1er Taller sobre Fuentes de Luz Basadas en Láseres de Pulsos Ultrabreves y Aplicaciones.

1st Workshop on short-pulse-laser based light sources and applications.

2, 3 y 4 de Junio, 2011 / June 2nd, 3th & 4th, 2011.

Instituto de Ciencias Físicas, UNAM.

Cuernavaca, Morelos. México

Una buena parte de los aspectos científicos, técnicos y las múltiples aplicaciones de los láseres de pulsos ultrabreves son, desafortunadamente, todavía poco conocidas en México. En este primer taller de Fuentes de Luz basadas en láseres de pulsos ultrabreves deseamos ofrecer una pequeña revisión de los fundamentos científicos de éstos, así como una primera aproximación a algunas de sus aplicaciones.

Por otra parte, deseamos proponer a los asistentes la construcción de una fuente de luz multi-usuario y multipropósito basada en láseres de pulsos cortos. Esta reunión servirá para identificar a los usuarios potenciales y las características que debería tener una fuente de este tipo y la formación de un grupo de trabajo que establezca un plan maestro para la construcción de una fuente de este tipo en nuestro país, la formación de estudiantes en las áreas relevantes y el planteamiento de las estrategias de financiamiento y alianzas estratégicas con grupos líder en el tema a nivel mundial.

Aunque el tema central en esta ocasión está dedicado a la creación, caracterización y algunas de las aplicaciones espectroscópicas de pulsos con duración de attosegundos, la sesión de carteles está abierta a contribuciones a cualquier tema relacionado con los aspectos científicos, tecnológicos y aplicaciones de estos láseres.

El comité organizador espera que este taller sea el primero de una serie que impulse el desarrollo de estas temáticas, nos ayude a consolidar el desarrollo de recursos humanos y a la creación de la infraestructura necesaria para éstos fines en nuestro país.

The purpose of this workshop is to spread, among Mexican students and researches, the latest basic science, techniques and applications related to ultrashort pulsed lasers.

This meeting will also be used to put forward to the Mexican community the proposal for building a Light Source based on ultrashort pulsed lasers. The organizing committee intends to create a catalogue of potential users as well as the characteristics that a source like this should posses. Additionally, we also want to create a task force for generating a master plan for the design and building of such source, the training of students in the relevant fields and the building of a network of collaborations with the state-of-the-art world leading groups.

In this occasion the aim of the workshop is focused on the creation, characterization and various applications of attosecond light pulses. Although, the meeting´s poster session is open for contributions in any subject related with scientific and technical developments of short pulse lasers and their applications.

The organizing committee wishes this workshop would be the first of a long series devoted to ultra short pulse laser science, techniques and applications thus paving the way to consolidate the development of human resources, infrastructure and common facilities needed for the advance of this field in our country.

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REDFAE

CONACYT

Los tópicos de la reunión están centrados pero no limitados a:

(a) Láseres.
  (i) Generación, diagnóstico y amplificación de pulsos ultracortos.
  (ii) Pulsos con duración de attosegundos.
  (iii) Aceleración de partículas.
(b) Aplicaciones.
  (i) Ablación.
  (ii) Plasmas.
  (iii) Metrología.
  (iv) Aplicaciones médicas.
  (v) Espectroscopia resuelta en tiempo.
  (vi) Aceleradores de partículas basados en láseres.

The topics of the workshop are focused but not limited to:

(a) Lasers.
  (i) Generation, characterization and amplification of ultrashort pulses.
  (ii) Attosecond light generation and its uses
  (iii) Particle acceleration
(b) Applications
  (i) Ablation
  (ii) Plasmas
  (iii) Metrology
  (iv) Medical Applications
  (v) Time-resolved spectroscopies
  (vi) Particle accelerators based on lasers

Comité Organizador / Organizing Committee

Dr. Santiago CAMACHO LÓPEZ, Centro de Investigaciones Científicas y de Educación Superior de Ensenada, (CICESE), Ensenada, México.

Dr. José Luis HERNANDEZ POZOS, Universidad Autónoma Metropolitana, Unidad Iztapalpa (UAM-I); Ciudad de México, México.

