Poster 2

April 30 (Tuesday) / 15:10 ~ 16:30 / Capri room

Systems / Power supply / Applications

P2-4.1 / A novel interleaved structure high-voltage transformer and its application in TWTA

Depeng Bai (China Academy of Space Technology, China), Xiaoming Ji (Nanjing University, China), Xinbo Ruan (Nanjing University, China), Bin HE (China Academy of Space Technology, China), Weibo HUANG (China Academy of Space Technology, China), Bin ZHOU (China Academy of Space Technology, China)

This paper proposes a planar high voltage interleaved transformer design method. The transformer is suitable to be used in power supply for TWT. Since the parasitic parameters of the transformer are adopted as resonant elements, the cross regulation problem is alleviated. Moreover, the iteration of FEA simulation and circuits design will greatly reduce the cost of design. The method is verified by a 600W multiple output power supply for TWTA, and the performance of the prototype shows this method is effective.

P2-4.2 / Design and Measurement of Induction Voltage Adder with Amorphous Metal Magnetic Cores

Jong-Won Yang (Agency for Defense Development, Korea), Woosang Lee (Agency for Defense Development, Korea), Han-Yong Ryu (Agency for Defense Development, Korea), Heo Hoon (Pohang Accelerator Laboratory, Korea), Young Joon Yoon (Yonsei University, Korea)

We designed and fabricated IVA (Induction Voltage Adder) with 2 unit cells. Two identical unit cells were connected in series. The unit cell consisted of 4 magnetic cores. The magnetic core was fabricated to have a toroidal shape using amorphous metal. The added double output voltage of input was measured in the load. We presented the features of design of IVA pulse generator and its experimental results.

P2-4.3 / Analysis of High Frequency Flyback Converters For High-voltage Low-power Applications

Bin Zhao (Chinese Academy of Sciences, China), Gang Wang (Chinese Academy of Sciences, China), Dong Lei Wang (Chinese Academy of Sciences, China)

This paper proposes a new working mode of the high frequency Flyback converter for the high-voltage low power applications, such as atomic clock, ion analysers, high voltage ignition system, vacuum electronic devices etc. With the proposed working mode, the main switch of the Flyback converter can achieve Zero Voltage Switching (ZVS) without extra auxiliary switch. Due to the advantage of ZVS, the Flyback converter can operate under high frequency and high

efficiency conditions. As a result, the volume of the passive components can be reduced and the power density of the converter can be improved. The proposed working mode of high-frequency Flyback converter is validated by simulations and experiments.

P2-4.4 / Analysis and Design of the Resonant Current of the LCLC Resonant Converters with Consideration of Zero-Voltage Switching and Zero-current Switching

Bin Zhao (Chinese Academy of Sciences, China), Gang Wang (Chinese Academy of Sciences, China), Dong Lei Wang (Chinese Academy of Sciences, China)

The LCLC resonant converters are widely used in the Electronic Power Conditioner (EPC) in a Travelling wave Tube Amplifier (TWTA) due to the advantage of Zero Voltage-Switching (ZVS) and Zero-Current-Switching (ZCS). However, in the physical circuit, problems such as non-Zero Current-Switching and reverse resonant current appear and the efficiency decreases. Based on the working principles of the LCLC resonant converters, this paper presents the method to remove the reverse resonant current and the non-zero switching. Furthermore, an empirical data is given to guide the design of the converter. Finally, the analysis is validated by the simulations and experimental results.

P2-4.5 / Thermal Analysis of The Slow Wave Structure (SWS) Assembly of The Travelling Wave Tube

Chirag Mistry (CSIR-CEERI, India), Sanjay Kumar Ghosh (CSIR-CEERI, India)

Thermal management of helix slow-wave structure (SWS) in a traveling-wave tube (TWT) has great influence on its performance namely, average power handling capability, TWT efficiency, S-parameters, etc. The main source of thermal load of helix SWS is the intercepted power loss, which is assumed to be uniform over the TWT and as a measure of helix interception current during DC or RF testing. However, practically intercepted power loss would be different in different sections of TWT. Typically, it is higher in output section than input section due to growth of signal. In this paper, thermal analysis of helix SWS has been presented for three different cases namely, uniform heating, non-uniform heating and localized heating respectively and corresponding temperature distribution in different section of the SWS have been estimated using ANSYS.

P2-4.6 / Automatic Magnetic Field Measurement System for Traveling Wave Tube based on Virtual Instrument

Jie Zhang (University of Electronic Science and Technology of China, China), Dapeng Gong (University of Electronic Science and Technology of China, China), Tao Huang (University of Electronic Science and Technology of China, China), Bin Li (University of Electronic Science and Technology of China, China)

This paper introduces an automatic magnetic field distribution measurement system for traveling wave tube magnetic ring based on virtual instrument, which is mainly used to measure

the axial magnetic field strength of TWT magnetic bunching system. The hardware system consists of optical table, non-magnetic chuck, motor controller, electronically controlled translation platform, high-precision Gauss meter, etc. In the LabWindows/CVI virtual instrument programming environment, modular development and debugging of measurement software are carried out, and finally the distributed measurement of the axial magnetic field of the traveling wave tube is achieved.

