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Ultrafast, low-noise, THz graphene photodetectors and applications in quantum science

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Bi-dimensional nano-materials and related heterostructures are establishing themselves as intriguing material systems for the development of electronic, photonic and plasmonic quantum devices with properties that can be engineered “from scratch”. Their peculiar band-structure and electron transport characteristics, which can be easily manipulated via layer thickness control, indeed suggest they could also form the basis for a new generation of high-performance devices operating in the Terahertz frequency range (1-10 THz) of the electromagnetic spectrum.

In this talk, I will review recent advances in the design and realization of state-of-the-art THz photothermoelectric high-speed, low noise detectors based on two-dimensional materials and related heterostructures with a focus on the role of material and cavity engineering in optimizing device performance, and the current challenges toward scalable and integrated THz technologies.

Finally, I will discuss emerging perspectives for the use of these platforms in quantum science, with a focus on their potential impact on future quantum sensing and opti communication architectures, where fast, sensitive, and compact THz detection may provide new functionalities and operational regimes.

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