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Magnetism of Stars

Bychkov V. D.[1], **Bychkova L. V.**[1], **Madej J.**[2]

[1] Special Astrophysical Observatory, Nizhny Arkhyz, Russia
[2] Warsaw University Observatory, Poland

Abstract. We present a brief review of magnetic fields of stars obtained as a result of direct measurements. We describe fundamental concepts on stellar magnetic fields based on the observational data.

1 Observational Data

We have collected magnetic data for 1579 stars on the main sequence and giants for which 19133 magnetic field estimates are obtained. 686 stars among them are CP stars. Many stars were measured only with a review objective and hence have few estimates.
Figure 1 displays the number of measurements of stellar magnetic fields. The number of stars in a single bin versus the number of individual B_e determinations for a single star. The width of bins is equal to 5. The leftmost bin (1 – 5 B_e measurements for a star) includes 1278 stars and has been cut to fit the above figure. Five very famous CP stars (β CrB, α^2 CVn, γ Equ, 52 Her, BX Boo) have more than 200 measurements and are not represented in the figure.
Figure 2 shows the quantity of the measured stars based on the spectral type. The number of measured stars of late type has essentially increased.
Figure 3 shows the number of individual measurements of stars by years. We see a constant growth of the number of measurements. The data can be inexact, since not all the measurements are published.
Figure 4 shows the distribution of stars on m_v. The magnetic fields are measured for more distant and faint objects. The measurements were mainly performed with the FORS1 (VLT), ESPaDOnS (CFHT), NARVAL (TBL) — Hubrig et al. (2006); Bagnulo et al. (2006), Morin et al. (2008, 2010), Donati et al. (2008).

2 Magnetic Fields of Stars

The main progress of observations is a large increase of measurement accuracy. It has allowed to find magnetic fields of many types of stars. Now the following is known: a number of OB stars have global fields with a simple structure up to several hundred Gauss, and normal chemical composition. The MiMeS survey operates for studying these objects. Chemically peculiar stars have global magnetic fields with a simple structure of up to 30 kG. The magnetic field and chemical composition of CP stars are mutually dependent (Bychkov et al., 2003, 2009). Young A_e/B_e stars also have fields up to several hundred Gauss. A low mass protostar FU Ori has a strong magnetic field (Donati et al., 2005). The cold stars of low mass possess local fields on the surfaces: G dwarfs — 1500 G, K dwarfs — 2500 G, M dwarfs — 3500 G.

Sun-like stars have global variable magnetic fields up to several and in some cases tens of Gauss. The M dwarfs have global variable magnetic fields up to several kGs (Morin et al., 2008; Donati et al., 2008). The origin of magnetic fields of hot massive stars is explained by the fossil field theory,

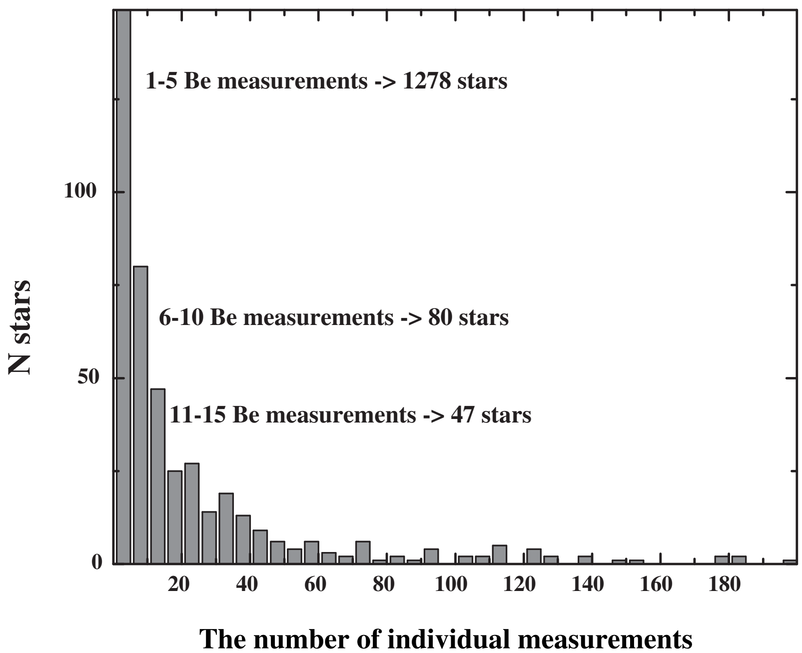

Figure 1: The number of stars in a single bin versus the number of individual B_e determinations for a single star. The width of bins is equal to 5.

