Connection between the Long Secondary Period phenomenon and the red giant evolution

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Abstract

The mechanism behind the Long Secondary Period (LSP) observed in pulsating red giants still remains unknown. In this work, I investigate the connection between the Red Giant Branch and Asymptotic Giant Branch evolution and the appearance of the LSP - the phenomenon observed in a large fraction the red giants I use the OGLE-III sample of the OSARG variables in the Large Magellanic Cloud.

I construct the density maps in the period-luminosity as well as color-magnitude planes for the stars showing LSP and compare them to the remaining giants. I also fit the spectral energy distribution to test whether an additional source of reddening is present in the LSP stars. I post a hypothesis that the LSP phenomenon may be related to a transition between the different pulsation period-luminosity sequences. I also show that an overabundance of the stars showing Long Period Variables can be observed around the Tip of the Red Giant Branch, and much more prominently, at the upper part of the Asymptotic Giant Branch. The main over-density region appears to be slightly fainter and redder than the bulk of the Asymptotic Giant Branch. It also seems to correspond to the area of the Hertzsprung–Russell diagram where stable winds and high mass loss are present. The LSP can possibly be a recurring phenomenon appearing and disappearing in various points of the red giant evolution. The LSP stars appear to be more reddened than other giants, which suggests the intrinsic nature of the reddening, likely related to large dust emission.

The analysis seems to confirms the hypothesis that there is a relation between the mass loss due to the presence of strong stellar wind and the appearance of LSP.