P2-4.7 / Development of a 3.3 kJ system and a 300 kJ system for Triggered Vacuum Switch

Wung-Hoa Park (Pohnag Accelerator Laboratory, Korea), Hyung Seop Kong (Pohnag Accelerator Laboratory, Korea), Suk Ho Ahn (Pohnag Accelerator Laboratory, Korea), Byung-Joon Lee (Pohnag Accelerator Laboratory, South Korea)

We have developed a 3.3 kJ system and a 300 kJ system to fabricate a sealed-off triggered vacuum switch (TVS). The goal of fabricated sealed-off TVS was a hold-off voltage of 20 kV, a maximum peak current of 150 kA, a maximum charge of 60 C, and a pulse width of 2 ms. In order to achieve the goal, we have progressed a fundamental research to understand the characteristics of the sealed-off TVS. The fabrication of the sealed-off TVS has processed based on the fundamental research. The performance estimation has conducted for the fabricated product. The 3.3 kJ system has been developed to employ the fundamental research and the fabrication process. Whereas, the 300 kJ system has been optimized to estimate the performance for the fabricated sealed-off TVS. The basic structure of the 3.3 kJ system and the 300 kJ system are same. They are consisted of a charging part and a discharging part. The 3.3 kJ system has used a charging capacitor bank of 16.52 μF and a discharging parallel-plate inductor of 1 μH. The 300 kJ system has employed a charging capacitor bank of 1.256 mF and a discharging bus-bar inductor of 10 μH. The estimated performance of the fabricated sealed-off TVS has achieved a hold-off voltage of 20 kV, a maximum peak current of 152 kA, a maximum charge of 90 C, and a pulse width of 2 ms.

P2-4.8 / The Effect of Multipactor on the Quality of a Signal

Patrick Y.Wong (University of Michigan / Michigan State University, USA), Y. Y. Lau (University of Michigan, USA), Peng Zhang (Michigan State University, USA), Nicholas Jordan (University of Michigan, USA), Ronald Gilgenbach (University of Michigan, USA), John Verboncoeur (Michigan State University, USA)

Recently, there is significant interest in multipactor discharge because of its threat to satellite communications. In this paper, an analytical model is presented which assesses the distortion of a signal by multipactor. Complex, multi-tone signals will also be investigated. The I-Q plot is resented to show the effects of multipactor.

P2-4.9 / ESS Klystron Production Test Stand

Marcel P.J. Gaudreau P.E. (Diversified Technologies, Inc., USA), Ian Roth (Diversified Technologies, Inc., USA), Noah Silverman (Diversified Technologies, Inc., USA), Michael Kempkes

(Diversified Technologies, Inc., USA), Rebecca Simpson (Diversified Technologies, Inc., USA)

Diversified Technologies, Inc. (DTI) has delivered a new long-pulse modulator klystron test stand to Communication and Power Industries (CPI) in Palo Alto, CA for full power testing of production VKP-8292A klystrons for the European Spallation Source (ESS). The output is flat to less than 0.5% over 3.3 ms. This test stand was built using hardware and designs from an earlier SBIR effort for the Department of Energy, with modifications to support ESS requirements and klystron testing operation. Earlier versions of this design are in use at IPN Orsay and CEA Saclay in France to test RF components for ESS.

P2-4.10 / UNIST-EBIT vacuum and confinement system (with simulations)

Sung Nam Park (UNIST, Korea), Kyung-Hun Yoo (UNIST, Korea), Moses Chung (UNIST, Korea)

Intense Beam and Accelerator Laboratory(IBAL) at Ulsan National Institute of Science and Technology(UNIST) is building a miniaturized Electron Beam Ion Trap(mini-EBIT) for the spectroscopy of the highly charged ions(HCIs). The compact, easily portable table-top mini-EBIT, which has the vacuum level of 10^{-10} mbar confines the electron impact ionized atoms in both longitudinal and radial directions using the electric and magnetic fields respectively. The mini-EBIT with an on-axis electron gun which generates up to 8 keV energy-tunable electron beam, and a 0.86 T room-temp permanent magnets, allows us to do the X-ray spectroscopy of the HCIs in a cost effective and low maintenance way. In this work, we present the overall vacuum structure of the EBIT with the simulations for the electron and ion confinements using the COMSOL and SIMION.

