

# Generation of second harmonic vortex beams at the nanoscale

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## Abstract

In the last years, all-dielectric nonlinear metasurfaces (MSs) have brought harmonic generation to sub-wavelength level, with frequency, spatial and polarization control unachievable in bulk crystals. Not only does nonlinear meta-optics define a field for investigating nonlinear physics at the nanoscale, but it also opens promising perspectives in electromagnetic engineering. In this seminar, I will first briefly review the evolution of this young research field, from modeling to technology and experimental techniques, with a focus on  $\chi^{(2)}$  nonlinear nanoantennas and MSs. Then, based on the  $\chi^{(2)}$  tensorial features of AlGaAs MSs, I will present our demonstration of  $0-2\pi$  phase-front control at the level of single meta-atoms, on an harmonic field generated for the first time with a sufficient efficiency for practical purposes. Finally, I will show our recent results in the second harmonic generation (SHG) of beams with non-zero orbital angular momentum (OAM) with such MSs, with a perspective on the SHG of more complex vortex beam topologies like knots or links. In the future, the control of the OAM of harmonic beams might provide an additional degree of freedom to the creative design of new nonlinear MSs.

**11:30 a.m. - May 15, 2023**

**IIT Center for Nanoscale Systems - Via Rubattino 81, 20134 - Milano**



## About the speaker

*Giuseppe Leo (b. 1966) received a Laurea degree (cum laude) in EE at La Sapienza, Rome (1990), and a PhD in Physics at Paris-Sud University (2001). He has been with Roma Tre University as assistant (1992-2002) then associate professor (2002-04), and visiting scientist at CSELT (1994-95) and Thomson-CSF (1998). Since 2004 he has been full professor at Université Paris Cité (formerly Paris Diderot), where he founded and directed the Denis Diderot School of Engineering (2010-22) and led the Nonlinear Optical Devices group of MPQ since 2007. His research is in nonlinear integrated optics, nanophotonics and metasurfaces. OSA Fellow since 2019, he coordinates and/or participates in several national and EU research programs. Prof. Leo served as co-chair in SPIE Photonics West and Optica MICS conferences, and he is member of the editorial board of Opto-Electronic Advances. He produced 130 articles, 2 books, 13 book chapters and 4 patents, and he gave 100 invited and 4 keynote conference presentations (h-38).*

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