80th IUVSTA Workshop

Ultra Low Emittance Light Source Vacuum Systems

Oct. 24 - 28, 2016, NSRRC, Hsinchu, Taiwan

PROGRAM BOOK

TVS NSRRC IUVSTA

www.taiwanvacuum.org • 台灣真空學會

TAIWAN VACUUM SOCIETY

真空產業推動服務・人才培育教育訓練・企業客製課程培訓・產學研發媒合平台

80th IUVSTA Workshop on the Ultra Low Emittance Light Source Vacuum Systems, Oct. 24-28, NSRRC, Hsinchu, Taiwan

Workshop Program

2016	10/24 MON		10/25 TUE		10/26 WED		10/27 THU		10/28 FRI
		08:30	**Departure (Hotel) to NSRRC**	08:30	**Departure (Hotel) to NSRRC**	08:30	**Departure (Hotel) to NSRRC**	08:30	**Departure (Hotel) to NTHU**
		Mod	**Hsiung, Gao-Yu**	Mod	**Cox, Matthew**	Mod	**Chiggiato, Paolo**		
		09:00	Opening	09:00	Ohkuma, Haruo (18)	09:00	Suetsugu, Yusuke (23)	09:00	**Registration**
		09:15	Grabski, Marek (12)	09:15		09:15		09:15	
		09:30		09:30	Oishi, Masaya (17)	09:30	Cox, Matthew(21)	09:30	**TVS-2016** (30th Anniversary) Annual Symposium
		09:45	Hahn, Michael (16)	09:45		09:45		09:45	
		10:00		10:00	Honda, Tohru (29)	10:00	Sonderegger, Kurt (31)	10:00	
		10:15	Schneck, Uwe (14)	10:15		10:15		10:15	
		10:30	Break	10:30	Break	10:30	Break	10:30	
		10:45		10:45		10:45		10:45	
		Mod	**Anders, Andre**	Mod	**Setina, Janez**	Mod	**Kersevan, Roberto**		
		11:00	Costa Pinto, Pedro(4)	11:00	Kersevan, Roberto (3)	11:00	Anders, Andre (11)	11:00	
		11:15		11:15		11:15		11:15	
		11:30	Amador, Lucia Lain (5)	11:30	Carter, Jason(27)	11:30	Mase, Kazuhiko (22)	11:30	
		11:45	He, Ping (28)	11:45		11:45		11:45	
		12:00	Porcelli, Tommaso (10)	12:00	Ady, Marton (6)	12:00	Sitko, Monika (7)	12:00	Lunch Break Industrial Presentations
		12:15	Chen, June-Rong (13)	12:15	Hsueh, Hsin-Pai (20)	12:15	Deiwiks, Jochen (15)	12:15	
		12:30		12:30	Tamimoto, Yasunori (30)	12:30	Hsueh, Hsin-Pai (19)	12:30	
		12:45	**Lunch Break**	12:45	**Lunch Break**	12:45	**Lunch Break**	12:45	
		13:00		13:00		13:00		13:00	**5th International Joint Symposium** on "Advanced Vacuum Technologies and Applications"
		13:15		13:15		13:15		13:15	
						Mod	**Suetsugu, Yusuke**		
		13:30	**Group Photo**	13:30	**Excursion**	13:30	Seify, Omid (9)	13:30	
		13:45	**TPS Tour**	13:45		13:45		13:45	
		14:00		14:00		14:00	Tanabe, Toshiya (8)	14:00	
		14:15		14:15		14:15		14:15	
		14:30		14:30		14:30	Setina, Janez (25)	14:30	
		14:45		14:45		14:45		14:45	
15:00	Check in at Lakeshore Hotel Hsinchu	15:00		15:00		15:00	Weston, Thomas(1)	15:00	
15:15		15:15	Break	15:15		15:15		15:15	
		Mod	**Chen, June-Rong**			15:30	Chen, Bob (32)	15:30	
15:30		15:30	Carter, Jason (26)	15:30		15:45		15:45	
15:45		15:45		15:45		16:00	Break	16:00	
16:00		16:00	Hseuh, Hsiao-Chaun (2)	16:00		16:15		16:15	
16:15		16:15		16:15		Mod	**Hsiung, Gao-Yu**		
16:30		16:30	Herbeaux, Christian (34)	16:30		16:30	**General Discussion**	16:30	
16:45		16:45		16:45		16:45		16:45	
17:00	Registration Badge & Package (at Hotel)	17:00	Ha, Taekyun (33)	17:00		17:00	**Summary & Closing**	17:00	
17:15		17:15	Flaemmich, Michael (24)	17:15		17:15		17:15	**Wrap up**
17:30		17:30		17:30		17:30	**Wrap up**	17:30	
17:45		17:45	**Wrap up**	17:45		17:45		17:45	
18:00	**Welcome Reception** (at Hotel)	18:00		18:00	**Workshop Dinner**	18:00		18:00	**Banquet** TVS-2016 Symposium
18:15				18:15				18:15	
18:30				18:30				18:30	
18:45				18:45				18:45	
19:00				19:00				19:00	
19:15				19:15				19:15	
19:30				19:30				19:30	
19:45				19:45				19:45	
20:00				20:00				20:00	

Name (Abstract #)
Invited Speaker
Session Moderator

Hotel: Lakeshore Hotel
NSRRC: National Synchrotron Radiation Research Center
NTHU: National Tsing Hua University

80th IUVSTA Workshop on the Ultra Low Emittance Light Source Vacuum Systems, Oct. 24-28, NSRRC, Hsinchu, Taiwan

No.	Participant Name	Affiliation, Country	E-mail
01	Ping He	IHEP, China	heping@ihep.ac.cn
02	Xiao Hu	SSRF, China	huxiao@sinap.ac.cn
03	Michael Hahn	ESRF, France	hahn@esrf.fr
04	Christian Herbeaux	Synchrotron SOLEIL, France	christian.herbeaux@synchrotron-soleil.fr
05	Nils Plambeck	DESY, Germany	nils.plambeck@desy.de
06	Jochen Deiwiks	FMB, Germany	j.deiwiks@fmb-berlin.de
07	Uwe Schneck	FMB, Germany	u.schneck@fmb-berlin.de
08	Michael Flaemmich	VACOM, Germany	michael.flaemmich@vacom.de
09	Omid Seify	ILSF, Iran	seify@ipm.ir
10	Paolo Manini	SAES Getters SpA, Italy	paolo_manini@saes-group.com
11	Tommaso Porcelli	SAES Getters SpA, Italy	tommaso_porcelli@saes-group.com
12	Kazuhiko Mase	KEK, Japan	kazuhiko.mase@kek.jp
13	Tohru Honda	KEK, Japan	tohru.honda@kek.jp
14	Yasunori Tanimoto	KEK, Japan	yasunori.tanimoto@kek.jp
15	Yusuke Suetsugu	KEK, Japan	yusuke.suetsugu@kek.jp
16	Akiko Itakura	NIMS, Japan	itakura.akiko@nims.go.jp
17	Haruo Ohkuma	SPring-8, Japan	ohkuma@spring8.or.jp
18	Masaya Oishi	SPring-8, Japan	moishi@spring8.or.jp
19	Taekyun Ha	PAL, Korea	hatae@postech.ac.kr
20	Aleksander Krasnov	BINP, Russia	A.A.Krasnov@inp.nsk.su
21	Alexandr Zhukov	BINP, Russia	A.A.Zhukov@inp.nsk.su
22	Konstantin Zolotarev	BINP, Russia	zolotarev@inp.nsk.su
23	Sergei Gurov	BINP, Russia	S.M.Gurov@inp.nsk.su
24	Yaroslav Kryuchkov	BINP, Russia	Yaroslav G. Kruchkov@inp.nsk.su
25	Janez Setina	IMT, Institute of Metals and Technology, Slovenia	janez.setina@imt.si
26	Marek Grabski	MAX Lab, Sweden	marek.grabski@maxiv.lu.se
27	Lucia Lain Amador	CERN, Switzerland	lucia.lain.amador@cern.ch
28	Marton Ady	CERN, Switzerland	marton.ady@cern.ch
29	Monika Sitko	CERN, Switzerland	Monika.Sitko@cern.ch
30	Paolo Chiggiato	CERN, Switzerland	paolo.chiggiato@cern.ch
31	Pedro Costa Pinto	CERN, Switzerland	Pedro.Costa.Pinto@cern.ch
32	Roberto Kersevan	CERN, Switzerland	roberto.kersevan@cern.ch
33	Kurt Sonderegger	VAT Vakuumventile AG, Switzerland	k.sonderegger@vat.ch
34	Gao-Yu Hsiung	NSRRC, Taiwan	hsiung@nsrrc.org.tw
35	Hsin-Pai Hsueh	NSRRC, Taiwan	hxh167@nsrrc.org.tw
36	June-Rong Chen	NSRRC, Taiwan	jrchen@nsrrc.org.tw
37	LingHui Wu	NSRRC, Taiwan	wu.lh@nsrrc.org.tw
38	Yi-Chen Yang	NSRRC, Taiwan	jolas@nsrrc.org.tw
39	Yuan-Ming Hsiao	NSRRC, Taiwan	Hsiao.ym@nsrrc.org.tw
40	Yu-Tsun Cheng	NSRRC, Taiwan	Cheng.yt@nsrrc.org.tw
41	Bob H. Y. Chen	Wave Power Technology Inc., Taiwan	Bob.chen@wavepower.com.tw
42	Apichai Kwankasem	SLRI, Thailand	apichai@slri.or.th
43	Supan Boonsuya	SLRI, Thailand	supan@slri.or.th
44	Visitchai Sooksrimuang	SLRI, Thailand	visitchai@slri.or.th
45	Matthew Cox	Diamond Light Source, UK	matthew.cox@diamond.ac.uk
46	Thomas Weston	STFC, Daresbury Laboratory, UK	thomas.weston@stfc.ac.uk
47	Jason Carter	APS, ANL, USA	jacarter@aps.anl.gov
48	Hsiao-Chaun Hseuh	BNL, USA	hseuh@bnl.gov
49	Toshiya Tanabe	BNL, USA	ttanabe@bnl.gov
50	Andre Anders	LBNL, USA	aanders@lbl.gov