P2-4.11 / Magnetron power modulator for driving a microtron THz FEL

Taesik Yoon (Korea Atomic Energy Research Institute / Chungnam National Univercity, Korea), B. A. Gudkov (Korea Atomic Energy Research Institute, Korea), Sangyoon Bae (Korea Atomic Energy Research Institute / Chungnam National Univercity, Korea), Sergey Miginsky (Korea Atomic Energy Research Institute, Korea), Young Uk Jeong (Korea Atomic Energy Research Institute, Korea), Kyu-ha Jang (Korea Atomic Energy Research Institute, Korea), Kitae Lee (Korea Atomic Energy Research Institute, Korea), Min Yong Jeon (Chungnam National University, Korea)

Korea Atomic Energy Research Institute (KAERI) has developed a new modulator using IGBT. The bipolar pulse generator provides preliminary dynamic magnetization of the transformer core. also, bipolar pulse generator makes possible computer control of the starting current of the magnetron. Computer operation with the bipolar pulse generator can produce 34% current change. Corrector for pulse waveform correction has been described. With the corrector we reduced magnetron frequency deviation down to 40kHz. Modulator output parameters: 10Hz 51kV 100A 6us.

P2-4.12 / A Vacuum Arc Diagnosis Method for the High Voltage Power Supply of Vacuum Tubes

Ramin Ayoubi (Sharif University of Technology, Iran), Mostafa Rahmanian (Sharif University of

Technology, Iran), Shahriyar Kaboli (Sharif University of Technology, Iran)

Vacuum tubes are widely used for various applications. These vacuum tubes are supplied by high voltage power supplies. The amount of delivered energy from the high voltage power supply to the vacuum tube is an important issue during the vacuum arc in the tube. The protection mechanism consists of a shunt crowbar which diverts the fault current from the tube to itself as a parallel path. Detection of the vacuum arc is crucial and only one sensor is usually employed to detect the vacuum arc. This characteristic intensifies the interference susceptibility of the vacuum arc diagnosis system in a noisy environment. As a result of the noise, the arc detection system can report false alarms. False alarms are very likely to damage to both the vacuum tube and the high voltage power supply. A low-pass filter is an usual preventive measure of reducing the noise effect.
Decreasing the bandwidth of the filter leads to the reduction of noise effects, while the delay of the filter diminishes the speed of the vacuum arc detection system. The more interval of arc detection increases, the more energy is delivered to the tube, and the more damage the tube suffers during the arc fault. Accordingly, a fast and noise-robust vacuum arc detection scheme is crucial to protect the tube. In this paper, a fast vacuum arc diagnosis system is proposed based on neural networks. The proposed scheme consists of two sensors those their data are combined by neural networks to diagnose the vacuum arc and to reject false alarms in a noisy environment. In order to adjust the neural networks weights, Levenberg-Marquardt algorithm is used. Simulations tests are carried out to evaluate the proposed scheme.

P2-4.13 / Experience from KSTAR ECRH Commissioning

Young-soon Bae (National Fusion Research Institute, Korea)

This paper presents technical and operational issues that have been experienced during the commissioning of electron cyclotron resonance heating (ECRH) system for Korean Superconducting Tokamak Advanced Research (KSTAR). Most of the technical issues occurred from the commissioning of high-power and long-pulse capable gyrotron which is an most important component determining reliability and stability of ECRH system.

P2-4.14 / Low Level RF Control of Cyclotron for Neutron Capture Therapy System

Sun-Hong Min (Korea Institute of Radiological and Medical Sciences, Korea), In Su Jung (Korea Institute of Radiological and Medical Sciences, Korea), Chawon Park (Korea Institute of Radiological and Medical Sciences, Korea), Ilsung Cho (Korea Institute of Radiological and Medical Sciences, Korea), Won Taek Hwang (Korea Institute of Radiological and Medical Sciences, Korea), Bong Hwan Hong (Korea Institute of Radiological and Medical Sciences, Korea)

A versatile digital Low-Level Radio Frequency (LLRF) system has been designed for the various energy cyclotrons being developed by Korea Institute of Radiological and Medical Sciences (KIRAMS). In this study, the contents of LLRF of 8MeV~30MeV cyclotron, which is a typical circular accelerator for neutron capture therapy, are discussed. Here we present blue print to construct an effective LLRF control system of the cyclotron.

