

Martina Carillo

Ph.D.

Education

- 2020–2024 **Ph.D. in Accelerator physics**, *Sapienza, University of Rome*, Rome, Italy.
Vote: cum laude
- 2017–2020 **Master's Degree in Physics (LM-17)**, *Sapienza, University of Rome*, Rome, Italy,
Vote: 108/110.
- 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,
Vote: 98/110.
- 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.
Vote: 95/100

PhD Thesis

- Title *Beam Dynamics of High Brightness Beams in RF Photoinjectors*
- Supervisor Professor Luigi Palumbo
- Co-Supervisor Professor Mauro Migliorati
- Co-Supervisor Professor James Rosenzweig

Affiliation

- 2024–present **Istituto Nazionale di Fisica Nucleare (INFN)**, LNF.
- 2020–2024 **Istituto Nazionale di Fisica Nucleare (INFN)**, Roma1.

Courses and Stages

- 11th Jan–11th Feb 2021 **Joint Universities Accelerator School (JUAS), Course on Particle Accelerator**, *European Scientific Institute, Archamps*, France. Score: 14/20
- 1st Feb–30th Jun 2021 **Physics of High Brilliance Accelerators**, Professor M. Ferrario, *Sapienza University of Rome*, Rome, Italy.(6 CFU). Exam Date: 18 October 2021. Score: 28/30

- 30th Sep- **Physics, Technology and Applications of Linear Accelerators**, Professor D.
 31th Oct Alesini, Sapienza University of Rome, Rome, Italy. Exam Date: 19 October 2021.
 2021 Score: 30/30.
- 7th -12th **Student tutorial lectures**, 14th International particle accelerator conference
 May 2023 (IPAC23), Venice Convention Center, Venice Lido, Italy

Working experience

- May 2024 - **Postdoctoral Researcher** Istituto Nazionale Fisica Nucleare (INFN), Laboratori
 present Nazionali di Frascati, Via Enrico Fermi 40, 00044 Frascati, Italy
- Nov 2023 - **Scholarships for research activities**, Sapienza, University of Rome, Dipartimento
 May 2024 di scienze di Base Applicate all'Ingegneria, on *Space charge effects in high brightness photoinjectors*. Bando Prot. n. 2166 del 12/09/2023

Research experience

- Nov 2020 - **Sapienza, University of Rome, Dipartimento di scienze di Base Applicate**
 May 2024 **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 - **INFN-LNF**: In the context of the SPARC-LAB experiment, I have contributed to
 Nov 2023 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 - **Visiting graduate student at UCLA**. During this period, I have been involved
 Jul 2023 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

- 11th May **International Particle Accelerator Conference 2023**, Venice, Italy. *Beam dy-*
 2023 *namics optimization for high gradient beam driven plasma wakefield acceleration at SPARC-LAB*, 15+5 minutes
- 18th July **SLAC National Accelerator Laboratory (SLAC)**, San Francisco, USA, Scientific
 2023 seminary and in-person interview. *Beam dynamics of high brightness beams in RF photoinjectors*, 45+15 minutes
- 26th **EuPRAXIA Preparatory Phase (EuPRAXIA_PP)**, La Biodola Bay, Isola d'Elba,
 September Italy. *Plasma-Based Solution for Beam Handling and Driver Extraction*, 20+5
 2024 minutes

Attended Conference

- 24th -28th May 2021 **International Particle Accelerator Conference 2021- online conference**, *Three-Dimensional Space Charge Oscillations in a Hybrid Photoinjector*, Poster presentation.
- 12th -17th June 2022 **International Particle Accelerator Conference 2022**, Bangkok, Thailand, *Space charge analysis for low energy photoinjector*, Poster presentation.
- 12th - 16th September 2022 **108° Congresso Nazionale, Società Italiana di Fisica**, Milano, Italy, *Space charge analysis for photoinjector emittance compensation*, Oral presentation.
- 18th - 24th 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.
- 7th -12th May 2023 **International Particle Accelerator Conference 2023**, Venice, Italy,
 o *Beam dynamics optimization for high gradient beam driven plasma wakefield acceleration at SPARC-LAB*, Contributed Oral Talk.
 o *A Space Charge Forces analytical model for emittance compensation* ,Poster presentation.
 Student grant winner.
- 19th -23th 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.
- 11th - 15th 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.
- 17th -23th 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.
- 16-20 October 2023 **15th Workshop on Breakdown Science and High Gradient Technology (HG2023)**, INFN Frascati National Laboratories. Local Organize Committee
- 9th - 13th September 2024 **110° Congresso Nazionale, Società Italiana di Fisica**, Bologna, Italy, *Dynamic simulations for optimizing beam transport in plasma-based accelerators: Preliminary investigations at SPARC_LAB*, Oral presentation.
- 22th - 28th September 2024 **EuPRAXIA Preparatory Phase (EuPRAXIA_PP), Annual Meeting**, La Biodola Bay, Isola d'Elba, Italy, *Plasma-Based Solution for Beam Handling and Driver Extraction*, Oral presentation.

