

CURRICULUM VITAE

Francesca Oronzio

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1 PERSONAL DATA

First Name: Francesca
Surname: Oronzio
Born: Scafati (SA), 09/10/1991
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2 POSITIONS

Post-Doc Resercher
KTH Royal Institute of Technology
Advisor: Klaus Kröncke
November 2023–October 2025

Post-Doc Resercher
Università degli studi di Roma La Sapienza
Advisor: Emanuele Spadaro
November 2022–October 2023

3 EDUCATION

Ph.D. in Mathematics and Applications
Università degli studi di Napoli Federico II
Thesis-title: *ADM mass and Linear Potential Theory.*
Supervisors: Carlo Mantegazza and Virginia Agostiniani
Grade: Ottimo con lode
April 2022

Master Degree in Mathematics
Università degli studi di Napoli Federico II
Thesis-title: *Alcune relazioni tra curvatura e topologia per mezzo delle funzioni distanza.*
Supervisor: Carlo Mantegazza

Grade: 110/110 cum laude
October 2018

Bachelor Degree in Mathematics

Università degli studi di Napoli Federico II
Thesis–title: *Superfici chiuse a curvatura costante*.
Supervisor: Guglielmo Lunardon
Grade: 110/110 cum laude
December 2013

Diploma di Maturità Scientifica

Liceo Scientifico “Filippo Silvestri” (Portici (NA), Italy)
Grade: 100/100
July 2010

4 TEACHING ACTIVITIES

- The **teaching support assignment** of 50 **hours** as part of the “Geometric Analysis” course at the University of Trento, Italy, February–September 2022
- **20 hours** in the **exercise sessions** of the “Geometry I” course at the University of Naples Federico II, Italy, 2019/2020

5 RESEARCH INTERESTS

My research activity is in the field of Geometric Analysis, with a specific focus on geometric inequalities arising in mathematical relativity.

6 PUBLICATIONS AND PREPRINTS

A new proof of the Riemannian Penrose inequality

with V. Agostiniani, C. Mantegazza and L. Mazziere (*Atti Accad. Naz. Lincei–Rend. Lincei Mat. Appl.*)

Abstract: We give an overview of our recent new proof of the Riemannian Penrose inequality in the case of a single black hole. The proof is based on a new monotonicity formula, holding along the level sets of the p –capacitary potential of the connected boundary of an asymptotically flat 3–manifold, with nonnegative scalar curvature.

ADM mass, area and capacity in asymptotically flat 3–manifolds with nonnegative scalar curvature (preprint 2022)

Abstract: We show an improvement of Bray sharp mass–capacity inequality and Bray–Miao sharp upper bound of the capacity of the boundary in terms of its area, for three–dimensional, complete, one–ended asymptotically flat manifolds

with compact, connected boundary and with nonnegative scalar curvature, under appropriate assumptions on the topology and on the mean curvature of the boundary. Our arguments relies on two monotonicity formulas holding along level sets of a suitable harmonic potential, associated to the boundary of the manifold. This work is an expansion of the results contained in the PhD thesis of the author.

Riemannian Penrose inequality via nonlinear potential theory

with V. Agostiniani, C. Mantegazza and L. Mazziere (*preprint 2022*)

Abstract: We provide a new proof of the Riemannian Penrose inequality by means of a monotonicity formula holding along the level sets of the p -capacitary potential of the horizon boundary, in any asymptotically flat 3-manifold with nonnegative scalar curvature.

A Green's function proof of the positive mass theorem

with V. Agostiniani and L. Mazziere (*preprint 2021*)

Abstract: In this short note, a new proof of the Positive Mass Theorem is established through a newly discovered monotonicity formula, holding along the level sets of the Green's function of an asymptotically flat 3-manifolds. In the same context and for $1 < p < 3$, a Geroch-type calculation is performed along the level sets of p -harmonic functions, leading to a new proof of the Riemannian Penrose Inequality in some case studies.

A geometric capacity inequality for sub-static manifolds with harmonic potentials

with V. Agostiniani and L. Mazziere (*Math. Engineering*)

Abstract: In this paper, we prove that associated with a sub-static asymptotically flat manifold endowed with a harmonic potential there is a one-parameter family $\{F_\beta\}$ of functions which are monotone along the level-set flow of the potential. Such monotonicity holds up to the optimal threshold $\beta = \frac{n-2}{n-1}$ and allows us to prove a geometric capacity inequality where the capacity of the horizon plays the same role as the ADM mass in the celebrated Riemannian Penrose Inequality.

