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Aula Voci – Dept. of Physics and Astronomy “G. Galilei”

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Shaping Light Across Dimensions: Upconversion PL in Bulk, Gels, Thin Films, and Low-Dimensional Photonic Materials

Photon upconversion (UC) in rare-earth (RE) doped phosphors has evolved remarkably with advancements in synthesis and nanostructuring techniques. The tunability of their optical output through controlled excitation parameters has enabled diverse applications, spanning light-emitting displays, lasers, QD-LEDs, optoelectronic devices, multiplexed bio-labelling, luminescent solar concentrators (LSCs), and optical thermometry. Beyond conventional bulk and gel-based phosphors, the exploration of UC photoluminescence in mechanically exfoliated 2D semiconductors such as GaTe, WS₂, MoSe₂, and ZnInS₄ opens new directions for nanoscale optical sensing and temperature-dependent emission studies. Our work includes detailed investigations of temperature-dependent PL in strained and unstrained GaTe nanosheets, two-photon excitation in WSe₂, and polarization-dependent UC anisotropy across wide temperature ranges (12–700 K). Moreover, UC-assisted white-light generation (WLG) through 1D photonic crystal architectures, including undoped aluminosilicate and titania multilayers designed as Bragg mirrors and Fabry–Pérot microcavities, demonstrates how photonic structuring can enhance emission efficiency. This talk will highlight the evolution of UC PL research from bulk to low-dimensional systems, emphasizing the underlying physics, emerging applications, and prospective directions in advanced photonic materials engineering.



Dr. Prasenjit Prasad Sukul is a physicist and materials scientist with over ten years of research experience in photoluminescence spectroscopy, optical thermometry, and upconversion nanomaterials. He is currently a Researcher at the Centro de Química Estrutural, Instituto Superior Técnico (IST), Universidade de Lisboa, Portugal, where his work focuses on 1D photonic crystal-enhanced upconverted white LEDs and rare-earth (RE) ion-doped phosphors for photonic and optoelectronic applications.

Previously, Dr. Sukul held research faculty appointments at Missouri University of Science and Technology (USA), postdoc fellow at the University of the Free State (South Africa), and a PhD researcher at the Indian Institute of Technology (ISM) Dhanbad (India), with collaborative fellowships at the University of Minnesota, twin cities (USA) and the Karlsruhe Institute of Technology (Germany). His interdisciplinary projects have explored strain-

engineered photoluminescence in 2D materials, thin-film solar concentrators, and metasurface-based optical sensing.

Condensed Matter Seminars