Vacuum Technology
Room: 202 C - Session VT-WeM

Pumps, Accelerators and Large Vacuum Systems

8:00am **VT-WeM1 Recent Innovation in Dry Pumping Technology**, ***A.D. Chew***, *I. Stones, N. Schofield*, Edwards, UK **INVITED**

Dry pump technologies have become routinely utilized in, and for, a wide range of vacuum based applications. Some of the most recent significant developments in dry technologies, including scroll, screw, roots-claw and turbo-molecular, will be discussed with reference to improved operation and productivity, maintenance and minimised environmental impact and cost of ownership. Specific examples will include semiconductor and flat panel production, mass spectrometry and chemical processing.

8:40am **VT-WeM3 Novel Approaches in the Pumping Speed Characterization of NEG, SIP and their Combination in UHV Systems**, ***F. Siviero***, *A. Bonucci, A. Conte, L. Caruso, T. Porcelli, L. Viale, G. Bongiorno, E. Maccallini, P. Manini*, SAES Getters, Italy

Thanks to their compactness and large pumping speed for H_2 and oxygenated gases Non Evaporable Getter (NEG) pumps are effective solutions in a variety of applications from particle accelerators to surface science equipment, scanning/transmission electron microscopes and other analytical systems or sealed off devices. The quest for more compact, efficient and performing UHV pumping systems, is however pushing towards the development of new and innovative pump designs. A deeper understanding of the pumping mechanisms and the development of suitable pumping speed characterization techniques, is key to achieve this objective. In the present paper we update on the activities being carried out at SAES R&D Labs on the characterization of getter and ion pumps performances, either tested separately or in combination. In particular we provide highlights on the experimental methodology and data analysis which have been introduced to overcome some limitations coming from the use of the well-known ASTM F798-97 standard method for the measurement of sorption curves at constant pressure. At the heart of this approach, is the extensive use of the quadrupole mass spectrometry which allows to identify and separate the different gas sorption/desorption mechanisms taking place during the simultaneous operation of NEG and SIP. A better understanding of the actual pumping speed for gases, as well as synergies or interference in a NEG/SIP structure is therefore possible.

9:20am **VT-WeM5 Symbiotic Relation between High Energy Accelerators and Advanced Medical Treatments**, ***J.R. Noonan***, *D.R. Walters*, Argonne National Laboratory **INVITED**

High energy particle accelerators have been essential to developing fundamental knowledge of the nature of matter and energy [1]. Even from the early history of accelerators, accelerators have applications in materials science, biology, and medical therapies. Over 70% of accelerators in operation are for industrial and medical applications. Medical treatment can be categorized into therapeutic and diagnostic applications. External beam radiation therapy refers to radiation sources that are non-invasive. Intensity Modulated Radiation Therapy in which multi-MeV electrons strike a tungsten target to make x-rays is the largest application. Cyberknife is a “pencil beam” of electrons is focused on a small target to make a narrow x-ray beam source. High energy proton and heavy ion beams are used for precise radiation delivery. However, because of the expense, there are only a limited number of proton (heavy ion) beam centers. External beam radiation therapy (mostly x-rays) has significantly improved cancer survivability. Electron beams are focused directly on tumors in Intraoperative Radiation Therapy. The electrons beam is used after a tumor is surgically removed. Accelerators are also used to produce radioactive isotopes that are used in diagnostic imaging. Proton cyclotrons and linacs are the most used accelerators. However, electron linacs are used for special isotopes. Nuclear reactors are currently the dominant sources for isotopes; however, because of nuclear security, accelerators for isotope production are being developed. The presentation will discuss how the accelerators are used in medicine and the long lead time before accelerator advances are incorporated into medical therapy. The presentation will also give examples of advanced accelerator technology for radiation therapy.

