Curriculum Vitae

Elisabetta Boella

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Personal data

Born	Female, in Asti (Italy) on August 10^{th}, 1982
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Summary

I approached the field of plasma physics at the end of my Bachelor degree. At that time, a project attracted my attention because it was innovative and had great potential outcomes: ion acceleration in laser-driven plasmas for medical applications. I enjoyed working on this topic very much and so a couple of years later I decided to investigate the subject further in the framework of my Master thesis. During the development of the thesis, I had the opportunity of spending few months in one of the most important research centers in the USA, the Los Alamos National Laboratory. It was a formative experience; it made me learn the meaning of collaborating within a research team. There, I fully realized that I wanted to pursue a career in research in plasma physics and laser-plasma interaction. Thus I applied for a PhD program that allowed me to spend time at Politecnico di Torino (Italy), where this passion was born, and at Instituto Superior Técnico (Portugal), where the Group of Lasers and Plasmas (GoLP), one of the most renowned teams in the field, was based. Joining GoLP was a life-changing experience: carrying out research on the topic of my interest in one of the most prestigious centers in Europe broadened my horizon and perspectives. The young and eclectic environment of GoLP contributed not only to my professional growth, but also to my personal one, thanks to the development of what are referred to as soft skills, absolutely essential in an international and multi-cultural context, as the one of GoLP. My research focused on shock wave acceleration and Coulomb explosion. Under the guide of Prof. Silva, I tackled some of the main questions on table-top ion accelerators from a theoretical perspective and from a numerical point of view. I performed massively parallel Particle-In-Cell (PIC) simulations and developed reduced gridless algorithms to focus on specific aspects of the acceleration dynamics. Therefore, during my PhD, I acquired experience in computational physics, high-performance-computing, laser-matter interaction, plasma physics and high energy density physics. After the end of my PhD, I developed a growing interest for astrophysical plasmas and for the possibility to merge my expertise in laser-plasma interaction and numerical simulations with astrophysics. In particular, my curiosity about the extreme acceleration mechanisms that are responsible for cosmic ray generation led me to join the group of Prof. Lapenta at KU Leuven. Prof. Lapenta is indeed a leading authority in the field of kinetic simulations of magnetic reconnection, a physical phenomenon that could explain the high-energy particles detected at Earth. Under his guidance, I contributed to the development of an innovative Energy Conserving PIC algorithm and I am currently applying it to study reconnection events in the solar corona and tangential discontinuities at the magnetopause, where high energetic electrons are observed.

Education

10.2001–03.2006 Bachelor Degree in Energy Engineering at Politecnico di Torino (Turin, Italy) defending the thesis "Proton acceleration for hadroterapic application by means of plasma expansion" (Supervisor Prof. G. Coppa, Dipartimento Energia, Politecnico di Torino); grade 104/110.

04.2006–07.2009 Master Degree in Energy and Nuclear Engineering at Politecnico di Torino defending the thesis "Study of ion acceleration by means of the expansion of a spherical plasma" (Supervisors: Prof. G. Coppa and Dr. G.L. Delzanno, T–5 Mathematics and Plasma Physics group, Los Alamos National Laboratory); grade 110/110 cum laude.

02.2010–05.2014 Joint PhD in Plasma Physics at Politecnico di Torino and Instituto Superior Técnico (Lisbon, Portugal) under the supervision of Prof. G. Coppa and Prof. L. Silva (Group of Lasers and Plasmas, Instituto Superior Técnico); dissertation title: "Ion acceleration driven by intense laser pulses".

Further relevant training

07.2011 High Energy Density Physics Summer School at UCSD (San Diego, CA, USA); duration: 1 week.

07.2012 Application of Electronics in Plasma Physics Erasmus Intensive Program (Rethimno, Greece); duration: 2 weeks.

07.2013 22^{nd} Summer School on Parallel Computing at CINECA (Rome, Italy); duration 2 weeks.

11.2014 Cern Accelerator School Plasma Wake Acceleration (Geneva, Switzerland); duration 1 week.

04.2015 Turbulence, magnetic fields and self organization in laboratory and astrophysical plasmas (Les Houches, France); duration 2 weeks.

07.2016 Computational Plasma Astrophysics (Princeton, NJ, USA); duration 2 weeks.

Professional Experience

02.2009–06.2009 Visiting student at Los Alamos National Laboratory (NM, USA); under the supervision of Dr. G.L. Delzanno, I worked on numerical aspects concerning the expansion of a spherical plasma.

