Vacuum Technology
Room: 303 - Session VT-WeM

Accelerator and Large Vacuum Systems I
Moderator: Marcy Stutzman, Thomas Jefferson National Accelerator Facility

8:00am **VT-WeM1 Vacuum Technology Developments at Daresbury Laboratory for Modern Accelerators**, ***Keith Middleman****, A.N. Hannah, J.D. Herbert, O.B. Malyshev, R. Valizadeh*, STFC Daresbury Laboratory, UK **INVITED**

The Vacuum Science group at the STFC Daresbury Laboratory has a unique position in that it has the capability to operate and design the vacuum systems for new accelerators whilst maintaining a very active research laboratory looking at many new facets of vacuum design for accelerators. This gives the group the opportunity to develop ideas in the laboratory before implementing them on the accelerator. This paper will present some of the latest accelerator ideas and machines at Daresbury and provide an insight into how some of our laboratory developments are helping improve the vacuum design.

A range of topics will be covered such as:

1) Machine developments – VELA, CLARA and ALICE

2) NEG coatings – a new quaternary alloy with a reduced activation temperature

3) Photocathode research – metal and semiconductor cathode developments

4) Bakeout – a new permanent thin film heater coating for in-situ bakeout

5) XHV – optimising the process to routinely achieve 10^{-12} mbar

6) Thin films – SRF coating developments

8:40am **VT-WeM3 First Year Operation of NSLS-II Vacuum Systems with Beam**, ***Hsiao-Chaun Hseuh****, W. DeBoer, S. DiStefano, C. Hetzel, S. Leng, K. Wilson, D. Zigrosser, H. Xu*, Brookhaven National Laboratory

National Synchrotron Light Source II is a new synchrotron radiation facility, consisting of a 200-MeV Linac, a 3-GeV Booster and a 3-GeV storage ring. The Linac and the Booster were completed and commissioned in 2012 and 2013, respectively. The 792m storage ring was completed in January. Commissioning with electron beam is underway in the last few months. The performance of these ultrahigh vacuum systems with intense electron and X-ray beams will be described. The reliability and usefulness of over 1500 vacuum pumps and instruments will be summarized. Experience with NEG coated narrow gap chambers, in-vacuum undulators and superconducting cavity will also be presented.

*Work performed under the auspices of U.S. Department of Energy, under contract DE-AC02-98CH10886.

9:00am **VT-WeM4 APS-Upgrade Storage Ring Vacuum System Conceptual Design**, ***Herman Cease****, B. Stillwell, B. Brajuskovic, J. Nudell, J. Carter*, Argonne National Laboratory

A conceptual design is being developed for a storage ring vacuum system at the Advanced Photon Source (APS) which is compatible with a seven-bend achromat lattice under consideration by the APS Upgrade (APS-U) project. The required proximity of the magnet poles to the beam, quantity and stability of beam position monitors, synchrotron radiation loading, beam physics considerations, and installation duration place a challenging set of constraints on the vacuum system design. These requirements can be satisfied with a hybrid system which combines NEG-coated copper chambers with conventional extruded aluminum chambers housing mechanically-mounted NEG strips and discrete absorbers. The hybrid design, expected outgassing and thermal loads, and preliminary vacuum pressure analysis is described.

9:20am **VT-WeM5 APS-Upgrade Vacuum System Pressure Using a 3-D Simulation Tool**, ***Jason Carter****, H. Cease*, Argonne National Laboratory

A conceptual design is being developed for a storage ring vacuum system at the Advanced Photon Source (APS) which is compatible with a seven-bend achromat lattice under consideration by the APS Upgrade (APS-U) project. The design features a hybrid vacuum system to address outgassing and thermal loads which will combine discrete pumping, NEG-coated copper chambers, and NEG strip pumping in conventional extruded aluminum chambers. A preliminary 3D vacuum pressure analysis is described which uses the SynRad/MolFlow+ 3D vacuum analysis package developed at CERN to determine if the system can meet pressure requirements. The analysis uses the software package to predict photon stimulated desorption loads and then determine the resulting vacuum system pressure.

