Revealing the Asymmetry of the Wind of the Variable Wolf-Rayet Star WR1 (HD4004) Through Spectropolarization

Nicole St-Louis

UniversitÃ© de MontrÃ©al

In this paper, high quality spectropolarimetric observations of the Wolf-Rayet (WR) star WR1 (HD 4004) obtained with ESPaDOnS at the Canada-France-Hawaii Telescope are presented. All major emission lines present in the spectrum show depolarization in the relative Stokes parameters Q/I and U/I. From the behavior of the amount of line depolarization as a function of line strength, the intrinsic continuum light polarization of WR1 is estimated to be P/I = 0.443% Â± 0.028% with an angle of Î¸ = â€“26.2 deg. Although such a level of polarization could in principle be caused by a wind flattened by fast rotation, the scenario in which it is a consequence of the presence of corotating interaction regions (CIRs) in the wind is preferred. This is supported by previous photometric and spectroscopic observations showing periodic variations with a period of 16.9 days. This is now the third WR star thought to exhibit CIRs in its wind that is found to have line depolarization. Previous authors have found a strong correlation between line depolarization and the presence of an ejected nebula, which they interpret as a sign that the star has relatively recently reached the WR phase since the nebula are thought to dissipate very fast. In cases where the presence of CIRs in the wind is favored to explain the depolarization across spectral lines, the above-mentioned correlation may indicate that those massive stars have only very recently transited from the previous evolutionary phase to the WR phase.

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Email: stlouis@astro.umontreal.ca