Development of a Multi-frequency Digital Imaging Riometer

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Spectral index of absorption n obtained from multi-frequency riometer observation usually equals to 2 when the absorption layer is formed above 85 km, where collisional effect between neutral atom and electron is relatively small. However, if the energy spectrum of precipitation is very hard, absorption layer can be formed below 85 km and n becomes smaller than 2 due to increased collisional effect in this altitude range. The spectral index is therefore useful to detect very energetic precipitations such as those observed at solar proton events. However, we must be careful that n can be smaller than 2 by an apparent effect for a localized absorption whose spatial extent is comparable to, or smaller than, the antenna beam width, as pointed out by Rosenberg et al. (1991). Multi-frequency absorption measurement by imaging riometers is advantageous because it provides n in various directions in the sky, and the narrowness of the beam width guarantees n to be free from the apparent effect. We are developing an imaging riometer which can be operated at different frequencies with the same antenna array. It is essential to introduce digital beam forming in this development, because we have to prepare different phase matrix for different operating frequency, and only the virtual phase matrices programmed in a computer can meet with this requirement.