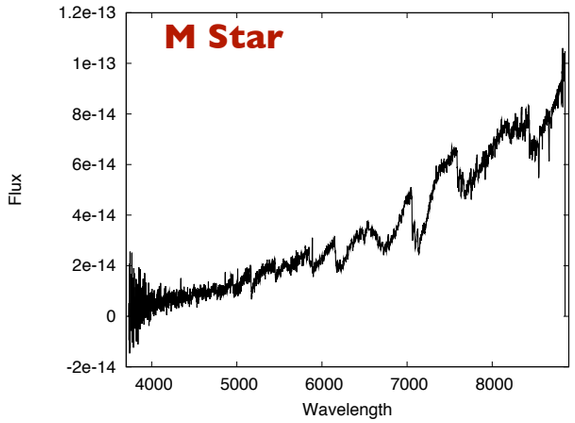
Visual preliminary Spectral Analysis

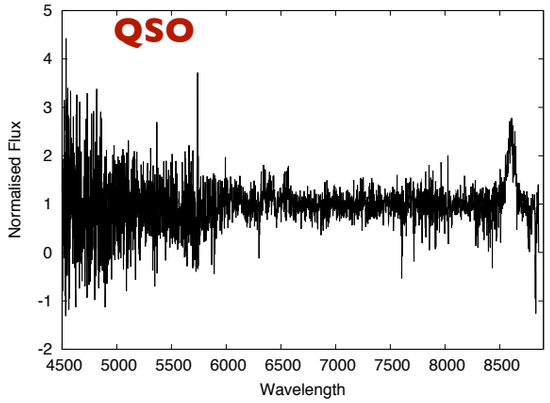
Interesting Contaminants:

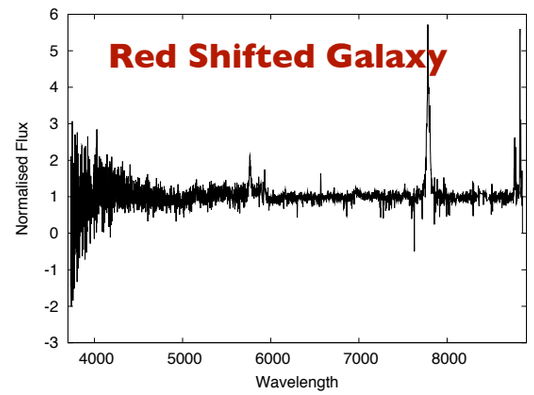












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Possible Post-AGB/YSO Candidates:

SMC = 150

LMC ~ 500

Note: Not full numbers (4 fields to be added!)

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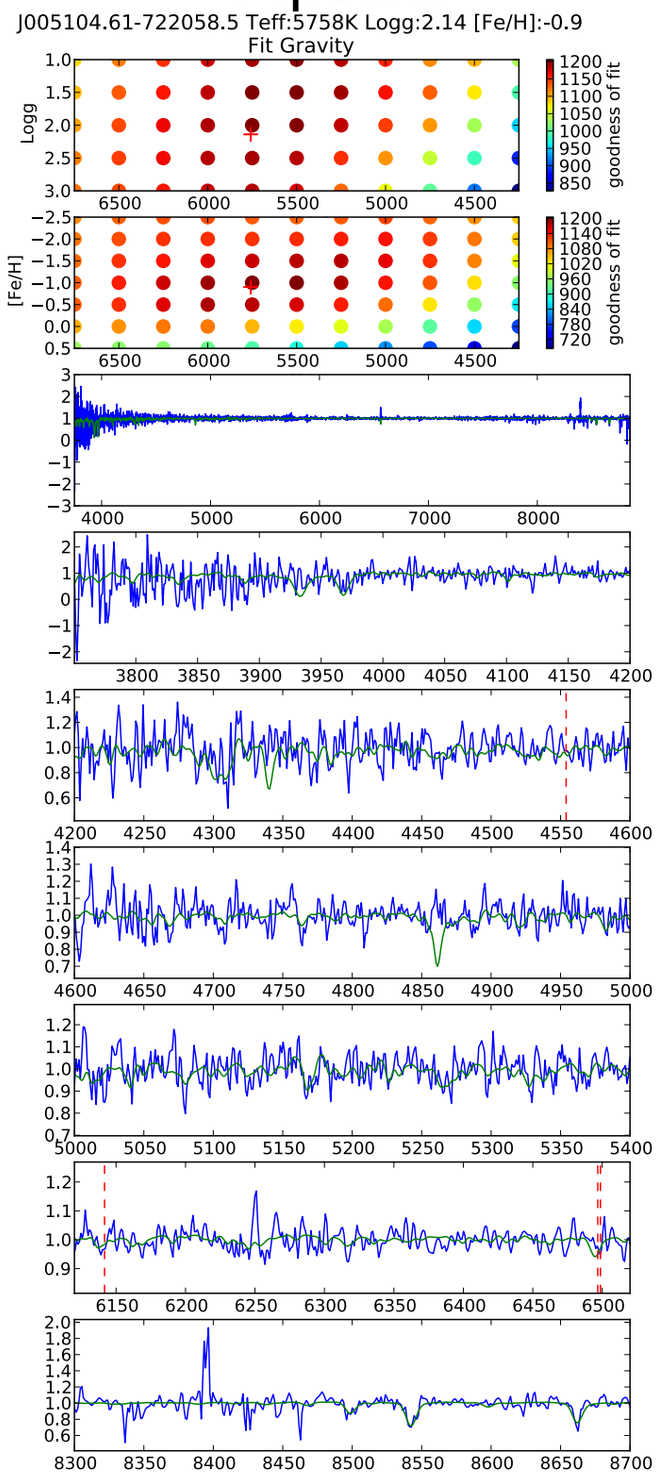
Low Signal Spectra !

