V116a Development of a D-band Dual-polarization Balanced Integrated SIS Mixer for Multi-beam Receiver Application

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Multibeam superconductor-insulator-superconductor (SIS) receivers are powerful equipments in millimeter and submillimeter astronomical observation, which allow wide field-of-view (FoV) observation with high spectral resolution and high sensitivity. To build multibeam receivers is however not trivial because it is not practically feasible to assemble a large number of signal-pixel receiver modules on the focal plane due to losing of reliability by various complexities. A solution is combining multiple pixels into one integrated circuit, similar to the configuration of a camera. In this way the system becomes highly compact and robust because most of the signal and bias wirings are integrated in a planar chip and interfaces between pixels are avoided .

We have been conducting the integrated multibeam receiver development in NAOJ, and have designed and fabricated a dual polarization balanced mixer on a single chip operating at a frequency range of $125-163\,GHz$ for the demonstration of the feasibility of this integration method. In 2018 spring annual meeting we have reported the low receiver noise ($< 50\,K$ SSB) and the low-level cross-polarization ($< -20\,dB$) of this device. This time we will focus on the balanced mixing performance. Our test results show that a noise rejection ratio as high as $15\,dB$ can be achieved with this integrated circuit. The high noise rejection ratio indicates that the balance of the mixer circuit, which is mainly determined by the uniformity of the circuit geometric dimensions, is better guaranteed by micro-fabrication techniques than in the non-integrated assemblies.