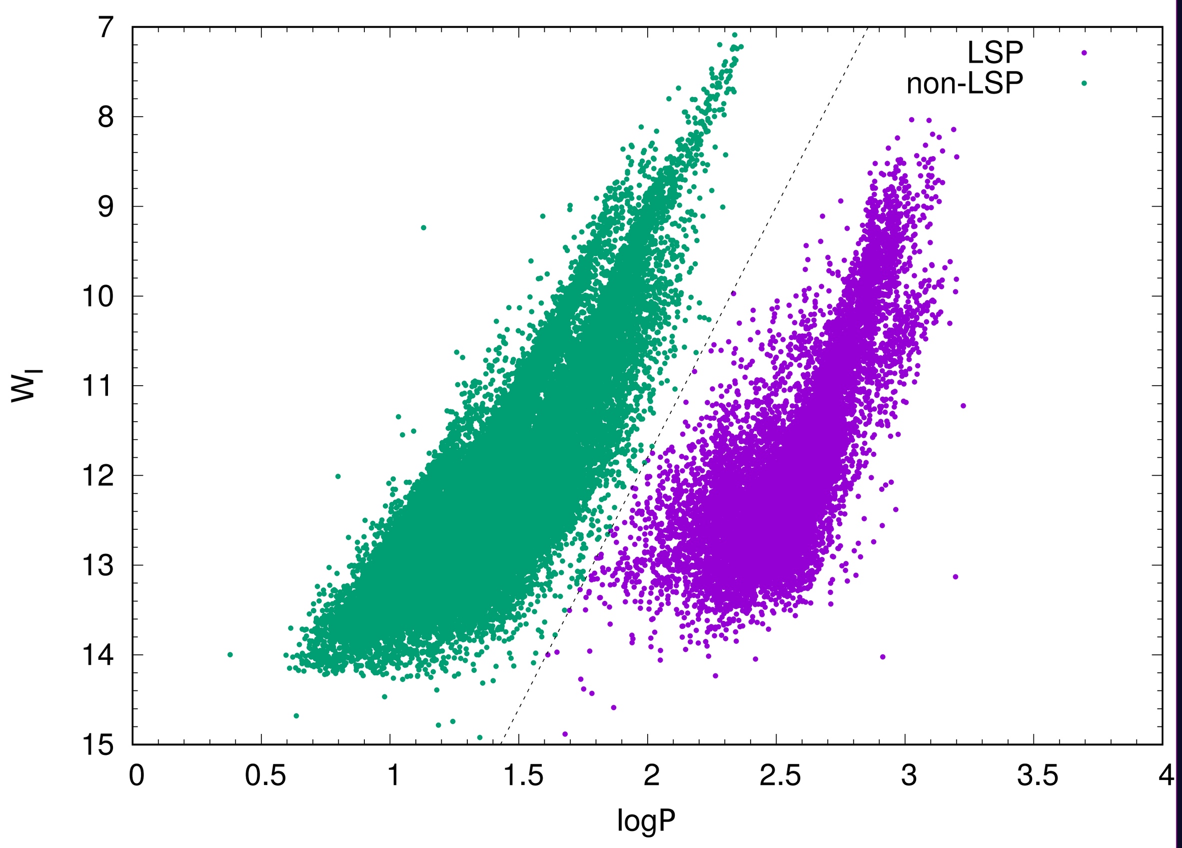

Fig. 1. Separation of the LSP OSARGs from the rest of the sample. All objects are polted with the strongest period provided by OGLE.

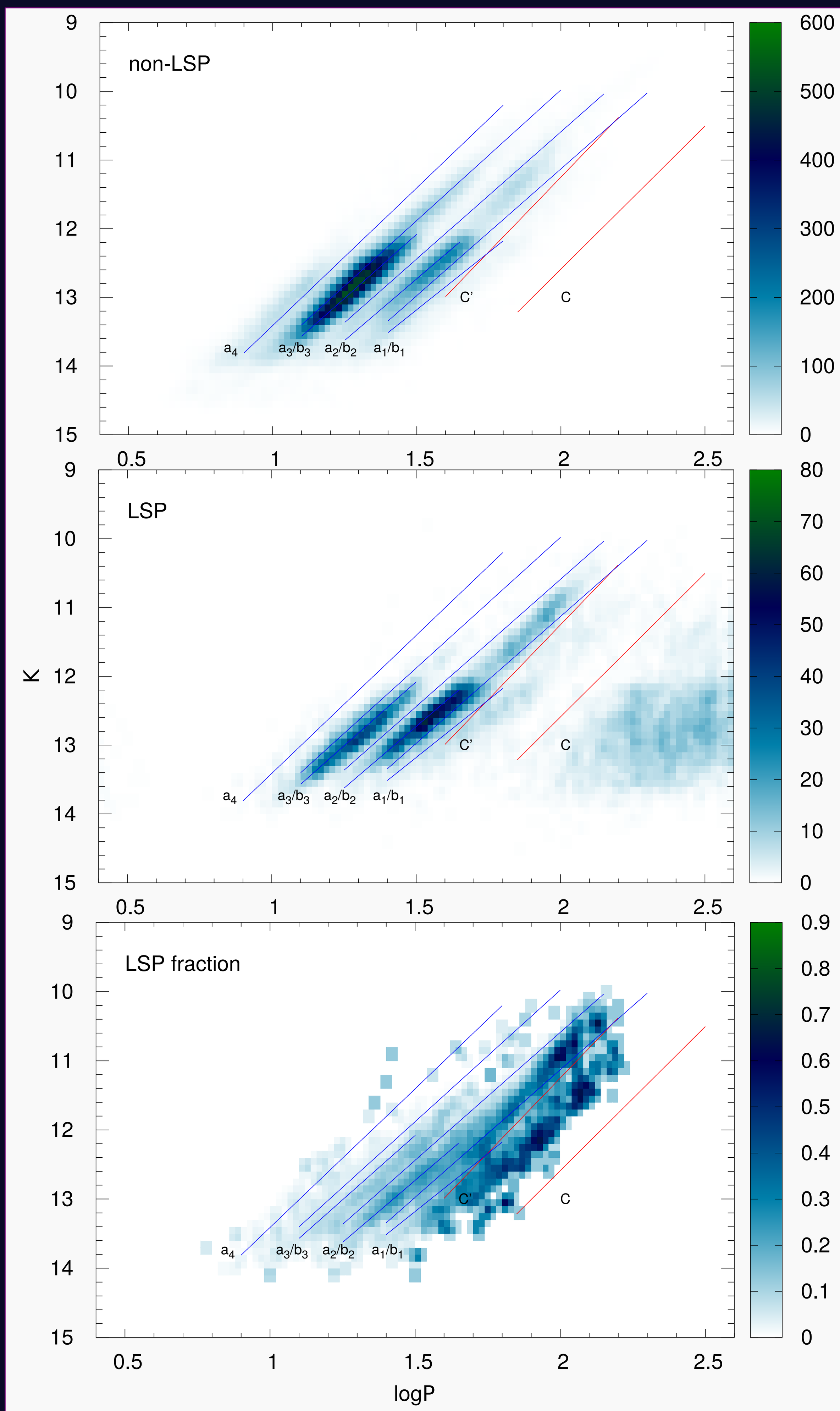

Fig. 2. Density map in the PL plane for non-LSP OSARGs - upper panel, LSP OSARGs - middle panel and the fraction of OSARGs showing LSP - lower panel. In the middle and lower panels, the period used for the LSP OSARGs is the pulsational (i.e. second most prominent) period, not the LSP itself. PL relation for OSARGs and SRVs (Soszyński et al. 2007) are marked with blue and red lines respectively.

