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COMSATS PHYSICS TODAY

DEPARTMENT OF PHYSICS COMSATS INSTITUTE OF INFORMATION TECHNOLOGY LAHORE DEFENCE ROAD
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UAN: 111-100-007 FAX NO: 042-9203100

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Head's Message

If we look at the energy crises in Pakistan ,an intellectual mind would think of finding an alternate source of energy ,other than hydroelectric ,petroleum or nuclear energy, all above ,either expensive or dangerous. Since we have very little petroleum, we have to look elsewhere. When we look into solar energy option ,it is also expensive and not feasible on large scale. Then we are left with only two options ,one is coal which we have more than 175 billion ton which is proven to be one of the largest coal reserve in the world and second is the wind energy. For coal ,we need lot of engineers and infrastructure to extract and process that coal for use which is a long term project. At present, this does not seem to be practicable under the stressful economic conditions prevailing in the country. Now the only option left is the power generation by air. Since Punjab is a flat land, air currents are not strong enough to drive wind turbine. In this perspective, a new idea is floated, to generate electricity at high altitude level ranging from 300ft to 1000ft. At this level, wind speed is sufficient to generate energy. The power generator can be uplifted in the air by Helium gas balloon and we are gratified to announce that Physics Department CIIT Lahore is working on this concept. I pray to Allah Almighty that this project may meet success and in due course of time, become a huge contribution to resolve the energy crises in our dear country may be from CIIT platform.

Dr. Syed Javaid Iqbal

News & Events

Air Born Wind Electric Generator

A wind energy project of Department of Physics CIIT Lahore.

The Physics Department is working on a wind energy project namely Air Borne Wind Electric Generator .The project is directly headed by Dr. Syed Javaid Iqbal Head Department of Physics CIIT Lahore.

Two balloons of diameter 12 feet and 10 feet respectively have been purchased. These balloons will be used to test practical feasibility of air borne power project. The practical feasibility will be tested within few weeks. In near future, a prototype air borne wind power electric generator will be launched in which balloon it self will act as a rotor. Similar model being developed by a Canadian based company which is already selling this type of technology. Our future prototype model will resemble as shown in the picture below. This type of system will address the small scale power needs for the people in villages including farmers. Actual model will provide about 5 to 10 kilowatt power which is enough to run a tube well or electricity of few houses using energy saving bulbs.

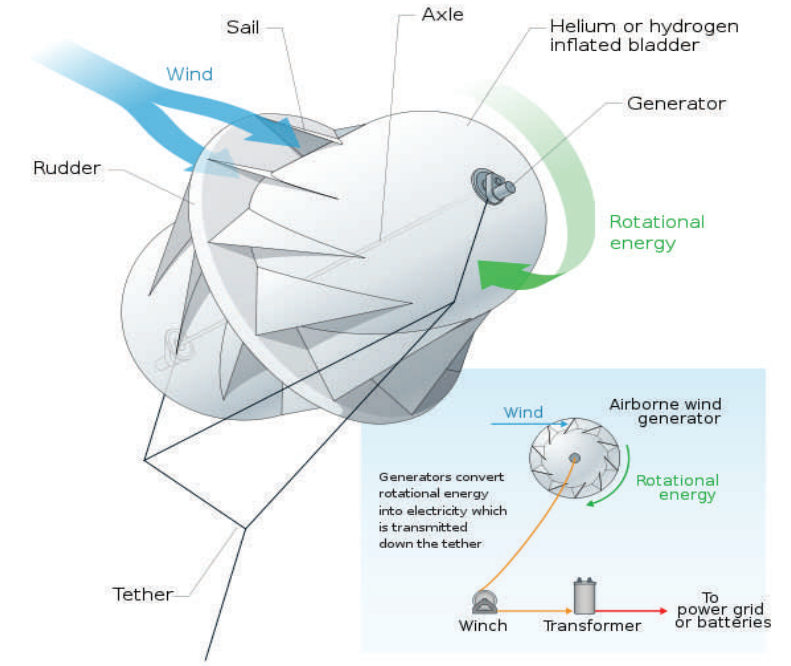
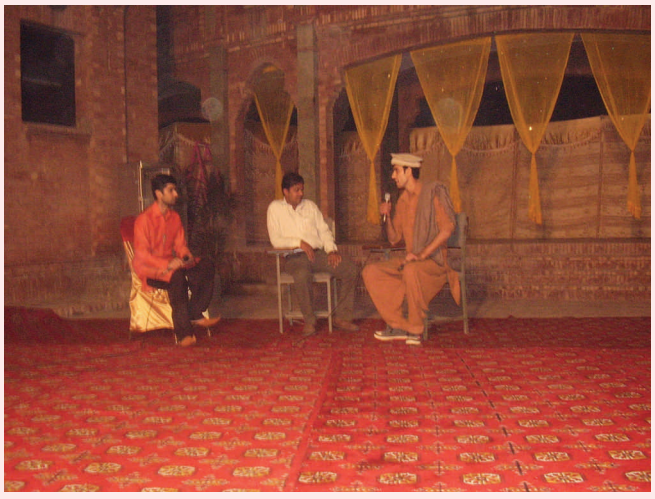


