

Martina Carillo

Ph.D. student

Golden Paragraph

I am a **PhD student** in the Accelerator Physics Program at Sapienza University of Rome. My passion for accelerator physics was born during my undergraduate studies: I achieved my **bachelor's degree in Physics** in 2018 by discussing the thesis "Proton Linear Accelerator for Adrotherapy: TOP-IMPLART". Later I continued my studies in the field of high energy physics and obtained my **master's degree in Physics** in 2021. My thesis "Analysis and simulation of cryogenic hybrid C-Band Photo-injector" was focused on a project that arises from the collaboration of **Sapienza University of Rome** with **UCLA, University of California Los Angeles**. The work was focused on the development of code for simulation and analysis of beam dynamics within RF structure, under the supervision of **Prof. Palumbo** and **Prof. Rosenzweig**. Afterwards, I chose to continue the collaboration with the accelerator research group in Sapienza and with the UCLA group, starting the PhD course in Rome that I am carrying out today. In the first year, in addition to continuing my individual studies on beam dynamics, I successfully attended and passed training courses: in February 2021 I attended at joint Universities Accelerator school (**JUAS**) the Course on Particle Accelerator, which allowed me to acquire basic knowledge on accelerating structures. During these first two years of her PhD, I carry out significant analytical and simulation results. I presented this at several conferences as the International Particle Conference Accelerators in May 2021 (**IPAC21**) and recently at **IPAC22**. In both conferences I was also co-author and presenter of other works. In the last year I start to work also with **SPARC group** at Laboratori Nazionali di Frascati (**LNF**) where I collaborate on experimental measurements. This experience provided me basic experimental knowledge on accelerator structures. From February to July 2023 I spend six months at UCLA in United States to collaborate with professor Rosenzweig' s group.

Education

- 2020–present **Ph.D. in Accelerator physics**, *Sapienza, University of Rome*, Rome, Italy.
- 2017–2020 **Master's Degree in Physics (LM-17)**, *Sapienza, University of Rome*, Rome, Italy.
 - Physics, High Energy physics, Computer Programming, Mathematical physics, Medical Application.
 - Laboratory experience of Radio Frequency systems, INFN, Frascati (Rome)
- 2013–2017 **Bachelor's Degree in Physics (L-30)**, *Sapienza, University of Rome*, Rome, Italy.
 - Mathematics, Physics, Optics, Electronics, Computer Programming (C language), Quantum Mechanics, Relativistic Mechanics, Fluidodynamics, Chemistry, Atmospheric Physics.
- 2014 **High school leaving qualification**, *Scientific High School Cavour*, Rome, Italy.

Master's Thesis

Title *Analysis and simulation of cryogenic hybrid C-band photo-injector*

Supervisor Professor Daniele del Re

Co-Supervisor Professor Luigi Palumbo

Description Development of code for simulation and analysis of beam dynamics within RF structure. Physical analysis of beam dynamics.

Affiliation

2020-present **Istituto Nazionale di Fisica Nucleare (INFN).**

Courses and Stages

Jan-Feb 2021 **Joint Universities Accelerator School (JUAS), Course on Particle Accelerator**, *European Scientific Institute, Archamps, France.*

Feb-Jun 2021 **Physics of High Brilliance Accelerators**, Professor M. Ferrario, Sapienza University of Rome, Rome, Italy.

Sep-Oct 2021 **Physics, Technology and Applications of Linear Accelerators**, Professor D. Alesini, Sapienza University of Rome, Rome, Italy.

May 2023 **Student tutorial lectures**, 14th International particle accelerator conference (IPAC23), Venice Convention Center, Venice Lido, Italy

Research experience

Nov 2020 - Present **Sapienza, University of Rome, Dipartimento di scienze di Base Applicate all'Ingegneria** In collaboration with Prof. Palumbo and his scientific research group in the field of accelerators, I have worked on the development of analytical and numerical models for optimizing the dynamics of high-brightness photoinjectors.

Nov 2021 - Present **INFN-LNF**: In the context of the SPARC-LAB experiment, I have contributed to the study and optimization of single-beam and double-beam dynamics for plasma beam-driven acceleration. During the accelerator's operation phases, I have also participated in machine control shifts, collaborating on data acquisition and analysis of experimental data.

Feb 2023 - Jul 2023 **Visiting graduate student at UCLA**. During this period, I have been involved in theoretical studies aiming to optimize the emittance of the beam exiting the hybrid photoinjector under the supervision of the Prof. Rosenzweig. Additionally, I have participated in beam characterization procedures of the outgoing beam at the MITHRA laboratory located at UCLA. Throughout this period, I have collaborated not only in data acquisition but also in dynamic optimization through simulations and magnet characterization.

