Revisiting the Rigidly Rotating Magnetosphere model for $sigma$ Ori E. I. Observations and Data Analysis

M.E. Oksala^{1,2}, G.A. Wade^2, R.H.D. Townsend^{3}, S.P. Owocki^{1}, O. Kochukhov^{4}, C. Neiner^{5}, E. Alecian^{5}, J. Grunhut^{2,6}, and the MiMeS Collaboration

1 - Bartol Research Institute, University of Delaware, USA;
2 - Royal Military College of Canada;
3 - University of Wisconsin-Madison, USA;
4 - Uppsala University, Sweden;
5 - LESIA, France;
6 - Queen's University, Canada

We have obtained 18 new high-resolution spectropolarimetric observations of the B2Vp star $sigma$ Ori E with both the Narval and ESPaDOnS spectropolarimeters. The aim of these observations is to test, with modern data, the assumptions of the Rigidly Rotating Magnetosphere (RRM) model of Townsend & Owocki (2005), applied to the specific case of $sigma$ Ori E by Townsend et al. (2005). This model includes a substantially offset dipole magnetic field configuration, and approximately reproduces previous observational variations in longitudinal field strength, photometric brightness, and H$alpha$ emission. We analyze new spectroscopy, including H~{sc i}, He~{sc i}, C~{sc ii}, Si~{sc iii} and Fe~{sc iii} lines, confirming the diversity of variability in photospheric lines, as well as the double S-wave variation of circumstellar hydrogen. Using the multiline analysis method of Least-Squares Deconvolution (LSD), new, more precise longitudinal magnetic field measurements reveal a substantial variance between the shapes of the observed and RRM model time-varying field. The phase resolved Stokes~V profiles of He{sc i} 5876 AA~and 6678 AA~lines are fit poorly by synthetic profiles computed from the magnetic topology assumed by Townsend et al. (2005). These results challenge the offset dipole field configuration assumed in the application of the RRM model to $sigma$ Ori E, and indicate that future models of its magnetic field should also include complex, higher-order components.

Reference: MNRAS
Status: Manuscript has been accepted

Weblink: http://arxiv.org/abs/1109.0328

Comments:

Email: meo@udel.edu