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691688 LASIG-TWIN: LASER IGNITION - A TWINNING COLLABORATION FOR FRONTIER RESEARCH IN ECO-FRIENDLY FUEL-SAVING COMBUSTION (http://www.lasig-twin.eu/)

The 5th LASER IGNITION CONFERENCE 2017 - LIC '17 -

Date:	20-23 June 2017
Organizer:	National Institute for Laser, Plasma and Radiation Physics Magurele 077125, Ilfov, ROMANIA
Location:	Hotel Novotel Bucharest City Centre, Calea Victoriei 37B, Bucharest 010061, ROMANIA

- ALL SESSIONS ARE LOCATED IN THE PARIS RIVE GAUCHE AMPHITHEATER UNLESS OTHERWISE INDICATED -

Tuesday, 20 June

13:00 - 17:00: **REGISTRATION.** LE FOYER

17:30 - 19:00 **WELCOME RECEPTION.** LE FOYER

Wednesday, 21 June

8:00 - 16:00 **REGISTRATION.** LE FOYER

8:30 - 9:30

W-S1: OPENING REMARKS and INTRODUCTORY SESSION

Presider: PAVEL Nicolaie; *National Institute for Laser, Plasma and Radiation Physics - INFLPR, Laboratory of Solid-State Quantum Electronics, Magurele, Romania*

- **Welcome Address LIC'17** BECKERT Erik*; Fraunhofer IOF, Jena, Germany*
- **Message for LIC'17** DASCALU Traian; *General Director of INFLPR, Magurele, Romania*
- **Message for LIC'17** TAIRA Takunori; *Institute for Molecular Science, Okazaki, Japan*
- **Message for LIC'17** LUPEI Voicu; *The Romanian Academy, Bucharest, Romania*
- **Message for LIC'17** TELEAGA Ioan; *Renault Technologie Roumanie, Romania*
- **Welcome Address LIC'17** PAVEL Nicolaie; *INFLPR, Magurele, Romania*

9:30 - 10:30

LWA1: PLENARY SESSION I

Presider: TAKUNORI Taira; *Institute for Molecular Science (IMS), Okazaki, Japan*

LWA1.1. Pollutant Emissions Reduction of Internal Combustion Engines by using Alternative Fuels and Enhanced Ignition Systems, CHIRIAC Radu; *Univ. Politehnica of Bucharest, Bucharest, Romania*

The researches performed for improvement of internal combustion engines performance using alternative fuels and enhanced ignition systems will be discussed. These approaches address the concerns about availability of petroleum derived fuels and pollutant emissions level.

10:30 - 10:45 **Break** *(coffee break)*

10:45 - 12:00

LWA2: DEVELOPMENTS IN LASER & LASER TECHNOLOGIES - APPLICATIONS IN LASER IGNITION - I -

Presider: WINTNER Ernst; *Vienna University of Technology, Vienna, Austria*

LWA2.1 • 10:45 - 11:15 (Invited)

Giant Micro-Photonics toward Innovative Ignition, TAIRA Takunori, *IMS, Okazaki, Japan*

Giant-pulse high-peak power, ceramic micro-laser has been identified as an ideal ignition source for internal combustion engines. Demonstration of the "world first micro-laser ignited self-consisted gasoline engine vehicle by micro solid-state photonics" has stimulated innovative laser ignition researches by Giant micro-photonics.

LWA2.2 • 11:15 - 11:30

Improvement the Optical-to-Optical Conversion Efficiency of Passively Q-switched Micro-laser Pumped by VCSEL Module, T. Ikeo[1], K. Hagita[1], Y. Ishikawa[1], Y. Higashi[1], N. Jikutani[1], T. Taira[2], T. Suzudo[1]; *[1]Ricoh Co., Miyagi, Japan; [2]Laser Research Center, IMS, Okazaki, Japan.*

The design of passively Q-switched micro-laser pumped by fiber coupled VCSEL modules was optimized, and an optical-to-optical conversion efficiency was improved to 19.0% from 10.1% by optimizing both cavity length and Cr:YAG initial transmittance.