Awards and Grants

- Jun 2022 **Call for founding of research projects**, Research Projects (Small, Medium) - Medium Projects, Manager: CHIADRONI ENRICA.
- Nov 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 2023.
- Sept 2023 **6th European Advanced Accelerator Concepts workshop**, Student Grant.

- Jun 2023 **Physics and Applications of High Brightness Beam Workshop**, Student Grant.
- May 2023 **International Particle Accelerator Conference 2023**, Student Grant.
- Sept 2023 **EuroNNAc Special Topics Workshop**, Student Grant.
- Jun 2022 **Call for founding of research projects**, Research Projects (Small, Medium) - Medium Projects, Manager: CHIADRONI ENRICA.

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

Teaching Activities

- Feb 2021- Nov 2021 **Lecture assistant** *Course of Physics I (Mechanics and Thermodynamics)*, for Electronic engineering students held by Professor L.Faillace. SAPIENZA, UNIVERSITY OF ROME, 40 hours.
- Feb 2021- Nov 2021 **Lecture assistant** *Course of Physics (Mechanics, Thermodynamics and Electromagnetism)*, for Gestional engineering students held by Professor R.Li Voti. SAPIENZA, UNIVERSITY OF ROME, 40 hours.
- Sept 2021- Nov 2022 **Lecture assistant** *Course of Physics II (Electromagnetism and Optics)*, for Aerospace engineering students held by Professor L. Palumbo. SAPIENZA, UNIVERSITY OF ROME, 40 hours.
- Feb 2022-Nov 2022 **Lecture assistant** *Course of Physics I (Mechanics and Thermodynamics)*, for Clinic engineering students held by Professor M.C.Larciprete. SAPIENZA, UNIVERSITY OF ROME, 40 hours.
- Sept 2022-Nov 2023 **Lecture assistant** *Course of Physics II (Electromagnetism and Optics)*, for Aerospace engineering students held by Professor L. Palumbo. SAPIENZA, UNIVERSITY OF ROME, 40 hours.

- Sept 2022-Nov 2023 **Lecture assistant** *Course of Physics II (Electromagnetism and Optics)*, for Electronic engineering students held by Professor M. Migliorati. SAPIENZA, UNIVERSITY OF ROME, 40 hours.
- Sept 2023-Nov 2024 **Lecture assistant** *Course of Physics II (Electromagnetism and Optics)*, for Aerospace engineering students held by Professor L. Palumbo. SAPIENZA, UNIVERSITY OF ROME, 40 hours.
- Sept 2023-Nov 2024 **Lecture assistant** *Course of Medical Physics*, for Medicina e chirurgia "B" (abilitante all'esercizio della professione di Medico Chirurgo) - Roma Azienda Policlinico Umberto I, held by Professor M. Migliorati. SAPIENZA, UNIVERSITY OF ROME, 40 hours.

Scientific Publications

Journal paper

D. Francescone;M. Carillo;E. Chiadroni;A. Curcio;A. Cianchi;M. Ferrario;G. Gatti;M. Galletti;L. Giuliano;M. Migliorati;A. Mostacci;L. Palumbo;A. R. Rossi;F. Stocchi;G. J. Silvi, "UV-Soft X-ray betatron radiation characterization from laser-plasma wakefield acceleration", *Proc. IPAC'24*, Nashville, TN, USA, May 2024, pp. 573–575, [doi:10.18429/JACoW-IPAC2024-MOPR58]

Pompili, R.;Anania, M. P.;Biagioni, A.;Carillo, M.;Chiadroni, E.;Cianchi, A.;Costa, G.;Crincoli, L.;Del Dotto, A.;Del Giorno, M.;Demurtas, F.;Ferrario, M.;Galletti, M.;Giribono, A.;Jones, J. K.;Lollo, V.;Pacey, T.;Parise, G.;Di Pirro, G.;Romeo, S.;Silvi, G. J.;Shpakov, V.;Villa, F.;Zigler, A., "Recovery of hydrogen plasma at the sub-nanosecond timescale in a plasma-wakefield accelerator "Communications Physics | (2024) 7:241, [https://doi.org/10.1038/s42005-024-01739-x]

