A 410-510GHz Local Oscillation Source for SIS Mixers

Peng Chen[1], Xian-Jin Deng[1], Li Li[1], Kun Huang[1],Sheng-Cai Shi[2] and Kun Zhang[2],
[1]Institute of Electronic Engineering, Microsystem and Terahertz Research Center,
China Academy of Engineering Physics, Mianyang, Sichuan, 621900, P. R. China
[2]Purple Mountain Observatory, National Astronomical Observatories, Nanjing, Jiangsu, 210008, P. R. China

***Abstract*—A 410-510GHz local oscillation source for SIS mixers has been designed, fabricated, and tested. The source is a × 24 frequency multiplier working at room temperature. It converts the input low band microwave signals to submillimeter signals. It is comprised of an E band quadrupler, a power amplifier, a D band doubler and a final trippler. Both of the D band doubler and the final trippler use plannar Schottky diodes and quartz based circuits to realize frequency multiplication. Over the 410-510GHz band, the output power of the source is above 50uW, and the maximum is 122uW in 461.2GHz. A horn antenna is connected with the source to radiate the power to SIS receivers which are used for submillimeter radio telescope in Purple Mountain Observatory in China.**

I. INTRODUCTION

THE submillimeter regime is the last window to be fully explored in astronomical observations, and scientifical studies in this area are becoming more and more important. Recent radio astronomical projects such as SMA, ALMA, and Herschel all operated in the submillimeter region [1].

The superconducting SIS (Superconductor-Insulator-Superconductor) mixers have excellent low-noise performance, and they are the most sensitive devices for the coherent detection of submillimeter signals. Heterodyne receivers based on a SIS mixer are attractive for astronomical observations, because the noise temperature of the receivers are approaching to the quantum limit and the requirements of local oscillator power are only at microwatt or submicrowatt [2]. A high quality local oscillator is of great importance to such a receiver.

At present, many kinds of LOs can be used for a SIS mixer, such as Gunn diodes followed by frequency multipliers, multiplier chains driven by frequency synthesizers in microwave region [3] [4], quantum cascade lasers, photonic local oscillators, and etc. In all of these LOs, multiplier chains driven by frequency synthesizers are the best choice for SIS mixers in the submillimeter region, since they have small size and weight comparatively, and it is very convenient to make electronic sweep to change the frequency and power of the local oscillator.

In this paper, a 410-510GHz local oscillation source for SIS mixers is presented. The SIS mixers are used to build the high sensitivity receiver of a radio telescope in Purple Mountain Observatory in China. The 410-510GHz source is a ×24 frequency multiplier working at room temperature. It mainly consists of four modules, and two modules of them work in E band: a quadrupler and a power amplifier. The other two modules are a D band doubler and a final trippler. Both of the quadrupler and the power amplifier are designed with GaAs MMICs. The D band doubler and the final trippler use plannar Schottky diodes and quartz based circuits to realize frequency multiplication. A horn antenna is connected with the source to radiate the power to SIS mixers.

II. RESULTS

The 410-510GHz local oscillation source has been designed, fabricated, and tested. The initial product is shown in Fig.1. Input RF power is provided by an Agilent signal generator, and the power supply is +12Vdc.

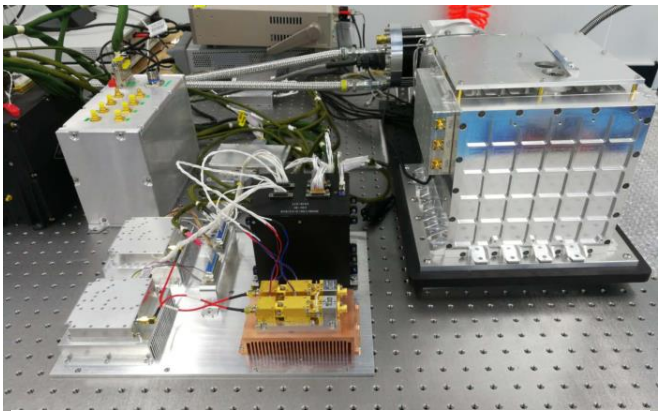

Fig. 1. Picture of the fabricated 410-510GHz Local Oscillation source

The test results are shown in Fig.2. Over the 410-510GHz band, the output power of the source is above 50uW, and the maximum is 122uW in 461.2GHz.

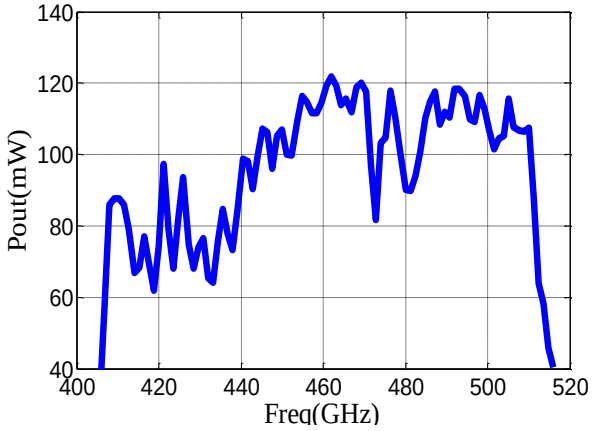

Fig. 2. Measured output power versus output frequency of the source

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