Procedura valutativa per la copertura di n. 1 posto di Professore di ruolo di prima fascia per il GSD 02/PHYS-01 (EX SC 02/A1) – Settore scientifico-disciplinare PHYS-01/A (EX SSD FIS/01) presso il Dipartimento di Scienze di Base e Applicate per l'Ingegneria – Facoltà di Ingegneria Civile e Industriale – **codice concorso 2024POR017**

Sapienza, Università di Roma - **D.R. n. 1494/2024 del 25.06.2024**

COPIA AI FINI DELLA PUBBLICAZIONE

ANDREA MOSTACCI
Curriculum Vitae

General Information

Full Name	**Andrea Mostacci**
Place and date of Birth	
Nationality	Italian
Address	
Phone Number	
Fiscal Code	
E-mail	
Spoken Languages	Italian (mother tongue), English, French (basic knowledge)
ORCID ID	0000-0002-4407-7312
Scopus Author ID	6602410134

The following CV is organized according to the guidelines given in D.R. no. 1494/2024 dated 25.06.2024. Section 1 provides a brief overview of my research and teaching activities, aligning with the requirements for the specified position. Sections 2-8 aim to present elements useful for individual evaluation as well as the assessment of scientific production. Sections 9-12 aim to provide elements for comparative evaluation.

I, the undersigned, declare under my own responsibility that the following curriculum is truthful and I am available to provide any supporting documentation for each specific point.

Rome, July 16th 2024

Andrea Mostacci
digitally signed

1. Brief overview of the research and teaching activity

Professor Andrea Mostacci obtained his master's degree in Electronic Engineering from Sapienza, University of Rome in 1997, followed by a PhD in Applied Electromagnetism and Electro-Physical Sciences in 2001. His doctoral thesis focused on the **interaction between particle beams and accelerator beam pipes** in the Large Hadron Collider (LHC). During this time, he was enrolled as a doctoral student and afterwards as research fellow at CERN.

Since 2002, Professor Mostacci has been a faculty member at Sapienza University, where he currently holds the position of Associate Professor of Experimental Physics, a role he has held since 2018. He is also a research associate at the Italian Institute of Nuclear Physics (INFN), closely collaborating with the National Frascati Laboratory (INFN-LNF), and actively participating in **several national and international research groups**. His primary international collaborations include institutions such as the University of Los Angeles (UCLA), Paul Scherr Institute (PSI), CERN, Lawrence Berkley National Laboratory (LBNL), and various other European laboratories through active participation and leadership in EU-funded research projects.

A. Mostacci research focuses on the application of electromagnetism to the **science and technology of particle accelerators**, encompassing with five main interests. A first one involves the development of novel RF devices for beam manipulation, covering the entire process from design to bench microwave measurements and beam characterization (sec. 10.1) while a second one concerns wakefield effects, primarily for all CERN accelerators and in particular for LHC (sec. 10.2). Other two research lines deal with experimental studies on the application of high-brightness electron beams to Free Electron Lasers, e.g. at INFN SPARC_LAB (sec. 10.3) and to plasma-based compact accelerators, e.g. within the EuPRAXIA initiative (sec. 10.4). Always open to new ideas, he is recently contributing to the use of machine learning in accelerator physics and beam diagnostics.

In 2002, he founded the **Advanced Particle Accelerator Laboratory** (APA-Lab) at the Department of Basic and Applied Sciences for Engineering in Sapienza and he still manages it. APA-Lab utilizes state-of-the-art instruments for microwave measurements to characterize advanced components for accelerators up to a 20GHz operating frequency. The laboratory is also actively engaged in designing and producing novel components using industrial and self-developed numerical tools.

Drawing on his extensive experience RF devices for accelerators and commissioning of advanced linear accelerator, A. Mostacci fifth research interest concerns compact electron accelerators capable of delivering high-intensity electron beams for **Ultra-High-Dose-Rate** (UHDR) **applications** in the emerging field **of FLASH radiotherapy** (sec. 10.5). His activity primarily focuses on experimental studies aimed at extending the knowledge of the FLASH effect to higher energies than the few MeVs where the effect was initially observed. To enable pre-clinical studies and demonstrate the feasibility of cost-effective compact machines for UHDR, A. Mostacci and his colleagues are proposing a combination of C-band (5.712 GHz) copper standing wave and traveling wave structures to capture and efficiently accelerate a 150nC, 1μs long beam from an industrially available thermo-ionic cathode. While A. Mostacci oversees all aspects of the project, he is responsible of the linear accelerator realisation and commissioning. He is also co-author of two patents: a first one on a FLASH device for oncological treatments and the second one on a radiotherapy linear accelerator.

In addition to his research endeavours, Professor Mostacci teaches courses in the **Faculty of Engineering and Physics** at Sapienza University of Rome. His teaching portfolio includes subjects such as basic Electromagnetism, Laboratory of Advanced Microwave Measurements, Accelerator Physics, and Relativistic Electrodynamics. He is also involved in teaching at **international Accelerator schools**, such as the Joint University Accelerator School (JUAS) and the CERN Accelerator School (CAS). He actively promoted master student exchanges with several world-wide international laboratories exploiting his research connections.

2. Documented training or research activities at qualified Italian or foreign institutions

2.1 Education

Type	Year	Institution	
University graduation	1997	Sapienza University of Rome	**Electronic Engineering** degree with a dissertation on “Coupling impedance of pumping holes for LHC beam pipe” - **110/110 cum laude**
Post-graduate studies	1997	European Scientific Institute, Archamps (France)	Joint Universities Accelerator School, Course on **Particle Accelerator Physics**
Post-graduate studies	1999	CERN Accelerator School, Bénodet (France)	Course on **General Accelerator Physics**, Intermediate Level
PhD	2001	Sapienza University of Rome CERN	Applied Electromagnetism and Electro-Physical Science, XIII cycle. Thesis on “**Beam wall interaction in the LHC liner**”
Licensure	1997	Sapienza University of Rome	Licensure for the profession of engineer
Licensure	2013	MIUR Ministry of Education, University and Research	National Academic Qualification as Associate Professor 2012 in Area 02-A1 **Experimental Physics of Fundamental Interactions**
Licensure	2013	MIUR Ministry of Education, University and Research	National Academic Qualification as Associate Professor 2012 in Area 02-B3 **Applied Physics**
Licensure	2021	MIUR Ministry of Education, University and Research	National Academic Qualification as Full Professor in SC 02-A1 (now GSD 02/PHYS-01) **Experimental Physics of Fundamental Interactions**

2.2 Academic Appointments

Start	End	Institution	Position
1/2018	Today	Sapienza, Univ. of Rome	**Associate Professor** at the SBAI Department ([1])
11/2006	12/2017	Sapienza, Univ. of Rome	**Staff Researcher (**Assistant Professor) at the SBAI Department ([1])
04/2006	10/2006	Sapienza, Univ. of Rome	**Research Contract** on Accelerator Physics (*Co.Co.Co.*) at the SBAI Department ([1])
04/2002	03/2006	Sapienza, Univ. of Rome	**Research Fellowship** on Experimental techniques for accelerators and particle physics (*Assegno di Ricerca*) at the SBAI Department ([1])

([1]) SBAI department stands for Department of Basic and Applied Science for Engineering. The Department of Energetics joined the SBAI Department in 2010.

2.3 Formal Appointments in qualified international institutions

Start	End	Institution	Position
06/1999	05/2001	CERN- Geneva (CH)	**Doctoral Student** (1)
12/1997	07/1998	CERN- Geneva (CH)	**Technical Student** (2)

(1) Limited duration contract paid by CERN.
(2) Fixed term contract paid by CERN.

2.4 Research activity in qualified international institutions

Start	End	Institution	Position
06/2019	Today	CERN-Geneva (CH)	Cooperation Associate (1)
07/2014	07/2015	CERN-Geneva (CH)	Visiting Scientist (1)
06/2013	06/2014	CERN-Geneva (CH)	Cooperation Associate (1) Research visit (2 weeks) (2) Research visit (1 month) (2)
08/2002	08/2002	CERN- Geneva (CH)	Research visit (1 month) (2)
05/2001	04/2002	CERN- Geneva (CH)	Research Fellowship (3)

(1) The Cooperation Associate and Visiting Scientist status foresees the usage of all the CERN research infrastructures within a collaboration interesting for CERN.
(2) Invitation including trip reimbursement and daily allowance.
(3) Limited duration contract paid by CERN

2.5 Research activity in qualified national institutions

Start	End	Institution	Position
2012	Today	INFN-Roma 1 Section	**Research appointment** renewed yearly on particle accelerators activities
2008	2011	INFN-Laboratori Nazionali di Frascati (LNF)	**Research appointment** renewed yearly on particle accelerators activities
1998	2007	INFN-Laboratori Nazionali di Frascati (LNF)	**Association appointment** renewed yearly on particle accelerators activities
		INFN-Laboratori Nazionali di Frascati (LNF)	**Member of various selection boards** for research and technologist in Accelerator Science

3. Organization, direction, and coordination of national and international research groups, or participation in them

3.1 Coordination of national and international researcher teams

Start	End	Position
11/2022	Today	**Coordination of Work Package on "Membership Extension Strategy"** (WP6) of the project "Compact European Plasma Accelerator with superior beam quality" (EUPRAXIA Preparatory Phase); Horizon Europe, grant agreement No 101079773
11/2015	11/2019	**Coordination of Work Package on "Accelerator prototyping and experiments at Test facilities"** (WP12) of the project "Compact European Plasma Accelerator with superior beam quality" (EUPRAXIA); Horizon 2020, grant agreement No 653782.
01/2018	12/2022	**Task responsible in the Work Package on "Gun and injectors"** (WP3) of the project "Compact light" (XLS); Horizon 2020 grant agreement No 777431
2015	2018	**Coordination of beam diagnostics group** for the linear accelerator of the Compton Gamma Source being built in the Extreme Light Infrastructure for Nuclear Physics (ELI-NP), Magruele (Romania)
2002	Today	**Coordination** of the activity in the **Advanced Particle Accelerator Laboratory** (former Accelerator and Detector Lab. of the Energetic Department) https://research.uniroma1.it/laboratorio/194488#/0
10/2011	09/2014	**Coordination of the Work Package "Accelerators: Novel compact particle sources"** (WP6) of the project "Cluster of Research Infrastructures for Synergies in Physics" (CRISP) in the framework of FP7-INFRASTRUCTURES-2011-1
2006	2013	**Coordination of the data analysis** of all the experiments executed on the SPARC photo injector at the LNF-INFN

3.2 Participation in international committee related to Accelerator Physics

Start	End	Membership
2022	Today	**Eupraxia-Doctoral Network steering committee** EuPRAXIA-DN is a MSCA Doctoral Network for a cohort of 12 fellows between universities, research centres and industry that will carry out an interdisciplinary and cross-sector plasma accelerator research and training program for this new research infrastructure https://www.eupraxia-dn.org/andrea-mostacci
2022	Today	**Eupraxia PP steering committee and collaboration board** EuPRAXIA-PP is a project designed to develop the organizational, legal, financial and technological aspects of the EuPRAXIA infrastructure, within the recommendations of the European Strategy Forum on Research Infrastructures. https://www.eupraxia-pp.org/steering-committee

2013	Today	**European Network for Novel Accelerators** (Sapienza representative) The EU-funded European Network for Novel Accelerators (EuroNNAc) brings together more than 60 institutes and aims at federating the significant European and international efforts in plasma-based accelerators. Goal is to prepare a roadmap for an efficient use of this novel technology in full-scale accelerators.
2018	2022	**Collaboration Board of XLS-Compact light** The EU-funded CompactLight design study, launched by a team of 22 International Laboratories and two Industries, brings together world experts in the fields of accelerators and magnetic structures for photon production**.**
2014	2021	**Governing board of EuroGammaS**, the European Consortium for the delivery of a High Intensity Gamma Beam System to the Extreme Light Infrastructure for Nuclear Physics (ELI-NP).
2015	2019	**Eupraxia steering committee and collaboration board** EuPRAXIA is the first European project that develops a dedicated particle accelerator research infrastructure based on novel plasma acceleration concepts and laser technology. It focuses on the development of electron accelerators and underlying technologies, their user communities, and the exploitation of existing accelerator infrastructures in Europe. https://www.eupraxia-project.eu/collaboration-board.html https://www.eupraxia-project.eu/steering-committee.html
2012	2014	**CRISP Steering Committee** The purpose of Cluster of Research Infrastructures for Synergies in Physics (CRISP) EU funded project is to create synergies and develop common solutions for an initial group of eleven ESFRI-PPs (European Strategy Forum on Research Infrastructure preparatory phase) projects in the field of Physics, Astronomy, and Analytical Facilities.