Dr. José I JIMÉNEZ MIER Instituto de Ciencias Nucleares, UNAM (ICN-UNAM), Ciudad de México, México.

Dr. Antonio M JUAREZ REYES Instituto de Ciencias Física, UNAM (ICF-UNAM), Cuernavaca, México.

Dr. Raúl RANGEL ROJO Centro de Investigaciones y Educación Superior de Ensenada, (CICESE), Ensenada, México.

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Programa de Actividades. 2 de Junio / June 2nd. Program

8:15 – 8:45 Registration

MORNING SESSION Chair:	
8:50 – 9:00	Opening
9:00 – 9:45 Th01	An introduction to ultrashort pulses: generation, measurement and amplification. Raúl Rangel (CICESE)
9:45 – 10:30 Th02	Ultrashort Pulse shaping and characterization Jesús Garduño García (CCADET-UNAM)
10:30 – 11:15 Th03	Generation of high energy few-cycle laser pulses Felix Frank, (Imperial College, UK)
11:15 – 11:30	CAFÉ / COFFE
11:30 – 12:15 Th04	High order harmonic generation José Luis Hernández Pozos (UAM-I)
12:15 – 13:00 Th05	Generation and characterization of attosecond pulses. Felix Frank, (Imperial College)
13:00 – 15:30	COMIDA
AFTERNOON SESSION Chair:	
15.30 – 16:15 Th06	Micro and nanostructuring with short pulses. Santiago Camacho (CICESE)
16:15 – 17:00 Th07	Charge Transfer in atomic collisions assisted by ultrashort and intense pulsed lasers. Remigio Cabrera. (ICF-UNAM)
17:00 – 17:45 Th08	Imaging of molecular structure and dynamics using laser driven electron recollisions. Thomas Siegel (ICF-UNAM)
17:45 – 18:00	Coffee
18:00 – 19:30	Sesión de Carteles / Poster Session
20:00	CENA / DINNER

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3 de Junio / June 3rd.

SESIÓN MATUTINA / MORNING SESSION Chair:	
9:00 – 9:45 Fr01	Excited state dynamics of molecules in solution Jorge Peón (IQ-UNAM)
9:45 – 10:30 Fr02	The use of high harmonic generation for x-ray photoelectron spectroscopy of metallic surfaces, and its use for measurement of plasmonic temporal dynamics. Christopher Arrell (Imperial College)
10:30 – 11:15 Fr03	Tunable ultrashort pulses Manuel Fernández Guasti (UAM-I).
11:15 – 11:30	COFFE
11:30 – 12:15 Fr04	Multipurpose high order harmomic light source at Rutherford Appleton Laboratory. Emma Springate. Central Laser Facility, Rutherford Appleton Laboratory
12:15 – 13:00 Fr05	"The Peta- Watt laser at Salamanca: Perspectives and opportunities of high power lasers" Camilo Ruiz Mendez . Universidad de Salamanca.
13:00 – 15:30	LUNCH
SESIÓN VESPERTINA / AFTERNON SESSION Chair:	
15.30 – 16:15 Fr06	Ultrashort pulse lasers and Optical Combs Héctor A. Castillo Matadamas (CENAM)
16:15 – 17:00 Fr07	Femtosecond Laser Focus Determination through Its Perturbation of an Electric Field Mayo Villagran (CCADET-UNAM)
17:00 – 17:15	COFEE
17:15 – 18:00 Fr08	Theoretical and experimental characterization of ultrashort pulses in the focal region of diffractive systms./Caracterización teórica y experimental de pulsos ultracortos en la región focal de sistemas refractivos Martha Rosete (CCADET-UNAM)
18:30 – 18:45	Concert

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4 de Junio 2011 / June 4th.

SESIÓN MATUTINA / MORNING SESSIONG Chair:	
9:30 – 10:30	Proposal for a multi-user/multi-purpose light source based in ultrashort pulses in Mexico. José Luis Hernández Pozos (UAM-I)
10:30 – 11:30	Mesa redonda / Discussion Session I: El punto de vista del usuario/ The users point of view
	COFFE
11:45 – 12:45	Mesa redonda/Discusion Session II: Requerimientos técnicos , humanos y financieros/Technical, human and financial requirements
12:45 - 13:30	Conclusiones y perspectivas / Conclusions and perspectives

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ABSTRACTS

Th01

An introduction to ultrashort pulses: generation, measurement and amplification.