80th IUVSTA Workshop on the Ultra Low Emittance Light Source Vacuum Systems
Oct. 24-28, NSRRC, Hsinchu, Taiwan

CONTENTS

- ## Organizations

TVS NSRRC IUVSTA

Hosted and Sponsored by

- Taiwan Vacuum Society (TVS)
- National Synchrotron Radiation Research Center (NSRRC)

Endorsed by

- International Union for Vacuum Science, Technique and Applications (IUVSTA)

- ## Goal of the workshop

The goal of this workshop is to find the best solutions on the vacuum design and the manufacturing processes for those upgrade projects, ongoing or being planned, of synchrotron light source facilities to achieve the ultra-low emittance of < 0.5 nm·rad. There are many challenging issues on vacuum design and engineering under debate and need to be well evaluated by the vacuum experts from the worldwide institutes or facilities. This workshop provides a forum for intensive discussions after each presentation.

- ## Principal Themes / Topics

1. Facility reports & project overview for synchrotron light sources with ultra low emittance, on-going or being planned
   - facility status, projects ongoing or under planning
2. Design concepts of the vacuum systems for ultra-low emittance synchrotron light sources
   - pros, cons and critical issues, beam duct with low impedance & UHV, materials, in-situ baking or not, etc.
3. Surface engineering and treatments for low outgassing and desorption rates
   - surface cleaning, oil-free machining, interior surface coating, etc.
4. NEG-coating technologies, development and applications
   - NEG-coating processes, characteristics of the NEG film, features of pumping and outgassing
5. Critical vacuum components accommodating high beam current operation
   - low impedance RF-bridges and vacuum sealing design, high heat load components, bimetallic components, ceramic chambers, BPM and diagnostics, etc.

6. Methodology of manufacturing and construction
    ■ manufacturing methods, processes, quality control, reliability and stability control
7. Pressure distribution & modelling
    ■ modelling, simulation codes, practical measurements, applications, etc.

• Committees (in alphabetical order by last name)

■ **International Organizing Committee (Chair*)**

Gao-Yu Hsiung* (NSRRC, Taiwan)
Jay Hendricks (NIST, USA)
Joe Herbert (ASTeC, UK)
Tohru Honda (KEK, Japan)
Hsiao-Chaun Hseuh (BNL, USA)
Yoshio Saito (ICRR, Univ. Tokyo, Japan)

■ **Program Committee (Chair*)**

Hsiao-Chaun Hseuh* (BNL, USA)
Eshraq Al-Dmour (MAX IV, Sweden)
Paolo Chiggiato (CERN, Switzerland)
Matthew Cox (Diamond, UK)
Michael Hahn (ESRF, France)
Jay Hendricks (NIST, USA)
Joe Herbert (ASTeC, UK)
Tohru Honda (KEK, Japan)
Gao-Yu Hsiung (NSRRC, Taiwan)
Hsin-Pai Hsueh (NSRRC, Taiwan)
Kazuhiko Mase (KEK, Japan)
Yusuke Suetsugu (KEK, Japan)

■ **Local Committee (Chair*)**

Hsin-Pai Hsueh* (NSRRC, Taiwan)
Chia-Mu Cheng (NSRRC, Taiwan)
Jyun Yan Chuang (NSRRC, Taiwan)
Ying-Tzu Huang (NSRRC, Taiwan)
Cheng-Ying Kuo (NSRRC, Taiwan)
An-Ping Lee (NSRRC, Taiwan)
Sherry Tsao (TVS, Taiwan)
Eleen Lin (TVS, Taiwan)

- ## Invited Speakers (in alphabetical order by last name)

  - **Andre Anders (LBNL, USA)**
    Non-evaporative getter (NEG) coatings for ultrahigh vacuum in very narrow chambers
  - **Jason Carter (ANL, USA)**
    APS-Upgrade Vacuum System Status
  - **June-Rong Chen (NSRRC, Taiwan)**
    The vacuum systems and studies for the low emittance storage rings at NSRRC
  - **Pedro Costa Pinto (CERN, Switzerland)**
    NEG coating for high aspect ratio vacuum chambers
  - **Matthew Cox (Diamond, UK)**
    Status of the Diamond Light Source DDBA cell vacuum system and ideas for a Diamond II upgrade
  - **Marek Grabski (MAX IV, Sweden)**
    MAX IV 3 GeV storage ring vacuum system: from development to operation
  - **Michael Hahn (ESRF, France)**
    Vacuum for the ESRF EBS project
  - **Roberto Kersevan (CERN, Switzerland)**
    Integrated montecarlo simulation environment for light source design
  - **Haruo Ohkuma (SPring-8, Japan)**
    20 year's operational experiences of SPring-8 storage ring vacuum system
  - **Masaya Oishi (SPring-8, Japan)**
    Design for the SPring-8 upgrade storage ring vacuum system
  - **Omid Seify (ILSF, Iran)**
    Challenges in design of vacuum system of ultra low emittance storage ring of Iranian Light Source Facility (ILSF)
  - **Yusuke Suetsugu (KEK, Japan)**
    Experiences in the KEKB and Super KEKB vacuum systems
  - **Toshiya Tanabe (BNL, USA)**
    Insertion Devices and Vacuum Related Activities at the NSLS-II

- ## Registration

Registration fee for the workshop is NTD18,000 (US$570 or 500 Euros) which includes shuttle service between the workshop Hotel and NSRRC, excursion, welcome reception, and workshop dinner. Registration fee is waived for the invited speakers. Registration fee can only be paid by bank transfer. Please provide the following information to the accountant for the bank transfer.

1. Full amount of payment: NTD18,000 (The amount should not include the transfer fee)
2. Please pay full amount into our account in bank, and promptly provide us the "name of the payer", "transferred bank account no.", "total amount of transfer", and "names of the registered participants", via the e-mail to iuvsta-80@nsrrc.org.tw for the confirmation.
3. Bank account information is shown as following:
   (1) Bank account number: 020-09107351
   (2) Bank address: Mega International Commercial Bank, No.1, Xin'an Rd., East Dist., Hsinchu City 300, Taiwan (R.O.C.)
   (3) SWIFT code: ICBCTWTP020
   (4) Bank account owner: Taiwan Vacuum Society
   (5) VAT number of account owner: 01006404
4. Download the Registration form: & Submit via e-mail to iuvsta-80@nsrrc.org.tw

- ## Accommodation

All the participants will be accommodated in the "Lakeshore Hotel Hsinchu" (4-star) during the workshop. The special discounted rate for the workshop's participants only from Oct. 23, 2016 through Oct. 30, 2016 (breakfast included) for Executive Room is NTD2,500 (US$80 or 70 Euros) per night.

- ## Venue

National Synchrotron Radiation Research Center (NSRRC), 101 Hsin-Ann Road, Hsinchu Science Park, Hsinchu 30076, Taiwan.

http://www.nsrrc.org.tw/english/location.aspx

- **Social Program**

Oct. 24 (Mon) **09:00 ~ 15:00** **County Tour**

Yingge Ceramics Museum

Let's Kiss Baby

Dialog box

Chick Creamer Tank

Beipu Township

Oct. 25 (Tue) **18:30 ~ 20:30** **Downtown Hsinchu**

Du Cheng Huang Temple

Du Cheng Huang Temple

Oct. 26 (Wed) **13:00 ~ 18:00** **Excursion: National Palace Museum, Taipei 101**

19:00 ~ 21:00 **Workshop Dinner: Hsin Sheng Ti Seafood Restaurant**

Oct. 27 (Thu) 18:30 ~ 20:30 Chiu-Chi Mochi DIY (邱記麻糬)

Oct. 28 (Fri) 18:30 ~ 20:30 Banquet of TVS-2016/InJoSy-5 Joint Symposia (US$50)

Pengyuan Agora Garden (彭園會館)

10/29 (Sat) ~ 10/30 (Sun) Tainan City Tour (USD250 including bus, meals, one-night hotel)

• Contact Information

■ **IUVSTA-80 Secretariat**

Phone: +886-3-5780281 ext. 6345

E-mail: iuvsta-80@nsrrc.org.tw

Website: http://iuvsta-80.nsrrc.org.tw/

■ **Taiwan Vacuum Society (TVS)**

Phone: +886-3-5795046

E-mail: taiwanvacuum@taiwanvacuum.org

Website: http://www.taiwanvacuum.org/index.php/en/ws80

Presentations of the 80th IUVSTA Workshop, Oct. 24-28, 2016, NSRRC, Hsinchu, TAIWAN