LWA2.3 • 11:30 - 11:45

Multistage Amplification of Microchip Laser for Air Breakdown Experiments, V. Yahia, T. Taira; *Laser Research Center, IMS, Okazaki, Japan*

We report the development of a compact high power laser system based on the Master Oscillator Power Amplifier concept and the microchip laser technology. 200 MW Gaussian beam was obtained and used for generating air-breakdown.

LWA2.4 • 11:45 - 12:00

Study of a Laser Packaging Technique Simulated with ANSYS and VirtualLab Fusion Software, P. Ribes-Pleguezuelo[1,2], S. Zhang[2], E. Beckert[1], R. Eberhardt[1], F. Wyrowski[2], A. Tünnermann[1,2]; *[1]Fraunhofer Inst. for Appl. Optics & Precision Engineering, Jena, Germany; [2]Inst. of Appl. Physics, Friedrich-Schiller Univ. Jena, Jena, Germany*.

Mechanico-optical simulations performed with ANSYS and VirtualLab Fusion software to analyze stress-induced birefringence for the packaging of a laser ignition device by a low-stress soldering technique showed almost no influence on the laser output beam.

12:00 - 13:30 **Lunch** *(on your own)*

13:30 - 14:45

LWA3: DEVELOPMENTS IN LASER & LASER TECHNOLOGIES - APPLICATIONS IN LASER IGNITION - II -

Presider: DASCALU Traian; *INFLPR, Magurele, Romania*

LWA3.1 • 13:30 - 14:00 (Invited)

New Trends in Development of Compact and Stable UV Microchip Lasers, BHANDARI Rakesh, *Shimadzu Corporation, Japan*

We report the design and performance of compact UV microchip lasers for various applications. A novel free-space-beam pumping technique improves their performance and stability, while reducing the size and cost.

LWA3.2 • 14:00 - 14:15

Pulse-Width Scaling Law of Air-Breakdown for Laser Ignition Application, H. H. Lim, T. Taira; *Laser Research Center, IMS, Okazaki, Japan*

The change of pulse-width scaling law of air-breakdown threshold intensity at sub-nanosecond region is discussed for an optimum pulse-width for laser ignition. Timing of plasma creation depending on pulse-energy is also discussed.

LWA3.3 • 14:15 - 14:30

Model for the Polarization Dependence of Saturable Absorption Characteristics in Cr^{4+}:YAG, Y. Sato, T. Taira; *Laser Research Center, IMS, Okazaki, Japan*

We theoretically proposed the practical notation for the saturable absorption in Cr^{4+}:YAG in terms of the polarization angle. This model was examined by use of (110)-cut Cr^{4+}:YAG with the initial transmittance of 75%.

LWA3.4 • 14:30 - 14:45

Direct Bonding of Crystalline Components for Application in High Power Laser Systems, C. Rothhardt[1], S. Risse[1], T. Schreiber[1], R. Eberhardt[1], J. Rothhardt[2,3], J. Limpert[1,2,3], A. Tünnermann[1,2,3]; *[1]Fraunhofer Inst. for Appl. Opt. & Precision Engineering, Jena, Germany; [2]Inst. Appl. Phys., Friedrich-Schiller Univ. Jena, Jena, Germany; [3]Helmholtz Inst., Jena, Germany*

Accumulated heat within optical crystals, like TGG or BBO, leads to unfavorable thermal lensing or even destruction. We propose distributing the heat by mechanically stable contacting the optical materials with transparent heat conductors (i.e. sapphire).

