The 60th ICFA Advanced Beam Dynamics Workshop

# FLS2018

March 5-9, 2018

Shanghai Institute of Applied Physics

# CONFERENCE GUIDE

中国科学院上海应用物理研究所

Shanghai Institute of Applied Physics, Chinese Academy of Sciences

# FLS 2018


## The 60TH ICFA ADVANCED BEAM DYNAMICS WORKSHOP

March 5 – 9, 2018
Shanghai

**Hotel Equatorial Shanghai**
**65 Yanan Road West, Shanghai**

**Hosted by**
Shanghai Institute of Applied Physics, CAS

**Supported by**
Chinese Academy of Sciences
National Natural Science Foundation of China


# CONTENT

# WELCOME

We are pleased to announce that the 60th ICFA Advanced Beam Dynamics Workshop on Future Light Sources (FLS 2018) will take place in Shanghai, from 5 to 9 March, 2018. FLS 2018 is hosted by the Shanghai Institute of Applied Physics, CAS.

The Future Light Source Workshop has a long history, dating back to the 1990s. The first FLS workshop was held in Grenoble, hosted by ESRF in 1996. It was followed by FLS 1999 in Argonne, FLS 2002 in Hyogo, FLS 2006 in Hamburg, FLS 2010 in Menlo Park, and FLS 2012 in Newport News.

In the spirit of the FLS workshop series, FLS 2018 will bring together worldwide scientists to exchange ideas and best practices about accelerator based light sources, their new development trend and related key technologies. The workshop program will consist of plenary talks and working group sessions. The working groups will include Linac-based light sources, Ring-based light sources, Compact light sources, and Key technologies.

Shanghai is the financial center in China and a famous international metropolis. It is also a popular tourist destination renowned for its historical landmarks such as the Bund, City God Temple and Yu Garden as well as the financial district of Lujiazui with its extensive skyline. In its metropolis, one finds a unique blend of oriental and occidental cultures, which makes the visit to Shanghai a memorable experience.

We look forward to welcoming you in Shanghai.

Yong Ho Chin (KEK), International Organizing Committee Chair
Zhentang Zhao (SINAP), Conference Chair

# CONFERENCE VENUE

The FLS 2018 conference will be held at Hotel Equatorial Shanghai. The hotel is ideally located at Jing'An in the heart of downtown Shanghai which is 20 minutes' drive away from Hongqiao Airport and 45 minutes from Pudong International Airport. The Metro Line 2, 7 and the famous tourist attraction, Jing'an Temple, are within walking distance.

**Hotel Equatorial Shanghai**

- 65 Yanan Road West, Shanghai
- Email: info@equatorialsha.com
- Tel: +86 21 6248 1688
- http://www.equatorialsha.com/home

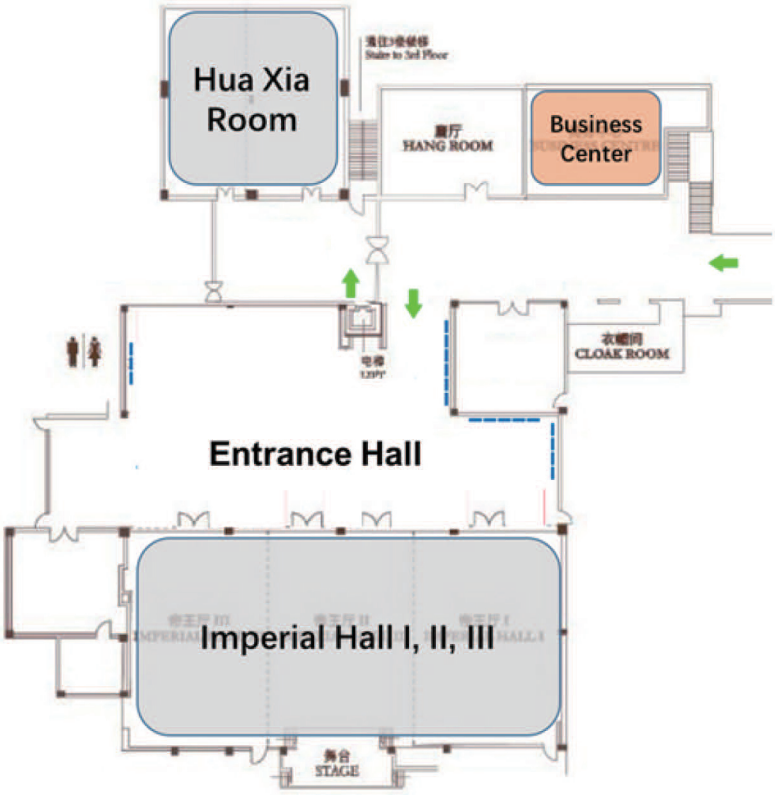
## Wi-Fi Access at the Venue

Instructions:

| 1> | 2> | 3> | 4 |
|---|---|---|---|
| Choose LAN network (Equatorial Free Access) | Enter number 15601867173 | Enter the verification code 1234 | Done |

# CONFERENCE FLOOR PLAN

宴会大厅总平面图 / 二楼 Ballroom & Function Rooms Layout / 2nd Floor




| Room | Location Description |
|---|---|
| Imperial Hall | Plenary / WG |
| Huaxia Room | Summary |
| Entrance Hall | Poster Session / Industrial Exhibition |
| Business Center | Proceeding Office / Presentation Preparation Room |

# PUBLIC TRANSPORT

**From Pudong International Airport (PVG), 50 km to the venue**

- Taxi: around 175 CNY
- Metro: Metro Line 2, Pudong International Airport to Jing'an Temple (20 stops)
- Maglev and Metro: Take Maglev from Pudong International Airport to Longyang Road Station (50 CNY), and transfer to Metro Line 2 from Longyang Road to Jing'an Temple.
- Airport Shuttle Bus Line 2: Take airport shuttle bus Line No 2 to Jing'an Temple. The trip takes one hour and costs 22 CNY. The bus starts at airport Terminal 1 and has a stop in Terminal 2, a 10 minuets walk in between. The first stop is recommended in rush hour. No reservation necessary. You pay bus fare after you are on board.

**From Hongqiao International Airport (SHA), 15 km to the venue**

- Taxi: around 50CNY
- Metro: Metro Line 2, Hongqiao International Airport to Jing'an Temple (8 stops)

# REGISTRATION

Registration fees are required of all participants.

### Registration Hours

On-site registration will take place from 16:00 to 20:00 on Sunday and from 08:00 to 17:00 on Monday to Thursday at the conference venue.

On-site registration fee is 5,600 CNY for delegates and 2500 CNY for students. Payment at the Registration Desk is cash (CNY) only.

The registration fee includes the conference kit, welcome reception, coffee breaks and banquet.

# TOURIST INFORMATION

## Currency and Credit Cards (useful tips):

The currency in China is the CNY. Currency exchange is available at the hotel and most banks. The nearest Bank of China is at No. 1717 West Nanjing Road, which is a few minutes' walk from the venue.

Payment by recognized international credit cards, such as VISA and MasterCard, is also commonly available in Chinese shops. Usually there are signs indicating this option at the entrance to the establishment.

Tipping is unnecessary unless otherwise stipulated.

## How to get IVA (VAT) back on shopping?

There is no reimbursement of VAT except the Airport Tax Free shop.

## Climate and Temperatures in Shanghai

Shanghai has a mild subtropical climate with four distinct seasons. The best time to visit Shanghai is May and September through December. In March the average temperature is between 5 to 13 degrees Centigrade.

## Electricity

The electricity in China is 220 Volts, 50HZ. A transformer may be necessary for foreign electrical devices. Hotel electricity sockets are shaped like this. You may need an adapter.

# SOCIAL EVENTS

## Welcome Reception

The Welcome Reception will take place at the Han Room (3rd floor in Hotel Equatorial Shanghai) from 18:00 to 20:00 Sunday, March 4.

## Conference Banquet

The banquet is scheduled at 19:00 to 21:00 on Thursday, March 8 at Xi Jia Garden Restaurant. The banquet ticket comes with your registration fee. If you want to buy additional Banquet tickets, please sign up at the registration desk during registration hours. The price for one ticket is 360 CNY.

**Direction to the Banquet:** Xi Jia Garden Restaurant is within walking distance, about 650 meters. There will be people guiding your way at each corner to the restaurant before 19:00.

**Note:** Do NOT forget to bring your Banquet ticket.


Directions from Hotel Equatorial Shanghai to Xi Jia Garden

## Lab Tour

The Lab Tour to Shanghai Synchrotron Radiation Facility (SSRF), Soft X-ray Free Electron Laser (SXFEL) and Shanghai Superintense Ultrafast Laser Facility (SULF) is scheduled on Friday afternoon. Please sign up at the registration desk at registration hours if you are interested.

**Important:** The bus to the lab tour will wait at the hotel park. The departure time from the hotel is 13:15, anyone who comes after 13:15 will miss the bus.

# WORKING GROUPS

## Working Groups Conveners

| Working Groups | Conveners |
|---|---|
| WG-A: Linac based light source | T. Raubenheimer (SLAC)<br>L. Giannessi (Elettra)<br>W. Decking (DESY) |
| WG-B: Ring based light source | M. Borland (ANL)<br>R. Bartolini (DLS)<br>Q. Qin (IHEP) |
| WG-C: Compact light source | C. Jing (ANL)<br>M.E. Couprie (SOLEIL)<br>H. Zen (Kyoto University) |
| WG-D: Key technologies | J. Byrd (ANL)<br>J. Pflueger (XFEL.EU)<br>Y.B. Leng (SINAP) |

## Discussion Agenda

### WG-A Linac-Based Light Sources

1. What are the optimization strategies used in tuning a single pass, linac based FEL for user operation ?
2. Will artificial intelligence play a role in tuning and optimizing FEL sources ?

3. What are the ultimate challenges and limitation in simultaneously serving multiple beamlines in FEL facilities?
4. Can we start thinking to experiments with multiple FEL pulses from independent FEL lines?
5. What are the main challenges and desiderata in the generation of ultrashort pulses in FELs?
6. What are the strategies for temporal synchronization of ultrashort (sub-fs) FEL pulses?
7. Seeded FELs have many nice properties with respect to SASE sources, as improved stability and longitudinal coherence. What are the available options to extend the wavelength range of seeded FELs to shorter wavelengths, covering the soft and hard X-ray spectral range?
8. What are the main differences between self-seeding and external seeding from the point of view of the light properties?
9. What are the main challenges in the understanding and mitigating the microbunching instability in linac based accelerators?
10. How well do the present simulations codes reproduce the detailed FEL performance?
11. What be included in the ideal FEL simulation code suite?