Image taken from wikipedia

Welcome Party

A welcome party was arranged by the senior BS-Physics batches for the junior most batch 5 on the beautiful evening of November 4, 2009 at the Campus . The event was graced by the presence of worthy Director Dr. Shaukat Ali Hayat , Dr. Ghulam Qanber Abbasi (HoD Mathematics) Dr. Moin-ud-Din Ghuari (Chairman Chemical engineering). The students presented beautiful skits to amuse the audience. Some of the skits were prepared in the scenario of ongoing terrorism situation in the country. The passion and theme reflected the patriotism of the youth which is undoubtedly a great asset for the country. The students had also arranged some interesting games in which they invited the faculty members to participate.The function ended with a dinner. CIIT Director, Dr. Shaukat Ali Hayat encouraged the faculty and the students to be more vibrantly participative in organizing healthy activities to promote quality academic and extracurricular activities in the Campus.

Memorable glimpses of Welcome Party



BS Physics Super Six Cricket Tournament

A cricket tournament of all BS-Physics Batches was arranged under the supervision of Shehzada Qamer Hussain Lecturer (Physics) A cricket tournament named "BS Physics Super Sixes Tournament" was played in CIIT Cricket ground on 21st and 24th of November 2009. Six teams participated in the event. Five teams were taken from five batches and a faculty team. There were two groups named A & B. Teams of Batch 3, 4 and faculty were in group A whereas the teams of Batch 1, 2, 5 were in group B. The six side matches were played on Saturday, 21st 2009. At the end of six side matches four teams (Batch 1, 2, 3, and 4) were advanced for the next level. Two semifinals were played on 24th, November 2009. Batch 1 won the first semifinal match whereas Batch 3 won the second semifinal . The final match was won by batch 1

At the end of Final match, faculty distributed the prizes and trophies to the winner and runner up teams. Mr. Elahi Bakhs(batch 3) and Anas Farooqi(batch 1) were declared as the Man of the series whereas Mr. Bilal(batch 1) was declared man of the match.

Faculty Research Publications During The Year 2009

1. ASHFAQ AND J. STAHN, Some improvement in Fe/Si multilayered neutron polarizer by modified sputtering geometry, Applied Surface Science, 255 (2009) 5902-4
2. A. ASHFAQ AND J. STAHN, Study of mono/multi layers fabricated via modified aperture sputtering, submitted to Br. J of Physics (2009)
3. Abdul Rashid, Lars Landstrom and Klaus Piglmayer "Excimer-Laser Surface Processing in CH2I2 Atmosphere: Simultaneous Localized Etching of Si and Deposition of C"
4. Rashid, L. Landstrom, D. Brodoceanu, K. Piglmayer "Lamp-assisted CVD of carbon micro/nano-structures using metal catalysts and CH2I2 precursor" Appl. Surf. Sci. 255, 5368-5372 (2009), Holland. [*I.F = 1.406*]
5. M. Asif, "Relationship between current density and mass density for ohmic tokamak plasmas". Int. J Mod. Phys. B 22 (2008) 5329.
6. M. Asif, A. Afaq, J. Ali and R. A. Rahman B. A. Tahir, A. Rashid, "Effect of Laser and Mechanical Parameters on Strength of Fiber Bragg Gratings" Int. J Mod. Phys. B. 23 (2009) 77
7. M. Asif, "Large-Aspect Ratio MHD Equations for Toroidal Plasmas" Int. J Mod. Phys. B. 23 (2009) 2463.
8. Muhammad Ashfaq Ahmad and Shutian Liu, "Superposition of two coherent states $\pi/2$ out of phase with average photon number as relative phase", Optik. 2009, 120: 68-73. (SCI, IF = 0.507)
9. Salman Naeem Khan, Zhang Shuai, Sailing He, "Low profile and compact size coplanar UWB antenna working from 2.8 GHz to over 40 GHz", *Microwave and optical Technology letters*, Vol. 51, Issue 2, 408-411, February 2009. (IF=0.743)
10. Dr. Syed Javaid Iqbal "Phase shift keying optical communication by mach zehnder technique using single laser ", Journal of Industrial Technology Vol. 18 No. (2) 2009.

