Why Galaxies Care About AGB Stars:
A Continuing Challenge through Cosmic Time
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RAMSES II Raman Search for Extragalactic Symbiotic Stars

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Abstract. Symbiotic stars (SySts) are long-period interacting binaries composed of a hot compact star, an evolved giant star, and a tangled network of gas and dust nebulae. Presently, we know 252 SySts in the Milky Way and 62 in external galaxies. However, these numbers are still in striking contrast with the predicted population of SySts in our Galaxy. In this contribution, I present the concept and the early results from RAMSES II (Raman Search for Extragalactic Symbiotic Stars), a Gemini/GMOS Upgrade Project which makes use of the Raman OVI 6830Å band as a powerful photometric tool to identify new SySts, within and beyond the Galaxy.

Keywords. stars: AGB and post-AGB – binaries: symbiotic – techniques: photometric

1. Introduction

Symbiotic stars (hereafter SySts) are long-period interacting binaries composed of a hot compact star – generally a white dwarf (WD) – an evolved giant star, and a tangled network of gas and dust nebulae. SySts represent unique laboratories to study several important astrophysical phenomena and their reciprocal influence (Munari (2012)). Noteworthy, they are among the most promising candidates as progenitors of SNIa (e.g., Meng & Han 2016, Dimitriadis *et al.* 2014, Dilday *et al.* 2012).

Presently, we know 252 SySts in the Milky Way and 62 in external galaxies (Akras *et al.* 2018, submitted). However, the slowly growing number of known SySts is still in striking contrast with the predicted symbiotic population in our Galaxy that, according to different estimates, may oscillate between 10^3 (Allen 1984, Lü *et al.* 2012) and a few 10^5 (Magrini *et al.* (2003)). One of the reasons for this embarrassing discrepancy likely originates from the fact that, historically, the SySt group has been characterized on the basis of purely spectroscopic criteria (e.g., Belczyński *et al.* 2000).

Because of many other stellar sources that appear mimicking SySt colors (PNe, Be and T Tauri stars, CVs, Mira LPVs, etc. – see, e.g., Figs. 1 & 2 in Corradi *et al.* 2008), no photometric diagnostic tool has so far demonstrated the power to unambiguously identify a SySt, thus making the recourse to costly spectroscopic follow-up still inescapable.

The two intense Raman OVI bands at 6830Å and 7088Å, due to Raman scattering of the O VI $\lambda\lambda$1032, 1038 resonance doublet by neutral H (Schmid 1989), are nonetheless so unique to the symbiotic phenomenon that their presence has been used as a sufficient criterion for classifying a star as symbiotic, even in those cases where the cool companion appears to be hiding. Our team has thus submitted in 2016, and then been awarded, a

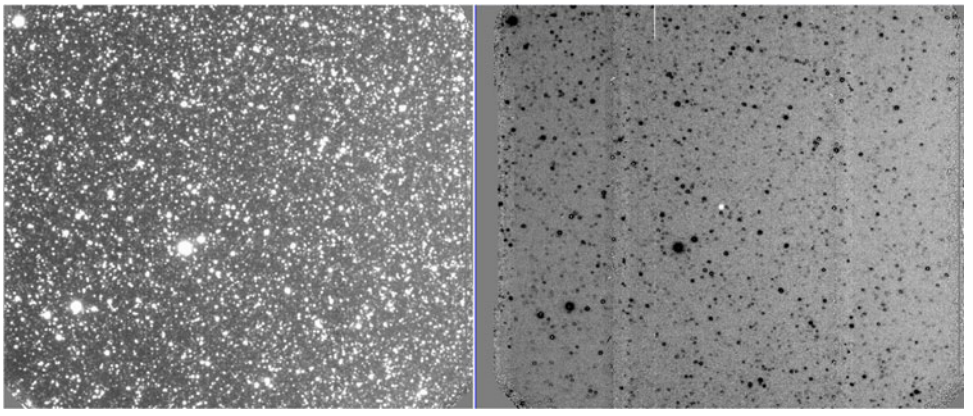

Figure 1. GMOS-South RAMSES II OVI (left) and OVI continuum-subtracted (right) images of Sanduleak's star, a Raman-emitter SySt in the Large Magellanic Cloud.

Gemini Instrument Upgrade Project with the aim of using Raman OVI emission as a new photometric diagnostic tool to systematically discover new SySts, within and beyond the Galaxy. Specifically, we have proposed to purchase two narrow-band filters for the GMOS at both Gemini telescopes: one filter centered on the Raman OVI 6830Å band, the other one centered in the adjacent continuum at 6780Å to be used as off-band filter.

2. Early results from the filter acceptance test at Gemini-South

After having gone through several tests at the optical labs of the Gemini Observatory at Cerro Pachón (Chile), the filters have been installed into GMOS-S at the beginning of 2018 for a series of day and on-sky Acceptance Tests (AT). In particular, a small sample of SySts with known Raman OVI bands have been observed in order to characterize the sensitivity of our method to Raman OVI emission of different intensities against different types of local continua. An example of GMOS-S/RAMSES II images of Sanduleak's star (Heo *et al.* 2016), a SySt in the Large Magellanic Cloud, is shown in Fig. 1. The Acceptance Tests will continue at Gemini North, and after a full characterization at both sites the full set of filters will be offered to the entire Gemini user community.

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