3.3 Participation in scientific committees and/or organization of international conferences

April 2024	EuPRAXIA-Doctoral Network School on Plasma Accelerator	Organization of the international school (https://agenda.infn.it/event/38913/)
September 2023	6th European Advanced Accelerator Concepts Workshop	Convener of the Working Group on *High Gradient Vacuum Structures* Member of the Program Committee and of the International Advisory Committee. (https://agenda.infn.it/event/35577/page/7497-committees)
September 2021	5th European Advanced Accelerator Concepts Workshop	Member of the International Advisory Committee (https://agenda.infn.it/event/24374/page/5770-committees)

September 2019	4th European Advanced Accelerator Concepts Workshop	Member of the International Advisory Committee (https://agenda.infn.it/event/17304/page/2406-committees)
September 2019	ICFA mini-Workshop on Mitigation of Coherent Beam Instabilities in Particle Accelerators	Member of the International Advisory Committee (https://indico.cern.ch/event/775147/page/15584-international-advisory-committee-iac)
June 2019	EupRAXIA FEL pilot user application workshop	Organization of the workshop (https://indico.desy.de/event/23123/)

3.4 Funding Information (last 10 years)

Year	Title	Programme (Topic ID for EU projects)	Funding
2024-Today	Time domain characterisation of devices for novel linear particle accelerator for FLASH radiotherapy **Role:** Principal Investigator	**Sapienza Research Projects** (Medium Size)	60k€
2024-Today	MInibeam RadiOtherapy - MIRO **Role:** research unit responsible	**National Scientific Committee V** of INFN	7k€
2023-Today	RESTART – TNEXT **Role:** investigator, "Massa critica"	**MIUR- PNNR actions** PE14 - Spoke 3	16k€/year
2022-Today	EuPRAXIA Preparatory Phase Project **Role:** Work Package leader, Steering committee member, Sapienza representative in the Collaboration Board	HORIZON (HORIZON-INFRA-2021-DEV-02-01)	100k€
2022-Today	Flash Radiotherapy with hIgh Dose rate particle beAms - FRIDA **Role:** Work Package leader	**National Scientific Committee V** of INFN	About 120k€
2014-Today	Plasma based acceleration at SPARC-LAB 4-years experiments were founded on different topics, namely: - comb beams (SL_COMB); - external injection (SL_EXIN); - FEL radiation (SL_COMB2FEL); - betatron radiation (SL_betaTest). **Role:** Research unit responsible	**National Scientific Committee V** of INFN	About 100k€

2017-2021	XLS - COMPACT LIGHT **Role:** Task responsible within WP3, Sapienza representative in the Collaboration Board	Horizon 2020 (INFRADEV-01-2017)	72k€
2015-2019	EUropean Plasma Research Accelerator with eXcellence In Applications – EUPRAXIA **Role:** Work Package leader, Steering committee member, Sapienza representative in the Collaboration Board	H2020 (INFRADEV-1-2014)	12k€
2018	Fund for the financing of basic research activities **Role:** Principal Investigator	ANVUR-FABR	3k€
2018	Beam energy measurement in advanced linear particle accelerators for electrons **Role:** Principal Investigator	**Sapienza Research Projects** (Medium Size)	About 13k€
2017-2018	X-BAnd resonator for Non-Destructive EPR measurement – Xbande **Role:** Research unit responsible	**National Scientific Committee V** of INFN	6k€
2012-2018	European FEL Design Study (EuroFEL project) **Role:** Research unit responsible	**National Scientific Committee V** of INFN MIUR project	About 250k€
2017	Advanced beam position monitors for the Compton Gamma Source of the Extreme Light Infrastructure **Role:** Principal Investigator	**Sapienza Research Projects** (Medium Size)	About 38k€
2012-2015	Generation of high brightness electron beams from plasma-based accelerators **Role:** Research unit responsible	**FIRB**-Futuro in Ricerca 2012 RBFR12NK5K_002	About 180k€
2012-2014	Cluster of Research Infrastructures for Synergies in Physics (CRISP project). **Role:** Work Package leader, Steering committee member, Sapienza representative in the Collaboration Board	FP7-INFRASTRUCTURES	About 470k€

4. Patents on linear accelerators for FLASH radiotherapy

Title	Description
Device for radiotherapy treatment of oncological patients (FLASH)	Italian patent no. 102019000016760, granted on 23/09/2021, valid until 19/09/2039 in collaboration with S.I.T., Sordina IORT Technologies S.p.A., a leading international company in the development and commercialization of equipment for intraoperative radiotherapy (IOeRT). This is a patent for a S-band Linac for FLASH therapy.
Linear accelerator, particularly for radiotherapy	Patent application no. 102022000024552 filed on 29/11/2022 in collaboration with S.I.T., Sordina IORT Technologies S.p.A. This is a patent for a compact standing wave C-band Linac for FLASH therapy.

5. Invited talks in international conferences or workshops

Date	Conference	Title
11/2004	**Care-HHH Workshop** “Beam Dynamics in Future Hadron Colliders and Rapidly Cycling High-Intensity Synchrotrons”, CERN, Geneva (Switzerland)	RF coupling impedance measurements versus simulations
06/2011	**China-Italy Bilateral Workshop** “New Advanced Coherent Light Sources’’, Beejing (China)	SPARC/SPARX activity at LNF
09/2011	**International Particle Accelerator Conference** (IPAC 2011), San Sebastian (Spain)	Advanced Beam Manipulation Techniques at SPARC FEL Facility
10/2013	**International Seminar** “Advanced Accelerator and Radiation Physics”, Adyge State University, Maykop (Russia)	Frontiers in modern accelerator physics (invited review)
04/2014	**ICFA Workshop** on “Electromagnetic wake fields and impedances in particle accelerators’’ Erice, Italy	History and development of bench measurement techniques for impedance evaluation
02/2015	1st Particle Accelerator Components Metrology and Alignment to the Nanometre scale (**PACMAN**) Workshop, CERN, Geneve (Switzerland)	Stretched wire measurements and impedance matching (invited review)
04/2015	**Advances in X-ray Free-Electron Lasers Instrumentation**, SPIE Optics Optoelectronics, Prague (Czech Republic)	Operational experience on the generation and control of high brightness electron bunch trains at SPARC-LAB
11/2015	**EuCARD-2 XBEAM-XRING-XLINAC** Workshop “Beam Dynamics meets Diagnostics”	Measurements of small impedances
03/2016	**ICFA Workshop** “Physics and Applications of High Brightness Beams”, Havana, Cuba	ELI: new frontiers of particle acceleration and radiation sources
08/2017	**IBIC 17** “International Beam Instrumentation Conference”, Grand Rapids, USA	Overview of the Diagnostics of the ELI-NP Gamma Beam System: Challenges for the Electron-Photon Interaction Point Diagnostics

09/2017	**ICFA Workshop** on “Impedances and Beam Instabilities in Particle Accelerators”, Benevento, Italy	Challenges and pitfalls for impedance measurements in the lab
06/2018	**ECLOUD'18 workshop,** “Electron-cloud workshop”, La Biodola - Isola d'Elba (Italy).	Experimental challenges in linear and circular accelerators driven by impedance issues
07/2021	Workshop on **Towards An Ultra-Compact X-Ray Free-Electron Laser,** Univ. of California UCLA, Los Angeles (United States), online contribution	High gradient test structures

6. National and international awards and recognitions for research activities

6.1 Editorial Board Membership or Participation

Editorial BOARD member of Physical Review – Accelerators and Beam journal The Physical Review – Accelerators and Beam journal is the American Physical Society reference journal of the Accelerator Physicist international community. https://journals.aps.org/prab/staff 3-years appointment starting in 01/2024
Associate Editor of Frontiers in Physics (section Accelerator Physics): https://www.frontiersin.org/ since February 2023.
Editorial Board Member of journal “Instruments” (EISSN 2410-390X) https://www.mdpi.com/journal/instruments/editors since March 2019.
Referee various international journals: Physical Review Accelerators and Beams, Journal of Instrumentation, Instruments, Review of Scientific Instruments, NIM-A

6.2 Invited Review Papers or Book chapters

The **International Committee for Future Accelerators (ICFA)** is the reference worldwide panel in accelerator physics. The ICFA Beam Dynamics Newsletter of December 2016 collects 26 articles on the “Collective Effects in Particle Accelerators”, edited by E. Métral (CERN, Switzerland); among them, **A. Mostacci wrote the review contribution on “Beam-Coupling Impedance and Wake Field – Bench Measurements”.**

For the 30 years of the **Joint Universities Accelerator School**, a book will be published collecting all the material discussed in the lectures. A. Mostacci has been asked to write a chapter titled ***Introduction to Radio Frequency engineering*** for particle accelerators.

6.3 Paper/Talks awards

The series of Virtual Journals in the physical science are designed by American Institute of Physics and the American Physical Society to highlight papers considered relevant to Nanoscience and Nanotechnology, Ultrafast Science, Biophysics, Quantum Information and Superconductivity. A publication of A. Mostacci has been selected for Virtual Journal of Ultrafast Science:
M. Ferrario, **A. Mostacci**, et al., "**Direct measurement of the double emittance minimum in the beam dynamics of the SPARC high-brightness photoinjector**", selected for Virtual Journal of Ultrafast Science, **January 2008** Vol. 7, Issue 1 - High Field Physics.

A. Mostacci received **a notice for oral communication** titled *Comb beam for particle driven plasma-based accelerators* at the Annual Meeting of the Italian Physical Society (Trieste, 23-27 September 2013). The contribution has been later published in:
A. Mostacci, *Comb beam for particle-driven plasma-based accelerators*, Il Nuovo Cimento, 37C (2014), doi:10.1393/ncc/i2014-11817-0.

7. Scientific production metrics

The following quality parameters scientific production have been computed on the 6th July, 2024 based on the information available in the database used for the ASN.

Reporting Period: from 1st January, 2010 to 6th July, 2024 (last 15 years)

	SCOPUS	**Web of Science**
Research products: papers on journals or conferences proceedings	163	124
Hirsch (H) index	34	31
Total Citations	5207	3693
Average citation number per research product	31.94	29.78

Reporting Period: from 1st January, 1997 to 6th July, 2024 (whole scientific production)

	SCOPUS	**Web of Science**
Research products: papers on journals or conferences proceedings	277	163
Hirsch (H) index	38	32
Total Citations	5320	4015
Average citation number per research product	19.21	24.63

Total impact factor on the whole scientific production
Source for journal impact factors: https://jcr.clarivate.com/jcr/home

The annual impact factor of each journal has been considered. Not all the journals, where the papers are published, have impact factors available in the database for the publication year. Considering the list in sec. 12, by summing the (yearly varying) impact factors of each journal (when available), one obtains

Total Impact Factor: **358.434** (computed on 115 journal papers)
Average Impact Factor: 358.434/115 = **3.117**

The 2024 papers are excluded from the total impact factor computation.

8. Teaching activities at the university level in Italy or abroad

8.1 University courses at Sapienza University of Rome

General Physics II (Classical Electromagnetism) – Bachelor degree

A.Y. 2021-22 to Today	Mechanical Engineering	9 CFU, about 400 exams/year ([1])
A.Y. 2012-13 to A.Y. 2020-21	Electrical Engineering	9 CFU, about 90 exams/year ([1])
A.Y. 2003-04	Environmental Engineering	6 CFU, about 20 exams
A.Y. 2002-03	Transportation Engineering	6 CFU, about 10 exams

Accelerator Physics and Relativistic Electrodynamics (Special Relativity, Charged Beam dynamics in particle accelerators) – Master degree

A.Y. 2017-18 to Today	Electronic Engineering	6 CFU, about 10 exams/year ([1])

Since A.Y. 2022-23, the course is included also in the Master Degree in Physics and it is attended by student of *LArge Scale Accelerators and LAsers* (LASCALA) program within the Erasmus Mundus initiative.

Multisciplinary Laboratory of Electronics (RF measurement) – Master degree

A.Y. 2014-15 to Today	Electronic Engineering	6 CFU, about 40 exams/year ([1])

The course is hosted in the Advanced Particle Accelerator laboratory and students get acquainted to state-of-the-art instruments for microwave measurements. Over the years, the course has been also supported by world leaders in microwave measurements, such as Keysight and Rohde&Schwarz companies and National Laboratories, such as Laboratori Nazionali di Frascati (INFN-LNF).

Guided Experiment at Laboratory of Physics, second module – Master degree

A.Y. 2021-22 to Today	Physics	100 hours, 4 students/year ([1])

Within the second module of Laboratory of Physics course, A. Mostacci is training the students on *Network Analysis of Accelerating Cavities* in the Advanced Particle Accelerator laboratory.

Radio Frequency cavities for next generation particle acceelrators– Master degree
Internship for Master students in Physics from the University of Liverpool (A.Y. 2023-24)

High Frequency measurement laboratory (RF measurement) – Master degree

A.Y. 2011-12 to A.Y. 2013-14	Electronic Engineering	6 CFU, about 5 exams/year ([1])

The course was an integrated didactic unity (UDI) with the course of "High Frequency systems".

Modern Physics laboratory (RF measurement) – Master degree

A.Y. 2006-07 to A.Y. 2007-08	Sciences for Engineering	4 CFU, about 10 exams/year ([1])

Laboratory of Experimental Physics (Mechanics, Thermodynamics, Electromagnetism) – Bachelor degree

A.Y. 2004-05 to A.Y. 2009-10	Aerospace Engineering	4 CFU, about 90 exams/year ([1])
A.Y. 2007-08	Mechanical Engineering	3 CFU, about 30 exams

General Physics I (Mechanics, Thermodynamics) – Bachelor degree

A.Y. 2007-08	Clinical Engineering	5 CFU, about 80 exams
A.Y. 2002-03	Transportation Engineering	6 CFU, about 10 exams

([1]) Computed as the average number of students attended the exam sessions of each academic year.

8.2 PhD and Post-Doc level teaching in national and international context as expert of Accelerator Physics and RF measurements.

Year	Place	Lecture/Course
2017-Today	Joint University Accelerator School, organised by the European Scientific Institute at Archamps (France)	**Introduction to RF engineering**
2022-Today	PhD school on Accelerator Physics at Sapienza University of Rome	**Collective effects in Circular Accelerators**
18 June to 1 July 2023	Lectures at the *RF for accelerators* course organised by CERN Accelerator School (CAS) Instructor in the Hands-on Session on RF measurements	**Impedances and wakefields** **RF Beam Diagnostics (2 lectures)** **Time and frequency domain measurements on traveling wave structures** (hands-on session)
22 Sep. 2018	Lecture at the *Introduction to Accelerator Physics* course organised by CERN Accelerator School (CAS) Costantia, Romania	**Advanced Accelerator Concepts**
April 2014	Advanced Particle Accelerator Laboratory, SBAI Department, Sapienza University of Rome	**RF measurements** 1-week intensive course for CERN researchers visiting Sapienza, including theoretical and practical parts

8.3 Supervision of Bachelor, Master and PhD thesis

A. Mostacci has actively supervised all the theses performed in the Advanced Particle Accelerator Laboratory since its foundation in 2002.

