BNL-93665-2010-CP

# NSLS-II Vacuum System*

M. Ferreira*, L. Doom, H. Hseuh, C. Longo, P. Settepani, K. Wilson
*National Synchrotron Light Source II Project*
*Brookhaven National Laboratory*
*Upton, NY 11973-5000, USA*

J. Hu
*National Synchrotron Light Source*
*Brookhaven National Laboratory*
*Upton, NY 11973-5000, USA*

*Brazilian Vacuum Congress , Hotel Leäo da Montanha, Campos do Jordäo, SP, Brazil, September 13-16, 2009*

National Synchrotron Light Source
Brookhaven National Laboratory
P.O. Box 5000
Upton, NY 11973
www.bnl.gov

**September 2009**

Notice: This manuscript has been authored by employees of Brookhaven Science Associates, LLC under Contract No. DE-AC02-98CH10886 with the U.S. Department of Energy. The publisher by accepting the manuscript for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this manuscript, or allow others to do so, for United States Government purposes.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessary constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expresses herein do not necessarily state to reflect those of the United States Government or any agency thereof.

## ABSTRACT

National Synchrotron Light Source II, being constructed at Brookhaven, is a 3-GeV, 500 mA, 3rd generation synchrotron radiation facility with ultra low emittance electron beams. The storage ring vacuum system has a circumference of 792 m and consists of over 250 vacuum chambers with a simulated average operating pressure of less than $1x10^{-9}$ mbar. A summary of the update design of the vacuum system including girder supports of the chambers, gauges, vacuum pumps, bellows, beam position monitors and simulation of the average pressure will be shown. A brief description of the techniques and procedures for cleaning and mounting the chambers are given.


## Introduction

National Synchrotron Light Source II (NSLS-II), being constructed at Brookhaven, is a 3 GeV, 500 mA, 3rd generation synchrotron radiation facility with ultra low emittance electron beams. The storage ring vacuum system has a circumference of 792 m and consists of over 250 vacuum chambers with a simulated average operating pressure of less than $1x10^{-9}$ mbar [1]. A summary of the design of the vacuum system including girder supports of the chambers, gauges, vacuum pumps, bellows, beam position monitors and simulation of the average pressure will be shown. A brief description of the techniques and procedures for cleaning and mounting the chambers are given.

## Vacuum system

The storage ring vacuum system includes all vacuum chambers, vacuum pumps, vacuum valves, bake-out systems, and vacuum instrumentation and control. There are 30 cells in the storage ring. Each vacuum cell consists of five basic chambers; an upstream straight chamber, a dipole chamber, a mid-section straight chamber, a second dipole chamber, and a downstream straight chamber. Most of the storage ring chambers will be made of extruded aluminum with a quasi elliptical cross-section including an anti-chamber for non-evaporable getter (NEG). Bi-metal Conflat flanges with copper gaskets will be used throughout the vacuum systems, except for the flanges and seals for beam position monitor buttons, where Helicoflex delta seals will be employed. A typical vacuum cell layout is shown in Figure 1

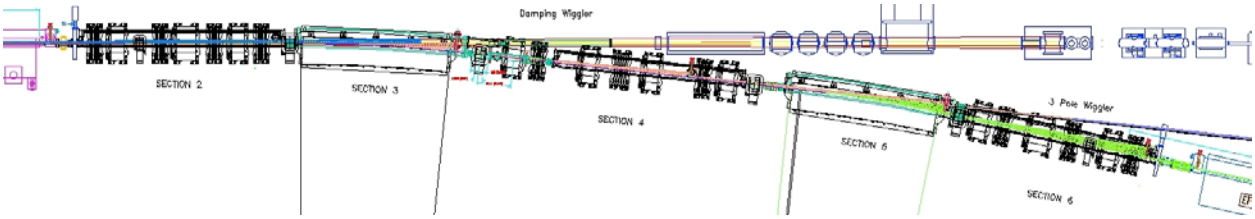


**Figure 1.** *Typical vacuum even cell including magnets (dipoles, quadrupoles, sextupoles, correctos and insertion devices), gate valves, ion pumps and a schematic of a front-end beam-line.*

The dipole magnet chambers are approximately three meters long and the straight chambers for the multipole magnets 4 to 5 m long. All-metal RF-shielded gate valves will be employed to isolate each of the 30 cells and the long straight sections between cells. The impedance of the vacuum chamber should be low enough so as not to excite higher-order mode resonances. Smooth cross sectional transitions between components are required, as are flexible interfaces such as RF-shielded bellows between cell chambers and insertion devices. The entire set of vacuum cells will be *in-situ* bakeable up to 150°C to remove adsorbents and contaminants using tubular Cal rod heater inserted at one chamber channel. A pre-baking after each girder assembling and magnets vibrating wire alignment [1] will be at 120°C following a 60°C oxygen/ozone 400 ppm treatment to remove carbon contaminants. External heating jackets will be used for the bakeout of the appendage vacuum components. The storage ring cell will be pumped down with a turbo-molecular pump backed by a dry mechanical pump during the bakeout.The chambers will use sputter ion pumps, NEG, and titanium sublimation pumps (TSP) for their main ultra-high vacuum pumping. The vacuum level in the storage ring, the front ends, and the beam lines will be monitored and interlocked with the ion pump current and with inverted-magnetron vacuum gauges. Residual gas analyzers will also be used for online monitoring and diagnosis. A summary of the vacuum system simulation will be presented, based on outcome window-version Monte-Carlo based MOLFLOW+ code.

**Reference**

[1] NSLS-II Conceptual Design Report, December 2006 (http://www.bnl.gov/nsls2/project/CDR/NSLS-II_Conceptual_Design_Report.pdf).

( * Work performed under auspices of the US Department of Energy, under contract DE-AC02-98CH10886)