Invited talk

May 2023 **International Particle Accelerator Conference 2023**, Venice, Italy, Contributed Oral Talk

July 2023 **SLAC National Accelerator Laboratory (SLAC)**, San Francisco, USA, Scientific seminary and in-person interview

Attended Conference

- May 2021 **International Particle Accelerator Conference 2021- online conference**, *Three-Dimensional Space Charge Oscillations in a Hybrid Photoinjector*, Poster presentation.
- June 2022 **International Particle Accelerator Conference 2022**, Bangkok, Thailand, *Space charge analysis for low energy photoinjector*, Poster presentation.
- September 2022 **108° Congresso Nazionale, Società Italiana di Fisica**, Milano, Italy, *Space charge analysis for photoinjector emittance compensation*, Oral presentation.
- September 2022 **EuroNNAc Special Topics Workshop**, La Biodola Bay, Isola d'Elba, Italy, *A novel analytical model of space charge forces in RF-guns*, Poster presentation. Student grant winner.
- May 2023 **International Particle Accelerator Conference 2023**, Venice, Italy,
 - *Beam dynamics optimization for high gradient beam driven plasma wakefield acceleration at SPARC-LAB*, Contributed Oral Talk.
 - *A Space Charge Forces analytical model for emittance compensation*, Poster presentation. Student grant winner.
- June 2023 **Physics and Applications of High Brightness Beam Workshop**, San Sebastian, Spain, *An Analytical Study of Space Charge Fields in the Emittance Compensation Process*, Poster presentation. Student grant winner.
- September 2023 **109° Congresso Nazionale, Società Italiana di Fisica**, Salerno, Italy, *Beam dynamics optimization for high gradient beam driven plasma wakefield acceleration at SPARC_LAB*, Oral presentation.
- September 2023 **6th European Advanced Accelerator Concepts workshop**, La Biodola Bay, Isola d'Elba, Italy, *Witness-driver beam dynamics optimization in the SPARC_LAB photoinjector*, Poster presentation. Student grant winner.

Awards and Grants

- November 2022 **Call for founding of research projects for the mobility abroad of PhD students**, Project: "Beam dynamics of RF guns for high brightness beams", to support the visiting period at University of California Los Angeles (UCLA) from February 1st to July 31st

Computer skills

- Programming languages **Python, C**
- Calculation codes **Matlab, Mathematica**
- Simulation codes **General Particle Tracer (GPT)**: a 3D particle tracer designed to simulate the movement of charged particles in the presence of electric and magnetic fields.
A Space Charge Tracking Algorithm (ASTRA): beam dynamics code that tracks the particles of a distribution under the influence of internal and external fields.

High-Frequency Structure Simulator (HFSS): electromagnetic (EM) 3D simulation software for designing and simulating high frequency electronic products.

Poisson Superfish: a collection of programs for calculating static magnetic and electric fields and radio-frequency electromagnetic fields in either 2-D Cartesian coordinates or axially symmetric cylindrical coordinates.

CST Studio Suite: simulation platform for all kinds of electromagnetic field problems and related applications.

Languages

English Advanced
Italian **Mother tongue**

Teaching Activities

- 2020-2021 **Lecture assistant** *Course of Physics I (Mechanics and Thermodynamics)*, for Electronic engineering students held by Professor L.Faillace. SAPIENZA, UNIVERSITY OF ROME.
- 2020-2021 **Lecture assistant** *Course of Physics (Mechanics, Thermodynamics and Electromagnetism)*, for Gestional engineering students held by Professor R.Li Voti. SAPIENZA, UNIVERSITY OF ROME.
- 2021-2022 **Lecture assistant** *Course of Physics II (Electromagnetism and Optics)*, for Aerospace engineering students held by Professor L. Palumbo. SAPIENZA, UNIVERSITY OF ROME.
- 2021-2022 **Lecture assistant** *Course of Physics I (Mechanics and Thermodynamics)*, for Clinic engineering students held by Professor M.C.Larciprete. SAPIENZA, UNIVERSITY OF ROME.
- 2022-2023 **Lecture assistant** *Course of Physics II (Electromagnetism and Optics)*, for Aerospace engineering students held by Professor L. Palumbo. SAPIENZA, UNIVERSITY OF ROME.
- 2022-2023 **Lecture assistant** *Course of Physics II (Electromagnetism and Optics)*, for Electronic engineering students held by Professor M. Migliorati. SAPIENZA, UNIVERSITY OF ROME.

Scientific Publications

- September 2023 **Journal paper**, F. Bosco, O. Camacho, M. Carillo, E. Chiadroni, L. Faillace, A. Fukasawa, A. Giribono, L. Giuliano, N. Majernik, A. Mostacci, L. Palumbo, J.B. Rosenzweig, B. Spataro, C. Vaccarezza, M. Migliorati, "Fast models for the evaluation of self-induced field effects in linear accelerators", Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, Volume 1056,(2023) doi:10.1016/j.nima.2023.168642.

