

PERSONAL INFORMATION

Leonida Antonio GIZZI

Male | 24/01/1965 | Italian

CONSIGLIO NAZIONALE DELLE RICERCHE
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WORK EXPERIENCE

- **Research Director** (Dirigente di Ricerca) at Istituto di Ottica CNR-INO, Pisa (current)
- **Head** of the Pisa Unit of Istituto Nazionale di Ottica (<http://www.pi.ino.cnr.it/pisa/>) (current)
- **Scientific Director** of the Intense Laser Irradiation Laboratory (current)

ONGOING RESEARCH PROJECT WITH LEADING ROLE

- > Next Generation EU (PNRR) - Tuscany Health Ecosystem (THE) 2022-2025 – Principal Investigator of Spoke 1 – “Advanced radiotherapies and diagnostics in oncology” (€ 9.140.725,78)
- > Next Generation EU (PNRR) - IPHOQS - INTEGRATED INFRASTRUCTURE INITIATIVE IN PHOTONIC AND QUANTUM SCIENCES, WP Leader (3,262,429.00)
- > EU H2020 - Innovation Fostering in Accelerator Science and Technology (I.FAST) 2020-2024, Task Leader on Laser Driver Development for Plasma Accelerators (€ 110.000,00)
- > EU H2020 - Compact European Plasma Accelerator with Superior Beam Quality (EuPRAXIA) 2022-2026, PP pf Research Infrastrucure, WP Leader (Laser Development); (€ 90.000,00)
- > IT MoD - "APOLLO (Advanced Pulsed Orientable Laser for Long distance Operations) – 2019-2024, High repetition rate Ultrafast Laser development (€ 3.350.000,00)

SAMPLE OF PAST PROJECTS WITH LEADING ROLE

- > IT MUR-CNR – Implementation of the European Roadmap ESFRI: “Extreme Light Infrastructure” (ELI), 2013-2019, PI of Research Unit at CNR-INO (€ 2.640,000).
- > EU FP7 - High Power laser Energy Research Facility (HiPER), Research Infrastructures, 2008-2011, PI of IPCF- CNR research unit; (€ 112.000,00)
- > INFN Commissione Nazionale V, Progetto FAST - Femtosecond timing and sync, 2007-2009, PI of Pisa Research Unit – INFN Sez. Pisa; (€ 95.500,00)
- > MIUR-FISR- national project on *Compact Ultrafast X-ray Sources*, National Coordinator, 2003-2007; (€ 276.097,00)
- > EU FP5 European training network XPOSE, *X-ray probing of the structural evolution of matter*, Head of IPCF-CNR node, 2000-2004; (€ 147.000,00)
- > ASI Italian Space Agency, Laue-diffraction optics for gamma-ray astronomy, Scientist in charge of Pisa research unit, 2000-2001; (€ 13.000,00)

SAMPLE OF OTHER RESEARCH PROJECTS WITH PARTICIPANT ROLE

- > EC European training network GAUS-XRP II, Generation and application of ultrashort, laser-produced X-ray pulses, 1996-200;
- > EC European training network SILASI, Superintense Laser Solid Interactions, 1996-2000;
- > EC European training network GAUS-XRP I, Generation and application of ultrashort, laser-produced X-ray pulses, 1993-1995;
- > CNR institutional projects on *High power density laser-matter interactions*, 1989-1996.

CONFERENCES AND WORKSHOPS

More than 70 oral and invited presentations at international conferences and workshops.

PUBLICATIONS

Author of 312 publications (Source ISI Web of Science) including more than 210 articles on **refereed** (JCR) journals (as of Feb 2022) with more than 5500 citations. H-Index: 43 (G. Scholar)^[1] H-Index: 35 (ISI WOS)

MASTER AND PhD SUPERVISION: more than 20 Master and PhD Theses Supervision

EDUCATION AND TRAINING

PhD: (1990-2004) 1994: Ph.D. in Plasma Physics and D.I.C (Imperial College of Science technology and Medicine, University of London);

FIRST DEGREE (Laurea): (1983-1989) Laurea in Fisica, Università degli studi di Pisa, Laurea in Fisica (Università di Pisa);

OTHER POSITIONS, SCHOLARSHIPS AND AWARDS: EU Marie Curie Fellowship at Imperial College, London, UK, 1995 • Scholarship of the Italian Space Agency at IFAM-CNR, Pisa, 1994 • Scholarship of the National Research Council at l'Imperial College di London, UK, 1993-94 • Research Associate at Imperial College, London, UK, 1993 • Scholarship of the National Research Council at IFAM-CNR, Pisa, 1991-92 • Scholarship of the National Research Council at Imperial College di London, UK, 1991.