Dr. Raúl Rangel Rojo.
Centro de Investigación y Educación Superior de Ensenada.
Ensenada. México.

Abstract:
In this talk, I present an introduction to the techniques for generating ultrashort light pulses, including a general explanation of laser action, and the techniques employed to produce pulses: Q-switching, and mode-locking, with a discussion of the different ways of achieving the latter. The techniques for measuring the duration of pulses are also presented, together with a brief introduction to pulse amplification.

Th02

Ultrashort Pulse shaping and characterization.

Dr. Jesus Garduño García.
Centro de Ciencias Aplicadas y Desarrollo Tecnológico-UNAM.
Mexico City. Mexico

Abstract:
In this work a review of different ultrashort pulse characterization and pulse shaping techniques are presented

ThO3

Generation of high energy few-cycle laser pulses.

Dr. Felix Frank.
Imperial College Of Science, Technology & Medicine.
London, United Kingdom.

Abstract:
In this talk I will show the basic principles and the technological implementations of few-cycle infra-red laser pulse generation. I introduce the basics of femtosecond laser pulse generation and their amplification to multi GW peak powers. I introduce the principles of non-linear pulse compression by self-phase modulation in a hollow-core fibre. This allows the production of sub TW peak-power level few-cycle pulse duration laser pulses. For these short pulse durations the relative phase of carrier-wave and pulse envelope becomes important in laser matter interactions and has to be stabilised. I show the basic principles and experimental implementations of stabilising a CPA laser system.

Th04

High Order Optical Harmonics: Generation, control and applications

José Luis Hernández Pozos.
Universidad Autónoma Metropolitana-Iztapalapa.
Mexico City, Mexico.

Abstract.

In this talk we will review the first experimental results of high order optical harmonic generation, then the most accepted model for explaining its features: the three step model (single atom response) and the collective influence of an ensemble of atoms. We also will show how different research groups have improved some its characteristics depending on the application they where look for a particular application.

Th05.

Generation and characterization of ultrashort attosecond pulses.

Dr Felix Frank.
Imperial College of Science, technology and Medicine.
London, United Kingdom.

Abstract:
In my talk I will introduce the basic physics behind single isolated attosecond (1as = 10^{-18}s) pulse generation. The necessary tools to generate single attosecond pulses via high harmonic generation are introduced, starting with a short description of the CEP stabilised few-cycle laser pulse. After a brief theoretical introduction about high harmonic generation I will show the production of isolated attosecond pulses by spectral filtering and temporal gating of high harmonic generation around 100eV. I will introduce the methods used to characterise the produced attosecond pulses focussing on the attosecond streak camera. Here, a photoelectron replica of the XUV attosecond pulse is streaked by a weak IR pulse (10^{12} W cm^{-2}) with a variable delay.

Th06

Micro and nanostructuring with ultrashort pulses.

Santiago Camacho López.
Centro de Investigación y Eduación Superior de Ensenada.
Ensenada. México

Abstract:

Abstract not available

Th07

Charge transfer in atomic collisions assisted by ultrashort and intense pulsed lasers.

Dr. Remigio Cabrera.
Instituto de Ciencias Físicas-UNAM
Cuernavaca, Mexico.

Abstract:

Abstract not available

Th08

Imaging of molecular structure and dynamics using laser driven electron recollisions.

Dr. Thomas Siegel
Instituto de Ciencias Físicas, UNAM.
Cuernavaca, México

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Abstract:
During this talk i will give an overview of the techniques based on laser driven recollisions which can be used for molecular imaging. I will list the possibilities offered by these techniques reviewing recent results obtained mainly by our group but also some of the other most talked about papers in this field. These recollisions have the unique capabilities of offering an accurate measurements on the intrinsic spatial and temporal scales of molecules i. e. the nanometer and femtosecond regimes

Fr01

Excited state dynamics of molecules in solution

Dr. Jorge Peón.
Instituto de Química, UNAM.
Mexico City, Mexico.

