



# Survey of symbiotic stars from MC and the Galaxy

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## Symbiotic stars and other H $\alpha$ emission line stars towards the Galactic Bulge\*

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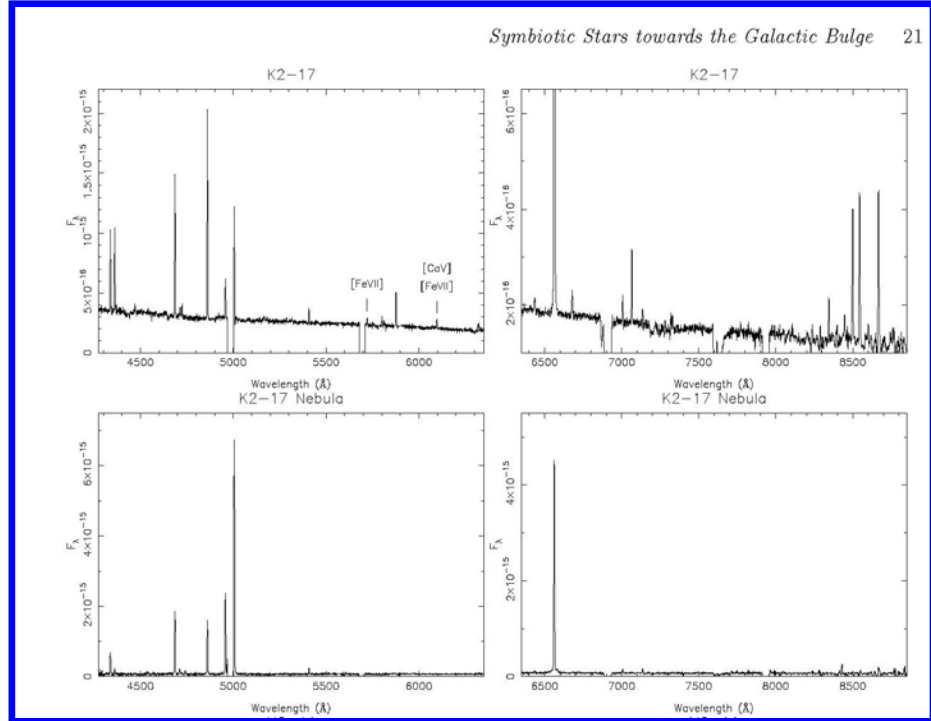
### ABSTRACT

Symbiotic stars are interacting binaries with the longest orbital periods and their multi-component structure makes them rich astrophysical laboratories. The accretion of a high mass loss rate red giant wind onto a white dwarf (WD) makes them promising type Ia supernovae (SNe Ia) progenitors. Systematic surveys for new Galactic symbiotic stars are critical to identify new promising SNe Ia progenitors (e.g. RS Oph) and to better estimate the total population size to compare against SNe Ia rates. Central to the latter objective is building a complete census of symbiotic stars towards the Galactic Bulge. Here we report on the results of a systematic survey of H $\alpha$  emission line stars covering 35 deg<sup>2</sup>. It is distinguished by the combination of deep optical spectroscopy and long-term lightcurves that improve the certainty of our classifications. A total of 20 bona-fide symbiotic stars are found (13 S-types, 6 D-types and 1 D'-type), 35% of which show the symbiotic specific Raman-scattered OVI emission bands, as well as 15 possible symbiotic stars that require further study (6 S-types and 9 D-types). Lightcurves show a diverse range of variability including stellar pulsations (semi-regular and Mira), orbital variations and slow changes due to dust. Orbital periods are determined for 5 S-types and Mira pulsation periods for 3 D-types. The most significant D-type found is H1-45 and its carbon Mira with a pulsation period of 408.6 days, corresponding to an estimated period-luminosity relation distance of  $\sim 6.2 \pm 1.4$  kpc and  $M_K = -8.06 \pm 0.12$  mag. If H1-45 belongs to the Galactic Bulge, then it would be the first bona-fide luminous carbon star to be identified in the Galactic Bulge population. The lack of luminous carbon stars in the Bulge is a longstanding unsolved problem. A possible explanation for H1-45 may be that the carbon enhancement was accreted from the progenitor of the WD companion. A wide variety of unusual emission line stars were also identified. These include central stars of PNe (one [WC10-11] Wolf-Rayet and 5 with high density cores), 2 novae, 2 WN6 Wolf-Rayet stars, 2 possible Be stars, a B[e] star with a bipolar outflow, an ultracompact HII region and a dMe flare star. Dust obscuration events were found in two central stars of PNe, increasing the known cases to 5, as well as one WN6 star. There is considerable scope to uncover several more symbiotic stars towards the Bulge, many of which are currently misclassified as PNe, provided that deep spectroscopy is combined with optical and near-infrared lightcurves.