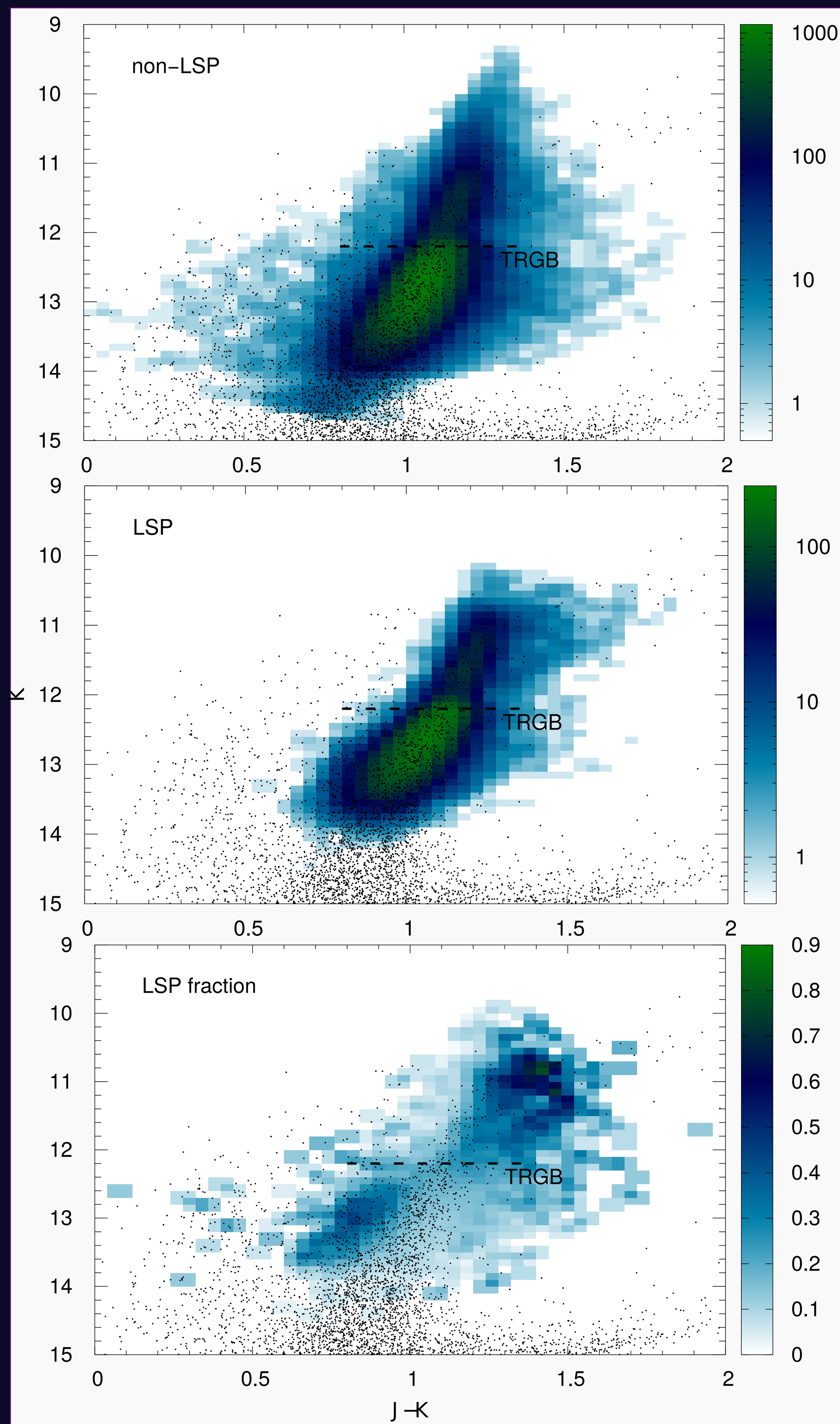

Fig. 3. Density map in the CMD plane. Panels as in Fig. 3 The upper and middle panels are plotted in log scale. The black dots are LMC field stars from the OGLE photometric map