10.2009–02.2010 Visiting student at Los Alamos National Laboratory (NM, USA); under the supervision of Dr. G.L. Delzanno, I investigated a suitable configuration to obtain the best ion acceleration during the plasma expansion.

06.2014–04.2016 Post-doctoral fellow at Instituto Superior Técnico; under the supervision of Prof. L. Silva, I conducted research on collisionless shocks in frameworks relevant for laboratory astrophysics.

05.2016– *today* Post-doctoral fellow at KU Leuven; under the supervision of Prof. G. Lapenta, I am currently participating in the development of an energy conserving particle-in-cell code to use for space plasma simulations. Furthermore I am applying the algorithm to model magnetic reconnection in the solar corona and tangential discontinuities at the earth magnetopause.

Publications

Accepted

- F. Fiúza, A. Stockem, E. Boella, R. Fonseca, L. Silva, D. Haberberger, S. Tochitsky, C. Gong, W. Mori and C. Joshi, "Laser-driven shock acceleration of mono-energetic ion beams", *Physical Review Letters*, vol. 109, p. 215001, 2012.
- F. Fiúza, A. Stockem, E. Boella, R. Fonseca, L. Silva, D. Haberberger, S. Tochitsky, W. Mori and C. Joshi, "Ion acceleration from laser-driven electrostatic shocks", *Physics of Plasmas*, vol. 20, p. 056304, 2013.

- A. Stockem, E. Boella, F. Fiúza and L.O. Silva, "Relativistic generalization of formation and ion reflection condition in electrostatic shocks", *Physical Review E*, vol. 87, p. 043116, 2013.
- A. d'Angola, E. Boella and G. Coppa, "On the applicability of the collisionless kinetic theory to the study of nanoplasmas", *Physics of Plasmas*, vol. 21, p. 082116, 2014.
- E. Boella, B. Peiretti Paradisi, A. d'Angola, L. Silva, and G. Coppa, "Study on Coulomb explosions of ion mixtures", *Journal of Plasma Physics*, vol. 82, p. 905820110, 2016.
- G. Lapenta, D. Gonzalez-Herrero and E. Boella, "Multiple-scale kinetic simulations with the energy conserving semi-implicit particle in cell method", *Journal of Plasma Physics*, vol. 83, p. 705830205, 2017.
- S.N. Chen, M. Vranic, T. Gangolf, E. Boella, P. Antici, M. Bailly Grandvaux, P. Loiseau, H. Pepin, G. Revet, J.J. Santos, A.M. Schroer, M. Starodubtsev, O. Willi, L.O. Silva, E. d'Humieres and J. Fuchs, "Collimated protons accelerated from an overdense gas jet irradiated by a $1\,\mu$m wavelength high-intensity short-pulse laser", *Scientific Reports*, vol. 7, p. 13505, 2017.
- P. Antici, E. Boella, S.N. Chen, D.S. Andrews, M. Barberio, J. Böker, F. Cardelli, J.L. Feugeas, M. Glesser, P. Nicolai, L. Romagnani, M. Sciscio, M. Starodubtsev, O. Willi, J.C. Kieffer, V. Tikhonchuk, H. Pepin, L.O. Silva, E. d'Humieres and J. Fuchs, "Acceleration of collimated 45 MeV protons by collisionless shocks driven in low-density, large-scale gradient plasmas by a $10^{20}\,\mathrm{W/cm^2}$, $1\,\mu$m laser", *Scientific Reports*, vol. 7, p. 16463, 2017.
- E. Boella, F. Fiúza, A. Stockem Novo, R. Fonseca and L.O. Silva, "Ion acceleration in electrostatic collisionless shock: on the optimal density profile for quasi-monoenergetic beams", *Plasma Physics and Controlled Fusion*, vol. 60, p. 035010, 2018.
- E. Boella, G. Coppa, A. d'Angola and B. Peiretti Paradisi, "Gridless simulation of collisionless plasmas with high degree of symmetry", *Computer Physics Communication*, vol. 224, p. 136, 2018.

Under revision

- E. Boella, K. Schoeffler, N. Shukla, G. Lapenta, R. Fonseca and L.O. Silva, "Interaction between electrostatic collisionless shocks generates strong magnetic fields", submitted to Physical Review Letters, September 2017, ArXiv e-prints, arXiv:1709.05908.
- D. Gonzalez-Herrero, E. Boella and G. Lapenta, "Performance analysis and implementation details of the Energy Conserving Semi Implicit Method code (ECsim)", submitted to Computer Physics Communication, November 2017, ArXiv e-prints, arXiv:1711.05051.

