On the Decay of Sunspots

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Sunspots are stable magnetic flux tubes in the solar photosphere. They are embedded in a flow cell, known as the moat. We will present our study on the stability and evolution of a (MHD) simulated sunspot in an extended box (98 x 98 x 18 $Mm^{3)}$. The extension of the box enables to take into account the surrounding plasma motions, at the surface and underneath the solar photosphere. In addition, we use HMI/SDO data to study the radial flow evolution within sunspots and in their surroundings in the decay phase. We find that the evolution and decay of the sunspot is influenced by the surrounding plasma motions. A few megameters below the surface, interchange instability and a radial inflow lead to the destabilization of the geometrical structure of the sunspot. The initially roundish sunspot magnetic flux tube becomes then ragged.

The evolution of sunspots and their surrounding moat flow, studied in HMI data, shows an inflow towards the sunspot in its final stage of evolution. When the penumbra has dissolved, the inflow becomes visible in the photosphere. We also find that the moat flow evolves into a supergranular flow when sunspots decays. The evolution of the sunspot cell depends on the interaction with surrounding supergranules. In some cases, the supergranular cell remains when the sunspot disappears. However, in some other cases, the competing effect can also squeeze the whole cell after the sunspot disappearance. In both cases, the remnant magnetic flux feeds the quiet Sun network eventually becoming part of it.