## WG-B Ring-Based Light Sources

1. Are there new ideas for storage ring lattices that could go beyond currently-envisioned MBA lattices?
2. Should we be making more use of permanent- or superconducting-magnet technologies?
3. Should new facilities plan for a full-energy linac injector to allow pushing the ring as far as possible?
4. How can we make short lifetimes workable, so we can continue pushing the emittance down?
5. What theory and code developments do we need to ensure that next-generation rings work as planned?
6. What experiments can be performed on existing rings to remove uncertainties for next-generation rings?
7. Besides rings optimized for ultra-high-brightness, what other types of rings should we be designing?
8. What's needed to make first-principles impedance models more accurate in predicting instabilities?
9. What commissioning strategies are best for next-generation rings?
10. How do storage ring design and beamline design interact; e.g., round vs flat beams, tailoring of beta functions vs lowest emittance?
11. Can ultra-bright rings also provide short pulses?
12. Is low emittance more demanding of insertion device quality, e.g., phase errors?
13. Are there new beam stability challenges and what are the best ways to address these?

## WG-C Compact Light Sources

1. What's the main challenges of laser driven plasma wakefield accelerator for FEL applications?
2. What's the main challenges of beam driven plasma wakefield accelerator and beam driven structure wakefield accelerator for FEL applications?
3. Road map of Wake Field accelerator based FELs and current position.
4. How can the key FEL elements (like undulator, timing control, etc.) be more tolerable to the new accelerator schemes?
5. Shall we consider efficiency of the overall facility? And how to improve it?
6. Comparison of new concept linac based with the ring based FEL.
7. Comparison of non-FEL sources (Compton & HHG) and future compact X-FELs.
8. Comparison of Compact sources to synchrotron radiation.
9. Comparison with advanced acceleration schemes with high gradient conventional accelerator approaches compact infra red sources.

## WG-D Key Technologies

1. What is more important for the future light sources, better resolution or higher data rate? What are challenges of bunch position and length monitors?
2. What are challenges for X-ray position and electron emittance monitors? Are intra-bunch instability (e.g. microwave/CSR) monitors needed and do they need further development?
3. Magnets technologies for low emittance lattices and combined function magnets, new developments, future directions
4. What are the challenges and technologies for future LER very high gradient and small aperture magnets? Are completely PM magnets viable? What is future of SSAs for normal conducting RF systems? Are fast kicker pulsers available commercially for most applications? Should LLRF design be standardized?
5. New concepts/ technology for short period undulators for use in high duty cycle FELs Achievements and comparison of peak field vs period length of PM/cryogenic with SC undulators. State of the art to achieve highest fields ? Nb3Sn / high TC superconductors State of technological development to build large undulator systems (with Quadrupoles, Phase shifters, BPMs correctors etc. ) for use in future light sources such as LCLSII Upgrade, the Chinese XFEL or a European XFEL CW upgrade.
6. Radiation damage in SC undulators, comparison of SC vs PM. Best technology for use in a harsh radiation environment such as high duty cycle linacs.

# SCIENTIFIC PROGRAMME

The Scientific Program for FLS2018 will consist of invited, contributed oral and poster presentations.

## Visual Aids

Visual presentations will be made electronically using the projection equipment provided by the Conference Center. Guidelines for speakers are published at the conference website. All presentations must be uploaded via SPMS half a day in advance of the presentation. The Speaker Presentations Office is located in the business center on the 2nd floor. All speakers are encouraged to visit this room the day before their presentation to verify their presentation on laptops identical to those being used in the auditorium, to ensure beforehand that their presentations will work correctly.

## Programme Codes

All contributions to the programme will have a programme code. They begin with the day (MO, TU, WE, etc.), time (A1 (early morning), A2 (late morning), P1 (early afternoon). P2 (late afternoon)) and contain the WG name or the plenary session name and the order within the session.

## Poster Sessions

The Poster Sessions will take place on Wednesday afternoon, from 16:00 to 18:00 at Entrance Hall.

Posters must be mounted before the lunch break on the day of the session such that they can be visited by conference participants during the day. They must be manned during the session from 16:00 to 18:00 and removed at the end of the session.

*Authors are reminded that no contributions are accepted for publication only. Any paper accepted for presentation, which is not presented at the conference, will be excluded from the Proceedings.*

*The Scientific Programme Committee reserves the right to refuse papers for publication if they have not been properly presented or manned in the poster sessions. Manuscripts of contributions to the proceedings (or enlargements of them) are not considered as posters and work presented in this way will not be accepted for publication.*

# PROCEEDINGS

The conference proceedings will be published at the JACoW web site (http://www.jacow.org). The deadline for the submission/upload of contributions to the Proceedings of FLS 2018 was 1 March at midnight. Authors with questions are invited to go to the Editor Room located on the 2nd floor.

# SPONSORS

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# COMMITTEES

## IOC Members

| Name | Affiliation |
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| **Zhentang Zhao (Conference Chair)** | SINAP |
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| Wei Lu | Tsinghua University Beijing |
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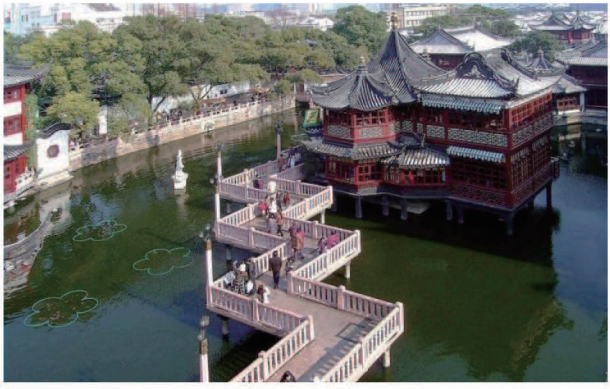

# PROGRAMME AND ABSTRACTS

# Programme and Abstracts

## MOA1PL — Plenary Session A

**Chair:** Y.H. Chin (KEK)

MOA1PL01 09:30 30

### Latest Developments in X-Ray FELs and Future Perspectives

***W. Decking*** *(DESY)*

The successful commissioning of the PAL-XFEL, SwissFEL and European XFEL in the last year has increased the number of operating hard X-Ray FELs together with SACLA and LCLS to five. This talk will try to summarize the status of the facilities, compare similarities and differences and give an outlook of what is to be expected in the coming years.

MOA1PL02 10:00 30

### Review of Schemes for Improved Peak Power and Coherence in X-Ray FELs

***E. Prat*** *(PSI)*

X-ray free-electron-lasers (FEL) are cutting-edge research instruments that produce transversely coherent radiation with peak powers of 10-100 gigawatts and pulse durations of the order of 10 femtoseconds or shorter. Standard FEL facilities based on the SASE mechanism have certain limitations concerning the properties of the produced radiation, namely the longitudinal coherence or bandwidth, the peak power and the pulse duration. In this talk a review of different schemes to enhance the peak power and the longitudinal coherence of FELs will be presented. The talk will cover well-established methods, such as tapering or seeding, as well as other promising but not yet demonstrated techniques, like the high-brightness SASE and some methods based on superradiance to generate terawatt-attosecond radiation. The progress of such schemes will be reviewed and, based on present limitations and challenges, areas for future development will be pointed out. Moreover, we will present how most of these schemes can be accommodated in the design of the next generation of FEL facilities.

05-Mar-18 11:00 – 12:30 Imperial Hall

## MOA2PL — Plenary Session B

**Chair:** R.P. Walker (DLS)

MOA2PL01 11:00 30

### Trends and Challenges in the Future Storage Ring Light Sources

***H. Tanaka*** *(RIKEN SPring-8 Center)*

Recent innovative design concepts have greatly improved ring-based SR source performance beyond the limitations experienced in the past few decades and this movement activates upgrades of operational SR facilities and new facility constructions. This talk gives a landscape of ring-based light source development and then, presents expected challenges in each development branch, beyond the current performance limit.

MOA2PL02 11:30 30

### Round Beam Related Challenges in Storage Ring Light Sources

***P. Kuske*** *(HZB)*

In future low emittance storage ring based light sources round beams are desired for reducing Touschek scattering losses, mitigating emittance growth from IBS, and, last but not least, round beams offer more suitable and better photon beam parameters at the end of beam lines and finally at the user's samples. Various schemes have been proposed to make the naturally flat electron beam in storage rings round. These schemes are more or less challenging and their pros and cons will be presented in this contribution.

MOA2PL03 12:00 30

### Review of New Developments in Superconducting Undulator Technol-ogy at the APS

***Y. Ivanyushenkov***, *I.D. Fuerst (ANL)*

Superconducting undulator (SCU) technology offers the possibility of enhancing the magnetic field of undulators compared to other undulator technologies. It also allows for the fabrication of circular polarizing devices in addition to the planar undulators. Work on SCUs therefore continues in the light source community. Recent developments in SCU technology will be presented.

## MOP1WA — WG-A

**Chair:** W. Decking (DESY)



MOP1WA01 14:00 30
**The Shanghai Hard X-ray Free Electron Laser Project**
***D. Wang*** *(SINAP)*
This talk is about the Shanghai Hard X-ray Free Electron Laser Project.

MOP1WA02 14:30 30
**Progress on the LCLS-II and the High Energy Upgrade of LCLS-II**
***T.O. Raubenheimer****, P. Emma (SLAC)*
The LCLS-II XFEL will be based on a 4 GeV CW SRF linac and will produce x-ray pulses at 1 MHz over the spectral range of 200 to 5,00 eV. The rf gun will be installed and tested in early 2018; cryomodules are being produced at Fermilab and Jefferson lab and shipped to SLAC; undulator segments are being fabricated at LBNL and measured at SLAC. In parallel, a High Energy upgrade will be described which would extend the linac to 8 GeV and increase the spectral range to 12.8 keV.

