OVI 6830A Imaging Polarimetry of Symbiotic Stars

Stavros Akras[1],Denise R. Gonçalves[2]

[1]Observatorio Nacional/MCTIC, Rua Gen. Jose Cristino, 77, 20921-400, Rio de Janeiro, Brazil

[2]Observatorio do Valongo, Universidade Federal do Rio de Janeiro, Ladeira Pedro Antonio 43, 20080-090, Rio de Janeiro, Brazil

Abstact: 50-60% of the Galactic symbiotic stars exhibit the Raman scattered OVI lines. The detection of these lines provide strong indications of the presence of a symbiotic star. We present here the first results from our ongoing pilot project with the 1.6m telescope at the OPD, Brasil, aimed at the detection of the OVI λ6830 line via linear polarization. Our goal is to demonstrate that OVI imaging polarimetry can be a very efficient technique for discovering SySts/OVI emitters. The OVI line is detected at 3σ in 5 out of 9 known SySts, whereas three new candidates have been found.

Symbiotic Stars

Symbiotic stars (SySts) are interacting binary systems consisting of both a cold red giant star and a hot star, generally a white dwarf. The UV-ionizing field of the white dwarf excites part of the atmosphere or the stellar wind of the cold component resulting in the formation of a colorful nebula.

OVI Raman-scattered line 6830 & 7082

55% of known Galactic SySts have been found to exhibit broad features centered at 6830 A and 7082 A (Allen 1980, Akras et al. in prep). These features have been attributed to Raman scattering of the ultraviolet O VI λλ1032, 1038 resonance doublet lines by neutral hydrogen (Schmid 1989; Nussbaumer et al. 1989). One of the criteria to classify an object as SySts is the detection of these lines (Belczynski et al. 2000).

The mechanism of Raman scattering is well known to produce strong polarization up to 10-15% (e.g. Harries & Howarth 2000). Spectro-polarimetric observations have become a very important tool for determining the orbital parameters of these systems as well as the mass-loss rate of the cold giant, by studying the O VI line profiles (Harries & Howarth 1997).

OVI λ6830 imaging polarimetry

The 1.6m telescope at the OPD in Brasil was used to observe a number of SySts. The The narrow band filter centered at 6810 A withband with of 100 A IAG polarimeter was used together with a narrow band filter centered at 6810A with bandwidth of 100A in order to obtain polarimetric measurements of the OVI RS line. The broad-band filter R was used in order to determine the degree of continuum polarization.

For the reduction of the data the BEACON pipeline was used and the degree of polarization (DoP) as well as the position angle (PA) for several stars in each field were estimated and
(i) the interstellar polarization is also determined by calculating the average value of the DoP measurements of the field stars, (ii) objects with DoP > 3σ (outliers) are considered candidate SySts (or OVI emitter).

Fig. 1 .OVI λ6830 line image of RR Tel taken with the IAGPOL. The two stars in the red circle refer to the real and imaginary part.

Preliminary results

Name	OVI line	P_OVI	σP_OVI	θ_OVI	P_R	σP_R	θ_R	<P_OVI>	<σP_OVI>	<θ_OVI>	<P_R>	<σP_R>
2MASS16422739	YES	9.3196	3.007	59.06	4.793	0.062	39.34	1.913	0.009	34	1.712	0.007
AR PAV	YES	1.2944	0.0256	4.31	1.1612	0.0169	8.19	0.608	0.011	17	0.606	0.01
BI Cru	NO	1.0373	0.0246	84.74	1.0704	0.0563	87.06	1.325	0.013	85	1.262	0.022
CD-43 14304	YES	0.6454	0.0311	33.43	0.217	0.0113	172	0.53	0.019	145	0.275	0.009
HD 330036	NO	2.7894	0.06	25.03	2.656	0.0212	27.07	2.055	0.0164	28	2.008	0.01
Hen 2-106	YES	4.1865	0.2014	147.78	3.0223	0.0238	151.63	2.214	0.013	140	2.134	0.009
Hen 3-1213	NO	2.8162	0.0363	41.77	3.0345	0.1411	42.4	2.007	0.007	51	2.098	0.009
Hen 3-1761	NO	0.9955	0.019	5.7	1.0049	0.0119	7.53	0.965	0.013	20	0.977	0.009
RR Tel	YES	3.087	0.1335	105.58	0.5826	0.0173	172.98	0.419	0.026	108	0.448	0.018
V4018	NO	0.3467	0.0286	124	0.3975	0.0224	123	0.495	0.007	110	0.505	0.008
StHa 164	YES	2.4721	0.1332	6.2	2.5767	0.1709	7.5	2.581	0.012	26	2.658	0.018
V 4074	YES	1.1529	0.0741	124.22	1.0524	0.3254	131.02	1.177	0.016	126	1.254	0.008
PN K 3-12	YES	0.9446	0.1659	30.72	0.7525	0.1269	48.18	0.921	0.0147	69	0.933	0.01
Hen 3-1341	YES	1.8868	0.0524	54.65	1.7519	0.1355	55.38	2.005	0.012	58	2.043	0.006

