Juan Rafael Álvarez Velásquez

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Birth date: 31/03/1993
(he/him)

Personal statement

I am interested in understanding the fundamentals of Quantum Mechanics, especially through experiments that involve the use of single photons. I am also interested in topics related to quantum information theory, quantum communications, quantum computing, nanophotonics, special functions, and asymptotic analysis. I am passionate about scientific outreach and teaching as tools to promote the personal development and academic empowerment of students.

Education

Ongoing (from 2018) **DPhil in Atomic and Laser Physics**, *University of Oxford*, United Kingdom.
Marie Skłodowska-Curie Actions - Early Stage Researcher fellowship - LIMQUET Innovative Training Network.
The Atom-Photon Connection Group - Supervisor: Prof. Axel Kuhn. (Small video of research here)

2017-18 **Master in Photonics**, *Europhotonics POESII Master - Erasmus+ Scholarship.*
Year 1: Aix-Marseille Université - Marseille, France. (GPA 17.097/20.00 - **Mention Très Bien**)
Year 2: Photonics BCN (UAB-UB-UPC-ICFO) - Barcelona, Spain. (GPA 9.21/10.00)
Master thesis: Coherence-based quantum random number generator. Director: Prof. Juan P. Torres. (Link here.)

2011-16 **Bachelor of Mathematics - Bachelor of Physics**, *Universidad de los Andes*, Bogotá, Colombia.
Mathematics: GPA 4.47/5.00 | Undergraduate thesis: *Stokes phenomena in classical special functions: Bessel and Weber functions with applications | Director: Prof. Alexander Getmanenko*
Physics: GPA 4.52/5.00. | Undergraduate thesis: *Coupling the spatial and polarization degrees of freedom of light: Applications in measurement theory and open quantum systems | Director: Prof. Alejandra Valencia*

Research Experience

2020 (Winter) **Secondment**, *Stéphane Guérin group*, Institut Carnot de Bourgogne, Dijon, France.
Project: Estimation of mode volume for leaky optical cavities.

2018 (Summer) **ICFO Summer Fellowship**, *Quantum Engineering of Light Group*, ICFO, Barcelona, Spain.
Project: Random number generation by coherent detection of quantum phase noise.

2017 (Summer) **Internship**, *Rupert Ursin Group*, IQOQI Vienna, Austria.
Project: *QPOINTS: Quantum POlarization-based mINiaturized phoTon pair Source.*

2016-17 (Winter) **Student research**, *Thomas Durt Group*, Aix-Marseille Université - École Centrale de Marseille, France.
Project: Bouncing oil droplets: Wave-particle duality at the macro-scale.

2015-16 **Student research**, *Experimental Quantum Optics group*, Universidad de los Andes, Bogotá, Colombia.

2015 (Summer) **Internship**, *Jin Suntivich Lab*, MSE - Cornell University, Ithaca, NY, USA.
Project: *Design of a ring resonator for strong cavity-matter coupling.*

Teaching Experience

2021 **Oxford Physics**.
Lab Demonstrator for Computing: Physics Prelims (Year 1) and Part A (Year 2)

2012-16 **Universidad de los Andes - Physics - Mathematics**.
Tutorials: Linear Algebra I - Integral Calculus - Prephysics
Monitoring: Quantum Mechanics I, II - Electronics, Waves and Fluids (twice), Basic Physics II
Personalized assistance: Physics Troubleshooting Clinic (link here), Mathematics Pentagon (link here)

Skills

Languages **Spanish** (Native language) | **English** (fluent - TOEFL iBT 112/120) | **French** (fluent - DELF B2 74.5/100) | **German** (Intermediate - Minor in German Language - Universidad de los Andes, Colombia).

Informatic Mathematica, Python, Matlab, Lumerical MODE Solutions, Adobe Illustrator, Inkscape, Roam Research.

Experimental Operation and design of optical systems. Basic skills in circuit analysis and electronics.

Photography (instagram.com/juanra_31/)

Outreach and voluntary experience

2018-21 **President (2021) - Secretary (2019-20)**, *Oxford University Colombian Society.*
Support of Colombian students in the University throughout the COVID-19 pandemic.
Organization of events regarding the welfare of Colombian students in the University.

2018-21 **Student Representative**, *Marie Skłodowska-Curie Actions - LIMQUET Innovative Training Network.*.

