S1-3 Mazhar Iqbal

mazharphy_05@yahoo.com
Principle Scientist/Associate Professor, National Institute of Lasers and Optronics, Pakistan

Title: Ultrafast Nature of Laser Plasma X-ray Source by Ultrafast XANES

Abstract : The development of laser from low intensity (~10^8 W/cm^2) to relativistic regime (>10^{18} W/cm^2) gave birth to a number of fascinating table-top techniques and their diagnostics alongside. A variety of applications of laser realized these days are intensity dependent and circumscribe a range of physics including laser spectroscopy, material science, plasma physics, laser generated ions, x-rays generation, particle acceleration, warm dense matter, etc. Laser induced plasma and x-rays generation (LPX) is one of the interesting candidates in this race. LPX, a powerful supplement to the large scale facilities, has become an attractive tool for laboratory scale experiments with high spatial resolution on ultrashort timescale. In this contribution, we present a compact laboratory scale ultrafast hard x-ray source (7.5 – 9 keV) developed for high-resolution time resolved x-ray absorption spectroscopy and x-ray diffraction experiments. The source emits 5.9×10^{10} ph/s in 4π sr at central photon energy of 8.05 keV. The source has been used to reveal the processes happening on sub picosecond time scale by the well-known pump-probe scheme using ultrashort x-ray pulses as shutter. The pump-probe techniques based on the compact laser plasma x-ray source has added advantage of being jitter-free, however, a more precise knowledge of their emission duration, determining the measurement temporal resolution, became indispensable.
In this regard we choose the broadband Bremsstrahlung radiation from LPX as an ultrafast shutter. Ultrafast behavior of near infra-red (NIR)/ultraviolet laser (UV) pumped NiO and Fe3O4 was investigated by using K-shell X-ray Absorption Near Edge Spectroscopy (XANES) as probe signal. The K-shell x-ray absorption edge of Ni and Fe red shifted its position with a time constant of about 188 fs and 150 fs respectively. Thus an upper limit of laser-plasma generated Bremsstrahlung x-rays is suggested on the basis of observed ultrafast response.

S1-4 Min ju Kim

mjkim8712@gmail.com
Ph.D. student, Department of Physics and Photon Science, GIST

Title: Introduction of the Warm Dense Matter; Measurement of physical parameter in the extreme condition

Abstract : The Warm Dense Matter (WDM) regime represents the state between condensed matter and plasma, where the thermal energy is comparable to the Fermi energy and the ions are strongly coupled. Investigation of the WDM regime provides a key understanding of non-equilibrium phase transition and energy relaxation processes in the extreme condition. [1],[2]Recently, a temporal-resolved reflectance is considered to obtain the optical properties in the condition of WDM regime. In this present, Chirped pulse Probe & femtosecond pulse Pump (CPP) experiment is performed, this technique has advantages about laser fluctuation and timing jitter. We present the experiment on aluminum using the Ti;sapphire CPA laser (30 mJ, 35 fs) at GIST. The aluminum film (40~100 nm) deposited on a glass substrate was pumped by the high fluence the first and second-order harmonic pulse (800, 400 nm, < 5 J/cm2), and the chirped pulse (800 nm, <10 ps) probe was used to measure the reflectivity. The FLASH code simulation is compared with the experiment result to understand the effect of hydrodynamics expansion on the target surface after 1~2 pico-second regime. Additionally, time-resolved x-ray absorption spectroscopy is briefly introduced. From this technique, the temporal evolution of electron temperature is obtained for non-equilibrium WDM heated by an intense femtosecond laser pulse. [2]

References

[1]B. I. Cho et al., PRL 106, 167601 (2011) [2]B. I. Cho et al., Scientific Report 6, 18843 (2016)

S1-5 Dongkyu Kim

dkkim1005@gist.ac.kr
Ph.D. student, Department of Physics and Photon Science, GIST

Title: Machine learning for many-body physics

Abstract : Machine learning(ML) has been widely applied to recent studies in many fields including physics. ML has been employed to make a function which predicts physical properties of a mathematical model and interpolates experimentally observed data without any preliminary physical knowledge. Especially, the artificial neural network(ANN) has attracted much attention as a method of applying ML to many-body physics, such as predicting a phase of matter, suggesting a many-body ground state of a given Hamiltonian. Here we demonstrate our examples of applying ML to predicting critical phenomena and discuss the mechanism of how it finds and encodes the key information into the ANN. We introduce supervised learning with ANN to classify ordered and disordered phases in the ferromagnetic Ising model and show how the ANN can approximate a ground state for a many-body Hamiltonian by replacing a conventional VMC method.

