

Fabrizio Sgrignuoli

Curriculum Vitae

Boston University
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UNIVERSITÀ DEGLI STUDI DI MILANO selezione pubblica per n.1 posto/i di Ricercatore a tempo determinato ai sensi dell'art.24, comma 3, lettera b) della Legge 240/2010 per il settore concorsuale 02/B2-Fisica Teorica della Materia, settore scientifico-disciplinare FIS/03-Fisica della Materia presso il Dipartimento di Fisica Aldo Pontremoli, (avviso bando pubblicato sulla G.U. n.68 01/09/2020) Codice concorso 4445

Personal information

first name Fabrizio
last name Sgrignuoli
place and date of birth Lanciano (Italy), 22 January 1984

Research profile

My current and previous work has positioned me at the intersection of theoretical and computational physics. During my previous experiences, first at the Physics department of the University of Trento and Florence (Italy) and currently at the Boston University, I have built a multi-disciplinary curriculum in numerical and theoretical physics, optical engineering, and applied mathematics. Specifically, I have extensive experience in solving large scale electromagnetic problems using different parallel computing architectures and I have acquired experimental skills in optical physics. Over the past five years, I have worked on a variety of projects which include but are not limited to: development of a light-polarimeter based on Liquid-Crystal-Elastomer material, engineering of cutting-edge laser platforms, demonstration of multifractality of light in the visible regime, design of sensors based on single photon source, and development of new light harvesting schemes for photovoltaic applications.

Work experience

Research experience

12/01/2017 – to date **Research Fellow.**

Title Light scattering from aperiodic media and metamaterials

Supervisor Prof. Luca Dal Negro

Laboratory/Research Skills:

- Computational modeling of complex photonic structures and metamaterials
- Computational design of different photonic components using rigorous theoretical and numerical methods, including finite-difference time-domain (FDTD), finite element method (FEM), and surface integration equations (SIE)
- Developed analytical, statistical and computational methods for optimization of large complex photonic devices
- Engineering novel photonic platforms based on elliptic curves cryptography and algebraic number theory to improve light-matter interactions
- Dark field and back scattering optical setups

03/01/2016 – **Research Fellow.**
11/30/2017

Title Light propagation in random media: interplay between order, disorder and correlation.
D.D.n. 182/2016; Prot.n. 3973(182); date: 01/14/2016

Disciplinary Sector FIS/03

Supervisor Prof. Diederik Sybolt Wiersma

Contract Prot.n. 24489(349); date: 02/19/2016

Laboratory/Research Skills:

- Design and characterization of diffractive optical devices and nanostructures
- Design, modeling and characterization of light propagation through random and turbid media
- Design of complex photonic structures for light harvesting
- Multicore programming techniques C++ based
- Basic elements of Python language
- Back scattering optical setups

09/01/2013 – **Research Fellow.**
02/29/2016

Title Quantum Electrodynamics effects in plasmonic systems.
D.D. n. 55/2013; Prot.n. 864; date: 06/10/2013

Disciplinary Sector FIS/03

Supervisor Prof. Francesco Saverio Cataliotti

Supervisor Dr. Costanza Toninelli

First contract Prot.n. 1257; date: 07/26/2013

Second contract Prot.n. 2566(52); date: 11/26/2014

Laboratory/Research Skills:

- Computational modeling of plasmonic and photonic systems
- Finite Different Time Domain (FDTD) and Finite Element Method (FEM) simulation techniques to design and engineer different photonic components
- Matlab, C++, C, Fortran programming languages
- Basic experience in single photon detection techniques

06/01/2013 – **Research Fellow.**
08/31/2013

Title Silicon Photovoltaic
D.D. n. 56/2013; date: 04/30/2013

Disciplinary Sector FIS/03

Supervisor Prof. Lorenzo Pavesi

Contract date: 05/22/2013

Laboratory/Research Skills:

- Finite Element Method (FEM) simulation techniques
- Modeling of electron-hole transport mechanism in silicon based CMOS structures
- Design, modeling and electrical characterization of back-contact silicon solar cells
- Experience in Technology Computer-Aided-Design (TCAD) to model semiconductor fabrication and semiconductor device operation