P2-4.15 / Heat Dissipation Analysis of M.2 NVMe Solid-State Drive in Vacuum

Eung Chang Lee (Korea Advanced Institute of Science and Technology, Korea), Jinsung Rho (Korea Advanced Institute of Science and Technology, Korea), Bong Jae Lee (Korea Advanced Institute of Science and Technology, Korea), Heeyoub Kang (Samsung Electronics, Korea)

The use of solid-state drive (SSD) in storage devices has been rapidly growing due to the development of memory technology for high performance and high integration. Further-more, the SSD is used in satellites, and the verification of the SSD operation is necessary in high vacuum condition without convection. Due to a small form factor and high performance in the vacuum, M.2 non-volatile memory express (NVMe) SSD is more susceptible to thermal failure. Recently, Samsung Elec- tronics SSD has applied a metal heat spreader to facilitate the heat dissipation on the top surface of the controller package. For designing such a thermal solution in the SSD, thermal analysis of the SSD during the operation must be preceded. However, the M.2 NVMe SSD has multiple heat sources, such as the controller, the NAND flash memory packages and the dynamic random-access memory (DRAM), making it difficult to analyze a heat dissipation mechanism of the M.2 NVMe SSD. In this research, we employ thermocouples and a temperature sensor in the controller to obtain temperature of the M.2 NVMe SSD in various operating conditions. For heat transfer analysis, we develop the thermal simulation model of the M.2 SSD and the model was validated by comparing to temperature measurement results at various conditions. We analyzed the heat dissipation mechanism of the M.2 NVMe SSD in the high vacuum and atmospheric environment

P2-4.16 / Beam Charge Monitor for quantitatively measuring electron bunch of very Low-charge pulse and Ultra-short pulse

H. Choi (PAL-XFEL, Korea), H. Heo (PAL-XFEL, Korea), H.-S. Kang (PAL-XFEL, Korea), Herve Bayle (Bergoz Instrumentation, France), H. Bayle, F. Stulle (Bergoz Instrumentation, France), Touzain Etienne (Bergoz Instrumentation, France)

The X-ray free-electron laser (XFEL) system of the Pohang accelerator laboratory (PAL) makes short electron beams with very low quantities of electric charge. It is difficult to measure bunch charge with very low-charge pulses and ultra-short pulses using an ordinary integrating current transformer (ICT). When there is a klystron modulator or a pulse power supply generating electromagnetic noise and ground noise in the surrounding area, it becomes especially difficult to measure the quantity of electric charge. In this paper we report on charge measurements performed at PAL-XFEL using a Turbo-ICT from Bergoz Instrumentation, which was developed to overcome various kinds of noise occurring in the surrounding areas.

P2-4.17 / Research of broadband digital predistortion with low sampling frequency

Rong Lan (Chinese Academy of Sciences / University of Chinese Academy of Sciences, China), Xin Hu (Beijing University of Posts and Telecommunications, China), Gang Wang (Chinese Academy of Sciences, China), Jirun Luo (Chinese Academy of Sciences, China), Lianbing Li (Chinese Academy of Sciences / University of Chinese Academy of Sciences, China), Jingyan

Song (Chinese Academy of Sciences / University of Chinese Academy of Sciences, China)

In order to solve the problem of high sampling rate in the feedback loop of broadband digital predistortion, a digital predistortion method based on probability distribution of the signal was proposed, which can provide good predistortion effect with far lower sampling rate in feedback loop.

P2-4.18 / Research of electronic optical system with power of 3kW and beam diameter of 0.1mm

Jie Qing (University of Electronic Science and Technology of China, China), Zhenhua Wu (University of Electronic Science and Technology of China, China), Chuanhong Xiao (University of Electronic Science and Technology of China, China), Min Hu (University of Electronic Science and Technology of China, China), Renbin Zhong (University of Electronic Science and Technology of China, China), Shenggang Liu (University of Electronic Science and Technology of China, China)

As the most cutting-edge and most potential technology in the whole 3D printing system, metal parts 3D printing technology is an important development direction of advanced manufacturing technology. One of the most important ways to achieve 3D printing of metal parts is by bombarding metal powder with electrons to melt it. Electron beam melting technology is an important part of metal 3D printing. Through CST software simulation, this paper aims to design an electronic optical system with voltage of 60kV, current of 0.05A, power of 3kW and transmission distance of more than 500mm for 3D printing of metal parts. The system can also be used to study terahertz waves.

P2-4.19 / Multi-Stage Slotted Waveguide Array Antenna for High Power Applications

Taek-Heon Kim (Electronics and Telecommunications Research Institute, Korea), Jung-Hoon Han (Electronics and Telecommunications Research Institute, Korea), Seung-Kab Ryu (Electronics and Telecommunications Research Institute, Korea)

An antenna for high power microwave (HPM) radiation should be required for HPM immunity test. In this paper, the design of longitudinal slotted waveguide array antenna for narrowband HPM is described. This antenna is connected to HPM source through WR-284 waveguide. To avoid electrical breakdown in the aperture for air condition, we first perform an electric field analysis on three baseline slots by using CST-Microwave studio. The overall slot array is composed of 16×16 radiating slots and is divided into 8×4 sub-arrays. The sub-array is connected to the multi-stage divider, which is designed so that the applied MW-class HPM signal decreases below the breakdown level at sub-array input. We improved the septum divider and analyzed its characteristics according to the corner radius. The simulation results for overall antenna shows that it has 21.8 dB return loss, 32.06dBi antenna gain. The maximum E-field value at overall antenna is 2.67MV/m for applied HPM signal. The fabricated prototype antenna and measured data for HPM radiation is presented.