In preparation

- E. Boella, R. Bingham, R.A. Cairns, P. Norreys, R. Trines, M. Vranic and L.O. Silva, "Fast Ignition using shock accelerated ions from the target corona".
- N. Shukla, K. Schoeffler, J. Vieira, E. Boella, R. Fonseca and L. O. Silva, "Weibel magnetic field competes with Biermann field in laser-solid interaction".

Conference Proceedings

- A. Stockem, F. Fiúza, E. Boella, R.A. Fonseca, L.O. Silva, C. Joshi, and W.B. Mori. "Theoretical studies of collisionless shocks for laser-acceleration of ions". *The proceedings of SPIE*, vol. 8779, p. 87790B, 2013.
- E. Boella, B. Peiretti Paradisi, A. d'Angola, G. Coppa and L.O. Silva. "Dynamics of the Coulomb explosion of composite clusters". *41st EPS Conference on Plasma Physics*, Berlin, June 2014. http://ocs.ciemat.es/EPS2014PAP/pdf/P2.098.pdf.
- A. d'Angola, E. Boella, G. Coppa, B. Peiretti Paradisi and R. Zaffina. "N-body simulation of nanoplasmas". *41st EPS Conference on Plasma Physics*, Berlin, June 2014. http://ocs.ciemat.es/EPS2014PAP/pdf/P2.104.pdf.

- A. Balzarini, R. Fonseca, J. Vieira, E. Boella and L. Silva, "Initialization of charged particle beam in OSIRIS", *42^{nd} EPS Conference on Plasma Physics*, Lisbon, June 2015.
  http://ocs.ciemat.es/EPS2015PAP/pdf/P1.206.pdf.
- R.A. Cairns, E. Boella, M. Vranic, L.O. Silva, R. Trines, P. Norreys and R. Bingham, "Pellet ignition using ions shock accelerated in the corona", *42^{nd} EPS Conference on Plasma Physics*, Lisbon, June 2015.
  http://ocs.ciemat.es/EPS2015PAP/pdf/P1.209.pdf.

Contributive and invited talks

- E. Boella, A. d'Angola and G. Coppa, "Shell model: a simple technique for plasma simulations", Univeristá della Basilicata, Potenza, April 2012 (keynote presentation).
- E. Boella, "Ion acceleration driven by intense laser pulses. Focus on shock wave acceleration and Coulomb explosion", GoLP Global Seminar, Lisbon, May 2014 (keynote presentation).
- E. Boella, A. Stockem, F. Fiúza, R. Fonseca and L. Silva, "Ion shock wave acceleration in realistic laser-target scenarios", 42^{nd} EPS Conference on Plasma Physics, Lisbon, June 2015.
- E. Boella, R. Bingham, R. A. Cairns, P. Norreys, R. Trines, M. Vranic and L. O. Silva, "Fast ignition using shock accelerated ions in the target corona", 12^{th} Direct Drive and Fast Ignition Workshop, Bordeaux, April 2016.
- E. Boella, K. Schoeffler, R. Fonseca and L. Silva, "Shock wave collisions in laser-produced plasmas", 43^{rd} EPS Conference on Plasma Physics, Leuven, July 2016.
- E. Boella, "How do collisionless shocks interact? Can lab studies help us to understand?", Computational Plasma Astrophysics Summer School, Princeton, July 2016 (pitch presentation).
- E. Boella, D. Gonzalez-Herrero and G. Lapenta, "Modelling multi-scale problems with the new Energy Conserving Semi-Implicit Method", Charm meeting, Brussels, October 2016.
- E. Boella, "Laser-driven collisionless electrostatic shocks", Laboratoire pour l'Utilisation des Lasers Intenses, Paris, December 2016 (keynote presentation).
- E. Boella, D. Gonzalez-Herrero and G. Lapenta, "On modelling multi-scale problems with the new Energy Conserving Semi-Implicit Method", Instituto Superior Técnico, Lisbon, February 2017.
- E. Boella, D. Gonzalez-Herrero, M. E. Innocenti and G. Lapenta, "Modelling magnetic reconnection events relevant for solar physics with the new Energy Conserving Moment Implicit Method", EGU General Assembly, Vienna, April 2017 (solicited talk).
- E. Boella, D. Gonzalez-Herrero, J. Amaya, F. Bacchini, E. Cazzola, L. Siddi and G. Lapenta, "Energy conservation in multiscale kinetic simulations: semi-implicit versus implicit approaches", 44^{th} EPS Conference on Plasma Physics, Belfast, June 2017.
- E. Boella, A. Micera, D. Gonzalez-Herrero, M. E. Innocenti, and G. Lapenta, "Modelling tangential discontinuities at the Magnetopause with the new Energy Conserving Moment Implicit Method", 59^{th} Annual Meeting of the APS Division of Plasma Physics, Milwaukee, October 2017.
- E. Boella, "Multi-scale kinetic simulations using the semi-implicit PIC code ECsim", Laboratoire pour l'Utilisation des Lasers Intenses, Paris, December 2017 (keynote presentation).
- E. Boella, "Electrostatic shocks in laser driven plasmas", Chalmers University of Technology, Gothenburg, January 2018 (keynote presentation).

