# Photospheric Magnetic Activities triggering X-ray Microflares around a Well-developed Sunspot

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Microflares, which are small energetic events in the solar corona, are an example of dynamical phenomena suitable for understanding energy release processes in the solar corona. We identified 55 microflares around a well-developed sunspot surrounded by a moat with high-cadence X-ray images from the Hinode X-Ray Telescope (Figure 1), and searched for their photospheric counterparts in line-of-sight magnetograms taken with the Hinode Solar Optical Telescope. We found opposite magnetic polarities encountering each other around the footpoints of 28 microflares, while we could not find such encounters around the footpoints of the other 27 microflares. Emerging magnetic fluxes in the moat were the dominant origin for causing the encounters of opposite polarities (21 of 28 events; Figure 2 left). Unipolar moving magnetic features with the negative polarity same as the sunspot definitely caused the encounters of opposite polarities for 5 microflares (Figure 2 right). The decrease of magnetic flux, i.e., magnetic flux cancellation, was confirmed at the encountering site in typical examples of microflares. Microflares were not isotropically distributed around the spot; the microflares with emerging magnetic fluxes were observed in the direction where magnetic islands with the same polarity as the spot were located at the outer boundary of the moat, while the microflares with negative moving magnetic features were observed in the direction where magnetic islands with the polarity opposite to the spot were located at the outer boundary of the moat. We also found that emerging magnetic fluxes in the moat had a unique orientation in which the same polarity as the spot is closer to the spot than the other. These observational results lead to two magnetic configurations including magnetic reconnection for triggering energy release at least in a half of microflares around the spot, and suggest that the global magnetic structures around the spot strongly affect what kinds of polarity encounters are formed in the sunspot moat[1].

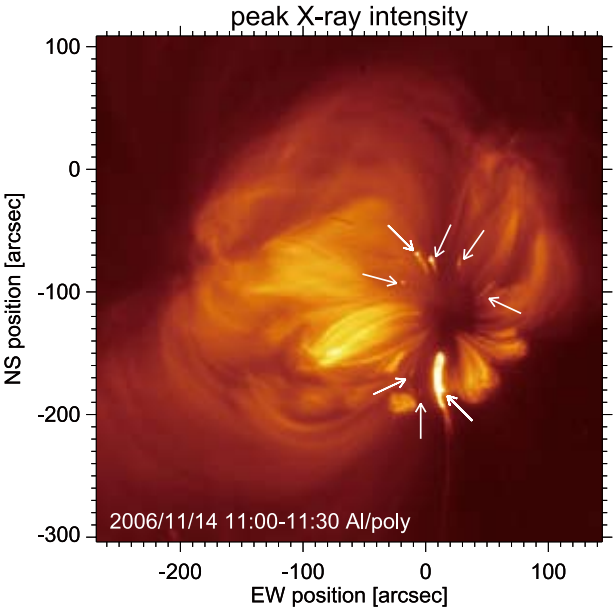


**Figure 1**: X-ray image taken with the Hinode/XRT. Some microflares used in the paper are shown by arrows.

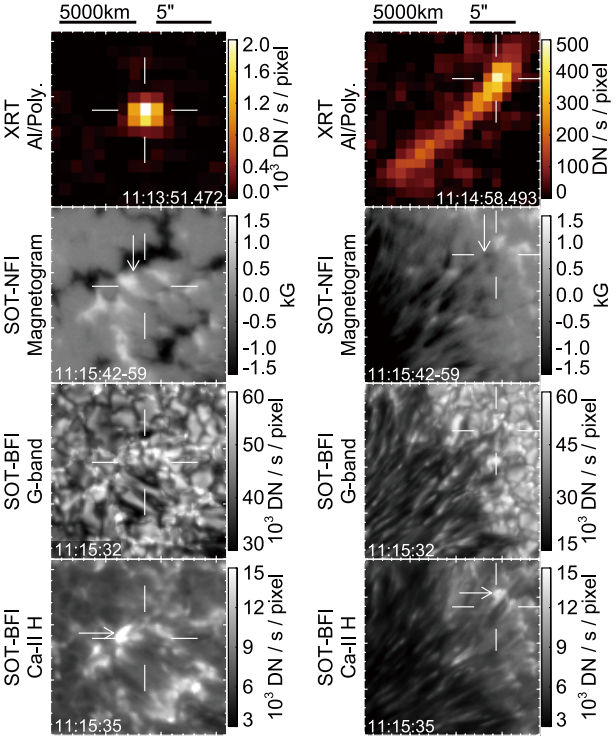


**Figure 2**: Microflares triggered by a emergning magnetic flux (left) and a moving magnetic feature (right). They are shown by arrows on the magnetograms. Brightening in Ca II H line were also observed.

## Reference

[1] Kano, R., Shimizu, T., Tarbell, T. D.: 2010, *ApJ*, **720**, 1136.