**Key words:** surveys - binaries: symbiotic - planetary nebulae: general - Galaxy: bulge - stars: carbon - stars: emission-line, Be

\* Based on observations made with the Anglo-Australian Telescope at Siding Spring Observatory, the 1.3-m Warsaw Telescope at Las Campanas Observatory of the Carnegie Institution for Science, Chile, the Very Large Telescope at Paranal Observatory

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**K2-17: PN with high density core**

**2012-1-RSA-009; PI B. Miszalski**

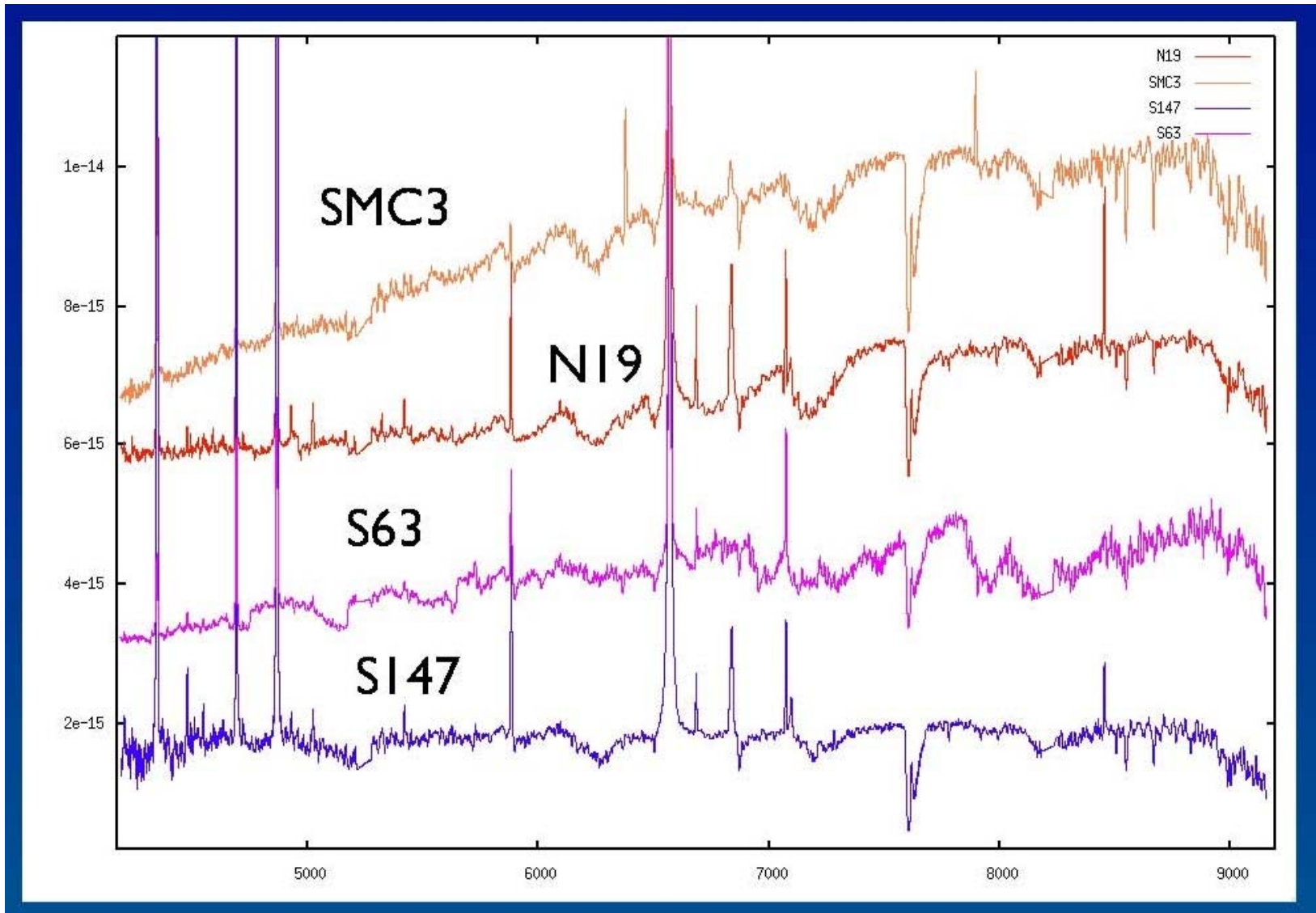
# **A deeper look at an enlarged sample LMC symbiotic stars**