7 NOTES

- *An example in dimension four of a Riemannian manifold such that its sectional curvature is positive and its curvature operator is not nonnegative,* 2022

8 TALKS AND SEMINARS

- University of Münster
Talk: *ADM mass and potential theory*
January 2024
- Uppsala University
Talk: *ADM mass and potential theory*
November 2023
- KTH Royal Institute of Technology
Talk: *Some inequalities involving the ADM mass via the potential theory*
November 2023
- Simons Center
Mass, the Einstein Constraint Equations, and the Penrose Inequality Conjecture
Talk (Online): *ADM mass and potential theory*
September 2023
- **Differential Geometry @L'Aquila 2023**
Talk: *ADM mass and potential theory*
September 2023
- Mittag-Leffler Institute
Einstein Spaces and Special Geometry
Talk: *Some inequalities involving the ADM mass via the potential theory*
July 2023
- Università degli studi di Roma Tor Vergata
Talk: *ADM mass and potential theory*
March 2023
- KTH Royal Institute of Technology
Talk: *ADM mass and potential theory*
January 2023
- University of Tübingen and Potsdam University
Talk: *Some inequalities involving the ADM mass via linear and nonlinear potential theory*
November 2022
- **Calculus of Variations and Free Boundary Problems IV**
Talk: *Some inequalities involving the ADM mass via linear and nonlinear potential theory*
November 2022
- **A Geometric Analysis Meeting at UniTo**
Talk: *Some inequalities involving the ADM mass via linear potential theory*
June 2022

- **First UMI meeting of Ph.D. students**
Talk: *A Green's function proof of the positive mass theorem*
May 2022
- Duke University
Convergence or Scalar Curvature Seminar
Talk: *A Green's function proof of the positive mass theorem*
February 2022
- Math Institute of the National Autonomous University of Mexico
mms&convergence seminar
Talk: *A Green's function proof of the positive mass theorem*
February 2022
- Università di Trento
“Doc in Progress” and #iorestoacasa for the Ph.D. students
Talk: *Sub-static manifolds with harmonic potential*
May 2021
- Università degli studi di Napoli Federico II
Minisymposium of “Shape optimization, control and inverse problems for PDEs, INDAM Intensive Period - 2019”
Talk: *Cartan–Hadamard theorem*
July 2019
- Università di Pisa
Seminars in Analysis and Probability M.A.P. for the Ph.D. students
Talk: *Some relations between curvature and topology via distance functions*
April 2019
- Università di Verona
Talk: *Some relations between curvature and topology via distance functions*
March 2019

9 CONFERENCES, WORKSHOPS AND SUMMER SCHOOLS ATTENDED

- *Mathematical Relativity: Past, Present, Future*
Four days, Vienna, Austria, December 2023
- *Three days between Analysis and Geometry in Trento*
Three days, Trento, Italy, August 2023
- *Vito Volterra Meeting 2023*
One week, Rome, Italy, June 2023
- *13th Central European Relativity Seminar*
Three days, Stockholm, Sweden, May 2023

- *Interdisciplinary junior scientist workshop: Mathematical General Relativity*
Two weeks, Wildberg, Germany, February and March 2023
- Università degli studi di Napoli Federico II
Shape Optimization, Geometric Inequalities and Related Topics
Two days, Napoli, Italy, January 2023
- The Fields Institute
Workshop on Mathematical Relativity, Scalar Curvature and Synthetic Lorentzian Geometry
Two weeks, Toronto, Canada, October 2022
- Università degli studi della Campania Luigi Vanvitelli
Summer School in Analysis and PDE
One week, Caserta, Italy, July 2022
- Università degli studi di Firenze
Differential Geometry and Geometric Analysis
One week, Firenze, Italy, June 2022
- Università di Torino
A Geometric Analysis Meeting at UniTo
Three days, Torino, Italy, June 2022
- Unione Matematica Italiana (UMI) and Università degli studi di Padova
First UMI meeting of Ph.D. students
Two days, Padova, Italy, May 2022
- Accademia Nazionale dei Lincei
Geometric Theory of PDE's and sharp functional inequalities
One day, online, September 2021
- Centro Internazionale per la Ricerca Matematica (CIRM)
XXX Convegno Nazionale di Calcolo delle Variazioni
One week, Levico Terme, Italy, February 2020
- Università degli Studi dell'Insubria
A Geometry Day in Como
One day, Como, Italy, January 2020
- ICPT School on Geometry and Gravity
Two weeks, Trieste, Italy, July 2019
- Lake Como School for Advanced Studies
Geometric Analysis on Riemannian and singular metric measure spaces (3rd edition)
One week, Como, Italy, July 2019

- Università degli studi di Napoli Federico II
Shape optimization, control and inverse problems for PDEs, INDAM Intensive Period - 2019
5 weeks, Napoli, Italy, May and June 2019
- Università di Torino
Differential Geometry Day
One day, Torino, Italy, April 2019
- Università degli Studi dell'Insubria
A Geometry Day in Como
One day, Como, Italy, January 2019

10 OTHER ACTIVITIES

- Member of the GNAMPA project “Problemi al bordo e applicazioni geometriche”, 2022
- Partially funded to participate in the “Nonsmooth Riemannian and Lorentzian Geometry” workshop which will be held at the Fields Institute (Toronto) from July to December 2022
- Participation to the event/collaboration “study in SISSA fellowship”, Italy, February–March 2019
- Member to the GNAMPA project “Problemi geometrici per strutture singolari”, 2019