Positive 3s detection of OVI line: black color - Negative detection of OVI line : red color

- 23 known or candidates SySts have been observed so far
- + 2 post-AGB stars in which the OVI line has been detected
- Raman line has been spectroscopically confirmed in 9 SySts.
- 5 out of 9 SySts show a positive detection of OVI line as 3s (56% success)
- There is zero false positive-detection (100% success)
- 3 OVI emitter candidates have been found with sufficient S/N ratio in a total observed area of 25 arcmin^2

✔ 75% of the negative detections is probable associated with the intensity of the Raman line itself.
✔ From the 4 negative cases, only Hen 3-1341 has a number of counts similar to the objects with positive detection
✓ Large telescope may do not have this problem
✓ Deeper observations are required but imaging polarimetry seems to be efficient technique for discovering new SySts / OVI emitters.

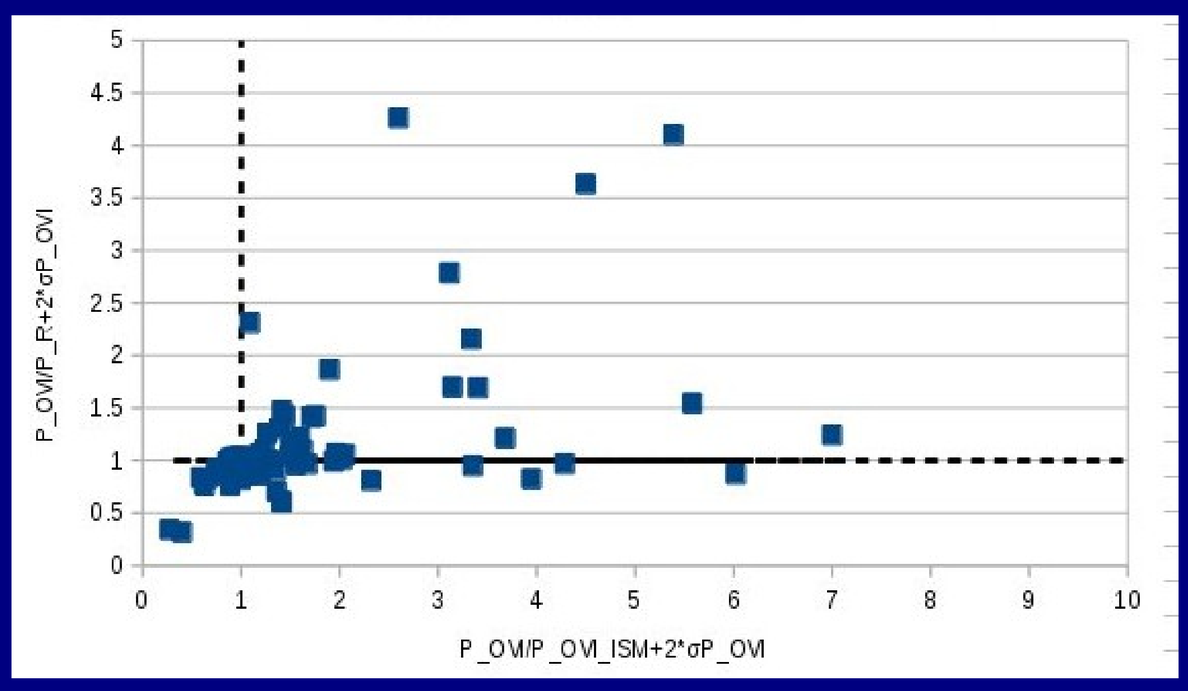

Fig. 2. The P_OVI/P_OVI_ISM+2σP_OVI vs. P_OVI/P_R+2σP_OVI. Positive detection of OVI line for th known SySts or new candidates are defined with both parameters > 1.

References

Allen D. A., 1980, MNRAS, 190, 75, Belczynski, K., et al., 2000, A&AS, 146, 407; Schmid H. M., 1989, A&A, 211, 31, Nussbaumer H., Schmid H. M., Vogel M., 1989, A&A, 211, 27, Harries & Howarth 1997, A&AS, 121, 15, Harries T. J. & Howarth I. D., 2000, A&A, 361, 139H.