

Abstract

We developed a 230 GHz band superconducting VLBI observation receiver called CPRx-W, which is the key to realizing the direct detection of Black hole shadow, in GLT project. In this seminar, I will talk about the details of this developments.

Black hole is an object predicted by the theory of general relativity, which has extremely strong gravity enough to deform the space-time around itself, having the extreme physical conditions; it is impossible for even the electromagnetic radiations to escape from inside of the black hole. According to the results of past astronomical observations, its existence is considered to be almost certain; however, no one have been observed the direct evidence of any black holes. The observation method which detects Black Hole Shadow (BHS) by Very Long Baseline Interferometry (VLBI) observation at submillimeter wavelength is thought to be the most effective and realistic to archive the direct detection of the black holes.

The Academia Sinica Institute of Astronomy and Astrophysics (ASIAA) researchers is aiming to realize submillimeter band VLBI observation and to achieve the BHS detection, so that they launched the Greenland Telescope (GLT) project. In this project, a 12m diameter submillimeter wave radio telescope is installed in Greenland as its name suggests, and then GLT would construct the largest VLBI observation network on the earth, with ALMA (Atacama) and SMA (Mauna-Kea). As a result, an extremely high angular resolution of 30 micro arcseconds would be obtained with the base line length of approximately 9000 km, and a BHS candidate at M87 galaxy center may be detectable in the 230 or 345 GHz band.

To realize the GLT project, we developed a 230 GHz band superconducting VLBI receiver called CPRx-W, which can separate dual circular polarized signals and can eliminate the image band noise, and has very low noise temperature using superconducting heterodyne receiver system. To obtain these functions, CPRx-W includes two unique devices; a 230 GHz band gap-spacing shifted Stepped Septum-Type Circular Polarizer (SST-CP) to separate dual circular polarization, and a Frequency Separation Filter (FSF) which separates the observation frequency bands to eliminate the image-band noise. The developed CPRx-W was already delivered to ASIAA, and now GLT team is preparing to perform the test observation with it on Greenland.