Scholarships, Honors & Awards

1. Mr. Noman Ahmad Khan (Lecturer) has been awarded Scolarship for MS leading to PhD studies at-Lancaster University UK by COMSATS under "Faculty Development Program"
2. Mr. Kaleem Ullah (Lecturer) has been awarded CIIT scholarship for MS (Physics) studies at CIIT Lahore.
3. Dr. Ashfaq Ahmad Associate Professor (Physics) CIIT, Lahore have been nominated as International Educator of the Year for 2009 by Director General, International Biographical Centre, England, vide ref. IEY/inv dated 7th August 2009

Many congratulations to all of them and we wish them all the best of luck for their future endeavors .

Faculty Participation In International Conferences And Foreign Visits During The Year 2009

1. Dr. Muhammad Asif, Assistant Professor, Department of Physics, has participated in the "Summer College on Plasma Physics, 10-28 August 2009, Trieste, Italy.
2. Dr. Muhammad Asif, Assistant Professor, Department of Physics, has participated in the "12th International Workshop on H-mode Physics and Transport Barriers", September 29-October 2, 2009, at the U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL), James Forrestal Campus, and Princeton, NJ 08543-0451.
3. Dr. Salman Naeem Khan, Assistant Professor visited Department of Physics, Suzhou University, Suzhou China in the month of August and September. He worked with the quantum optics group and did some experiments in anechoic chamber to measure the radiation performance of different Antennae.

Research Corner

Laser Matter Interaction

By Mahrukh Bokhari

When lasers were invented in 1960, they were called "a solution looking for a problem".[1] Since then, they have become popular everywhere, finding utility in thousands of highly varied applications in every section of modern society, including consumer electronics, information technology, science, medicine, industry, law enforcement ,entertainment, and the military [1]. The interaction of intense laser light with matter has been an active topic in the field of plasma and atomic physics for more than 15 years. During this period, an amazingly rich diversity of plasma conditions has been investigated. The key to understanding physics in these interactions is to realize that ordinary matter whether solid, liquid or gas will be rapidly ionized when subjected to high intensity irradiation. These interactions depend on:

- Nature of material. (Chemical composition)
- Laser parameters. (Wavelength of the radiations etc)
- Ambient conditions. (Pressure of the residual gas in the plasma chamber)

As a consequence of the laser-matter interaction, the ejected material is in a plasma state. This is usually referred to as Laser-produced plasma as shown in figure 1 (a) & 1(b)

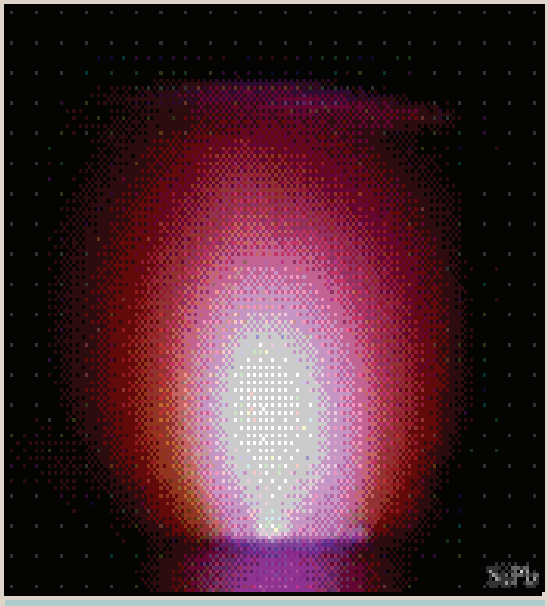


Fig: 1 (a) laser produced plasma plume (Image courtesy) www.engineering.leeds.ac.uk

