Francesco Basso Basset

Curriculum Vitae

Work Experience

03/2021–current **Postdoctoral Researcher**, *Sapienza University of Rome, Physics Department*, Rome (Italy).

Research project on quantum communication using entangled photons emitted from quantum dots, performed in the Nanophotonics group (P.I.: Prof. Rinaldo Trotta, link) under the project FET Open QUROPE.

Achieved secure quantum communication at a distance based on entanglement generated by quantum dots (work published on *Science Advances*) in collaboration with the Quantum Information Lab group lead by Prof. Fabio Sciarrino.

02/2018–02/2021 **Postdoctoral Researcher**, *Sapienza University of Rome, Physics Department*, Rome (Italy).

Research project on entangled photon sources based on epitaxial quantum dots, performed in the Nanophotonics group (P.I.: Prof. Rinaldo Trotta, link) under the project ERC Starting Grant SPQRel.

Main scientific goals achieved related to the original use of quantum dots in quantum optics experiments, such as entanglement swapping (published on *Physical Review Letters*) and quantum teleportation (published on *npj Quantum Information*).

Active international collaborations with several research institutes: Johannes Kepler University Linz (Prof. Armando Rastelli), University of Paderborn (Prof. Klaus D. Jöns), KTH Stockholm (Prof. Val Zwiller), Tyndall National Institute Cork (Prof. Emanuele Pelucchi), University of Milano-Bicocca (Prof. Stefano Sanguinetti).

Education and Training

12/2014–03/2018 **PhD in Materials Science and Nanotechnology**, *University of Milano-Bicocca*, Milan (Italy).

Research project focused on the design, modeling and optical characterization of an innovative class of GaAs nanostructures, based on droplet epitaxy, as a material for the development of entangled photon sources. Secondary activities on similar semiconductor quantum dots and ultrathin films of transition metal dichalcogenides for other applications in optoelectronics.

Thesis title: GaAs nanostructures for the generation of entangled photons: design, development, and spectroscopy. Activities performed at the Laboratory of Semiconductor Spectroscopy of the University of Milano-Bicocca in close collaboration with the Interuniversity Center L-NESS in Como.

11/2016–06/2017 **Research Traineeship**, *Johannes Kepler University Linz, Institute of Semiconductor and Solid State Physics*, Linz (Austria).

Research period spent abroad during the PhD program working in advanced optical spectroscopy and semiconductor microfabrication laboratories. Supported by the Erasmus+ Traineeship program (supervisor: Prof. Rinaldo Trotta, mentor: Prof. Armando Rastelli).

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03/2012–07/2014 **Master's Degree in Physics**, *University of Milan*, Milan (Italy), *mark 110 out of 110, cum laude*.
Thesis title: Elastic and plastic properties of Ge mesostructures integrated on Si investigated by optical spectroscopy. Activity performed at the Laboratory of Semiconductor Spectroscopy of the University of Milano-Bicocca in close collaboration with the Interuniversity Center L-NESS in Como.

10/2008–02/2012 **Bachelor's Degree in Physics**, *University of Milan*, Milan (Italy), *mark 110 out of 110, cum laude*.
Thesis title: Time-resolved emission spectroscopy of free carbon clusters. Activity performed at the Interdisciplinary Centre for Nanostructured Materials and Interfaces of the University of Milan.

09/2003–07/2008 **Secondary School Leaving Certificate in Scientific Studies**, *Liceo Scientifico Statale "Edoardo Amaldi"*, Alzano Lombardo (BG, Italy), *mark 100 out of 100*.

Language Skills

Italian	Mothertongue	
English	Advanced	*Fluent in conversation and writing*
German	Basic	*Only basic words and expressions*

Digital Skills

Excellent	Microsoft Office (word processor, spreadsheet, presentation program), MATLAB programming language
Good	NI LabVIEW development environment, Mathematica computing environment
Basic	C/C++ programming language, Bash scripting language

Technical Skills

Wide experience in experimental techniques of semiconductor physics and quantum optics acquired during the PhD and postdoctoral activities:

- High level of experience in the realization of quantum communication protocols (quantum teleportation, entanglement swapping, quantum key distribution) in photonic systems.
- High level of experience in advanced optical characterization techniques (micro-Raman, time- and polarization-resolved micro-photoluminescence, Michelson interferometry, temporal correlation of optical signals, quantum tomography).
- High level of experience in high-vacuum and cryogenic technologies.
- Experience with microfabrication techniques in the cleanroom (selective chemical etching, metalization, and thermo-adhesive wafer bonding).
- Excellent knowledge of molecular beam epitaxy deposition techniques and of morphological characterization using atomic force microscopy.

Laboratory experience in other solid-state physics experimental techniques acquired during the Master's degree:

- Optical characterization (UV-VIS and IR absorption, ellipsometry).
- Morphological characterization (atomic force microscopy, profilometry).

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- Growth of nanostructured materials (evaporation, sol-gel, pulsed microplasma cluster source).

Proficiency in the theoretical and practical tools required for the analysis and interpretation of experimental data.