Awards

- Scholarship "Piano Locale Giovani" (2008), city of Asti, 5.000 €.
- Associazione per lo Sviluppo tecnoclogio del Piemonte (ASP) scholarship (2009), 5.000 €.
- Grant for participating to the High Energy Density Physics Summer School (2011), 400 $.
- Special PhD fellowship awarded by the president of Politecnico di Torino (2011), 28.000 €.
- Grant for participating to the 22^{nd} Summer School on Parallel Computing awarded by CINECA (2013), 500 €.
- Prace Preparatory Access (2016), 300.000 CPUhours.
- FWO travel grant for participating to the 59^{th} APS-DPP Meeting (2017), 1.000 €.

Mentoring activities

I have been involved in the co-supervision of the following Master projects:

- B. Peiretti Paradisi, "Studio sulle esplosioni coulombiane di microplasmi" (Study on Coulomb explosions of micro-plasmas), Master Thesis, Politecnico di Torino, 2014 (final mark: 110/110 cum laude, now PhD candidate at Politecnico di Torino).
- A. Balzarini, "Self-consistent particle beam EM field initialization for PIC simulations", Master Thesis, Politecnico di Torino, 2015 (final mark: 110/110 cum laude, now at Cornaglia Group, Italy).
- A. Micera, "Analysis of a new energy conserving particle in a cell method for plasma simulations", Master Thesis, Politecnico di Torino, 2017 (final mark: 104/110, now PhD candidate at KU Leuven).

Teaching activities

09.2016–01.2017 Teaching assistant for the course "Plasma Physics of the Sun" held at KU Leuven by Dr. E. Chane.
I have prepared the tasks of the homework for the students and I have corrected their report.

09.2016–01.2017 Teaching assistant for the course "Introduction to plasma dynamics" held at KU Leuven by Prof. G. Lapenta.
I have supervised two small research projects on ion acceleration in laser-driven plasmas and on the Grad-Shafranov equation, which were carried out during the semester and presented at the exam.

02.2017–06.2017 Teaching assistant for the course "Space weather" held at KU Leuven by Prof. G. Lapenta.
I have supervised a small research project on ion acoustic shockwaves, which was carried out during the semester and presented at the exam.

09.2017–01.2018 Teaching assistant for the course "Introduction to plasma dynamics" held at KU Leuven by Prof. G. Lapenta.
I have supervised a small research project on Coulomb explosion.

Professional Service

- Conference assistant at the International Conference on High Energy Density Physics, Lisbon, May 2011.
- Organiser of the Extreme Plasma Physics group seminars at Instituto Superior Técnico, Lisbon, September 2015 – April 2016.
- Organiser of the GoLP day, the annual retreat for GoLP members, Lisbon, April 2016.
- Conference assistant at the 43^{rd} EPS Conference on Plasma Physics, Leuven, July 2016.

- Conference organizer at the International Conference on Numerical Simulation of Plasma, Leuven, September 2017 (Program Committee).
- Session chair at the International Conference on Numerical Simulation of Plasma, Leuven, September 2017.

Other Work Experiences

In order to support myself economically during my undergraduate studies, I worked part-time.

10.2002–05.2004 Clerk at "Brian and Barry" clothing store in Alba, via Vittorio Emanuele.

07.2004–03.2008 Crew at McDonald's restaurant in Turin, piazza Castello,

03.2008–05.2008 Waitress at "Lingotto Hotels" in Turin, via Nizza.

Languages

English Very good

Portuguese Good

Italian Mother tongue