Spectral Analysis => T_{eff}, log g and [Fe/H]

Probable Post-AGB/ YSO candidates

Fully Automated Spectral Typing Pipeline



SMC

Post-AGB candidates = 100

YSO candidates = 50

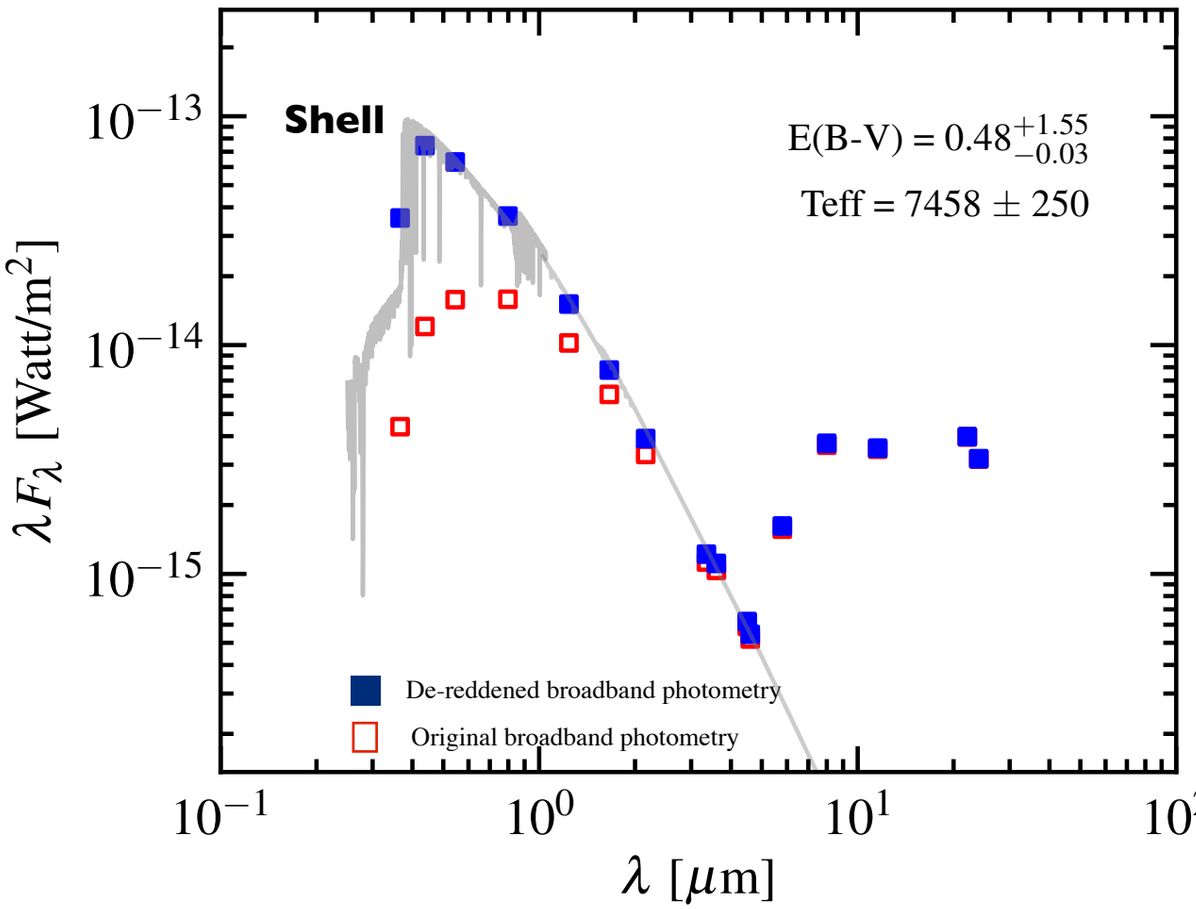