MOP1WA03 15:00 30
**PAL-XFEL and Its Time-Resolved Experiment with sub-20-fs Timing Jitter**
***C.-K. Min****, I. Eom, J. Hu, S.H. Jung, H.-S. Kang, S.H. Kim, H.-S. Lee, S.S. Park (PAL)*
A tunable femtosecond X-ray laser, PAL-XFEL have sub-20- fs timing jitter between XFEL pulses and optical laser pulses, which make this machine extremely useful for time-resolved experiments with high time resolution. We describe the effort made to minimize timing jitter of XFEL machine and to synchronize optical laser system to our low phase noise RF reference. Passively stabilized RF timing distribution system and phase-locked oscillators provide 1 fs level jitter, and carefully designed LLRF and modulator system provide $10^{-4}$ level energy stability of electron bunches. The electron bunch arrival jitter is measured less than 20 fs with a phase cavity. Cross correlation between XFEL and optical laser also showed less than 20 fs timing jitter.

05-Mar-18 16:00 – 18:00 Imperial Hall I

**MOP2WA — WG-A**

**Chair:** L. Giannessi (Elettra-Sincrotrone Trieste S.C.p.A.)

MOP2WA01 16:00 30

**Report on the First ICFA Mini-Workshop on Machine Learning for Particle Accelerators**

***D.F. Ratner**, C.E. Mayes, T.O. Raubenheimer (SLAC)*

Machine learning techniques are playing a growing role in operation of particle accelerators around the world. To facilitate collaborations and discussions at this early stage, we have organized the first ICFA mini-workshop on machine learning applications at SLAC National Accelerator Laboratory: https://conf.slac.stanford.edu/icfa-ml-2018/. Here we report on the outcome of the meeting.

MOP2WA02 16:30 30

**Automated Optimization of Machine Parameters at the European XFEL**

***S.I. Tomin** (XFEL. EU) , L. Froehlich, M. Scholz (DESY)*

In today's single-pass free-electron lasers, a lot of time and effort is spent on the manual optimization of machine parameters with the goal of improving the photon beam. Identifying and automating these tuning procedures holds the promise of faster set-up times and higher machine efficiency. This talk gives an overview of various optimization routines used for this purpose at the European XFEL. Our first attempts at exploiting machine learning algorithms are also included.

MOP2WA03 17:00 20

**The Feasibility of Neuron Network-based Beam-based Alignment**

***L. Zeng** (SINAP)*

Artificial neuron networks which inspired by biological neural networks have been widely used in various domains, including computer vision, machine translation, pattern/speech recognition, medical diagnosis and so on, due to its overwhelming superiorities. But it's not until recently that intelligent algorithms have been introduced in light source field. M.P. Ehrlichman, Yi Jiao, Juhao Wu and A. Sanchez-Gonzalez did some work in this respect and got commendable results. Considering Shanghai X-ray Free-Electron Laser (SXFEL) conditions, we are urgent to improve the FEL performance, and fundamental technique turns out to be beam-based alignment. But it's difficult to implement this means in SXFEL due to the low electron beam energy resulting in uncontrollable orbit disturbance. Thus, a new method which is suitable for SXFEL is an eager desire. Here, we discuss the feasibility of neuron network-based beam-based alignment, and try to take it into reality in SXFEL. In fact, Hornik have proved, as early as 1989, that a single hidden layer feedforward networks can approximate any measurable function arbitrarily well, which provides the theoretical evidence to our suggestion.

MOP2WA04 17:20 20

**FEL Optimization Through BBA with Undulator Spectrum Analysis and Undulator Optics Matching**

***H.-S. Kang**, H. Yang (PAL)*

The use of electron-beam-based alignment incorporating undulator radiation spectrum analysis has allowed reliable operation of PAL-XFEL with unprecedented stability in terms of orbit, energy, and timing. The hard XFEL operation procedure established using e-BBA and incorporating undulator radiation spectrum analysis proved to be highly reliable and robust, and essential for the variable-gap undulators. The undulator optics matching using the wire-scanner based emittance measurement is extensively used to maximize the FEL intensity even at higher photon energy up to 14.5 keV.

## MOP1WB — WG-B

**Chair:** Q. Qin (IHEP)



MOP1WB01 14:00 30 **Lattice Design for PETRA IV: Towards a Diffraction-Limited Storage Ring**

***I.V. Agapov**, R. Brinkmann, Y.-C. Chae, X.N. Gavaldà, J. Keil, R. Wanzenberg (DESY)*

Machine design for the PETRA III storage ring upgrade – PETRA IV – aiming at a $10^{-30}$ pm emittance range has been ongoing at DESY. We present the design challenges and approaches for this machine, the baseline lattice and the alternative lattice concepts currently under consideration.

MOP1WB02 14:30 30 **Overview of the APS-U Project**

***A. Xiao** (ANL)*

This talk is about the overview of the APS-U Project.

MOP1WB03 15:00 20 **Current and Future of Storage Ring Based Light Sources in KEK**

***N. Higashi**, K. Harada, T. Honda, Y. Kobayashi, N. Nakamura (KEK) K. Hirano (Hiroshima University, Graduate School of Science)*

KEK has two storage-ring light sources. One is Photon Factory (PF). This is the first storage-ring light source in X-ray region in Japan, and the user-run started in 1983. The ring energy is 2.5 GeV, and the emittance has been reduced to 36 nm·rad from 460 nm·rad through some improvements. Another is Photon Factory Advanced Ring (PF-AR). The ring energy is 6.5 GeV, and the single-bunch operation and hard X-ray are featured. The user-run started in 1987, and the emittance is 293 nm·rad. The magnetic lattice is almost the same as the original one. Now we consider the future plans of KEK light sources. One is the fully new facility applying DQBA lattice, named KEK-LS. The circumstance is 571 m, and the emittance is 315 pm·rad @ 3 GeV and 500 mA. In parallel with that, two plans of the only replacements of the lattices reusing existing tunnels of PF and PF-AR are considered. For the PF upgrade, only the arc lattice will be replaced with a new lattice employing combined bends, and the emittance will be improved to 8 nm·rad from 35 nm·rad. For the PF-AR update, fully replacement will be carried out with a new HMBA lattice, and the expected emittance is 520 pm·rad @ 3 GeV and 500 mA.

| 05-Mar-18 | 16:00 – 18:00 | Imperial Hall III |
|---|---|---|

**MOP2WB — WG-B**

**Chair:** M. Borland (ANL)

MOP2WB01 16:00 30

**Accelerator Physics Studies for the High Energy Photon Source (HEPS) in Beijing**

***Y. Jiao*** *(IHEP)*

The High Energy Photon Source (HEPS) is the next ring-based light source with an emittance of tens of picometers, and a circumference of about 1.3 km to be built in China soon in a few years. After 10 years' evolution, the design for the High Energy Photon Source is recently bascially determined. We will report the lattice design and physics studies on HEPS, covering issues of storage lattice design and optimization, booster design, injection design, collective effects, error study, insertion device effects, longitudinal dynamics, etc.

MOP2WB02 16:30 30

**Status of Construction for ESRF EBS**

***T.P. Perron*** *(ESRF)*

The ESRF ' the European Synchrotron Radiation Facility ' is a user facility in Grenoble, France, and the source of the most intense high-energy (6 GeV) X-rays in the world. In 2019, the existing storage ring will be removed and a first-of-a-kind new lattice, based on an innovative arrangement of magnets, will be installed in its place, dramatically reducing the horizontal equilibrium emittance. This 'fourth-generation' synchrotron will produce an X-ray beam 100 times more brilliant and coherent than the ESRF source today. Coupled with upgraded beamlines and beamline support it will provid previously unimaginable opportunities for applications as varied as nanoscopy, science at extreme conditions and structural biology. The ESRF — Extremely Brilliant Source (EBS) project was launched in 2015 and its current status will be presented, alongside the expected performance of the accelerator, the technical challenges confronted and its future potential fields of applications. A special attention will be put in this paper to the beam dynamics issues (lattice, injection efficiency, lifetime, beam losses,…).

MOP2WB03 17:00 30

**Baseline Lattice for the Upgrade of SOLEIL**

***A. Loulergue****, P. Brunelle, A. Nadji, L.S. Nadolski, R. Nagaoka, M.-A. Tordeux (SOLEIL)*

Previous MBA studies converged to a lattice composed of 7BA-6BA with a natural emittance value of 200-250 pm·rad range. Due to the difficulties of non-linear optimization in targeting lower emittance values, a decision was made to symmetrize totally the ring with 20 identical cells having long free straight sections longer than 4 m. A 7BA solution elaborated by adopting the sextupole paring scheme with dispersion bumps originally developed at the ESRF-EBS, including reverse-bends, enabling an emittance of 72 pm·rad has been defined as the baseline lattice. The sufficient on-momentum dynamic aperture obtained allows to consider off-axis injection. The linear and nonlinear dynamic properties of the lattice along with the expected performance in terms of brilliance and transverse coherence are presented. In particular, the beta functions tuned down to 1 m in both transverse planes at the center of straight sections allow matching diffraction limited photons up to 3 keV. In addition, a 9BA solution reaching 32 pm·rad and a novel longitudinal on-axis injection scheme involving rapidly decaying RF kicks developed at SOLEIL shall also be presented.

MOP2WB04
17:30 20

**Study of Multi-bend Achromat Lattices for the HALS Diffraction-limited Storage Ring**

***Z.H. Bai**, L. Wang (USTC/NSRL)*

In this paper, two multi-bend achromat (MBA) lattice concepts are proposed for designing a soft X-ray diffraction-limited storage ring, the Hefei Advanced Light Source (HALS). The first MBA concept proposed is called the locally symmetric MBA, where the beta functions of each cell are made to be locally symmetric about two mirror planes, between which the phase advance is made so as to cancel out the nonlinear effects produced by sextupoles. The second MBA concept is called the MBA with interleaved dispersion bumps, where two pairs of dispersion bumps are created in each cell, which are interleaved from the nonlinear cancellation point of view. Three lattices, an 8BA, a 6BA and a 7BA, were designed with natural emittances of about 30 pm·rad for the HALS storage ring using these two MBA lattice concepts. The optimized nonlinear dynamics results for these three lattices were rather good, showing large on- and off- momentum dynamic apertures and large dynamic momentum aperture. Especially the dynamic momentum aperture was larger than 7% or even 10%, which could not only guarantee a very long beam lifetime, but also promise the implementation of longitudinal injection for the HALS.

## TUA1WB — WG-B

**Chair:** M. Borland (ANL)



TUA1WB01 09:00 30

### Survey of Injection Schemes for Next-generation Light Source Rings

***Z. Duan*** *(IHEP)*

Next-generation storage ring-based light sources will be based on the multi-bend achromat (MBA) lattice, as successfully demonstrated in MAX-IV. Such designs promise substantial brightness improvements compared to third-generation light sources, while there is likely to be a trade-off between the optimized brightness, available dynamic aperture for injection and local momentum acceptance related to beam lifetime. Different injection schemes have been proposed for these designs with different requirements on the ring dynamic aperture. In fact, the choice of injection schemes will significantly affect the figure of merit in the lattice optimisation and even the overall design of the facility. This talk will survey these injection schemes, their merits and challenges, and the R&D efforts involved.