P2-4.20 / Operation of Compact X-Band Linear Acelerator System Mounted on the Gantry for Radiation Therapy

Sanghoon Kim (Korea Electrotechnology Research Institute, Korea), Geun-Ju Kim (Korea Electrotechnology Research Institute, Korea), Yong-Seok Lee (Korea Electrotechnology Research Institute, Korea), Jeong-Hun Lee (Korea Electrotechnology Research Institute, Korea), Insoo S. Kim (Korea Electrotechnology Research Institute, Korea), Young-Wook Choi (Korea Electrotechnology Research Institute, Korea), Jung-Il Kim (Korea Electrotechnology Research Institute, Korea), Jinho Hwang (The Catholic of University of Korea, Korea), Aeran Kim (The Catholic of University of Korea, Korea), Yunji Seol (The Catholic of University of Korea, Korea, Korea), Taegeon Oh (The Catholic of University of Korea, Korea), Nayoung An (The Catholic of University of Korea, Korea), Youngah Oh (The Catholic of University of Korea, Korea), Young-Nam Kang (The Catholic of University of Korea, Korea)

Linear accelerators (LINAC) that generate high energy X-rays have been widely used for radiotherapy. With the combination of advanced imaging modalities, an image-guided radiation therapy (IGRT) has greatly improved the quality of radiotherapy by acquiring instant knowledge of changes in tumor volume, radiation dose distribution, and effective tumoricidal doses during treatment. In this study, we developed a compact 9.3 GHz X-band LINAC system and installed on the gantry for potential applications in IGRT. We confirmed X-ray generation using radio frequency transmission tests and measured the X-ray dose rates while the gantry was rotating, which demonstrates stable and reliable operation of the developed system. The field size of an X-ray beam was 10.31 cm × 10.31 cm at the solid water phantom (depth 0 cm) of the film, and the standard deviation of the X-ray dose was 0.016 while rotating. Therefore, we describe the design and test results of the X-band LINAC system mounted on the O-arm gantry. We expect the use of our design for the fusion system that integrates a diagnostic imaging instrument with a radiation therapeutic device.

P2-4.21 / The photoresponse of ZnO nanowire cold cathode flat panel detector using ZnS photoconductor

Xinpeng Bai (Sun Yat-sen University, China), Zhipeng Zhang (Sun Yat-sen University, China), Kai Wang (Sun Yat-sen University, China), Juncong She (Sun Yat-sen University, China), Shaozhi Deng (Sun Yat-sen University, China), Ningsheng Xu (Sun Yat-sen University, China), Jun Chen (Sun Yat-sen University, China)

A large area flat panel detector using ZnO nanowire cold cathode and ZnS photoconductor was fabricated. The effect of film thickness of ZnS photoconductor on the photoresponse of the device was studied. It found that the maximum current gain increased initially and decreased gradually as the ZnS films thickness increased. A maximum gain of 6.49×10^4 was obtained at the thickness of 3.75 μm at an applied voltage of 730V. The results were explained using an equivalent circuit model, which considered EBIPC mechanism. Our results show that the cold cathode flat panel photodetector has great potential in indirect-conversion X-ray imaging.

P2-4.22 / The Application of Electron Beam Welding on Vacuum Electron Devices

Bofeng wang (Chinese Academy of Sciences / University of Chinese Academy of Sciences, China), Xuhua hu (Chinese Academy of Sciences, China), Guanli zhou (Chinese Academy of Sciences, China), Jianyong zhou (Chinese Academy of Sciences, China), Xiaoxia wang (Chinese Academy of Sciences, China), Yongqing zhang (Chinese Academy of Sciences, China), Zhaochuan zhang (Chinese Academy of Sciences, China)

Electron beam welding is widely used in the field of Vacuum Electron Devices (VED). Oxygen free copper (OFC) was welded by electron beam welding with appropriate process parameters for the application of VED. The effects of welding speed and current parameter on welding depth have been studied in the experiment. Microstructure properties of OFC welding were compared with base material. The results show that the welding joint has no apparent surface defects. The welding joint has good performance, and weld penetration has increased with increasing the welding current.

