V76b Recent Progress on ALMA Band 10

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Designs of SIS mixers and the cartridge for ALMA Band 10 (787-950 GHz) are under extensive evaluation. A combination of NbTiN/Al tuning circuit with Nb-based SIS junctions employing AlN tunnel barrier (A = 0.5 μm^2, J_c= 15 - 20 kA/cm^2) is being fabricated using SNAP process. A tuning circuit employing epitaxial films of NbN is also under consideration. A quasioptical double-slot antenna mixer is designed for the comparative material test (NbTiN vs. NbN) and for evaluation of the lens-antenna beam pattern. The conclusion on better material will be drawn via evaluation of FTS and heterodyne data. The signal RF loss of about 1.5-3 dB is expected in the tuning circuit due to the material loss only. The following parameters are estimated for a 20- Ω SIS mixer using Tucker's 3-port mixer theory and taking into account the 3-dB input loss: G_m= -7.5...-9 dB, $P_{LO} < 0.5$ μW at 950 GHz; $T_{RX} < 200$ K (DSB) for $T_{IF} < 10$ K; the IF range of 4 - 12 GHz is simulated successfully for the quasioptical mixer. The use of a special cross-slot antenna makes possible a balanced quasioptical mixer, which utilizes almost 100% of the LO power. The quasioptical balanced mixer can reduce LO power requirement down to only 3-5 μW for the whole two- polarized cartridge along with essential simplification of its optical scheme. The efficiency of silicon lens-antenna is expected above 80 % with sidelobes below -18 dB that makes, in combination with simplicity of the optical system, the quasioptical approach a very promising solution for ALMA Band 10.