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UHF Band RFI Measurements at VERA Four Stations in Japan

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The ultrahigh frequency (UHF, 300 MHz – 3 GHz) band is the optimum frequency to explore magnetic field in the intergalactic medium using Faraday tomography [1]. Moreover, the UHF band is a promising band for exploring fast radio bursts [2], which are newly-found radio transient events. With these scientific drivers, we are considering UHF-band observations at the VERA four stations of Mizusawa VLBI Observatory, the National Astronomical Observatory of Japan. Since the UHF band has been used for social infrastructure such as communication and broadcasting, their radio frequency interference (RFI) is a major problem of radio observation using ground-based facilities. We have developed high temperature superconducting bandpass filters [3], as one of the RFI mitigation solutions.

In 2022, we performed RFI measurements at the VERA stations in Ogasawara, Mizusawa, Ishigaki, and Iriki (see https://www.miz.nao.ac.jp/veraserver/system/index-e.html for details). We used an omni-directional discone antenna D3000N of Diamond Antenna cooperation. It is sensitive to vertical polarization at ultra-wide band from 25 MHz to 3 GHz, though it is insensitive to horizontal polarization and to the emission came from above of the antenna. The antenna connects to a room-temperature amplifier PE15A3260 of Pasternack Enterprise Inc. It amplifies the input signals by 30 dB from 10 MHz to 6 GHz. The amplified signals are transmitted to a spectrum analyzer via standard 50-ohm coaxial cable. We have recorded spontaneous (one sweep time of 0.1-1 second) and max-hold (10-30 minutes) values using the spectrum analyzer.

Some example results are shown in Figure 1. Overall, RFI is loud below 1 GHz, while there are some RFI-quiet bands above 1 GHz such as 1.0-1.4 GHz, 1.6 GHz, 2.0-2.1 GHz, 2.3 GHz, and 2.7-3.0 GHz. Even for RFI-loud bands, RFI is not always strong; it fluctuates over time and varies in depending on the sites. For example, 700-750 MHz band would be usable although there is mediate RFI, and Ogasawara and Ishigaki sites indicate relatively RFI-quiet. The above frequencies and sites would be promising to consider for UHF-band observation in future.

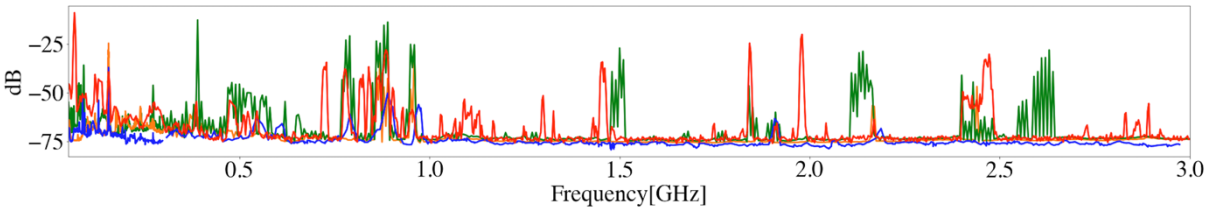

Figure 1. Examples of RFI measured from 50 MHz to 3 GHz. Lines are the results measured at VERA Ogasawara 13 June 2022 (orange), VERA Mizusawa 21 April 2022 (green), VERA Ishigaki 2 August 2022 (blue), VERA Iriki 28 September 2022 (red). Band characteristic of the system was subtracted.

References

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