MAIN RESEARCH FIELDS: Radiation Sources • High Power Laser Interaction with Matter • X-Ray Emission From Laser Produced Plasmas – X and Gamma Ray Generation and Applications • High Energy Astrophysics.

RESEARCH INTERESTS: Ultra Short, Ultraintense Laser Plasma Interactions • E.m. wave propagation • Atomic physics of ionised species • Collective phenomena and instabilities • Inertial confinement fusion related studies • X-ray generation and characterisation • Particle acceleration in laser-matter interactions • X-ray and gamma ray optics • Plasma acceleration of particles • Dosimetry • Radiobiology.

REVIEWER ROLE

 **JOURNALS** Member of the Editorial Board of “High Power Laser Science and Engineering”

 since 1997 *Referee of Phys. Rev. Lett., Phys Rev. E*

 since 2008 *Outstanding Referee of the American Physical Society (APS).*

nature since 2010, *Referee of Nature, Nature Communications, Nature Physics, Scientific Reports.*

Other referee roles: *Physics of Plasmas, Laser and Particle Beam, New J. Physics*

RESEARCH ACHIEVEMENTS

During my career I have conducted and promoted research activities that have led me and my institution to gain leadership roles in the most innovative fields of physics with high intensity lasers, plasmas and their applications in the main sectors of socio-economic interest, such as medicine, environment and cultural heritage, also in collaboration with high-tech companies. Since my first degree thesis (1989) I have been dealing with the experimental study of laser-plasma interactions in conditions relevant for laser fusion. In this context I have promoted, with roles of coordinator or work-package leader, experimental campaigns at the main international laser facilities, including the Vulcan laser at the Central Laser Facility (CLF, GB), the Prague Asterix Laser (PALS, Czech Rep.), the OMEGA laser (USA), the J-KAREN laser (Japan). Since 1992, I have been developing experimental study of laser-plasma interaction with ultra-intense lasers of the Chirped Pulse Amplification type and in 1999 I have promoted and coordinated the first Italian project (MURST) on the development of ultrashort radiation pulses based on laser-plasma interaction for materials and medical



Figure 1. World map of laser with peak power >100 TW, tratto da "Gerard Mourou: Nobel Lecture: Extreme light physics and application", *Rev. Mod. Phys.*, **91**, 030501 (2019).

applications. I have carried out and coordinated experimental activities at international laboratories of high power ultra-short pulse lasers at the Rutherford Appleton Laboratory (GB), the Laboratoire d'Optique Appliquée (Ecole Polytechnique, France), the CEA of Saclay (France), the Japan Atomic Energy Research Institute (Japan).

Following the results obtained, I was able to establish a program for the development of laser-plasma acceleration of particles for X-ray imaging and novel radiotherapy approaches within the ESFRI Extreme Light Infrastructure (ELI) initiative which, in 2007, led to the first demonstration of laser-plasma acceleration in Italy, at the ILIL laboratory of the INO-CNR in Pisa, a key international infrastructure (see figure) of which I became Scientific Director in 2009. On the basis of these results and European developments, I coordinated, from 2009 to 2013, the establishment of the FLAME Laboratory at the National Laboratories of Frascati (LNF) of the INFN which to date constitutes another key infrastructure of the SparcLAB project at the LNF (see Figure) and of the new ESFRI infrastructure on Plasma Acceleration called EuPRAXIA. Starting from 2013, I have been responsible for the design and construction, at the Pisa headquarters of the National Institute of Optics, of the ILIL-PW installation, the first infrastructure in Italy based on ultra-intense sub-PW class lasers, entirely dedicated to the study of laser-plasma interaction and laser-plasma acceleration, which was inaugurated in March 2018. Thanks to these results, the ILIL laboratory is today among the main laboratories in the world for plasma physics with ultra-intense lasers and plasma acceleration. ILIL is also a node of the European Network on Innovative Accelerators (Euronac), a partner of the ESFRI EuPRAXIA Infrastructure Project and a member of LASERLAB-EUROPE association. Since 2013, I have also been responsible for the CNR-INO-Pisa node of the Italian Extreme Light Infrastructure Network (ELI-Italy, ELI-Attosecond, ELI-Nuclear Physics) coordinated by CNR and participated by the Sincrotrone of Trieste and the INFN. Within this Network, the Pisa node is home to the development of plasma acceleration of particles for applications to high-energy radiation sources, diagnostics and radiotherapy in the biomedical field, focused on the role of the ultrashort (femtosecond domain) nature of laser-driven radiation sources.