We report details of the supervision activity from the <u>A.Y. 2017-18 onwards</u>:
14 Bachelor Degree thesis in Electrical Engineering,
23 Master degree thesis in Electronic Engineering (21), in Electrical Engineering (2) and Nanotechnology Engineering (2),
3 Master degree thesis in Electronic Engineering are presently ongoing.

Among them, a significative number of the Master degree thesis in Electronic engineering have been performed within the collaboration with high profile international research institutions and industries

14 theses	CERN, Genève, Switzerland
3 theses	Paul Scherr Institute (PSI), Villigen, Switzerland
1 these	Lawrence Berkley National Laboratory (LBNL), Berkley, USA
1 these	IBA (a world leader in particle accelerator technology), Leuven, Belgium

Concerning the supervised PhD thesis, the information is reported in the following table.

University	PhD school	Supervised Students
Sapienza University of Rome	Accelerator Physics	**Marco Marongiu** (XXXI cycle) * **Giovanni Franzini** (XXXII cycle) **Shalva Bilanishvili** (XXXIII cycle) **Hikmet Bursali** (XXXIV cycle) **Chiara Antuono** (XXXVII cycle, ongoing) **Michela Neroni** (XXXVII cycle, ongoing) **Gilles J. Silvi** (XXXVII cycle, ongoing) **Phani Meruga Deep** (XXXIX cycle, ongoing)
University of Sannio, Benevento	Information Technology for Engineering	**Luca Sabato** (XXXI cycle) *
Sapienza University of Rome	Engineering and Applied Science for Energy and Industry	**Gianmarco Ricci** (XXXVII cycle, ongoing)

(*) XXXI cycle corresponds to Academic Year 2016-17

8.4 Industrial Training

From 2011 to 2012 (3 years), A. Mostacci gave lectures on Mechanics, Structure engineering, Electrical engineering as well as supervising laboratory activities, at the *ENI corporate university* within ENI personnel training program.

8.5 Knowledge Exchange Activities ("Terza Missione")

Since 2023, A. Mostacci gives talks in Secondary schools about "Education in Universities" within the EU funded, PNRR project *Orientamento Next Generation*. Such initiative is the joint project of all the universities in the Lazio Region, aimed at helping students in our region to make informed choices about their educational paths after completing secondary school, as well as defining their personal and professional trajectories.

9. Other academic activities including participation in elective collegial bodies

Start	End	Institution	Position
2016	Today	Sapienza, Univ. of Rome	**Member of Professor Board of the PhD** in Engineering and Applied Science for Energy and Industry ([1])
2011	Today	Sapienza, Univ. of Rome	Member of the Professor Board of **Electronic Engineering**
2021	Today	Sapienza, Univ. of Rome	Member of the Professor Board of **Mechanical Engineering**
02/2023	Today	Sapienza, Univ. of Rome	**Elected Member of the Media and Communication Committee** of the SBAI Department
2012	2021	Sapienza, Univ. of Rome	Member of the Professor Board of **Electrical Engineering**
2004	2009	Sapienza, Univ. of Rome	Member of the Professor Board of **Aerospace Engineering**
11/2024	…	Sapienza, Univ. of Rome	**Member of Professor Board of the PhD** in Accelerator Physics. The participation will start in the next academic year, i.e. in November 2024.
07/2024	10/2024	Faculty of Sciences, University Paris-Saclay	**Member of board** for the selection of "directeur de thèse" in France.
08/2023	08/2023	Faculty of Sciences, University Paris-Saclay	**Member of board** of final exam for the LArge Scale Accelerators and LAsers - LASCALA Master (Erasmus Mundus program)
09/2022	02/2023	Sapienza, Univ. of Rome	**Elected Member of the Scientific Research Committee** of the SBAI Department
02/2022	02/2022	Sapienza, Univ. of Rome	**Member of board** of final exam of PhD course in Accelerator Physics
05/2021	05/2021	University of Naples, Federico II	**Member of board** of final exam of PhD course in Information Technology
09/2015	09/2015	Sapienza, Univ. of Rome	**Member of the selection board** for the PhD in Accelerator Physics
04/2008	06/2008	Sapienza, Univ. of Rome	Member of the "Research and cultural activity'' working group of the Faculty of Engineering
		Sapienza, Univ. of Rome	**Member of several boards for selection** of research and post-doc grants at the SBAI Department ([2])
		Istituto Nazionale di Fisica Nucleare - INFN	**President/Member of several boards for selection** for research and technological positions at INFN
		Physics Department of Milano University	**Member of boards for selection** of post-doc grants within FIS/01 scientific sector

([1]) former Sciences and Technologies for Complex Systems
([2]) SBAI department stands for Department of Basic and Applied Science for Engineering. The Department of Energetics joined the SBAI Department in 2010.

10. Highlights of the research activity

10.1 Development of radio frequency devices for novel particle accelerators at the Advanced Particle Accelerator Laboratory

Related journal publications: [J6, J11, J27, J30, J79, J85, J100, J101, J105, J111, J113, J115, J117]
Selected publications: [S7]
National and international collaboration: CERN, INFN-LNF, LBNL, UCLA.

One of the key research areas for A. Mostacci has been the development of advanced RF devices operating in the 3 to 12 GHz frequency range. His work spans a variety of structures, including **standing wave cavities and traveling wave sections**: some examples are radiofrequency (RF) deflectors, phase space linearizing structures, hybrid electron guns, and high-gradient, compact accelerating sections. A. Mostacci has been involved not only in the design of these devices but also in their realization and tuning through low-power bench measurements.

Leveraging his expertise gained at CERN and during his early years at Sapienza, **A. Mostacci proposed the creation of a dedicated laboratory for the RF aspects of accelerator physics**. This led to the establishment of the Advanced Particle Accelerator Laboratory (APA-Lab) at the SBAI Department of Sapienza. Over approximately 20 years, under A. Mostacci's supervision, the APA-Lab has been developed through a collaborative effort with CERN and INFN, which have partially funded the laboratory's instrumentation. (https://research.uniroma1.it/laboratorio/194488).

The APA-Lab specializes in **frequency domain measurements using vector network analyzers** (VNAs) ranging from 100 kHz to 20 GHz at power levels up to 30 dBm. The laboratory also boasts spectrum analyzers covering similar frequency ranges.

The quantity and quality of state-of-the-art VNAs in the APA-Lab are remarkable for a university laboratory. The laboratory is equipped with five VNAs (including one with four ports) and seven manual and electronic calibration kits. Additionally, the laboratory has two spectrum analyzers, a 3 GHz signal generator, and a calibrated antenna for EMC measurements. Recently, A. Mostacci secured funding to acquire a time domain test stand capable of measuring 6 GHz pulsed signals.

The extensive number of network analyzers enables the laboratory to host advanced Radio Frequency measurement courses for both Electronic Engineering (approximately 40 students per year) and Physics students. The laboratory has also hosted advanced RF measurement courses for particle accelerator physicists from CERN in Switzerland.

The laboratory offers dedicated computing resources for designing electromagnetic devices across all frequencies using state-of-the-art simulation tools such as Simulia-CST and Ansoft-HFSS. These tools are particularly effective in simulating RF components and systems, allowing for comprehensive analysis and optimization of advanced accelerator components.

Moreover, these RF simulation tools are crucial for understanding measurement artifacts, providing researchers with insights into the complexities of experimental setups and refining measurement techniques for enhanced accuracy and reliability. In addition, the laboratory possesses advanced numerical codes for **studying and designing beam dynamics** in particle accelerators. Analyzing the impact of devices on beam dynamics is integral to RF design.

The APA-Lab is also equipped with a **bead-pull measurement system** capable of measuring the electromagnetic field inside standing wave and traveling wave structures. This system has been used on devices operating from S-band (3 GHz) to X-band (11 GHz), now installed in operational machines (e.g., SPARC LINAC) or in prototype phases (FLASH LINAC). One of the laboratory most productive research directions has been the development of advanced bead-pull measurements for fast and accurate tuning of novel accelerating structures. For example, tuning the **hybrid gun**, which features closely coupled standing wave and traveling wave sections, required significant improvements to the traditional measurement method.

10.2 Beam self-induced effects and coupling impedance

Related journal publications: [J5, J13, J23-J26, J51, J89, J99, J110, J114, J116, J118-J123]
Selected Publications: [S14]
National and international collaboration: CERN, INFN-LNF, LBNL.

The electromagnetic interaction between the beam in a particle accelerator and its surroundings (beam pipe) in a circular accelerator is investigated through the concept of **coupling impedance**. This interaction can result in energy losses (longitudinal impedance) or transverse instability (transverse impedance). Over the course of more than two decades of research, A. Mostacci has examined numerous **potential sources of impedance** relevant to novel particle accelerators using classical electromagnetism approaches.

The design of the beam pipe for the **Large Hadron Collider** (LHC) was unconventional upon its initial proposal. To shield the magnets' cold bore from synchrotron radiation emitted by 7TeV protons, a beam screen (referred to as the "liner") was introduced along the length of the machine. The design of the liner represents a compromise among various factors, including beam stability considerations, vacuum requirements, heat load on the cold bore, electron cloud effects, and practical constraints. This unique geometry has served as inspiration for the design of beam pipes in other large-scale machines, such as the **Future Circular Collider** (FCC).

A. Mostacci early research focused on the LHC beam pipe, addressing three primary sources of beam energy loss: interaction with pumping holes, surface corrugation (saw tooth), and the effect of azimuthally inhomogeneous metallic beam pipes. Utilizing **theoretical methods of classical electromagnetism** (e.g. Green's function approach, field matching, approximate boundary conditions) he developed approximated but analytical estimation which are now also revisited in the context of the FCC studies, where the availability of analytical formulas can streamline the design phase. The main importance of all those studies has been the assessment of the LHC beam pipe which is now used in most of the 27 km length of the ring.

The theoretical environment built to study the LHC liner impedance issues has been subsequently applied to similar problem to give estimations of the impedance contribution in more complicated devices in order to explain unexpected phenomena (e.g. heat load) suffered by the beam, particularly relevant in **cryogenic machines**.

Bench measurements represent an important tool to estimate the coupling impedance of any particle accelerator device. The well-known technique based on the **coaxial wire method** allows to excite in the device under test a field like the one generated by an ultra-relativistic point charge.

With the coaxial wire method, A. Mostacci measured the coupling impedance of many particle accelerator devices of interest of CERN machines such as LHC and its injectors. A. Mostacci also performed **beam experiments at CERN to compare bench measurement with direct beam measurement on the same devices**. The coaxial line approach has also been used to bench measured the effect of coating in the secondary emission yield, relevant for LHC electron cloud issues. Also, the next generation of LHC collimators has been bench measured in order to estimate the coupling impedance and look for possible trapped modes in the moving jaws.

10.3 High brightness beams for advanced radiation sources: physics, diagnostics and applications

Related journal publications:
[J1, J3, J4, J17, J18, J20-J22, J31, J32, J34, J39, J43, J46-J48, J53, J54, J58, J61-J64, J66-J70, J75, J77, J78, J80, J82-J84, J87, J88, J91, J92, J94-J96, J98, J102-J104, J106, J109]
Selected Publications: [S1], [S6], [S8], [S10], [S15], [S16]
National and international collaboration: INFN-LNF, FERMI@ELETTRA, PSI, UCLA.
EU funded project: XLS-Compact Light

Since 2006, A. Mostacci joined SPARC commissioning and operation participating to all the scientific achievements reported below. SPARC is a high brightness linear accelerator initially conceived to drive proof-of-principle experiments in the generation of radiation with Free Electron Laser (FEL). Nowadays the SPARC accelerator has been upgraded to SPARC_LAB with the installation of multi TW class lasers, allowing world-class, ground breaking experiments in accelerator and plasma physics as well as interdisciplinary research.

Following the time line of the SPARC_LAB upgrades, the activity can be roughly divided in research on physics of **high brightness electron beams**, on **FEL innovative schemes**, on the generation of **THz radiation**, on novel plasma-based particle acceleration techniques and on **Compton effect**-based radiation sources.

Concerning the physics of high brightness electron beam, SPARC measured for the first time the **emittance oscillation of beams** generated by RF photocathodes, assessing the working point used world-wide in all the FELs based on RF guns. Such result has been possible due to a carefully conducted experiments and data analysis. In order to longitudinally compress the electron beam (to increase the bunch current), SPARC introduced and demonstrated the **low beam energy compression** (namely “velocity bunching”) properly tuning low energy focusing solenoids, for the first time used there. Such velocity bunched beam exhibits non-negligible energy spread that must be considered in beam measurements or exploited in to produce radiation with non-conventional FEL configurations. SPARC high brightness beams are also used to propose and demonstrate novel concepts in beam diagnostics or medical applications in electron-based radiotherapy.

SPARC contributed to develop and test innovative ideas on Free Electron Laser schemes which have been afterword applied in bigger FEL facilities; such results have possible also to extensive benchmarking of code against experiments and innovative diagnostics. For instance, SPARC introduced the undulator tapering to compensate energy spread or demonstrated the generation of a super radiant pulse in the long radiator of a single stage cascaded FEL, by seeding the modulator with an external laser. Seeded FELs can operate either in the amplifier “direct seeding” scheme, or in the **high gain harmonic generation** configuration, where the seed in a first undulator (modulator) is used to induce an energy-density modulation in the electron beam longitudinal phase space. This bunched beam then emits a higher order harmonic in a following undulator (radiator). This scheme can be repeated in a multiple stage cascade of modulators and radiators, extending the operation wavelength toward a range where seed sources are not available. The versatility of the SPARC LINAC allowed also to send a train of bunches in the FEL undulator, resulting in a **two colour FEL radiation**, time modulated FEL radiation and seeded two colours radiation. Also, this scheme was pioneered at SPARC and it is now used in several other laboratories for pump-probe FEL experiments.

