Vacuum Technology Division
Room 610 - Session VT-FrM
Vacuum Systems, Design, and Engineering

Moderator: L.A. Smart, Brookhaven National Laboratory

8:20am **VT-FrM1 Electron-Cloud-Induced Effects in the APS Storage Ring*,** ***R.A. Rosenberg****, K.C. Harkay,* Argonne National Laboratory

Synchrotron radiation interacting with the vacuum chamber walls in a storage ring produces photoelectrons that can be accelerated by the beam and scatter from the walls, producing secondary electrons. If the secondary-electron yield (SEY) coefficient of the wall material is greater than one, the electron intensity can be amplified (termed "multipactoring") and a runaway condition can develop. This "electron cloud" can degrade the stored beam through direct interaction or by electron-stimulated desorption of gases from the chamber walls. The energy and intensity of the electron cloud is strongly dependent on both the amount of charge in each bunch of the stored beam and their temporal distribution. In order to obtain direct evidence of the properties of the electron cloud, a special aluminum (SEY > 1) vacuum chamber was built and inserted into the Advanced Photon Source (APS) storage ring. The chamber contains ten rudimentary electron-energy analyzers. Measurements to date have shown that the intensity and electron energy distribution are highly dependent on the temporal spacing between adjacent positron bunches and the amount of current contained in each bunch. Dramatic increases in pressure are observed when the temporal distribution and intensity of the bunches are configured to maximize multipactoring. Results of measurements of the electron energy distribution and concurrent pressure will be presented and discussed in terms of models of the electron cloud. *The submitted manuscript has been created by the University of Chicago as Operator of Argonne National Laboratory ("Argonne") under Contract No. W-31-109-ENG-38 with the U.S. Department of Energy. The U.S. Government retains for itself, and others acting on its behalf, a paid-up, nonexclusive, irrevocable worldwide license in said article to reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, by or on behalf of the Government.

8:40am **VT-FrM2 Vacuum Simulation of Linac Components to Optimize Pump Designs*,** ***L.S. Tung,*** Lawrence Livermore National Laboratory, US*; P. Shoaff, S. Shen,* Lawrence Livermore National Laboratory

Methods have been developed to model the pressure history in linear accelerator components using Mathematica@footnote 1@ and Mathcad.@footnote 2@ The components are divided into sub-volumes represented as a lumped volume at a point in space. These sub-volumes are separated by conductances. The pressure distribution is obtained by solving the gas load equations for each sub-volume simultaneously for each time during pumpdown to the base pressure. Our models include the pressure dependence of speeds for all the system pumps as determined by a numerical fit to graphs provided by the vendor. Also included is the time-dependent outgassing history of oven-brazed copper based on recent rf cavity experiments and textbook data. Additionally, cryogenic pumping effects have been integrated into the modeling of the vacuum response in a superconducting linac structure. With these models, we can optimize the manifold design and pumping configurations. Our approach is especially useful for extrapolating costs for a large-scale linac. @FootnoteText@ *Work performed under the auspices of the U. S. Department of Energy by the Lawrence Livermore National Laboratory under contract number W-7405-ENG-48. @footnote 1@Mathematica software by Wolfram. @footnote 2@Mathcad software by Math Soft.

9:00am **VT-FrM3 Experiences on the Preparation and Assembly of The Superconducting Linear Accelerator for the TESLA Test Facility,** ***A. Matheisen,*** TESLA Collaboration, DESY, Germany **INVITED**

A description of the superconducting TESLA Test Facility Linear Accelerator, which is under installation at DESY by the TESLA collaboration and of the planed VUV FEL user facility will be given. We report on the infrastructure and technologies for preparation of accelerator components. Detailed information on the preparation sequences for cavities and the connected UHV beam-line equipment under cleanroom conditions of class 10 ASTM quality will be given. Experiences in handling, preparation and the efforts in quality control of components with the need of minimum contamination by particulates to reach acceleration gradients of above 25 MV/m will presented. @FootnoteText@ *TESLA Collaboration: Armenia: Yerevan Pysics Institue, P.R.China: IHEP Beijing, Tsinghua Univ. Beijing, Finland: Inst. of Physics Helsinki, France: CEA/DSM Saclay, IN2P3 Orsay, Germany: May Born Inst. Berlin, DESY Hamburg/ Zeuthen, Univ. Wuppertal, Univers. Hamburg, Univ. Frankfurt, GKSS Geesthacht, FZ Karlsruhe, TU Darmstadt, TU Berlin, TU Dresden, RWTH Aachen, Univ. Rostock. Italy: INFN Frascati, INFN Legnaro, INFN Milano, INFN Roma II, Poland: Polish Acad. of science, Univ. Warsaw, INP Cracow, Univ. of Mining &Metallurgy, polish Atomic Energy Agency Energy Agency, Soltan Inst. for Nuclear Studies, Russia: JINR Dubna, IHEP Portvino, INP Novosibirsk, INR Troitsk, USA Argonne National Lab. Cornell Univ., FNAL, UCLA