As of today, my [research group](#) carries out basic research and develops applications of plasmas in the main sectors of socio-economic interest and, in particular in biology and medicine, energy and cultural heritage. The research activity on plasmas today constitutes the main research line for planning and scientific production active at the Pisa Branch of the National Institute of Optics and one of the main ones of the Institute at a national level. As head of the Pisa section of the National Institute of Optics, I have attracted regional/national/European resources and collaborations in particle acceleration and applications to radiobiology. I have engaged a major research programme in the development of innovative radiobiology and future radiation therapies also based on Very High Energy Electron (VHEE) and ultra-high dose rate for FLASH radiotherapy. This programme, supported by the Next Generation EU programme through the Italian Ministry of Research, includes infrastructure development and a full multi-disciplinary approach to the investigation of biological effects of ionizing radiations, from the microscopic, ultrafast scale to the clinics.

SELECTED PUBLICATIONS

- G. Cristoforetti, P. Koester, S. Atzeni, D. Batani, S. Fujioka, A. Schiavi, K. Shigemori, R. Takizawa, T. Tamagawa, D. Tanaka, A. Tentori, Y. Umeda, A. Yogo, and **L.A. Gizzi**, Multibeam laser-plasma interaction [...] for direct-drive inertial confinement fusion, *High Power Laser Science and Engineering* 11, 24 (2023).
- A. Borghini, C. Vecoli, L. Labate, D. Panetta, MG Andreassi, **L.A. Gizzi**. FLASH ultra-high dose rates in radiotherapy: preclinical and radiobiological evidence. *Int J Radiat Biol.* 98, 127-135 (2022).
- **L.A. Gizzi**, M.G. Andreassi, Ready for translational research. *Nat. Phys.* 18, 237–238 (2022).
- F. Albert, M E Couprie, A. Debus, M. C. Downer, J. Faure, A. Flacco, **L. A. Gizzi** et al., *2020 roadmap on plasma accelerators*, *New J. Phys.* 23, 031101 (2021).
- L. Labate, D. Palla, D. Panetta, F. Avella, F. Baffigi, F. Brandi, F. Di Martino, L. Fulgentini, A. Giulietti, P. Köster, D. Terzani, P. Tomassini, C. Traino, **L. A. Gizzi**, Toward an effective use of laser-driven very high energy electrons for radiotherapy: Feasibility assessment of multi-field and intensity modulation irradiation schemes, *Scientific Reports* 10, 17307 (2020).
- **L. A. Gizzi**, G. Cristoforetti, F. Baffigi, F. Brandi, G. D'Arrigo, A. Fazzi, L. Fulgentini, D. Giove, P. Koester, ^[SEP]L. Labate, G. Maero, D. Palla, M. Romé, M. Russo, D. Terzani, and P. Tomassini, Intense proton acceleration in ultrarelativistic interaction with nanochannels, *Phys. Rev. Research* 2, 033451 (2020).