LMC

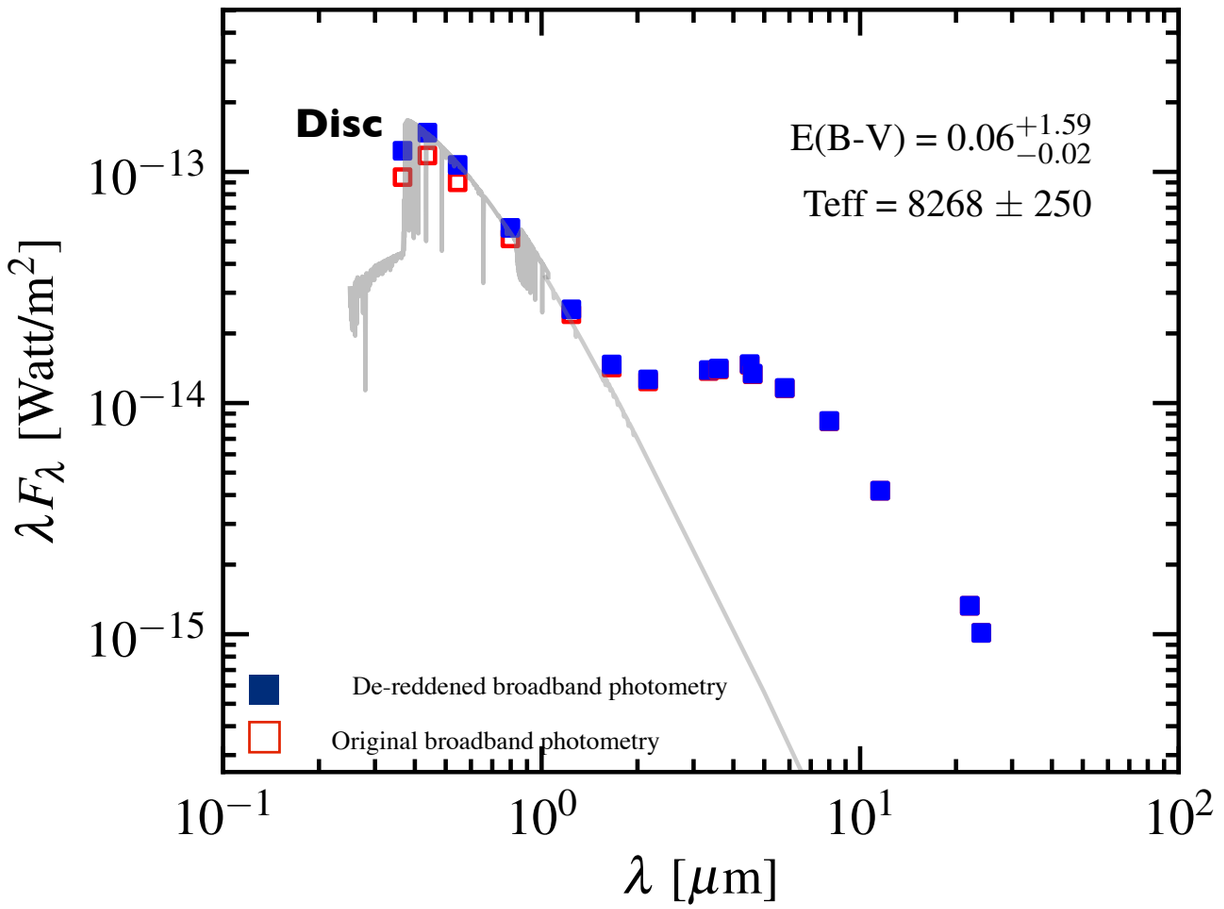
Post-AGB candidates ~ 350

YSO candidates ~ 70

Observational Biases: Optically Visible ones, A-K spectral types

SED Analysis
Luminosities & E(B-V)