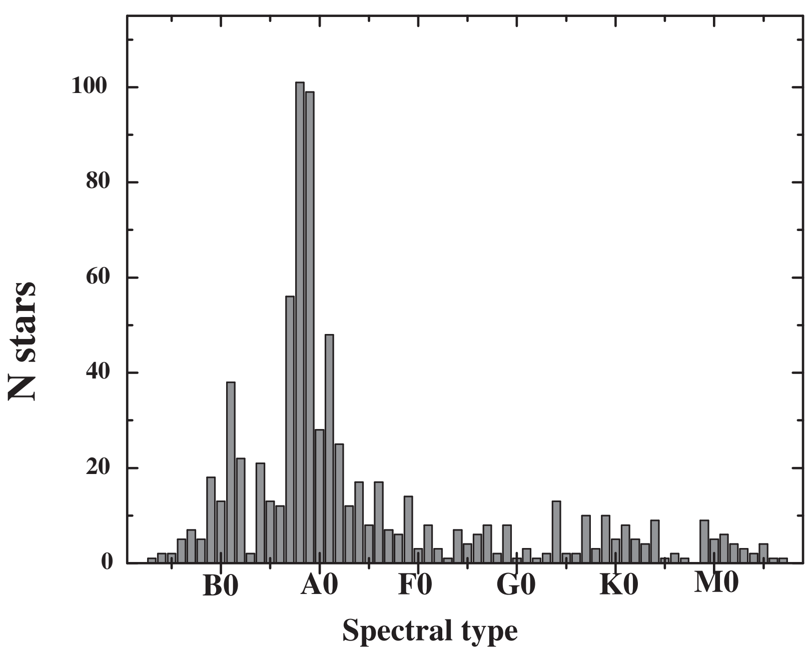

Figure 2:

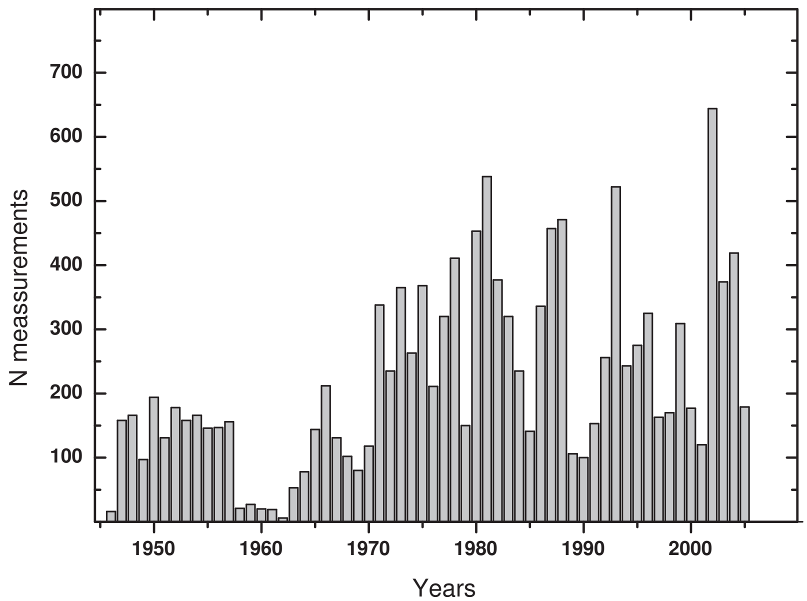

Figure 3:

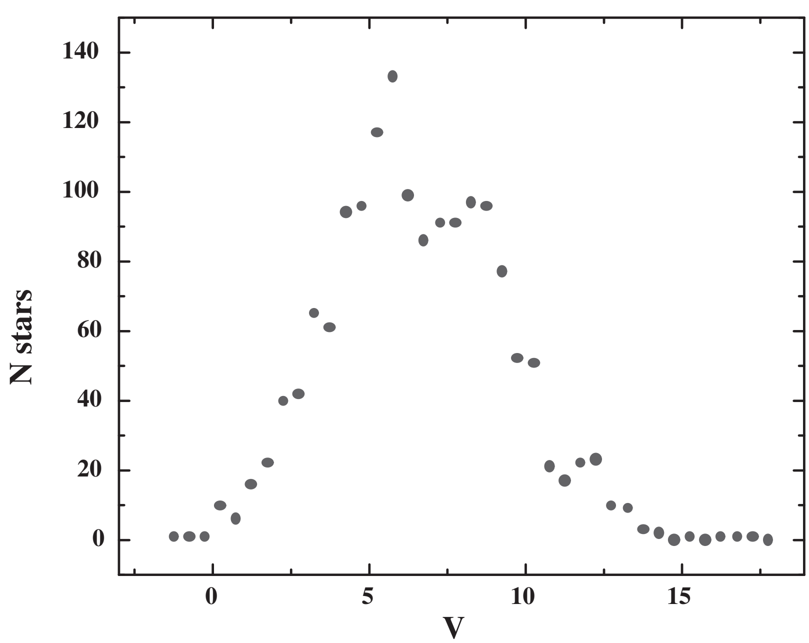

Figure 4:

whereas for cold low mass stars there exist various versions of a dynamo mechanism (Mestel & Moss, 2010). A lot of explanations can be found in the review by Donati & Landsreet (2009).

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