S2-1 Kyung Taec Kim

kyungtaec@gist.ac.kr
Professor, Department of Physics and Photon Science, GIST

Title: Coherent extreme-ultraviolet emission generated from an atom excited by a few-cycle laser pulse

Abstract : An extreme-ultraviolet (EUV) emission is an electromagnetic wave in the range from 10 nm to 124 nm. An EUV emission has been used in many applications such as EUV lithography and EUV imaging due to its short wavelength. It is well known that an EUV radiation can be generated using an intense laser pulse in a few different ways. While an incoherent EUV radiation is generated from excited atoms or molecules through collisional excitation in a laser-produced plasma, a coherent EUV radiation can be obtained through high harmonic generation [1] or free induction decay after multi-photon absorption [2]. These models have been accepted as well-established theories for EUV emission.

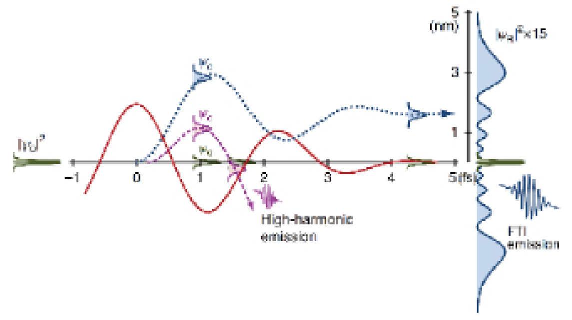

Fig. 1. Generation of EUV emission through frustrated tunneling ionization.

In this work, we report the observation of coherent EUV emission which cannot be explained with previously known phenomena [3]. The EUV emission was generated from He atoms excited by intense few-cycle laser pulses. An atom can be excited after tunneling in a strong laser field through the process known as frustrated tunneling ionization (FTI) [4]. We found that the excitation through FTI results in coherent EUV emission as shown in Fig. 1. Its intensity strongly modulated depending on the ellipticity and carrier-envelope phase of the laser pulses. In addition, the propagation direction of the emission can be coherently controlled by using the attosecond lighthouse technique [5]. The coherent control of tunneling and recombination dynamics promises the utilization of FTI emission as an intense EUV light source and offers new opportunities in ultrafast spectroscopy.

References

[1]K. T. Kim, D. M. Villeneuve, and P. B. Corkum, Nat. Photonics 8, 187 (2014).
[2]S. Bengtsson, E. W. Larsen, D. Kroon, S. Camp, M. Miranda, C. L. Arnold, A. L'Huillier, K. J. Schafer, M. B. Gaarde, L. Rippe, and J. Mauritsson, Nat. Photonics 11, 252 (2017).
[3]H. Yun, J. H. Mun, I. H. Sung, S. B. Park, I. A. Ivanov, C. H. Nam, and K. T. Kim, Nat. Photonics 12, 620 (2018).
[4]T. Nubbemeyer, K. Gorling, A. Saenz, U. Eichmann, and W. Sandner, Phys. Rev. Lett. 101, 233001 (2008).
[5]K. T. Kim, C. Zhang, T. Ruchon, J.-F. Hergott, T. Auguste, D. M. Villeneuve, P. B. Corkum, and F. Quéré, Nat. Photonics 7, 651 (2013)

S2-2 Sun Young Hamh

syhamh@kistep.re.kr
Associate Research Fellow, Center of Bio & Basic Science R&D Coordination, KISTEP

Title: 과학정책기관에서 이공계 연구자의 역할에 대한 고민

Abstract : GIST 대학원생 시절 매달 통장으로 입금되는 돈을 사용하고 연구실에서 수행하는 정부 과제를 통해 열심히 연구하였지만 정부의 과학기술 정책이란 것이 나와 직접적으로 연관되어 있다고 생각되지 않았다. 그러나 한국과학기술기획평가원(KISTEP)에서 1년간 업무 경험을 하면서 조금이나마 내가 받던 혜택들이 어떤 단계를 거쳐 나에게 도착했는지 알게 되었다. 본 발표에서는 정부 연구개발의 행정 체계 및 관리 프로세스를 알아보고 그 안에서 KISTEP의 역할을 살펴보고자 한다. 또한 KISTEP 업무를 경험하면서 느낀 과학기술정책기관에서 이공계 연구자의 역할에 대한 고민을 공유하고자 한다.