- July 2023 **Conference proceeding**, Fabio Villa, David Alesini, Maria P. Anania, Marco Angelucci, Alberto Bacci, Antonella Balerna, Marco Bellaveglia, Angelo Biagioni, Bruno Buonomo, Sergio Cantarella, Fabio Cardelli, Martina Carillo, et al. "EuPRAXIA@SPARC_LAB status update", Proceedings Volume 12581, X-Ray Free Electron Lasers: Advances in Source Development and Instrumentation VI; 125810H (2023) doi:10.1117/12.2668643
- February 2023 **Journal paper**, L. Giuliano, F. Bosco, M. Carillo, G. Felici, L. Ficcadenti, A. Mostacci, M. Migliorati, L. Palumbo, B. Spataro and Luigi Faillace, "RF Design and Measurements of a C-Band Prototype Structure for an Ultra-High Dose-Rate Medical Linac", Instruments 2023, 7, 10. doi.org/10.3390/instruments7010010
- December 2022 **Journal paper**, V. Shpakov, D. Alesini, M.P. Anania, M. Behtouei, B. Buonomo, M. Bellaveglia, A. Biagioni, F. Cardelli, M. Carillo, E. Chiadroni, A. Cianchi, G. Costa, M. Del Giorno, L. Faillace, M. Ferrario, M. Del Franco, G. Franzini, M. Galletti, L. Giannessi, A. Giribono, A. Liedl, V. Lollo, A. Mostacci, G. Di Pirro, L. Piersanti, R. Pompili, G. Di Raddo, S. Romeo, G.J. Silvi, A. Stella, C. Vaccarezza, F. Villa and A. Vannozzi, "Design, optimization and experimental characterization of RF injectors for high brightness electron beams and plasma acceleration", Journal of Instrumentation, Volume 17, December 2022 doi:10.1088/1748-0221/17/12/P12022
- November 2022 **Journal paper**, L. Faillace, D. Alesini, G. Bisogni, F. Bosco, M. Carillo, P. Cirrone, G. Cuttone, D. De Arcangelis, A. De Gregorio, F. Di Martino, V. Favaudon, L. Ficcadenti, D. Francescone, G. Franciosini, A. Gallo, S. Heinrich, M. Migliorati, A. Mostacci, L. Palumbo, V. Patera, A. Patriarca, J. Pensavalle, F. Perondi, R. Remetti, A. Sarti, B. Spataro, G. Torrisi, A. Vannozzi, L. Giuliano, "Perspectives in linear accelerator for FLASH VHEE: Study of a compact C-band system", Physica Medica 104 (2022) 149–159. doi:10.1016/j.ejmp.2022.10.018
- June 2022 **Conference proceedings**, M. Carillo, M. Behtouei, F. Bosco, O. Camacho, E. Chiadroni, L. Faillace, et al., "Space Charge Analysis for Low Energy Photoinjector", in *Proc. 13th International Particle Accelerator Conference (IPAC'22)*, Bangkok, Thailand, Jun. 2022, pp. 2272–2275. doi:10.18429/JACoW-IPAC2022-WEPOMS017
- June 2022 **Conference proceedings**, L. Faillace, R.B. Agustsson, M. Behtouei, F. Bosco, D.L. Bruhwiler, O. Camacho, M. Carillo, et al., "Start-to-End Beam-Dynamics Simulations of a Compact C-Band Electron Beam Source for High Spectral Brilliance Applications", in *Proc. 13th International Particle Accelerator Conference (IPAC'22)*, Bangkok, Thailand, Jun. 2022, pp. 687–690. doi:10.18429/JACoW-IPAC2022-MOPOMS023
- June 2022 **Conference proceedings**, M. Behtouei, F. Bosco, M. Carillo, F. Di Paolo, L. Faillace, S. Fantauzzi, et al., "Studies of a Ka-Band High Power Klystron Amplifier at INFN-LNF", in *Proc. 13th International Particle Accelerator Conference (IPAC'22)*, Bangkok, Thailand, Jun. 2022, pp. 683–686. doi:10.18429/JACoW-IPAC2022-MOPOMS022
- June 2022 **Conference proceedings**, F. Bosco, O. Camacho, M. Carillo, E. Chiadroni, L. Faillace, A. Fukasawa, et al., "Modeling and Mitigation of Long-Range Wakefields for Advanced Linear Colliders", in *Proc. 13th International Particle Accelerator Conference (IPAC'22)*, Bangkok, Thailand, Jun. 2022, pp. 2350–2353. doi:10.18429/JACoW-IPAC2022-WEPOMS045