Refined skills of research, critical selection, and synthesis of scientific and technical literature.

Organizational Skills

Key skills developed during the PhD program and the postdoctoral fellowships:

- Marked problem-solving skills.
- Ability to independently plan and carry out work activities.
- Good inclination towards teamwork, both within a research group and in external collaborations.
- Experience in the supervision and training of Master's and PhD students.
- Aptitude towards quickly learning new technical knowledge and competences aimed at the solution of practical problems.
- Familiarity with several channels of written and oral communication, from within the work group to dissemination in front of an international audience.

Bibliometric Indicators

Google Scholar (link). Citations: 266. *h*-index: 10.

Scopus (link). Citations: 165. *h*-index: 6.

Publications

[1] Neuwirth J., Basso Basset F., Rota M. B., Roccia E., Schimpf C., Jöns K. D., Rastelli A. and Trotta R., Quantum dot technology for quantum repeaters: from entangled photon generation towards the integration with quantum memories. *Materials for Quantum Technology* **1**, 043001 (2021).

[2] Carvacho G., Roccia E., Valeri M., Basso Basset F., Poderini D., Pardo C., Polino E., Carosini L., Rota M. B., Neuwirth J., Covre da Silva S. F., Rastelli A., Spagnolo N., Chaves R., Trotta R. and Sciarrino F., Quantum violation of local causality in urban network with hybrid photonic technologies. *arXiv:2109.06823*, (2021).

[3] Vichi S., Bietti S., Basso Basset F., Tuktamyshev A., Fedorov A. and Sanguinetti S., Optically controlled dual-band quantum dot infrared photodetector. *arXiv:2103.03582*, (2021).

[4] Schimpf C., Reindl M., Basso Basset F., Jöns K. D., Trotta R. and Rastelli A., Quantum dots as potential sources of strongly entangled photons for quantum networks. *Applied Physics Letters* **118**, 100502 (2021) [Editor's Pick].

[5] Basso Basset F., Valeri M., Roccia E., Muredda V., Poderini D., Neuwirth J., Spagnolo N., Rota M. B., Carvacho G., Sciarrino F. and Trotta R., Quantum key distribution with entangled photons generated on-demand by a quantum dot. *Science Advances* **7(12)**, eabe6379 (2021).

[6] Ranjbar Jahromi I., Juska G., Varo S., Basso Basset F., Salusti F., Trotta R., Gocalinska A., Mattana F. and Pelucchi E., Optical properties and symmetry optimization of spectrally (excitonically) uniform site-controlled GaAs pyramidal quantum dots. *Applied Physics Letters* **118**, 073103 (2021).

[7] Basso Basset F.*, Salusti F., Schweickert L., Rota M. B., Tedeschi D., Covre da Silva S. F., Roccia E., Zwiller V., Jöns K. D., Rastelli A. and Trotta R., Quantum teleportation with imperfect quantum dots. *npj Quantum Information* **7**, 7 (2021). *corresponding author

[8] Rota M. B., Basso Basset F., Tedeschi D. and Trotta R., Entanglement teleportation with photons from quantum dots: toward a solid-state based quantum network. *IEEE Journal of Selected Topics in Quantum Electronics* **26(3)**, 1-16 (2020).

[9] Bietti S., Basso Basset F., Tuktamyshev A., Bonera E., Fedorov A. and Sanguinetti S., High-temperature droplet epitaxy of symmetric GaAs/AlGaAs quantum dots. *Scientific Reports* **10**, 6532 (2020).

[10] Basso Basset F., Rota M. B., Schimpf C., Tedeschi D., Zeuner K. D., Covre da Silva S. F., Reindl M., Zwiller V., Jöns K. D., Rastelli A. and Trotta R., Entanglement swapping with photons generated on-demand by a quantum dot. *Physical Review Letters* **123(16)**, 160501 (2019).

[11] Basso Basset F.*, Bietti S., Tuktamyshev A., Vichi S., Bonera E. and Sanguinetti S., Spectral broadening in self-assembled GaAs quantum dots with narrow size distribution. *Journal of Applied Physics* **126(2)**, 024301 (2019). *corresponding author

[12] Bietti S., Basso Basset F., Scarpellini D., Fedorov A., Ballabio A., Esposito L., Elborg M., Takashi K., Nemcsics A., Tóth L., Manzoni C., Vozzi C. and Sanguinetti S., Ga metal nanoparticle-GaAs quantum molecule complexes for terahertz generation. *Nanotechnology* **29(36)**, 365602 (2018).

[13] Basso Basset F.*, Bietti S., Reindl M., Esposito L., Fedorov A., Huber D., Rastelli A., Bonera E., Trotta R. and Sanguinetti S., High-yield fabrication of entangled photon emitters for hybrid quantum networking using high-temperature droplet epitaxy. *Nano Letters* **18(1)**, 505-512 (2018). *corresponding author

[14] Marzegalli A., Cortinovis A., Basso Basset F., Bonera E., Pezzoli F., Scaccabarozzi A., Isa F., Giovanni Isella G., Zaumseil P., Capellini G., Schroeder T. and Miglio L., Exceptional thermal strain reduction by a tilting pillar architecture: Suspended Ge layers on Si (001). *Materials & Design* **116**, 144-151 (2017).

