Multi-periodic photospheric pulsations and connected wind structures in HD64760

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We report on the results of an extended optical spectroscopic monitoring campaign on the early-type B supergiant HD64760 (B0.5Ib) designed to probe the deep-seated origin of spatial wind structure in massive stars. This new study is based on high-resolution echelle spectra obtained with the FEROS instrument at ESO La Silla. 279 spectra were collected over 10 nights between February 14 and 24, 2003. From the period analysis of the line-profile variability of the photospheric lines we identify three closely spaced periods around 4.810hrs and a splitting of +/-3%. The velocity - phase diagrams of the line-profile variations for the distinct periods reveal characteristic prograde non-radial pulsation patterns of high order corresponding to pulsation modes with l and m in the range 6-10. A detailed modeling of the multi-periodic non-radial pulsations with the BRUCE and KYLIE pulsation-model codes favors either three modes with l=-m and l=8,6,8 or m=-6 and l=8,6,10 with the second case maintaining the closely spaced periods in the co-rotating frame. The pulsation models predict photometric variations of 0.012-0.020mag consistent with the non-detection of any of the spectroscopic periods by photometry. The three pulsation modes have periods clearly shorter than the characteristic pulsation time scale and show small horizontal velocity fields and hence are identified as p-modes. The beating of the three pulsation modes leads to a retrograde beat pattern with two regions of constructive interference diametrically opposite on the stellar surface and a beat period of 162.8hrs (6.8days). This beat pattern is directly observed in the spectroscopic time series of the photospheric lines. The wind-sensitive lines display features of enhanced emission, which appear to follow the maxima of the photospheric beat pattern. The pulsation models predict for the two regions normalized flux amplitudes of A=+0.33,-0.28, sufficiently large to raise spiral co-rotating interaction regions. We further investigate the observed Halpha wind-profile variations with a simple rotating wind model with wind-density modulations to simulate the effect of possible streak lines originating from the localized surface spots created by the NRP beat pattern. It is found that such a simple scenario can explain the time scales and some but not all characteristics of the observed Halpha line-profile variations.

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