



Valerio Flavio Gili

Curriculum Vitae

Education

- 2015–2018 **PhD in Physics**, Sorbonne Paris cité, Université Paris Diderot - Paris 7, Paris.
- 2012–2014 **Master's Degree in Physics**, University of studies of Rome "La Sapienza", Rome, final score 110/110 .
- 2009–2012 **Bachelor's Degree in Physics**, University of studies of Rome "La Sapienza", Rome.
- 2004–2009 **Scientific High School**, Istituto San Giuseppe del Caburlotto, Rome.

PhD thesis

- Title *All-dielectric nonlinear nanophotonics*
- Funding Sorbonne Paris cité - Contract Doctoral "Double Culture"
- Supervisors Prof. Giuseppe Leo (Université Paris Diderot) & Dott. Andrei Kanaev (Paris 13)
- Description The purpose of this project is to demonstrate the capabilities of a new monolithic Aluminium Gallium Arsenide (AlGaAs) on Aluminium Oxide (AlOx) nonlinear photonic platform. The novelty of our approach consists in the efficient and selective oxidation of an AlGaAs layer with high Al content, while the active structures are lithographically patterned in an Al-poor layer, exhibiting both negligible oxidation and Two-photon-absorption-free operation at telecom wavelengths. The high lateral and vertical refractive index contrast provided by the adoption of an AlOx substrate allows to access the Mie theory regime at the nanoscale, enabling the demonstration of enhanced nonlinear optical frequency conversion in resonant nanostructures. The results we achieved include the observation of Second Harmonic Generation from isolated nanocylinders, dimers, hybrid AlGaAs-Au nanostructures. We studied as well the polarization properties of the measured nonlinear emission and we were able to control the SHG radiation pattern through pump reconfiguration and the integration of asymmetric diffraction gratings. Finally, we observed other two second-order mixing effects connected to each other through quantum-classical correspondence, i.e. Sum-frequency Generation (SFG) and Spontaneous Parametric Down-conversion (SPDC).

NANOPHI visiting program

- Title *SFG nonlinear imaging*
- Period December 2017- June 2018
- Host University The Australian National University - Canberra
- Supervisor Prof. Dragomir Neshev
- Description My PhD project also fell within the contest of the "NANOPHI project", funded by the ERASMUS MUNDUS Action 2 Strand 2 program, and coordinated by the University of Brescia. The project run from 2014 to 2018 with the purpose of strengthening partnerships between leading European and Asian Pacific research groups in the field of nanophotonics. Thanks to this project, I was able to interact and work with the group led by Dragomir Neshev in The Australian National University of Canberra. During my stay, I was working on the optimization of a pump-probe optical setup, delivering pulses at 1550nm and 840nm, for Sum-frequency Generation (SFG) measurements. Once the setup was operational and SFG from an AlGaAs metasurface was observed, we demonstrated nonlinear imaging, i.e. transfer of a certain light structure from the fundamental to the harmonic frequency achieved through the nonlinear process.

Master's Internship

- Title *Quantum Validation of Boson Sampling*
- Supervisors Professor Paolo Mataloni & Professor Fabio Sciarrino
- Description In the frame of the Photonics' approach to Quantum Information, this thesis experimentally explored the Validation problem in an integrated linear photonic device for Boson Sampling, a promising model of Quantum Simulation with non-interacting photons. The experimental challenges comprised preparation of a high-quality single-photon source, complete characterization of the evolution of the generated photons' quantum state implemented by the integrated chip via single-photon and two-photon measurements. The chip was fabricated in "Politecnico di Milano", in the group led by Roberto Osellame, with the femtosecond-laser writing technique, enabling the fast, mask-less and 3D realization of photonics circuits on a low-cost borosilicate glass substrate.

Bachelor's thesis

- Title *Quantum logic gates with quantum optics*
- Supervisor Professor Fabio Sciarrino
- Description This brief thesis reviewed the recent advances in the experimental implementation of quantum single-qubit and two-qubit logic gates, the fundamental bricks needed to achieve Universal Quantum Computation. In particular I focused on the frame of the Quantum Optics' approach to Quantum Information and investigated a recently developed technique for chip fabrication: Femtosecond-laser writing technique.