2019 **Instructor**, *Clubes de Ciencia Colombia 2019.*
Sending secrets using light - Universidad EAFIT, Medellín, Colombia. (Small video here)
Instruction to high school students aged 15-16 in scientific training.

2016 **Organizer**, *Seminar for students in Regular singular points in Ordinary differential Equations.*
Universidad de los Andes, Bogotá, Colombia.

2015-16 **President (2015-16) - Secretary (2014)**, *GOA (Grupo de Óptica de los Andes) OSA Student Chapter.*
Universidad de los Andes, Bogotá, Colombia.
Represented the student chapter in the Student Leadership conference in San Jose, California.
Created the student chapter's web page (link here)

2010 **Student Representative**, *Student Representative on the School Board.*
Montessori School, Medellín, Colombia.
Involved in the resolution of disciplinary cases.

Outreach presentations

2021 **Schrödinger's Camel: a philosophical discussion about the nature of quantum physics**.
Michael Mahony Graduate Seminar. Mansfield College, University of Oxford.

2016 **Measuring the speed of light with a chocolate bar**.
Demonstrative experiments in Optics - GOA OSA Student Chapter - Bogotá, Colombia.

2015 **The Optical Fiber - History, Working principle and applications**.
Planetarium of Bogotá, Bogotá, Colombia.

Publications

2021 **Saving the life of Schrödinger's cat**.
J.-R. Álvarez, M. IJspeert, O. Barter, B. Yuen, T.D. Barrett, D. Stuart, J. Dilley, A. Holleczek, and A. Kuhn, *In preparation.*

2021 **Light-matter interaction in open cavities with dielectric stacks**.
A. Saharyan, J.-R. Álvarez, T. Doherty, A. Kuhn, and S. Guérin.
Accepted for Publication in Applied Physics Letters, https://arxiv.org/abs/2009.07949

2020 **Random number generation by coherent detection of quantum phase noise**.
J.-R. Álvarez, S. Sarmiento, J. A. Lázaro, J. M. Gené and J. P. Torres. Optics Express 28, 4, 5538 (2020)

2018 **Implementation and characterization of a controllable dephasing channel based on coupling polarization and spatial degrees of freedom of light**.
Daniel F. Urrego, Juan-Rafael Álvarez, Omar Calderón-Losada, Jiří Svozilík, Mayerlin Nuñez and Alejandra Valencia. Optics Express 26, 9, 11940 (2018)

2016 **Interference of two pulse-like spatial beams with arbitrary transverse separation.**.
Jefferson Flórez, Juan-Rafael Álvarez, Omar Calderón-Losada, Luis José Salazar-Serrano and Alejandra Valencia. Journal of Optics, 18, 125201 (2016).

Participation in Conferences

2020 **Cavity-based photon-generation schemes using STIRAP re-preparation**.
QTech 2020 Conference - Barcelona, Spain.

2020 **Cavity-based single photon generation schemes using STIRAP re-preparation**.
OSA Siegman School All Stars. (Virtual poster here)

2019 **New Cavity-Based Photon Generation Schemes**.
J.-R. Alvarez, T. D. Barrett, and A. Kuhn. YAO 25 Conference - Hamburg, Germany.

2019 **Cavity-based photon generation schemes using STIRAP re-preparation**.
CAMEL XV conference, Nesebar, Bulgaria.

2017 **Spatial Interference of light: a method to generate structured environments to study quantum dynamics**.
QIM IV Conference, April 2017, Paris, France.

2016 **Synthesizer of arbitrary polarization states**.
J.R. Alvarez, D. F. Urrego, M. Nunez Portela, and A. Valencia. LAOP Conference, (OSA 2016), paper LTh2B.5.

2015 **Light Interference in Position and Momentum Variables: the Spatial Alford and Gold Effect**.
J. Florez, O. Calderon-Losada, L.-J. Salazar-Serrano, J.R. Alvarez, and A. Valencia. FiO 2015, OSA paper FTh1C.5.

2015 **Grupo de Óptica de los Andes - OSA Student Chapter**.
OSA Student Chapter Leadership Conference 2015, San Jose, CA, USA.

2015 **Making optics appealing in Colombia through low-cost experiments with lasers**.
J.R. Álvarez, N. Barbosa, S. Cotrino, D.A. Guzmán, V. Mahecha, C. Medina, M.C. Navarrete, L. Uribe and A. Valencia. Proc. SPIE 9793 - ETOP 2015, 979333 (Oct 8, 2015).