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Morphology of Ca II K bright points and their link to G band bright points

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Abstract. We present the results of a preliminary analysis of a time series of a sequence of Ca II K bright points and G band bright points observed co-spatially and co-temporally. Inspection of these images shows that the larger Ca II K bright points occur between two G band bright points suggesting a loop structure with the top of the loop housing the Ca II K bright point. The velocities of the center of mass of G band pair and that of the corresponding K line bright point seem to be correlated even though these features appear at different heights in the solar atmosphere. The velocity of the K line bright point is estimated to lie between 0.5 km/sec to 5.0km/sec, while that of G band bright points between 3.0 km/sec and 8.0 km/sec. The diffuse K line brightenings are found to trace out the boundary of photospheric granulation. We estimate the sizes of the cells enclosed by Ca II K brightenings.

1. Observational details

The total period of observation is 70 min. Observations of the bright points have been carried out in continuum 4686 Å, G band 4305 Å and Ca II K 3934 Å. Telescope : 50 cm Swedish Vacuum Solar Telescope, on the island of LaPalma in Spain (Berger et al. 1996). The field of view is 29″ × 70″ near disk center, with exposure time of 170 millisecond. Images were obtained at time cadence of 25 sec. The images were processed using the Phase Diverse Speckle Restoration method (Löfdahl 1998).

2. Analysis methods

Both the Ca II K line and G band bright points were tracked manually for estimating their velocities and intensities. The cells enclosed by the Ca II K brightenings were identified by visual inspection and their sizes estimated using a gradient-based algorithm of tessellation. As

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a first step the algorithm determines the local minima in the intensity field of the image. Next it groups all points converging to a given minimum according to the steepest descent technique into a cell or tile which is labelled by that minimum (Hagenaar et al. 1997; Srikanth et al. 2000). By this, the image is transformed into a system of surface filling non-overlap tiles.

3. Results of the analysis

1. Ca II K bright points are seen as diffuse structures corresponding to the intergranular regions in the photosphere.

2. (a) Statistically, the larger K line bright points are found between two G band bright points. (b) The region in the photosphere where complex G band structures are seen are co-spatial with chromospheric regions where K line bright points are seen. (c) The density of the K line bright points is seen to be directly proportional to the density of G band bright points. Where G band bright points are not seen, K line bright points are also not seen.

3. G band and K line in the supergranular network region show an irregular cell pattern, with cells typically 3-5 Mm. These large cells correspond at the photospheric level to the intergranular lane surrounding large (supergranular) network granules, else that surrounding a cluster of smaller structures that are either smaller granules or remnants of a vanishing large granule.

4. The technique of tessellation was applied to the K line filtergrams to get length scale information. It is not always clear if the tiles correspond to any known physical feature. Depending on the pixel scale of the image, they could correspond sometimes to actual granules, or substructures therein. Here we used those tiles that visibly outline granules to obtain objective estimates of granule area (A) and perimeter (P). From this, the "circularity parameter" ($4\pi A/P^2 \leq 1.0$, with equality satisfied for a circle on a 2-D plane) was found to be about 0.8, suggesting that they are roundish with not many wall corrugations at the resolution considered (pixel scale = 0.2″).

References

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