14:45 - 15:00 **Break** *(coffee break)*

15:00 - 16:30

LWA4: **ADVANCED IGNITION SYSTEMS FOR TRANSPORTATION APPLICATIONS - I -**

Presider: BRÜGGEMANN Dieter; *Univ. Bayreuth, Bayreuth, Germany*

LWA4.1 • 15:00 - 15:30 (Invited)

Laser and Spark-Plug Ignitions in High-Speed Flows, ENDO Takuma, *Inst. of Engineering, Hiroshima Univ., Hiroshima, Japan*

Laser ignition and spark-plug ignition were experimentally compared in high-speed flows of up to approximately 100 m/s. The flame-spread behavior and ignition ability were examined in lean-fuel conditions. The laser ignition was superior to the spark-plug ignition in the aspect of rapid flame spread, although the laser ignition showed lower probability of successful ignition than the spark-plug ignition near the lean ignitable limit.

LWA4.2 • 15:30 - 15:45

Influence of Laser Incident Energy and Focal Length on Multi-Point Laser Ignition in an Internal Combustion Engine at N_2 Dilution, T. Saito[1], T. Sugaya[1], E. Takahashi[2], H. Furutani[3]; *[1]Meisei Univ., Tokyo, Japan; [2]Research Institute for Energy Conservation, AIST, Tsukuba, Japan; [3]Renewable Energy Research Center, AIST, Koriyama, Japan.*

This study investigated the influence of the laser incident energy on combustion state and engine performance. The influence of the beam waist was also investigated by changing the focal length at the same ignition position.

LWA4.3 • 15:45 - 16:00

Laser Ignition of a Gasoline Engine Automobile, N. Pavel[1], A. Birtas[1,2], G. Croitoru[1], M. Dinca[1,3], N. Boicea[2], Traian Dascalu[1]; *[1]INFLPR, Magurele, Romania; [2]Renault Tech. Roumanie, Voluntari, Romania; [3]Fac. of Physics, Univ. of Bucharest, Magurele, Romania*

A Renault vehicle with gasoline indirect injection engine was fully operated with laser spark plugs that were build using high-peak power passively Q-switched Nd:YAG/Cr^{4+}:YAG lasers. Some engine performances were measured at various speeds and loads.

LWA4.4 • 16:00 - 16:30 (Invited)

Requirement Time and Space for Laser Ignition under Fuel Lean Premixed Mixture, HAYASHI Jun, N. Nakatsuka, I. Morimito, F. Akamatsu; *Dept. Mech. Engineering, Osaka Univ., Japan.*

Temporal and spatial scale of laser ignition is discussed in this presentation. Required time and space for ignition are obtained from experimental results of laser ignition of lean premixed mixture in the constant volume chamber.

16:30 - 17:30

LWA5: POSTER SESSION / SPONSORS DISCUSSION. FOYER

Presider: BÄRWINKEL Mark; *Univ. Bayreuth, Bayreuth, Germany*

LWA5.1. Physical Properties of an Atmospheric Pressure Filamentary Plasma Discharge, M. Teodorescu, E. R. Ionita, B. Mitu, G. Dinescu; *INFLPR, Magurele, Romania*

The properties of an atmospheric pressure discharge generated using radiofrequency in a small space are discussed. The physical aspects such as gas flow, forwarded power and operating parameters are investigated, showing their dependences on each other. The results point out to the stability of such a long plasma discharge in ambient air.

LWA5.2. Withdrawn

LWA5.3. Withdrawn

LWA5.4. Nd^{3+}:YAG Ceramic Materials with Efficient Laser Emission under Diode-Laser Pumping, I. O. Vorona[1], R. P. Yavetskiy[1], A. G. Doroshenko[1], S. V. Parkhomenko[1], A. V. Tolmachev[1], L. Gheorghe[2], M. Greculeasa[2], C. Gheorghe[2], S. Hau[2], C. Brandus[2], G. Croitoru[2]; *[1]Inst. of Single Crystals of NAS, Kharkov, Ukraine; [2]INFLPR, Magurele, Romania*

Nd:YAG transparent ceramics were fabricated by reactive sintering. The influence of dopant concentration on optical and luminescence properties of ceramics was studied. Slope efficiency of 58% during laser emission at 1.06 µm was achieved from 2.0-at.% Nd:YAG.

