Central Laser Facility

Introduction

The Central Laser Facility (CLF) is involved in studying laser interaction with matter (atoms, molecules, clusters and materials). Laser irradiation may induce selective stimulation, ionization, molecular decomposition, breakdown etc. The information gathered by monitoring the induced ionic current, the energy of the produced electrons and the emitted light, contributes to understanding the structure of materials and their coupling mechanisms with the electromagnetic field of the laser beam. It is further possible to achieve materials' characterization and to develop high sensitivity analytical techniques.

Facilities & Infrastructure

The currently available equipment includes:

- Nd:YAG pumped pulsed dye laser: 3 nsec pulse duration with 150 mJ at 532 nm, covering the 370-1036 nm spectral range
- Nd:YAG pumped pulsed dye laser: 3 nsec pulse duration with 400 mJ at 532 nm, equipped with second harmonic generation crystals able to extend the wavelength range down to 205 nm
- Nd:YAG laser producing light pulses of 35, 50, 100 and 200 psec at 1064 nm (100 mJ), 532 nm (60 mJ), 355 nm (18 mJ), 266 nm (18 mJ) and 213 nm (1 mJ).
- Ti:Sapphire laser producing light pulses of 20 fs (5 mJ, 1KHz), at 800 and 400 nm. The fs laser system is in close connection with a home-made arrangement that produces high-order harmonic pulses (~10 fs) of UV and VUV coherent radiation.

To exploit the laser sources above, a variety of work-stations have been developed (Fig. 1), such as mass spectrometers, a photoelectron spectroscopy system, a laser-induced fluorescence (LIF) spectroscopy system, arrangements for fast monitoring and analysis of light, for z-scan measurements, for thin film development by pulse lase deposition etc. In case a more specialized experimental setup is needed, the users may provide their own equipment or work with the CLF staff to design and construct new arrangements.

Services

The CLF aims to support research activities in the University of Ioannina and to provide services to social and industrial sectors.

Figure 1: Measuring arrangements at CLF.

Research activities that may be supported include:

- **Physics Department:** Interaction of light with atoms, molecules, clusters, polymers and solids, laser ablation of materials, development of thin films and nanostructures, etc.
- **Chemistry Department:** Photochemistry, laser-induced polymerization, catalysis materials, ultra sensitive analytical and diagnostic techniques, etc.
- **Materials Science and Engineering Department:** Laser ablation, characterization and development of novel materials, micromachining, lithography, etc.
- **School of Medicine:** Diagnostic, therapeutic and surgical techniques for the Clinics and the Pharmacology, Biology and Pathologoanatomy Labs.
- **Department of History and Archeology:** Cleaning and material analysis of objects of Archeological interest, etc

Concerning the services to social and industrial sectors, we can mention the study of pollutants in gaseous, liquid and solid samples, the analytical and diagnostic techniques for product characteri-

zation, materials processing, etc.

As illustrated in Fig. 2, during the past five year, the CLF has been used by staff members from the Departments of Physics, Chemistry, Materials Science & Engineering and Biological Applications & Technologies. External users from the Aristotle University of Thessaloniki, the National Technical University and the Technical Educational Institute of Crete have also been supported.

Furthermore, the CLF is cooperating with research groups from the Institute of Electronic Structure and Lasers and the Center of Plasma Physics and Laser (Crete), in the framework of the Extreme Light Infrastructure (ELI), High Power Laser Energy Research Facility (HIPER) and X-ray Free Electron Laser (X-FEL) programs. At the European level, the CLF has developed cooperation with various Research Centers, such as the Rutherford Appleton Laboratory (Oxfordshire-UK), the Max Planck Institute (Munich- Germany), the LENS (Florence –Italy) etc.

It is also worth-noting that the CLF contributes to educational activities in the University, both at the undergraduate and postgraduate level.

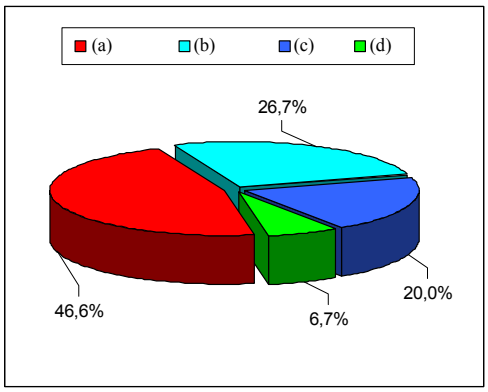

Figure 2. Indicative distribution of the CLF operating time between users from the Departments of (a) Physics, (b) Chemistry, (c) Materials Science & Engineering and (d) Biological Applications & Technologies.