Teaching Experience

December 2017 **Teaching Assistant (Boston University).**

Course Nanophotonics

Supervisor Prof. Luca Dal Negro

December 2016 **Teaching Assistant (University of Florence).**

Course Science and Technology of Light

Disciplinary Sector FIS/03

Supervisor Prof. D.S. Wiersma

11/01/2015 – **Teaching Assistant (University of Florence).**

06/10/2016 D.D. n. 5368/2015; Prot.n. 127535; date: 01/10/2015

Course Introductory Physics 1

Disciplinary Sector FIS/03

Contract Prot.n. 144243; date: 10/29/2015

Supervisor Prof. Francesco Saverio Cataliotti

10/01/2010 – **Teaching Assistant (University of Trento).**

12/20/2010

Course Advanced Quantum Mechanics

Disciplinary Sector FIS/03

Contract date: 09/21/2010

Supervisor Prof. Giuseppina Orlandini

Education

Nov.2009 – Mar.2013 **Ph.D in Physics at University of Trento (Trento, Italy)**

Thesis defended on March 26th 2013

Thesis Title *Silicon nanocrystals downshifting for photovoltaic applications*

Mark Excelent

Thesis subject Exploitation of luminescent downshifting effect produced by silicon nanoparticles to improve silicon-solar-cell performances. This work was carried out within the european project LIMA (<http://www.limaproject.eu>).

Supervisor Prof. Lorenzo Pavesi

Sep.2007 – Jun.2009 **Master of Science in Physics at University of Bologna (Bologna, Italy)**

Thesis defended on June 19th 2009

Specialisation Quantum Field Theory

Thesis Title *Induced Lorentz & CPT Invariance Violations in QED*

Mark 110/110 summa cum laude

Thesis subject Modification of the quantum electrodynamics (QED) induced by an axial-vector background coupled to massive fermions. In particular, the possibility of radiative effects induced by the Lorentz and CPT non-invariance interaction terms was investigated.

Supervisor Prof. Roberto Soldati

Sep. 2003 – Jun. 2006 **Bachelor of Science in Physics at University of Bologna (Bologna, Italy)**

Thesis defended on December 15th 2006

Thesis Title *Integer Quantum Hall Effect*

Mark 110/110 summa cum laude

Thesis subject Analysis of the integer quantum Hall effect in two dimensional electron systems.

Supervisor Prof. Fabio Ortolani

Sep.1998 – Jun.2003 **High school diploma at “ liceo scientifico Galileo Galilei” of Lanciano (Chieti, Italy)**

Mark 100/100

Conferences and Workshops

Dates 2019

- **Invited talk:** *"Light localization in hyperuniform sub-random media"*, in Anacapri (Italy) from September 9th to September 11th, Optics at the Nanoscale, special session "Waves in Complex Photonic Media: Fundamental and Device Applications"
- *"Spectral properties of aperiodic Vogel spirals"*, in Boston (USA) from March 4th to March 8th, APS March meeting 2019: **oral presentation**

Dates 2018

- *"Direct visualization of scattering resonances in Complex Prime arrays of dielectric nanoparticles"*, in Anacapri (Italy) from June 4th to June 7th, EOS Topical Meeting on Waves in Complex Photonics Media: **oral presentation**
- *"Light localization in aperiodic Vogel spirals"*, in Anacapri (Italy) from June 4th to June 7th, EOS Topical Meeting on Waves in Complex Photonics Media: **oral presentation**

Dates 2017

- **Invited talk:** *"Light propagation in random media: interplay between order and disorder"*, in Dresden (Germany) from May 8th to May 12th, DINDOS 2017
- **Invited talk:** *"Disordered Photonics: taking inspiration from the "Nature" around us"*, January 19th, Langevin institute, Paris (France)

Dates 2016

- **Invited talk:** *"Necklace state in disordered 2D photonic systems"*, November 4th, College of Optical Science University of Arizona, Tucson USA .
- *Strongly disordered optical systems: from the white paint to cold atoms*, in Cargese (France) from September 26th to September 30th: **oral presentation**.
- *Workshop on Matter Physics 2016*, in Florence (Italy) 19th of February: **oral presentation**.
- *Advances in Photonics and Applications*, in Florence (Italy) from June 9th to June 10th

Dates 2015

- *Quantum Effects in Biological Systems Workshops (QuEBS) 2015*, in Florence (Italy) from June 29th to 2nd July: **poster presentation**.
- *Progress in Electromagnetics Research Symposium (PIERS) 2015*, in Prague (Czech Republic) from July 6th to July 9th: **oral presentation**.
- *Progress in Photonics 2015*, in Florence (Italy) from October 15th to October 16th.
- *INO Annual Symposium 2015*, in Naples (Italy) from November 11th to November 13th: **oral presentation**.

Dates 2014

- *Europhotonics Spring School*, in Porquerolles (France) from March 31st to April 3rd: **poster presentation**.
- *Waves and Disorder Summer School*, in Cargese (France) from June 30th to July 12th: **oral presentation**.
- **Invited talk:** *"Coupling between disordered photonic structure and DBT molecules: possible chain of hybrid modes"*, July 25th, University of Kwazulu-Natal (UKZ) Durban, South Africa.

