



**VIU
PhD
academy
Intense
Lasers For
new societal
aPPlications**

Intense lasers for new societal applications

May 13-17, 2024

**Venice International University
Isola di San Servolo, Venice**

VIU International PhD
Academy

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Venice International
University

Scientific Coordinator:

Andrea Macchi,
National Research Council
of Italy (CNR)

Co-Coordination:

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Joerg Schreiber, Ludwig-
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Since the invention of the laser in 1960, many big laser systems have been built to exploit the capability of light pulses to strongly focus large amounts of energy into narrow space regions (micrometric) and short time intervals (nanoseconds i.e 10^{-9} seconds). The biggest of such systems (National Ignition Facility, USA) enabled to create in the laboratory the extreme conditions found inside stars and in 2022 led to the first ignition of a thermonuclear fusion reaction with net energy gain, opening new perspectives for the unlimited production of clean energy. But laser systems can be very compact and yet deliver enormous power ($> \text{terawatt} = 10^{12} \text{ W}$), in pulses of ultra-short duration ($< 1 \text{ picosecond} = 10^{-12}$ seconds), thanks to the technique invented by the two 2018 Nobel laureates in Physics, Gerard Mourou and Donna Strickland. Ultrashort, intense lasers opened up several new fields of applications. These latter include attosecond science, based on converting the laser pulses (via nonlinear atomic or electronic processes) in even shorter pulses of ultraviolet- and X-rays down the scale of the attosecond (10^{-18} seconds). The techniques recognized with the Nobel Prize 2023 to Pierre Agostini, Ferenc Krausz, Anne l'Huillier now allow atomic and molecular processes to be studied and controlled on their typical temporal scale, opening up new perspectives in chemistry and in the understanding of biomolecular processes. Another prominent application is laser-plasma particle acceleration which allows to generate pulses of high energy ions, electrons and secondary radiation over a length scale 1000 times smaller than "conventional" radiofrequency-based particle accelerators, such as LHC at CERN in Geneva. Besides potential economic benefits through compactness, laser-plasma particle accelerators feature unique characteristics, such as very high fluxes of particles produced in a very short time of the order of the laser pulse duration. The investigation of laser-accelerated particle beams and their use is currently challenging many research laboratories worldwide, in particular for its manifold applications. In the biomedical field, the recent indications for the enhanced

radiobiological efficiency of very high doses delivered in ultrashort times ("FLASH" effect) further motivates the application of laser-driven accelerators.

The enormous potential of high power laser applications has been recognized since more than a decade, when the European Commission and other countries have financed numerous high power laser infrastructures totaling several billion dollars as investment. Among them are the Extreme Light Infrastructure (laser infrastructure, constructed in Hungary, Czech Republic and Romania), CALA in Munich, Germany; APOLLON, in Palaiseau, France; CLPU in Salamanca, Spain; Eupraxia in Frascati, Italy; etc... Hence, there is a strong international movement to promote what will be the applications of tomorrow.

This PhD Academy is led by:

- University of Bordeaux, France
- National Research Council of Italy (CNR)
- Ludwig-Maximilians-Universität München

Faculty

Andrea Macchi, CNR-National Institute of Optics
Emmanuel d'Humieres, University of Bordeaux
Joerg Schreiber, Ludwig-Maximilian University
Inka Manek-Hönniger, University of Bordeaux
Emanuela Reale, CNR-Institute for Research on Sustainable Economic Growth
Elisabetta Baldanzi, CNR-National Institute of Optics
Caterina Vozzi, CNR- Institute for Photonics and Nanotechnologies
Katia Parodi, Ludwig-Maximilian University
Joao Santos, University of Bordeaux
Pier Luigi Mazzeo, CNR - Institute of Applied Sciences and Intelligent Systems

Guest speakers

Patrizio Antici, Institut National de la Recherche Scientifique, Québec
Anne Hildenbrand-Dhollande, ISL French-German Research Institute of Saint-Louis

Topics

The program will provide the basics of intense laser-matter interactions on which scientific and societal applications are built. Specific topics will include laser technology, attosecond science,

laser-plasma accelerators, and high energy density physics of relevance for fusion energy production and astrophysics. Lectures will cover both potential long-term applications and mid-term ones doable with current technology.

The inclusion of transversal skills sessions comes from the need of providing PhD students with a solid background on additional skills that are currently required by the labour market (either at academia, industry or research).

Learning outcomes for participants

The specific formation provided by the scientific program will be particularly important for students willing to pursue a career in the field of intense lasers. The latter currently shows a lack of working force, as several intense laser facilities are now becoming operational. Nevertheless, the basic knowledge acquired on topics of great societal relevance (for instance with applications in biomedical and energy sectors) will be useful also for students who will enter different areas in either academia or industry.

The transversal skill program and the personal exchange with specialists completes this specific knowledge, and sensitizes participants for a balance between rigorous scientific work, communication of results and exploitation as well as advertising.

Who can apply?

This international PhD Academy is offered to PhD students, post-docs, and junior researchers with background in Sciences, Physics, Chemistry, Biology, Health Sciences, Materials Sciences, Cultural Heritage, and Astrophysics. Open to candidates from all the VIU Member Institutions; applications from excellent candidates from non-member institutions will be also considered and evaluated.

Fees & Grant Support

Students from the VIU member institutions will pay no participation fees. Grant support is also available to support, partially or fully, the costs of international travel and accommodation. The participation fee for students of non-member institutions is Euro 1,150 (incl. VAT). The fee is inclusive of tuition, course materials, accommodation, lunches, social events, and taxes. Students from non-member institutions are not eligible for VIU grant support. VIU Alumni are eligible for a reduced fee.

Call for applications

December 1 2023 - January 31, 2024

via the VIU website

Applicants must submit the (1) application form, (2) a letter of motivation – which should include a short bio and a brief description of the candidate's research project, (3) a curriculum vitae and (4) a photo.

For further information: phdacademy@univiu.org

VIU International PhD Academies

Venice International University is a consortium of 21 institutions, representing 14 countries throughout the world.

The mission of VIU is to foster cooperation among VIU member institutions while facilitating the exchange of knowledge and ideas, by developing, promoting, and organizing joint academic, research and training/capacity-building program. Students from non-member universities may participate in selected academic programs.

The academic programs at VIU are distinguished by a markedly interdisciplinary approach to the topics, and by the international perspectives that the participants contribute to the discussions. The VIU campus is on the island of San Servolo in Venice, Italy.

Venice International University holds two/three International PhD Academies each year. They are intensive training opportunities open to PhD candidates from the member universities of VIU.

A PhD is the highest diploma awarded by universities in the world, and PhDs are naturally expected to take on major responsibilities in their professional life. Apart from the disciplinary scientific skills acquired during doctoral study and research, it is the ability to respond to the requirements of creativity, innovation, and project management, that produce the significant added value of a doctoral degree.

Whether they will work within or outside academia, PhDs must be able to develop a forward-looking vision of the challenges they have to face. The interdisciplinary approach of all VIU activities is adopted also in the PhD Academy, where the participants have the opportunity to meet their peers from all over the world, and to tackle transversal topics.

www.univiu.org/study/phd-academy

Location



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