L. Verra;M. Galletti;R. Pompili;A. Biagioni; **M. Carillo**;A. Cianchi;L. Crincoli;A. Curcio;F. Demurtas;G. Di Pirro;V. Lollo;G. Parise;D. Pellegrini;S. Romeo;G. Silvi;F. Villa;and M. Ferrario, "Experimental observation of space-charge field screening of a relativistic particle bunch in plasma", *PHYSICAL REVIEW LETTERS* 133, 035001 (2024) [10.1103/PhysRevLett.133.035001]

Pompili, R.; Anania, M. P.; Biagioni, A.; **Carillo, M.**; Chiadroni, E.; Cianchi, A.; Costa, G.; Curcio, A.; Crincoli, L.; Del Dotto, A.; Del Giorno, M.; Demurtas, F.; Frazzitta, A.; Galletti, M.; Giribono, A.; Lollo, V.; Opromolla, M.; Parise, G.; Pellegrini, D.; Di Pirro, G.; Romeo, S.; Rossi, A. R.; Silvi, G. J.; Verra, L.; Villa, F.; Zigler, A.; Ferrario, M.. "Guiding of charged particle beams in curved plasma-discharge capillaries" In: *PHYSICAL REVIEW LETTERS.*, ISSN 0031-9007. - 132:21(2024), pp. 1-5. [10.1103/physrevlett.132.215001]

Rosenzweig, J.B.; Andonian, G.; Agustsson, R.; Anisimov, P.M.; Araujo, A.; Bosco, F.; **Carillo, M.**; Chiadroni, E.; Giannessi, L.; Huang, Z.; et al. "A High-Flux Compact X-ray Free-Electron Laser for Next-Generation Chip Metrology Needs". *Instruments* 2024, 8, 19. <https://doi.org/10.3390/instruments8010019>

Pompili, R. and Anania, M. P. and Biagioni, A. and **Carillo, M.** and Chiadroni, E. and Ciani, A. and Costa, G. and Curcio, A. and Crincoli, L. and Del Dotto, A. and Del Giorgio, M. and Demurtas, F. and Galletti, M. and Giribono, A. and Lollo, V. and Oromolla, M. and Parise, G. and Pellegrini, D. and Di Pirro, G. and Romeo, S. and Silvi, G. J. and Verra, L. and Villa, F. and Zigler, A. and Ferrario, M. "Acceleration and focusing of relativistic electron beams in a compact plasma device". *Phys. Rev. E* 2024,109,5. <https://link.aps.org/doi/10.1103/PhysRevE.109.055202>

Williams, O.; Fukasawa, A.; Sakai, Y.; Andonian, G.; Bosco, F.; **Carillo, M.**; Manwani, P.; O'Tool, S.; Pan, J.; Yadav, M.; et al. "Overview and Commissioning Status of the UCLA MITHRA Facility". *Instruments* 2023, 7, 54. <https://doi.org/10.3390/instruments7040054>

Vidal García P, Sarti S, **Carillo M**, Giuliano L, Marcelli A, Spataro B, Alimenti A, Torokhtii K, Silva E, Pompeo N. "Effect of Molybdenum Coatings on the Accelerating Cavity Quality Factor". *Instruments*. 2023; 7(4):33. <https://doi.org/10.3390/instruments7040033>

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.

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

V. Shpakov, D. Alesini, M.P. Anania, M. Behtouei, B. Buonomo, M. Bellaveglia, A. Biagioni, F. Cardelli, **M. Carillo**, E. Chiadroni, A. Ciani, G. Costa, M. Del Giorgio, 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

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

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

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

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

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

Conference proceeding

L. Crincoli, **M. Carillo**, P. Iovine, M. P. Anania, A. Biagioni, G. Costa, M. Del Giorno, V. Lollo, D. Pellegrini, R. Pompili, S. Romeo and M. Ferrario, M. Galletti, C. Mariani, "CHARACTERIZATION OF PLASMA-DISCHARGE CAPILLARIES FOR PLASMA-BASED PARTICLE ACCELERATION", in *Proc. 14th International Particle Accelerator Conference (IPAC'23)*, Venice, Italy, May 2023, pp. 1545-1548. doi:10.18429/JACoW-IPAC2023-TUPA097

Fabio Villa, David Alesini, Maria P. Anania, Marco Angelucci, Alberto Bacci, Antonella Balerna, Marco Bellaveglia, Angelo Biagioni, Bruno Buonuomo, 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

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

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

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

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

- 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
- 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-THP0TK054
- 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
- Ł. 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
- 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
- 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

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

Prof. **Migliorati** Mauro, Full 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.