Tuesday, 25 Oct, 2016

08:30	**Bus leaves from Lakeshore Hotel to NSRRC**	
Session 1 - Moderator - Gao-Yu Hsiung		
09:00	**Opening**	**Shangjr Gwo, NSRRC**
09:15	**MAX IV 3 GeV storage ring vacuum system: from development to operation (Invited)**	**Marek Grabski, MAX Lab.**
09:45	**Vacuum for the ESRF EBS project (Invited)**	**Michael Hahn, ESRF**
10:15	Preparing and executing production of complete storage ring vacuum systems – Experience of a supplier	Uwe Schneck, FMB
10:30	**Break**	
Session 2 - Moderator - Andre Anders		
11:00	**NEG coating for high aspect ratio vacuum chambers (Invited)**	**Pedro Costa Pinto, CERN**
11:30	Development of copper electroformed chambers with integrated getter thin film coating	Lucia Lain Amador, CERN
11:45	NEG coating R&D for HEPS-TF at IHEP	Ping He, IHEP
12:00	Different approaches in the design of vacuum systems for synchrotron light sources based on NEG technology	Tommaso Porcelli, SAES
12:15	**The vacuum systems and studies for the low emittance storage rings at NSRRC (Invited)**	**June-Rong Chen, NSRRC**
12:45	**Lunch Break**	
13:30	**Group Photo**	
13:45	**TPS Tour**	
15:15	**Break**	
Session 3 - Moderator - June-Rong Chen		
15:30	**APS-Upgrade Vacuum System Status (Invited)**	**Jason Carter, APS**
16:00	Two-Year Operation Experience of NSLS-II Storage Ring Vacuum Systems	Hsiao-Chaun Hseuh, BNL
16:30	10 year experience of operation with NEG coating in storage ring the SOLEIL synchrotron light source	Christian Herbeaux, Synchrotron SOLEIL
17:00	Study of Vacuum Chamber Upgrading in PLS-II	Taekyun Ha, PAL
17:15	Low outgassing stainless steel and aluminum CF components	Michael Flaemmich, VACOM
17:45	**Wrap up**	

Wednesday, 26 Oct., 2016

08:30	**Bus leaves from Lakeshore Hotel to NSRRC**	
Session 4 - Moderator - Matthew Cox		
09:00	**20 year's operational experiences of SPring-8 storage ring vacuum system (Invited)**	**Haruo Ohkuma, SPring-8**
09:30	**Design for the SPring-8 upgrade storage ring vacuum system (Invited)**	**Masaya Oishi, SPring-8**
10:00	Design Concept of KEK Light Source based on HMBA Lattice	Tohru Honda , KEK
10:30	**Break**	
Session 5 - Moderator - Janez Setina		
11:00	**Integrated montecarlo simulation environment for light source design (Invited)**	**Roberto Kersevan, CERN**
11:30	APS-Upgrade Vacuum System Simulations with SynRad and MolFlow	Jason Carter, APS
12:00	Simulating synchrotron radiation and ultra-high vacuum in the SuperKEKB interaction region	Marton Ady, CERN
12:15	Pressure analysis of Taiwan Photon Source storage ring vacuum system during commissioning	Hsin-Pai Hsueh, NSRRC
12:30	A Simulation Study on Beam Lifetime Evolution for KEK Light Source	Yasunori Tanimoto, KEK
12:45	**Lunch Break / Bus departures from NSRRC**	
13:00	**Excursion**	
18:00	**Workshop Dinner**	
20:30	**Bus leaves for Lakeshore Hotel**	

Thursday, 27 Oct., 2016

08:30	**Bus leaves from Lakeshore Hotel to NSRRC**	
Session 6 - Moderator - Paolo Chiggiato		
09:00	**Experiences in the vacuum systems for KEKB and SuperKEKB (Invited)**	**Yusuke Suetsugu, KEK**
09:30	**Status of the Diamond Light Source DDBA cell vacuum system and lessons learned for a Diamond II upgrade (Invited)**	**Matthew Cox, Diamond**
10:00	All metal RF sector valves – development and possibilities	Kurt Sonderegger, VAT
10:30	**Break**	
Session 7 - Moderator - Roberto Kersevan		
11:00	**Non-evaporative getter (NEG) coatings for ultrahigh vacuum in very narrow chambers (Invited)**	**Andre Anders, LBNL**

11:30	Development of Low-Cost, High-Performance Non-Evaporable Getter (NEG) Pumps for Synchrotron Light Facilities	Kazuhiko Mase, KEK
12:00	Thermal optimization of coating process – numerical simulations	Monika Sitko, CERN
12:15	Management of large NEG-coating projects: What can go wrong and what can help resolve it	Jochen Deiwiks, FMB
12:30	Impedance consideration, practice, and results of vacuum components of Taiwan Photon Source	Hsin-Pai Hsueh, NSRRC
12:45	**Lunch Break**	
Session 8 - Moderator - Yusuke Suetsugu		
13:30	**Challenges in design of vacuum system of ultra low emittance storage ring of Iranian Light Source Facility (Invited)**	**Omid Seify, ILSF**
14:00	**Insertion Devices and Vacuum Related Activities at the NSLS-II (Invited)**	**Toshiya Tanabe, BNL**
14:30	EMPIR SIP01 project on standardization of QMS calibrations and outgasing rate measurements	Janez Setina, IMT
15:00	Contamination Control for Vacuum Systems	Thomas Weston, STFC Daresbury Laboratory
15:30	Introduction to hermetic sealing of metal/metal and metal/dielectric joints	Bob Chen, Wave Power
16:00	**Break**	
Session 9 - Moderator - Gao-Yu Hsiung		
16:30	**General Discussion**	**Hsiao-Chaun Hseuh, BNL**
17:00	**Summary & Closing**	**Gao-Yu Hsiung, NSRRC**
17:30	**Wrap up**	

Friday, 28 Oct., 2016

08:30	**Bus leaves from Lakeshore Hotel to National Tsing Hua University (NTHU)**	
*** TVS-2016 (30th Anniversary) Annual Symposium (Venue: NTHU)**		
09:00	**Registration**	
09:30	**TVS Annual Meeting / Vacuum Exhibition / Posters**	
10:00	**TVS-2016 30th Anniversary Opening Ceremony**	
11:00	**Keynote Speech: The progress of optical coatings and vacuum technology**	**Cheng-Chung Lee (NCU)**
12:00	**Industrial Presentations: Vacuum Technologies & Applications (Lunch Break)**	
5th Int'l Joint Symposium on "Advanced Vacuum Technologies and Applications"		
Session 1 (13:10~14:40) - Chair: H. C. Wang (王祥辰), Co-Chair: D. S. Liu (劉代山)		

13:10	Operand measurement of Permeated Hydrogen through Membrane samples	Akiko Itakura (NIMS, Japan)
13:40	Vacuum Technology Issues for High Energy Particle Accelerators	Tohru Honda (KEK, Japan)
14:10	Vacuum techniques for field emission electron guns on electron microscopes	Boklae Cho (KRISS, Korea)
14:40	Break	
Session 2 (15:30~17:10) - Chair: M. Y. Lu (呂明彥), Co-Chair: C. H. Chen (陳家浩)		
15:30	Fabrication and Morphology Control of Polymer Nanomaterials	Jiun-Tai Chen (NCTU, Taiwan)
16:00	Graphene-enabled Molecular Electronics	Mario Hofmann (NCKU, Taiwan)
16:30	3D Atomic Arrangement Around Specific Atoms Studied by Atomic Resolution Holography and Stereography	Hiroshi Daimon (NAIST, Japan)
17:00	A Metal-Insulator Transition of the Buried MnO2 Monolayer in Complex Oxide Heterostructure	Ying-Hao Chu (NCTU, Taiwan)
17:30	Wrap up	
18:30	Banquet (TVS-2016/InJoSy-5 Joint Symposia) : at Pengyuan Agora Garden (彭園會館)	
20:30	Bus leaves for Lakeshore Hotel	

MAX IV 3 GeV storage ring vacuum system: from development to operation

Marek Grabski[1*], Eshraq Al-Dmour[1], Jonny Ahlbäck[1]
[1]Max IV Laboratory, Lund, Sweden
[*]E-mail: marek.grabski@maxiv.lu.se

Abstract

Max IV laboratory is a synchrotron light facility situated in Lund, Sweden. It houses two electron storage rings of 1.5 GeV and 3 GeV, a full-energy linear accelerator serving as an injector to the rings and to a short pulse facility.

The 3 GeV accelerator is an ultra-low emittance ring (0.33 nm rad horizontal bare lattice emittance) of 528 m in circumference. It features a seven-bend achromat lattice with 25 mm magnet aperture. Due to compact magnet design the vacuum system has very limited conductance without space for many lumped absorbers and pumps. To provide necessary pumping and to reduce PSD (Photon Stimulated Desorption) yield all the vacuum chambers were NEG (Non-Evaporable Getter) coated along the electron beam path. Furthermore, the copper vacuum pipes act as distributed absorbers to cope with heat from bending magnet radiation and some insertion devices.