The **generation of THz radiation** at SPARC relies on the usage of sub-ps high brightness electron bunches when a broadband radiation is needed, while longitudinally modulated electron beams allow for tunable narrow-band radiation. The generation is quite efficient since the velocity bunching imposes a longitudinal phase space distortion, leading to asymmetric current profiles with sharp rising charge distribution at the bunch head; therefore, high frequency (THz) radiation can be emitted if the bunch goes across a radiator (coherent transition radiation). The resulting THz radiation is more intense than other sources and it has been used for **advanced material studies**.

A. Mostacci's research interests also encompass **high-brightness beam diagnostics**, focusing on the measurement principles, uncertainty evaluation, and the development of devices to be installed in machines. This includes advanced data analysis when possible. One notable example is the RF deflector used for longitudinal phase space measurement, including bunch length and energy-position correlation. He contributed to the development of the device installed at SPARC, participated in its use, and played a significant role in analyzing the acquired data for numerous experiments. He has also enhanced the underlying theory, demonstrating its application for advanced measurements. Recently, he has explored the field of virtual bunch length measurement using **machine learning** at the SwissFEL operating at PSI.

A. Mostacci has extensive experience in all measurements relevant to high-brightness photoinjectors. Due to this expertise, he served as the data analysis leader at SPARC and was **responsible for beam diagnostics** of the Gamma Beam Source, the Compton machine at the ELI-NP facility in Romania.

Several novel initiatives are emerging in the field of conventional FELs. The goal is to develop **more compact and cost-effective FELs** that can be deployed in national laboratories while maintaining RF acceleration schemes. In this context, A. Mostacci has joined the research effort focused on the design of X-band high-brightness accelerators, such as the XLS project, where he was responsible for the traveling wave linearizer. Recently, he has also been contributing to the High-Flux Compact FEL for chip metrology proposed by UCLA, specifically optimizing C-band structures to reach a high accelerating field.

10.4 Plasma based accelerators

<u>Related journal publications</u>:
[J2, J8, J9, J12, J15, J16, J19, J28, J29, J33, J35-J38, J40-J42, J44-J45, J49-J50, J52, J55-J57, J59, J60, J65, J71, J73, J74, J76, J81, J86, J90, J93, J97]
<u>Selected Publications</u>: [S2], [S3], [S5], [S9], [S11], [S12], [S13]
<u>National and international collaboration</u>: INFN-LNF, UCLA.
<u>EU funded project</u>: EuPRAXIA, CRISP

Plasma accelerators offer a revolutionary approach to particle acceleration, providing **compact and cost-effective solutions with superior energy gradients** compared to traditional methods. Their versatility enables the generation of high-quality particle beams tailored to diverse research and industrial applications, from high-energy physics to medical therapy and materials science. By driving interdisciplinary collaborations, plasma-based technologies foster innovation and skill development in multiple fields, paving the way for future scientific breakthroughs. Their sustainable nature and potential for reducing environmental impact make them attractive candidates for next-generation accelerators, while their adaptability to different plasma regimes ensures scalability and versatility. In summary, plasma accelerators hold the key to unlocking new frontiers in particle physics, materials science, and beyond, shaping the future of scientific exploration and technological advancement.

Plasma-based accelerators represent the **new frontier for the acceleration of high quality**, i.e. high brightness, **electron beams** because of their capability to sustain extremely large accelerating gradients. In conventional Radio-Frequency (RF) linear accelerators, accelerating gradients are currently limited to ~100 MV/m, mainly due to breakdown occurring on the metallic walls of the devices. Ionized plasmas, however, can sustain electron plasma waves with electric fields three orders of magnitude higher than those achievable with actual RF technologies. Moreover, the accelerating field strength is tunable by adjusting the plasma density.

Even though the principle of plasma-based acceleration has been proven by several groups, the so accelerated beams still suffer from large angular divergence, large energy spread, poor reproducibility, which prevent their use as an alternative to conventional RF accelerators which typically provide stable and high-quality electron beams.

A possible solution is to use innovative transport lines based on conventional technology, such **quadrupole or solenoid-based transport lines** arranged in a clever way. Another approach towards plasma-accelerated high-brightness electron beams relies on the use of the plasma only as the active media, injecting electrons into a **pre-formed plasma channel**. A first scheme consists in injecting a witness electron bunch in a plasma where the plasma wave is excited by a high-power laser pulse, i.e. external injection in a Laser Wake Field Accelerator (LWFA). The second scheme relies on the induction of coherent plasma oscillations with multiple electron bunches, that is a resonant Plasma Wake Field Accelerator (PWFA). Such idea relies on using a comb beam, i.e. a train of equidistant bunches, to increase the accelerating gradient.

A scheme to produce comb-like beams was conceived at INFN-LNF and successfully tested at SPARC for the first time. The additional benefit of resonant PWFA relies on the use of lower charge bunches in the train with respect to traditional PWFA, with the advantage of a better control of acceleration and transport.

The proof of principle experiments of resonant wake field acceleration triggered improvements in the plasma generation schemes, in **active plasma lens** for symmetric beam focusing, in the SPARC synchronisation, in standard bunch measurement as well as in **non-intercepting beam diagnostics**; also, the betatron radiation emitted by electron moving in the plasma channel can be used. A scheme to reduce the energy spread tailoring the plasma bubble allowed to demonstrate **the first FEL light from a PWFA accelerator**; the result has been published in Nature. A. Mostacci actively contributed to all the scientific achievements in PWFA at SPARC.

10.5 Particle accelerators for radiation therapy
Related journal publications: [J7, J10, J14, J72, J107, J108, J112]
Selected Publications: [S4]
National and international collaboration: INFN-LNF, INFN-LNS, Curie Institute.
Industrial collaboration: S.I.T., Sordina IORT Technologies S.p.A

The interest in medical applications of accelerators by A. Mostacci and his research colleagues, dates back to 2011 when they proposed a **post-acceleration scheme utilizing modified hospital proton LINAC cavities**. This innovative approach aimed to harness the tens of MeV protons produced by high-energy laser pulses impacting a target. The proposed scheme demonstrated notable advantages in terms of beam properties, versatility, and compactness. Presently, the utilization of laser-plasma generated particles for medical purposes is a subject of extensive investigation in numerous national and international initiatives. A. Mostacci actively collaborates with these initiatives within the framework of the EuPRAXIA EU-initiative and the FRIDA INFN-initiative, contributing to the advancement of this field. Dosimetry of Very High Energy Electrons (VHEE) for radiotherapy applications was also investigated at SPARC LINAC in 2014 with a joint effort involving A. Mostacci and other researchers from INFN, Scottish research institutes and US hospitals.

Nowadays, radiotherapy is a widely used method for cancer treatment that offers significant curative potential. Over the past decade, advancements in treatment delivery and imaging techniques have improved the tolerability of radiotherapy and reduced side effects. However, radiation resistance remains a clinical challenge as some tumors are resistant to conventional radiotherapy as well radiation-induced side effects can limit the maximum delivered dose and impact the patient's quality of life.

Therefore, there is a need for more potent and better-tolerated radiotherapy options to enhance the balance between tolerance and efficacy. To address this goal, a novel irradiation modality called **FLASH radiotherapy** is currently being developed. This technique involves delivering short pulses of electrons with ultrahigh dose rates (>40 Gy/s), significantly higher than the typical values of 0.05 Gy/s in conventional radiotherapy. FLASH radiotherapy significantly increases the differential effect between tumors and normal tissues and it has shown promise in destroying tumors while better protecting normal tissues and minimizing side effects.

Currently, several scientific groups are investigating the mechanism underlying the FLASH effect. For clinical applications, the development of a compact electron linear accelerator (LINAC) with high current (around 100 mA) and beam conditions closely resembling those used in preclinical studies is crucial.

However, despite the growing interest in the FLASH effect, only a handful of **LINAC systems worldwide are dedicated to its study**. Through a longstanding collaboration with Sordina IORT Technologies (SIT), a prominent company specializing in the production of dedicated electron linear accelerators for IOeRT (Intra-Operative electron Radiation Therapy), A. Mostacci and his colleagues have engineered an S-band (3GHz) LINAC specifically tailored for FLASH therapy. This groundbreaking system is currently operational at the Curie Institute in France. Furthermore, the fundamental design concept of this LINAC has been patented, underscoring its innovative and proprietary nature. A second system has also been designed and patented, aimed at FLASH therapy, consisting of a more compact C-band (5.712GHz) LINAC. With this new machine, an energy of 12 MeV can be achieved with high currents in a very compact space for radiobiology experiments. APA-Lab is presently devoting all its research efforts to such project.

Within this research background, A. Mostacci research interests range from **the development of particle accelerating devices to beam diagnostics**. Resonant cavities and travelling wave structures are used for generating the high-energy electron beams used for cancer treatment. By utilizing the principle of resonance, the cavities can produce high fields to accelerate the electrons to the needed energies; on the contrary, traveling wave structures are able to provide a field synchronous with the particles to allow interaction on longer distances than with resonant cavities. Beam diagnostics also plays a critical role in ensuring the safe and effective delivery of radiation in FLASH radiation therapy using a high current linear accelerator. Developing, for instance, reliable beam current monitors, beam profile monitors, energy monitors, position monitors, and timing monitors can provide the necessary information for continuous monitoring and optimization of the beam parameters. A. Mostacci is responsible for the linac realization and he is designing and prototyping the diagnostics and control needed for its commissioning.

This research activity is included in the PNR-PE6 funded initiative named HEAL-ITALIA (**H**ealth **E**xtended **AL**liance for **I**nnovative **T**herapies, **A**dvanced **L**ab-research, and **I**ntegrated **A**pproaches). HEAL ITALIA is based on a multidisciplinary network of laboratories, clinical research centers and enterprises, sharing knowledge and technologies to reach results with timeliness and increase the quality of health services to ultimately carry a frontier activity into a contemporary era of Precision Medicine. APA-Lab is having a leading role in building a prototype of a FLASH LINAC for VHEE electrons suitable for deep tumors. For instance, a reduced size prototype of the accelerating structure has been realized, measured and tuned; such prototype included all the key components, such as accelerating cells, coupling cells, cooling pipes and a sensitive tuning system.

11. Selected papers highlighting individual contribution (2015-2024)

The papers are listed in chronological order, starting from the most recent one. For each paper, the impact factor and the number of citations are reported, according to the SCOPUS database on the 6th July, 2024.

[S1] S. Bettoni, G.L. Orlandi, F. Salomone, R. Boiger, R. Ischebeck, R. Xue and **A. Mostacci**
Machine learning based longitudinal virtual diagnostics at SwissFEL,
Review of Scientific Instruments (**2024**); doi: 10.1063/5.0179712
IF: 1.3 (2023), Citations: 0, **Downloads: 135** (from Journal website)

Summary, novel ideas and individual contribution:
The paper focuses on the implementation and optimization of a Machine Learning (ML) algorithm to determine the electron bunch length at SwissFEL. Studies were conducted at both magnetic compressors to cover a wide range of bunch lengths, varying by a factor of 200 (from about 2 ps down to about 10 fs). A relative difference of a few percent between the ML predictions and the measured values for the entire bunch length range was achieved. The ML results helped address the systematic discrepancy affecting the synchrotron radiation monitor-based predictions of the bunch length, providing an alternative, reliable, shot-to-shot, and non-invasive approach to measure the electron bunch length. ML enabled the determination of the bunch length and longitudinal profile in a non-invasive manner, achieving a high level of accuracy in predictions even with a limited number of data points (less than 100 per machine set-points) and a relatively small number of channels (RF amplitudes and phases of the accelerating structures upstream of the compressor).

A. Mostacci conceived this research initiative with PSI researchers. A collaboration with PSI started on this topic, allowing a master's thesis student to join PSI for an internship. A. Mostacci validated the research, in particular the methodology as well as the data analysis and interpretation of the results, leveraging his extensive experience in bunch length measurements with RF deflectors. Recently, A. Mostacci has started similar researches trying to apply ML to relevant issues in accelerator physics, for instance virtual diagnostics at the SPARC high-brightness photoinjector or fast alignment of LHC crystal collimators (also directing a CERN-Sapienza PhD thesis).

[S2] M. Galletti, D. Alesini, M.P. Anania, S. Arjmand, M. Behtouei, M. Bellaveglia, A. Biagioni, B. Buonomo, F. Cardelli, M. Carpanese, E. Chiadroni, A. Cianchi, G. Costa, A. Del Dotto, M. Del Giorno, F. Dipace, A. Doria, F. Filippi, G. Franzini, L. Giannessi, A. Giribono, P. Iovine, V. Lollo, **A. Mostacci**, F. Nguyen, M. Opromolla, L. Pellegrino, A. Petralia, V. Petrillo, L. Piersanti, G. Di Pirro, R. Pompili, S. Romeo, A.R. Rossi, A. Selce, V. Shpakov, A. Stella, C. Vaccarezza, F. Villa, A. Zigler and M. Ferrario
Stable Operation of a Free-Electron Laser Driven by a Plasma Accelerator,
Physical Review Letters (**2022**); doi: 10.1103/PhysRevLett.129.234801
IF: 8.6 **Citations: 10**

Summary, novel ideas and individual contribution:
This paper presents a proof-of-principle experiment demonstrating the stable and reproducible generation of coherent amplified Free Electron Laser (FEL) radiation driven by a centimeter-scale plasma accelerator. Stability is achieved by using an external laser to seed the emission process, thereby stabilizing its amplification across six consecutive undulators. This seeding mechanism significantly suppressed the fluctuations observed in previous experiments operating in the Self-Amplified Spontaneous Emission (SASE) regime. The use of the seed laser improved the reproducibility of the radiation threefold. These results mark a significant breakthrough towards the development of next-generation ultracompact accelerators, a goal

pursued by the accelerator and plasma research community, and represent a crucial step towards user facilities based on plasma accelerators. Numerical simulations supported the experimental observations. Spectral measurements performed with an imaging spectrometer at the end of the undulators' beamline demonstrated single-mode amplification of light.

