Wideband receiver based on AlN barriers

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Abstract

In current receiver technology different device technologies are used for different frequency bands. The recent finding[1] that a plasma source can be used to create tunnel barriers with high quality I,V curves and current densities up to J_C of 100 kA/cm^2 creates the opportunity to cover a full band of 350 GHz potentially covering several atmospheric windows, for example Band 9 and Band 10 of ALMA.

We report on the design and technology-development of Niobium based aluminum-nitride barrier tunnel junctions with NbTiN/Al striplines.

The receiver is made by first depositing a NbTiN groundplane and covering it with a Nb/Al/AlN/Nb junction layer. This layer is etched away and covered with SiOx except where the junctions will be. Finally the Al stripline is deposited. Deposition is done by magnetron (reactive) plasma sputtering.

For CHAMP+ we are developing both single as twin junction receivers. CHAMP+ is a sky survey telescope for band 9 and 10 of ALMA to search for interesting sub millimeter sources. These sources can be examined more detailed later by ALMA.

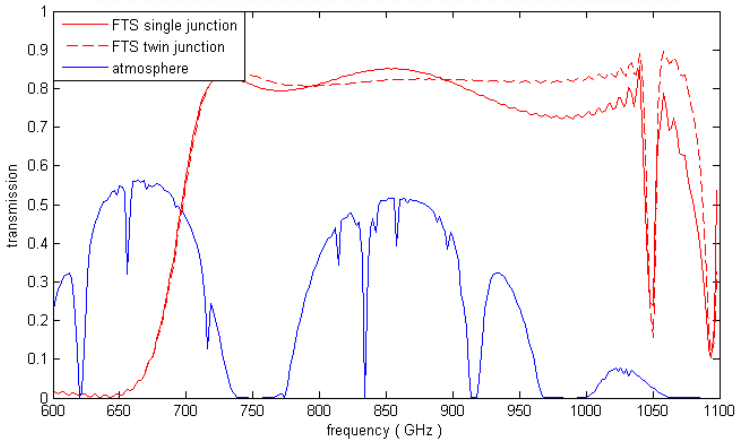

Figure 1 FTS prediction of single junction (full red line) twin junction (dashed red line) and the atmospheric transmission at Atacama (blue line).

Fig.1 shows the predictions made for a center frequency of 850 GHz. The width of the band is wide enough to cover both band 9 as well as band 10 for CHAMP+ with just 1 receiver. This would make measuring with CHAMP+ more efficient. The present design is based on a feed horn and waveguide antenna suited for frequencies of 680 GHz and higher. The dip at 1050 GHz is due to the antenna.

Results will be presented on mixers based on the current design to demonstrate the potential of the technology.

[1] T. Zijlstra, C.F.J. Lodewijk, N. Vercruyssen, F.D. Tichelaar, D.N. Loudkov, T.M. Klapwijk, "*Epitaxial aluminum nitride tunnel barriers grown by nitridation with a plasma source*", Applied Physics Letters **91**, 2007