The commissioning of the 3 GeV ring started in August 2015, since that time two in-vacuum undulators, one in-vacuum wiggler and one EPU (Elliptically Polarized Undulator) were installed and more will follow. Until August 2016 the accumulated beam dose in the machine was 112 Ah. The dynamic pressure rise per machine current (P/I) decreased by more than 2 orders of magnitude since the start of the operation. The product of total beam lifetime and current in multibunch mode was reaching maximum of 6 Ah.

This presentation will cover few aspects of the design, development and installation of the 3 GeV ring vacuum system as well as most recent commissioning results.

(16)

Vacuum for the ESRF EBS project

Michael Hahn[1]*
[1]ESRF – European Synchrotron Radiation Facility, Grenoble, FRANCE
*E-mail: hahn@esrf.fr

Abstract

ESRF is the first third generation synchrotron light source which launched an accelerator upgrade program aiming for an important reduction of the horizontal emittance of the electron beam (from 4 nm rad to 150 pm rad). This is achieved by replacing the actual double bend achromat lattice (DBA) of the electron storage ring with a multi bend achromat lattice (MBA) which contains seven dipoles per unit cell. The new storage ring is called EBS – Extreme Brilliant Source. All unit cell magnets will be replaced by stronger magnets with a smaller bore size which requires a total replacement of the entire unit cell vacuum system as well.

The energy of the electron beam (6 GeV) remains unchanged, the new machine is going to be installed in the same storage ring tunnel after dismantling the existing one. A tight time schedule has been defined for the dismounting and re-installation in order to keep the time without beam for the users as short as possible. On the vacuum side this led to a number of conservative choices, where vacuum devices with a proven performance and reliability record were preferred.

The general aspects of the project will be discussed. Choice of vacuum chamber and photon absorber design and construction material as well as choice of vacuum generation, measurement and analysis instrumentation will be explained. The new machine which is going to be in-situ bake-able, so information will be given on heaters and bake control. Due to larger girders, there will be less space for conventional pre-pumping stations in the walkways, so new pre-pumping concepts are envisaged. The expected pressure profiles will be presented together with the expected conditioning behavior.

(14)

Preparing and executing production of complete storage ring vacuum systems – Experience of a supplier

Uwe Schneck
FMB Feinwerk- und Messtechnik GmbH
Friedrich-Woehler-Strasse 2, 12489 Berlin
E-Mail: u.schneck@fmb-berlin.de

Abstract

In a new synchrotron project the supplier of the storage ring vacuum chambers usually faces new and challenging specifications. Nevertheless he has to perform the scope of work within limited budget and short time frame.

A number of technical and contractual issues have to be discussed and resolved along the way from tender to final acceptance.

Based on the experience of manufacture of vacuum chambers for total 10 new synchrotrons, the talk makes an effort to discuss opportunities to optimize the project realization. This includes the development from conceptual design to detailed design and manufacturing drawings, material procurement issues, design of gauges and measurement tools as well as the qualification of manufacturing processes such as welding and brazing.

Examples of the impact of design changes, delayed material deliveries and interface problems on cost and project schedule will be mentioned as well as opportunities to minimize this.

Short talk (15 min) to topic:

6). Methodology of manufacturing and construction

(04)

NEG coating for high aspect ratio vacuum chambers

P. Costa Pinto[*], P. Chiggiato, A. Sapountzis, M. Taboreli
CERN, European Organization for Nuclear Research, Geneva, Switzerland
[*]E-mail: pedro.costa.pinto@cern.ch

Abstract

Non Evaporable Getter thin films become an essential component of ultra-low emittance light sources vacuum systems. The coating technology have been progressively adapted to cope with the myriad of beam pipe geometries found in particle accelerators, including the narrow gap vacuum chambers of synchrotron light sources. In this paper, we report on the CERN experience on coating beam pipes with internal diameters ranging from 500 mm down to 5 mm.

(05)

Development of copper electroformed chambers with integrated getter thin film coating

Lucia Lain Amador[1*], Wilhelmus Vollenberg[1], Leonel M. Antunes Ferreira[1], Mauro Taborelli[1], Paolo Chiggiato[1], Jean-Yves Hihn[2]
[1]CERN, Route de Meyrin 385, Geneva, Switzerland
[2]Université de Franche-Comté, Route de Gray 16, Besancon, France
[*]E-mail: lucia.lain.amador@cern.ch

Abstract

The evolution of particle accelerators to higher energy and brightness beams at a reasonable cost has a common approach of bringing the poles of the magnet closer to the beam by reducing vacuum chambers diameter. Physical vapor deposition techniques cannot be applied to indefinitely small pipe cross sections (the practical limit is about 8-10 mm diameter) and other complex shapes require specific developments.

The aim of this project is to develop a novel procedure of coating/assembly, using a sacrificial mandrel as substrate of the thin film together with the creation of a surrounding copper chamber by electroforming. The electroforming process should integrate the stainless steel vacuum flanges to the copper tube. This technology could enable to produce chambers of small diameter or complex shape, which fulfil the necessary criteria of vacuum tightness and low outgassing rate while keeping the best getter performance for the application in ultra-high vacuum systems of particle accelerators. We will present the first results of the method applied to small flat samples and the first prototype of copper tube.

(28)

NEG coating R&D for HEPS-TF at IHEP

P. He[1*], D.Z. Guo, Y.S. Ma, B.Q. Liu, Y.C. Yang, L. Zhang
[*]E-mail: heping@ihep.ac.cn

Abstract

Non Evaporable Getter(NEG) coating technology was widely used around the world's ultra-low emittance storage rings. It will provide the distributed pumping which is the obvious solution to solve the conductance limitation of small magnet aperture. It can improve the accelerator vacuum, reduce bremsstrahlung radiation and boost beam performances.

The HEPS-TF is the R&D project of HEPS (High Energy Photon Source), it will cover all of the key technology for HEPS accelerator system and beamlines. In order to meet the small aperture vacuum chamber distributed pumping requirement, the NEG coating R&D for HEPS vacuum chamber is under the way. This R&D try to verify the feasibility of the NEG coating on small diameter and bent tubes, also need verify NEG-coating adhesion on surfaces OFS copper substrate. The coating test bench will be shown here and coating procedure will be presented.

(10)

Different approaches in the design of vacuum systems for synchrotron light sources based on NEG technology

Tommaso Porcelli*, Fabrizio Siviero, Gero Bongiorno, Enrico Maccallini,
Paolo Manini
SAES Getters S.p.A. – viale Italia 77, 20020 Lainate (MI), Italy
*E-mail: tommaso_porcelli@saes-group.com

Abstract

Ultra-low emittance synchrotron light sources pose stringent requirements in terms of vacuum-system design, as pressures in the high vacuum/ultra-high vacuum (HV/UHV) regime should be ensured all along a machine of this kind, in order to efficiently deal with its high-luminosity targets during beam operations.

Nowadays, non-evaporable getter (NEG) coatings are widely adopted because—besides providing a very effective and distributed pumping for all the getterable gas species—their use leads to a significant reduction of the thermal outgassing along a beam pipe, as well as of its secondary electron yield. An extensive use of NEG coating is particularly suitable in presence of long, small-aperture beam pipes (<10 mm), which cannot be efficiently pumped by traditional UHV pumps due to conductance reasons.

On the other side, a more traditional approach, based on a distribution of lump pumps along a beam pipe, might be envisaged for specific sectors of a machine, e.g., where the outgassing loads can be particularly severe, as in proximity of undulators and collimators. Also in this case, NEG technology represents a very effective solution, as NEG pumps are very compact and small, have a limited weight, cause no vibrations and consume negligible power.

This presentation aims at illustrating the use of NEG pumps and NEG coatings in synchrotron light sources; examples of past and future projects relying on each of these two pumping approaches will be proposed, together with an overview of the methods (including simulation tools) adopted to assess the best pumping layout for a given machine, starting from its specific geometrical and physical characteristics.

(13)

The vacuum systems and studies for the low emittance storage rings at NSRRC

J.-R. Chen[1, 2]* and the NSRRC Vacuum Group

[1]National Synchrotron Radiation Research Center, Hsinchu
[2]Department of Medical Engineering and Environmental Sciences, NTHU, Hsinchu
*E-mail: jrchen@nsrrc.org.tw

Abstract

The NSRRC vacuum group has been devoting manpower into the basic studies and developments of UHV for more than three decades, mainly on the design and construction for the third generation synchrotron light sources – the 1.5 GeV Taiwan Light Source (TLS) and the 3 GeV Taiwan Photon Source (TPS). The processes to achieve a low thermal outgassing rate of < 1×10^{-14} Torr-l/s-cm^2 after in-situ bake out, to achieve a low photo-desorption rate of ~ 10^{-5} molec./ph. at a low dose rate of ~ 10mA-h, etc. had been developed and applied to the TPS construction. The studies on water in vacuum have been conducted, an extreme-dry venting process was developed, attempting to relief the risk and tension of the in-situ baking in the tunnel.

