Multiplexing of Terahertz Wireless Communication Channels Using Vortex Beams

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***Abstract*—We present the design and experimental results of channel multiplexing using orbital angular momentum (vortex beams) at 0.14 THz. A 3D printed spiral and porous phase masks are used to generate vortex beam of order m=+1 and m=-1 for channel 1 and 2 multiplexing and the inverse phase masks (m=-1 and m=+1) is used for demultiplexing. The phase masks are validated by measuring the output amplitude and phase using the THz time domain system. We will also demonstrate and compare the bit error rate of spiral and porous phase masks in each communication channel.**

I. INTRODUCTION

MULTIPLEXING of communication channels using orbital angular momentum (OAM) on top of conventional frequency and polarization multiplexing is a promising path to increase the capacity of communication links [1]. In the meantime, in wireless systems, the need for higher bandwidth is leading towards the THz frequency spectrum. Contrary to the circular polarization which offers only two states, OAM beams have large number of states available for the channel encoding [1]. Few researches have demonstrated the application of OAM in the communication channel below 100 GHz [2]. In this work, we will present a channel multiplexing at 0.14 THz using a spiral and porous phase mask and their comparison.

II. EXPERIMENTAL SET UP

The schematic of the THz communication system with a spiral phase mask for channel encoding and decoding is shown in Fig. 1. One of the two Distributed Feedback (DFB) lasers operating in the C-band is intensity modulated with the pseudo random bit sequence (PRBS) data, amplified using Erbium doped fiber amplifier (EDFA) and mixed in the photomixer to generate the THz wave at 0.14 THz. A beam splitter is used to divide the collimated Gaussian beam into two separate channels. Each channel is then encoded with the phase mask creating two different OAM modes. In Fig.2, we show the design of a spiral and porous phase masks that we 3D print using PlasCLEAR. The inverse phase masks convert the vortex beams back to Gaussian beams. The THz signal is then directly demodulated by the Schottky detector and the baseband signal is pre-amplified using the low noise amplifier.

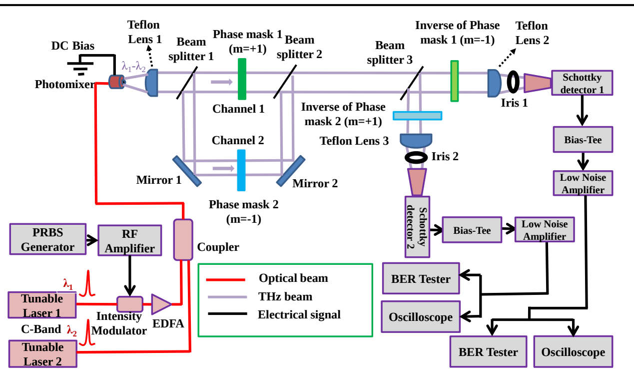

Fig.1. Schematic of the Terahertz wireless communication system with OAM multiplexing and demultiplexing.

a) b)

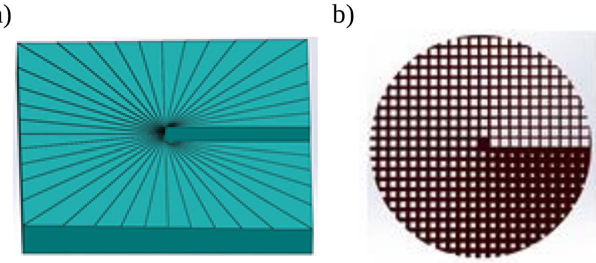

Fig.2. a) Spiral and b) Porous phase mask designed for

In Fig.3, we present the result of validation (doughnut shaped amplitude and vortex phase) of spiral phase mask at 0.14 THz using a THz time-domain imaging system.

a) b)

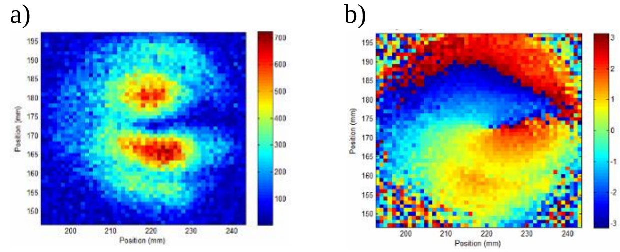

Fig.3. a) Amplitude and b) Phase of the porous phase mask at 0.14 THz measured using a THz time-domain system.

CONCLUSION

A photonic based THz wireless communication system operating at 140 GHz with OAM multiplexing using spiral and porous phase mask has been designed and established. The comparison and performance of the system will be presented with a data rate of 1 Gbps.

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