9:40am **VT-WeM6 For Some Results Solving Key Issues of Vacuum Systems in Electron Storage Rings**, ***Hiroshi Saeki***, Japan Synchrotron Radiation Research Institute, Japan, *T. Momose*, Emeritus Professor of Miyagi National College of Technology, Japan

From 1980's to 2000's in Japan, electron storage rings had some key issues of their vacuum systems. To overcome two key issues especially, we observed dust trapping phenomena as a key issue, using lead-glass counters at first.[1,2] Dust particles collected in beam ducts were analyzed [3] and simulation experiments to trap dust particles were carried out using these collected dust particles[2,4,5] As the results, the mechanism of the phenomena was found clearly and we knew how to prevent these phenomena occurring.[6,7] We review and discuss the phenomena using published and unpublished data.

As the other key issue, it was that ionization gauges misread due to radiation-induced currents. [8] A hot-cathode-ionization gauge with correcting electrode was developed and tested in simulation experiments [9,10,11] and in actual radiation environments.[12,13] The pressure-measurement error of the developed vacuum gauge was about 20%. We also review and discuss the vacuum gauge and other devices [14] to overcome other issues using latest data.

References

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11:00am **VT-WeM10 Progress in Thin Film Technology for Superconducting RF Applications**, ***Anne-Marie Valente-Feliciano***, Thomas Jefferson National Accelerator Facility **INVITED**

Bulk Nb has so far been the material of choice for Superconducting RF (SRF) applications. With RF cavity performance approaching the theoretical limit for bulk niobium, alternative routes for the future of superconducting structures used in accelerators are explored. Over the years, Nb/Cu technology has positioned itself as an alternative route for the future of superconducting structures used in accelerators, but has suffered shortcomings due to the commonly used magnetron sputtering. The recent developments in ionized PVD coating techniques (i.e. vacuum deposition techniques using energetic ions) such as Electron Cyclotron Resonance (ECR) and High Power Impulse Magnetron Sputtering (HiPIMS) are opening avenues for the production of thin films tailored for SRF applications based on Nb and alternative materials.

This contribution reports the on-going efforts pursued at Jefferson Lab and in different institutions to exploit the potential of novel film technologies to produce bulk-like Nb films and go beyond Nb performance with the development of film systems, based on other superconducting materials and multilayer structures.

11:40am **VT-WeM12 Modeling and Measurement of a Tesla-like Cage Cavity**, ***John Noonan***, *M.J. Virgo, T.L. Smith*, Argonne National Laboratory

The cage cavity is an RF cavity fabricated by forming tubes to follow the surface contour of a cavity design, e.g. a TESLA cavity, and assembling the tubes to form a closed cavity. Computer simulations demonstrated that the cage cavity had the potential to be a cost effective alternative to solid wall cavities. However, early RF spectrum measurements did not agree with the simulations. The cage cavity can approach RF properties of a solid wall cavity by using a coupled cavity design: The cage cavity is mounted in a large RF cavity in which this cavity's Eigen frequencies are decoupled from the cage cavity's Eigen frequencies. Computer models of the coupled cavity system will be presented to show that the quality factor of the cage cavity can be ~90% of the Q for a solid wall, superconducting cavity. The simulations also demonstrate several advantages of the cage cavity over a solid wall cavity, i.e. high order harmonic suppression, power coupling, and tuning. A prototype coupled cavity system has been fabricated and measurements of a cage cavity in a coupled cavity will be presented.

12:00pm **VT-WeM13 e-Cloud Activity of DLC Coated Chamber at FNAL Main Injector**, ***Shigeki Kato***, KEK-High Energy Accelerator Research Organization, Japan, *J. Eldred*, Indiana University, *C.Y. Tan, M. Backfish, B. Zwaska*, FNAL

Carbon material that has a low mass density (resulting a long electron penetration depth in bulk), a low δ_{max} and a low secondary electron yield is of good option to mitigate electron cloud activity in particle beam chambers. In addition to this, diamond-like-carbon (DLC) coating on beam chambers would give advantages of a large deposition rate (a couple of μm/h), inexpensiveness(~US$800.- /m for coating of 100m), a good uniformity(±5%) and coating applicability on any type of beam chamber (even bent one) and on any material without requirement of magnetic field. A DLC coated stainless steel chamber and a reference stainless chamber were installed into the FNAL main injector simultaneously in order to investigate e-cloud activity in the chambers with three retarding field analyzers(RFAs). Preliminary results at the low beam intensity showed RFA signals in the DLC coated chamber showed only 1/100 of that in the steel chamber. The e-cloud activity at the higher beam intensity and comparison of e-cloud activity at usually prepared surface (smooth surface) with roughed surface to aim further reduction of the activity will be also reported in the presentation.

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