

## Statistical analysis of the gyroresonance sources using Nobeyama Radioheliograph and sunspot sketches

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Nobeyama Solar Radio Observatory of National Astronomical Observatory of Japan has continued the solar full-disk observation using Radioheliograph (NoRH) since 1992. NoRH can measure the intensity and circular-polarization intensity of solar radio waves and identify the regions where the gyroresonance occurs. Gyroresonance is the mechanism in which the strongly circular-polarized radio waves are emitted from the resonance of the electrons gyrating around the magnetic field lines of sunspots. The radio flux coming from the gyroresonance mechanism depends on the magnetic field strength of its source and the observing wavelength. NoRH adopts 17 GHz radio waves and detects the gyroresonance emission from the strong magnetic field region with more than 2000 gauss. The statistical analysis combining gyroresonance sources and their magnetic field, or identifying them as the NOAA (National Oceanic and Atmospheric Administration) active region, however, has not been done sufficiently. So, the database including these informations is urgently needed.

In this study, we developed the database which combines the gyroresonance sources with NOAA active region number and the photospheric field strength. We listed up the location, radio flux and the circular-polarization ratio of each gyroresonance source with its area, using NoRH observation data. We also examined the area, McIntosh sunspot group classification, sunspot number and the magnetic classification of sunspots of each active region corresponding to the gyroresonance source. We used the sunspot sketches from Mt. Wilson and Crimea observatories because of the merits of covering solar full-disk and being free from the saturation effect at the strong field. The temporal coverage of our database is from 1992 to 2013, which corresponds to almost two solar cycles.

The statistical analysis using our database clarified that the ratio of the active regions accompanied by the gyroresonance emissions increases in the latter half of cycle 23 (2002-2007). This phenomenon is not confirmed in cycle 22. There is a quadratic correlation between the number of occurrences of gyroresonance and the total number of active regions. This means that the ratio of the active regions accompanied by the gyroresonance emissions is proportional to the total number of active regions. Furthermore, we classified the active regions with the gyroresonance by their magnetic classification of sunspots and found that the complex magnetic configurations (beta-gamma-delta etc.) were predominant. Our statistical analysis provides new diagnostics to the past solar cycles and the prediction for the future solar activities.

Keywords: Sun, Radio, Sunspot