Abstract:
Understanding the pathways of electronically excited states of molecular systems is of great importance since these species are the original precursors of all photochemical reactions. In this contribution we will present recent results on the sub-picosecond dynamics of several systems which have been studied at UNAM's Institute of Chemistry in recent years. We will include investigations of nitrated aromatic compounds which are important atmospheric pollutants which's degradation takes place through photo-induced reactions. We will show that these molecules show intersystem crossing times as short as sub-100 fs due to conical intersections with specific receiver states in the triplet manifold. In addition, we will present studies abouth the photophysics of Schiff bases and the effect of chelation with organo tin centers. Finally, we will present the characterization of phtalocyanines which undergo ultrafast energy transfer from their axial ligands.

Fr02

The use of high harmonic generation for x-ray photoelectron spectroscopy of metallic surfaces, and its use for measurement of plasmonic temporal dynamics.

Dr. Christopher Arrell.
Imperial College of Science, Technology and Medicine.
London, United Kingdom.

Abstract:
I will give a brief overview of hollow fibre pulse compression to produce a few cycle (3.5fs) IR pulse which is subsequently used to produce an isolated attosecond pulse of soft x-ray light through high harmonic generation. By controlling the carrier envelope phase it is shown the ionisation can be restricted to a single half-cycle of the IR field. I will then describe the use of soft x-rays produced by high harmonic generation in x-ray photoelectron spectroscopy measurements of metallic surfaces, and their use in measuring the thermalisation time of hot electrons in a gold target. Our recent investigations have been studying enhanced localised plasmonic fields on rough Au surfaces. This work has revealed the onset of tunnelling emission from surfaces irradiated with moderate IR field intensities. I will also discuss the use of XUV pulses to measure the temporal dynamics of plasmonic fields.

Fr03

Tunable ultrashort pulses.

Dr. Manuel Fernández Guasti.
Universidad Autónoma Metropolitana-Iztapalapa.

Mexico City, Mexico.

Abstract.

Abstract not available

Fr04

Multipurpose high order harmonic light source at Rutherford Appleton Laboratory.

Dr. Emma Springate.
Central Laser facility, Rutherford Appleton Laboratory.
Oxfordshire, United Kingdom.

Abstract:
Abstract not available

Fr05

The Peta- Watt laser at Salamanca: Perspectives and opportunities of high power lasers

Dr. Camilo Ruiz Méndez
Universidad de Salamanca.
Salamanca, Spain.

Abstract:
We will present the new Centro de Laseres Pulsados Ultracortos Ultraintensos CLPU which will host the Petawatt Spanish project. The extreme optics that can be accessed with these lasers will boost the research of Spanish and international users, in this paper we present the characteristics of the laser and the target areas that will be constructed in Salamanca. Also we will briefly review the new CEP lab for attoscience and the Khz facility for micromachining. Finally we will give a quick overview of the activities and networks involved in this project.

Fr. 06

Ultrashort pulse lasers and Optical Combs

Dr. Héctor A. Castillo Matadamas.
Centro Nacional de Metrología.
Querétaro, México.

Abstract:
In the past, absolute measurements of optical frequencies was an extremely difficult task, because the determination of the absolute frequency of a laser or optical source requires the measurement of frequency in the order of hundreds of tera Hertz, using oscillators with reference frequency is in giga Hertz as in the case of atomic cesium clocks.
Currently, some primary metrology labs in the world (BIPM, Paris, PTB-Germany, NIST-USA, and others) made the absolute measurement of optical frequency standards, using systems developed in recent years, commonly called frequency combs. These systems are based on ultrashort laser pulses in solid state or fiber and nonlinear phenomena like “Kerr-Lens mode locking" (KLM) and selfmodulation in fibers to cover a wide range of optical frequencies.
The key element in a frequency comb is the ultrashort pulse laser which generates an emission of coherent modes each separated by a fixed frequency. The small frequency comb obtained from the ultrashort pulse

laser is extended spectrally by means of a micro-structured fiber.

The operating frequency combs usually include a lasers based in Titanium Sapphire crystal as the active medium, and requires a typical pump laser operating at 532 nm and high power (greater than 5 watts). However, systems have been reported for generation of ultrashort pulses with high probability of metrological application using the material Cr: LiSAF. [1] These Kerr-Lens Mode-Locked lasers operate with less than 1 W of optical pump power at 670 nm, which represents considerable savings in size, cost and power of the pumping source.

