Confirmation of the magnetic oblique rotator model for the Of?p star HD 191612

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This paper reports high-precision Stokes V spectra of HD 191612 acquired using the ESPaDOnS spectropolarimeter at the Canada-France-Hawaii Telescope, in the context of the Magnetism in Massive stars (MiMeS) Project. Using measurements of the equivalent width of the HÎ± line and radial velocities of various metallic lines, we have updated both the spectroscopic and orbital ephemerides of this star. We confirm the presence of a strong magnetic field in the photosphere of HD 191612, and detect its variability. We establish that the longitudinal field varies in a manner consistent with the spectroscopic period of 537.6 d, in an approximately sinusoidal fashion. The phases of minimum and maximum longitudinal field are respectively coincident with the phases of maximum and minimum HÎ± equivalent width and Hp magnitude. This demonstrates a firm connection between the magnetic field and the processes responsible for the line and continuum variability. Interpreting the variation of the longitudinal magnetic field within the context of the dipole oblique rotator model, and adopting an inclination i = 30â—¦ obtained assuming alignment of the orbital and rotational angular momenta, we obtain a best-fit surface magnetic field model with obliquity Î² = 67 Â± 5â—¦ and polar strength Bd = 2450 Â± 400 G . The inferred magnetic field strength implies an equatorial wind magnetic confinement parameter Î·âˆ— â‰ƒ 50, supporting a picture in which the HÎ± emission and photometric variability have their origin in an oblique, rigidly rotating magnetospheric structure resulting from a magnetically channeled wind. This interpretation is supported by our successful Monte Carlo radiative transfer modeling of the photometric variation, which assumes the enhanced plasma densities in the magnetic equatorial plane above the star implied by such a picture, according to a geometry that is consistent with that derived from the magnetic field. Predictions of the continuum linear polarisation resulting from Thompson scattering from the magnetospheric material indicate that the Stokes Q and U variations are highly sensitive to the magnetospheric geometry, and that expected amplitudes are in the range of current instrumentation.

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