Self-cancellation of ephemeral regions in the quiet Sun

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Abstract

With the observations from the Helioseismic and Magnetic Imager aboard the Solar Dynamics Observatory, we
statistically investigate the ephemeral regions (ERs) in the quiet Sun. We find that there are two types of ERs:
normal ERs (NERs) and self-canceled ERs (SERs). Each NER emerges and grows with separation of its opposite
polarity patches which will cancel or coalesce with other surrounding magnetic flux. Each SER also emerges and
grows and its dipolar patches separate at first, but a part of the magnetic flux of the SER will move together and
cancel gradually, which is described with the term "self-cancellation" by us. We identify 2988 ERs, among which
there are 190 SERs, about 6.4% of the ERs. The mean value of self-cancellation fraction of SERs is 62.5%, and the
total self-canceled flux of SERs is 9.8% of the total ER flux. Our results also reveal that the higher the ER magnetic
flux is, (1) the easier the performance of ER self-cancellation is, (2) the smaller the self-cancellation fraction is, and
(3) the more the self-canceled flux is. We think that the self-cancellation of SERs is caused by the submergence of
magnetic loops connecting the dipolar patches, without magnetic energy release.

Keywords: Sun: activity – Sun: photosphere – Sun: surface magnetism

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