Pole-Equator-Difference of the Size of the Chromospheric Ca II K Network in Quiet and Active Solar Regions

H. Münzer, A. Hanslmeier, E.H. Schröter and H. Wöhl

Kiepenheuer-Institut für Sonnenphysik, Schöneckstr. 6, D-7800 Freiburg, Federal Republic of Germany
Institut für Astronomie, Universität Graz, Universitätsplatz 5, A-8010 Graz, Austria

ABSTRACT. The dependence of the size of chromospheric network cells on latitude was investigated for quiet and active solar regions. Calibrated photographic Ca II K filtergrams were taken at the Schaulinsland observatory of the Kiepenheuer-Institut during the period 1982 until 1984. Six overlapping images on 24 mm x 36 mm film were taken from the solar equatorial and meridional belts, respectively. A total of 53 series could be reduced. The images were digitized with a stepwidth of about 1500 km in the solar center and 2400 km near to the limb. After transforming the densities into intensities a smoothing with a 4th order polynomial was performed. The deconvolution of the geometric shortening was done using a cylindric projection, which preserves the area. Two-dimensional Fourier transformations were performed on subimages of 20 deg x 20 deg heliographical sizes to obtain the network cell sizes. The power spectra were corrected by a filtering for influences of seeing effects. The two-dimensional power spectra were integrated over the azimuthal angles to obtain mean cell sizes. The mean at the equator being 28 700 (± 200) km from the east to west scans. Above 60 deg in latitude the cell sizes were found to be about 10% smaller than at the equator. From the integration parallel and normal to the solar rotation it was found that the cell sizes are about 5% larger perpendicular to the solar rotation than parallel to it.

Using the image intensity in the Ca II K line as a measure for the local solar activity the subimages were divided into subgroups with non active, low active and strong active regions. An increase of the cell sizes with locally increasing Ca II K intensity was found. The differences of cell sizes between non active and strong active regions amount to about 10%.

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Discussion

FOX — Given that these observations are at a time of decreasing activity, have you attempted to obtain and compare the torsional oscillation data (shear pattern) as a function of time, to see whether any correlation exists between the supergranular scale flows and the true indicators of solar activity?

WOHL — No, we have not done that.

SIMON — Your observation that the size of the network structure is larger in active regions seems to contradict the extensive earlier work of Zwaan¹, and also our small set of observations from Spacelab 2, which suggest that supergranules are smaller in active regions.

A reason for this may be that if the activity is strong enough, the convection cell can be completely suppressed. So you may be including regions in your measurements where there are ‘missing’ cells, and therefore your cells appear larger because they contain areas without a cell.

WOHL — Perhaps we miss some cell borders which might happen in regions of low activity, e.g. in polar regions. Within active regions, however, the cell borders are pronounced, and the Ca II K network structure is more clearly detectable.

SCHRÖTER — I would like to add a comment.

The mean cell size was defined as the center of gravity of the power spectrum. Being aware that changes of the tail of the power spectrum at high \( k \)-numbers due to seeing etc. may shift the center of gravity, we used only those spectra for further reduction (filtering etc.) which had similar high-frequency tails.

TITLE — How can you reconcile your result with that of Zwaan (ibid.), who finds diameters of 12–15.10⁵ km for network cells in plages?

WOHL — There is a continuous increase of the Ca II K network cell sizes with increasing local activity. The strongest activity nevertheless shows only an increase by 10% to 15%, and not a variation by a factor two or so.