LWA5.5. Laser Gain Transparent Ceramics Media, G. Stanciu, C. A. Stanciu, C. A. Brandus, F. M. Voicu, T. Dascalu; *INFLPR, Magurele, Romania*

The main research of this study was focused on synthesis of laser materials based on Nd^{3+}:YAG and Sm^{3+}:YSAG transparent ceramics by solid-state reaction and vacuum sintering method, with high absorption and low residual diffusion.

LWA5.6. Epitaxially Grown Magnetic Garnet Film on Nd:YAG Substrate for Microchip Lasers, R. Morimoto[1], T. Goto[1,2], H. Takagi[1], Y. Nakamura[1], P. B. Lim[1], T. Taira[3], H. Uchida[1], M. Inoue[1]; *[1]Toyohashi Univ. of Technology, Toyohashi, Japan; [2]JST PRESTO, Kawaguchi, Japan; [3]IMS, Okazaki, Japan*

~0.8 µm thick rare-earth substituted iron garnet films were grown on single crystalline Nd:YAG substrates using pulsed laser deposition for integration of active magneto-optical Q-switches with microchip lasers.

LWA5.7. Development of Laser Ignited Hydrogen Fueled Supercharged Engine, R. K. Prasad, A. K. Agarwal; *Indian Inst. of Technology, Kanpur, India*

In this study, a prototype single cylinder engine (capacity 948cc) was fuelled with H_2 in both naturally aspirated (NA) as well as in supercharged (SC) conditions and ignited with the help of spark ignition (SI) and laser ignition (LI) respectively.

LWA5.8. Acoustic Emission after Laser Irradiation in SiO_2, SiO_2 + Si and Automated System "KERN-DP",
A. P. Onanko, G. T. Prodayvoda, Y. A. Onanko; *Kyiv National Univ., Kyiv, Ukraine*
Effects of acoustic emission after laser thermal-mechanical strains in fluid SiO2, SiO_2 + Si are investigated. The broadening of internal friction maximums represents the relaxation process of structural defects new types.

LWA5.9. Aspects of Air-Breakdown with a High-Peak Power Passively Q-Switched Nd:YAG/Cr^{4+}:YAG Laser,
G. Croitoru[1], O. V. Grigore[1], M. Dinca[1,2], N. Pavel[1], M. Bärwinkel[3], P. Heinz[3], D. Bruggemann[3]; *[1]INFLPR, Magurele, Romania; [2]Fac. of Physics, Univ. of Bucharest, Magurele, Romania; [3]Univ. of Bayreuth, Bayreuth, Germany*
A passively Q-switched Nd:YAG/Cr^{4+}:YAG laser is used to investigate the air breakdown in a static chamber. The laser pulse characteristics are measured and the energy transfer from pulses to plasma is evaluated. As the air pressure increases in the chamber the amount of transferred energy increases.

LWA5.10. 6.3 eV DUV Generation Based on Microchip Nd:YAG Laser, Yuji Oki[1], Takashi Ohe[2], Hiroaki Yoshioka[1], Koji Kosaka[2], Takaaki Kanemaru[1]; *[1]Kyushu Univ., Fukuoka, Japan; [2]TCK In., Fukuoka, Japan*
Deep ultraviolet light source using passively Q-switch Nd:YAG laser was proposed and designed for soft laser ablation on scanning electron microscopic application. Design wavelength is from 193 nm to 196.7 nm that exceeds 6.3 eV in photon energy for chemical dissociation of organic sample. Frequency mixing of 4th harmonic beam and optical parametric generated red beam are adopted by using flux-less BBO crystal. Initial design of BBO and PPLN-OPG has been performed.

