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# Experimental detection of quantum coherent phenomena in artificial nanomaterials

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2D electronic spectroscopy (2DES) techniques have become increasingly popular due to their ability to track ultrafast coherent and non-coherent processes in real time [1]. 2DES has garnered significant attention for its role in studying energy and charge transport in complex systems (from biological light-harvesting proteins [2] to solid-state materials [3]), where it has revealed unexpected dynamics driven by quantum effects. Recently, it has also been recognized as a valuable tool for examining transport processes in artificial nanomaterials and nanodevices. This lecture will provide examples of experimental detection of coherent phenomena that drive relaxation dynamics in artificial nanomaterials [4, 5] within the sub-picosecond timescale. Despite the varying nature of the samples reviewed, quantum phenomena consistently appear to dominate the early stages of relaxation dynamics.

[1] E.Fresch et al., Nature Reviews Methods Primers 2023, 3, 84; E.Collini, J Phys Chem C 2021, 125, 13096.

[2] G.Marcolin et al., J Phys Chem Lett 2024, 15, 2392; E. Meneghin et al., Nature Comm 2018, 9, 3160.

[3] E.Collini et al., J Phys Chem C 2020, 124, 16222; JR Hamilton et al., Adv Quantum Technol 2022, 2200060.

[4] A Casotto et al., JACS 2024, 146, 14989.

[5] N. Peruffo et al., Adv Opt Mater 2023, 2203010; F. Toffoletti et al., 2025, in preparation.

## Theme

**Primary author:** COLLINI, elisabetta (DiSC)

**Presenter:** COLLINI, elisabetta (DiSC)

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