In addition to the efforts for reducing the pressure, the stability issues have been highly treated for the TLS and TPS. At the TLS, solutions to the rf impedance issues, such as on the bellows, pumping ports, flanges, gate vales, and the tapers, have been successfully adopted. More stringent designs were applied to the TPS, which has a maximum beam current of 500mA and a shortest bunch length of 3 mm. Comb type rf shield was utilized for the gate valves and the spring-finger type rf shield with low steps was used for the bellows at space limited area. The rf shield for the flange gap was upgraded from the TLS- to TPS-type with a better contact. The BPM unit was carefully designed to reduce the impedance and to keep the mechanical stability and electrical properties. Together with a step control of < 0.3 mm on each welding joint between two different pieces of the beam duct, a small effective longitudinal impedance $|Z/n|_{eff} = 0.12\ \Omega$ was achieved at the 518 m TPS. In this report, the vacuum systems and studies for the low emittance storage rings at NSRRC are presented.

(26)

APS-Upgrade Vacuum System Status

J. Carter[1*], B. Stillwell[1], B. Brajuskovic[1], H. Cease[1], J. Hoyt[1], R. Lill[1], R. Lindberg[1], K. Suthar[1], G. Wiemerslage[1], J. Zientek[1], J. Noonan[1], M. Sangroula[2]
[1]Argonne National Laboratory, Lemont, IL USA
[2]IIT, Chicago, IL USA
[*]E-mail: jacarter@anl.gov

Abstract

Design and R&D is ongoing for the APS-Upgrade storage ring vacuum system which will service a future multi-bend achromat (MBA). The proposed vacuum system design will employ a hybrid of pumping elements and vacuum chamber types including ion and NEG cartridge pumps, NEG strip pumping in vacuum chambers with antechambers, and NEG coated tubular vacuum chambers. Ongoing R&D activities include the construction of a full vacuum sector mockup, prototype vacuum chamber manufacturing, and flange and joint testing. Details of the MBA lattice have yet to be finalized so the vacuum system group are developing flexible design and analysis tools that can evaluate design changes effecting manufacturing, ray tracing, vacuum performance, and more as quickly as possible.

(02)

Two-Year Operation Experience of NSLS-II Storage Ring Vacuum Systems**

Hsiao-Chaun Hseuh*, Charles Hetzel, Shuwei Leng, King Wilson, Douglas Zigrosser
National Synchrotron Light Source II
Brookhaven National Laboratory
Upton, New York 11973, USA
*E-mail: hseuh@bnl.gov

Abstract

National Synchrotron Light Source II (NSLS-II) at Brookhaven is the latest and lowest emittance double-bend achromat (DBA) synchrotron radiation (SR) facilities constructed. It consists of a 200-MeV linac, a 3-GeV Booster, and a 3-GeV storage ring. NSLS-II has been in steady operation since late 2014, providing the brightest X-ray beam for SR users with 11 insertion device beam lines. The design of NSLS-II vacuum system, the fabrication of vacuum chambers and other hardware, the installation, the commissioning and the continuing beam conditioning will be presented. The performance and reliability of the vacuum systems will be summarized. Problems encountered and lessons learned will be detailed.

**Work supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences, under Contract No. DE-SC0012704

(34)

10 year experience of operation with NEG coating in storage ring the SOLEIL synchrotron light source

Christian HERBEAUX*, Nicolas BECHU
Synchrotron SOLEIL
*E-mail: Christian.herbeaux@synchrotron-soleil.fr

Abstract

The SOLEIL synchrotron, a 3rd generation light source, has been in operation since 2006. The vacuum system has been designed from the beginning with the choice to use in an extensive way, the NEG coating as pumping and for reducing the Photon Stimulated Desorption (PSD) yields. After ten years of operation the efficiency of the NEG coating seems to be still at the higher lever despite all the operation of maintenance requiring venting of full sections of the ring and then reactivations of the coatings. Also, the sections which have never been reactivated after initial activation are still at the same level of vacuum.

The behavior of the different sections of the ring will be compared regarding their respective history during these 10 years.

Unfortunately, some bad surprise occurred after few years of operation due to radiation resulting from the interaction of the photon beam with the NEG coated surfaces causing damages on the neighboring equipment.

The presentation will summarize what we have learn from this 10 years of operation and will present what we would keep and what we would change in the design of the vacuum system regarding NEG coating.

(33)

Study of Vacuum Chamber Upgrading in PLS-II

Taekyun Ha, Chongdo Park*
Pohang Accelerator Laboratory, Pohang, S. Korea
*E-mail: cdp@postech.ac.kr

Abstract

The PLS-II vacuum system which is designed for double bend achromat lattice has been successfully operated in 3 GeV and 400 mA top-up mode. Today, the need for study of vacuum chamber upgrading is increased because highly compact design of vacuum components becomes essential in the future upgrade of PLS-II into an ultra-low emittance light source. Recently several bending chambers and straight chambers are modified to improve mechanical stability and to increase compactness as well as to simplify pumping system. A compact bending chamber made of copper alloy where distributed photon absorbers and distributed vacuum pumps are embedded is also being studied. In this talk, we will introduce the current status of these upgrade studies in PLS-II.

Low outgassing stainless steel and aluminum CF components

Michael Flämmich*, Christian Worsch, René Bauer, Ute Bergner
VACOM Vakuum Komponenten & Messtechnik GmbH,
Gabelsbergerstraße 9, 07749 Jena, Germany
*E-mail: michael.flaemmich@vacom.de

Abstract

The requirement of high quality vacuum components for ultra high vacuum (UHV) has become stronger over the last years, especially driven by research institutions and accelerator facilities. Besides the prerequisite of ultra clean surfaces, the outgassing properties from the bulk material are critical for in-situ baked UHV systems. For these applications stainless steel has been and still is the most commonly used raw material. The challenge of suppressing hydrogen outgassing from the bulk material has extensively been discussed in the past. Some approaches seem to be promising, but at the same time they are quite expensive and economically hardly viable. As an alternative to stainless steel, aluminum is regarded as a promising raw material due to some fundamental advantages, even though metal sealed CF components and chambers made from aluminum are hardly available and rarely used.

The present talk focusses on low outgassing vacuum components and chambers for UHV applications made from both raw materials, stainless steel and aluminum. In order to carefully characterize the extremely low outgassing of components appropriate setups for outgassing rate measurements (throughput, accumulation, and pressure rise) will be discussed and respective experimental data will be shown. Measuring, verifying and, at the end, knowing the outgassing rate of the produced components enables to explicitly specify, classify and guarantee the outgassing properties of UHV vacuum components.

As a further focus of the talk, metal-sealed CF vacuum components made from aluminum are introduced. In this context, adequate knife edge stability, thermal stability and reliable outgassing properties have always been discussed as major challenges. Based on detailed experimental studies it will be shown that these challenges have been solved lately and that aluminum CF components and chambers (AluVaC®) are today a serious alternative to the established components made from stainless steel.

(18)

20 year's operational experiences of SPring-8 storage ring vacuum system

Haruo Ohkuma[1*]
[1]Japan Synchrotron Radiation Research Institute (JASRI)
[*]E-mail: ohkuma@spring8.or.jp

Abstract

SPring-8 is the 8 GeV synchrotron radiation facility, which has been in operation since 1997. An overview of the experience about 20 years of SPring-8 storage ring will be presented from the viewpoint of vacuum technology. The evolution of the vacuum system and the performance of its components are summarized.

The main vacuum chambers are extrusions made from aluminum alloy (A6063-T5), which are equipped with cooling water channels which are also used as baking using super-heated-hot-water. The chamber consists of a beam chamber and a slot-isolated ante-chamber in which NEG strips are installed. The photon absorbers are made from OFHC and Glid-Cop AL-15. The main pumping system is based on NEG strips, and the lumped NEG pump composing of NEG wafer modules for evacuating mainly SR-induced outgassing at the crotch and absorber locations.

The initial lattice structure of the SPring-8 storage ring was based on the DBA with 48 unit cells. There were four long straight cells with two missing-bends. In 2000, in order to obtain more brilliant photons, we have realized four magnet-free long straight sections of 27 m by rearranging quadrupole and sextupole magnets and by installing new vacuum chambers.

In addition, the main vacuum trouble and malfunctions and their impact on accelerator operation will be described.

(17)

Design for the SPring-8 upgrade storage ring vacuum system

M. Oishi[1,2*], S. Takahashi[1,2], M. Shoji[1], K. Tamura[1], Y. Taniuchi[1], T. Bizen[1,2], H. Ohkuma[1]

[1]Japan Synchrotron Radiation Research Institute (JASRI)

[2]RIKEN SPring-8 Center

[*]E-mail: moishi@spring8.or.jp

Abstract

A new lattice design for SPring-8 upgrade project (SPring-8-II) aiming at an ultralow-emittance ring significantly affects the storage ring vacuum design as well as severe time constraints. To solve complicated boundary conditions, some design strategies are proposed, including “exclusion of in-situ baking” and “introduction of a 12-m-long integrated chamber (LIC) by welding without flange connections.” In this talk, not only the vacuum system design but also the current progress in the R&D work, such as test productions of a straight section vacuum chamber and other components, are presented.