18:00 - 20:00CONFERENCE DINNER. Hotel Novotel Bucharest City Centre (RESTAURANT TEATRO)

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  The Laser Society of Japan — http://www.konpon.com/
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- Shimadzu Co. — http://www.shimadzu.com/

Thursday, 22 June

8:00 - 16:00 **REGISTRATION.** LE FOYER

8:30 - 9:30

LThA1: PLENARY SESSION II

Presider: BECKERT Erik; *Fraunhofer IOF, Jena, Germany*

LThA1.1. The Evolution of Laser Ignition over Four Decades, WINTNER Ernst, *Vienna Univ. of Technology, Vienna, Austria*

Laser spark ignition of reactive gases was first attempted in 1969; one decade later first engine tests were achieved. Several concepts for an ignition scheme including fiber transportation of ns pulses were pursued successfully. A number of different prototypes, mostly Nd:YAG lasers, transversally or longitudinally, directly or fiber-transmission pumped were developed. Studies have shown that the problem of window failing can be avoided. The temperature management for the solid-state as well as the diode lasers still represents major problems in laser ignition of car engines to date.

9:30 - 10:30

LThA2: DEVELOPMENTS IN LASER & LASER TECHNOLOGIES - APPLICATIONS IN LASER IGNITION - III -

Presider: BHANDARI Rakesh; *Shimadzu Corporation, Kanagawa, Japan*

LThA2.1 • 9:30 - 10:00 (Invited)

Power Scaling and Wavelengths Coverage of VECSEL, GUINA Mircea, J.-P. Penttinen, A. Rantamäki, E. Kantola*; Tampere Univ. of Technology, Tampere, Finland*

The main concepts and recent results underpinning the rapid development of vertical-external-cavity surface-emitting lasers (VECSELs) are reviewed. In particular, we focus on developments addressing new wavelength domains and emerging applications.

LThA2.2 • 10:00 - 10:15

Ignition and Stabilization of a Premixed Methane/Air Flame with Repetitive Laser-Induced Plasmas, Xiahui Li[1,2,3], Y. Yu[1,2], X. An[1,2], X. Yu[1,2], D. Chen[1,2], R Sun[3]; *[1]Nat. Key Lab. of Science & Techn. of Tunable Lasers, Harbin Inst. of Techn., Harbin, China; [2]Inst. of Opto-Electron., Harbin Inst. of Techn., Harbin, China; [3]Inst. of Combustion Engineering, Harbin Inst. of Techn., Harbin, China;*

Laser-induced plasma ignition of a premixed methane/air flame was investigated with different repetition rates. Flame stabilization in terms of flame kernel catch-up was achieved. Temporal evolution of the flame kernels at different repetition rates was investigated.

LThA2.3 • 10:15 - 10:30

Laser Ignition of Atomized Ethanol-Air Mixture by Low Energy Laser Pulses, A. P. Singh, U. P. Padhi, R. Joarder; *Indian Institute of Technology, Kharagpur, India*

The atomized ethanol-air mixture will be ignited by low energy laser pulses, with a control over the time of occurrence of the air breakdown and the injection of the fuel-air mixture. The ignition and subsequent flame kernel development will be observed with a high-speed camera.

10:30 - 10:45 **Break** *(coffee break)*

10:45 - 12:00

LThA3: LASER IGNITION SYSTEMS FOR STATIONARY NATURAL GAS ENGINES - I -

Presider: KROUPA Gerhard; *Carinthian Tech. Research, Villach, Austria*

LThA3.1 • 10:45- 11:15 (Invited)

Performance of Laser and Spark Ignition Systems in a Reciprocating Natural Gas Engine, B. Almansour[1], S. Vasu[1], Q. Wang[2], R. V Leeuwen[2], GUPTA Sreenath[3], B. Bihari[3]; [1]*University of Central Florida, Orlando, FL, USA*; [2]*Princeton Optronics, Inc., NJ 08619, USA*; [3]*Argonne Nat. Lab., Argonne, IL, USA*

Results from single-cylinder engine tests comparing three ignition systems - Spark Ignition (SI), Laser Ignition (LI), and Prechamber Laser Ignition (PCLI) – will be presented. Insights into the exceptional performance of PCLI will be presented.

