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Similarities of magnetoconvection in the umbra and in the penumbra of sunspots

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Sunspots consist of a dark umbra and a brighter penumbra. Both regions exhibit magnetoconvection, manifested in penumbral filaments in the penumbra and in umbral dots in the umbra. The origin of the sharp transition from the umbra to the penumbra is unclear.

Here we investigate how the properties of individual convective cells vary across the umbra-penumbra boundary using spectropolarimetric observations of two sunspots performed with the Hinode spacecraft. We compare the physical properties of umbral dots and penumbral filaments by deriving ensemble averages of the physical properties of the different types of convective features.

There are strong similarities between the convective features in the outer parts of the umbra and the ones in the penumbra, with most physical parameters being smooth and continuous functions of the length of the features.

Our results indicate that the transition in brightness from the umbra to the penumbra is solely caused by the larger size and higher brightness of penumbral filaments compared to umbral dots. There is no significant difference in the number density of convective elements between the outer umbra and the inner penumbra. It is still unclear, how exactly the underlying magnetic field causes the increase in size of convective features in the penumbra.

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