Thanks to experience previously gained by A. Mostacci on FEL and plasma based accelerators, he contributed to the experiment design, its execution, the data analysis, and discussion of the results. Additionally, he guided the Sapienza PhD students involved in the experiment.

[S3] R. Pompili, D. Alesini, M.P. Anania, S. Arjmand, M. Behtouei, M. Bellaveglia, A. Biagioni, B. Buonomo, F. Cardelli, M. Carpanese, E. Chiadroni, A. Cianchi, G. Costa, A. Del Dotto, M. Del Giorno, F. Dipace, A. Doria, F. Filippi, M. Galletti, L. Giannessi, A. Giribono, P. Iovine, V. Lollo, **A. Mostacci**, F. Nguyen, M. Opromolla, E. Di Palma, L. Pellegrino, A. Petralia, V. Petrillo, L. Piersanti, G. Di Pirro, S. Romeo, A.R. Rossi, J. Scifo, A. Selce, V. Shpakov, A. Stella, C. Vaccarezza, F. Villa, A. Zigler and M. Ferrario,
Free-electron lasing with compact beam-driven plasma wakefield accelerator,
Nature (**2022**); doi: 10.1038/s41586-022-04589-1
IF: 64.8 Citations: 40

Summary, novel ideas and individual contribution:
This paper presents experimental evidence of free-electron lasing using a compact (3-cm) particle-beam-driven plasma accelerator. In this setup, the accelerating field, generated in the plasma by a relativistic particle bunch acting as a driver, is used to accelerate a trailing witness bunch. The accelerated beams are fully characterized in six-dimensional phase space and exhibit high quality, comparable to state-of-the-art accelerators. This allowed for the observation of narrow-band amplified radiation in the infrared range, with typical exponential growth in intensity over six consecutive undulators. This proof-of-principle experiment represents a fundamental milestone in the use of plasma-based accelerators, contributing to the development of next-generation compact facilities for user-oriented applications. Considering the continuous efforts of the research community to develop ultra-compact accelerators, these results represent an important milestone for next-generation and compact multidisciplinary user facilities, such as EuPRAXIA. The experiment was performed at the INFN SPARC_LAB test facility.

A. Mostacci contributed to the experiment design and execution, to the discussion of the results as well as in the reviewing of the manuscript. Under the INFN-funded experiments on plasma acceleration, he was leading the Sapienza team in joining the experimental activity at SPARC.

[S4] 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 and L. Giuliano,
Perspectives in linear accelerator for FLASH VHEE: Study of a compact C-band system,
Physica Medica (**2022**); doi: 10.1016/j.ejmp.2022.10.018
IF: 3.4 Citations: 8

Summary, novel ideas and individual contribution:
Irradiating a patient with Very High Electron Energy (VHEE) can be an effective technique for treating deep-seated tumors, also leveraging the FLASH effect. This work addresses the design of a VHEE Linac for FLASH therapy in the C-band (5.712GHz). The machine consists of an initial standing wave accelerating structure (injector), followed by four additional traveling wave structures capable of producing electrons up to 160MeV. The overall length of the machine is just over 5 meters. Current pulses beyond 200mA and a duration of 4μs allow the achievement of the integrated dose parameters and dose rates necessary for the FLASH regime. This paper proposes also an optimized dual magnetic quadrupole scheme to produce variable output field sizes. Monte Carlo simulations demonstrate a delivery of in pulse dose-rates $\gg 10^6$Gy/s and dose per pulse up to 200Gy at the build-up. Such a machine is suitable for the investigation of the FLASH fundamental mechanisms in pre-clinical and radiobiological experiments.

A. Mostacci contributed to the design and optimization of the standing wave injector as well as to the traveling wave device profiting of his expertise in RF technology. Prototype of the structures described in this paper have been realized and measured in the Advanced Particle Accelerator Laboratory at SBAI department. He contributed also to the beam dynamics studies given his expertise on high brightness 120MeV Linacs used in pioneering experiments of VHEE at LNF back in 2014 [J72].

[S5] R. Pompili, D. Alesini, M.P. Anania, M. Behtouei, M. Bellaveglia, A. Biagioni, F.G. Bisesto, M. Cesarini, E. Chiadroni, A. Cianchi, G. Costa, M. Croia, A. Del Dotto, D. Di Giovenale, M. Diomede, F. Dipace, M. Ferrario, A. Giribono, V. Lollo, L. Magnisi, M. Marongiu, **A. Mostacci**, L. Piersanti, G. Di Pirro, S. Romeo, A.R. Rossi, J. Scifo, V. Shpakov, C. Vaccarezza, F. Villa and A. Zigler,
Energy spread minimization in a beam-driven plasma wakefield accelerator,
Nature Physics (**2021**); doi: 10.1038/s41567-020-01116-9
IF: 18.684 Citations: 32

Summary, novel ideas and individual contribution:
This paper reports a proof-of-principle plasma wakefield acceleration experiment where the simultaneous acceleration of a witness bunch and reduction of its energy spread was observed for the first time. This task is accomplished by assisting the witness beam-loading with an externally imprinted energy chirp and can be extended to larger energies by tuning these two quantities. Considering the continuous efforts of research community to bring advanced accelerators from laboratory experiments to user-oriented applications such as free-electron lasers, with very demanding requirements in terms of beam quality, this approach allows us to sustain large accelerations over meter-scale distances while preserving the beam quality by enabling ultralow energy spreads. The experimental observations are supported by a complete start-to-end simulations; this feature is important to use the achieved working point in different situations. For instance, this is the key premise to the free-electron lasing reported in [S3] and [S4]. Moreover, the experimental results and start-to-end simulations confirm the working principle of the proposed method to assist the beam-loading process.

Because of his experience in measurements in high brightness beam in photoinjectors, A. Mostacci was involved in the preparation of the experiment, in the experiment itself and he extensively discussed the results and he reviewed the manuscript. He was leading the Sapienza team joining the experiments on advanced plasma accelerators in LNF.

[S6] L. Sabato, P. Arpaia, A. Gilardi, **A. Mostacci**, L. Palumbo and A. Variola,
A Measurement Method Based on RF Deflector for Particle Bunch Longitudinal Parameters in Linear Accelerators,
IEEE Trans. on Instrumentation and Measurement (**2021**); doi: 10.1109/TIM.2020.30093421
IF: 5.332 Citations: 5

Summary, novel ideas and individual contribution:
This article introduces a method for measuring longitudinal bunch parameters and the correlations between particle positions, divergences, and energies. The theory behind measurements using an RF deflector (RFD) is expanded to account for the effects of energy chirp and correlation terms. The innovative approach of using only the RFD to measure energy spread and chirps is particularly beneficial for novel high-brightness linear accelerators. To validate the method's accuracy, results from a virtual measurement campaign conducted using the ELEGANT tracking code, widely used in the design and commissioning of modern particle accelerators, are presented. The study includes case analyses of various linacs designed or operated as radiation sources (e.g., Compton sources and FELs), as well as linacs intended for plasma acceleration. Across these cases, the proposed technique achieves a relative error of about 5% in measuring energy chirp, reducing to 1% for GBS (a typical Compton source) . where strong correlations due to machine misalignment may exist.

A. Mostacci made significant contributions to this research, playing a key role in the theoretical analysis, demonstrating the potential of using RFD to measure parameters beyond bunch length. Leveraging his expertise in beam diagnostics, he proposed the case studies for numerical analysis. This paper is part of the activities of the GBS beam diagnostics group, coordinated by A. Mostacci.

[S7] L. Faillace, S. Barone, G. Battistoni, M. Di Francesco, G. Felici, L. Ficcadenti, G. Franciosini, F. Galante, L. Giuliano, L. Grasso, **A. Mostacci**, S. Muraro, M. Pacitti, L. Palumbo, V. Patera and M. Migliorati,
Compact S-band linear accelerator system for ultrafast, ultrahigh dose-rate radiotherapy,
Phys. Review Accelerators and Beams (**2021**); doi:10.1103/PhysRevAccelBeams.24.050102
IF: 1.879 Citations: 18

Summary, novel ideas and individual contribution:
Radiotherapy remains the most prevalent technique for treating tumors with ionizing radiation, aiming to target tumor tissues while sparing healthy tissues. Recent studies have demonstrated that irradiation with very short electron pulses (100-200 ms) and high instantaneous dose rates (exceeding 10^6 Gy/s) enhances the differential response between healthy and cancerous cells, without compromising the effectiveness of tumor treatment. This technique is known as FLASH therapy. This paper details the design, development, commissioning, and dosimetric characterization of the first dedicated S-band (~3 GHz) linear accelerator (linac) system optimized for ultrahigh dose rates in the FLASH regime, capable of producing variable output field sizes. The linac can generate electrons with energies up to 7 MeV and average currents around 100 mA. The project was conducted in collaboration with Sordina IORT Technologies (SIT), a global leader in intra-operative radiotherapy equipment production and commercialization. The resulting linac, now operating in a compact, relatively lightweight, commercially available machine called Electron Flash, is installed in various research institutes conducting pre-clinical studies of FLASH therapy.

A. Mostacci contributed both to the design of the accelerating structure and to the beam dynamics studies, actively participating from its conceiving to its realization. The most relevant contributions are the RF design and the low-power measurements of the prototypes.

[S8] P. Arpaia, R. Corsini, A. Gilardi, **A. Mostacci**, L. Sabato and K.N. Sjobak,
Enhancing particle bunch-length measurements based on Radio Frequency Deflector by the use of focusing elements,
Scientific Reports (**2020**); doi: 10.1038/s41598-020-67997-1
IF: 4.380 Citations: 10

Summary, novel ideas and individual contribution:
This paper revisits the RF deflector (RFD) measurement technique for determining bunch length in linear accelerators, proposing its use in combination with additional focusing elements between the RF deflector and the measurement screen. After conducting a theoretical analysis and numerical validation using state-of-the-art tracking codes, the results were compared against measurements taken at the CLEAR facility at CERN, showing a remarkable agreement. The use of focusing elements can increase the measurement resolution without introducing systematic errors, while preserving the self-calibration feature of bunch length measurement with RFDs. Additionally, this method increases the input dynamic range of the measurement, leading to further enhancements in resolution and precision. The measurements at CLEAR also demonstrated the capability to measure correlations between the vertical plane and the longitudinal position by varying the focusing power of the quadrupole. This feature is particularly important when wavefields are relevant, such as in high-frequency (X-band) modern linacs.

A. Mostacci guided the work, providing significant suggestions and insights, particularly on the theoretical aspects and in the CLEAR data analysis. His contributions to developing a comprehensive theoretical framework were essential in identifying measurement artifacts and proposing the use of RFDs for correlation term measurements.

[S9] V. Shpakov, M.P. Anania, M. Bellaveglia, A. Biagioni, F. Bisesto, F. Cardelli, M. Cesarini, E. Chiadroni, A. Cianchi, G. Costa, M. Croia, A. Del Dotto, D. Di Giovenale, M. Diomede, M. Ferrario, F. Filippi, A. Giribono, V. Lollo, M. Marongiu, V. Martinelli, **A. Mostacci**, L. Piersanti, G. Di Pirro, R. Pompili, S. Romeo, J. Scifo, C. Vaccarezza, F. Villa and A. Zigler,
Longitudinal Phase-Space Manipulation with Beam-Driven Plasma Wakefields,
Phys. Rev. Lett. (**2019**); doi: 10.1103/PhysRevLett.122.114801
IF: 8.385 Citations: 43 Editors' Suggestion

Summary, novel ideas and individual contribution:
This paper demonstrates, for the first time, the use of plasma wakefields to manipulate the longitudinal phase space of an electron beam. The proof-of-principle experiment involved the full characterization of a plasma-based device consisting of a 3-cm-long capillary filled with H_2 gas. The large fields excited in a confined plasma can be used to tune the time-energy correlation of the particles according to the desired task. This device is not only compact but also highly flexible. Measurements demonstrated the possibility of completely removing a negative energy chirp and reducing the total energy spread to the level of uncorrelated energy spread. These results paved the way for the so-called plasma-dechirper, which can remove any correlated energy spread by tuning the plasma density or beam spot size at the plasma entrance. Several applications can benefit from these results. For instance, it represents an interesting tool for FEL facilities to imprint an energy chirp in the beam and achieve shorter bunch lengths in a magnetic compressor. However, the major advantage is when employing this device downstream of a plasma-based accelerator. It is an essential feature to make plasma-accelerated beams usable with conventional magnetic optics and in applications like inverse Compton scattering or FEL.

A. Mostacci contributed to the experiment from the preliminary discussion, to its preparation as well as the measurements, and eventually to the discussion of the results. The longitudinal phase space measurements were performed with a combination of a RF deflector and spectrometer dipole developed years earlier with the relevant contribution of A. Mostacci.

[S10] D.B. Durham, F. Riminucci, F. Ciabattini, **A. Mostacci**, A.M. Minor, S. Cabrini and D. Filippetto,
Plasmonic lenses for tunable ultrafast electron emitters at the nanoscale,
Phys. Rev. Applied (**2019**); doi: 10.1103/PhysRevApplied.12.054057
IF: 4.194 Citations: 16

Summary, novel ideas and individual contribution:
This paper presents a design for ultrafast nanoscale electron emitters, offering several advantages for advanced electron-based instrumentation. The design is compatible with high accelerating fields while reducing the source size by two orders of magnitude compared to an unpatterned flat cathode. Additionally, this cathode significantly minimizes emittance increase due to surface roughness and aberrations from field curvature. Plasmonic lenses lower the laser power needed to achieve the optical-field emission regime. The geometric parameters of the cathode can be adjusted to optimize photocurrent and temporal response without altering the emission spot size. Cathodes capable of emitting sub-10fs pulses have been realized at the Molecular Foundry at LBNL and measured. Their use in RF environments enables the production of relativistic accelerated electrons with picometer emittance, which can be focused down to nanometer sizes.