1. Accelerators for America, Washington, D.C., (editors W. Hennig and C. Shank , DOE, June 2010

11:00am **VT-WeM10 LHC Experimental Beam Pipe Vacuum Chambers Characterization and Validation**, ***G. Lanza***, *G. Bregliozzi, V. Baglin, J.M. Jimenez*, CERN, France

The LHC experiments ATLAS, CMS and LHCb will profit of the LHC Shutdown 1 (years 2013- 2014) to improve and upgrade their detectors included the vacuum beam pipes.

The new chambers and modules positioned in the central core of the detector have been designed and optimized following the experiment specification. The material used for the chamber walls are aluminium, beryllium, copper or inox in order to grant the required transparency for the radiation. The internal wall NEG coating is a fundamental characteristic to reach the ultrahigh vacuum pressure required to lower the detector background.

Several vacuum chambers and modules have been tested and validated to grant their efficiency after the installation in the cavern. The validation tests of the uncoated components included: leak tightness, ultimate vacuum pressure, material outgassing, and residual gas composition. The validation tests of the NEG coated elements included also the NEG pumping speed for different gases and the sticking coefficient measurement. The integration of new pumping components on the vacuum modules have been studied, simulated and tested as well.

In this paper the motivation for the beam pipe upgrade, the validation test and the results are illustrated and commented.

11:20am **VT-WeM11 Commissioning of NSLS-II Vacuum Systems**, ***H.-C. Hseuh***, *A. Anderson, W. DeBoer, C. Hetzel, S. DiStefano, S. Leng, K. Wislon, H. Xu, D. Zigrosser*, Brookhaven National Laboratory

The National Synchrotron Light Source II is a synchrotron radiation facility designed with ultra-high-flux and -brightness. It consists of a 200-MeV Linac, a 3-GeV Booster and a 3-GeV, 792-meter circumference storage ring. The Booster vacuum system is made of thin-wall stainless steel chambers and is pumped with ion pumps. The Linac and Booster vacuum systems are completed and have reached ultrahigh vacuum. The storage ring vacuum chambers are mainly made of extruded aluminium with ante-chamber. The synchrotron radiation from the bending magnets in the storage ring is intercepted at discrete photon absorbers made of GlidCop. NEG strips in the ante-chamber provide the distributed pumping, while lumped ion pumps and titanium sublimation pumps at photon absorbers remove the desorbed gas. The 250 long aluminium chambers were manufactured by extrusion, bending, machining and welding. They are assembled with pumps, photon absorbers and diagnostic components, integrated into magnet girders and installed in the storage ring tunnel. All 30 DBA cells with 210 chambers have been connected with RF bellows, pumped down, in-situ baked and have reached 10^{-11} mbar. The narrow gap insertion device chambers are to be coated with NEG, and are currently under fabrication. This paper describes conditioning, installation, integrated testing and commissioning of the NSLS-II vacuum systems. Experience from the large scale production, testing and lesson learned will be summarized.

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11:40am **VT-WeM12 Higher Order Mode RF Absorbers for Cornell ERL Superconducting Cavity Cryo-Module**, ***Y. Li***, *Y. He, J.V. Conway, R.G. Eichhorn*, Cornell University

As a part of continuing R&D efforts toward to Cornell Energy Recover LINAC based hard X-ray light sources, a superconducting RF (SRF) cavity cryo-module (the so-called horizontal test cryo-module or HTC) has been designed and constructed, and a series of tests has been carried out during the past year to evaluate performance of the SRF cavities. One of the key and challenging components, which are still in development, is the higher order mode (HOM) RF absorber. The UHV compatibility is essential for these HOM RF absorbers, as they form part of electron accelerator beampipes adjacent to the SRF cavities. The out-gassing rates of various HOM RF absorber materials were measured by a throughput method. In the presentation, we report vacuum out-gassing measurements on various candidate HOM absorber materials, including two promising materials, namely SiC and AlN. We will also discuss several joint designs (such as vacuum brazing and shrink-fit) for the absorbers to ensure that the assembly is not only UHV compatible, but also works properly from bakeout temperature (150C) to cryogenic temperature (80K).

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