LThA3.2 • 11:15 - 11:30

Noise Robust Acoustic Signal Processing Using a Wavelet Packet Decomposition Approach for Detection and Characterization of Laser Induced Breakdown, J. Griffiths, J. Grebenik, A. Kirk; *Univ. of Lincoln, Lincoln, UK.*

Wavelet packet decomposition is used to de-noise acoustic signals from optical breakdown in a high noise, engine-like environment. Individual breakdown events are resolved and their consistency is used to characterize the operating conditions.

LThA3.3 • 11:30 - 12:00 (Invited)

Laser Ignition of Hydrogen Enriched Compressed Natural Gas (HCNG) Fueled Supercharged Engine, AGARWAL Avinash Kumar; *Indian Inst. of Technology, Kanpur, India*

The effect of enriching CNG with H_2 on engine combustion, performance and emissions was investigated using a prototype single-cylinder supercharged engine at naturally aspirated and supercharged operating conditions and using spark ignition and laser ignition.

12:00 - 13:30 **Lunch** *(on your own)*

13:30 - 14:30

LThA4: LASER IGNITION IN AEROSPACE APPLICATIONS

Presider: BÖRNER Michael; *German Aerospace Center - DLR, Hardthausen, Germany*

LThA4.1 • 13:30 - 14:00 (Invited)

Laser Ignition for Space Applications using a Rugged and Highly Miniaturized Nd:YAG Laser System, KROUPA Gerhard[1], G. Bruckner[1], N. Rackemann[2], S. Soller[2]; [1]*Carinthian Tech. Research, Villach, Austria;* [2]*Airbus Safran Launchers GmbH, Munich, Germany*

A summary on the development history of the CTR HiPoLas ignition system is given and performance data of the latest generation including testing under harsh environmental conditions is shown.

LThA4.2 • 14:00 - 14:15

Determination of the Minimum Laser Pulse Energies for Ignition in a Subscale Rocket Combustion Chamber, M. Börner[1], J. C. Deeken[1], C. Manfletti[2], M. Oschwald[1]; [1]*Inst. for Space Propulsion - DLR, Hardthausen, Germany;* [2]*European Space Agency, Paris, France*

The minimum laser pulse energy for ignition is determined and compared for two injection concepts and ignition locations for CH_4/O_2 and H_2/O_2 in a subscale rocket engine combustion chamber.

LThA4.3 • 14:15 - 14:30

Study of Two Nanosecond Laser Systems for Ignition of Aeronautic Combustion Engines, G. Amiard-Hudebine[1,2], G. Tison[1,2], P. Beaure d'Augères[3], J. Didierjean[3], M. Orain[4], E. Freysz[1,2]; *[1]Laboratoire Ondes et Matière d'Aquitaine, Université de Bordeaux, France; [2]CNRS, LOMA, Talence, France; [3]Fibercryst, Decines Charpieu, France; [4]ONERA - The French Aerospace Lab Centre du Fauga, Mauzac, France*

We have studied and developed two compact nanosecond lasers delivering up to 11 mJ, TEM_{00} and linearly polarized nanosecond pulses centered at 1064 nm. Their use in ignition of a prototype of aeronautic combustion engine is presented.

14:30 - 15:00

LThA5 PRE-TOUR PRESENTATION

LThA5.1: **New Research Perspectives at Extreme Light Infrastructure - Nuclear Physics**, UR Calin; *Head of Research Activity 2 'High-Brilliance Gamma Beam', ELI-NP/IFIN-HH, Romania*

A new research field at the frontier between nuclear and laser physics is being established at the ELI–NP facility. With two highly technological advanced photon beam systems, a 2×10 PW high power laser system and a high brilliance gamma beam system, ELI–NP offers unique possibilities to uncover a broad range of key topics in frontier fundamental physics and innovative applications.