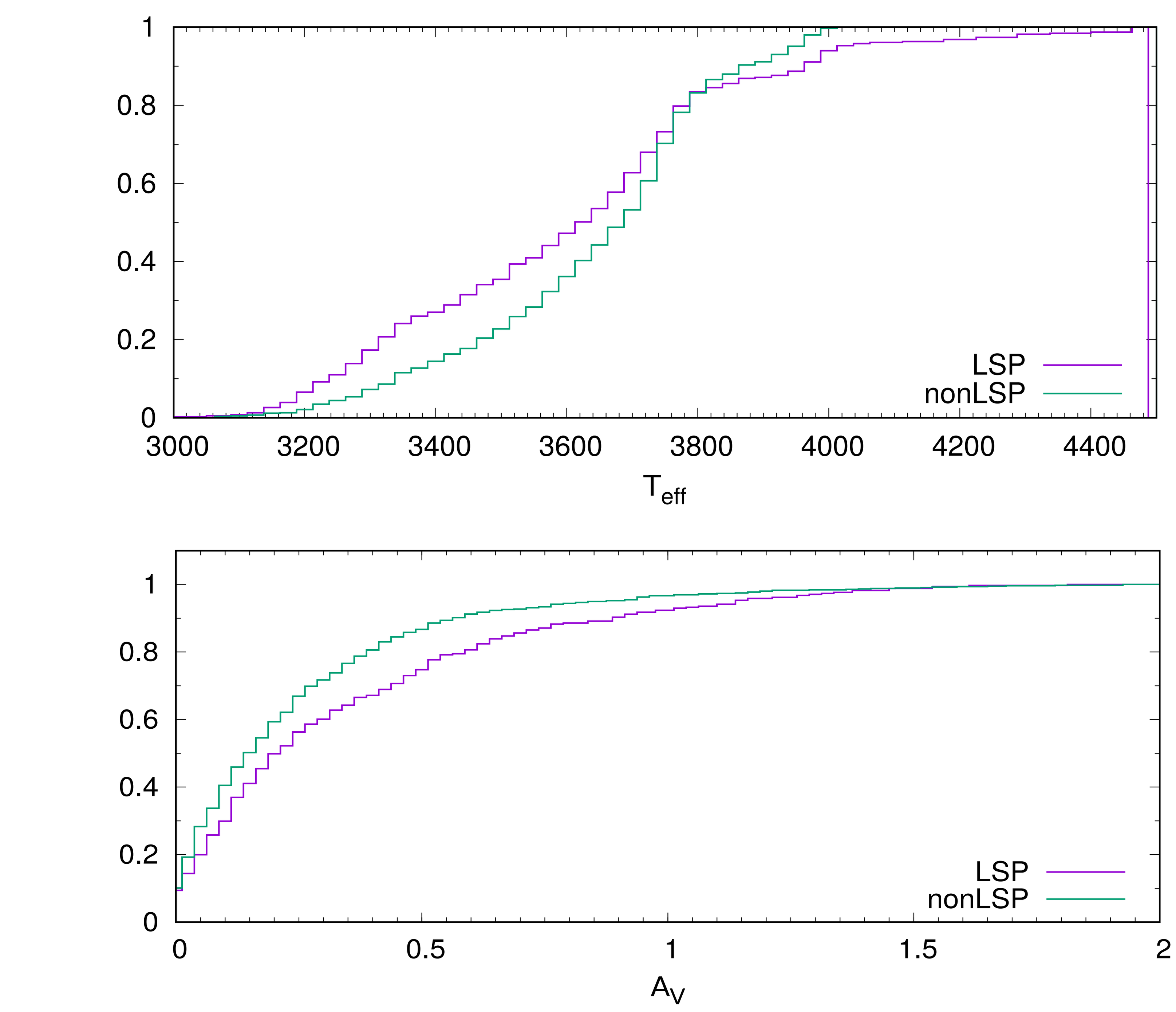

Fig. 4. Cumulative distribution of Teff (upper panel) and the total extinction value Av derived with the SED fitting for LSP and non-LSP stars. The Av seems to be higher for the LSP stars.

