

International Traveling Summer School on Terahertz Sciences and Technology (ITSS-TSaT) 2024

Student challenge project

Title: Multiple Laser Integrated Photonic for Broadband THz devices
Supervisor: Shihab Al-Daffaie

General description

Terahertz radiation is not yet widely used despite its enormous potential for applications in food safety, biomedicine, and communications. The main obstacle for many scientific and commercial applications is the lack of suitable sources and detectors of THz radiation with sufficient power and sensitivity, and small footprint and portability. Currently, available photonic-based THz systems have already demonstrated great potential in terms of high tunability, standard room temperature operation, and signal quality. However, they still suffer from many drawbacks, such as large device size (requires an optical stage), mechanical disturbances (in addition to noise and alignment), high power consumption (electrical and optical), and low system flexibility (each application requires a new setup). Therefore, the researcher proposes a new THz system platform that aims to overcome all the above mentioned drawbacks. It is based on photonic integrated circuits (PICs) and nanotechnology. The target system-on-chip includes a fully integrated THz source such and detector with enhanced emission power and sensitivity. This is achieved by using photonics-based THz sources (such in Figure 1) and detectors with co-integrated electronics and terahertz antenna. The THz system-on-chip will find applications in areas such as communications, food safety and biomedicine, among others. The integration platform built in this project will represent a technological leap from current bulky devices to an extremely flexible, portable and energy-efficient THz system-on-chip.

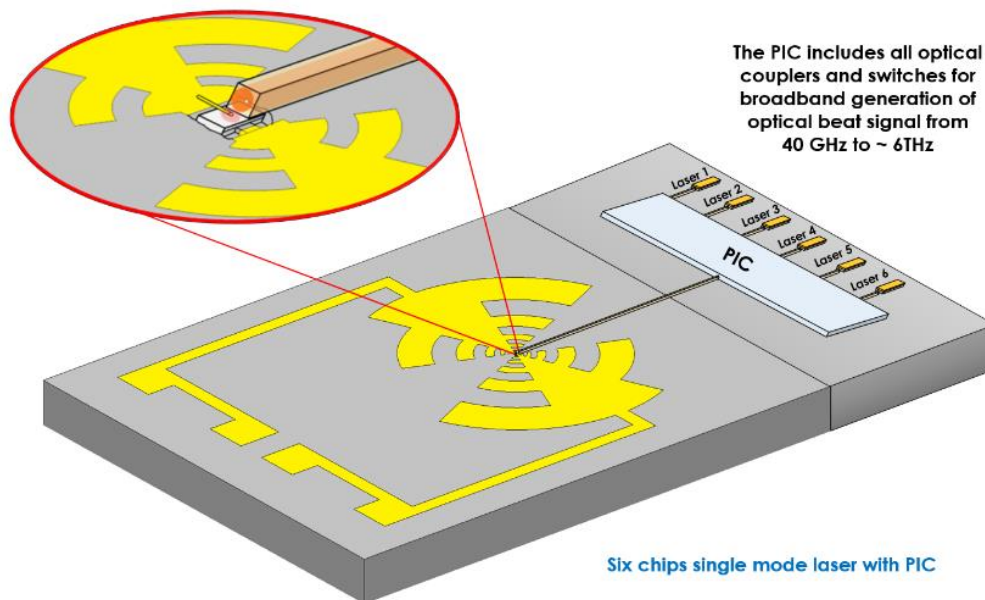


Figure 1: Integrated photonic of six laser sources for broadband THz transmitter.

Students task description

Task 1: What is the state of the art in photonic integrated circuits?

Task 2: Explore the benefits of using photonic integrated circuits in THz applications.

Task 3: What requirements/specifications do you need to integrate a THz emitter with its laser sources?

References:

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- [7] J. Xu, L. Hou, Q. Deng, L. Han, S. Liang, H. Zhu, and J. H. Marsh, "Optoelectronic THz Frequency Synthesizer Based on a Multiple Laser Photonic Integrated Circuit," in *Conference on Lasers and Electro-Optics, OSA Technical Digest* (2016) (Optica Publishing Group, 2016), paper STh1I.1.