This paper results from a joint scientific initiative by A. Mostacci and LBNL researchers, also involving a master's student exchange. He contributed to the cathode design phase, the discussion of experimental results, the guidance of the student's work and the validation of the results.

[S11] R. Pompili, M.P. Anania, M. Bellaveglia, A. Biagioni, S. Bini, F. Bisesto, E. Brentegani, F. Cardelli, G. Castorina, E. Chiadroni, A. Cianchi, O. Coiro, G. Costa, M. Croia, D. Di Giovenale, M. Ferrario, F. Filippi, A. Giribono, V. Lollo, A. Marocchino, M. Marongiu, V. Martinelli, **A. Mostacci**, D. Pellegrini, L. Piersanti, G. Di Pirro, S. Romeo, A.R. Rossi, J. Scifo, V. Shpakov, A. Stella, C. Vaccarezza, F. Villa and A. Zigler
Focusing of High-Brightness Electron Beams with Active-Plasma Lenses,
Phys. Rev. Lett. (**2018**); doi: 10.1103/PhysRevLett.121.174801
IF: 9.227 Citations: 48

Summary, novel ideas and individual contribution:
The paper provides a comprehensive characterization of an active plasma lens device consisting of a 3 cm-long capillary filled with H_2 gas, aimed at optimizing lensing while preserving beam emittance. To efficiently exploit the plasma lensing effect, the beam is focused in the plasma channel using state-of-the-art permanent magnet quadrupoles. The main result is the experimental demonstration that, by increasing the discharge current through the capillary and employing proper bunch shaping, the detrimental effects of plasma on beam dynamics are minimized. This system achieves strong focusing with minimal increase in horizontal beam emittance. Given that preserving beam emittance is crucial for high-brightness beams, these results represent a significant step towards developing next-generation focusing optics. While the first plasma lensing was reported in [S13], this paper demonstrates the effective usability of plasma-based beam manipulation in new compact facilities. The impact

of this research is quite significant, and active plasma lenses are now used in several plasma accelerators, both particle and laser-driven.

A. Mostacci contributed to the planning of the experiments, data collection, beam characterization, and discussion of the final results. The emittance measurements were performed using a method and apparatus developed with the relevant contribution of A. Mostacci in earlier years.

[S12] A. Marocchino, M.P. Anania, M. Bellaveglia, A. Biagioni, S. Bini, F. Bisesto, E. Brentegani, E. Chiadroni, A. Cianchi, M. Croia, D. Di Giovenale, M. Ferrario, F. Filippi, A. Giribono, V. Lollo, M. Marongiu, **A. Mostacci**, G. Di Pirro, R. Pompili, S. Romeo, A.R. Rossi, J. Scifo, V. Shpakov, C. Vaccarezza, F. Villa and A. Zigler,
Experimental characterization of the effects induced by passive plasma lens on high brightness electron bunches,
Applied Physics Letters (**2017**); doi: 10.1063/1.4999010.
IF: 3.495 Citations: 33

Summary, novel ideas and individual contribution:
This paper focuses on the experimental characterization of the passive lens effect on high-brightness electron bunches using a plasma channel in a capillary. The passive lens effect starts when the electron avalanche behavior (active phase) produced by the current discharge ends. Typically, active lenses, despite their stronger focusing gradients, are more prone to aberrations due to nonlinear magnetic fields or beam misalignments. Passive lenses overcome these limitations because the focusing is caused by electrons in thermal motion without a geometric center. The uniform background allows the bunch to be focused regardless of the transverse injection position. The passive lens provides gentler focusing compared to the active lens, making it suitable for use in a conventional RF line. During the transition from the over-dense to the under-dense regime, focusing occurs without phase-space deterioration, enhancing the appeal of this technique. The interpretation of experimental data in this paper has been supported by numerical simulations, which involved tracking the beam along the high-brightness linac, studying its evolution in the plasma with fluid models, and eventually tracking the beam at the plasma exit up to the measurement screen.

A. Mostacci contributed to the experiment by helping to define the correct machine operating point, measuring the properties of the beam before and after the plasma channel, as well as discussing the final results and the manuscript.

[S13] R. Pompili, M.P. Anania, M. Bellaveglia, A. Biagioni, S. Bini, F. Bisesto, E. Brentegani, G. Castorina, E. Chiadroni, A. Cianchi, M. Croia, D. Di Giovenale, M. Ferrario, F. Filippi, A. Giribono, V. Lollo, A. Marocchino, M. Marongiu, **A. Mostacci**, G. Di Pirro, S. Romeo, A.R. Rossi, J. Scifo, V. Shpakov, C. Vaccarezza, F. Villa and A. Zigler,
Experimental characterization of active plasma lensing for electron beams,
Applied Physics Letters (**2017**); doi: 10.1063/1.4977894.
IF: 3.495 Citations: 49

Summary, novel ideas and individual contribution:
The paper presents a comprehensive study on the focusing properties of the active plasma lens, marking an initial step toward its full optimization. It features the first experimental characterization of an active plasma lens using a short discharge capillary. This device stands out for its compactness, strong focusing capability, and easy tunability, offering a reliable and cost-effective solution. The research explores the effects of the active plasma lens on a high-

brightness electron beam across various discharge current values. The findings indicate that the lens can achieve a beam waist approximately five times smaller than that of the unfocused beam. However, at low discharge currents, the magnetic focusing field can become highly nonlinear at larger radii, leading to an increase in emittance due to spherical aberrations, likely caused by low partial ionization in the H2 gas. The study evaluates several setups with different capillary geometries and discharge circuits to enhance the overall quality of the focused beam. Notably, this paper provides a systematic investigation into the tunability of focusing by altering the beam's arrival time in the plasma discharge, although it does not address emittance preservation, which will be resolved in a subsequent study [S11].

A. Mostacci played an important role in the experiment by helping to define the optimal machine operating point and measuring the beam properties to ensure the reproducibility of the setup. Achieving the published results required multiple measurement sessions to understand the impact of various parameters.

[S14] N. Biancacci, F. Caspers, J. Kuczerowski, E. Métral, N. Mounet, B. Salvant, **A. Mostacci**, O. Frasciello and M. Zobov,
Impedance simulations and measurements on the LHC collimators with embedded beam position monitors,
Phys. Rev. ST Accel. Beams (**2017**); doi: 10.1103/PhysRevAccelBeams.20.011003.
IF: 1.413 Citations: 7

Summary, novel ideas and individual contribution:
The LHC collimators have complex mechanical designs that include movable jaws made of resistive materials, RF contacts, ferrite materials, and cooling pipes to ensure stability under thermal and mechanical stress. Secondary and tertiary LHC collimators have been upgraded to incorporate embedded button BPMs to improve machine cleaning and performance optimization. However, this progress necessitated a compromise in terms of coupling impedance as the RF contacts had to be removed, introducing high-order modes (HOMs) at lower frequencies, which are more problematic because well inside the LHC beam spectrum. This paper evaluates the impact of these upgrades on collimator design in terms of coupling impedance, using both simulations and measurements to demonstrate the negligible effect on LHC machine stability. The HOMs introduced by the upgrade have been effectively mitigated with carefully designed ferrite blocks. The undamped modes, which are dangerous for the LHC beam spectrum (i.e., below 500MHz), have been identified through careful and complex numerical simulations and experimentally confirmed with bench impedance measurements. The paper concludes that these modes do not pose a threat to the LHC, and the upgraded collimators can be safely installed in the machine; such conclusion has been confirmed during subsequent LHC operations.

Due to his expertise in bench measurements of the coupling impedance of accelerator devices, A. Mostacci was invited to CERN to organize and perform the stretched wire measurements and to experimentally characterize the HOMs.

[S15] F. Giorgianni, E. Chiadroni, A. Rovere, M. Cestelli-Guidi, A. Perucchi, M. Bellaveglia, M. Castellano, D. Di Giovenale, G. Di Pirro, M. Ferrario, R. Pompili, C. Vaccarezza, F. Villa, A. Cianchi, **A. Mostacci**, M. Petrarca, M. Brahlek, N. Koirala, S. Oh and S. Lupi,
Strong nonlinear terahertz response induced by Dirac surface states in Bi2Se3 topological insulator,
Nature Communications (**2016**); doi: 10.1038/ncomms11421.
IF: 12.124 Citations: 131

Summary, novel ideas and individual contribution:
This paper experimentally demonstrates, for the first time, the strong nonlinear THz properties of the Bi_2Se_3 Dirac material. Its characteristics could open promising perspectives in the rapidly evolving field of THz technologies. The ability to control light by light in the THz regime is a subject of intense study, with potential applications including ultrafast THz tabletop sources, quantum cascade lasers, and ultrafast THz communications based on optical bistability. The THz properties are measured using nearly single-cycle THz pulses obtained from coherent transition radiation of ultra-relativistic electron bunches with a charge of 650pC, a time duration of ~120fs, and a repetition rate of 10Hz, available at INFN-LNF in the SPARC_LAB linac. The THz field on the sample can be tuned over four decades, a capability unmatched by other THz sources. The THz radiation is fully characterized with integrated transmittance measurements and spectrally resolved measurements using a step-scan Michelson interferometer.

A. Mostacci contributed significantly to setting up the linac to produce high-intensity THz radiation and to the measurements reported in the paper. Utilizing the SPARC linac as a THz source is complex, as the machine working point differs significantly from those used in free electron lasing or plasma acceleration set-ups.

[S16] A. Petralia, M.P. Anania, M. Artioli, A. Bacci, M. Bellaveglia, M. Carpanese, E. Chiadroni, A. Cianchi, F. Ciocci, G. Dattoli, D. Di Giovenale, E. Di Palma, G.P. Di Pirro, M. Ferrario, L. Giannessi, L. Innocenti, **A. Mostacci**, V. Petrillo, R. Pompili, J.V. Rau, C. Ronsivalle, A.R. Rossi, E. Sabia, V. Shpakov, C. Vaccarezza and F. Villa,
Two-Color Radiation Generated in a Seeded Free-Electron Laser with Two Electron Beams, Phys. Rev. Lett. (**2015**) doi: 10.1103/PhysRevLett. 115.014801
IF: 7.645 Citations: 24

Summary, novel ideas and individual contribution:
Two-color radiation enables a wide range of experiments, from time-resolved analysis of atomic, surface, and plasma dynamics to the imaging of biomedical samples and molecules. This paper presents experimental evidence of generating coherent and statistically stable free-electron laser two-color radiation. This was achieved by seeding electron beams with double-peaked energy using laser pulses that are single-spiked in time and frequency. This method produces high-quality light and can be extended to higher frequencies using high-gain harmonic generation or self-seeding techniques. The core idea is to use a seed, single-spiked in frequency and time, applied to an electron beam with two peaks centered at slightly different energies. The resulting radiation displays two distinct colors occurring sequentially in time, with controllable time delay, frequency separation, and relative intensity by adjusting the electron beam parameters. The study of the emission statistics shows enhanced temporal coherence and regularity in frequency compared to the conventional free-electron laser regime (Self Amplified Spontaneous Emission).The experiment was conducted at the SPARC_LAB facility on the seeded SPARC FEL, where the double peak structure in the electron distribution was generated using low-energy compression (velocity bunching) of a double-peaked electron bunch (comb beams).

Due to his expertise in manipulating and measuring comb beams at SPARC, A. Mostacci extensively contributed to setting up the machine working point and its full characterization. This phase is crucial, as accurate knowledge of beam parameters is essential to set the undulators and measure the two-color radiation.

12. List of peer reviewed papers on international Journals (1997 - 2024)

[J1] J. Rosenzweig, **A. Mostacci**, et al., *A High-Flux Compact X-ray Free-Electron Laser for Next-Generation Chip Metrology Needs*, Instruments (**2024**); doi: 10.3390/instruments8010019

[J2] F. Bosco, **A. Mostacci**, et al., *Manipulation and Wakefield Effects on Multi-Pulse Driver Beams in PWFA Injector Stages*, Instruments (**2024**); doi: 10.3390/instruments8010012

[J3] S. Bettoni, et al., **A. Mostacci**, *Machine learning based longitudinal virtual diagnostics at SwissFEL*, Review of Scientific Instruments (**2024**); doi: 10.1063/5.0179712

[J4] G. D'Auria, **A. Mostacci**, et al., *The CompactLight Design Study*, European Physical Journal: Special Topics (**2024**); doi: 10.1140/epjs/s11734-023-01076-0

[J5] F. Bosco, **A. Mostacci**, et al., *Fast models for the evaluation of self-induced field effects in linear accelerators*, Nucl. Instrum. Methods Phys. Res. A (**2023**); doi:10.1016/j.nima.2023.168642

[J6] L. Giuliano, **A. Mostacci**, et al., *RF Design and Measurements of a C-Band Prototype Structure for an Ultra-High Dose-Rate Medical Linac*, Instruments (**2023**); doi:10.3390/instruments7010010

[J7] L. Giuliano, **A. Mostacci**, et al., *Characterization of Ultra-High-Dose Rate Electron Beams with ElectronFlash Linac*, Applied Sciences (**2023**); doi:10.3390/app13010631

[J8] M. Galletti, **A. Mostacci**, et al. *Stable Operation of a Free-Electron Laser Driven by a Plasma Accelerator*, Physical Review Letters (**2022**); doi: 10.1103/PhysRevLett.129.234801

[J9] V. Shpakov, **A. Mostacci**, et al., *Design, optimization and experimental characterization of RF injectors for high brightness electron beams and plasma acceleration,* Journal of Instrumentation (**2022**); doi: 10.1088/1748-0221/17/12/P12022

