

# Alessandro Rosa

Imola (BO), Italy

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## EDUCATION

### PhD in Mathematics

2025 - Present

Alma Mater Studiorum - Università di Bologna, Italy, XLI cycle

- *Supervisor*: Annalisa Baldi
- *Co-supervisor*: Andrea Bonfiglioli

### Master's Degree in Mathematics

2022-2024

Alma Mater Studiorum - Università di Bologna, Italy, 24/07/2024

- *Thesis*: Rumin's Differential Forms and  $L^2$ -Hodge Decomposition in Sub-Riemannian Contact Manifolds
- *Supervisor*: Annalisa Baldi
- *Final mark*: 110/110 cum laude (weighted average grades: 30/30)

### Bachelor's Degree in Mathematics

2019-2022

Alma Mater Studiorum - Università di Bologna, Italy, 30/09/2022

- *Thesis*: Il Teorema di Connettività per i Campi Vettoriali di Hörmander, e Applicazioni
- *Supervisor*: Andrea Bonfiglioli
- *Final mark*: 110/110 cum laude (weighted average grades: 29.91/30)

### High School Diploma

2014-2019

IIS "Francesco Alberghetti" Liceo delle Scienze Applicate, Imola (BO), Italy

- *Final mark*: 100/100

## RESEARCH INTERESTS

- Differential forms and integral inequalities in Carnot groups
- Riemannian and Sub-Riemannian Geometry
- Calculus of Variations and Functional Analysis
- Machine Learning, Physics-Informed Neural Networks (PINNs)

## PUBLICATIONS

1. **A. Rosa**, *Analysis of the Quasi-Static Maxwell Equations in Resistive Solid-State Particle Detectors* (submitted, 2026) <https://doi.org/10.48550/arXiv.2606.09269>
2. **A. Baldi**, **A. Rosa**,  *$L^p$ -Hodge Decomposition and global integral estimates on the Cartan group* (submitted, 2026) <https://doi.org/10.48550/arXiv.2604.15206>
3. **L. Anderlini**, **A. Bombini**, **C. Buti**, **G. Passaleva**, **A. Rosa**, *Simulation of solid-state particle detectors with arbitrary geometries using Physics-Informed Neural Networks* (to appear, 2026) Il Nuovo Cimento, Proceedings of SIF Congress 2025.
4. **L. Anderlini**, **A. Bombini**, **C. Buti**, **G. Passaleva**, **A. Rosa**, *Physics-Informed Neural Networks for design optimisation of diamond particle detectors for charged particle fast-tracking at high luminosity hadron colliders* (submitted, 2025) <https://doi.org/10.48550/arXiv.2509.21123>
5. **A. Baldi**, **A. Rosa**,  *$L^p$ -Hodge Decomposition with Sobolev classes in Sub-Riemannian Contact Manifolds* (2025) <https://doi.org/10.1016/j.jmaa.2025.129739>

## EMPLOYMENT

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### Research fellowships

- **Researcher**, Development of Flash Simulation techniques for radiation detectors and other physical systems using Generative Models and Physics-Informed Neural Networks (PINNs) - Project SPOKE 2 (PNRR as part of the ICSC Project - Italian Research Center on High Performance Computing, Big Data and Quantum Computing)  
INFN - Firenze, *Supervisor*: Lucio Anderlini 01/2025-10/2025

### Teaching

- **Teaching assistant**, Analisi Matematica IA (Calculus I) AY 25-26  
Bachelor's Degree in Mathematics, University of Bologna (30h) (Profs. A. Baldi, A. Bonfiglioli).
- **Teaching assistant**, Analisi Matematica II (Calculus II) AY 24-25  
Bachelor's Degree in Astronomy, University of Bologna (24h) (Profs. L. Lanzani, A. Parmeggiani).
- **Teaching assistant**, Analisi Matematica I (Calculus I) AY 24-25  
Bachelor's Degree in Astronomy, University of Bologna (24h) (Prof. M. C. Tesi).
- **Teaching assistant**, Analisi Matematica IB (Calculus I) AY 23-24  
Bachelor's Degree in Mathematics, University of Bologna (30h) (Profs. A. Baldi, A. Bonfiglioli).
- **Teaching assistant**, Analisi Matematica IA (Calculus I) AY 23-24  
Bachelor's Degree in Mathematics, University of Bologna (30h) (Profs. A. Baldi, A. Bonfiglioli).
- **Teaching assistant**, Analisi Matematica I (Calculus I) AY 23-24  
Bachelor's Degree in Astronomy, University of Bologna (24h) (Profs. L. Lanzani, A. Parmeggiani).
- **Teaching assistant**, Analisi Matematica (Calculus I and II) AY 22-23  
Bachelor's Degree in Computer Science & Information Science for Management, University of Bologna (108h) (Profs. D. Morbidelli, M. Mughetti, M. Casali).