Dates 2013

- **Invited talk:** *"Study of the luminescent downshifting effect produced by silicon nanoparticles to improve the performance of the silicon based solar cells"*, April 17th, Universiteit Van Amsterdam, Amsterdam, Holland.

- **Invited talk:** *"Study of the luminescent downshifting effect produced by silicon nanoparticles to improve the performance of the silicon based solar cells"*, May 29th, University of Florence, Italy.

Dates **2012**

- *MINAP 2012, International Conference on Micro and Nano Photonics materials and devices*, in Trento (Italy) from January 16th to January 18th: **oral presentation**.
- *Workshop: "Comsol Multi-Physics"* in Trento (Italy), February 14th.
- *Fotonica 2012, 14th Italian National Conference of Photonic Technologies*, in Florence (Italy) from May 15th to May 17th: **oral presentation**.
- *27th European Photovoltaic Solar Energy Conference and Exhibition*, in Frankfurt (Germany) from September 25th to September 28th: **poster presentation**
- *Workshop: "Nanophotonics for Photovoltaics, A step Forward"*, in Valencia (Spain) from November 6th to November 7th: **poster presentation**.

Dates **2011**

- *Workshop: "Science and Technologies of matter and photon"*, in Trento (Italy), April 1st: **poster presentation**.
- *Workshop: "Photovoltaic in Italy"*, in Milan (Italy), November 29th: **poster presentation**.
- *Workshop in Computational Science*, in Trento, November 9th: **poster presentation**.

Dates **2010**

- *New frontiers in graphene physics*, at the European Centre for Theoretical Studies in Nuclear Physics and Related Area (ETC*) in Trento (Italy) from April 12th to April 14th.
- *25th European Photovoltaic Solar Energy Conference and Exhibition*, in Valencia (Spain) from September 6th to September 10th: **poster presentation**.
- *HZB QuantSol Summer School*, in Hirschegg (Austria), from September 18th to September 25th.
- *Turkish-Italian Workshop: on the frontiers in nanomaterial research and applications*, in Istanbul (Turkey) from December 8th to December 10th: **oral presentation**.

Participation in Research Project

HELIOS project ICT-FP7-224312, <http://www.helios-project.eu> (Team member)

LIMA project ICT-FP7-248909, <http://www.limaproject.eu> (Team member)

FIRB Futuro in Ricerca 2008 - "Hybrid Quantum Technologies"-RBFR085XVZ002 (Team member)

ERC- Advanced Grant "PhotBots" Proj.Ref. 291349 (Team member)

Army Research Laboratory- Cooperative Agreement No. W911NF-12-2-0023 (Team member)

Scientific highlights & skills

Scientific highlights

Photonic design engineer

Software developer

High level experience in different numerical computational tools

Data analysis

Mentoring

Teaching

Project management

Experience of working in multicultural teams

Computer skills

Data acquisition	LabView, Matlab
Basic	JAVA,PYTHON,HTML
Intermediate	L ^A T _E X, Sage, C and C++, PC1D5, Silvaco, Origin, Lumerical
Advanced	Mathematica, Matlab, Comsol Multi-Physics, Scout, Meep AbInitio, Mbp, Coupled-Dipole method and T-matrix formalism
Software languages	Linux, Mac

Experimental skills

Experience in electrical characterization of solar cells

Experience in optical characterization: PL, time resolved PL

Experience in light scattering setups: dark-field microscopy and backscattering

Experience in single photon detection techniques

Referee

Referee of the following scientific journals:

- Solar Energy and Materials & Solar Cells, <http://www.journals.elsevier.com/solar-energy-materials-and-solar-cells>
- Nanoscale, <http://www.rsc.org/journals-books-databases/about-journals/nanoscale/>
- ACS Photonics, <http://pubs.acs.org/journal/apchd5>
- Scientific Report, <http://www.nature.com/srep/>
- Physical review A, <https://journals.aps.org/prd/>
- Physical review B, <https://journals.aps.org/prb/>
- Physical review E, <https://journals.aps.org/pre/>

Additional Information

Current research activities

<http://www.bu.edu/nano/>

Letters of recommendation

The following people would be happy to write letters of recommendation on my behalf:

- Prof. Luca Dal Negro ([dalnegro@bu.edu](mailto:dalnagro@bu.edu))
- Prof. Diederik Wiersma (wiersma@lens.unifi.it)
- Prof. Lorenzo Pavesi (lorenzo.pavesi@unitn.it)

