

Chromospheric micro-jets discovered above sunspot penumbrae

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The Solar Optical Telescope (SOT) aboard HINODE allows us to observe dynamical activities in the solar photosphere and the chromosphere with high and stable image quality of 0.2 arcseconds. This superior performance of SOT provides new findings of fine-scale transient activities occurring in the chromosphere. In this paper, we report a discovery of fine-scale jet-like phenomena ubiquitously observed above sunspot penumbrae. The jets are identified in images sequences of a sunspot taken through a Ca II H line filter at 3968Å. The Ca II H line is sensitive to about 10^4 K plasma in the chromosphere.

Their length is typically between 3000 and 10000km, and their width is smaller than 500km. It is notable that their lifetime is shorter than 1 minute. Those small spatial and temporal scale possibly makes it difficult to identify the phenomena in existing ground-based observations. The jets are easily identified when a sunspot is located far from the disk center, and motion of the bright features suggests that mass is erupted from lower chromosphere to upper atmosphere. Velocities of the motion are estimated to be 50 to 100 km/s from their lateral motion of intensity patterns. The velocities are much faster than sound speeds in the chromosphere. A possible cause of such high-speed jets is magnetic reconnection at the lower chromosphere resulted from fluted magnetic configuration in penumbrae which is suggested by vector magnetic field measurements in the photosphere.