P2-4.23 / Design and tuning of a C-band 6 MeV linear accelerating structure

Yongtao Liu (Beijing Vacuum Electronics Research Institute, China), Pan Pan(Beijing Vacuum Electronics Research Institute, China), Jingang Han (Beijing Vacuum Electronics Research Institute, China), Huanhuan Niu (Beijing Vacuum Electronics Research Institute, China)

A C-band 6 MeV standing wave biperiodic on-axis coupled linear accelerating structure has been designed both for industrial and medical applications. The total length of the accelerating structure is less than 22 cm, which is powered by 3 MW klystrons. The pulsed beam current is 100 mA. The simulations of the geometry and beam dynamics study of the accelerating structure are performed by CST. A set of cavities based on design have been machined and tuned.

P2-4.24 / Design study of the electron beamline, and the beam optimization for the AWAKE RUN 2 experiment at CERN

S. Y. Kim (UNIST, Korea), M. Dayyani Kelisani (IPM, Iran), S. Doebert (CERN, Switzerland), M. Chung (UNIST, Korea)

Demonstration of the electron acceleration through the proton beam-driven plasma wakefield has been successfully done by the AWAKE RUN 1 experiment. Moreover, next AWAKE experiment is scheduled. Main goal of the AWAKE RUN 2 experiment is to achieve the capturing efficiency and the energy gain over 90%, and 10 GeV. In order to accomplish the goal, beam size, and its length have to be less than 50 um, and 100 fs rms, respectively. Since the conventional beamline cannot meet the AWAKE RUN 2 requirements, we are focusing on designing new type of the electron beamline. In this paper, we present simulation results of the beam size, and the bunch length along the new beamline.

P2-4.25 / A Study of Pulse Control of Millimeter-wave Gyrotron using High Density Plasma

Mun Seok Choe (UNIST, Korea), Ashwini Sawant (UNIST, Korea), Ingeun Lee (UNIST, Korea), Taegyu Han (UNIST, Korea), Wonjin Choi (UNIST, Korea), EunMi Choi (UNIST, Korea)

We study the fast time control of high-power millimeter-wave by means of plasma. We designedplasma chamber as helical type inductively coupled plasma to generate high density plasma in large volume. Weestimate that high-power millimeter-wave can be absorbed and reflected to plasma depending on plasma density which may be usefulto control millimeter-wave pulse switching externally.

P2-4.26 / Tuning Results of The Pulse Energy Doubler

KwangHoon Kim (Pohang Accelerator Laboratory, Korea), Soung-Soo Park (Pohang Accelerator Laboratory, Korea), Sang-Hee Kim (Pohang Accelerator Laboratory, Korea), Yong-Jung Park (Pohang Accelerator Laboratory, Korea), Juho Hong (Pohang Accelerator Laboratory, Korea), Chang-Ki Min (Pohang Accelerator Laboratory, Korea), Heung-Soo Lee (Pohang Accelerator Laboratory, Korea), Heung-Sik Kang (Pohang Accelerator Laboratory, Korea)

The PAL-XFEL has a 716m hard X-ray linac and a soft X-ray linac. There are 51 modulators, 178 accelerators structures, and the pulse energy doublers in the linac. The construction was completed at the end of 2015. After RF-conditioned for one year in 2016, The machines provide to the user service in 30Hz, 4μs on hard x-ray. The pulse energy doubler is one of the important devices that increases the peak output power of the 2.856 GHz high frequency generated by the Klystron. The device receives a 4μs length for high frequency power from the klystron and reduces the length of the pulse output to 1μs. However, the maximum peak output power can be increased four times. The total of 42 pulsed energy doublers are installed in the PAL XFEL RF system. It consists of two resonators and one 3dB coupler. The amount of heat generated depends on the operation repetition frequency. There are two ways to prevent it. Change the water temperature of the cavity cooling system or adjust the volume of each resonator. We installed a system that can remotely adjust the resonator volume by connecting a motor to each resonator. This paper reports the results of tuning at 30Hz. We also experimented a few to prepare for 60Hz operation. It reports the results of adjusting the resonance frequency by changing the volume and the cavity cooling temperature using a remote cavity tuning system.

P2-4.27 / Prototype of Field Emission Cathodoluminescent Lamp for General Lighting with a Built-in AC-DC Converter

Evgenii P. Sheshin (Moscow Institute of Physics and Technology, Russia), Nikolai N. Chadaev (Moscow Institute of Physics and Technology, Russia), Artem Yu. Kolodyazhnyj (Moscow Institute of Physics and Technology, Russia), Alexandr O. Getman (Moscow Institute of Physics and Technology, Russia), Dmitry I. Ozol (Moscow Institute of Physics and Technology, Russia)

The prototype of cathodoluminescent bulb for general lighting with field emission cathode on

the basis of carbon fiber is manufactured. The bulb comprises a high-voltage built-in AC-DC converter of the electric line voltage and a standard E27 cap.