Languages

Italian	Mother tongue
English	Intermediate
Spanish	Basic

Bibliometrics indicator

Scholar	○ Total citations: 237 ○ h-index: 7 ○ i10-index: 7
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List of Publications and Patents

In preparation:

- 28 **F. Sgrignuoli**, Y.Chen, R. Xiaoming, L. Dal Negro
"Catalysis induced by surface lattice resonances in Pt-nanostructured gratings"
- 27 **F. Sgrignuoli**, S. Gorsky, L. Dal Negro
"Light transport phase diagram in three-dimensional hyperuniform media"
- 26 F. Riboli, L.Pattelli, D.S. Wiersma, **F. Sgrignuoli**, and S. Skipetrov
"Entropy of light in disordered photonic system"
- 25 **F. Sgrignuoli**, L. Dal Negro
"Magnetic scattering contribution to wave localization in Vogel spiral structures"
- 24 **F. Sgrignuoli**, S. Gorsky, L. Dal Negro
"Mesoscopic effects in hyperuniform media"

In review:

- 23 **F. Sgrignuoli**, Y. Chen, S. Gorsky, W. Britton, L. Dal Negro
"Optical rogue waves in photonic prime numbers arrays"
submitted to PRL
- 22 W. Britton, Y. Chen, **F. Sgrignuoli**, L. Dal Negro
"Phase-modulated axilenses as ultra-compact spectroscopic tools"
submitted to ACS Photonics, arXiv:2003.08012
- 21 W. Britton, Y. Chen, **F. Sgrignuoli**, L. Dal Negro
"Compact dual-band multi-focal diffractive lenses"
submitted to Laser & Photonic Review, arXiv:2004.08670
- 20 O.Trojak, S. Gorsky, C. Murray, **F. Sgrignuoli**, F.A. Pinheiro, L. Dal Negro, L. Sapienza
"Efficient visible light confinement in bio-inspired aperiodic nano-photonic devices"
submitted to ACS Photonics, arXiv:2001.06723

Published:

- 19 O.Trojak, S. Gorsky, **F. Sgrignuoli**, F.A. Pinheiro, Suk-In Park, J. Dong Song, L. Dal Negro, L. Sapienza
"Cavity quantum electro-dynamics with solid-state emitters in aperiodic systems"
accepted for publication in APL (09/10/2020), arXiv:2001.06723
Impact Factor 3.597
- 18 **F. Sgrignuoli**, L. Dal Negro
"Subdiffusive light transport in three-dimensional subrandom arrays"
PRB, 101,**214204** , (2020)
<https://doi.org/10.1103/PhysRevB.101.214204>
Impact Factor 3.575
- 17 **F. Sgrignuoli**, S. Gorsky, W. Britton, F. Riboli, A. D'Ambrosio, L. Dal Negro
"Multifractality of light in photonic arrays based on algebraic number theory"
Nature Comm. Physics, 3, **106**, (2020)
<https://doi.org/10.1038/s42005-020-0374-7>
- 16 L. Dal Negro, Y. Chen, **F. Sgrignuoli**,

"Aperiodic photonics of elliptic curves"

Crystals, 9 (9), 482 (2019)

