Observational effects of magnetism in O stars: surface nitrogen abundances

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We investigate the surface nitrogen content of the six magnetic O stars known to date as well as of the early B-type star tau Sco. We compare these abundances to predictions of evolutionary models to isolate the effects of magnetic field on the transport of elements in stellar interiors. We conduct a quantitative spectroscopic analysis of the sample stars with state-of-the-art atmosphere models. We rely on high signal-to-noise ratio, high resolution optical spectra obtained with ESPADONS at CFHT and NARVAL at TBL. Atmosphere models and synthetic spectra are computed with the code CMFGEN. Values of N/H together with their uncertainties are determined and compared to predictions of evolutionary models. We find that the magnetic stars can be divided into two groups: one with stars displaying no N enrichment (one object); and one with stars most likely showing extra N enrichment (5 objects). For one star (Theta1 Ori C) no robust conclusion can be drawn due to its young age. The star with no N enrichment is the one with the weakest magnetic field, possibly of dynamo origin. It might be a star having experienced strong magnetic braking under the condition of solid body rotation, but its rotational velocity is still relatively large. The five stars with high N content were probably slow rotators on the zero age main sequence, but they have surface N/H typical of normal O stars, indicating that the presence of a (probably fossil) magnetic field leads to extra enrichment. These stars may have a strong differential rotation inducing shear mixing. Our results should be viewed as a basis on which new theoretical simulations can rely to better understand the effect of magnetism on the evolution of massive stars.

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