1.55 µm photomixer LO sources operating at cryogenic temperatures for heterodyne mm-wave receivers

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Photomixing is a flexible and efficient method of providing the local oscillator input to mm-wave heterodyne receivers. Photodiode based photomixers have conventionally been characterised at room temperature, but for use with superconducting mixers for astronomy it is desirable to locate and operate them in a cryogenic environment close to the superconductor-insulator-superconductor junction. We have thus investigated the effects of cooling W-Band waveguide photomixers based upon 70 GHz bandwidth, λ = 1.55 µm, photodiodes from u^2t Photonics AG.

Operation is maintained to ambient temperatures below 30 K, and optical to mm-wave power conversion efficiency is found to increase upon cooling. In contrast to 300 K operation, the photocurrent is found to depend strongly with reverse bias, Fig. 1, although the $(\text{photocurrent})^2$ dependence of output power is maintained. Maximum detected mm-wave powers are of are order 100 µW at 85 GHz, and have been limited by the capability of the bias current supply. Temperature cycling the photomixer to 300 K was found to restore the original room temperature photoresponse.

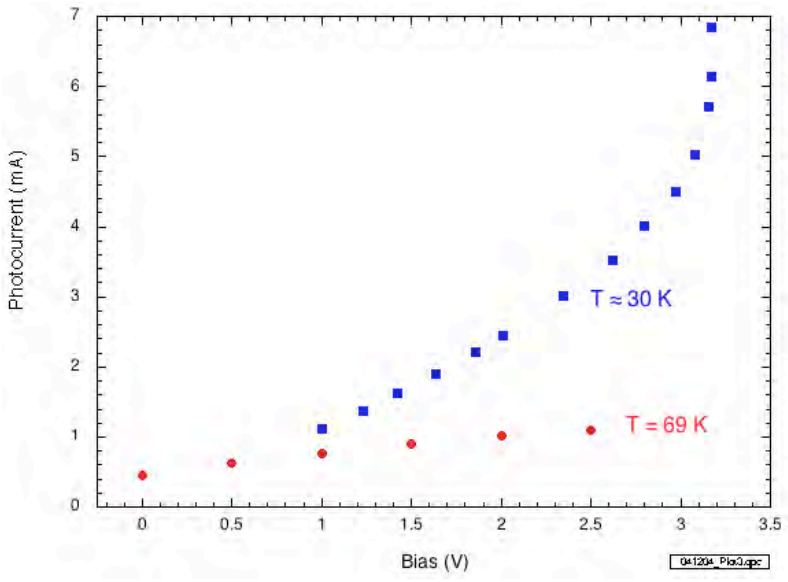

Figure 1: Mm-wave power as a function of bias for cryogenic photomixer operation.