[J10] L. Faillace, **A. Mostacci**, et al., *Perspectives in linear accelerator for FLASH VHEE: Study of a compact C-band system*, Physica Medica (**2022**); doi: 10.1016/j.ejmp.2022.10.018

[J11] L. Faillace, **A. Mostacci**, et al., *High field hybrid photoinjector electron source for advanced light source applications*, Physical Review Accelerators and Beams (**2022**); doi: 10.1103/PhysRevAccelBeams.25.063401

[J12] R. Pompili, **A. Mostacci**, et al., *Free-electron lasing with compact beam-driven plasma wakefield accelerator*, Nature (**2022**); doi: 10.1038/s41586-022-04589-1

[J13] D. Quartullo, **A. Mostacci**, et al., *Electromagnetic characterization of the crystal primary collimators for the HL-LHC*, Nucl. Instrum. Methods Phys. Res. A, (**2021**); doi:10.1016/j.nima.2021.165465

[J14] L. Faillace, **A. Mostacci**, et al., *Compact S -band linear accelerator system for ultrafast, ultrahigh dose-rate radiotherapy*, Physical Review Accelerators and Beams (**2021**); doi: 10.1103/PhysRevAccelBeams.24.050102

[J15] V. Shpakov, **A. Mostacci**, et al., *First emittance measurement of the beam-driven plasma wakefield accelerated electron beam*, Physical Review Accelerators and Beams (**2021**); doi: 10.1103/PhysRevAccelBeams.24.051301

[J16] R. Pompili, **A. Mostacci**, et al., *Energy spread minimization in a beam-driven plasma wakefield accelerator*, Nature Physics (**2021**); doi: 10.1038/s41567-020-01116-9

[J17] L. Sabato, **A. Mostacci**, et al., *A Measurement Method Based on RF Deflector for Particle Bunch Longitudinal Parameters in Linear Accelerators*, IEEE Transactions on Instrumentation and Measurement (**2021**); doi: 10.1109/TIM.2020.3009342

[J18] F. Cioeta, **A. Mostacci**, et al., *Optical transition radiation screens: A numerical procedure to choose the most performing material*, Nucl. Instrum. Methods Phys. Res. A, (**2021**); doi:10.1016/j.nima.2021.165888

[J19] R. Assmann, **A. Mostacci**, et al., *EuPRAXIA Conceptual Design Report*, European Physical Journal: Special Topics (**2020**);doi: 10.1140/epjst/e2020-000127-8

[J20] S. Di Mitri, **A. Mostacci**, et al., *Scaling of beam collective effects with bunch charge in the Compact-Light free-electron laser,* Photonics (**2020**); doi: 10.3390/photonics7040125

[J21] E. Chiadroni, **A. Mostacci**, et al., *A versatile THz source from high-brightness electron beams: Generation and characterization,* Condensed Matter (**2020**); doi: 10.3390/condmat5020040

[J22] P. Arpaia, **A. Mostacci**, et al., *Enhancing particle bunch-length measurements based on Radio Frequency Deflector by the use of focusing elements*, Scientific Reports (**2020**); doi: 10.1038/s41598-020-67997-1

[J23] A. Abada, **A. Mostacci**, et al., *HE-LHC: The High-Energy Large Hadron Collider: Future Circular Collider Conceptual Design Report Volume 4*, European Physical Journal: Special Topics (**2019**); doi: 10.1140/epjst/e2019-900088-6

[J24] A. Abada, **A. Mostacci**, et al., *FCC-hh: The Hadron Collider: Future Circular Collider Conceptual Design Report*, European Physical Journal: Special Topics (**2019**); doi: 10.1140/epjst/e2019-900087-0

[J25] A. Abada, **A. Mostacci**, et al., *FCC Physics Opportunities: Future Circular Collider Conceptual Design Report Volume 1*, European Physical Journal C (**2019**); doi: 10.1140/epjc/s10052-019-6904-3

[J26] A. Abada, **A. Mostacci**, et al., *FCC-ee: The Lepton Collider: Future Circular Collider Conceptual Design Report*, European Physical Journal: Special Topics (**2019**); doi: 10.1140/epjst/e2019-900045-4

[J27] G. Castorina, **A. Mostacci**, et al., *Conductor losses calculation in two-dimensional simulations of H-plane rectangular waveguides*, Journal of Electromagnetic Waves and Applications (**2019**); doi: 10.1080/09205071.2019.1583136

[J28] V. Shpakov, **A. Mostacci**, et al., *Longitudinal Phase-Space Manipulation with Beam-Driven Plasma Wakefields*, Phys. Rev. Lett. (**2019**); doi: 10.1103/PhysRevLett.122.114801

[J29] D.B Durham, **A. Mostacci**, et al., *Plasmonic lenses for tunable ultrafast electron emitters at the nanoscale*, Phys. Rev. Applied (**2019**); doi: 10.1103/PhysRevApplied.12.054057

[J30] S. Pisa, **A. Mostacci**, et al., *Design and realization of an open EPR resonator at x-band frequencies*, IEEE Transactions on Magnetics (**2019**) doi: 10.1109/TMAG.2018.2886148

[J31] C.F. Ndiaye, **A. Mostacci**, et al., *Low power commissioning of an innovative laser beam circulator for inverse Compton scattering γ-ray source*, Phys. Rev. Accel. Beams (**2019**) doi: 10.1103/PhysRevAccelBeams.22.093501

[J32] M. Marongiu, **A. Mostacci**, et al*., Energy measurements by means of transition radiation in novel Linacs* Nucl. Instrum. Methods Phys. Res. A (**2018**); doi: 10.1016/j.nima.2018.02.093

[J33] E. Brentegani, **A. Mostacci**, et al., *Numerical studies on capillary discharges as focusing elements for electron beams*, Nucl. Instrum. Methods Phys. Res. A (**2018**); doi: 10.1016/j.nima.2018.03.012

[J34] G. Campogiani, **A. Mostacci**, et al., *Progress of the development of the ELI-NP GBS high level applications*, Nucl. Instrum. Methods Phys. Res. A (**2018**); doi: 10.1016/j.nima.2017.12.021

[J35] A. Cianchi, **A. Mostacci**, et al., *Conceptual design of electron beam diagnostics for high brightness plasma accelerator*, Nucl. Instrum. Methods Phys. Res. A (**2018**); doi: 10.1016/j.nima.2018.02.095

[J36] A. Biagioni, **A. Mostacci**, et al., *Wake fields effects in dielectric capillary*, Nucl. Instrum. Methods Phys. Res. A (**2018**); doi: 10.1016/j.nima.2018.01.028

[J37] R. Pompili, **A. Mostacci**, et al., *Recent results at SPARC_LAB*, Nucl. Instrum. Methods Phys. Res. A (**2018**); doi: 10.1016/j.nima.2018.01.071

[J38] E. Chiadroni, **A. Mostacci**, et al., *Overview of plasma lens experiments and recent results at SPARC_LAB*, Nucl. Instrum. Methods Phys. Res. A (**2018**) doi: 10.1016/j.nima.2018.02.014

[J39] J. Scifo, **A. Mostacci**, et al., *Nano-machining, surface analysis and emittance measurements of a copper photocathode at SPARC_LAB*, Nucl. Instrum. Methods Phys. Res. A (**2018**); doi: 10.1016/j.nima.2018.01.041

[J40] M. Ferrario, **A. Mostacci**, et al, *EuPRAXIA@SPARC_LAB Design study towards a compact FEL facility at LNF*, Nucl. Instrum. Methods Phys. Res. A, (**2018**); doi: 10.1016/j.nima.2018.01.094

[J41] R. Pompili, **A. Mostacci**, et al., *Focusing of High-Brightness Electron Beams with Active-Plasma Lenses*, Phys. Rev. Lett. (**2018**); doi: 10.1103/PhysRevLett.121.174801

[J42] A. Cianchi, **A. Mostacci**, et al., *Frontiers of beam diagnostics in plasma accelerators: Measuring the ultra-fast and ultra-cold*, Physics of Plasmas (**2018**); doi: 10.1063/1.5017847

[J43] L. Sabato, **A. Mostacci**, et al., *Effects of Correlations Between Particle Longitudinal Positions and Vertical Plane on Bunch Length Measurement: a case study on GBS Electron LINAC at ELI-NP*, Meas. Sci. Technol. (**2018**); doi: 10.1088/1361-6501/aaa281.

[J44] A. Marocchino, **A. Mostacci**, et al., *Experimental characterization of the effects induced by passive plasma lens on high brightness electron bunches*, Applied Physics Letters. (**2017**); doi: 10.1063/1.4999010.

[J45] E. Chiadroni, **A. Mostacci**, et al., *Beam manipulation for resonant plasma wakefield acceleration*, Nucl. Instrum. Methods Phys. Res. A (**2017**); doi: 10.1016/j.nima.2017.01.017

[J46] F. Villa, **A. Mostacci**, et al., *Generation and characterization of ultra-short electron beams for single spike infrared FEL radiation at SPARC_LAB*, Nucl. Instrum. Methods Phys. Res. A (**2017**); doi: 10.1016/j.nima.2017.02.042

[J47] J. Zhu, **A. Mostacci**, et al., *Misalignment measurement of femtosecond electron bunches with THz repetition rate*, Phys. Rev. Accel. Beams (**2017**); doi: 10.1103/ PhysRevAccelBeams.20.042801.

[J48] L. Sabato, **A. Mostacci**, et al., *Effects of energy chirp on bunch length measurement in linear accelerator beams*, Meas. Sci. Technol. (**2017**); doi: 10.1088/1361-6501/aa6c8a.

[J49] D. Alesini, **A. Mostacci**, et al, *Design of high gradient, high repetition rate damped C-band rf structures*, Phys. Rev. Accel. Beams (**2017**); doi: 10.1103/PhysRevAccelBeams. 20.032004.

[J50] R. Pompili, **A. Mostacci**, et al., *Experimental characterization of active plasma lensing for electron beams*, Applied Physics Letters (**2017**); doi: 10.1063/1.4977894.

[J51] N. Biancacci, **A. Mostacci**, et al., *Impedance simulations and measurements on the LHC collimators with embedded beam position monitors*, Phys. Rev. ST Accel. Beams (**2017**); doi: 10.1103/PhysRevAccelBeams.20.011003.

[J52] M. Sciscciò, **A. Mostacci**, et al., *Parametric study of transport beam lines for electron beams accelerated by laser-plasma interaction*, Journal of Applied Physics (**2016**); doi: 10.1063/1.4942626.

[J53] M. Marongiu, **A. Mostacci**, et al., *Thermal behavior of the optical transition radiation screens for the ELI-NP Compton Gamma source*, Nucl. Instrum. Methods Phys. Res. A (**2016**); doi: 10.1016/j.nima.2016.07.040.

[J54] A. Cianchi, **A. Mostacci**, et al., *Transverse emittance diagnostics for high brightness electron beams*, Nucl. Instrum. Methods Phys. Res. A (**2016**); doi: 10.1016/j.nima.2016.11.063

[J55] F. Filippi, **A. Mostacci**, et al., *Plasma density characterization at SPARC_LAB through Stark broadening of Hydrogen spectral lines*, Nucl. Instrum. Methods Phys. Res. A (**2016)**; doi: 10.1016/j.nima.2016.02.071.

[J56] A.R. Rossi, **A. Mostacci**, et al., *Stability study for matching in laser driven plasma acceleration*, Nucl. Instrum. Methods Phys. Res. A (**2016**); doi: 10.1016/j.nima.2016.02.015

[J57] F. Bisesto, **A. Mostacci**, et al., *Laser–capillary interaction for the EXIN project*, Nucl. Instrum. Methods Phys. Res. A (**2016**); doi: 10.1016/j.nima.2016.01.037.

[J58] C Vaccarezza, **A. Mostacci**, et al., *The SPARC_LAB Thomson source*, Nucl. Instrum. Methods Phys. Res. A (**2016**); doi: 10.1016/j.nima.2016.01.089.

[J59] R. Pompili, **A. Mostacci**, et al., *Beam manipulation with velocity bunching for PWFA applications*, Nucl. Instrum. Methods Phys. Res. A (**2016**); doi: 10.1016/j.nima.2016.01.061

[J60] A. Biagioni, **A. Mostacci**, et al., *Electron density measurement in gas discharge plasmas by optical and acoustic methods*, Journal of Instrumentation (**2016**); doi: 10.1088/1748-0221/11/08/C08003.

[J61] R. Pompili, **A. Mostacci**, et al., *Femtosecond timing-jitter between photo-cathode laser and ultra-short electron bunches by means of hybrid compression*, New Journal of Physics (**2016**); doi: 10.1088/1367-2630/18/8/083033.

[J62] F. Giorgianni, **A. Mostacci**, et al., *Strong nonlinear terahertz response induced by Dirac surface states in Bi2Se3 topological insulator*, Nature Communications (**2016**); doi: 10.1038/ncomms11421.

[J63] F. Giorgianni, **A. Mostacci**, et al., *Tailoring of highly intense THz radiation through high brightness electron beams longitudinal manipulation*, Applied Sciences (**2016**); doi: 10.3390/app6020056.

[J64] A. Cianchi, **A. Mostacci**, et al., *Six-dimensional measurements of trains of high brightness electron bunches*, Phys. Rev. ST Accel. Beams (**2015**); doi: 10.1103 /PhysRevSTAB.18.082 804

[J65] B. Paroli, **A. Mostacci**, et al., *Coherence properties and diagnostics of betatron radiation emitted by an externally-injected electron beam propagating in a plasma channel,* Nucl. Instr. and Methods in Physics Research B (**2015**); doi: 10.1016/j.nimb.2015.03.070.

[J66] V. Shpakov, **A. Mostacci**, et al., *Pre-wave zone studies of Coherent Transition and Diffraction Radiation*, Nucl. Instr. and Methods in Physics Research B (**2015**); doi: 10.1016/j.nimb.2015.03.047.