(29)

Design Concept of KEK Light Source based on HMBA Lattice

T Honda*, K Harada, Y. Kobayashi, N. Nakamura, S. Sakanaka, R. Kato, K. Tsuchiya, M. Adachi, T. Miyajima, Y. Tanimoto, N. Funamori, K. Amemiya
High Energy Accelerator Research Organization (KEK)
*E-mail: tohru.honda@kek.jp

Abstract

KEK manages two synchrotron radiation (SR) sources, the Photon Factory storage ring (PF-ring) and the Photon Factory Advanced Ring (PF-AR) for more than 30 years since the commissioning of the PF-ring in 1982. In 2016, KEK proposed a construction plan of a new SR facility "KEK Light Source (KEK-LS)" towards the completion of the first half of the 2020s. The energy and the natural horizontal emittance are 3 GeV and 0.13 nm rad, respectively. Because of the intra-beam scattering effect, the emittance will increase to 0.31 nm rad at the maximum current of 500 mA. The low emittance lattice has been designed based on the Hybrid Multi-Bend Achromat (HMBA), which was originally developed at the ESRF upgrade project. We have modified the design to insert a short straight section at the center of the unit cell so it can be called as the Double Quadruple-Bend Achromat (DQBA). The number of unit cells is 20, and the circumference is about 570 m. Except for an RF cavity section and an injection section, the ring can accommodate 18 undulators in the long straight sections of 5.6 m, and the additional 20 short straight section of 1.2 m will be used for the installation of short-period narrow-gap undulators. If we assume an undulator of the magnetic period 12 mm, total length 5.0 m, and the smallest gap 4 mm, the SR brightness reaches 10^{22} Photons/mrad^2/mm^2/s/0.1%B.W. at X-ray range. The short undulators are also useful in the soft to hard x-ray range with the brightness better than 10^{20} Photons/mrad^2/mm^2/s/0.1%B.W.

(03)

Integrated montecarlo simulation environment for light source design

Roberto Kersevan*
CERN, Geneva, Switzerland
*E-mail: roberto.kersevan@cern.ch

Abstract

Ultra-low emittance is becoming the standard feature of all new or upgraded light sources. For this kind of machines, the vacuum scientist is expected to find solutions, often novel ones, which allow the co-existence of conflicting machine parameters, such as small magnet apertures allowing a large dynamic aperture, on-axis injection with very small internal diameter chambers, extremely high-brightness beams, compact and densely assembled magnetic lattices, very narrowly collimated photon fans, and so on. The aim is to obtain a design of the vacuum system which allows a quick conditioning, a low average pressure, and low bremsstrahlung levels along the straight sections leading to the experimental hutches. Modern ray-tracing, montecarlo simulations allow an integrated analysis of the distribution of synchrotron radiation fans and the concomitant outgassing profiles. This talk will review some applications of such methodology, and will discuss its advantages and limitations, together with possible improvements.

(27)

APS-Upgrade Vacuum System Simulations with SynRad and MolFlow

J. Carter[1*]
[1]Argonne National Laboratory, Lemont, IL USA
[*]E-mail: jacarter@anl.gov

Abstract

SynRad and MolFlow+ (CERN) have been extensively employed to evaluate and inform the design for the APS-Upgrade storage ring vacuum system. SynRad is used to understand the photon ray trace and thermal loading and MolFlow+ is used to calculate pressures and evaluate pumping speeds and vacuum conductance. The two programs can be coupled to predict dynamic photon stimulated desorption (PSD) outgassing and to help plan for the future conditioning of the vacuum system. The pressure calculations are used to predict beam lifetimes and to evaluate the need for design changes such as increased pumping or better photon shielding. The most uncertainty in a coupled analysis comes from the PSD outgassing predictions so studies have been performed comparing multiple sources of published PSD yield data to better understand error margins of the pressure calculations. Pressure measurements from a recently vented and conditioned APS vacuum subsystem presented an opportunity to test these new tools in-situ. New tools are also being developed to evaluate electron beam path missteering in order to evaluate worst case thermal loading conditions. SynRad is then used to verify calculations and evaluate beam footprints on photon absorbing components.

(06)

Simulating synchrotron radiation and ultra-high vacuum in the SuperKEKB interaction region

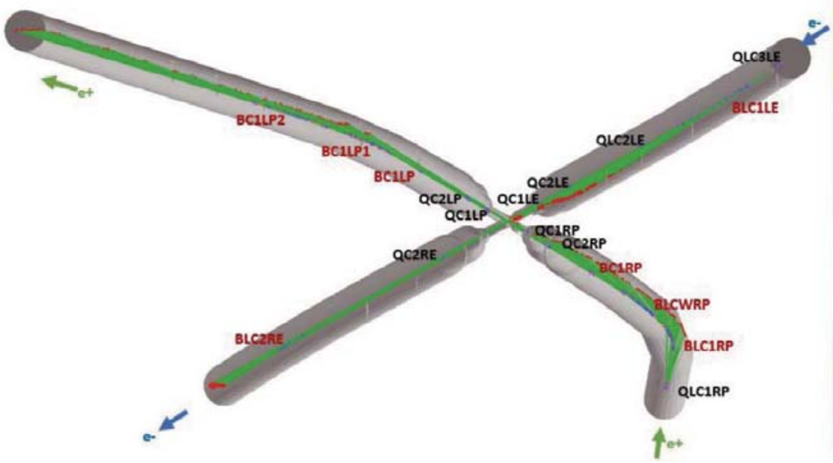
Marton Ady, CERN

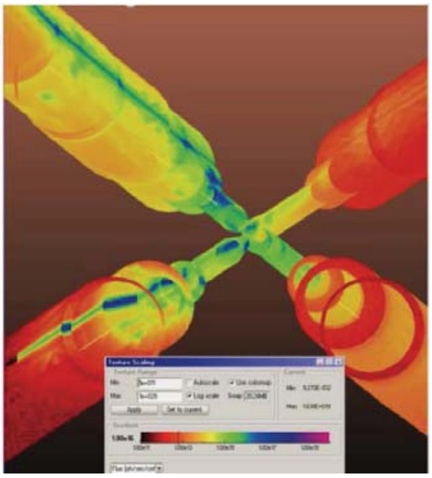
KEKB, a 3 km circumference electron-positron collider in Tsukuba, Japan is being upgraded to a higher luminosity version. The new machine, named SuperKEKB, differs from its predecessor in many aspects, and has a new vacuum system. The gas present in the region originates mainly from dynamic desorption caused by synchrotron radiation. Since this region consists of several materials, each with a different outgassing yield, furthermore the pumping is limited by the conductance of the geometry, estimating the pressure is a complex task.

The aim of this presentation is to show how two Monte Carlo tools, MolFlow+ and SynRad+, developed at CERN and available for everyone, allowed the simulation of the synchrotron radiation, then subsequently the induced outgassing and the resulting pressure of the region. Results confirm calculations of the KEK team presented in the Belle 2 Design Report.

The case study was carried out with Jason Carter within the framework of a collaboration between CERN and Argonne National laboratory.

Keywords: SuperKEKB, synchrotron radiation, ultra-high vacuum, Monte Carlo, MolFlow, SynRad





(20)

Pressure analysis of Taiwan Photon Source storage ring vacuum system during commissioning

Hsin-Pai Hsueh[1*], Gao-Yu Hsiung[1], June-Rong Chen[1,2]
[1]National Synchrotron Radiation Research Center, Hsinchu
[2]Department of Medical Engineering and Environmental Sciences, NTHU, Hsinchu
[*]E-mail: hxh167@nsrrc.org.tw

Abstract

The Taiwan Photon Source storage ring vacuum system has been developed to be pre-baked and installed under vacuum for 14-m arc sections. The straight sections were in-situ baked followed the installation of adjacent arc sections. During first stage commissioning, foreign object was found and the bending vacuum chamber of this particular arc section was replaced without baking (either pre-baked with vacuum installation or in-situ baking). Subsequently, four more bending chambers in other four different arc sections were replaced without baking either. Since this time saving method is different from our system design philosophy, a detailed pressure and mass spectrum analysis is necessary. From preliminary data, the photon stimulated desorption is no longer as dominant as we would like it to be as designed. The thermal outgassing could be higher than 25% of total outgassing at highest current (520mA). In this presentation, the analysis results will be presented.

(30)

A Simulation Study on Beam Lifetime Evolution for KEK Light Source

Yasunori Tanimoto*, Tohru Honda, and Norio Nakamura
High Energy Accelerator Research Organization (KEK)
*E-mail: yasunori.tanimoto@kek.jp

Abstract

The KEK Light Source (KEK-LS) project is proposed as a successor to the two existing Photon Factory storage rings. As in the case of recent low emittance light sources, a modified hybrid multi-bend achromat (HMBA) lattice for KEK-LS also imposes severe restrictions in the vacuum system design; the beam ducts will have a physical aperture of as narrow as 25 mm and special measures must be taken to cope with the meager conductance of the beam ducts. In the design of the vacuum system under such conditions, beam duct configurations and vacuum pump arrangements must be optimized by accurate simulations in order to ensure a sufficiently long beam lifetime within a moderate period of machine commissioning. For this purpose, a combination of two Monte Carlo simulators, SynRad+ and MolFlow+ currently developed by CERN, is used together with experimental data of gas desorption yields as a function of photon dose. Thus, the vacuum pressures averaged along the ring are obtained as a function of beam dose, and this simulated progress of the vacuum conditioning is converted into the evolution of the beam lifetime. Three types of beam ducts are examined in this simulation study; 25-mm round copper ducts, NEG-coated ducts with the same dimensions, and uncoated ducts with ante-chamber structure. The calculation results indicate that the NEG coating is the most promising and the ante-chamber structure is satisfactorily effective. The effect of NEG coating on resistive wall impedance is also evaluated for the 25-mm copper ducts. With our machine parameters, the effect is estimated to be sufficiently small as long as the coating thickness is below 1 μm.