**2012-2-RSA\_POL-001**

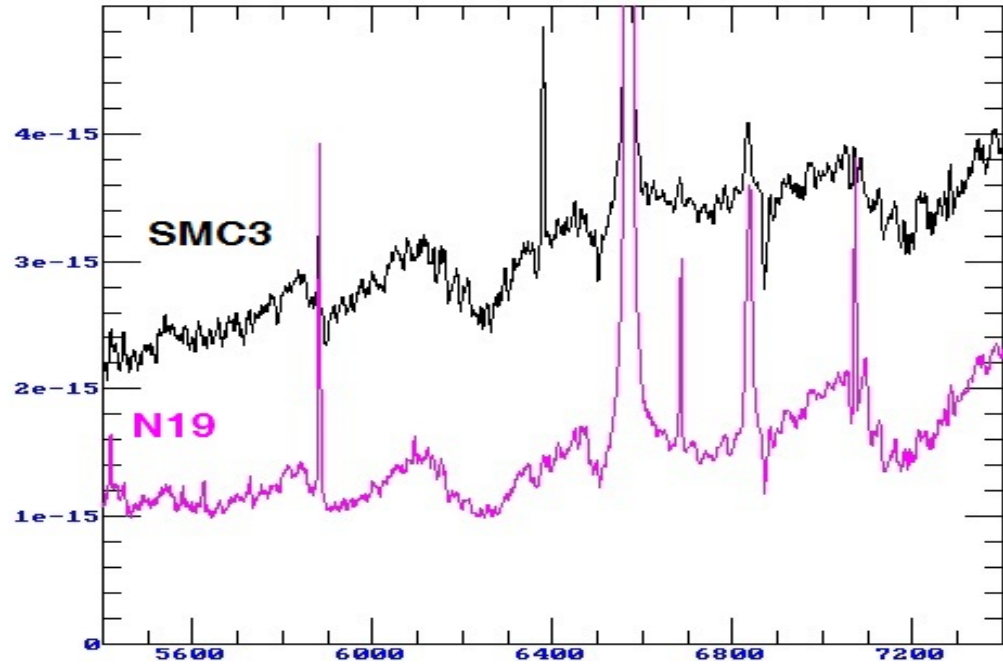
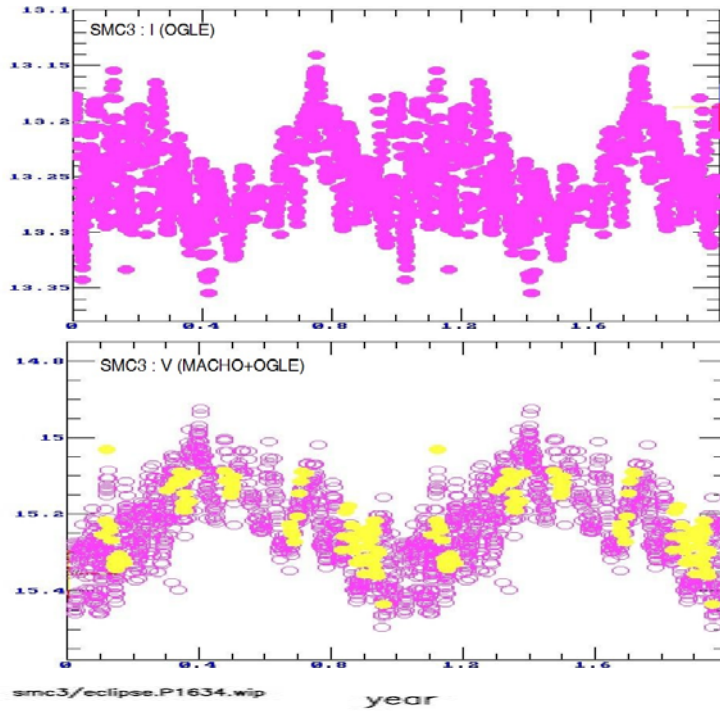
**PI: Miszalski, Co-I: Mikolajewska**