[15] Vangelista S., Cinquanta E., Martella C., Alia M., Longo M., Lamperti A., Mantovan R., Basso Basset F., Pezzoli F. and Molle A., Towards a uniform and large-scale deposition of MoS_2 nanosheets via sulfurization of ultra-thin Mo-based solid films. *Nanotechnology* **27(17)**, 175703 (2016).

Presentations

Invited talks

09/2020 YIQIS 2020, Young Italian Quantum Information Science Conference, online.

01/2019 PQE-2019, 49th Winter Colloquium on the Physics of Quantum Electronics (Snowbird, Utah, USA).

09/2018 NanoInnovation 2018, at the Sapienza University of Rome (Rome).

09/2017 Semicon Nano 2017, 6th International Workshop, Epitaxial Growth and Fundamental Properties of Semiconductor Nanostructures at the Centro Congressi Sala Bianca del Teatro Sociale in Como (Como).

Talks

10/2021 IQIS 2021, 13th Italian Quantum Information Science Conference at the Centro Congressi Federico II (Napoli).

09/2021 OECS 17, International conference on optics of excitons in confined systems, online.

12/2020 QD2020, 11th International Conference on Quantum Dots, online.

11/2020 QTech 2020, Quantum Technology International Conference, online.

10/2020 Quantum 2020, IOP Publishing Virtual Conference, online.

01/2020 POM20, Photonics Online Meetup 1st edition, online.

11/2017 Italian Crystal Growth 2017, Materials and Methods in Crystal growth at the University of Milano-Bicocca (Milano).

10/2017 FisMat 2017, Italian National Conference on the Physics of Matter at the ICTP-SISSA Miramare Campus (Trieste).

Posters

10/2019 QLight 2019, Quantum devices for non-classical light generation and manipulation at the Centro di Cultura Scientifica Ettore Majorana (Erice).

09/2018 NOEKS 14, 14th International Conference on Nonlinear Optics and Excitation Kinetics in Semiconductors at the TU Berlin (Berlin, Germany).

09/2017 OECS 2017, International conference on optics of excitons in confined systems at the University of Bath (Bath, UK).

02/2016 19th International Winterschool on New Developments in Solid State Physics (Mauterndorf, Austria).

07/2014 International solid-state physics school Epioptics-13 and workshop Silicene-1 at the Centro di Cultura Scientifica Ettore Majorana (Erice).

Seminars and lectures

04/2021 'Entanglement generation from semiconductor quantum dots', seminar for Physics Master's students attending the course Solid-state physics experiments at the University of Milano-Bicocca (Milano).

12/2020 'Sources of single photons based on semiconductor quantum dots', lecture for Physics Master's students attending the course Non Linear and Quantum Optics at the Sapienza University of Rome (Rome).

12/2020 'Sources of single photons based on semiconductor quantum dots', lecture for Physics Master's students attending the course Physics and Nanostructures at the Sapienza University of Rome (Rome).

02/2020, 03/2021 'Nanophotonics lab activity introduction', lecture for Physics Master's students attending the course Physics Laboratory II for Condensed Matter Physics at the Sapienza University of Rome (Rome).

Honors and Awards

2021 Research project "Progetti per Avvio alla Ricerca" funded by the Sapienza University of Rome, title: Experimental investigation of novel entangled states in the photon pair generation from a quantum dot, for a total amount of € 3200.

2020 Research project "Progetti per Avvio alla Ricerca" funded by the Sapienza University of Rome, title: Solid-state-based entangled photon emitters matched to Rb vapor cells as a viable interconnect technology for quantum networks, for a total amount of € 2000.

2016–2017 Erasmus+ Traineeship for an international mobility period at the Johannes Kepler University Linz (Austria), for a total amount of € 3600.

2008–2012 Scholarship "Progetto Lauree Scientifiche" funded by the Società Italiana di Fisica, second place at the national level, for a total amount of € 12000.

Scientific Training

10/2016 Introductory course on high-vacuum technologies from the AIV - Associazione Italiana di Scienza e Tecnologia at the University of Milano-Bicocca (Milano).

09/2015 7th School on Organic Electronics at the Lake Como School of Advanced Studies (Como).

07/2015 International School of Atomic and Molecular Spectroscopy at the Centro di Cultura Scientifica Ettore Majorana (Erice).

09/2012 16th JCNS Laboratory Course Neutron Scattering at the Forschungszentrum Jülich (Jülich, Germany) and Heinz Maier-Leibnitz Zentrum (Garching, Germany).

Other Professional Duties

03/2021–current Scientific reviewer for the journals npj Quantum Information (link), Physical Review B, and Applied Physics Letters.

12/2020–current Review Editor for the journal Frontiers in Photonics, Quantum Optics section. (link)

11/2020–current Postdoctoral representative in the Physics Department Council, Sapienza University of Rome. (link)

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