(23)

Experiences in the vacuum systems for KEKB and SuperKEKB

Yusuke Suetsugu*, Kyo Shibata, Takuya Ishibashi, Mitsuru Shirai, Shinji terui,
Ken-ichi Kanazawa, Hiromi Hisamatsu
High Energy Accelerator Research Organization (KEK)
*E-mail: yusuke.suetsugu@kek.jp

Abstract

KEKB and SuperKEKB are electron-positron colliders at KEK, Japan. KEKB was operational from 1998 to 2010, while SuperKEKB started its first operation from February, 2016, after the upgrade from KEKB took more than 5 years of work. Some key parameters related to the accelerators of both rings are listed in Table 1. The main features are their high stored beam currents, low beam emittance, and small bunch lengths, which are required to achieve the high luminosities. Therefore, the vacuum systems were designed and fabricated to manage high currents, intense synchrotron radiation (SR) powers and photon numbers, and to make the beam impedance as small as possible to avoid over-heating of vacuum components and beam instabilities. The suppression of electron cloud effects (ECE) in the positron rings has also been a serious issue in both the vacuum systems.

Here, we will summarize the experiences in designing and operating the vacuum systems, especially the major results and troubles at high beam currents observed in the key components such as beam pipes, connection flanges, bellows chambers, gate valves and beam collimators, as well as in the countermeasures against ECE.

Table 1 Main achieved parameters of KEKB and SuperKEKB (Phase-1), where the figures in parentheses are designed values.

	KEKB (Design)		SuperKEKB in Phase-1 (Design)	
	LER: e^+	HER: e^-	LER: e^+	HER: e^-
Beam energy [GeV]	3.5	8.0	4.0	7.0
Beam current [A]	1.637 (2.6)	1.188 (1.1)	1.01 (3.6)	0.87 (2.6)
Circumference [m]	3016		3016	
Bunch numbers	1585 (5000)		1576 (2500)	
Bunch spacing [m]	~1.84 (0.6)		~1.84 (1.2)	
Bunch length w/ beam [mm]	~7 (4)	~7 (4)	~8 (6)	~7 (5)
Emittance x/y [nm/pm]]	18/267 (18/360)	24/316 (18/360)	1.8/8 (1.9/2.8)	4.6/9-120 (4.4/1.5)
Total SR power (arc) [MW]	1.4	4.9	1.1	5.3
Critical Energy (arc) [keV]	5.8	10.9	1.9	7.3

(21)

Status of the Diamond Light Source DDBA cell vacuum system and lessons learned for a Diamond II upgrade

Matthew Cox
Diamond Light Source, Harwell Science and Innovation Campus,
Didcot, Oxfordshire, OX11 0DE, UK
E-mail: matthew.cox@diamond.ac.uk

Abstract

The need for additional insertion device (ID) beamlines at Diamond Light Source led to the concept of converting one or more individual cells of the existing Double Bend Achromat (DBA) lattice into a Double Double Bend Achromat (DDBA) cell, thus introducing a new straight section for an additional insertion device (ID) in the middle of the arc. Preparations for upgrading the first such cell have been completed and the installation is scheduled for late 2016. This presentation will report on the status of the project and the experience so far with the vacuum design, manufacture, assembly, bakeout and final preparations for installation.

Longer term, an in-place lattice upgrade for Diamond (so-called Diamond II) is being considered to decrease the emittance. While this is still at an early design stage, one strong contender for the new lattice is a Double Triple Bend Achromat (DTBA) configuration which would have vacuum system requirements rather similar to the DDBA cell. This presentation will also focus on the lessons learned from the DDBA experience which will provide useful input into the Diamond II vacuum system design.

(31)

All metal RF sector valves – development and possibilities

Kurt Sonderegger
[1]VAT Vakuumventile AG
[2]General manager All-metal Valves
E-mail: k.sondereggere@vat.ch

Abstract

The presentation will explain how the All metal RF sector valves did develop over the years, basically based on customer requirements. How these valves work, what different concepts VAT is able to offer, where we see limitations.

Non-evaporative getter (NEG) coatings for ultrahigh vacuum in very narrow chambers

André Anders, Csaba Toth, Yuchen Yang, Charles Swenson, Thomas Oliver, Christoph Steier, and Wim Leemans
Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA
*E-mail: aanders@lbl.gov

Abstract

The next generation synchrotron light sources based on diffraction-limited electron storage rings make use of very narrow vacuum chambers. Narrow chambers have severe pumping speed limitations and therefore it is difficult to satisfy the ultrahigh vacuum (UHV) requirements. A popular solution to this problem is to turn the narrow vacuum chambers into vacuum pumps by depositing non-evaporative getter (NEG) coatings in them. NEG materials are alloys of Ti-V-Zr deposited by magnetron sputtering from axially aligned, twisted wires, a technology originally developed at CERN. Going to very narrow chambers, less than 10 mm in diameter, pushes the envelope of this technology. We report on coatings made by twisted-wire sputtering and by alloy-wire sputtering, both at relatively high pressure of greater than 100 mTorr. This has been demonstrated for vacuum chambers as small as 6 mm in diameter at a length of 1.2 m. For even smaller diameter chambers, wire sputtering becomes impractical due to electrical shorts and non-uniformity of coatings. We therefore also report on preliminary results of a potential alternative to narrow tube coating using pulsed laser deposition.

Advanced sputtering development was initially supported by the LDRD Program of Lawrence Berkeley National Laboratory, and later by the Office of Basic Energy Sciences, Scientific User Facility Division, of the U.S. Department of Energy. Funding for the exploratory pulsed laser deposition was provided by the Accelerator Stewardship Program of U.S. Department of Energy, all under Contract No. DE-AC02-05CH11231.

(22)

Development of Low-Cost, High-Performance Non-Evaporable Getter (NEG) Pumps for Synchrotron Light Facilities

Hiraku Kodama,[1] Shinya Ohno,[1] Masatoshi Tanaka,[1] Masato Tanaka,[2]
Koji K. Okudaira,[2] Kazuhiko Mase,[3,4,*] Takashi Kikuchi[3]
[1]Faculty of Engineering, Yokohama National University, 79-5 Tokiwadai, Hodogaya-ku, Yokohama 240-8501, Japan
[2]Faculty of Engineering, Chiba University, 1-33 Yayoi-cho, Inage-ku 263-8522, Japan
[3]Institute of Materials Structure Science, KEK, 1-1 Oho, Tsukuba 305-0801, Japan
[4]SOKENDAI (The Graduate University for Advanced Studies), 1-1 Oho, Tsukuba 305-0801, Japan
[*]E-mail: mase@post.kek.jp

Abstract

Non-evaporable getter (NEG) pumps are widely used for maintaining a clean ultra-high vacuum (UHV) of $\leq 10^{-8}$ Pa because of their high pumping speeds for hydrogen (H_2) and active gases in the UHV region. In addition, they are oil free, evaporation free, sputtering free, sublimation free, magnetic field free, vibration free, economical, compact, lightweight, and energy saving. Here we report a new NEG pump which is composed of commercial 60 NEG pills (f10 mm × 3 mm; 70 wt% Zr, 24.6 wt% V, and 5.4 wt% Fe), titanium parts, a DN 40 conflat flange, and a tantalum heater. The NEG pills are vertically and radially aligned around the heater to maximize the effective area for pumping. After activation at 400 °C for 30 min, the pumping speeds of the NEG pump were measured with the orifice method. Pumping speeds of 140–130, 200–140, 190–130, and 35–17 L/s were estimated for H_2, CO, CO_2, and N_2 gasses, respectively, in a pumped-quantity range of 0.01–0.1 Pa·L. Since the NEG pump is composed of a heating unit and a NEG module, the pumping speeds can be improved by increasing the number of NEG modules. These NEG pumps are favorable alternatives to sputtering ion pumps.

(07)

Thermal optimization of coating process – numerical simulations

Monika Sitko[1*]
[1]CERN, Geneva, Switzerland
[*]E-mail: monika.sitko@cern.ch

Abstract

Numerical simulations of temperature profiles are nowadays widely used for the design of particle accelerators. Such computational tools are not only useful to design accelerator equipment but also to simulate the thermal behaviour associated with manufacturing or treatment processes. The state of art of temperature profile simulation is presented with emphasis on synchrotron light induced heating.

In addition, a recent case study elaborated at CERN is introduced; it concerns the optimization of the amorphous carbon coating process foreseen for the beam screen of the LHC inner-triplet quadrupole magnets. For this specific example, transient thermal simulations during all phases of the coating process are performed. The outcome of the simulation allows a better optimization of the coating parameters with respect to thermal load.

The presentation highlights the methodology of the chosen thermal simulations and possible further developments for the improvement of vacuum equipment for particle accelerators.