- Focused on symbiotic stars, candidate symbiotic stars and difficult to classify PNe**
- Status: the data have been reduced by BM, and analysis of the sample has started**
- At least four papers based on the observations in this successful program expected**

# Known symbiotic stars



# SMC 3 & N19



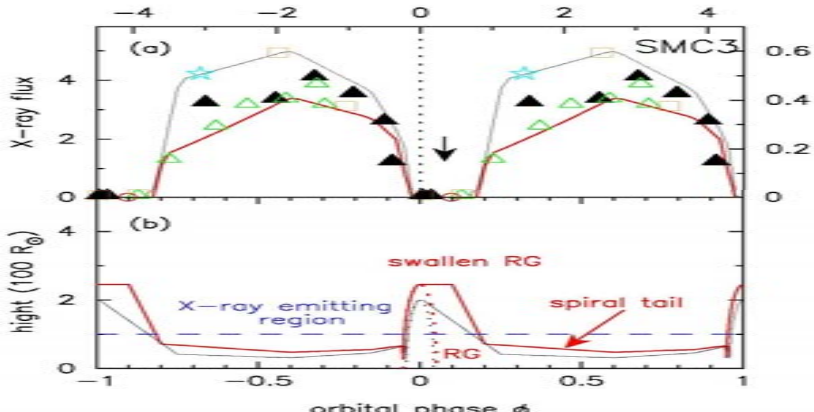
Known orbital periods:

N19: 946 d (Mikolajewska 2004)

