The brightness variability of active stars on different timescales by robotic observations

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1. Introduction

The late-type star VY Ari is included in the activity cycles search program at the Catania Observatory (webusers.ct.astro.it/sme/apt/target-list.html). The continuous observations best pursued by a robotic telescope, i.e. almost daily and for several years, allowed us to detect different time scales of variability and disentangle different causes of variability.

1.1 Causes and time scales of variability

1.1 Stellar rotation: it modulates the visibility of spotted regions and, consequently, the stellar light flux, spotted regions being cooler than surrounding photosphere (Fig. 1, left panel). Numerous observations collected within a relatively short interval of time, such that the spot pattern remains stable, allow a periodogram analysis to successfully detect with a high confidence level the period of modulation (Fig. 1, right panel).

1.2 Active region growth and decay (ARGD): the season-to-season monitoring allows us to investigate the evolution and lifetime of spot activity centers (Fig. 2, left panel). If ARGD is not properly taken into account, spurious frequencies come out from periodogram analysis, which may lead to incorrect estimates of rotational periods and to spurious variations eventually interpreted as due to surface differential rotation (Fig. 2, right panel).

1.3 Long-term cyclical modulation: the mean magnitude and, consequently, the total spotted area vary in time and cyclically in the case of VY Ari. A reliable estimate of cycle period and amplitude requires that observations are pursued over a sufficiently long time interval, in order to sample several activity cycles (Fig. 3).

1.4 Random (flaring) variability: it is the shortest-scale and unpredictable type of variability (Fig. 4).

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Fig. 1. VY Ari: variability due to rotational modulation (left) and power spectrum from Fourier analysis (right).

Fig. 2. VY Ari: variability due to rotation and ARGD (left) and power spectrum from Fourier analysis (right).

Fig. 3. VY Ari: cyclical variability due to long-term spot evolution

Fig. 4. (All figures online colour at www.an-journal.org) EV Lac: example of flare-induced variability in a M-type dwarf star

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