B fields in OB stars (BOB) on the detection of weak magnetic fields in the two early B-type stars beta CMa and epsilon CMa Possible lack of a "magnetic desert" in massive stars

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Abstract

Only a small fraction of massive stars seem to host a measurable structured magnetic field, whose origin is still unknown and whose implications for stellar evolution still need to be assessed. Within the context of the “B fields in OB stars (BOB)” collaboration, we used the HARPSpol spectropolarimeter to observe the early B-type stars βCMa (HD 44743; B1 II/III) and e CMa (HD 52089; B1.5II) in December 2013 and April 2014. For both stars, we consistently detected the signature of a weak (<30 G in absolute value) longitudinal magnetic field, approximately constant with time. We determined the physical parameters of both stars and characterise their X-ray spectrum. For the βCep star βCMa, our mode identification analysis led to determining a rotation period of 13.6±1.2 days and of an inclination angle of the rotation axis of 57.6 ± 1.7■, with respect to the line of sight. On the basis of these measurements and assuming a dipolar field geometry, we derived a best fitting obliquity of about 22■ and a dipolar magnetic field strength (Bd) of about 100 G (60 < Bd < 230 G within the 1σ level), below what is typically found for other magnetic massive stars. This conclusion is strengthened further by considerations of the star’s X ray spectrum. For e CMa we could only determine a lower limit on the dipolar magnetic field strength of 13 G. For this star, we determine that the rotation period ranges between 1.3 and 24 days. Our results imply that both stars are expected to have a dynamical magnetosphere, so the magnetic field is not able to support a circumstellar disk. We also conclude that both stars are most likely core hydrogen burning and that they have spent more than 2/3 of their main sequence lifetime. A histogram of the distribution of the dipolar magnetic field strength for the magnetic massive stars known to date does not show the magnetic field “desert” observed instead for intermediate-mass stars. The biases involved in the detection of (weak) magnetic fields in massive stars with the currently available instrumentation and techniques imply that weak fields might be more common than currently observed. Our results show that, if present, even relatively weak magnetic fields are detectable in massive stars and that more observational effort is probably still needed to properly access the magnetic field incidence..

Keywords

Stars: atmospheres, Stars: evolution, Stars: magnetic field, Stars: individual: e CMa, Stars: individual: β CMa, Stars: massive.