9:40am **VT-FrM5 APT LEDA CCDTL "HOT MODEL" Vacuum System,** ***T.J. Whelan,*** AlliedSignal Federal Manufacturing and Technologies*; P.O. Leslie,* Los Alamos National Laboratory

The vacuum system for the APT/LEDA/CCDTL (Accelerator Production of Tritium/ Low Energy Demonstration Accelerator/Coupled-Cavity Drift Tube Linac) Hot Model has been installed and is currently operating at Los Alamos National Laboratory (LANL). The Hot Model has been built to test a new concept in accelerator technology. The vacuum system was designed and partially assembled and then shipped to LANL for final assembly and installation on the APT/LEDA/CCDTL. The system was designed for both flexibility and low cost. Simple outgassing and conduction models were used to predict pumping needs. This design contains almost no custom parts, which allows for quick and inexpensive changes as needed. The system consists of three pumping stages: roughing, turbomolecular, and ion and utilizes all four of the available ports on the Hot Model. This has allowed the system to reach a better level of vacuum than the originally anticipated need. @FootnoteText@ Work performed at AlliedSignal FM&T which is Operated for the United States Department of Energy under Contract No. DE-ACO4-76-DP00613.

10:00am **VT-FrM6 DA@PHI@NE Vacuum System,** ***A. Clozza,*** *V. Chimenti, C. Vaccarezza,* Istituto Nazionale di Fisica Nucleare, Italy

A 510 MeV high luminosity @PHI@-factory is operating at INFN Fascati National Laboratory, Italy. The accelerator complex consists of a full energy Linac, a small damping ring and a double electron-positron high current storage ring. We describe in the following the main rings vacuum system. The design is based on the requirement of 1x10@super -9@ mbar as dynamic pressure with a gas load of about 1x10@super -4@ mbar l/s per ring. The main features of the vacuum system are: all metal aluminum vacuum chamber with proper surface finishing; special alloy bolt set; monolithic water cooled copper synchrotron light absorbers; high capacity titanium sublimation pumps; lumped and distributed sputter ion pumps and high capacity non evaporable getter pumps.

10:20am **VT-FrM7 Thin-walled Vacuum Chambers of Austenitic Stainless Steel,** ***B.C. Moore,*** Consultant

It is proposed, and recommended, that vacuum chambers and systems to be built of austenitic stainless steel should be designed for the thinnest walls possible, consistent with structural integrity under atmospheric pressure. The reason for this design goal is to greatly reduce the time, effort and cost needed to outgas the chambers to reach the desired and specified vacuum level. Of course, this is directly contrary to the universally accepted concern with permeation of atmospheric hydrogen. This concern has recently been shown to be greatly exaggerated. Atmospheric permeation is at least 100 times less than previously estimated, and is possibly non-existent. Errors in the previous estimate will be briefly summarized. Published outgassing of two relatively thin-walled chambers will be discussed. Methods to predict the hydrogen outgassing rates for specific wall thicknesses and bakeout procedure will be given. Vacuum oven bakes result in a flat, uniform atomic hydrogen concentration profile within the wall and give clean, unoxidized surfaces; the instantaneous outgassing rate is directly proportional to the hydrogen recombination coefficient (at the bake temperature), and to the hydrogen concentration level, while the time required for this rate to decay varies linearly with the wall thickness. In contrast, an 'in situ' bake, with atmosphere on one side and vacuum on the opposite side of the wall, results in an asymmetric concentration profile, with a minimum on the atmospheric side and a maximum on the vacuum side. To further confuse the issue, room temperature operation also causes an asymmetric concentration profile, but in the opposite direction, with the minimum on the vacuum side. Thin walls can be stiffened with rolled in ribs which are substantially thicker than the wall itself. This ribbed structure can be further strengthened by coaxial wraps over the ribs, or by longitudinal bars added outside the ribs. Methods of measuring and calibrating the hydrogen outgassing rates, and of presenting the data, will be discussed briefly.

10:40am **VT-FrM8 Increased Utilization of Semiconductor Process Equipment through Comprehensive Downstream By-product Management**, ***T.E. Nilsson***, Nor-Cal Products, Inc.

Fab maintenance personnel and equipment manufacturers share the common goal of extending preventative maintenance intervals and reducing wafer defects in process equipment in order to increase return on investment. Condensable by-product accumulation in forelines, dry pumps and exhaust lines is a significant contributor to wafer defects and planned and unplanned maintenance. Vacuum components, such as heater jackets and foreline traps, can extend preventative maintenance intervals dramatically when applied properly to a specific process. A Comprehensive Downstream Solution is one that first takes into account the specific process chemistries, temperatures and pressures, as well as any equipment constraints. The array of vacuum components and special treatments are passed through two filters: component configuration and a cost of ownership model. Component configuration considers the effect on the performance of the components by changing their relative position in the system. A cost of ownership model is developed with the customer for each option proposed showing the cost of the improvement and the pay back in terms of savings on maintenance and increased production.

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