Claudia Rella

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EDUCATION

Doctor of Philosophy in Mathematical Physics 2020, Oct – present
Department of Theoretical Physics, University of Geneva, Switzerland

Thesis: Supervised by Prof Marcos Marino.

Affiliations: ERC Synergy Grant ReNewQuantum – National Centre of Competence in Research SwissMAP.

Solvay Doctoral School (2020, Oct – Dec): Type-II String Theory – Superstrings and D-branes – Holographic Dualities and AdS/CFT Correspondence – Bootstrap and Integrability Methods in Conformal Field Theory – Resurgence and Non-Perturbative Methods in Quantum Field Theory – Quantum Information and Quantum Gravity.

Master of Science in Mathematical and Theoretical Physics – Distinction 2018, Oct – 2019, Jun
Mathematical Institute and Department of Physics, University of Oxford, UK

Thesis: *Motivic Amplitudes*. Supervised by Prof Francis Brown.

Affiliations: St John's College.

Coursework in Physics: General Relativity – Relativistic Quantum Field Theory – Gauge Field Theory – Symmetries in Particle Physics – The Standard Model and Beyond – Radiative Processes and High-Energy Astrophysics – Bosonic String Theory – Supersymmetry and Supergravity – Topological Quantum Field Theory – Topological Quantum Matter – Topological Quantum Computation.

Coursework in Mathematics: Groups Representations – Algebraic Geometry – Algebraic Topology.

Bachelor of Science in Physics – Summa cum Laude 2015, Oct – 2018, Jun
Department of Physics, University of Rome La Sapienza, Italy

Thesis: *Photonic Bloch Waves*. Supervised by Prof Fabio Sciarrino.

Coursework in Physics: Classical, Analytical and Relativistic Mechanics – Inorganic Chemistry – Thermodynamics – Non-Relativistic Electromagnetism – Non-Relativistic Quantum Mechanics – Classical and Quantum Statistical Mechanics – Nuclear and Subnuclear Physics – Atomic and Molecular Physics – Optics and Photonics.

Laboratory Coursework: Mechanics – Thermodynamics – Electronics – Signals and Systems – Optics.

Coursework in Informatics: C Programming Language – Numerical Analysis – Algorithms.

Coursework in Mathematics: Linear Algebra – Real Analysis – Complex and Functional Analysis – Probability Calculus. Number Theory (*) – Groups, Rings and Fields (*) – Numerical Semigroups (*) – Galois Theory (*) – Modules and Algebras (*) – Representation Theory (*) – Lie Groups and Lie Algebras (*) – Affine and Projective Geometry (*) – Differential and Riemannian Geometry (*) – General, Algebraic and Differential Topology (*) – PDEs (*).

(*): Extra-curricular coursework at Department of Mathematics.

RESEARCH EXPERIENCE AND INTERNSHIPS

Particle Physics Research Internship in Modelling and Programming 2020, Jul – Sep
NA62 @ CERN, Geneva, Switzerland

Specifics: Contributed to the design of an experimental framework for the detection of muon-philic light Dark Sector particles in proton beam dump experiments. Contributed to the implementation of a model to exploit the displaced-vertex signal from the secondary muons of NA62-type experiments to probe the parameter space of a theoretically conjectured light exotic scalar generated via muon bremsstrahlung. Produced the sensitivity prediction using programming language C++, data analysis software ROOT, and simulation software MadGraph5_aMC@NLO. NA62 is a proton-on-target collision experiment recently searching for Beyond Standard Model physics at low energies at the Super Proton Synchrotron.

Master Class in Mathematical Physics 2019, Oct – 2020, Jun
University of Geneva and NCCR SwissMAP, Geneva, Switzerland

Coursework: Random Matrix Theory – Brownian Motion – Stochastic Calculus – Random Growth – Loewner Evolution.

Research: Collaborated with Prof Francis Brown (University of Oxford) on *Motivic Feynman Integrals*, specifically investigating the motivic Galois coaction and factorisation theorems for scalar Feynman graphs with non-generic kinematics. Collaborated with Prof Francesco Riva (University of Geneva) on *Effective Field Theory*, specifically investigating the restrictions placed by beyond-positivity bounds on Horndeski theories of modified gravity.

