Early magnetic B-type stars: X-ray emission and wind properties

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We present a comprehensive study of X-ray emission and wind properties of massive magnetic early B-type stars. Dedicated XMM-Newton observations were obtained for three stars xi1 CMa, V2052 Oph, and zeta Cas. We report the first detection of X-ray emission from V2052 Oph and zeta Cas. The observations show that the X-ray spectra of our program stars are quite soft. We compile the complete sample of early B-type stars with detected magnetic fields to date and existing X-ray measurements, in order to study whether the X-ray emission can be used as a general proxy for stellar magnetism. We find that hard and strong X-ray emission does not necessarily correlate with the presence of a magnetic field. We analyze the UV spectra of five non-supergiant B stars with magnetic fields by means of non-LTE iron-blanketed model atmospheres. The latter are calculated with the PoWR code, which treats the photosphere as well as the the wind, and also accounts for X-rays. Our models accurately fit the stellar photospheric spectra in the optical and the UV. The parameters of X-ray emission, temperature and flux are included in the model in accordance with observations. We confirm the earlier findings that the filling factors of X-ray emitting material are very high. Our analysis reveals that the magnetic early type B stars studied here have weak winds. The mass-loss rates are significantly lower than predicted by hydrodynamically consistent models. We find that, although the X-rays strongly affect the ionization structure of the wind, this effect is not sufficient in reducing the total radiative acceleration. When the X-rays are accounted for at the intensity and temperatures observed, there is still sufficient radiative acceleration to drive stronger mass-loss than we empirically infer from the UV spectral lines. (abridged)

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