Microwave Imaging of a Hot Flux Rope Structure During the Pre-impulsive Stage of an Eruptive M7.7 Solar Flare
Zhao Wu¹, Yao Chen¹, Guangli Huang², Hiroshi Nakajima³, Hongqiang Song¹, Victor Melnikov⁴, Wei Liu⁵, Gang Li⁶, Kalugodu Chandrashekhar¹, and Fangran Jiao¹

1. Shandong Provincial Key Laboratory of Optical Astronomy and Solar-Terrestrial Environment, and Institute of Space Sciences, Shandong University, Weihai, Shandong 264209, China; 2. Purple Mountain Observatory, Chinese Academy of Sciences (CAS), Nanjing, 210008, China; 3. Nobeyama Radio Observatory, NAOJ, 462-2 Nobeyama, Minamimaki, Minamisaku, Nagano 384-1305, Japan; 4. Central Astronomical Observatory at Pulkovo, Russian Academy of Sciences, Saint Petersburg 196140, Russia; 5. W. W. Hansen Experimental Physics Laboratory, Stanford University, Stanford, CA 94305, USA; 6. Department of Space Science and CSPAR, University of Alabama in Huntsville, Huntsville, AL 35899, USA.

An eruptive M7.7 flare occurred at the southwest limb on 2012 July 19. The event, well observed by SDO/AIA, was characterized by a gradual ascent and eventual eruption of a hot flux rope structure (a, b). During its pre-impulsive stage, the NoRH 17 GHz data present clear radio sources that are co-spatial with the central part of the rising flux rope structure (c).

Microwave sources at 17 GHz exhibit an overall arcade-like feature consisting of several intensity enhancements bridged by generally weak emissions (c, d). It is inferred that at least a part of the emission is excited by non-thermal energetic electrons. High localization of the sources indicates that the distribution of energetic electrons is strongly affected by the large-scale magnetic structure within the flux rope.

The microwave structure moves outward along with the gradual ascent of the AIA-observed hot flux rope. Wavelet analysis shows a pronounced 2 minute period of the microwave $T_B$ variation (e, f), agreeing with the occurrence rate of the AIA sunward contracting loops and upward ejective plasmoids that are manifestations of reconnection outflows during the pre-impulsive stage. This suggests that the microwave periodicity is associated with the reconnection that takes place and releases energetic electrons intermittently at a 2 minute timescale.

The study demonstrates the potential of microwave imaging in exploring the flux rope magnetic geometry and relevant reconnection process during the onset of solar eruption. For more details of the study, please refer to Wu et al. (ApJL, 2016, http://stacks.iop.org/2041-8205/820/L29).