Lower mass loss rates in O-type stars: Spectral signatures of dense clumps in the wind of two Galactic O4 stars

J.-C. Bouret (1), T. Lanz (2), D. J. Hillier (3)

(1) Laboratoire d'Astrophysique de Marseille
(2) University of Maryland
(3) University of Pittsburgh

We have analyzed the far-UV spectrum of two Galactic O4 stars, the O4If+ supergiant HD190429A and the O4V((f)) dwarf HD96715, using archival FUSE and IUE data. We have conducted a quantitative analysis based on the two NLTE model atmosphere and wind codes, TLUSTY and CMFGEN. We have derived the stellar and wind parameters and the surface composition of the two stars. The surface of HD190429A has a composition typical of an evolved O supergiant (N-rich, C and O-poor), while HD96715 exhibits surface N enhancement similar to the enrichment found in SMC O dwarfs and attributed to rotationally-induced mixing. We find that homogeneous wind models could not match the observed profile of O V1371 and require very low phosphorus abundance to fit the PV1118-1128 resonance lines. However, we are able to match the O V and P V lines using clumped wind models. We find that N IV1718 is also sensitive to wind clumping. For both stars, we have calculated clumped wind models that match well all these lines from different species and that remain consistent with Halpha data. These fits therefore provide a coherent and thus much stronger evidence of wind clumping in O stars than earlier claims. We find that the wind of these two stars is highly clumped, as expressed by very small volume filling factors, namely f=0.04 for HD190429A and f=0.02 for HD96715. In agreement with our analysis of SMC stars, clumping starts deep in the wind, just above the sonic point. The most crucial consequence of our analysis is that the mass loss rates of O stars need to be revised downward significantly, by a factor of 3 and more. Accounting for wind clumping is essential when determining the wind properties of O stars. Our study therefore calls for a fundamental revision in our understanding of mass loss and of O-type star winds. (abridged)

Reference: Astron. Astrophys. (in press)
Status: Manuscript has been accepted

Weblink: http://xxx.lanl.gov/abs/astro-ph/0412346

Comments:

Email: tlanz@umd.edu