

Statistical study of photospheric bright points in an active region and quiet Sun

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Abstract The statistical properties of photospheric bright points (PBPs) in active regions (ARs) and the quiet Sun (QS) are investigated using two data sets obtained with the Dutch Open Telescope. Data for AR NOAA 10642 (July 12, 2004) and the QS (October 19, 2005) near the disk center are analyzed. For extracting PBPs, an automatic algorithm, employing Laplacian and morphological dilation (LMD) technique, is developed. The statistical properties of PBPs such as size distribution, contrast between maximum of PBPs and mean photospheric intensity, area coverage, number coverage and geometric shape are quantified. We then use goodness-of-fit to evaluate the fit of the size distribution of PBPs in the two regions. Finally, the Kolmogorov-Smirnov test is used to analyze the statistical difference in the AR and the QS. The following results are obtained: (1) the size distributions (probability density function) of PBPs in the two regions follow

a lognormal distribution, moreover they are from the same size distribution; (2) the number coverage and the area coverage in the AR are about twice larger than those in the QS, respectively; (3) the geometrical shape of PBPs is quantified by the ratio of the length of major axis to the length of minor axis by the center of gravity. The ratio of about 50 % PBPs is less than 1.5, and their geometrical shapes are exactly alike in the two regions; (4) the ratio of maximum intensity of PBPs to their corresponding mean photospheric intensity is larger in the AR than in the QS. The results suggest that size and shape of PBPs in the AR and the QS are just the same, but the brightness of PBPs in the AR is different from that in the QS.

Keywords Techniques: image processing · Sun: granulation · Sun: photosphere · Methods: statistical analysis

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1 Introduction

Observations of the solar photosphere performed in the G-band have revealed many tiny bright points which appear as roundish or elongated features. The “photospheric bright points (PBPs)” which appear in active regions (ARs) or the quiet Sun are usually locate in the intergranular lanes (Sánchez Almeida et al. 2004, 2010; Berger et al. 2004; Rimmele 2004; Beck et al. 2007; Utz et al. 2009a; Vitičić et al. 2009, 2010; Andić et al. 2011). Although all PBPs are shown to be cospatial and cotemporal with magnetic elements, the opposite is not always true, with some high magnetic field in plague regions appearing devoid of PBPs (Ishikawa et al. 2007). Therefore, PBPs represent a subset of the magnetic elements. Because analysis of statistical distributions of PBPs may shed light on the fundamental properties of magnetic elements, the interest in their statistical