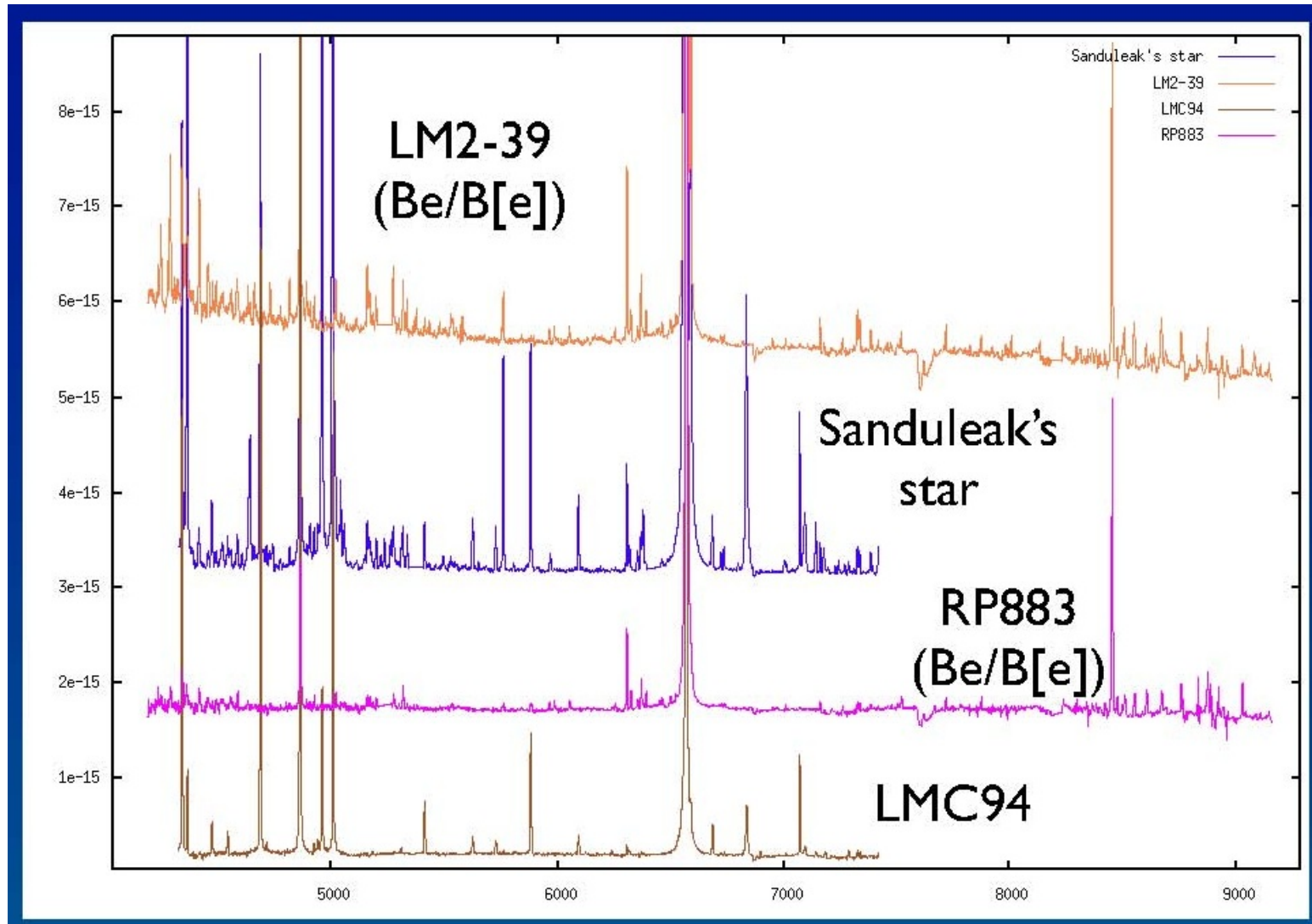
SMC3: 1643 d (e.g. Kato, Hachisu & Mikolajewska 2013)

Emission line fluxes vary with  $P_{orb}$

Evidence for s-process elements: ZrO, Ba...