S2-3 Hyun-Sik Jeong

hyunsik@gist.ac.kr
Ph.D. student, Department of Physics and Photon Science, GIST

Title: Life & Theoretical physics

S2-4 Hyun Suk Shin

hyunseok@gist.ac.kr
M.S. student, Department of Physics and Photon Science, GIST

Title: GIST 학부에서 대학원을 진학한 경험

GIST 설립 25주년

젊은 물리학자 포럼

Young Physicist's Forum

with alumni, students, professors

2018년 11월 9일(금) 오후3시~8시
대학C동 104호, 로비

November 9th(Fri) 15:00~20:00,
GIST College C Building #104, lobby

초대의 글

물리광과학과 동문선배들과 대학원생들의
현재와 미래를 공유하고 교류와 협력을 도모하고자
『젊은 물리학자 포럼』을 개최하오니
재학생 여러분의 많은 참석 바랍니다

광주과학기술원
물리·광과학과

GIST 설립 25주년

Welcome Message

일반적으로 우리가 미래를 상상할 때 진보된 첨단기술을 기반으로

미래의 모습을 생각하게 됩니다.

이러한 첨단기술의 발전은 기초과학, 특히 물리학의 혁신에서 시작되고 있습니다.

따라서 물리학의 미래에 대한 논의는 미래의 과학기술을

예측하는 시발점이 될 것입니다.

현재와 가까운 미래의 AI, 양자컴퓨터 등과 같은 테크놀로지가 8, 90년대의

상상력과 과학기술에 기반한 것과 마찬가지로,

향후 10년, 20년 이후의 과학기술과 인류의 삶은 젊은 과학자들의

상상력과 비전에 영향을 받게 될 것입니다.

이에, 만 45세 미만의 물리학자들과 대학원생들이 현재와 향후 물리학의

주요 토픽과 관심사에 대하여 토론하고 비전을 공유하며,

25살 젊은 지스트의 역할을 논의할 수 있는

Young Physicist's Forum at GIST를 개최합니다.

지스트, 스물다섯 빛나는 청춘 25

S1-1 Inhyuk Nam

GIST 설립 25주년

ihnam@postech.ac.kr
Staff scientist, FEL beam physics team at Pohang Accelerator Laboratory(PAL)

Title: Recent Accelerator R&D Activities at PAL X-ray Free Electron Laser

Abstract : The hard X-ray free-electron laser at the Pohang Accelerator Laboratory (PAL-XFEL) with the shortest femtosecond-scale timing jitter has been developed which provides a unique tool for ultrashort time-resolved X-ray studies in the femtosecond regime. We will present on-going accelerator R&D activities to enhance the qualities of soft X-ray and measure the temporal properties of femtosecond hard X-ray pulse.

In order to provide the beams that can be brilliant, stable and narrow-band the harmonic lasing is a promising way. We demonstrate the 3rd harmonic lasing operation in the current configuration with gap-tunable planar hybrid type undulators at soft X-ray beam line at PAL-XFEL. In order to suppress the fundamental resonant radiation, we used a set of phase shifters for optimal condition. This new operation mode can improve the spectral brightness compare to Self-Amplified Spontaneous emission (SASE) mode. In this paper, we report the results of these studies of the harmonic lasing mode for soft X-ray in the wavelength down to 1 nm with the electron beam energy of 3 GeV at PAL-XFEL.

The pulse duration of X-ray from free electron laser (FEL) is from few tens of fs to few fs scale which is difficult to be directly measured. We measured a temporal profile of the X-ray pulse at PAL-XFEL using a narrow emittance spoiling foil method. The emittance spoiling foil method is used to vary the pulse duration or generate two pulses, which located at the center of the bunch compressor. The slotted foil (emittance spoiling foil) position is correlated to the temporal position of the x-ray pulse. Thus, the temporal profile of the x-ray can be measured by scanning the position with a very narrow emittance spoiling foil. This method is very simple and effective temporal diagnostic tool of x-ray pulse for XFEL user facilities.

