

Stefano Merlini, PhD

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Professional Experience

Research Associate (Current role), Postgraduate Research – Experimental Plasma Physicist & Pulsed Power Engineer – Imperial College London, London, UK

Oct. 2019 – Current

Responsible for undertaking experimental studies of pulsed power-driven, high-energy density science experiments, specifically on laser-plasma interactions with highly non-homogenous media. This involves both experimental and computational activities, from developing new advanced laser-based to code raytracing tools for 3D radiation-MHD simulations. As part of MAGPIE and MACH facilities, additional responsibilities include regular maintenance of the pulsed power generator and laser systems. Other aspects of the current role are:

- Leading the design, build and testing of advanced optical diagnostic systems, including a new dual harmonic (532 nm and 1064 nm) laser beamline for experiments on laser propagation through turbulent plasmas.
- Hands-on experience with spatially resolved optical spectroscopy measurements in high energy density plasmas.
- Co-supervise MSc and PhD students within the research group. Supervised multiple Undergraduates Summer Projects, the most recent one on laser-based synthetic diagnostics tools for turbulent media using ray-tracing algorithms (computational).
- Maintaining (GitHub experience) and developing the in-house software for data-analysis and synthetic laser optical diagnostics (Python and Fortran). Perform 3-Dimensional Radiative MHD simulations using FLASH and GORGAN codes on Imperial High-Performance Computing (HPC) cluster.
- Coordinate and establish international collaborations with project partners at the Laboratory of Plasma Studies, Cornell University, scientists at Sandia National Laboratory and sponsors at AFOSR (Air Force Office of Scientific Research).
- Assisted in various laboratories within the undergraduate Physics degree programme. First and second marker in Microprocessors, Second Year Computing, Radioactivity (GEANT4), First Year Electronics and Second Year Lab Interferometry (approx. 350 hours).

List of Publications:

- **S. Merlini**, et. al. "Anomalous diffusion of Light Through Shock-driven Turbulence in High Energy Density Science Experiments", 2025 (in progress)
- **S. Merlini**, et. al. "Experimental evidence of intermittency in laboratory shock-driven turbulent Plasma", 2025 (in progress)
- **S. Merlini**, et. al. "[Radiative cooling effects on reverse shocks formed by magnetized supersonic plasma flows](#)", Physics of Plasma, 2023.
- V. Valenzuela-Villasaca, L. G. Suttle, F. Suzuki-Vidal, J. W. D. Halliday, **S. Merlini**, et. al. "[Characterization of Quasi-Keplerian, Differentially Rotating, Free-Boundary Laboratory Plasmas](#)", Physical Review Letter, 2023.
- D. R. Russell, G. C. Burdiak, J. J. Carroll-Nellenback, J. W. D. Halliday, J. D. Hare, **S. Merlini**, et. al. "[Perpendicular subcritical shock structure in a collisional plasma experiment](#)", Physical Review Letter, 2022.
- J. Halliday, A. Crilly, J. Chittenden, R. C. Mancini, **S. Merlini**, et. al. "[Investigating radiatively driven, magnetized plasmas with a university scale pulsed-power generator](#)", Physics of Plasma, 2022.
- Hare, J. D., Burdiak G. C., **Merlini S.** et. al. "[An Imaging Refractometer for Density Fluctuation Measurements in High Energy Density Plasmas](#)", Review Scientific Instruments, 2020.
- L. G. Suttle, J. D. Hare, J. W. D. Halliday, **S. Merlini**, et. al. "[Collective optical Thomson scattering in pulsed-power driven high energy density physics experiments](#)", Review Scientific Instruments, 2020.

Major Collaborations:

- AFOSR - "New diagnostics for extreme plasma conditions", Cornell University (USA).
- Prosperity Partnership - "Hydrodynamic instability and radiation transport", First Light Fusion Ltd (UK)
- NNSA (or MACH) Centre – "Support the needs of the Stockpile Stewardship Program (SSP) in the area of pulsed-power-driven HEDP", Cornell University, UCSD, University of Michigan, Weizmann, UNM, MIT and University of Rochester (USA)
- "Experimental validation of a new multi-species optical Thomson scattering fitting code", V. Valenzuela-Villasaca, Astrophysical Science, Princeton University (USA)

Junior System Engineer – Moving Picture Company, London, UK

May 2019 – Oct. 2019

MPC is an award-winning visual effects and production company headquartered in London. MPC's creative services include concept design, shoot supervision, 2D compositing, 3D/CG effect, software development and virtual production.

- Provided First-Line Tech Support for VFX artists. Set-up and assembled workstations to meet production requirements.
- Acquired knowledge of HPC Systems, Unix/DOS Shell Scripting (Sh, Batch files).

The installation Aero S-Duct group at Rolls-Royce UTC aims to exploit Boundary Layer Ingestion and Electric Propulsion Architecture for the next generation of Aircraft.

- Developed optical correction methods using image processing and feature identification algorithms (Python and OpenCV library) for Particle Image Velocimetry (PIV) techniques applied to convoluted aeroengine intakes.
- Successfully achieved 97% image recovery and 80% error reduction in both simulations and experimental PIV velocity measurements.

SPES (Selective Production Exotic Species) Project at National Institute for Nuclear Physics (INFN) is the primary experimental facility at Legnaro National Laboratories which aims to produce radioactive beams for several applications, such as Theoretical Physics, Nuclear Medicine and Materials Science.

- Assisted the maintenance of DYE Lasers and conducted resonance atomic ionisation experiments on refractive materials with Time-of-Flight Spectrometer (TOF-MS). Involved in the upgrading and testing operations of the TOF-MS extraction chamber.

Other Experience

- Developed a working on-chain mock-up application using Node.js. Presented and 3rd prize awarded at the Algorand Foundation & IC3RE dApp Competition.
- Attended Venture Catalyst Challenge 2022 in the Digital & Finance Track as dGit team leader. Pitched to investors and industry experts at the semi-final event.

- Served in the local Red-Cross first-aid rescue team.
- Supported logistic and infrastructure management activities as a Civil Defence Volunteer during several local and international events, including L'Aquila Earthquake (2009).

Education

Major achievement / Awards

- Successfully established the first data analysis pipeline for the new Imaging Refractometry diagnostic with results published and awarded the AIP “Physics of Plasmas Early Career Collection 2023”.
- Twice Awarded - Malcolm Haines Prize for Outstanding Young Plasma Physicists. First time awarded in June 2020 for the best research presentation within the plasma physics group.
- 2nd Place Award – APS-DPP 2022 Visual Science Communication Contest.
- 2022 Postgraduate Research Symposium Prize - “Radiative shocks and instabilities in colliding supersonic plasma jets” - Awarded for the best overall performance in the talk - content and presentation given at the PGR Symposium.
- Meritorious Public Service Award, III class, 1st Slot, Civil Protection Recognised for voluntary service during L'Aquila Earthquake 2009 with National Meritorious Public Service Award, III Class – 1st Slot, Feb. 2013.

Skills/Interests/Miscellaneous

- 5+ years of hands-on experience with UV, IR and optical class-4 laser imaging systems, mega ampere class pulsed power systems. This includes CMOS and CCD camera sensors and control software development.
- Proficient IT User (Unix, Microsoft Office, Adobe Suite) with coding experience (Python, C, Fortran, MATLAB, Node.js)
- Writer of the “inFusion”, a newsletter about the new emerging Fusion economy (<https://in-fusion.beehiiv.com>)
- Native Italian speaker, proficient in English and basic Greek
- Interests: Space Industry, Fusion Energy, Business Development