## TALKS

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- **Simulation of solid-state particle detectors with arbitrary geometries using Physics-Informed Neural Networks (PINNs)**  
111° *Congresso Nazionale Società Italiana Fisica (SIF)*, University of Palermo, Italy ([link](#)). 22-26/09/2025
- **Simulation of solid-state particle detectors with arbitrary geometries using Physics-Informed Neural Networks (PINNs)** (Poster presentation)  
*International Summer School "INFIERI (INtelligent signal processing for FrontIER Research and Industry)"*, Department of Physics and INFN of Pisa, Italy ([link](#)). 01-13/09/2025

## AWARDS

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- Award for best presentations in nuclear and subnuclear physics section  
111° *Congresso Nazionale Società Italiana Fisica (SIF)*, Palermo, Italy ([link](#)). 2025

## INTERNSHIPS

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- **University of Leeds**, Leeds, UK  
Invited by F. Tripaldi. 01/2026 (1 week)

## CONFERENCES AND SCHOOLS ATTENDED

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- **Conference**, *III Meeting UMI for Doctoral Students*  
Firenze, Italy ([link](#)). 29/06/2026-01/07/2026
- **School**, *14th School on Analysis and Geometry in Metric Spaces*  
Trento, Italy ([link](#)). 15-19/06/2026
- **Conference**, *NonPUB26 - Nonlinear and nonlocal Partial Differential Equations at the University of Bologna*  
Bologna, Italy ([link](#)). 4-5/06/2026

- **Conference**, *Hard Science for AI*  
Bologna, Italy ([link](#)). 09/10/2025
- **School**, *International Summer School INFIERI (INtelligent signal processing for FrontIER Research and Industry)*  
Pisa, Italy ([link](#)) 01-13/09/2025
- **Conference**, *Three Days in Sub-Riemannian Geometry*  
Bologna, Italy ([link](#)). 16-18/06/2025
- **Conference**, *Noncommutativity at the Interface of Topology, Geometry and Analysis (first JHU-UNIBO Conference)*  
Bologna, Italy ([link](#)). 24-28/06/2024
- **Conference**, *NonPUB24 - Nonlocal and nonlinear Partial Differential Equations at the University of Bologna*  
Bologna, Italy ([link](#)). 6-7/06/2024
- **Conference**, *Symposium in Harmonic & Complex Analysis, Microlocal & Geometrical Analysis and Applications*  
Bologna, Italy ([link](#)). 24-26/01/2024
- **Periodic Seminars**, *ASK seminars*  
Bologna ([link](#)). 2024-Present
- **Conference**, *Nonlinear Meeting in Bologna*  
Bologna, Italy ([link](#)). 6-7/06/2022
- **Periodic Seminars**, *Seminari di Analisi Matematica Bruno Pini*  
Bologna, Italy ([link](#)). 2021-Present

## PHD COURSES ATTENDED

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- *The Total Variation Flow*  
taught by J. M. Mazon Ruiz (10 hours), University of Bologna, Italy. 06/2026
- *Degenerate or Singular Elliptic and Parabolic Equations*  
taught by P. Ambrosio (16 hours), University of Bologna, Italy. 03-04/2026
- *Boundary Integral Equations and Boundary Element Methods*  
taught by E. Cinti, M. Ruggeri (20 hours), University of Bologna, Italy. 03-04/2026
- *Advanced Topics in Holomorphic Function Theory*  
taught by N. Arcozzi, (20 hours), University of Bologna, Italy. 02-03/2026
- *Microlocal Analysis and Scattering Theory*  
taught by M. Vogel, (20 hours), University of Bologna, Italy. 02/2026
- *Sub-Riemannian Geodesics*  
taught by M. Galeotti, (15 hours), University of Bologna, Italy. 01-02/2026
- *Second Order Parabolic Equations*  
taught by S. Ciani, (20 hours), University of Bologna, Italy. 12/2025
- *Numerical Resolution of Differential Equations for applications using Physics-Informed Neural Networks*  
taught by A. Bombini, (24 hours), University of Firenze, Italy. 01/2025
- *Elements of Fractional Calculus*  
taught by A. Giusti, I. Colombaro, (30 hours), University of Bologna, Italy. 12/2024 - 01/2025
- *Mathematical Relativity*  
taught by A. Giusti, (18 hours), University of Bologna, Italy. 12/2023 - 01/2024

## ADDITIONAL EXPERIENCES

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- *Participant*, International Masterclass hands on Particle Physics, Department of Physics, University of Bologna. 25/02/2019
- *Alternanza scuola-lavoro* (high school work-based learning program), Pollution s.r.l., Budrio (BO), Italy.  
Activities: assembly, testing, and quality assessment of the products offered by the company for environmental pollution analysis. Summer 2018-2019
- *Volunteering*, Banco Alimentare Emilia-Romagna, Imola (BO), Italy 2019
- *Participant*, CAD 3D PON project (SOLIDWORKS), Imola (BO), Italy, (30h). 04/2018
- *Participant*, Summer school “OLIFIS ER-Marche 2017”, Bagnacavallo (RA), Italy.

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| Activities: lessons and workshops in preparation to AIF Teams Physics Olympiad.    | 4-9/09/2017 |
| • <i>Participant</i> , “OII Olimpiadi Italiane di Informatica”, Imola (BO), Italy. | 2016-2017   |
| • <i>Participant</i> , “Olimpiadi della Matematica”, Imola (BO), Italy.            | 2016-2017   |
| • <i>Participant</i> , “OLIFIS Olimpiadi di Fisica”, Imola (BO), Italy.            | 2016-2017   |

## SKILLS

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### Technical Skills

- **Programming languages:** Python, C++, Matlab
- **Machine learning libraries:** PyTorch, NVIDIA PhysicsNeMo
- **CAD programs:** SolidWorks, AutoCAD 2D (ECDL Specialized Level, May 2018)
- **Others:** L<sup>A</sup>T<sub>E</sub>X, HTML, Office

### Languages

- **Italian:** Mother tongue
- **English:** B2

Imola, 05/07/2026