List of publications

Journal articles

- (1) *Monolithic AlGaAs second-harmonic nanoantennas*, V. F. Gili, L. Carletti, A. Locatelli, D. Rocco, M. Finazzi, L. Ghirardini, I. Favero, C. Gomez, A. Lemaître, M. Celebrano, C. De Angelis, and G. Leo, *Optics Express* 24, 15965 (2016).
- (2) *Polarization properties of second-harmonic generation in AlGaAs optical nano antennas*, L. Ghirardini, L. Carletti, V. Gili, G. Pellegrini, L. Duó, M. Finazzi, D. Rocco, A. Locatelli, C. De Angelis, I. Favero, M. Ravaro, G. Leo, A. Lemaître, and M. Celebrano, *Optics Letters* 42, 559 (2017).
- (3) *Controlling second-harmonic generation at the nanoscale with monolithic AlGaAs-on-AIOx antennas*, L. Carletti, D. Rocco, A. Locatelli, C. De Angelis, V. F. Gili, M. Ravaro, I. Favero, G. Leo, M. Finazzi, L. Ghirardini, M. Celebrano, G. Marino, and A. V. Zayats, *Nanotechnology* 28, 114005 (2017).
- (4) *Role of the substrate in monolithic AlGaAs nonlinear nanoantennas*, V.F. Gili, L. Carletti, F. Chouchane, G. Wang, C. Ricolleau, D. Rocco, A. Lemaître, I. Favero, L. Ghirardini, M. Finazzi, M. Celebrano, C. De Angelis, and G. Leo, *Nanophotonics* 7, 2 (2018).
- (5) *Tuning the second-harmonic generation in AlGaAs nanodimers via non-radiative state optimization*, D. Rocco, V.F. Gili, L. Ghirardini, L. Carletti, I. Favero, A. Locatelli, G. Marino, D.N. Neshev, M. Celebrano, M. Finazzi, G. Leo, and C. De Angelis, *Photonics Research* 6, 5 (2018).
- (6) *Imaging Electric and Magnetic Modes and their Hybridization in Single and Dimer AlGaAs Nanoantennas*, C.P.T. McPolin, G. Marino, A.V. Krasavin, V.F. Gili, L. Carletti, C. De Angelis, G. Leo, and A.V. Zayats, *Advanced Optical Materials*, accepted (2018).
- (7) *Metal- dielectric hybrid nanoantennas for efficient frequency conversion at the anapole mode*, V.F. Gili, L. Ghirardini, D. Rocco, G. Marino, I. Favero, I. Roland, G. Pellegrini, L. Duó, M. Finazzi, L. Carletti, A. Locatelli, A. Lemaître, D.N. Neshev, C. De Angelis, G. Leo, and M. Celebrano, *Beilstein Journal of Nanotechnology*, accepted (2018).
- (8) *Shaping the nonlinear emission pattern of a dielectric nanoantenna by holographic gratings*, L. Ghirardini, G. Marino, V.F. Gili, I. Favero, D. Rocco, L. Carletti, A. Locatelli, C. De Angelis, M. Finazzi, M. Celebrano, D.N. Neshev, and G. Leo, *Nano Letters*, submitted (2018).
- (9) *Nonlinear goniometry by second harmonic generation in AlGaAs nanoantennas*, L. Carletti, G. Marino, L. Ghirardini, V.F. Gili, D. Rocco, I. Favero, A. Locatelli, A.V. Zayats, M. Celebrano, M. Finazzi, G. Leo, C. De Angelis, and D.N. Neshev, *ACS Photonics*, submitted (2018).
- (10) *Optical nanoantenna for nonlinear generation of heralded photons*, G. Marino, A.S. Solntsev, L. Xu, V. F. Gili, L. Carletti, A.N. Poddubny, M. Rahmani, D.A. Smirnova, H. Chen, G. Zhang, A.V. Zayats, C. De Angelis, G. Leo, Y.S. Kivshar, A.A. Sukhorukov, and D.N. Neshev, *in preparation*.

Other experiences

2012–present **Private Tutoring**, Rome.

I held private lessons for high school and university students who have difficulties in mathematics, physics and statistics.

February, **Bartender**, Rome.

March and May 2015 I was hired as a bartender at the Olympic Stadium during the sports events of "Rugby Six Nations" and "Internazionali BNL di tennis".

Computer skills

Intermediate C, G, \LaTeX , OpenOffice, Linux, Mathematica
knowledge:

2007 **Microsoft Windows**, *Obtained the European Computer Driving Licence (ECDL)*, Rome.

Languages

Italian **Mothertongue**

English **Fluent**

Obtained CAE in 2007, IELTS in 2009

French **Fluent**

Obtained DELF A2 in 2008

Spanish **Basic**

Basic words and phrases only

Interests and Sports

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|----------------------------|---------------------------|
| - Piano | - 2000-present |
| - Swimming | - 2004-2010, 2014-present |
| - Mixed Martial Arts (MMA) | - 2010-2014 |
| - Volunteering | - 2013 |