TUA1WB02 09:30 30

### Compensation of Transient RF Voltage in a Double RF System Using a Kicker Cavity

***N. Yamamoto****, S. Sakanaka, T. Takahashi (KEK)*

In quasi diffraction-limited synchrotron light sources especially in the low-to-medium energy range, emittance growth due to intrabeam scattering (IBS) is a serious concern. To mitigate the IBS, a double rf system is used to lengthen the beam bunches. In the double RF system, the performance of bunch lengthening is limited by the transient beam-loading effect which is induced by bunch gaps in the fill pattern. Even if the superconducting (SC) harmonic cavities (HCs) are used, the performance of bunch lengthening is limited when the bunch gap is large. To improve their performances, we propose the use of a single "kicker" cavity having low loaded Q. The "kicker" cavity provides an rf voltage that is comparable to the fluctuating rf voltages in the main and harmonic cavities, and mitigates the phase shift of beam bunches over the bunch train, while keeping its required generator power modest. As a results of our numerical investigation, the significantly improvement of the bunch lengthening performance can be expected. We will present the concept of this technique and show expected bunch-lengthening performances.

TUA1WB03 10:00 20

### Injection Transient Observation via Bunch-by-bunch Beam Size Measurement System

***H.J. Chen****, J. Chen, B. Gao, Y.B. Leng (SINAP)*

A bunch-by-bunch beam size measurement system has been developed at SSRF as a sub-system of 6-dimension bunch-by-bunch diagnostic system, which is an attempt for global bunch information capturing during instabilities by SSRF BI group. The system is composed of direct-imaging optical front-end, high-speed photomultiplier array detector, signal amplifiers and high sampling rate oscilloscope as signal acquisition method. An injection transient process has been successfully captured based on 4-channels signal with strongly bunch position and horizontal beam size oscillation after injection point as betatron oscillation of SSRF storage ring. It demonstrates the bunch-by-bunch measurement capability of the system, which will be used for other fast instabilities monitoring and analysis. Further 16 channels detection using synchronized digitizers and other optimizations is also under developing for high size resolution.

## TUA2WB — WG-B

**Chair:** Q. Qin (IHEP)

TUA2WB01 11:00 20

### Future Synchrotron Light Source in Thailand

***T. Chanwattana****, N. Juntong, K. Kittimanapun, P. Klysubun, T. Pulampong, P. Sudmuang (SLRI)*

A 3-GeV synchrotron light source has been designed as a future light source in Thailand. The storage ring is designed utilising Double Triple Bend Achromat (DTBA) lattice to achieve beam emittance below 1 nm·mrad, maximum beam current of 300 mA and two straight sections per cell. A full energy linac is a promising choice as the storage ring injector due to its potential to be operated as the storage ring injector and an injector for a short pulse facility. The linac can be upgraded to a soft X-ray Free Electron Laser (FEL) facility by extending an undulator section. The design of the linac injector consists of a pre-injector based on a photocathode RF gun, two main linacs based on high gradient S-band structures, and two bunch compressors. The high gradient S-band structure with the accelerating gradient of 35-40 MV/m is suitable to achieve the beam energy of 3 GeV within the injector length of about 150 m. The bunch compressors are included for generating 100-fs electron bunches for the short pulse facility. This paper presents designs and simulation results of the storage ring and the linac injector of Thailand new light source.

TUA2WB02 11:20 20

### Multi-Bend Lattice Analysis Towards a Diffraction Limited Ring Based Light Source

***E. Karantzoulis*** *(Elettra-Sincrotrone Trieste S.C.p.A.)*

An analysis of lattice configurations up to 10 bend achromat is presented aiming towards diffraction limited ring based light source. The described analysis can apply to any type of a ring based light source however for practical reasons we consider Elettra that has been operating for users for 24 years; to stay competitive for world-class photon science in the future a massive upgrade of the storage ring is needed. The optimum solution is based on certain design criteria, constraints regarding certain accelerator components and their implications on beam dynamics and user requirements. The space available for insertion devices as well as the impact of anti-bends on the design is also addressed. Two proposed realistic lattices are further discussed taking into account different criteria and user requirements. Those lattices reduce the emittance of the present machine by more than one order of magnitude but at the same time respect many other criteria such as realistic magnet gradients, magnets with magnetic length equal to the physical length, drift space enough for radiation extraction, large available space for insertion devices, minimal shift of the beam lines etc.

TUA2WB03 11:40 20
**Modeling Ion Effects for the APS-U**
***J.R. Calvey**, M. Borland (ANL)*
Ions are produced in an accelerator when the beam ionizes residual gas inside the vacuum chamber. If the beam is negatively charged, ions can become trapped in the beam's potential, and their density will increase over time. Trapped ions can cause a variety of undesirable effects, including instability and emittance growth. Typically, simulation of ion effects is done using a "weak-strong" model, in which the ions are modeled using macroparticles, but the beam is assumed to be a fixed Gaussian distribution, with only centroid motion allowed. This type of model necessarily neglects incoherent beam effects, such as decoherence, emittance growth, and tune spread. Recently, an IONEFFECTS element has been incorporated into the particle tracking code ELEGANT. The code has been parallelized, and allows for modeling intra-bunch effects, in combination with other elements. Ion effects have been modeled for the APS-U storage ring and Particle Accumulator Ring, using both a weak-strong code and ELEGANT. Some of the questions investigated include ion instability in the presence of train gaps, ion-induced emittance growth, and multiple ionization.

TUA2WB04 12:00 20
**Ion Instability in the HEPS Storage Ring**
***S.K. Tian**, N. Wang (IHEP)*
The High Energy Photon Source (HEPS), a kilometre scale storage ring light source, with a beam energy of 6 GeV and transverse emittances of a few tens of pm.rad, is to be built in Beijing and now is under design. We investigate the ion instability in the storage ring with high beam intensity and low-emittance. We performe a weak-strong simulation to show characteristic phenomena of the instability in the storage ring.

## TUP1WD — WG-D

**Chair:** Y.B. Leng (SINAP)

TUP1WD01 14:00 30

### Comparative Study of RF BPM Performance via Beam Measurements at NSLS-II

***D. Padrazo Jr***, *T.V. Shaftan (BNL)*

NSLS-II developed and built RF BPM receivers that have been used in the past three years during commissioning of 200 MeV linac, 3 GeV booster and storage ring and now are in routine operations. Recently we completed an upgrade of BPM DFE Digital Front End gaining benefits of a Xilinx Zynq FPGA. This FPGA includes a hard dual-core ARM A9 processor which will permit more advanced signal processing routines, faster ethernet communication, as well as resources to implement a pilot tone based active calibration, eliminating the need of thermal controlled racks. In the past year we procured a Libera Brilliance Plus BPM electronics unit to benchmark the outcome of our upgrade with respect to one of the best commercially available solutions. This presentation is focused on comparison of performance between NSLS-II RF BRM version 2 with the Libera unit focusing on the following performance parameters: Long term stability for 10Hz,as well as characterization of FA, TBT and ADC Raw data set. We conclude our presentation by outlining future directions in upgrading NSLS-II RF BPM AFE, DFE and high-level controls to enable breakthrough in the area of diagnostics of charged particle beams.

TUP1WD02 14:30 30

### A Study on the Improved Cavity Bunch Length Monitor for FEL

***Q. Wang***, *P. Lu, Q. Luo, B.G. Sun, L.L. Tang, F.F. Wu, Y.L. Yang, T.Y. Zhou, Z.R. Zhou (USTC/NSRL)*

Bunch length monitors based on cavities have great potential especially for future high quality beam sources because of many advantages such as simple structure, wide application rage, and high signal-to-noise ratio (SNR). The traditional way to measure bunch length needs two cavities at least. One is reference cavity, whose function is to get the beam intensity. The other one is defined as main cavity, which is used to calculate the bunch length. There are some drawbacks. To improve performance, the mode and the cavity shape are changed. At the same time, the position and orientation of coaxial probe are designed to avoid interference modes which come from the cavity and beam tube according to the analytic formula of the electromagnetic field distribution. A series simulation based on CST is performed to verify the feasibility, and the simulation results reveal that the improved monitor shows good performance in bunch length measurement.

TUP1WD03
15:00 20

**The Development and Applications of the Digital BPM Signal Processor at SINAP**

***L.W. Lai***, *F.Z. Chen, Y.B. Leng, Y.B. Yan, W.M. Zhou (SSRF) J. Chen, Y.B. Leng, Y.B. Yan, W.M. Zhou (SINAP)*

BPM signal processor is one of key beam diagnostics instruments. It has been progressing from analog to digital. The current major processors are digital BPM signal processor (DBPM). Except for some commercial products on-the-shelf, several laboratories developed in-house DBPMs for their own facilities. SINAP started the DBPM development since 2009, when the SSRF phase-I has been completed. After years of optimization, the DBPM has been used in large-scale on some facilities, including SSRF, DCLS and SXFEL. At the same time, some extended functions have been developed to meet special applications on accelerator based on the hardware platform. This topic will introduce the development and applications of the DBPM at SINAP, also the future DBPM development for next generation light source will be discussed here.

## TUP2WD — WG-D

**Chair:** Y.B. Leng (SINAP)

TUP2WD01 16:00 30

### Next Generation X-Ray Beam Position Monitor Development for the Advanced Photon Source Upgrade

***B.X. Yang*** *(ANL)*

Current undulator XBPMs in the Advanced Photon Source (APS) can handle limited beam power and have strong bend magnet background. The next generation XBPM will separate the power-handling elements from the signal detectors using x-ray fluorescence from aperture components and x-ray scattering from low-Z blades. They showed distinct design advantages: (1) The water-cooled aperture components greatly enhance power-handling capacity, up to the APS-U 20-kW undulators. (2) Additional x-ray optics, such as pinhole-camera, enables center-of-mass, gap-independent measurements. (3) Proper beam-intercepting elements tailor the XBPM spectral properties and suppress the background, improving undulator measurement accuracy. (4) Using limiting apertures as the XBPM allows aiming the undulator beam reliably at the aperture during user operations, eliminating the common alignment issue between the aperture and the XBPM. In this report, we discuss the x-ray physics, mechanical design, computer simulation and beam measurements of these x-ray beam position monitors for the APS Upgrade. Possible applications to the free electron laser will be discussed.