Business Consulting Internship in Big Data and AI 2019, Jul – Aug
Pangea Formazione, Rome, Italy

Specifics: Contributed to a Deep Learning predictive model for preventative maintenance of large infrastructures equipped with alarm nets. Project implemented using Bayesian Neural Networks and programming language R and customized to fit the specific needs of the commissioning telecom company. Pangea Formazione is a Big Data Analytics and AI company providing customised software for management consulting and training.

Particle Physics Research Internship in Simulation and Data Analysis 2017, Sep – Nov
PADME @ INFN – LNF, Frascati, Italy

Specifics: Contributed to the development of a Monte Carlo optical simulation of the Small-Angle Calorimeter of PADME's detector using simulation software Geant4 and programming language C++. Characterised the performance of a single PbF_2 crystal attached to a Hamamatsu R13478UV photomultiplier tube with focus on time and energy resolutions using data analysis software ROOT. PADME (Positron Annihilation into Dark Matter Experiment) is a positron-on-target collision experiment searching for dark photon production at high intensity at the DAFNE Beam Test Facility.

OTHER ACTIVITIES

Junior Member of the Scientific Council of the SRS Conference Centre 2020, Sep – present
SwissMAP Research Station (SRS), Les Diablerets, Switzerland

Invited Contributor to the Theory Frontier of the 2021 Snowmass Process 2020, Aug – present
Division of Particles and Fields of the American Physical Society, United States

Mentee at LeadTheFuture Mentorship Program 2019, Sep – present
LeadTheFuture, Italy

COMPETITIONS

AI Game Europe Regional Terminal – 3rd to Last Round Final 2021, Mar
Coding Competition by Correlation_One and Citadel

PUBLICATIONS

An Introduction to Motivic Feynman Integrals 2021, Mar
SIGMA 17 (2021), 032, 56 pages, https://doi.org/10.3842/SIGMA.2021.032

Characterization and Performance of PADME's Cherenkov-Based Small-Angle Calorimeter 2019, Mar
With A. Frankenthal et al., Nucl. Instrum. Methods Phys. Res. A 919 (2019) 89-97,
https://doi.org/10.1016/j.nima.2018.12.035

TALKS

Introduction to Motivic Amplitudes 2019, Nov
Research Seminar on Lie Groups and Moduli Spaces, University of Geneva, Switzerland

Motivic Scattering Amplitudes 2019, Aug
Conference on Representation Theory and Integrable Systems, ETH, Zürich, Switzerland

Monte Carlo Simulation of PADME's Small-Angle Calorimeter 2017, Dec
PADME Weekly Meeting, INFN – LNF, Frascati, Italy

TEACHING EXPERIENCE

Lecturer on Topological Surfaces 2019, Oct
Master Class in Mathematical Physics – Department of Mathematics, University of Geneva, Switzerland

Topics: Introduction to Topological Spaces – Hausdorff Separation Axiom – Connectedness and Compactness – Abstract Topological Manifolds and Surfaces – Normal Forms for Surfaces – Real Projective Plane $\mathbb{R}\mathbf{P}^2$ in detail.

Lecturer on Riemannian Geometry 2018, Mar – May
Excellence Program in Physics – Department of Mathematics, University of Rome La Sapienza, Italy

Topics: Introduction to Riemannian Geometry – Riemannian Manifolds with Non-Positive Curvature – Jacobi Fields and Conjugate Points – Cartan-Hadamard Theorem – Killing Fields.

ACADEMIC ACHIEVEMENTS AND SCHOLARSHIPS

Excellence Fellowship 2019
NCCR SwissMAP, Switzerland

Degree Prize for Distinction 2019
St John's College, University of Oxford, UK

Torno Subito Scholarship 2018
Department of Education, Research and University, Lazio, Italy

Best Student Award for the Course in Nuclear and Subnuclear Physics 2018
University of Rome La Sapienza and INFN, Italy

Summer Student Scholarship 2017
INFN, Italy

Excellence Program 2016 – 2018
Department of Physics, University of Rome La Sapienza, Italy

Deserving Student Scholarship 2015 – 2018
University of Rome La Sapienza, Italy

SKILLS

Italian Language	Native
English Language	Fluent (Level C2 (CEFRL) - Cambridge ESOL Level 3 Certificate)
Programming Languages	C, C++, Python, R, Perl, HTML
Data Analysis Languages	MATLAB, ROOT, gnuplot
Symbolic Calculus Languages	Mathematica
Version-control Systems	Git
Simulation Software	Geant4

MEMBERSHIPS

Italian Physics Society (SIF) 2019 – present
European Physics Society (EPS) 2020 – present