
UNIVERSITÀ DEGLI STUDI
DI TRENTO
Dipartimento di Fisica

# Dott. Simone Lamon

*University of Shanghai for Science and Technology, China*

**Thursday 26th March 2026 - 14:30 p.m.**
**Aula A207 – Polo Ferrari 1**

## Topology-Engineered Upconversion Nanoparticles for Low-Power U-STED Super-Resolution Imaging

**Abstract:**

**Lanthanide-doped upconversion nanoparticles (UCNPs) are attractive probes for super-resolution microscopy due to their photostability, non-bleaching emission, and compatibility with low-intensity near-infrared excitation. However, achieving efficient upconversion stimulated emission depletion (U-STED) imaging remains challenging, as conventional UCNP designs largely overlook the role of spatial ion topology, leading to inefficient energy transfer and high laser power requirements. Here, we introduce a topology-driven design strategy that engineers energy transfer networks in core–shell UCNPs to enable low-power U-STED imaging without sacrificing emission brightness. By spatially separating $Yb^{3+}$ sensitizers and $Tm^{3+}$ activators within 50-nm nanoparticles, we create geometry-controlled energy pathways that enhance energy migration and cross-relaxation.**
**This results in strong 450-nm upconversion emission and a reduced saturation intensity of 0.06 MW $cm^{-2}$. Using this optimized architecture, we achieve U-STED imaging with 65-nm lateral resolution at substantially reduced excitation and depletion powers, establishing topology-guided dopant engineering as a powerful design principle for low-phototoxicity super-resolution imaging.**

**Contact:**
Department of Physics
Via Sommarive, 14
38123 Povo, Trento
+39 0461/283172
chiara.rindone@unitn.it

**Scientific Coordinator:**
prof. Lorenzo Pavesi