TUP2WD02 16:30 30

### Emittance Measurements on Future Ring Light Sources

***Å. Andersson*** *(MAX IV Laboratory, Lund University)*

The MAX IV 3 GeV ring is designed to produce a bare lattice horizontal electron beam emittance of 330 pm·rad. We present different methods using visible or near visible SR, for measuring this so far unsurpassed low horizontal emittance. In this way we can minimize systematic errors, and we also point out those measurement methods that could best serve emittance determinations on future, below 100 pm·rad, emittance light sources.

TUP2WD03 17:00 30

### Turn-by-Turn Measurements for Systematic Investigations of the Micro-Bunching Instability

***J.L. Steinmann****, M. Brosi, E. Bründermann, M. Caselle, B. Kehrer, A.-S. Müller, L. Rota, M. Schuh, P. Schönfeldt, M. Weber (KIT)*

While recent diffraction limited storage rings provide bunches with transverse dimensions smaller than the wavelength of the observed synchrotron radiation, this is still challenging in the longitudinal plane. The benefit would be single cycle pulses of coherent radiation with many orders of magnitude higher intensity. However, the self interaction of a short electron bunch with its emitted coherent radiation can lead to the micro-bunching instability. Therefore, the bunch compression in storage rings is currently limited to the picosecond range. In that range, the bunches emit coherent THz radiation corresponding to their bunch length. In this presentation, new measurement setups developed at KIT are described for turn-by-turn systematic investigations of the micro-bunching instability. They lead to a better understanding thereof and enable appropriate observation in future efforts of controlling and mastering the instability. Furthermore, the described setups might also be used as high repetition rate bunch compression monitors for bunches of picosecond length and below.

TUP2WD04
17:00 20

**The Design of HEPS Vacuum Chambers**

***P. He**, D.Z. Guo, B.Q. Liu, Y. Ma (IHEP)*

In the design process of HEPS vacuum system, we meet the following limitations. Vacuum chamber must fit inside multipole magnet bore diameter of 25mm (without touching). Water channels and x-ray extraction ports must pass through a 11mm vertical pole gap. Provide an average pressure of 1nTorr during operations with 200mA beam current. Control thermal drift of BPM to ~ μm and vibration amplitude ~nm level. Minimize impedance effects. This paper introduces the design of various vacuum chambers, including material selection, mechanical simulation analysis, welding test and so on.

## TUA1WC — WG-C

**Chair:** C.-J. Jing (Euclid TechLabs, LLC)

TUA1WC01 09:00 30 **Progress on High Peak Current Laser Wakefield Electron Acceleration**
***U. Schramm*** *(HZDR)*

Not only beam quality of laser wakefield accelerated electron beams but parameter control has been improved in recent years by individual optimization of electron injection and acceleration. We here present novel results of a scheme called tailored self-truncated ionization injection that allows for independent tuning of the injected bunch charge and the acceleration conditions, and results in unprecedented charges of up to 0.5 nC or peak currents exceeding 10s of kA with typical quasi monoenergetic spectra. Beam loading is demonstrated to improve beam parameters if properly controlled. Such bunches are ideal drivers for various radiation sources and potentially for lab-scale beam driven plasma wakefield accelerators.

TUA1WC02 09:30 30 **A Conceptual Design of a Compact Wakefield Accelerator for a High Repetition Rate Multi User X-ray Free-Electron Laser Facility**
***J.F. Power*** *(ANL)*

This talk is about a conceptual design of a compact wakefield accelerator for a high repetition rate multi user X-ray Free-Electron Laser facility.

TUA1WC03 10:00 30 **The SPARC Lab Activity and Eupraxia European Program**
***M. Ferrario*** *(INFN/LNF)*

On the wake of the results obtained so far at the SPARC_LAB test-facility at LNF, we are currently investigating the possibility to design and build a new multi-disciplinary user-facility, equipped with a soft X-ray Free Electron Laser (FEL) driven by a ~1 GeV high brightness linac based on plasma accelerator modules. It is in fact widely accepted by the international accelerator scientific community that a fundamental milestone towards the realization of a plasma driven future Linear Collider (LC) will be the integration of the new high gradient accelerating plasma modules in a FEL user facility, as proposed in the approved H2020 Design Study EuPRAXIA. This fundamental goal will be integrated in the LNF facility by using a high gradient X-band RF linac and the high power laser FLAME to drive Plasma Oscillations in the accelerator module. This activity is performed in synergy with the EuPRAXIA and CompactLight design studies. In this talk we report about the recent progresses in the on going European and National design studies and about opportunities and perspectives for the FEL community.

## TUA2WC — WG-C

**Chair:** M.-E. Couprie (SOLEIL)



TUA2WC01 11:00 30

### Undulator Radiation After Coxinel Transport Line With a Laser Plasma Acceleration Source

***A. Ghaith***, *T. André, I.A. Andriyash, F. Blache, F. Bouvet, F. Briquez, M.-E. Couprie, Y. Dietrich, J.P. Duval, C. Herbeaux, N. Hubert, C.A. Kitegi, M. Labat, N. Leclercq, A. Lestrade, A. Loulergue, O. Marcouillé, F. Marteau, D. Oumbarek, P. Rommeluère, E. Roussel, M. Sebdaoui, K.T. Tavakoli, M. Valléau (SOLEIL) S. Bielawski, C. Evain, C. Szwaj (PhLAM/CERLA) S. Corde, J. Gautier, G. Lambert, B. Mahieu, V. Malka, K.T. Phuoc, C. Thaury (LOA)*

The ERC Advanced Grant COXINEL aims at demonstrating free electron laser amplification, at a resonant wavelength of 200 nm, based on a laser plasma acceleration source. To achieve the amplification, a 10 m long dedicated transport line was designed to manipulate the beam qualities. It starts with a triplet of permanent magnet with tunable gradient quadrupoles (QUAPEVA) that handles the highly divergent electron beam, a demixing chicane with a slit to reduce the energy spread per slice, and a set of electromagnetic quadrupoles to provide a chromatic focusing in a 2 m long cryogenic undulator. Electrons of energy 176 MeV were successfully transported throughout the line, where the beam positioning and dispersion were controlled efficiently thanks to a specific beam based alignment method, as well as the energy range by varying the slit width. Observations of undulator radiation for different undulator gaps are reported.

TUA2WC02 11:30 20

### "LWFA-driven" Free Electron Laser for ELI-Beamlines

***A.Y. Molodozhentsev***, *G. Korn, L. Pribyl (Czech Republic Academy of Sciences, Institute of Physics) A.R. Maier (University of Hamburg)*

Free-electron lasers (FEL) are unique light source for different applications on the femto-second scale, including for instance the most basic reaction mechanisms in chemistry, structural biology and condense physics. Laser wake field acceleration (LWFA) mechanism allow to produce extremely short electron bunches of a few fs length with the energy up to a few GeV providing peak current of many kA in extremely compact geometries. This novel acceleration method therefore opens a new way to develop compact "laser-based" FELs. ELI beamlines is an international user facility for fundamental and applied research using ultra-intense lasers and ultra-short high-energy electron beams. In frame of this report we present conceptual solutions for an compact "LFWA" based soft X-ray FEL, which can deliver a photon peak brightness of $10^{31}$ ph/sec/mm$^2$/mrad$^2$/0.1%bw. A combination of this achievement with novel laser technologies will open a new perspective for the development of extremely compact FELs with few or even sub-femtosecond photon bunches for a very wide user community.

TUA2WC03
11:50 20

**Progress Towards BELLA Center's Free Electron Laser Driven by a Laser Plasma Accelerator**

***J. van Tilborg***, *M.V. Ambat, S.K. Barber, F. Isono, W. Leemans, C.B. Schroeder (LBNL)*

I will present the latest BELLA Center efforts towards realizing a free-electron laser (FEL) driven by a laser plasma accelerator (LPA). In addition to simulation and modeling results performed to optimize FEL performance, the experimental status of the laser system, accelerator, electron beam transport line, and characterization of the undulator, will be addressed. Several of our recent publications play a critical role in the LPA FEL project: Parametric studies of the LPA emittance for two injection techniques based on a single-shot dispersive diagnostic will be presented, and recent insight into the advantages and limitations of active plasma lenses will be covered.

## TUP1WA — WG-A

**Chair:** T.O. Raubenheimer (SLAC)

TUP1WA01 14:00 30

### Generation of Atto-Second FELs

***A. Marinelli*** *(SLAC)*

Sub-fs X-ray pump/probe capabilities hold great promise for understanding the role of coherent electron dynamics in molecules and solids. At the Linac Coherent Light Source (LCLS) for hard X-ray energies the sub-fs regime can be reached by shortening the electrong bunch and operating the FEL in the single-spike SASE FEL limit. In the soft X-ray region, achieving sub-fs pulses requires bandwidth broadening by means of an enhanced SASE scheme. In this talk I will present recent results on the generation of sub-fs X-ray pulses at LCLS and discuss the path to time-resolved experiments with attosecond time resolution

TUP1WA02 14:30 20

### Ultrashort Pulse Generation and Superradiance in FELs

***X. Yang*** *(BNL) L. Giannessi (Elettra-Sincrotrone Trieste S.C.p.A.)*

The generation of a single X-ray isolated spike of radiation with peak power at multi-GW level and femtosecond temporal duration represents an almost unique opportunity in time resolved diffraction imaging of isolated molecules or non-periodic structures, for the possibility of acquiring single shot images before the Coulomb explosion of the sample takes place. Such a condition is met by an FEL operating in superradiant regime when the pulse has a self-similar shape deriving from the combined dynamics of saturation and slippage of the radiation over fresh electrons. We show that the peak of the pulse moves at superluminal speed similarly to the case of pulses propagation in anomalous dispersive active media and it is followed by a long pedestal resulting from the complex dynamics occurring in the tail after saturation. We analyze the dynamical conditions leading to the formation of the main pulse and the following tail and we study the correlation of the tail structure with the longitudinal phase space of the e-beam, providing recipes to partially suppress it.