15:00 - 15:30 PHOTO SHOOT (CONFERENCE ROOM)
and
Break with
POSTER SESSION / SPONSORS DISCUSSION. LE FOYER

15:30 - 18:00 **LABORATORY TOUR EVENT**
VISIT OF EXTREME LIGHT INFRASTRUCTURE - NUCLEAR PHYSICS (ELI - NP), Magurele, Romania

18:30 - 20:30 **SPONSORED CONFERENCE DINNER. Hotel Novotel Bucharest City Centre** (RESTAURANT TEATRO)

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• Shimadzu Co.	http://www.shimadzu.com/

FRIDAY, 23 June

8:00 - 12:00 **REGISTRATION.** LE FOYER

8:30 - 9:30

LFA1: PLENARY SESSION III

Presider: ZIMMER Laurel; *CNRS, Châtenay-Malabry, France*

LFA1.1. Nonequilibrium Plasma-Assisted Combustion: Advanced Spectroscopic Methods for Fundamental Studies, Gabi Daniel STANCU, S. Stepanyan, C. O. Laux; *CentraleSupélec, Paris, France*

Non-equilibrium plasmas have strong potential to enhance performance of combustion systems due to generation of large numbers of reactive species. Kinetic and dynamic fundamental studies using advanced spectroscopic diagnostics are presented.

9:30 - 10:45

LFA2: MEASUREMENTS TECHNIQUES FOR INDUCED PLASMAS, IGNITION AND COMBUSTION PROCESSES - I -

Presider: DEARDEN Geoffrey; *Liverpool University, Liverpool, UK*

LFA2.1 • 9:30 - 10:00 (Invited)

Application of Laser Induced Ignition Interferometry and Plasma Spectroscopy (LI3PS) to Spray Ignition, ZIMMER Laurent; *CNRS, Laboratoire d'Energétique Moléculaire et Macroscopique, Combustion (EM2C), Châtenay-Malabry, France*

Different measurement techniques are developed to help understanding the ignition phenomena of practical aeronautical combustion chamber. They allow having instantaneous information on the local equivalence ratio within each sparks. Using Laser Ignition, it is also possible to have direct measurements of droplets interacting with the laser pulse and measure their position in 3D, as well as their actual size. Using high-speed approach with Mie scattering images, it is possible to understand the dynamics of the spray under an initial flame kernel development. Using simultaneously all those techniques can provide useful information on conditionally resolved events.

LFA2.2 • 10:00 - 10:15

Laser Ignition in Flowing Air-Fuel Mixture, E. Takahashi; *Natl. Inst. of Adv. Industrial Sci. & Tech., AIST, Japan*

Influence of the flow of air-fuel mixture on laser ignition in a high-pressure environment was studied. It was found that the lean ignition limit of laser ignition was reduced by the flow.

LFA2.3 • 10:15 - 10:45 (Invited)

Application of an Analytical Laser Ignition Model to Liquid Rocket Engines, KAESS Roland, S. Soller, B. Mewes; *Airbus Safran Launchers GmbH, Munich, Germany*

The article describes an analytical model for the laser ignition of rocket engines and the application to a hydrocarbon gas generator. The model assesses the laser power density required for plasma breakthrough and the amount of energy required and available for ignition. As combustion devices in rocket engines operate in a non-premixed way and under high propellant velocities, CFD is used to examine the local parameters present in the domain and to find a suitable spot for the laser focus.

10:45 - 11:00 **Break** *(coffee break)*

11:00 - 12:15

LFA3: JOINED SESSIONS A & B

Presider: MANFLETTI Chiara; *European Space Agency, Paris, France*

LFA3.1 • 11:00 - 11:30 (Invited)

Impact of Turbulent In-Cylinder Air Motion and Local Mixture Formation on Inflammation in Lean Engine Operation: Is Multiple Point Ignition a Solution? GRZESZIK Roman; *Robert Bosch GmbH, Renningen, Germany*

Results of in-cylinder optical diagnostics showed the limitation of one point ignition systems for gasoline engines. A three point ignition system is used to improve the lean operation limit thus decreasing fuel consumption and NOx-emissions.

