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５チャンネルHRO電波干渉計の開発と流星軌道およびエコー絶対受信強度の計測の試み
Development of a 5ch HRO-IF and a trial of measureing trajectory and absolute reception power of each meteor echo

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Ham-band Radio meteor Observation (HRO) has an advantage of 24-hour continuous data-detection. In Kochi University of Technology (KUT), a 5ch HRO-IF was developed in 2009 and has been observing the meteor appearance position of every meteor echo, with operating an automatic meteor observation system that automatically publishes observational results on web in quasi-real time (Noguchi, 2009). Meteor parameters acquired by the observation system are: time of detection, elevation and azimuth of the echo, and relative intensity. During 2010-2012, we developed a system of meteor trajectory measurement by multiple-sites observation with precise GPS timing and the 5ch HRO-IF. Then, during 2011-2013, we developed a calibration device for measuring absolute reception power of each meteor echo. Since high time resolution is needed for the determinations of meteor trajectories by the multiple-sites simultaneous observation, a program to analyze the reception power trend with tracking a peak frequency of every 0.001 s by quick repetition of FFT was developed by using the IDL. For the determination of absolute reception power of each meteor echo, we developed a signal generator of observation frequency of 53.75 MHz by applying PLL (Phase Locked Loop) circuit with switching attenuator devices from -80 dBm to -120 dBm per 10 dB in every 5 s. The calibration signal is supplied into a receiver once per 10 minutes, then the artificially supplied stepped function is analyzed automatically and determine each meteor echo reception power in dBm by developed software.

In order to verify the observation system of meteor trajectory measurement, we observed meteor echoes during 4-nights active period of Geminids 2011. We tried a simultaneous observation by high sensitivity video instruments (Watec, WAT-100N) and by a combination of the 5ch HRO-IF and multiple-sites HRO. In the period, 71 meteor echoes were detected, however, only 1 simultaneously observed meteor echo at 3 radio sites as well as the camera site was obtained. Though it was only 1 case, the azimuth angles of the meteor trajectory obtained by the both methods were nearly consistent with each other, within an error range of about 5 degrees for direction-determination by the 5ch HRO-IF. For the confirmation of absolute reception power measurement of each meteor echo, we observed meteor echoes in a peak night of Geminids 2012 with multiple-site optical observations, resulting in 101 absolute reception power of echoes of determined in -80 dBm to -125 dBm. In a region between -100 dBm and -120 dBm, within 1 dB accuracy was confirmed by using test calibration signal supplied by a signal generator (Agilent N9342C).

We improved the KUT radio meteor observation system by adding the measurement of each meteor trajectory and reception power, yielding meteor velocity and its plasma line density for each meteor echo, in case all of the parameter can be fixed. In order to verify the system performance we need more dataset to make a statistical approach, however, here we successfully built a forward-scattering meteor radar system with a capability of meteor trajectory and reception power measurement for obtaining physical parameters. In this paper, we will introduce current status of the KUT radio meteor observation system, that all of the instruments/software were developed by students in this decade.

キーワード: 流星, 流星電波観測, 軌道, 絶対受信強度, 較正, 前方散乱
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