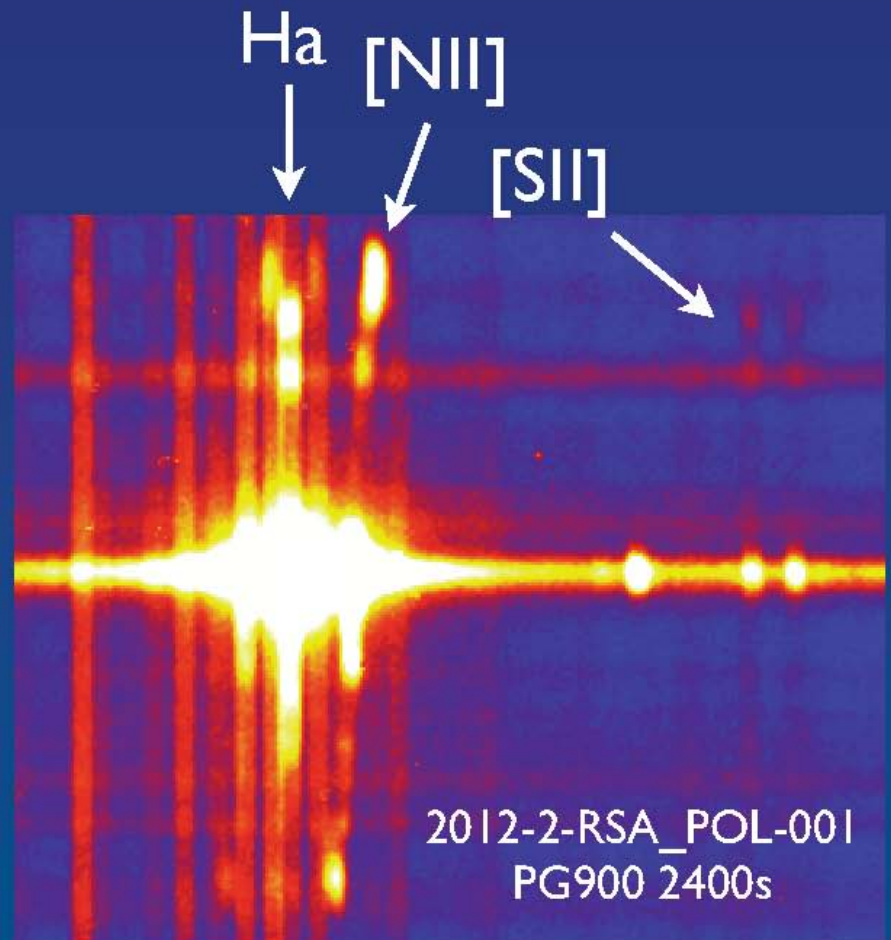
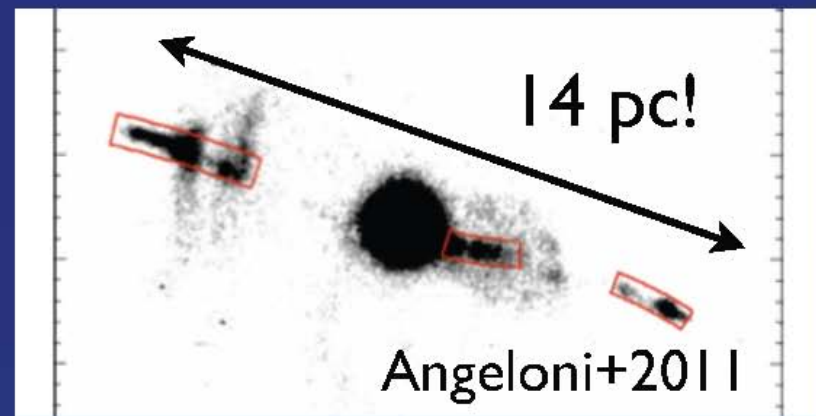


