

W E B I N A R

Controlling two-photon interference and entanglement with mechanical rotations

Prof Marko Toroš (University of Ljubljana, Slovenia)

Friday, 2 October 2026 @ 14h00-15h00 SAST

Venues: Streamed in the NITheCS Seminar Room, Stellenbosch University; & online

ABSTRACT:

Optical experiments on rotating platforms provide an accessible setting for exploring the interplay between quantum mechanics and relativistic motion. In this talk, I will review experimental and theoretical results showing how low-frequency mechanical rotations can control two-photon interference and the observable signatures of photonic entanglement.

I will discuss experiments demonstrating rotation-induced changes in photon bunching and the symmetry of entangled states, followed by proposals to generate entanglement through mechanical rotation. These include entanglement between a photon's path and polarisation degrees of freedom, as well as entanglement between spatially separated photons with correlations that violate Bell inequalities. I will conclude by discussing potential applications to quantum sensing and prospects for investigating gravitational effects, including frame dragging.

[1] S Restuccia, M Toroš, GM Gibson, H Ulbricht, D Faccio, MJ Padgett, Photon bunching in a rotating reference frame, Phys. Rev. Lett. **123**, 110401 (2019)

[2] M Toroš, S Restuccia, GM Gibson, M Cromb, H Ulbricht, MJ Padgett, D Faccio. Revealing and concealing entanglement with noninertial motion, Phys. Rev. A **101**, 043837 (2020)

[3] M Cromb, S Restuccia, GM Gibson, M Toroš, MJ Padgett, D Faccio, Mechanical rotation modifies the manifestation of photon entanglement, Phys. Rev. Research **5**, L022005 (2023)

[4] M Toroš, M Cromb, M Paternostro, D Faccio, Generation of Entanglement from Mechanical Rotation, Phys. Rev. Lett. **129**, 260401 (2022)

[5] M Toroš, MC Braidotti, M Paternostro, MJ Padgett, D Faccio, Generating quantum non-local entanglement with mechanical rotations, Phys. Rev. Research **7**, 033197 (2025)

BIOGRAPHY:

Marko Toroš is an Assistant Professor at the University of Ljubljana, where he leads the Quantum Theory Group. Working at the interface of theory and experiment, his research spans quantum optics, levitated optomechanics, open quantum systems, quantum foundations and quantum gravity, linking fundamental physics with quantum technologies. His work includes proposals to test the quantum nature of gravity through gravity-mediated entanglement, theoretical modelling of the dynamics, control and sensing of levitated nanoparticles, and studies showing how mechanical rotation can control photon interference, entanglement and nonlocality.

He obtained his PhD from the University of Trieste in 2017 and has held research positions at the University of Southampton, University College London and the University of Glasgow.



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