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Antennas and Packaging for a Photonic-Assisted Multi-User Wireless Link

This talk presents antennas and packaging solutions for a photonic-assisted multi-user wireless link operating in the sub-terahertz (sub-THz) band around 300 GHz. While the vast absolute bandwidth available at these frequencies offers the potential for ultra-high data rates, significant challenges remain—most notably, high free-space path loss and limited transmitter output power. These issues necessitate the use of high-gain directional antennas, often referred to as pencil beams, to efficiently concentrate radiated power. Furthermore, enabling simultaneous high-speed data transmission to multiple users requires the ability to radiate and steer multiple beams concurrently.

To address these challenges, we explore the use of planar and rectangular waveguide leaky-wave antennas [1][2], integrated within a packaging concept that combines a uni-traveling-carrier photodiode (UTC-PD), a sub-THz power amplifier, and a high-gain antenna [3]. Two distinct antenna and packaging integration strategies are experimentally demonstrated.

- A **miniaturized hybrid integration platform**, which combines components fabricated in different technologies using low-loss, broadband, 3D-printed interconnects.

- **Split-block waveguide modules** interconnected via standard WR3 waveguide flanges for robust and precise alignment.

In addition, a novel **conformal lens design** is introduced to further enhance the effective isotropic radiated power (EIRP) of the system [2].

A photonic-assisted multi-user wireless link demonstration over a 16-meter distance achieves data rates of up to **80 Gbps using 16-QAM modulation** [4], underscoring the feasibility and performance potential of the proposed system.

References:

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