# Possible symbiotic stars

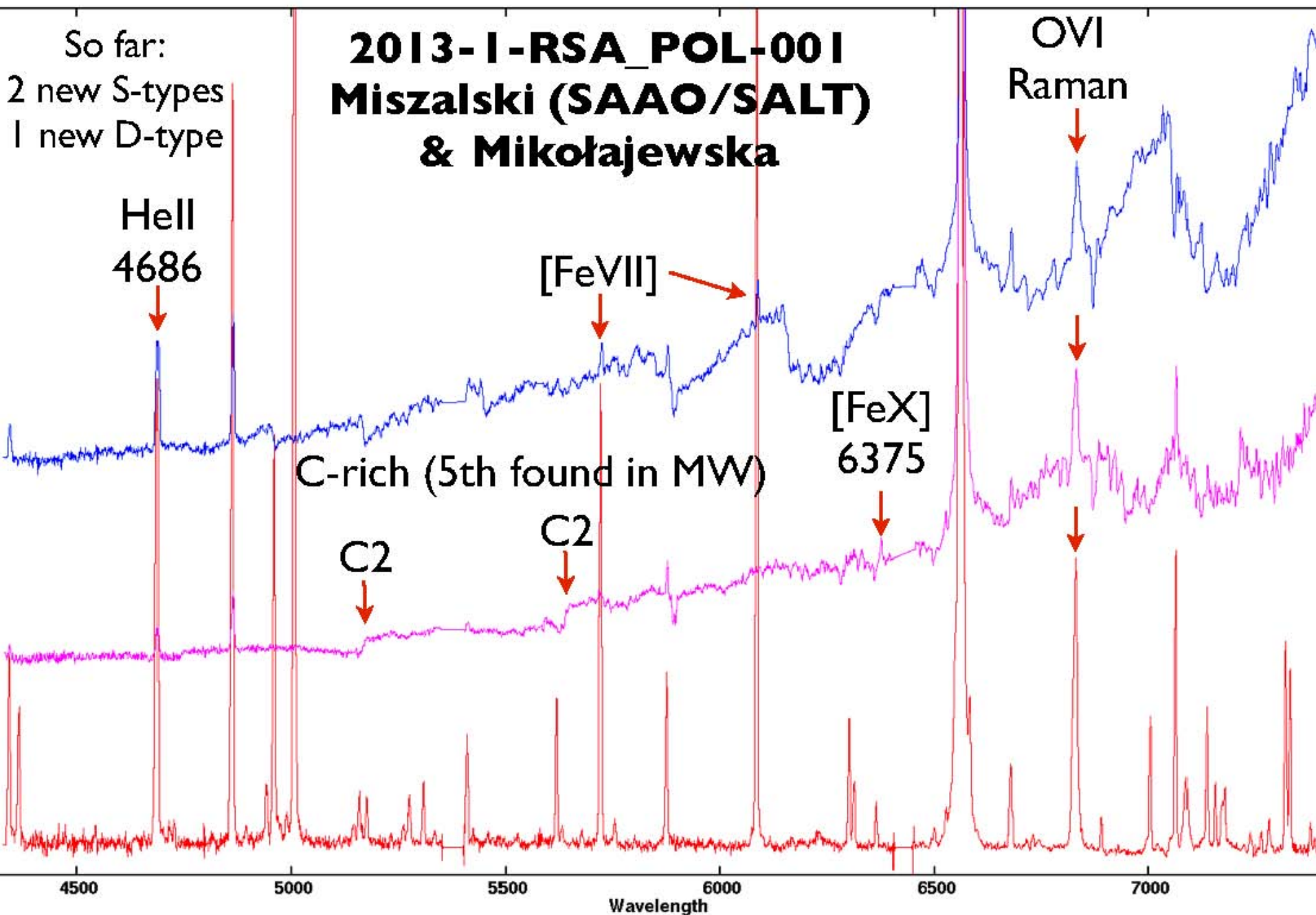


# Sanduleak's star

- LMC D-type symbiotic with huge jet (Angeloni+2011)
- 40 min PG900 RSS spectrum taken
- Deeper than 20 min 300 line grating Magellan 6.5 m spectrum
- New detection of [SII], [OIII], [NI] in jet
- Constrain jet properties



# A SALT survey for new Galactic symbiotic stars





# **A deeper look at SMC symbiotic stars**

**2013-1-POL\_RSA001  
Mikołajewska, Miszalski & Gałan**

**Waiting for rising SMC 😊**