TUP1WA03 14:50 20

### Free-Electron Laser R&D in the UK - Steps Towards a National X-FEL Facility

***N. Thompson****, J.A. Clarke, D.J. Dunning (STFC/DL/ASTeC) J.A. Clarke, D.J. Dunning (Cockcroft Institute) B.W.J. M$^{c}$Neil (USTRAT/SUPA)*

In this contribution we present highlights of FEL R&D in the UK with a focus on progress towards a national X-Ray FEL user facility. We discuss the aims and status of CLARA, a dedicated FEL test facility under construction at STFC Daresbury Laboratory and present highlights of recent research into the development of novel FEL output possibilities.

## TUP2WA — WG-A

**Chair:** L. Giannessi (Elettra-Sincrotrone Trieste S.C.p.A.)

TUP2WA01 16:00 30

### EEHG Experiment at FERMI

***E. Allaria*** *(Elettra-Sincrotrone Trieste S.C.p.A.)*

Echo enabled harmonic generation (EEHG) has been recognized as a possible solution to extend the tuning range of externally seeded FELs to wavelength as short as few nm. Previous experiments have confirmed the capabilities to produce bunching at very high harmonic but they have been done only at long wavelength. An experiment to demonstrate EEHG operations at high harmonic and short wavelength is planned at FERMI. With few modifications to the FERMI FEL-2 layout, EEHG will be studied and performances will be compared to other seeding schemes such as high gain harmonic generation (HGHG). Attention will be focused to the spectral purity and to the sensitivity of EEHG and HGHG to microbunching instabilities.

TUP2WA02 16:30 30

### An X-Ray FEL Oscillator for Novel Sciences

***K.-J. Kim*** *(ANL)*

An X-ray FEL Oscillator (XFELO) is capable of producing fully coherent flux of $\sim 10^{15}$ photons /s/ (meV bandwidth) over the hard X-ray spectral range 5 to 25 keV. This is higher by about three orders of magnitude than that from the self-amplified-spontaneous-emission (SASE) sources and about six orders magnitudes than the MBA sources. A CW, MHz rep rate, multi-GeV superconducting linac, such as planned at several laboratories is ideally suited for operating an XFELO. The XFELO pulses are also highly stable in contrast to the SASE pulses. In contrast to the ultrafast sciences probed by SASE, the XFELO is well-suited for sciences probing ultra fine spectral resolution. An XFELO can thus greatly extend the parameter space of the techniques established in third generation sources (IXS, XPCS, NRS) as well as opening up entirely new field, for example the nuclear physics of Mössbauer states and fundamental physics with X-ray spectral comb. The performance listed above is based on experimentally demonstrated level of X-ray power density on diamond reflectors and a fixed (4%) out-coupling efficiency. Further enhancement could be feasible if these constraints can be relaxed.

TUP2WA03 17:00 20

### Harmonic Lasing in XFELs: Theory and Experiment

***E. Schneidmiller****, M.V. Yurkov (DESY)*

Harmonic lasing in XFELs is an opportunity to extend operating range of existing and planned X-ray FEL user facilities. Contrary to nonlinear harmonic generation, harmonic lasing can provide much more intense, stable, and narrow-band FEL beam which is easier to handle due to the suppressed fundamental. Another interesting application of harmonic lasing is Harmonic Lasing Self-Seeded (HLSS) FEL that allows to improve longitudinal coherence and spectral power of a SASE FEL. Recently this concept was successfully tested at FLASH2 in the range 4.5 - 15 nm. That was also the first experimental demonstration of harmonic lasing in a high-gain FEL and at a short wavelength (before it worked only in infrared FEL oscillators). In this contribution we describe the concepts of harmonic lasing and of HLSS FEL, and present the experimental results from FLASH2.

TUP2WA04
17:20 20

**Simulations and Performance Study of an Optimized Longitudinal Phase Space for the Hard X-Ray Self-Seeding at the European XFEL**

***S. Liu**, W. Decking, V. Kocharyan (DESY) G. Geloni, S. Serkez (XFEL. EU)*

A two-stage Hard X-ray Self-Seeding (HXRSS) set-up will be implemented at European XFEL in late 2018. For the demonstration of the HXRSS, short electron beam bunches (FWHM ≤ 50 fs) are preferred to mitigate spatio-temperal coupling effect and to fit to the seeding bump width. In preparation for the commissioning of the HXRSS, beam dynamics simulations have been performed to optimize the longitudinal phase space for a 100 pC electron beam with 5 kA peak current. Performance of the optimized longitudinal phase space will be studied using a transverse deflecting structure in early 2018. With the optimized electron beam, HXRSS simulations have been performed for the lower (~3 keV) and the upper (~14 keV) photon energy range planned for the HXRSS operation. The locations of the two HXRSS stages have been studied and chosen to optimize the performance for the upper photon energy. We will present the longitudinal phase space optimization and measurement results for the 100 pC case as well as the expected performance of the HXRSS with the optimized set-up.

## WEA1PL — Plenary Session C

**Chair:** H.-H. Braun (PSI)

WEA1PL01 09:00 30

### Status and Prospects for Plasma Accelerator Based Light Sources

***W. Lu*** *(TUB)*

In the past decade, the field of plasma based accelerators and light sources has witnessed remarkable progresses worldwide. In this talk, the current status of light sources based on plasma accelerators will be reviewed. For incoherent synchrotron like sources, the development and preliminary applications of Betatron and inverse-Compton X/Gamma-ray sources will be discussed. For coherent sources, the development of intense THz and Infrared sources based on plasma nonlinear optics, as well as EUV/X-ray sources based on FELs will be discussed, with an emphasis on the challenges and opportunities of compact FELs based on laser and beam driven wakefield accelerators. Particularly, the prospects of generating high quality electron beams with extremely high brightness in plasma accelerators and its implication for future light source development will be discussed in details.

WEA1PL02 09:30 30

### Dielectric Accelerators and Other Non-Plasma Accelerator Based Compact Light Sources

***R.J. England*** *(SLAC)*

We review recent experimental progress in developing nanofabricated dielectric laser-driven accelerators and discuss the possibility of utilizing the unique sub-femtosecond electron pulse format these accelerators would provide to create ultra-compact EUV and X-ray radiation sources.

WEA1PL03 10:00 30

### Attosecond Timing

***F.X. Kärtner*** *(Deutsches Elektronen Synchrotron (DESY) and Center for Free Electron Science (CFEL))*

Photon-science facilities such as X-ray free-electron lasers (XFELs) and intense-laser facilities are emerging world-wide with some of them producing sub-fs X-ray pulses. These facilities are in need of a high-precision timing distribution system, which can synchronize various microwave and optical sub-sources across multi-km distances with attosecond precision. Here, we report on a synchronous laser-microwave network that permits attosecond precision across km-scale distances. This was achieved by developing new ultrafast timing metrology devices and carefully balancing the fiber nonlinearities and fundamental noise contributions in the system. New polarization-noise-suppressed balanced optical crosscorrelators and free-space-coupled balanced optical-microwave phase detectors for improved noise performance have been implemented. Residual second- and third-order dispersion in the fiber links are carefully compensated with additional dispersion-compensating fiber to suppress link-induced Gordon-Haus jitter and to minimize output pulse duration; the link power is stabilized to minimize the nonlinearity-induced jitter as well as to maximize the signal to noise ratio for locking.

## WEA2WC — WG-C

**Chair:** H. Zen (Kyoto University)

WEA2WC01 11:00 30

### CEP-Stabilized Few-cycle MIR-FELs for Driving High-Repetition-Rate (>10 MHz) Attosecond X-ray Sources Based on HHG

***R. Hajima*** *(QST)*

High harmonic generation (HHG) is a well-established technology to produce attosecond pulses in VUV wavelengths. So far HHG sources have been driven by femtosecond solid-state lasers not FELs, because it has been believed that FELs have no ability to provide carrier-envelope-phase (CEP) stabilized few-cycle pulses essential to the HHG. Here, we propose a scheme to CEP stabilized few-cycle pulses from a FEL oscillator. Operated at a mid-infrared wavelength, the proposed method is able to drive a HHG photon source to produce isolated attosecond pulses at photon energies above 1 keV with a repetition > 10 MHz. The FEL-HHG photon source will open a door to full-scale experiments of attosecond X-ray pulses and push ultrafast laser science to the zeptosecond regime [1].

WEA2WC02 11:30 20

### High-efficient XFELO Based on Optical Resonator with Self-modulated Q-factor

***C.-J. Jing****, S.P. Antipov (Euclid Beamlabs LLC) S.P. Antipov (ANL) S.P. Antipov (Euclid TechLabs, LLC) S.V. Kuzikov, A.V. Savilov (IAP/RAS) A.V. Savilov (UNN)*

We suggest an efficient XFELO having a new non-stationary out-coupling scheme. It consisted of two undulator sections located in sequence with a free space gap in-between. The first section is a conventional uniform undulator, the second one is a tapered undulator. At start time point X-ray radiation is basically produced by the uniform section. Mirrors of XFELO's optical resonator are calculated so that diffraction Q-factor reaches the highest value, i.e losses asre near to zero. As X-ray power increases the tapered undulator begins to bring more contribution in radiation power. Finally, at a new steady state regime all power is being produced by the tapered section. Because mirrors were optimized for Gaussian wavebeam to be produced in the first section, in the final steady state regime a portion of X-ray power will be out-coupled missing partly the mirrors.

WEA2WC03 11:50 20

### A 1d Time-Dependent Theoretical Model of X-Ray Free-Electron Laser Oscillator

***K. Li****, H.X. Deng (SINAP)*

FEL is a cutting-edge tool for generating high brilliant, wavelength adjustable radiation. FEL oscillators (FELO) is one of FEL's operation mode. A novel simplified theoretical model for fast simulation and optimization of FELO is proposed. Instead of utilizing conventional macro particles tracking, i.e., GENESIS and OPC codes, the theoretical model takes advantage of low-gain theory to calculate single-pass gain analytically and it is able to considerably reduce calculation time, i.e., from several days to a few minutes. In addition, it is useful for simulating new FELO scheme such as gain cascading.

## WEP1WC — WG-C

**Chair:** M.-E. Couprie (SOLEIL)

WEP1WC01 14:00 30

### The CompactLight Project: Towards Compact Accelerators and Beyond

***G. D'Auria*** *(Elettra-Sincrotrone Trieste S.C.p.A.)*

CompactLight (XLS) is a three-year project, funded by EU in the context of the Horizon 2020 Programme (Research Infrastructures - Design Studies). The aim of the project, started in January 2018, is to design a hard X-ray FEL facility beyond today's state of the art, using the latest concepts for bright electron photo injectors, very high-gradient X-band structures operating at 12 GHz, and innovative compact short-period undulators. A consortium of 21 leading European institutions, including industry, together with 3 non-European institutes, are partnering up to achieve this ambitious goal. An overview of the project with the main organizational aspects and the expected outcomes will be reported.