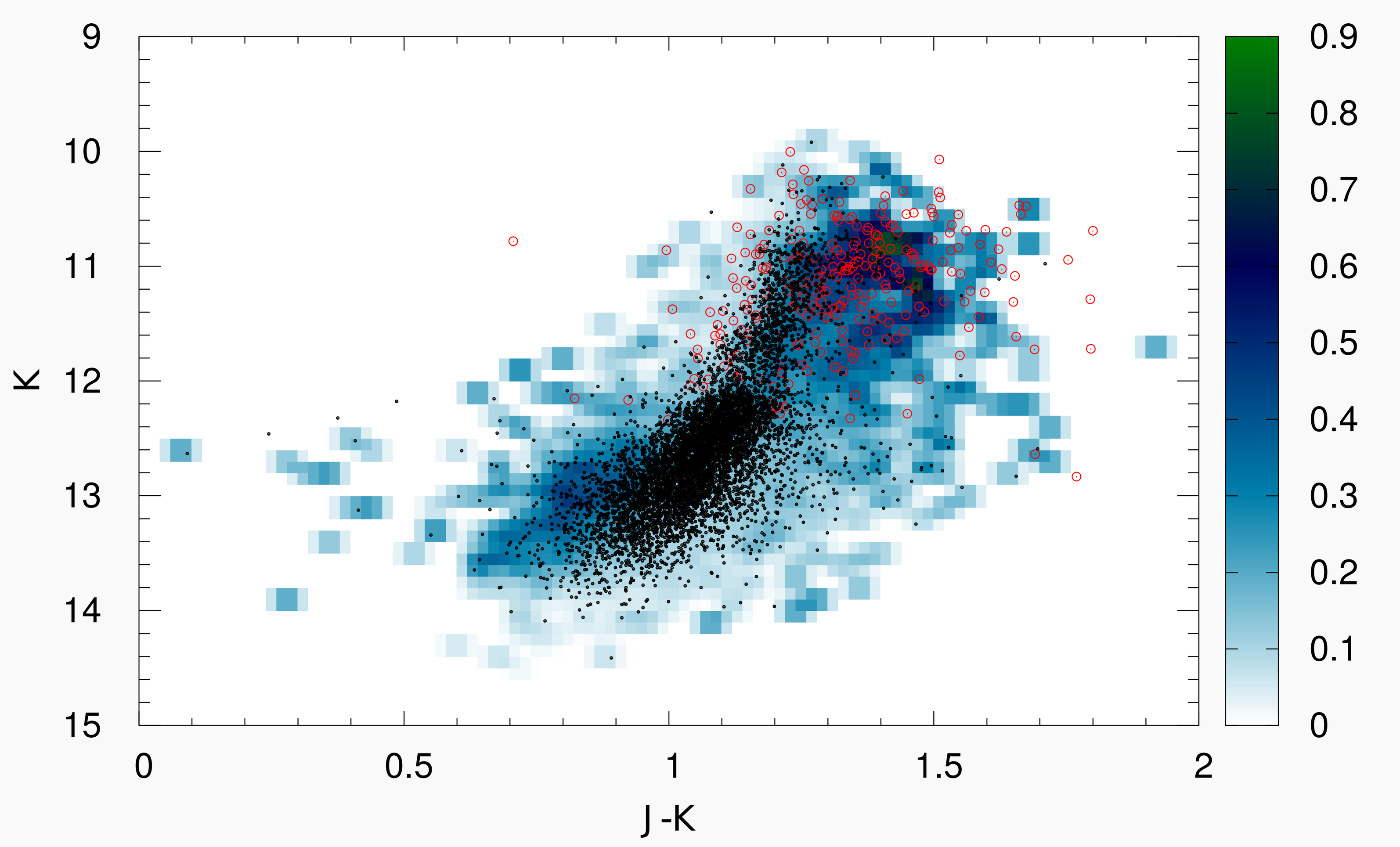

Fig. 5. O- and C-rich LSP stars plotted over the LSP relative density map. O-rich stars are marked in black and C-rich - in red. The C-rich stars lie in the region where the LSP over-density appears.

Acknowedgement

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