Magnetic field measurements in white dwarfs. Magnetic field, rotation and spectrum of 40 Eri B

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Abstract. This paper describes results of magnetic field measurements of white dwarfs carried out on the 6 m telescope over the last few years. A magnetic field of about $B^e \approx 28$ kG has been discovered in the degenerate star WD 1953-011 (which has been selected from high-resolution spectroscopy of non-LTE $H\alpha$ core by Koester et al. (1998)). A rotational period of 1.83 hours has been discovered in WD 00094-501, the average magnetic field of the star is $< B^e >= -42.3 \pm 5.4$ kG and the semi-amplitude of its rotational variability is 32.0 ± 6.8 kG. The variable magnetic field of the bright normal (non-magnetic) degenerate star 40 Eridani B was confirmed in January 1999 by Zeeman time-resolved spectroscopy. Both the $H\alpha$ and the $H\beta$ lines give about the same results, we have selected two best periods in the magnetic field variability, 2^h25^m and $5^h\,17^m$. The semi-amplitude of the rotational variations is $B^{max} \approx 4000 \div 5000$ G and the average field is about zero ± 500 G. If the magnetic field of 40 Eridani B is a central dipole, then the rotational axis inclination to the line of sight is $i \sim 90°$, and the magnetic axis inclination to the rotational axis is about the same, $\beta \sim 90°$. For the first time an ultra-high signal-to-noise spectrum of the white dwarf has been obtained (S/N > 1000). We have found in this hydrogen-rich DA white dwarf 40 Eridani B (16500 K) that the helium abundance is low ($N(He)/N(H) < 10^{-7}$), but the spectrum is rich in ultra-weak absorption lines of metals in low ionization states. It was proposed that these lines were produced in both circumstellar and interstellar gas. The gas may be supplied by accretion from the interstellar medium and from the dM4e companion 40 Eridani C at an accretion rate $\dot{M}_a \sim 10^{-19} M_\odot$/y. The accreting gas may form a circumstellar rotating envelope in the magnetosphere at a distance of $\sim 4 \cdot 10^{11}$ cm.