WEP1WC02 14:30 30

### CompactLight Design Study

***A. Latina****, D. Schulte, S. Stapnes, W. Wuensch (CERN) G. D'Auria (Elettra-Sincrotrone Trieste S.C.p.A.)*

H2020 CompactLight Project aims at designing the next generation of compact hard X-Rays Free-Electron Lasers, relying on very high accelerating gradients and on novel undulator concepts. CompactLight intends to design a compact Hard X-ray FEL facility based on very high-gradient acceleration in the X band of frequencies, on a very bright photo injector, and on short-period/superconductive undulators to enable smaller electron beam energy. If compared to existing facilities, the proposed facility will benefit from a lower electron beam energy, due to the enhanced undulators performance, be significantly more compact, as a consequence both of the lower energy and of the high-gradient X-band structures, have lower electrical power demand and a smaller footprint. CompactLight is a consortium of 24 institutes (21 European + 3 extra Europeans), gathering the world-leading experts both in the domains of X-band acceleration and undulator design.

WEP1WC03 15:00 20

### Design of a Very Large Acceptance Compact Storage Ring

***A.I. Papash****, E. Bründermann, A.-S. Müller, R. Ruprecht, M. Schuh (KIT)*

Design of a very large acceptance compact storage ring is underway at the Institute for Beam Physics and Technology of the Karlsruhe Institute of Technology (Germany). Combination of storage ring and a laser wake-field accelerator (LWFA) might be the basis for future compact light sources and advancing user facilities. Meanwhile the post-LWFA beam is not fitted for storage and accumulation in conventional storage rings. New generation rings with adapted features are required. Different geometries and lattices of a ring operating between 50 to 500 MeV energy range were investigated. The model suitable to store the post-LWFA beam with a wide momentum spread (2% to 3%) and ultra-short electron bunches of fs range was chosen as basis for further detailed studies. The DBA-FDF lattice with relaxed settings, split elements and high order optics of tolerable strength allows to improve the dynamic aperture up to 20 mm. The momentum acceptance of compact lattice exceeds 8% while dispersion is limited. The physical program includes turn-by-turn phase compression of a beam, crab cavities, dedicated alpha optics mode of operation, non-linear insertion devices etc.

## WEA2WD — WG-D

**Chair:** J. Pflueger (DESY)

WEA2WD01 11:00 30

### QUAPEVA: Variable High Gradient Permanent Magnet Quadrupole

***A. Ghaith***, *T. André, L. Chapuis, M.-E. Couprie, J. Idam, C.A. Kitegi, A. Loulergue, F. Marteau, D. Oumbarek, M. Sebdaoui, M. Valléau, J. Vétéran (SOLEIL) C. Benabderrahmane, J. Chavanne, G. Le Bec (ESRF) O. Cosson, F. Forest, P. Jivkov, J.L. Lancelot (Sigmaphi) P. N'gotta (MAX IV Laboratory, Lund University) C. Vallerand (LAL)*

We present the magnetic and the mechanical design of tunable high gradient permanent magnet (PM) quadrupoles. The tunable gradient of the so-called QUAPEVAS extends from 100T/m up to 200T/m. Seven of them with various lengths, ranging from 26mm up to 100mm, for different integrated quadrupole strengths were manufactured. The measured magnetic performance of these devices is also reported. These devices were successfully developed to transport laser plasma accelerated electron beam. Such applications have however less stringent multipole harmonic content constraints than diffraction limited Light sources. Trails for lowering the multipole harmonics will be discussed.

WEA2WD02 11:30 30

### Design Study of the High Gradient Magnets for a Future Diffraction-Limited Light Source at MAX IV

***A.S. Vorozhtsov***, *P.F. Tavares (MAX IV Laboratory, Lund University)*

The introduction of the multibend achromat lattice has ushered in a new era for storage-ring based light sources allowing order-of-magnitude improvements in source performance. A central ingredient in various engineering implementations of the MBA concept is the use of high gradient magnets with significantly smaller apertures than in previous generations of storage rings. Another increasingly common theme is the large scale use of permanent magnet technology. This paper describes the design study of 11 mm bore diameter high gradient magnets in frame of the upgrade concept for a future diffraction-limited light sources reaching the diffraction limit at X-ray wavelengths, i.e. providing emittances on the order of 10 pm·rad within the constraints of the existing MAX IV 3 GeV ring tunnel (528 m circumference). Preliminary lattice designs with 19 bends per achromat have been used as the starting point for the magnet design study. Two solutions such as conventional electromagnet and a hybrid magnet (combination of permanent magnet and electromagnet) are compared. The possible technical challenges that shall be overcome to realize this project are discussed.

WEA2WD03
12:00 15

**Analysis of Electron Trajectories in Harmonic Undulator with SCILAB's Model Based Design Codes**

***H. Jeevakhan**, S. Kumar (NITTTR) G. Mishra (Devi Ahilya University)*

Scilab's X-cos model-based simulation blocks has been used to simulate the trajectories of an electron traversing through an Harmonic undulator. The trajectory of electron along X and Y directions has been simulated from Numerical and analytical methods. Analysis given in the present paper is compared with the other codes. Parallel simulation of Harmonic undulator magnetic field along with trajectories of electron is given in the present analysis.

WEA2WD04
12:15 15

**Harmonic Undulator Radiation With Dual Non Periodic Magnetic Components**

***H. Jeevakhan** (NITTTR) G. Mishra (Devi Ahilya University)*

Undulator radiation at third harmonics generated by harmonic undulator in the presence dual non periodic constant magnetic field. Electron trajectories along the x and y direction has been determined analytical and numerical methods. Generalized Bessel function is used to determine the intensity of radiation and Simpson's numerical method of integration is used to find the effect of constant magnetic fields. Comparison with previous analysis has also been presented.

## WEP1WD — WG-D

**Chair:** J.M. Byrd (ANL)

WEP1WD01 14:00 30

### Injection Kicker and Pulser Development for ALS-U

***W.L. Waldron**, S. De Santis, T.H. Luo, G.C. Pappas, C. Steier, C.A. Swenson (LBNL)*

The upgrade of the Advanced Light Source (ALS) at LBNL to a diffraction limited storage ring (ALS-U) is an approved project that is currently in the conceptual design phase. There is a focused R&D program to develop critical components of the ALS-U design. The design includes swap-out on-axis injection with a fast stripline kicker as the key enabling technology. The development of the kicker and the associated pulser will be presented as well as results from installation and beam tests at the ALS.

WEP1WD02 14:30 30

### High Power RF Solid State Amplifiers for Accelerators and Storage Rings

***J. Jacob** (ESRF)*

Solid state amplifiers (SSA) are being increasingly used instead of electronic vacuum tubes to feed accelerating cavities with radio frequency power in the 100 kW range. Power is obtained from the combination of hundreds of transistor amplifier modules. The dramatic evolution of SSA technology will be presented and illustrated with a number of examples from existing accelerator applications at various frequencies.

WEP1WD03 15:00 20

### RF System for the Storage Ring and Linac of the Future Synchrotron Light Facility in Thailand

***N. Juntong**, T. Chanwattana, K. Kittimanapun, T. Pulampong (SLRI)*

The future synchrotron light facility in Thailand is in designing process, which has a goal to complete a detailed design report in 2018. The new light source will be a ring-based light source with the circumference of approximately 300m and an electron energy of 3GeV. The maximum beam current is 300mA with a beam emittance below 1.0 nm·rad. The accelerator is based on a full energy linac, which will utilize a S-band frequency structures. The RF system of the storage ring is based on 500MHz frequency. The EU-HOM damped cavity and the new SPring-8 design TM020 cavity is the choice of the storage ring cavity. The RF power transmitter can either be a high-power klystron (1 MW klystron) feed all RF cavities or a combination of low power IOTs or solid-state amplifiers feed each cavity. The high gradient S-band structure is considered as the main accelerating structure for linac. The RF power system for linac will base on klystron and a modular modulator. This paper presents details of RF systems options for this new light source project.

A - Linac-based Light Sources

WEP2PT001 **Ultrahigh Brightness Electron Beams from Very High Field Cryogenic Radiofrequency Photocathode Sources**
***J.B. Rosenzweig*** *(UCLA)*
Recent investigations of RF copper structures operated at cryogenic temperatures performed by a SLAC/UCLA collaboration have shown a dramatic increase in the maximum surface electric field, to 500 MV/m. We examine use of these fields to enable very high field cryogenic photoinjectors that can attain over an order of magnitude increase in peak electron beam brightness. We present beam dynamics studies relevant to X-ray FEL injectors, using start-to-end simulations that show the high brightness and low emittance of this source enables operation of a compact FEL reaching a photon energy of 80 keV. The preservation of beam brightness in compression is discussed. While the gain in brightness at high field is due to increase of the emission current density, further increases in brightness due to lowering of the intrinsic cathode emittance in cryogenic operation are also enabled. The potential to probe fundamental brightness limits in these cold, dense beam systems is examined. Issues in experimental implementation, including: dark current suppression, cavity optimization for cryogenic thermal dissipation, external coupling, and cryocooler systems are discussed.

WEP2PT002 **A Separation System Based on RF Deflecting Cavity for Superconducting Linac-Driven XFEL**
***C. Meng****, J.P. Dai, J.Y. Zhai, J.R. Zhang (IHEP)*
The CW superconducting linac driven free-electron laser (FEL) is a very important development direction and there are several projects in the world. The separating system will transport the electron beam to different beamlines where the use of RF deflecting cavity as fast-switching devices at hundred MHz frequency. Based on SC-HXFEL a separation system using RF deflecting cavity will be proposed.

WEP2PT003 **Phase Matching Strategy for the Undulator System in the European XFEL**
***Y. Li****, J. Pflüger (XFEL. EU)*
The undulator system in the European XFEL is mainly comprised 5-m long undulator segments and 1.1 m long intersections in between. In intersections the electron velocity is faster than it inside an undulator and the optical phase is detuned. The detune effect is also from the undulator fringe field where electron longitudinal speed also deviates from the oscillation condition. The total detune effect is compensated by a magnetic device called phase shifter, which is correspondingly set for a specific undulator gap. In this paper we introduce the method to set the phase shifter gap for each K parameter according to the measured magnetic field.