(15)

Management of large NEG-coating projects: What can go wrong and what can help resolve it

Jochen Deiwiks
FMB Feinwerk- und Meßtechnik GmbH
Friedrich-Wöhler-Straße 2, 12489 Berlin
E-mail: j.deiwiks@fmb-berlin.de

Abstract

In large long-term projects, problems of any kind can occur, occasionally unfortunately independent of the degree of project preparation. If a problem occurs, the Project Management Team has to find a solution and (if needed) reorganize the project – ideally, maintaining the delivery date(s) of the goods. It is usually easier to manipulate the project plan and meet the original delivery dates when the Project Management Team has more support options / project parameters to consider.

The talk attempts to illustrate this project management principle using the example of a NEG-coating project, requiring many different vessels to be delivered in varied lots over a long-time period. Technical and logistic problems will be mentioned, along with the feasible responses from a manufacturer's point of view. The interaction of the different work steps, machine/coating system capacity and human resources will be discussed, as well as highlighting the advantage of professional exchange of information and solution oriented cooperation with the customer.

I would prefer to assign the short talk (15 min) to one of the two topics

4). NEG-coating technologies, development and applications or

6). Methodology of manufacturing and construction.

(19)

Impedance consideration, practice, and results of vacuum components of Taiwan Photon Source

Hsin-Pai Hsueh[1*], Gao-Yu Hsiung[1], June-Rong Chen[1,2]
[1]National Synchrotron Radiation Research Center, Hsinchu
[2]Department of Medical Engineering and Environmental Sciences, NTHU, Hsinchu
[*]E-mail: hxh167@nsrrc.org.tw

Abstract

With shorter electron beam bunch length, higher beam current, and smaller vacuum vessel aperture, problems, majorly localized heating, caused by non-smooth vacuum components have been more severe than ever. Taiwan Photon Source, a newly constructed third generation medium energy(3 GeV) low emittance(<5 nm-rad) synchrotron facility, is no exception. In this presentation, all considerations toward reducing these problems both in designs and manufacturing practices will be presented in detail for components including bellows, ceramic chambers, beam position monitors, pumping ports, stripline kickers, and tapers etc. The operation results will also be presented for components monitored.

(09)

Challenges in design of vacuum system of ultra low emittance storage ring of Iranian Light Source Facility (ILSF)

Omid Seify[1*], Javad Rahighi[1]
[1]Iranian Light Source Facility, ILSF, Institute for Research in Fundamental Sciences, IPM, Tehran, P.O. Box 19395-5746, Iran
[*]E-mail: seify@ipm.ir
Javad.rahighi@ipm.ir

Abstract

Iranian Light source facility (ILSF) is a modern third generation light source with an electron energy of 3(GeV) and a nominal current of 400 (mA). The facility is under construction by the Institute for research in fundamental sciences. It has a 20-fold symmetric storage ring. In the conceptual design phase, it is envisaged that it should provide a 400mA beam current with 0.27 (nm.rad) emittance, covering the user's requirement. The concept of antechamber accepted for the current design and foreseen lumped absorbers and lumped pumps. The vacuum chambers will be made of stainless steel 316L and will be baked out before installation. The MBA gives a very low emittance, but it requires strong gradient multipole magnets and compact optics, which leave little space for a conventional vacuum. In addition, compact lattice with strong gradient magnets lead to use thin and narrow vacuum chambers with poor vacuum conductance. Also, instabilities make an important role in design of vacuum system of such low emittance machine. Several methods were employed to calculate radiation reach to lumped absorbers and vacuum chambers and pressure profile in different working modes of storage ring.

(08)

Insertion Devices and Vacuum Related Activities at the NSLS-II

Toshi Tanabe[1]*, Charles Hetzel, Charles Kitegi, Dean Hidas, James Rank,
Peter Cappadoro, Huston Fernandes, David A. Harder and Marco Musardo
[1]Photon-Energy Directorate, Brookhaven National Laboratory, Upton, NY 11973, USA
*E-mail: ttanabe@bnl.gov

Abstract

National Synchrotron Light Source-II (NSLS-II) is the latest storage ring of 3 GeV energy at the Brookhaven National Laboratory (BNL) in the U.S.A. The horizontal emittance of the electron beam with the currently installed six damping wigglers (DWs)is 0.9 nm.rad, which could be further reduced with more insertion devices (IDs). NSLS-II ring vacuum system utilizes fairly conventional system based on APS design. Nine in-vacuum undulators (IVUs) with unique side window feature have been installed. Extensive R&D was conducted to ensure that aluminum wire seal method originally developed at Cornell University could be applied to our devices. Other in-air devices utilize vacuum chambers coated with Non-Evaporable Getter (NEG). In-Vacuum Magnetic Measurement System (IVMMS) has been developed for 1.5m long Cryo-Permanent Magnet Undulator (CPMU).

For storage ring vacuum, heating issues with kickers have been surfaced with increased ring current. Damage to coating was found on one chamber which was exchanged. The current mitigation plans are: forced air cooling, in house coating for future chambers and possible new stripe kicker design. Vacuum anomalies in various sections during high current run (400mA) were also found. Short chambers in the center of 3 storage ring arcs were replaced with NEG coated chambers. Magnets were split for this exchange and returned to their original positions within 10 microns. Biggest vacuum struggles are related to vacuum conditioning of the SC-RF cavities.

(25)

EMPIR SIP01 project on standardization of QMS calibrations and outgasing rate measurements

Janez Setina[1*], Karl Jousten[2]
[1]Institute of Metals and Technology (IMT), Lepi pot 11, SI 1000 Ljubljana, Slovenia
[2]Physikalisch-Technische Bundesanstalt (PTB), Abbestr. 2-12, 10587 Berlin, Germany
[*]E-mail: janez.setina@imt.si

Several European National Metrology Institutes (NMIs) combined their research capabilities in an joint research project EMRP-IND-12 Vacuum Metrology for Production Environments (2011-2014), (https://www.ptb.de/emrp/ind12-home.html). A significant part of the activities in this project was devoted to partial pressure measurements in vacuum systems using quadrupole mass spectrometers (QMS) and outgassing rate measurements of vacuum materials and components.

Investigation of metrological characteristics of QMS led to a conclusion that great care needs to be taken to receive valuable and reliable results with these instruments. A clear need for standardization of procedures for characterization and calibration of QMS was identified. Internationally agreed procedures will enable users to compare QMS performance and use them with the best possible accuracy.

Outgassing rate measurements are closely linked to residual gas analysis when a complete characterization of a vacuum material or component requires determination of partial outgassing rates of different gas components. The construction of outgassing measurement apparatus and measurement procedure may also have significant contribution to the final uncertainty.

A spread of outgassing rates of different materials that were published in vacuum literature in the past 50 years is very high. Comparison of published results that were obtained by different in-hose developed methods is very difficult, as detailed description of measurement procedure is often missing. Very rarely the measurement uncertainty was estimated, so accuracy of results is not known. The work towards standardization of outgassing rate measurements can significantly improve this situation, as the important uncertainty contributions for the standardized systems and methods will be evaluated, so the accuracy of results shall be well known or easy to evaluate.

EMPIR SIP01 is a follow-up project (https://www.ptb.de/emrp/14sip01-home.html) where German National Metrology Institute PTB and Slovenian counterpart IMT work jointly on preparation of the two ISO standard proposals: ISO TS 20175 Characterization of quadrupole mass spectrometers for partial pressure measurements, and ISO TS 20177 Procedures to measure and report outgassing rates.

In the presentation the calibration and measurement methods in both standards will be presented.

(01)

Contamination Control for Vacuum Systems.

Author: Thomas M Weston
Facility: STFC, Daresbury Laboratory, Warrington Cheshire, WA4 4AD, UK
thomas.weston@stfc.ac.uk

Abstract

Contamination control for accelerators, Linear and Synchrotron, includes both particulate and other surface contaminants such as hydrocarbons. In this presentation I show how we have controlled both for the construction of many accelerators such as SRS, ALICE, VELA and CLARA. Topics presented will include the use of our clean rooms for particulate control and the types of cleaning and vacuum baking systems we use for removing surface contaminants from vacuum chamber surfaces.

Please submit the title and brief abstract via e-mail to hsiung@nsrrc.org.tw no later than August. 31, 2016. On-line registration will be open on June 10 2016.

(32)

Introduction to hermetic seal involving metal/metal and metal/dielectric

Bob, H. Y. Chen[1*], Chaota Fan[1]
[1] Wave Power Technology Inc., Miaoli, Taiwan
[*]E-mail: bob.chen@wavepower.com.tw

Abstract

A wide repertoire of interesting physical phenomena won't happen substantially unless a good vacuum is involved. Hermetically sealed components, e.g. feedthroughs, dielectric viewports and beryllium windows, are needed to communicate with interiors of vacuum chamber from outside world. In addition to precision machining of parts, associated material selections, chemical cleaning processes, surface treatments, brazing processes and design of brazing jigs are all critical factors for making qualified components to be used in a good vacuum system.

In this talk, we are going to report some important details of the following subjects.

1. Selection of raw material forms for making metal parts
2. Grinding and metallization of ceramic part
3. Chemical cleaning
4. Surface treatment of dull Ni-plating on metal parts before brazing.
5. Brazing with non-active filler and active filler.
6. Products with hermetic seal.
   Crotch Absorber
   BPM feedthrough
   Pulsed Magnet High Voltage (>35kV) feedthrough
   Viewport using dielectric disk of sapphire, quartz, CaF2 and ZnSe
   Beryllium window assembly with/without target for X-ray transmission