- P. Tomassini, D. Terzani, F. Baffigi, F. Brandi, L. Fulgentini, P. Koester, L. Labate, D. Palla and **L. A. Gizzi**, High- quality 5 GeV electron bunches with resonant multi-pulse ionization injection, *Plasma Physics and Contr. Fusion*, 62, 014010 (2020).
- **L.A. Gizzi**, L. Labate, F. Baffigi, F. Brandi, G.C. Bussolino, L. Fulgentini, P. Koester, D. Palla, F. Rossi, Laser– plasma acceleration of electrons for radiobiology and radiation sources, *Nuclear Instruments and Methods in Physics Research B355*, 241–245 (2015).
- P. Ferrara, M. Ciofini, L. Esposito, J. Hostaša, L. Labate, A. Lapucci, A. Pirri, G. Toci, M. Vannini, and **L. A. Gizzi**, 3-D numerical simulation of Yb:YAG active slabs with longitudinal doping gradient for thermal load effects assessment, *Optics Express* 22, 5375–5386 (2014).
- L. A. Gizzi**, S. Betti, E. Förster, D. Giulietti, S. Höfer, P. Köster, L. Labate, R. Löttsch, A. P. L. Robinson, and I. Uschmann, Role of resistivity gradient in laser-driven ion acceleration *Phys. Review ST Acc. Beams*, 14, 011301 (2011).
- F. Zamponi, A. Lübcke, T. Kämpfer, I. Uschmann, E. Förster, A. P. L. Robinson, A. Giulietti, P. Köster, L. Labate, T. Levato, and **L.A. Gizzi**, *Directional Bremsstrahlung from a Ti Laser- Produced X-Ray Source at Relativistic Intensities in the 3–12 keV Range*, *Phys. Rev. Lett*, 105, 085001 (2010).
- S. Betti, C. A. Cecchetti, E. Förster, A. Gamucci, A. Giulietti, D. Giulietti, T. Kämpfer, P. Köster, L. Labate, T. Levato, A. Lübcke, I. Uschmann, F. Zamponi, and **L. A. Gizzi**, *On the effect of rear-surface dielectric coatings on laser-driven proton acceleration*, *Phys. Plasmas*, 16, 100701 (2009).
- **L. A. Gizzi**, S. Betti, M. Galimberti, A. Giulietti, D. Giulietti, L. Labate T. Levato, P. Tomassini, P. Monot, T. Ceccotti, P. De Oliveira, and Ph. Martin, *Tracking propagation of ultrashort intense laser pulses in gases via probing of ionization*, *Phys. Rev. E* 79, 056405 (2009).
- **L.A. Gizzi**, A. Giulietti, D. Giulietti, P. Koester, L. Labate, T. Levato, F. Zamponi, A. Luebcke, T. Kaempfer, I. Uschmann, E. Foerster, A. Antonicci, D. Batani, Observation of electron transport dynamics in high intensity laser interactions using multi-energy monochromatic X-ray imaging, *Plasma Phys. Control. Fusion* 49, B221-B221 doi: 10.1088/0741-3335/49/12B/S19 (2007).
- **L.A. Gizzi**, M. Galimberti, A. Giulietti, D. Giulietti, P. Köster, L. Labate, P. Tomassini, Ph. Martin, T. Ceccotti, P. D'Oliveira, P. Monot, *Femtosecond interferometry of propagation of a laminar ionization front in a gas*, *Phys. Rev. E* , 144609PRE, (2006).
- **L.A. Gizzi**, C.A. Cecchetti, M. Galimberti, A. Giulietti, D. Giulietti, P. Köster, L. Labate, S. Laville, P. Tomassini, *Soft laser-plasma X-ray sources for differential absorption imaging of tracing elements in thin samples*, *Laser Part. Beams* 22, 367 (2004).
- **L.A.Gizzi**, C.A.Cecchetti, M.Galimberti, A.Giulietti, D.Giulietti, L.Labate, S.Laville, P.Tomassini, *Transient ionization in plasmas produced by point-like irradiation of solid Al targets* , *Phys. Plasmas* 10 4601 (2003).
- **L.A.Gizzi**, A.Giulietti, O.Willi, D.Riley, *Soft-x-ray emission dynamics in picosecond laser-produced plasmas*, *Phys. Rev. E*, 62, 2721 (2000).
- **L.A.Gizzi**, A.Giulietti, O.Willi, *Time-resolved, multiframe X-ray imaging of laser-produced Plasmas*, *J. X-ray Sci. Technol.* 7, 186 (1997)
- **L.A.Gizzi**, D.Giulietti, A.Giulietti, P.Audebert, S.Bastiani, J.P.Geindre, A.Mysyrovicz, *Simultaneous measurements of hard X-rays and 2nd harmonic emission in fs laser-target interactions*, *Phys. Rev. Lett.* 76, 2278 (1996).
- **L.A.Gizzi**, A.J.Mackinnon, D.Riley, S.M.Viana, O.Willi, *Measurements of thermal transport in plasmas produced by picosecond laser pulses*, *Laser Part. Beams*, 13, 511 (1995).
- **L.A.Gizzi** , D.Giulietti, A.Giulietti, T.Afshar-Rad, V.Biancalana, P.Chessa, E.Schifano, S.M.Viana, O.Willi, *Characterisation of Laser Plasmas for Interaction Studies*, *Phys. Rev. E*, 49, 5628 (1994).
- D.Riley, **L.A.Gizzi**, F.Y.Khattak, S.M.Viana, O.Willi, *Plasma Conditions Generated by Interaction of a High Brightness, Pre-pulse Free Raman Amplified KrF Laser Pulse with Solid Targets*, *Phys. Rev. Lett.* 69, 3739 (1992).
- M.Desselberger, **L.A.Gizzi**, V.Barrow, J.Edwards, F.Y.Khattak, S.M. Viana, O.Willi, R.Bann, C.N.Danson, *Generation of High Aspect Ratio Line Focus Using a Random Phase Plate*, *Applied Optics*, 31, 3759 (1992).
- **L.A.Gizzi**, D.Batani, V.Biancalana, A.Giulietti, D.Giulietti, *X-Ray emission from Thin Foil Laser produced Plasmas*, *Laser and Particle Beams*, 10, 65 (1992).
- T.Afshar-Rad, **L.A.Gizzi**, M.Desselberger, F.Khattak, O.Willi, A.Giulietti, *Evidence for Whole-Beam Self-Focusing of Induced Spatially Incoherent Laser Light in Large Underdense Plasmas*, *Phys Rev.Lett.* 68, 942 (1992).
- A.Giulietti, D.Giulietti, D.Batani, V.Biancalana, **L.A.Gizzi**, L.Nocera and E.Schifano, *Spectroscopic Evidence for Sum Frequency of Forward and Backscattered Light in Laser Plasmas*, *Phys. Rev. Lett.* 63, 524 (1989).