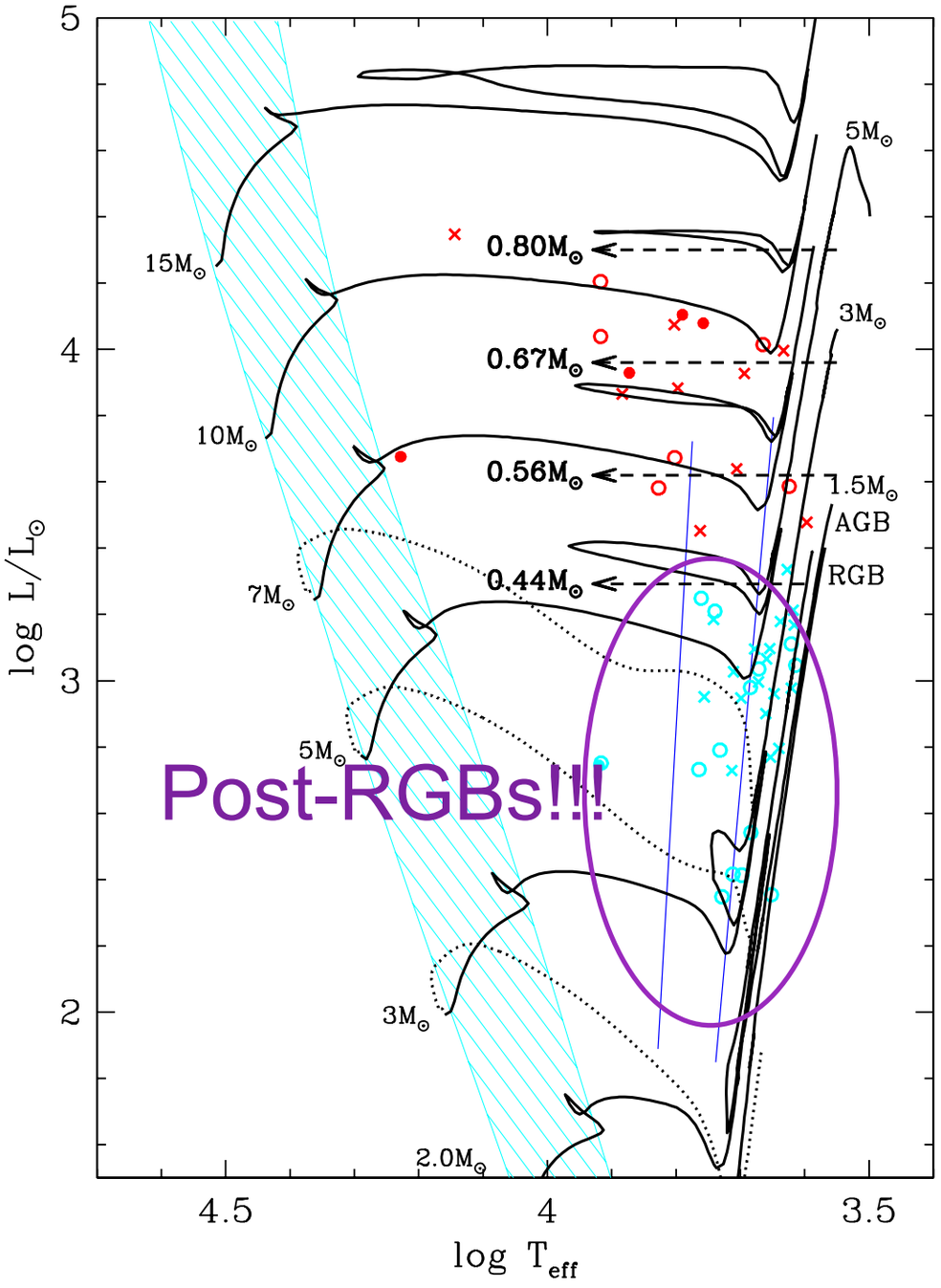


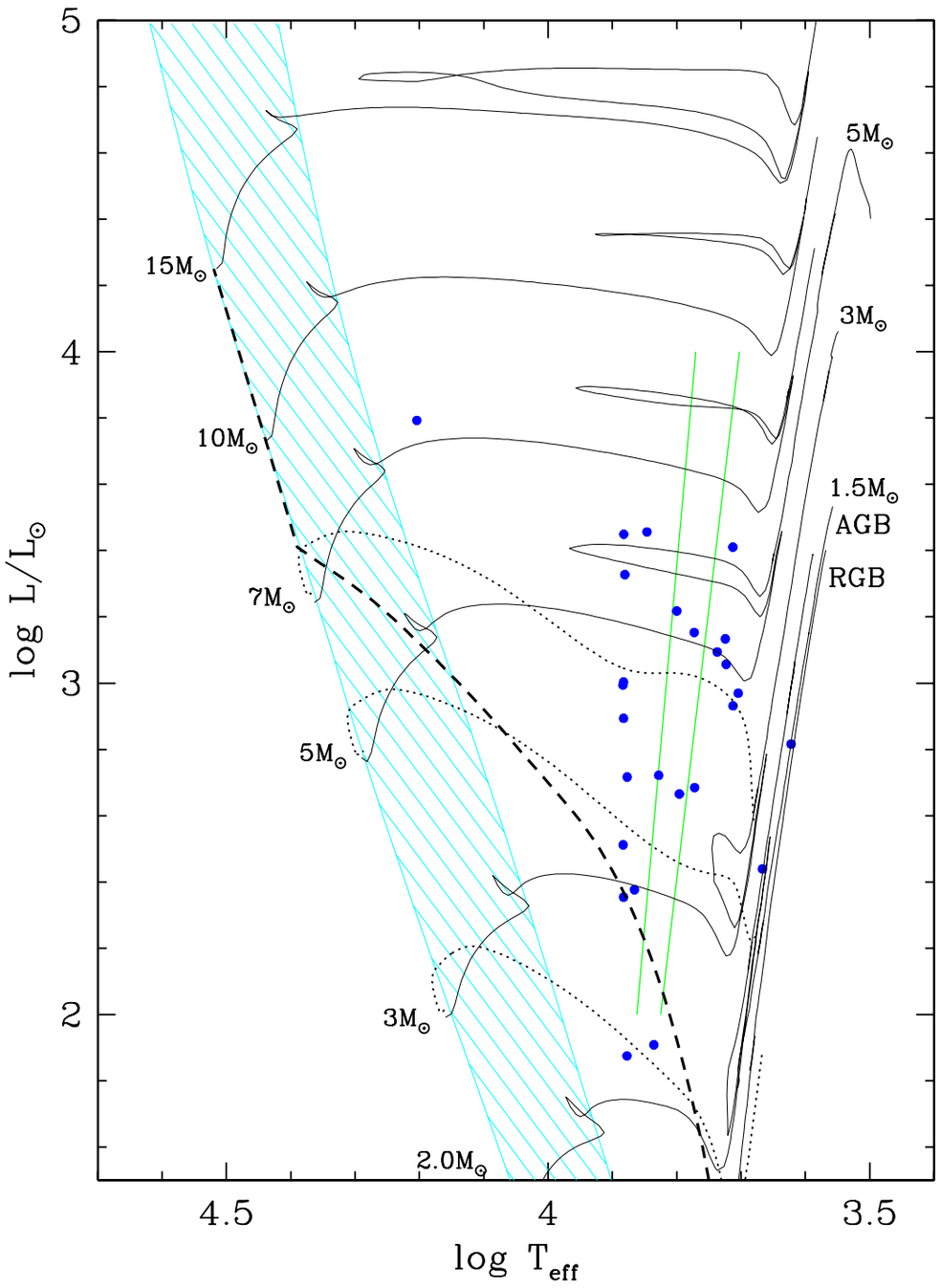
- Post-AGB candidates in the LMC/SMC show similar SED types as in the Galaxy

- The ‘Disc’ sources are likely to be wide binaries (similar to the Galactic ones) with circumbinary discs (P = 100 to 2000 days)

These wide binary post-AGB systems *probably evolve* into axi-symmetric PNe

SMC Post-AGB and YSO Candidates on the HR-Diagram





So it is very likely that a few?/a lot? of the Post-AGB stars (binaries) in the Galaxy are Post-RGBS!!!

Take Away...

1) Spectroscopically verified catalogues of LMC and SMC optically visible post-AGB/RGB stars

SMC - Kamath et al. 2013 MNRAS (Accepted)
LMC - Kamath et al. 2014 MNRAS (in prep)

3) Disc sources are (very) common in the post-AGB and post-RGB phase and they are likely connected to binary evolutionary channels which AVOID spiral-in!

These 100-2000d period objects should evolve into axi-symmetric PN

4) Post-RGBs in the Galaxy???

WATCH THIS SPACE!!!

1) Detailed chemical abundance studies of the LMC and SMC Post-AGB sources: *to constrain AGB nucleosynthesis (especially s-process nucleosynthesis) as a function of initial mass and metallicity*

2) **Long-term radial velocity monitoring of the LMC and SMC disc sources**