S1-2 Dong Hoon Song

GIST 설립 25주년

dhsong@etri.re.kr
Researcher, Electronics and Telecommunications Research Institute(ETRI)

Title: Toward extreme light

Abstract : Over the last three decades, the development of high power femtosecond lasers based on chirped pulse amplification (CPA) [1], for which a Nobel Prize in 2018 has been awarded, has led to ad-vances in a wide range of scientific fields. Recently, much effort in CPA-based femtosecond laser development has been expended towards achieving a high peak power such as PW level. 20 years ago, Only NOVA petawatt (PW) glass-based laser in Lawrence Livermore National Laboratory in USA was in existence. The introduction of Ti:sapphire lasers provided the opportunity to produce high repetition rate, ultrashort pulses, typically 30 fs, because of the inherent broad bandwidth of the medium. In recent years, the number of PW class Ti:sapphire lasers are currently operational, under construction or in the planning phase. The reason for this is because the sub-components of the whole laser system itself become commercially available, even large Ti:sapphire crystals. Thus, since the world's first PW class Ti:sapphire laser (J-KAREN, JAEA in Japan) was constructed in 2003, USA, France, UK, China, Russia, etc. joined to develop the PW class laser. Currently, Ultra-high power femtosecond lasers with 200 PW level is being built by European Extreme Light Infra-structure (ELI) project. In Korea, GIST have joined the race and demonstrated the first 0.1 Hz repe-tition rate, PW Ti:sapphire laser in the world in 2010. In addition, the ETRI Ti:sapphire laser makes available for users high brightness 0.5 PW pulses at 0.1 Hz repetition rate now and has been up-grading to PW level.

In this talk, overview of ETRI laser system will be presented. The ETRI laser consists of double CPA stages. The first CPA for pulse cleaning comprises an oscillator, two multi-pass amplifiers, a small compressor, and a cross-polarized wave generation filter. In the second CPA stage, the cleaned pulses are temporally stretched up to ~ 1 ns in a grating-based all reflective Offner triplet stretcher with 1200 gr/mm and pass through an actively controlled acousto-optic programmable dispersive filter (AOPDF) to pre-compensate the spectral phases. This pulse is then amplified up to ~1 mJ in a regenerative amplifier and in a series of four multi-pass amplifiers. The final multi-pass amplifier generates ~ 20 J pulse energy with the help of two 25 J flash-lamp pump lasers. At the compressor composed of four gratings with 1480 gr/mm, 14 J, ~30 fs, 10^11 contrast pulses are generated at 0.1 Hz repetition rate.

References

[1] D. Strickland et al., Opt. Commun. 56, 219 (1985)

Department of Physics and Photon Science

GIST 설립 25주년

PROGRAM

14:50~15:00	**Registration**
15:00~15:10	Opening Announcement
15:10~16:30	**Session1. Science & Physics**
15:10~15:30	Dr. Inhyuk Nam (Pohang Accelerator Laboratory)
15:30~15:50	Dr. Dong Hoon Song (ETRI)
15:50~16:10	Dr. Mazhar Iqbal (National Institute of Lasers & Optronics, Pakistan)
16:10~16:20	Min Ju Kim (Ph.D. student, GIST)
16:20~16:30	Dongkyu Kim (Ph.D. student, GIST)
16:30~16:50	**Coffee break**
16:50~18:00	**Session2. Life & Physics**
16:50~17:10	Prof. Kyung Taec Kim (GIST)
17:10~17:30	Dr. Sun Young Hamh (KISTEP)
17:30~17:40	Hyun-Sik Jeong (Ph.D. student, GIST)
17:40~17:50	Hyun Suk Shin (M.S. student, GIST)
17:50~18:00	**Photography**
18:00~20:00	**Banquet**

Banquet invitation

You are cordially invited to the banquet.
It is the dinner party for a meet and greet with people of the department of physics and photon science.

Department of Physics and Photon Science