[J67] A. Petralia, **A. Mostacci**, et al., *Two-Color Radiation Generated in a Seeded Free-Electron Laser with Two Electron Beams*, Phys. Rev. Lett. (**2015**) doi: 10.1103/PhysRevLett. 115.014801

[J68] B. Marchetti, **A. Mostacci**, et al., *Novel schemes for the optimization of the SPARC narrow band THz source*, Rev. Sci. Instrum. (**2015**); doi: 10.1063/1.4922882.

[J69] M.D. Alaimo, **A. Mostacci**, et al, *Mapping the transverse coherence of the Self Amplified Spontaneous Emission of a Free-Electron Laser with the heterodyne speckle method*, Optics Express 22 (**2014**); doi: 10.1364/OE.22.030013.

[J70] L. L. Lazzarino, **A. Mostacci**, et al, *Self-amplified spontaneous emission free electron laser devices and nonideal electron beam transport*, Phys. Rev. ST Accel. Beams 17 (**2014**); doi: 10.1103/PhysRevSTAB.17.110706.

[J71] **A. Mostacci**, *Comb beam for particle-driven plasma-based accelerators*, IL NUOVO CIMENTO, 37C (**2014**); doi: 10.1393/ncc/i2014-11817-0.

[J72] A. Subiel, **A. Mostacci**, et al, *Dosimetry of Very High Energy Electrons (VHEE) for radiotherapy applications*, Phys. Med. Biol. 59 (**2014**); doi:10.1088/0031-9155/59/19/5811.

[J73] A.R. Rossi, **A. Mostacci**, et al, *The External-Injection experiment at the SPARC_LAB facility*, Nucl. Instrum. Methods Phys. Res., A (**2014**); doi:10.1016/j.nima.2013.10.063.

[J74] M.P. Anania, **A. Mostacci**, et al, *Design of a plasma discharge circuit for particle wakefield acceleration*, Nucl. Instrum. Methods Phys. Res., A (**2014**); doi: 10.1016/j.nima.2013.10.053.

[J75] R. Pompili, **A. Mostacci**, et al, *First single-shot and non-intercepting longitudinal bunch diagnostics for comb-like beam by means of Electro-Optic Sampling*, Nucl. Instrum. Methods Phys. Res. **A** (**2014**); doi: 10.1016/j.nima.2013.10.031.

[J76] F. Massimo, **A. Mostacci**, et al, *Transformer Ratio Studies for Single Bunch Plasma Wakefield Acceleration*, Nucl. Instrum. Methods Phys. Res. **A** (**2014**); doi: 10.1016/j.nima.2013.10.046.

[J77] M. Ferrario, **A. Mostacci**, et al, *IRIDE: Interdisciplinary research infrastructure based on dual electron linacs and lasers*, Nucl. Instrum. Methods Phys. Res. **A** (**2014**); doi: 10.1016/j.nima.2013.11.040.

[J78] C. Ronsivalle, **A. Mostacci**, et al, *Large-bandwidth two-color free-electron laser driven by a comb-like electron beam*, New Journal of Physics (**2014**); doi: 10.1088/1367-2630/16/3/033018.

[J79] D. Alesini, **A. Mostacci**, et al, *Tuning procedure for traveling wave structures and its application to the C-Band cavities for SPARC photo injector energy upgrade*, Journal of Instrumentation, (**2013**); doi:10.1088/1748-0221/8/10/P10010.

[J80] V. Petrillo, **A. Mostacci**, et al, *Observation of time-domain modulation of free-electron-laser pulses by multipeaked electron-energy spectrum*, Phys. Rev. Lett. (**2013**); doi: 10.1103/ PhysRevLett.111.114802.

[J81] A. Cianchi, **A. Mostacci**, et al, *Challenges in plasma and laser wakefield accelerated beams diagnostic*, Nucl. Instrum. Methods Phys. Res. **A** (**2013**); doi: 10.1016/j.nima.2012.12.012.

[J82] L. Giannessi, **A. Mostacci**, et al, *Superradiant cascade in a Seeded Free-Electron Laser*, Phys. Rev. Lett. (**2013**); doi: 10.1103/PhysRevLett.110.044801.

[J83] M. Ferrario, **A. Mostacci**, et al, *Sparc_Lab Present and Future*, Nucl. Instrum. Methods Phys. Res., **B** (**2013**); doi: 10.1016/j.nimb.2013.03.049.

[J84] A. Bacci, **A. Mostacci**, et al, *Electron Linac design to drive bright Compton back-scattering gamma-ray sources*, J. Appl. Phys. (**2013**); doi:10.1063/1.4805071.

[J85] D. Alesini, **A. Mostacci**, et al, *The C-band accelerating structures for SPARC photoinjector energy upgrade*, Journal of Instrumentation (**2013**); doi:10.1088/1748-0221/8/05/P05004.

[J86] M. Migliorati, **A. Mostacci**, et al, *Intrinsic normalized emittance growth in laser-driven electron accelerators*, Phys. Rev. ST Accel. Beams (**2013**); doi:10.1103/PhysRevSTAB.16. 011302

[J87] E. Chiadroni, **A. Mostacci**, et al, *Characterization of the THz radiation source at the Frascati linear accelerator*, Rev. Sci. Inst. (**2013**); doi: 10.1063/1.4790429.

[J88] E. Chiadroni, **A. Mostacci**, et al, *The SPARC linear accelerator based terahertz source*, Applied Physics Letters (**2013**); doi: 10.1063/1.4794014.

[J89] S. Casalbuoni, **A. Mostacci**, et al, *Beam heat load due to geometrical and resistive wall impedance in COLDDIAG,* Journal of Instrumentation (**2012**); doi: 10.1088/1748-0221/7/11/P11008.

[J90] P. Antici, **A. Mostacci**, et al, *Sensitivity study of a compact accelerator for laser generated protons*, Journal of Plasma Physics (**2012**); doi:10.1017/S0022377812000414.

[J91] L. Giannessi, **A. Mostacci**, et al, *High-Order-Harmonic Generation and Superradiance in a Seeded Free-Electron Laser*, Phys. Rev. Lett., (**2012**); doi: 10.1103/PhysRevLett.108.16 4801.

[J92] G. Marcus, **A. Mostacci**, et al, *Time-Domain Measurement of a Self-Amplified Spontaneous Emission Free-Electron Laser with an Energy-Chirped Electron Beam and Undulator Tapering*, Applied Physics Letter (**2012**); doi: 10.1063/1.4754612.

[J93] P. Antici, **A. Mostacci**, et al, *Laser-driven electron beamlines generated by coupling laser-plasma sources with conventional transport systems*, J. Appl. Phys. (**2012**); doi: 10.1063/1.4740456.

[J94] **A. Mostacci**, et al, *Chromatic effects in quadrupole scan emittance measurements*, Phys. Rev. ST Accel. Beams (**2012**); doi: 10.1103/PhysRevSTAB.15.082802.

[J95] M. Labat, **A. Mostacci**, et al, *High-Gain Harmonic-Generation FEL seeded by harmonics generated in gas*, Phys. Rev. Lett. (**2011**); doi: 10.1103/PhysRevLett.107.224801.

[J96] D. Filippetto, **A. Mostacci**, et al, *Phase space analysis of velocity bunched beams*, Phys. Rev. ST Accel. Beams (**2011**); doi: 10.1103/PhysRevSTAB.14.092804.

[J97] P. Antici, **A. Mostacci**, et al, *A Compact Post-Acceleration Scheme for Laser Generated Protons*, Physics of Plasmas (**2011**); doi: 10.1063/1.3574361.

[J98] L. Giannessi, **A. Mostacci**, et al, *Self-amplified spontaneous emission for a single pass free-electron laser,* Phys. Rev. ST Accel. Beams **(2011**); doi: 10.1103/PhysRevSTAB.14 .060712.

[J99] S. Casalbuoni, **A. Mostacci**, et al, *COLDDIAG: A Cold Vacuum Chamber for Diagnostics,* IEEE Trans. Appl. Supercon., **(2011**); doi:10.1109/TASC.2010.2096176

[J100] B. Spataro, **A. Mostacci**, et al, *RF properties of a X-band hybrid photoinjector*, Nucl. Instrum. Methods Phys. Res. **A** (**2011**); doi: 10.1016/j.nima.2011.05.046.

[J101] J. Rosenzweig, **A. Mostacci**, et al, *Design and applications of an X-band hybrid photoinjector*, Nucl. Instrum. Methods Phys. Res. **A** (**2011**); doi: 10.1016/j.nima.2011.04.057.

[J102] L. Giannessi, **A. Mostacci**, et al, *Self Amplified Spontaneous Emission Free-Electron Laser with an Energy-chirped Electron beam and Undulator tapering*, Phys. Rev. Lett., (**2011**); doi: 10.1103/PhysRevLett.106.144801.

[J103] M. Ferrario, **A. Mostacci**, et al, *Experimental demonstration of emittance compensation with velocity bunching*, Phys. Rev. Lett., (**2010**); doi: 10.1103/PhysRevLett.104.054801.

[J104] A. Cianchi, **A. Mostacci**, et al, *High brightness electron beam emittance evolution measurements in an rf photoinjector*, Phys. Rev. ST Accel. Beams (**2008**); doi: 10.1103/PhysRevSTAB.11.032801.

[J105] B. Spataro, **A. Mostacci**, et al., *A biperiodic X-band cavity for SPARC,* Nucl. Instrum. Methods Phys. Res., A **(2008**); doi: 10.1016/j.nima.2007.10.040.

[J106] **A. Mostacci**, et al, *Analysis methodology of movable emittance-meter measurements for low energy electron beams*, Rev. Sci. Inst. (**2008**); doi: 10.1063/1.2835715.

[J107] G. Battistoni, **A. Mostacci,** et al., *The FLUKA code and its use in hadron therapy*, Il Nuovo Cimento C, (**2008**): doi: 10.1393/ncc/i2008-10281-9.

[J108] C. Agodi, **A. Mostacci,** et al., *The INFN TPS project*, Il Nuovo Cimento C, (**2008**): doi: 10.1393/ncc/i2008-10284-6.

[J109] M. Ferrario, **A. Mostacci**, et al, *Direct measurement of double emittance minimum in the SPARC high brightness photoinjector,* (**2007**); doi: 10.1103/PhysRevLett.99.234801.

[J110] **A. Mostacci**, et al., *Coupling impedance studies and power loss measurements of COLDEX upgraded vacuum chamber,* Nucl. Instrum. Methods Phys. Res (**2007**); doi: 10.1016/j.nima.2007.08.147.

[J111] D. Alesini, **A. Mostacci**, et al., *Design and RF measurements of an X-band accelerating structure for the SPARC project*, International Journal of Modern Physics A, (**2007**); doi: 10.1142/S0217751X07037603.

[J112] P. Sala, **A. Mostacci**, et al, *The physics of the FLUKA code: recent developments,* Advances in Space Research, **(2007**); doi: 10.1016/j.asr.2007.05.031.

[J113] D. Alesini, **A. Mostacci**, et al., *RF deflector design and measurements for the longitudinal and transverse phase space characterization at SPARC,* Nucl. Instrum. Methods Phys. Res., A **(2006**): doi: 10.1016/j.nima.2006.07.050.

[J114] B. Spataro, **A. Mostacci**, et al., *Impedances of the cold bore experiment, COLDEX, installed in the SPS machine,* Nucl. Instrum. Methods Phys. Res., A **(2006**); doi: 10.1016/j.nima.2006.03.038.

[J115] D. Alesini, **A. Mostacci**, et al., *Design and RF measurements of an X-band accelerating structure for linearizing the longitudinal emittance at SPARC,* Nucl. Instrum. Methods Phys. (**2005**): doi: 10.1016/j.nima.2005.07.072.

[J116] **A. Mostacci**, *Image currents in azimuthally inhomogeneous metallic beam pipes,* Phys. Rev. ST Accel. Beams (**2005**); doi: 10.1103/PhysRevSTAB.8.084402.

[J117] U. Iriso, **A. Mostacci,** et al., *Traveling wave resonant ring for electron cloud studies,* Phys. Rev. ST Accel. Beams, (**2004**); doi: 10.1103/PhysRevSTAB.7.073501.

[J118] B.Spataro, **A. Mostacci**, et al., *On trapped modes in the LHC recombination chambers: numerical and experimental results*, Nucl. Instrum. Methods Phys. Res., A (**2004**); doi: 10.1016/j.nima.2003.09.046.

[J119] M. Angelici, **A. Mostacci**, et al., *Wakefields effects due to roughness in a circular pipe*, Nucl. Instrum. Methods Phys. Res., A (**2002**); doi: 10.1016/S0168-9002(02)00795-7.

[J120] **A. Mostacci**, et al., *Wakefields due to surface waves in a beam pipe with a periodic rough surface*, Phys. Rev. Accel. Beams, (**2002**); doi: 10.1103/PhysRevSTAB.5.044401.

[J121] **A. Mostacci**, et al., *Impedance and loss factor of a coaxial liner with many holes: effect of the attenuation*, Phys. Rev. Accel. Beams, (**1999**): doi: 10.1103/PhysRevSTAB.2.124401.

[J122] S. De Santis, **A. Mostacci**, et al., *Analytical expressions for the coupling impedance of a long narrow slot in a coaxial beam pipe*, Phys. Rev. E (**1998**); doi: 10.1103/PhysRevE.58.6565.

[J123] S. De Santis, **A. Mostacci,** et al., *Interference effects on the coupling impedance of many holes in a coaxial beam pipe*, Phys. Rev. E (**1997**); doi: 10.1103/PhysRevE.56.5990.

Il sottoscritto dichiara sotto la propria responsabilità che il suddetto curriculum è veritiero e si rende disponibile a fornire l'eventuale documentazione a supporto di ciascun punto specifico.

Roma, 16/7/2024

Andrea Mostacci

Firmato digitalmente