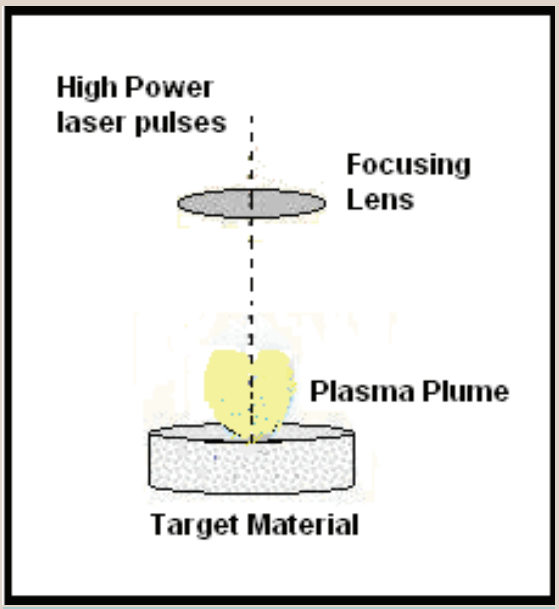


Fig: 1 (b) Mechanism of laser produced plasma (Image courtesy) www.engineering.leeds.ac.uk

When a powerful laser pulse is focused on a surface, a tiny amount of the material is vaporized and through further photon absorption it is heated up until it ionizes and expands from sample surface as plasma cloud. In fact the plasma ignition is caused by the generation of a large concentration of electrons (n_e ~ 10^{13} to 10^{15} cm^{-3}) above the surface due to thermionic emission before or during vaporization. Plasma has maximum density of excited species near the target surface (Knudsen layer). Knudsen layer is a thin layer between liquid and vapor [2]. Laser produced plasma have been used in wide ranging fields of investigations. Like LIBS (laser induced breakdown spectroscopy) which is particularly used for detecting metals in the soil, Plasma as a source of radiation (X-rays, particles), Inertial Confinement fusion, Medical diagnostics and surgery, Thin film Deposition, X-ray Spectroscopy. When laser interacts with matter, it normally changes its properties, this is known as ablation

Let us have a look at different interaction and feedback mechanisms involved in studying laser-matter interaction and how different types of ablations are produced in the matter as a result. The process is initiated with single photon or multi-photon material excitation. If the excitation energy is instantly transformed into heat, the rise in temperature causes variation in the optical properties of the materials and thereby the absorbed laser power. This temperature rise may lead to thermal material ablation with or without surface melting. The temperature rise also induces stresses which can be so high that explosive-type ablation or material pop-off is observed. Likewise, thermally induced defects can contribute a lot to laser absorption and thereby to changes in optical properties. Overall, this mechanism is termed as photo thermal ablation [3]. If the photon energy is high enough, laser light excitation can result in direct bond breaking. As a consequence, single atoms, molecules, clusters or fragments desorbs from the surface. This process takes place without any change in the surface temperature. Therefore, it can be conveniently termed as photochemical ablation[4]. Now, how these ablations are produced in the material, let us have a look at atomic level. When a laser pulse strikes a solid surface ,the surface will absorb its energy. If the energy absorbed is greater than the binding energy of the atom the atom will be removed from the surface and the material is said to be ablated. In order to remove an electron from this mechanism this energy must be greater than the Fermi (highest) energy level of the electron.The rate of ablation depends upon average laser intensity

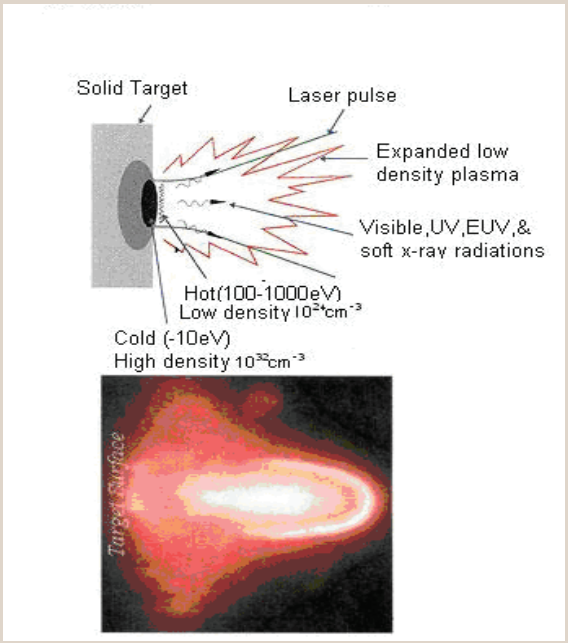


Fig: 3 The Formation of a laser produced plasma (Image courtesy) www.webpages.dcu.ie

the surface. The average intensity used for ablation is above $10^{13}W/cm^2$.