Metrological application of short pulse lasers has direct impact on the maintenance and development of standards of length and time, which is the goal of the National Metrology Centre (CENAM) in Queretaro, Mexico. There is growing interest in research and development of systems for measuring the absolute frequency of the set of primary standard lasers that currently make the realization of the definition of the meter.

In this talk the basic concepts of a frequency comb based in femtosecond pulsed lasers are described. Also, the current status and some technical details of the ultrashort pulse lasers developed in the CFATA and CENAM and metrological applications are given, as well as short-term outlook for the construction of two frequency combs based on ultrashort pulsed lasers of Cr: LiSAF and Ti: Za [2-4].

[1] R. Holzwarth, M. Zimmermann, Th. Udem, and T. W. Hänsch, *White-light frequency comb generation with a diode-pumped Cr:LiSAF laser*, OPTICS LETTERS, (2001), Vol. 26, No. 17.

[2] Castillo M. Quintero T., *"Improvement of the operation parameters for a Cr: LiSAF Ultachort-Pulse Laser"*, Laser Physics, 18 (2008), 246-252.

[3] Castillo M. Quintero T., *"Pump efficiency and beam quality control in an end-pumped Cr:LiSAF laser"*, Laser Physics, 18 (2008), 625-631.

[4] H A Castillo-Matadamas, R M Lima-García and R Quintero-Torres, *Ultra fast nonlinear optical properties of TiO2 nanoclusters at 850 nm.* Próxima publicación, Journal of Modern Optics (2010).

Fr07

Femtosecond laser focus determination through its perturbation on an electric field.

Dr. Mayo Villagrán.
Centro de Ciencias Aplicadas y Desarrollo Tecnológico-UNAM.
Mexico City. Mexico.

Abstract

Laser-induced plasmas inside a capacitor cause a redistribution of electric charges between the plates. This efect is measured as a voltage drop through a resistor connected to the ground plate. In previous works we found that the amplitude of the signal was helpful for focusing nanosecond laser pulses onto a target, ref. [1]. In this work, this procedure was applied in order to determine the best focus of plasmas generated by femtosecond lasers. The result was corroborated by recording the noise amplitude of the shockwave generated by the plasma. The experimental setup used in this work was modified in order to have the maximum signal-noise ratio of the electrical signal. The variation of the intensity of the electrical signal as a function of the number of pulses impinging on the target is another important factor that must be taken into account in order to find the best focus.

[1] Bredice, F., D. Orzi, D. Schinca, M. Sobral, and M. Villagrán-Muniz, Characterization of pulsed laser generated plasma through its perturbation in an electric field," *IEEE Transactions on Plasma Science*, Vol. 30, No. 6, 2139{2143, Dec. 2002.

Fr08

Theoretical and experimental characterization of ultrashort pulses in the focal region of diffractive systems.

Dr. Martha Rosete.
Centro de Ciencias Aplicadas y Desarrollo Tecnológico-UNAM.
México City, Mexico.

Abstract:

In the ultrashort pulse laboratory of the Centro de Ciencias Aplicadas y Desarrollo Tecnologico at UNAM we have a Ti-Sapphire pulse laser that produces 200fs@800nm with a repetition rate of 76MHz. In the last four years we have studied the effects that produce the spatio-temporal spreading of pulses propagating through conventional optical systems: group velocity dispersion, propagation time difference and aberrations.

We will present theoretical work on the characterization of ultrashort pulses with durations of 10fs, 20fs and 200fs @810nm as well as some experimental results for 200fs pulses propagating through single and achromatic lenses of low numerical aperture. Basic concepts such as the group velocity, the group refractive index, the group velocity dispersion and the propagation time difference will be described. The pulses are analyzed at the focal region of the lenses by using both the geometrical approach and scalar diffraction theory. We will show that both the group velocity dispersion and the propagation time difference produce a large temporal spreading of sub-20fs pulses @810nm making the use of a phase reconfigurator and apochromatic optics necessary.

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