P2-4.28 / Mitigation of the diocotron instability in a hollow electron beam using rotating magnetic fields

CheongBin Cheon (Pusan National University, Korea), Young Hyun Jo (Pusan National University, Korea), Hae June Lee (Pusan National University, Korea)

A two-dimensional cylindrical particle-in-cell (PIC) simulation is utilized to understand the tendency of the diocotron instability in a hollow electron beam and to mitigate it. We have conducted a parametric study with the variation of the number density of electrons, the cathode voltage, the system size, and the amplitude and the frequency of periodic dipole magnets. Two orthogonal arrays of periodic dipole magnets make rotating magnetic fields which perturb the shear flow of the electron beam by the ExB drift motion. Finally, the conditions for the mitigation of the diocotron instability are investigated. This study is based on our previous study on the control of the diocotron instability of a hollow electron beam with periodic dipole magnets.

P2-4.29 / Design and modeling of a microwave plasma enhanced chemical vapor deposition system

Yilang Jiang (Hanyang University, Korea), Kaviya Aranganadin (Hanyang University, Korea), Jing-Shyang Yen (National Taipei University of Technology, Taiwan), Hua-Yi Hsu (National Taipei University of Technology, Taiwan), Ming-Chieh Lin (Hanyang University, Korea)

A Chemical Vapor Deposition (CVD) is a chemical process often used in semiconductor industry to produce high quality, high performance, solid material and thin films. In order to produce desired deposit using CVD, a wafer or a substrate is exposed to one or more violated precursors which react and/or decompose on the substrate surface and this also produces some volatile by-products which are then removed by gas flow through the reaction chamber. If the chemical reaction in CVD is initiated by microwave plasma then it is called Microwave Plasma Enhanced Chemical Vapor Deposition (MPECVD). A crucial issue for a roll-to-roll thin film cell production system is the deposition rate of the microcrystalline layer and this can be tackled using MPECVD. This technique has gained popularity in diamond and graphene fabrication. This paper discusses about the designing of an MPECVD chamber operated at 2.45 GHz of frequency using Finite Element Method (FEM) simulation. The design consists of a coaxial waveguide and a cylindrical chamber at the center connected using 4 slots in each direction. The placement of slot affects the resonant mode in the chamber. Hence the slot placements in the middle and the bottom positions of the plasma chamber produce the TE_{111} and TM_{011} mode inside the plasma chamber at 2.45 GHz, respectively. Detailed analysis will be presented using FEM simulations.

P2-4.30 / Emittance Exchange Based Bunch Compression at Argonne Wakefield Accelerator Facility

Jimin Seok (UNIST, Korea), Gwanghui Ha (Argonne National Laboratory, USA), John Gorham Power (Argonne National Laboratory, USA), Manoel Conde (Argonne National Laboratory, USA), Moses Chung (UNIST, Korea)

An emittance exchange (EEX) beamline can manipulate longitudinal phase space via control of the transverse one at the entrance to the beamline. This EEX beamline can compress a bunch length to a sub-fs level when a specific transverse focusing is applied to the small beam at the entrance of the beamline. The Argonne Wakefield Accelerator Facility (AWA) plans to generate the sub-fs bunch for applications to wakefield accelerators. A preliminary experiment has been performed using the existing EEX beamline at AWA. In this poster, results of the experiment and feasibility of sub-fs bunch compression with a modified EEX beamline are presented.

P2-4.31 / Influence of Ionization Processes on Virtual Cathode Formation

Artem Badarin (Saratov State University, Russia), Semen Kurkin (Saratov State University, Russia), Alexey Koronovskii (Saratov State University, Russia), Alexander Hramov (Saratov State University, Russia)

The paper presents the results of the study of the influence of plasma effects on the processes occurring in high-power electronic systems. The results are obtained using electromagnetic PIC code for a promising class of high-power microwave devices – relativistic vircators (generators and amplifiers with a virtual cathode). A detailed study of the behavior of critical current of a relativistic electron beam with a change of the control parameters of the system (concentration of residual gases, external magnetic field parameters, energy of electron beam and shape of current pulse) is carried out. The results obtained within the framework of the research are intended to broaden the fundamental concepts about the dynamics of intense electron beams in a plasma.

P2-4.32 / Fabrication of high resolution electron source for microscope application

Ha Rim Lee (Kyunghee university, Korea), Kyu Chang Park (Kyunghee university, Korea)

A reliable source of electrons to observe an object is one of the most important part of a microscope. The technology has been developed rapidly with the goal of complete computer control. This state is the most advanced state for field emission sources. However, the next generation of field emitters is still under development.
We evaluated whether our carbon nanotube (CNT) emitters were suitable for electron microscope such as, angular current density, virtual source size and brightness. Various emitters were measured, and it was found that electrical and structural properties affect the brightness.