One can distinguish between various kinds of ablation on the basis of the following arguments. First, we recall that the fundamental interaction of light with matter involves the following physical processes. The incident laser radiation first penetrates the target and induces oscillations of the optical electrons[5].These electrons gain energy from the oscillating field through the disruption of the oscillating phase due to random collisions with atoms.

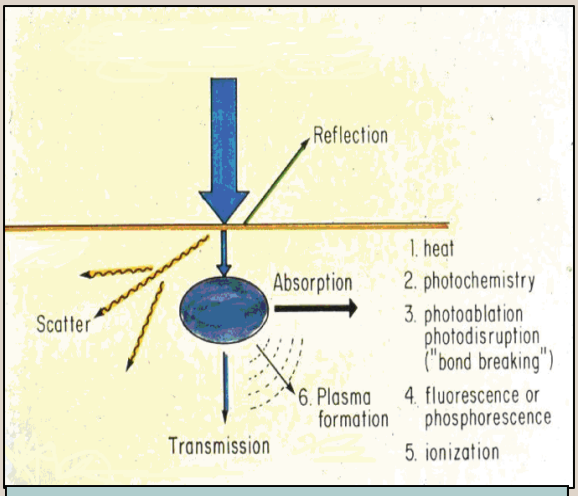


Fig 4 : Laser matter Interaction
(Image courtesy) www.amyshah.co

The electron oscillation energy thereby converts to electron excitations Following this, the electrons transfer energy to the lattice (ions) (electron–ion) by means of electron heat conduction, this process takes place generally for pulse duration of the order of picoseconds. Therefore, the target material is ionized early in the laser pulse creating high-density plasma. Free electrons absorb the laser energy in the resulting plasma The ions remain cold during the short pulse and at very high intensities even long after the pulse, there is not enough time to transfer energy from electrons to ions. However, the electrons and ions can interact through an electrostatic field that can appear due to charge separation. This field becomes significant if the energy absorbed by the electrons exceeds a characteristic energy of 10 eV (the Fermi energy in metals). Energetic electrons can then escape from the target and pull ions from the solid via the electrostatic field resulting from charge separation. This non-equilibrium process is known as electrostatic ablation.

Conversely, for long-pulse interaction, the electrons and the lattice become in thermal equilibrium during the pulse, and therefore the laser–matter interaction and ablation proceeds under equilibrium conditions. Ablation in this regime is close to conventional equilibrium evaporation and is referred to as thermal ablation [5].

References:

1. Charles H. Townes (2003). "The first laser",in Laura Garwin and Tim Lincoln. A Century of Nature: Twenty-One Discoveries that Changed Science and the World. University of Chicago Press, pp.–12. ISBN 0-226-28413-1
2. "Laser Processing and Chemistry" by Dieter Bäuerle Springer; 2nd edition (April 1996)
3. "Pulsed laser deposition of thin films", edited by R W Eason, University of Southampton, UK
4. An-Chun Tien et al, Short-Pulse Laser Damage in Transparent Materials as a Function of Pulse Duration, Phys. Rev. Lett. » Volume 82 » Issue 19, (1999).
5. "Lasers in the Conservation of Artworks", edited by Marta Castillejo, 2008.

Physics behind the nature

When the moon is directly overhead, our body weighs slightly less than the normal. This is because the gravitational forces of the moon and the earth are oppositely directed at such a spot.

Learning is not Child's play, we cannot learn without pain.

Aristotle

Acknowledgement

We are thankful to Ms Samia Aslam for designing the new template for the COMSATS Physics Today

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COMSATS Physics Forum

Dr. Abdul Rashid

COMSATS Institute of Information Technology

Defence Road, off- Raiwind Road Lahore.

Phone: 111-001-007 / ext.235, 295 Fax: 042-9203100

Cell Phone: 0332-4331077

E-mail: drabdulrashid@ciitlahore.edu.pk

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Department of Physics
COMSATS Institute of Information Technology
M. A. Jinnah Campus Defence Road, off Raiwind Road, Lahore 54000, Pakistan
Tel: 042-111-001-007 **Fax**: 042-9203100 **URL**: www.ciitlahore.edu.pk