

## Dependence of sunspot appearance on the deep structure

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We carry out a parameter survey of the sunspot with using radiative magnetohydrodynamic simulations. We investigated the influence of the shape of the sunspot magnetic field structure in the solar deep layer on the physical quantity on the solar surface. The sunspot is the most prominent phenomena at the solar surface. Rempel (2012) carried out the sunspot simulation and discussed the influence of the numerical resolution and the upper boundary condition of the magnetic field. However, parameter survey has not been conducted to investigate the influence of the magnetic field shape of the sunspot model on the observed quantity. In this study, we use R2D2 (Hotta et al. 2019), a radiative magnetohydrodynamic simulation code. We change the magnetic field strength about 5 Mm below the solar surface and discuss the influence. We find that the inclination of the magnetic field at the solar surface is not affected by the magnetic field strength deep in the sunspot.

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