LFA3.2 • 11:30 - 11:45

Interferometric Density Measurements in Laser-Induced and Spark Discharge Plasmas, N. D. Peters[1], S. Gupta[2], B. Akih-Kumgeh[1]; *[1]Syracuse Univ., Syracuse, USA; [2]Argonne Nat. Lab, Argonne, USA*

The early phase of laser and spark ignition is investigated using two color interferometry. The measurements yield electron and neutral number densities. They also reveal differences in the two types of plasma generation.

LFA3.3 • 11:45 - 12:00

Passively Q-switched Laser Ignition: Influence of Focusing Properties on the Combustion of Lean Methane-Air Mixtures, M. Bärwinkel, S. Lorenz, D. Brüggemann; *Univ. of Bayreuth, Bayreuth, Germany*

The influence of focusing properties on the flame kernel development and combustion characteristics is investigated by the application of a passively Q-switched laser ignition system. Focal point properties are varied by changing the distance of the lenses in the focusing line.

LFA3.4 • 12:00 - 12:15

Combustion Characteristics of a Gasoline-Air Mixture Laser Ignition, A. Birtas[1], N. Boicea[1], G. Croitoru[2], M. Dinca[2,3], T. Dascalu[2], N. Pavel[2]; *[1]Renault Tech. Roumanie, Voluntari, Romania; [2]INFLPR, Magurele, Romania; [3]Fac. of Physics, Univ. of Bucharest, Magurele, Romania*

Characteristics of fuel-air mixture combustion in a naturally aspired spark-ignition engine with indirect injection that was ignited by classical spark plugs and by laser sparks are presented. Differences between the durations of combustion are discussed.

12:15 - 14:00 **Lunch** (on your own)

COMMITTEE MEETING. CANNES HALL

14:00 - 15:15

LFA4: JOINED SESSIONS C & D & E

Presider: GUPTA Sreenath; *Argonne National Laboratory, Argonne, IL, USA*

LFA4.1 • 14:00 - 14:30 (Invited)

Future Space Transportation, Propulsion Systems and Laser Ignition. Chiara MANFLETTI, *European Space Agency, Paris, France*

The development of future space transportation systems poses new design challenges also affecting the ignition system. For these challenges, laser ignition could be an alternative to the existing technologies.

LFA4.2 • 14:30 - 14:45

Laser-Induced Breakdown Spectroscopy on the Ignition Spark of a Cryogenic Rocket Combustion, R. Stützer, M. Börner, M. Oschwald; *Inst. for Space Propulsion - DLR, Hardthausen, Germany*

Ignition sparks of cryogenic rocket combustions were investigated using laser-induced breakdown spectroscopy. Ignition and combustion performance were deduced and local equivalence ratio from within the plasma volume of the ignition spark has been determined.

LFA4.3 • 14:45 - 15:15 (Invited)

Laser Ignition Application to Cryogenic Propellant Rocket Thrust Chambers, SOLLER Sebastian[1], N. Rackemann[1], G. Kroupa[2]; [1]*Airbus Safran Launchers GmbH, Munich, Germany;* [2]*Carinthian Tech. Research, Villach, Austria.* The experimental activities performed at Airbus Safran Launchers demonstrate the use of a laser-based ignition system in cryogenic liquid rocket engine while taking into account the typical requirements and constraints of a flight mission.

15:15 - 15:45

F-F1: **ROUND TABLE DISCUSSION: Challenges of Laser Ignition; Present and Future**

Presider: BECKERT Erik; *Fraunhofer IOF, Jena, Germany*; WASHIO Kunihiko*; Paradigm Laser Research Ltd., Tokyo, Japan*

15:45 - 16:00 **Break**

16:00 - 17:00

F-S7: **CLOSING SESSION**

- AWARDS PRESENTATION
  - The Best Paper Award
  - Young Scientist Award
  - The Best Poster Presentation
- SUMMARY OF LIC'17. PAVEL Nicolaie
- ANNOUNCEMENT OF LASER IGNITION CONFERENCE 2018 (LIC '18). TAIRA Takunori

---------- **CONFERENCE END** ----------

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