Staff & Contact Information

A 5-member committee is responsible for the operation of the Central Laser Facility. Information can be obtained from Prof. C. Kosmidis.

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Representative Publications

1. S. Kaziannis, P. Siozos and C. Kosmidis, "Dynamic alignment of CH3I by strong picosecond pulses", Chem. Phys. Lett. 401, 115 (2005).
2. C. Kosmidis, P.Siozos, S. Kaziannis, L. Robson, KWD Ledingham, P.McKenna, DA Jaroszynski, "On the interaction mechanism of some alkyliodines with strong femtosecond lasers", J. Phys. Chem. A 109, 1279 (2005).
3. S. Cohen, I. Liontos, A. Bolovinos, A. Lyras, S. Benec'h and H. Bachau, "Two-photon ionization of Calcium above the 3s1/2 threshold", J. Phys. B. v39, 2693 (2006).
4. C. Kosmidis, S. Kaziannis, P. Siozos, A. Lyras, L. Robson, KWD Ledingham, P.McKenna, DA Jaroszynski, "Molecular hydrogen ion elimination from alkyl iodides under strong laser beams irradiation", Int. J. Mass Spectrom. 248, 1 (2006).
5. G.M. Matenoglou, G.A. Evangelakis, C. Kosmidis, and P. Patsalas, "Hybrid pulsed laser deposition of Ti-Cu-N ternary nitride thin films", Reviews in Advanced Materials Science, 15, 38 (2006).
6. S. Kaziannis and C. Kosmidis, "Comparative Study of Multielectron Ionization of Alkyl halides Induced by ps Laser Irradiation", J. Phys. Chem A 111, 2839 (2007).
7. N. Kapakoglou, Betzios P, S. Kazianis, C. Kosmidis, C. Drouza, M. Manos, M. Sigalas, A. Keramidas, and T. Kabanos, "Polyoxomolybdenum(V/VI)-Sulfite Compounds: Synthesis, Structural, and Physical Studies", Inorganic Chem. 46, 6002-6010(2007).
8. J.G. Philis and V.S. Melissas, "Resonance-enhanced multiphoton ionization of jet-cooled 2-methyfuran", Chem. Phys. 336, 136 (2007).
9. A. Bolovinos, S. Cohen and I. Liontos, "One- and two-photon phase-sensitive coherent control of total ionization yields in the presence of static electric fields", Phys. Rev. A, v77, 023413 (2008).
10. G.M. Matenoglou, LE Koutsokeras, Ch E Lekka, G. Abadias, S. Camelio, GA Evangelakis, C. Kosmidis and P. Patsalas, "Optical properties, structural parameters, and bonding of highly textured rocksalt tantalum nitride films", J. Appl. Phys. 104, 124907 (2008).
11. E.G. Robertson, D.E. Martin, C.D. Thompson, R.J.S. Morrison and J.G. Philis, "Structure determination of sec-butylbenzene rotamers by UV spectroscopy and an initio calculations", Chem. Phys. Lett. 463, 29 (2008).
12. J.G. Philis, "Resonant two-photon ionization spectra of p-difluorobenzene mixed van der Waals complexes", J. Mol. Struct. 924, 32 (2009).

13. S. Kaziannis and C. Kosmidis, "The ejection anisotropy in the Coulomb explosion of some alkyl halide molecules under strong ps laser fields", Chem. Phys. Lett. 467, 281 (2009).
14. G.M. Matenoglou, Ch.E. Lekka, L.E. Koutsokeras, G. Karras, C. Kosmidis, G.A. Evangelakis, P.Patsalas, "Structure and electronic properties of conducting, ternary TixTa1-xN films", J. Appl. Phys. 105, (2009).
15. G.M. Matenoglou, L.E. Koutsoheras, Ch. E. Lekka, G. Abadias, C. Kosmidis, G.A.Evangelakis and P. Patsalas, "Structure, stability and bonding of ternary transition metal nitrides", Surface and Coatings Technology 204, 911 (2009).
16. G. Karras, C. Kosmidis, "Multielectron Dissociative Ionization of CH3I clusters under moderate intensity ps laser irradiation", International Journal of Mass Spectrometry 290, 133 (2010).
17. G.A. Almyras, G.M. Matenoglou, P. Komninou, C. Kosmidis, P. Patsalas, G.A. Evangelakis, "On the deposition mechanisms and the formation of glassy Cu-Zr thin films", J. Appl. Phys. 107, 084313 (2010).