- June 2022 **Conference proceedings**, D. Alesini, M.P. Anania, A. Battisti, M. Bellaveglia, A. Biagioni, F. Cardelli, M. Carillo *et al.*, "The New SPARC-LAB RF Photo-Injector", in *Proc. 13th International Particle Accelerator Conference (IPAC'22)*, Bangkok, Thailand, Jun. 2022, pp. 671–674. doi:10.18429/JACoW-IPAC2022-MOPOMS019
- June 2022 **Conference proceeding**, L. Giuliano, D. Alesini, M. Behtouei, M.G. Bisogni, F. Bosco, M. Carillo, *et al.*, "Proposal of a VHEE Linac for FLASH Radiotherapy", in *Proc. 13th International Particle Accelerator Conference (IPAC'22)*, Bangkok, Thailand, Jun. 2022, pp. 2903–2906. doi:10.18429/JACoW-IPAC2022-THPOTK054
- June 2022 **Journal paper**, L. Faillace, R. Agustsson, M. Behtouei, F. Bosco, D. Bruhwiler, O. Camacho, M. Carillo, *et al.*, "High Field Hybrid Photoinjector Electron Source for Advanced Light Source Applications", *Phys. Rev. Accel. Beams* 25, 063401 (2022). doi:10.1103/PhysRevAccelBeams.25.063401
- May 2021 **Conference proceedings**, M. Carillo, M. Behtouei, F. Bosco, L. Faillace, L. Ficcadenti, A. Giribono, *et al.*, "Three-Dimensional Space Charge Oscillations in a Hybrid Photoinjector", in *Proc. IPAC'21*, Campinas, SP, Brazil, May 2021, pp. 3240–3243. doi:10.18429/JACoW-IPAC2021-WEPAB256
- May 2021 **Conference proceedings**, L. Faillace, R.B. Agustsson, M. Behtouei, F. Bosco, M. Carillo, A. Fukasawa, *et al.*, "Beam Dynamics for a High Field C-Band Hybrid Photoinjector", in *Proc. IPAC'21*, Campinas, SP, Brazil, May 2021, pp. 2714–2717. doi:10.18429/JACoW-IPAC2021-WEPAB051
- May 2021 **Conference proceedings**, F. Bosco, M. Behtouei, M. Carillo, L. Faillace, A. Giribono, L. Giuliano, *et al.*, "Modeling Short Range Wakefield Effects in a High Gradient Linac", in *Proc. IPAC'21*, Campinas, SP, Brazil, May 2021, pp. 3185–3188. doi:10.18429/JACoW-IPAC2021-WEPAB238
- May 2021 **Conference proceedings**, L. Giuliano, D. Alesini, M. Behtouei, F. Bosco, M. Carillo, G. Cuttone, *et al.*, "Preliminary Studies of a Compact VHEE Linear Accelerator System for FLASH Radiotherapy", in *Proc. IPAC'21*, Campinas, SP, Brazil, May 2021, pp. 1229–1232. doi:10.18429/JACoW-IPAC2021-MOPAB410
- September 2021 **Journal paper**, M. Behtouei, B. Spataro, L. Faillace, M. Carillo, M. Comelli, A. Variola, M. Migliorati, "A Novel method to calculate the magnetic field of a Solenoid generated by a surface current element", arXiv, (2021). doi:10.48550/arXiv.2109.04464
- September 2021 **Journal paper**, B. Spataro, M. Behtouei, F. Cardelli, M. Carillo, V. Dolgashev, L. Faillace, M. Migliorati, L. Palumbo, "A hard open X-band RF accelerating structure made by two halves", arXiv, (2021). doi:10.48550/arXiv.2109.03954
- September 2021 **Journal paper**, M. Behtouei, B. Spataro, L. Faillace, M. Carillo, A. Leggieri, L. Palumbo, M. Migliorati, "Relativistic approach to a low perveance high quality matched beam for a high efficiency Ka-Band klystron", arXiv, (2021). doi:10.48550/arXiv.2109.03520

Reference

Prof. **Palumbo** Luigi, Vice Rector for Strategic Planning - Full Professor at Dept. of Basic and Applied Science for Engineering, Sapienza University of Rome.

Prof. **Migliorati** Mauro, Associate Professor at Dept. of Basic and Applied Science for Engineering, Sapienza University of Rome.

Prof. **Mostacci** Andrea, Associate Professor at Dept. of Basic and Applied Science for Engineering, Sapienza University of Rome.

Prof.ssa **Chiadroni** Enrica, Associate Professor at Dept. of Basic and Applied Science for Engineering, Sapienza University of Rome.

Prof. **Rosenzweig** James, Distinguished Professor of Physics at the Department of Physics and Astronomy , University of California, Los Angeles.