URSI AP-RASC 2019, New Delhi, India, 09 - 15 March 2019

Quarter Century of Nobeyama Radioheliograph and Its Contribution to Space Weather Research

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Nobeyama Radioheliograph (NoRH) is a radio interferometer specially designed to observe the full Sun. NoRH started its scientific operation in 1992 with a single frequency of 17 GHz and then, 34 GHz capability was added in 1995. NoRH consists of eighty-four antennas with a diameter of 80 cm, installed along a T-shape baseline (North - South: 250 m, East - West: 500 m). The spatial resolution is about 10 arcseconds and 5 arcseconds in 17 GHz and 34 GHz, respectively. The time resolution is 1 second in quiet time and 0.1 second during a solar flare. NoRH continuously observes the sun for about eight hours (22:45 - 6:30 UT) every day. The National Astronomical Observatory of Japan had operated NoRH from 1992. It is currently operated by the Institute for Space-Earth Environmental Research; ISEE, Nagoya University as a representative of the International Consortium for the Continued Operation of Nobeyama Raidoheliograph (ICCON; https://hinode.isee.nagoya-u.ac.jp/ICCON/). NoRH has contributed extensively to the study on active Sun and quiet Sun by observing a number of phenomena such as flares, prominence eruptions, coronal holes, sunspots, and the polar brightening over three solar cycles.

NoRH detected more than 4,000 solar flares during this quarter century. It provided us a lot of scientific results on solar flares. In 1990s, most of NoRH results were produced through the corroborative researches with Yohkoh. It was revealed where the energy-release and particle acceleration take place in impulsive flares. The coronal magnetic structure observed with Soft X-ray Telescope (SXT) on board Yohkoh played an important role for this kind of researches. Of course, the simultaneous observation with Hard X-ray Telescope (HXT) on board Yohkoh was a great help to understand the behavior (acceleration/transport/loss) of high-energy electrons. After 2002, NoRH collaborated with RHESSI, Hinode, SDO and so forth. More detailed discussions on particle acceleration were done based on really multi-wavelength observations. In this situation, NoRH provides the information of accelerated electrons in the higher energy range from a few hundred keV to a few MeV. Also microwave emissions contain the information of the pitch-angle distribution of accelerated electrons. Thanks to these two characteristics, valuable researches using NoRH have been carried on.

From a point of view of the space weather research, prominence eruption is one of important target of NoRH. NoRH has demonstrated the ability to see an eruption start in the low corona, and to follow prominence material out to heights in excess of 1 solar radius. Its observations are not affected by the weather (rain and cloud) at the observational site. Also even if a prominence has a large velocity along the line of sight, the Doppler effect does not interrupt observations since microwaves are emitted by free-free continuum. All of these characteristics are advantages of NoRH for observation of prominence eruption.

In this presentation, I briefly review the scientific results of NoRH on solar flares and on space weather research during its continuous observations in this quarter-century.