<https://doi.org/10.3390/cryst9090482>

Impact Factor 2.404

- 15 S. Zanotto, **F. Sgrignuoli**, S. Nocentini, D. Martella, C. Parmeggiani, D.S. Wiersma
"Multichannel remote polarization control enabled by nanostructured Liquid Crystalline Networks"
APL, 114, 201103 (2019)
Featured Article
<https://aip.scitation.org/doi/abs/10.1063/1.5096648?journalCode=apl>
Impact Factor 3.597
- 14 **F. Sgrignuoli**, R.Wang, F.A. Pinheiro, L. Dal Negro
"Localization of scattering resonances in Aperiodic Vogel spirals"
PRB, 99, **104202**, (2019)
<https://journals.aps.org/prb/abstract/10.1103/PhysRevB.99.104202>
Impact Factor 3.575
- 13 **F. Sgrignuoli**, M.Rontgen, C. V. Morfonios, P.Schmelcher , L. Dal Negro
"Compact localized states of open scattering media: a graph decomposition approach for ab-initio design"
Optics Letter, 44, **2**, (2019)
<https://doi.org/10.1364/OL.44.000375>
Impact Factor 3.714
- 12 D.Balestri, M-Petruzzella, S. Checcucci, F.Intonti, N. Caselli, **F. Sgrignuoli**, F.W.M. van Otten, A. Fiore, M. Gurioli
"Mechanical and electric control of photonic modes in random dielectrics"
Advanced Material, 1807274, (2019)
<https://doi.org/10.1002/adma.201807274>
Impact Factor 27.398
- 11 S.Checcucci, P.Lombardi, S.Rizvi, **F. Sgrignuoli**, N. Grhuler, F.B.C. Dieleman, F.S. Cataliotti, W. H.P. Pernice, M. Agio, C. Toninelli
"Beaming light from a quantum emitter with a planar optical antenna"
Light: Science & Applications, **6**, e16245, (2017)
<https://www.nature.com/articles/lsa2016245>
Impact Factor 14.098
- 10 **F.Sgrignuoli**, P.Bettotti
"Roughness induced enhancement of optical absorption in random media"
JOSA B, 33 **5**, 915–921 (2016),
<https://www.osapublishing.org/josab/abstract.cfm?uri=josab-33-5-915>
Impact Factor 2.180
- 9 **F.Sgrignuoli**, G.Mazzamuto, N.Caselli, F.Intonti, F.S.Cataliotti, M.Gurioli, C.Toninelli.
"Necklace state hallmark in disordered 2D photonic systems"
ACS Photonics, 2 **11**, 1636 –1643 (2015),
<https://pubs.acs.org/doi/10.1021/acsphotonics.5b00422>
Impact Factor 6.880

- 8 **F.Sgrignuoli**, P. Ingenhoven, D.Mihallecchi, G.Pucker, E.Froner, E.Moser, Y. Jestin, G.Sanchez, L.Pavesi
"Purcell effect and luminescent downshifting in Silicon nanocrystals coated back-contact solar cells"
Solar Energy Materials & Solar Cells, **132**, 267 –274 (2015)
<https://www.sciencedirect.com/science/article/pii/S0927024814004887>
Impact Factor 6.984
- 7 **F.Sgrignuoli**, G.Pucker, L.Pavesi
"Photovoltaic based on nanocrystalline silicon"
AEIT
- 6 A. Anopchenko, A. Marconi, **F. Sgrignuoli**, L. Cattoni, A. Tengattini, G. Pucker, Y. Jestin, and L.Pavesi
"Electroluminescent devices based on nanosilicon multilayer structures"
Physica Status Solidi a, 210 **8**, 1525–1531, (2013),
<https://onlinelibrary.wiley.com/doi/abs/10.1002/pssa.201200957>
Impact Factor 2.291
- 5 P. Ingenhoven, A. Anopchenko, A. Tengattini, D. Gandolfi, **F. Sgrignuoli**, G. Pucker, Y. Jestin, L. Pavesi, R. Balboni
"Quantum effects in silicon for photovoltaic applications"
Physica Status Solidi a, 210 **6**, 1071–1075, (2013),
<https://onlinelibrary.wiley.com/doi/abs/10.1002/pssa.201200939>
Impact Factor 2.291
- 4 *"Silicon nanophotonic and photonic based on nano-silicon"*
Il Nuovo saggatore, **1-2**, (2012)
- 3 **F.Sgrignuoli**, Y. Jestin, E. Moser, P. Ingenhoven, G. Pucker, and L. Pavesi
"Silicon Nanocrystals for Downshifting Applications: A Preliminary Study"
27th European Photovoltaic Solar Energy Conference and Exhibition (2013),
DOI:10.4229/27thEUPVSEC2012-1BV.8.9
- 2 **F. Sgrignuoli**, G. Paternoster, A. Marconi, P. Ingenhoven, A. Anopchenko, G. Pucker, and L. Pavesi
"Modeling of silicon nanocrystals based down-shifter for enhanced silicon solar cell performance"
Journal of Applied Physics, **111**, 0343403 (2012),
<https://aip.scitation.org/doi/abs/10.1063/1.3679140?journalCode=jap>
Impact Factor 2.328
- 1 Z. Yuan, G. Pucker, A. Marconi, **F. Sgrignuoli**, A. Anopchenko, Y. Jestin, L. Ferrario, P. Bellutti, and L. Pavesi
"Silicon nanocrystals as a photoluminescence down shifter for solar cells"
Solar Energy Materials & Solar Cells, **95**, 1224 –1227 (2011),
<https://www.sciencedirect.com/science/article/pii/S0927024810007130>
Impact Factor 6.984

Patents

- 1 M. Agio, C. Toninelli, S. Checcucci, **F. Sgrignuoli**, S.Rizvi, P. Lombardi
"Device for the beaming of light emitted by light sources, in particular fluorescence of molecules"
Patent Pending n.RM2015A000155, (2017)

Date
15/09/2020