P2-4.33 / Comparison of the effect of rotating electric fields and rotating magnetic fields on the diocotron instability using particle-in-cell simulations

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Recently, a beam collimator system using a hollow electron beam to enclose a circulating beam has been proposed for the high energy vacuum. In this system, the hollow electron beam should remain stable during propagation, obviously. However, the diocotron instability, which is one of the nonneutral plasma instabilities induced by shear in the flow velocity of surface waves, makes the deformation of the beam. Therefore, it is important to control the hollow electron beam at first. Previously, we investigated the stabilizing effect of periodic dipole magnets on the diocotron instability using a two-dimensional particle-in-cell simulation. In the simulation, the beam cross section of the hollow electron beam was investigated under periodic dipole magnets in addition to the axial magnetic field. In addition to the previous work, we study the effect of rotating-wall electric fields on the diocotron instability, which also makes perturbations on the ExB drift, and compared the results of rotating magnetic fields.

P2-4.34 / Development of the Gas-Cell-based Plasma Source for Laser-Wakefield Electron Acceleration

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In laser-plasma accelerator research, a density tailored gas-cell/plasma source is intensively studied. We use a high-Z and low-Z gas together in the capillary gas-cell for laser-wakefield acceleration to control the gas and plasma density distribution. In this paper, some details of the research are presented.

P2-4.35 / Ultrashort bunch duration measurement using S-band RF deflector in UED system at KAERI

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As demanding the ultrashort bunches for the pump & probe experiments to investigate ultrafast phenomena occurring at atomic size level, the diagnostic tools should be developed to measure. by measuring the electron diffraction pattern directly. We have developed an S-band RF deflecting cavity working on TM_{120} mode to measure the femto-second bunch duration of electron beam in UED (Ultrafast Electron Diffraction) system at KAERI. In this conference, we will present on design, fabrication and experimental performance of the deflecting cavity. The estimated temporal resolution of RF deflector, operating with the deflecting voltage of 1.5 MV

and the drift length of 1.7 m, is 50 fs. The electron beam with 3 MeV and 1.88 pC, electron bunch duration has 67 fs in rms, which is well agreed with the simulation results.

P2-4.36 / A CMOS-compatible ionic/electronic hybrid transistor based on 2D α-MoO_3

Chuansen Yang (Beijing Orient Institute of Measurement and Test, China), Yaowen Lu (Beijing Orient Institute of Measurement and Test, China), Dashan Shang (Institute of Microelectronics of the Chines Academy of Sciences, China)

In contrast with 2D transition metal dichalcogenides, less attention was paid to 2D transition metal oxides for generally wider bandgap and low carrier concentration in stoichiometric states. Nevertheless, the layered structure of 2D transition metal oxides facilities the mechanical exfoliation and the injection of different donor ions (e.g. protons, alkali metal ions) into free spaces, which gives large density states within the bandgap. And, the dynamic process of the injected ions, which can be modulated by external voltage, closely resembles the transmission of the chemical signals in biological synapses and provides a chance to design ionic/electronic hybrid three-terminal devices based on 2D transition metal oxides to mimick artificial synapses. In this work, we fabricated a CMOS-compatible three-terminal device based on 2D α-MoO_3 nanoflakes (as channel material), and a solid electrolyte containing mobile Li^+ (as gating dielectric). The dynamic of channel conductance and its relaxation behaviors under continual and pulsed gating voltage was investigated. We demonstrated the gating-controlled electrochemical Li^+-doping is feasible to modulate the conductance of α-MoO_3 in a non-volatile and volatile way. Furthermore, the simulation of transition from short-term plasticity to long-term plasticity by the relaxation of channel conductance was implemented.

P2-4.37 / A calibration apparatus for pressure leak with the lower limit of 2×10^{-10} Pam^3/s

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A calibration apparatus with the lower limit of calibration of 2×10^{-10} Pam^3/s is developed to solve the calibration problem of leak with tiny leak rate. The concentration of the indicator gas in the gas mixture in the accumulating chamber was increased by using accumulation method. The standard gas mixtures were obtained by direct measurement and inflation pressure attenuation method, respectively. The 'fractionation' effect in the gas mixture was eliminated and the partial pressure of the leak indicator gas in the mass analysis chamber was increased by using dynamic injection of molecular flow method and pumping orifice with constant flow conductance. Using the quadrupole mass spectrometer (QMS) as a comparator, the leak rate of a pressure leak can be calibrated by measuring the partial pressure of the leak indicator gas in the accumulation gas through the leak and that in the standard gas mixture in the mass analysis chamber. The impact of temperature on the measurement results is reduced by using high precise two-stage semiconductor water bath method to limit the temperature within 296±0.02K. The experimental results show that the calibration of the apparatus is in the range

from 7×10^{-6} Pam^3/s to 2×10^{-10} Pam^3/s with the combined standard uncertainty between 2.0% and 7.5%.