WEP2PT004 **The Commissioning and Early User Operation of Dalian VUV Free Electron Laser**
***W.Q. Zhang****, D.X. Dai, G.L. Wang, G.R. Wu, X.M. Yang (DICP) B. Liu, D. Wang, Z.T. Zhao (SINAP)*
A Free Electron Laser with high brightness, ultrafast laser pulses in the vacuum ultraviolet (VUV) wavelength region is an ideal light source for excitation of valence electrons and ionization of molecular systems with very high efficiency. it is quite helpful for studies of important dynamic processes in physical, chemical and biological systems. Dalian Coherent Light Source (DCLS) plans to deliver

optical beam from 50-150 nm in picoseconds or 100 femtoseconds for such research. High gain harmonic generation is the perfect choice in VUV FEL for narrow bandwidth, stable power and low cost due to fewer undulators. At the beginning of 2017, DCLS succeed second harmonics of 266 nm seed laser via high gain harmonic generation, whose power is more than 200 μJ/pulse. The gain curve and spectrum of HGHG & SASE FEL was measured, and tapering undulator helps increase the power by almost 100% when the FEL output saturated. The early user operation starts on June 2017. The preliminary results are coming up. Now it calls for proposals using the VUV FEL from the whole world.

WEP2PT005 **Large Bandwidth Free-Electron Laser Proposals at SXFEL User Facility**
***J.W. Yan**, H.X. Deng, M. Song (SINAP)*
X-ray free-electron lasers (XFELs) are leading-edge instruments in a wide range of research fields. Besides pursuing narrow bandwidth FEL pulses, the large-bandwidth operation mode has been proposed in recent years. Broad-bandwidth FEL pulses are very useful in many spectroscopy experiments and X-ray crystallography. In this work, we discuss two methods to generate large bandwidth pulses in the SXFEL user facility. One optimizes the compression strategy with multi-objective genetic algorithms and the other uses a vertically tilted electron beam passing through a planar undulator by taking advantage of its natural transverse gradient. Start-to-end numerical simulations demonstrates a full bandwidth of 5% for both two schemes.

WEP2PT007 **Final Design and Simulation of Voltage Multiplier Column of a 1 MeV 100 mA Parallel Fed Cockcroft Walton DC Electron Accelerator as an Injector of a Linac and Also for Industrial Applications**
***M. Nazari** (Shahid Beheshti University)*
In this article a 1MeV 100mA voltage multiplier column (VMC) has been designed and simulated for a parallel fed Cockcroft Walton DC electron accelerator as an injector of a Linac and also for industrial applications. In this research has been tried to get a low ripple dc High voltage. At first, the VMC has been simulated with pspice simulation software. After doing the pspice simulations, optimum value of different parameters has been get. At the end we try to get the optimum values of pspice simulations with a mechanical design with CST STODIO. The mechanical design of VMC and its equivalent circuit have a good accordance with each other.

WEP2PT008 **Microbunching Instability Study in the Linac-Driven Fermi FEL Spreader Beam Line**
***S. Di Mitri**, S. Spampinati (Elettra-Sincrotrone Trieste S.C.p.A.)*
Suppression of microbunching instability (MBI) along high brightness electron beam delivery systems is a priority for Free Electron lasers (FELs) aiming at very narrow bandwidth. The impact of MBI on FEL spectral brilliance is aggravated by the growing demand for multi-user FEL facilities, which adopt multi-bend switchyard lines traversed by high charge density electron beams. This study provides practical guidelines to switchyards design largely immune to MBI, by focusing on the FERMI FEL Spreader line. First, two MBI analytical models are successfully benchmarked along the accelerator. Being the second model flexible enough to describe an arbitrary multi-bend line, and found it in agreement with particle tracking and experimental results, it was used to demonstrate that a newly proposed Spreader optics provides unitary MBI gain while preserving the electron beam brightness.

WEP2PT010 **BESSY VSR Project: Design Status and Project Challenges**
***P. Schnizer**, M. Ries (HZB)*
Complementary to many other upgrade programs, BESSY VSR strives to provide a train of ultra-short bunches while maintaining a large average beam current and thus high brilliance to the users. This upgrade program requires installing a set of superconducting cavities into the machine next to improvements and refurbishments in the existing accelerator chain. In this paper we present the current project status, describe the different preparation steps and tests currently being executed next to a summary of the challenges to tackle.

WEP2PT012 **Review of Injection Schemes for Lepton Storage Rings**
***P. Kuske** (HZB)*
Traditional and newly proposed injection schemes will be presented. Whether these transverse and longitudinal schemes are suitable for the injection into low emittance storage rings will be discussed in more detail. Whenever possible, examples of realized injection schemes and injection related observations from existing rings will be presented.

WEP2PT013 **General Considerations for Choice of RF Frequency in High Brightness Rings**
***J.M. Byrd** (LBNL)*
There has been substantial discussion regarding the choice of RF frequency for the next generation of storage rings. It is assumed that harmonic RF systems are used to lengthen the bunches and minimize effects of intrabeam scattering. This paper considers two cases for bunch fill patterns: 1) a fixed number of bunches regardless of harmonic number or 2) filling of all RF buckets.

WEP2PT014 **Lattice Design for SSMB**
***T. Rui**, X.J. Deng, W.-H. Huang, C.-X. Tang (TUB) A. Chao (SLAC)*
A storage ring applicable for SSMB operation is a critical part of a high average power SSMB EUV light source. A lattice for SSMB based on longitudinal strong focusing is under design in Tsinghua University. To generate and maintain micro-bunching in a longitudinal strong focusing storage ring, the momentum compaction has to be small. A lattice with low momentum compaction factor is presented in this work. The lattice of the current design consists of two MBA cells with isochronous unit cells to minimize local and global momentum compaction, and two straight sections for insertion devices. The design energy of the ring is 400MeV and the circumference is 94 meters. Nonlinear effects such as higher order momentum compactions will continue to be optimized.

WEP2PT017 **A Possible Lattice Design for the Reversible SSMB in Storage Rings**
***C. Feng**, B.C. Jiang, C.L. Li, X.F. Wang, Z.T. Zhao (SINAP) A. Chao (SLAC)*
Several methods have been developed in the last decade to improve the temporal properties of a storage ring based light source. Most of these methods employ external lasers to manipulate the longitudinal phase space of the electron beam to precisely tailor the properties of the radiation pulses. In this work, we show a possible lattice for the realization of reversible SSMB and generating fully coherent intense EUV radiation pulse via three-dimensional manipulation of the electron beam phase space in storage rings. Lattice design and numerical simulations are given to show the performance of this technique.

WEP2PT018 **Preparation Work of the SSMB Principle-of-test Experiment**

***X.J. Deng***, *W.-H. Huang, T. Rui, C.-X. Tang (TUB) A. Chao, D.F. Ratner (SLAC) J. Feikes, J. Li, M. Ries (HZB)*

Steady-state microbunching (SSMB) is a novel mechanism to generate high average power coherent radiation in electron storage rings and has attracted much attention since it was proposed by Ratner and Chao. A key step towards opening up the potential of SSMB is the principle-of-test experiment. In this paper, we present the preparation work of the first SSMB Amplifier scenario test experiment planned on the Metrology Light Source (MLS). In the context of single particle dynamics, important for SSMB are control of the first and higher order components of the momentum compaction function, the longitudinal radiation excitation effects generated by the fluctuations of the local momentum compaction along the circumference and the longitudinal transverse emittance coupling. Concerning collective effects, CSR, IBS and space charge will be some of those potentially constraining the performance of SSMB. Methods to investigate the influences of some of these parameters and effects on the formation and maintenance of microbunches in a test experiment will be developed.

WEP2PT021 **The Design and Test of a Stripline Kicker for HEPS**

***H. Shi***, *J. Chen, L. Huo, X.L. Shi, G. Wang, L. Wang, N. Wang, LIU,P. Liu (IHEP)*

A fast stripline kicker is adopted for High Energy Photon Source (HEPS) on-axis injection. The optimization of a prototype 750 mm long kicker has been finished. The 3D simulation results show the final design of wide vane with end cover lowers the beam loss about 31% than the original design does. We develop a feedthrough model with machinable glass ceramic and achieve a VSWR under 1.3 in 0~2 GHz. The assembly of kicker and commercial feedthroughs has been tested with Keysight E5071C. The testing results of S parameters and TDR value show a good agreement with simulation ones.

WEP2PT022 **Phase Shifter Application in Hard X-Ray Region of HEPS**

***X.Y. Li*** *(IHEP)*

For over 6 meters long straight-section of HEPS, collinear double-cyrogenic permanent magnet undulator(CPMU) is designed for some high energy photon users. The efficiency of phase shifter on improving the brightness of double-CPMU is therefore evaluated with considering the electron beam parameters. Efficiency comparation of phase shifter between triple quadrupole DMBy lattice is obtained as well.

WEP2PT023 **Preparation and Characterization of Non-Evaporable TiZrV Getter Films for HEPS**

***Y. Ma***, *P. He (IHEP)*

For the low activation temperature and high pumping speed, surface pumping capacity, the TiZrV coatings were chosen to high energy photo source (HEPS). Films of TiZrV alloy have been deposited on 1.5 meter long, cylindrical vacuum chambers of 22mm diameter copper substrates in krypton ambient using DC magnetron sputtering system. Substrate temperature, film composition, the activation temperature and pumping properties have been investigated in order to optimize the deposition parameters for vacuum applications. Energy Dispersive X-ray spectroscopy (EDX) was employed for the surface and bulk chemical composition. The microstructure of the deposited films was investigated by Scanning Electron Microscopy (SEM). Films of TiZrV exhibited columnar growth with nanocrystalline grains smaller than 5 nm by X-Ray Diffraction (XRD). The films were also studied using the X-ray photo-emission electron spectroscopy (XPS)

after annealing them at different temperatures ranging from 120°C to 300°C for two hours in ultra-high vacuum environment. Pumping speed and surface pumping capacity testing facilities were also being constructed to investigate the characterization of TiZrV.

WEP2PT024 **Influences of Harmonic Cavities on the Single-Bunch Instabilities in Electron Storage Rings**

***H.S. Xu*** *(IHEP)*

The single-bunch currents in ultra-low emittance storage rings are mainly limited by the single-bunch instabilities. Passive harmonic cavities, which can provide bunch lengthening and Landau damping, are widely used to stabilize the electron bunches. However, higher flexibility may be obtained from the active harmonic systems. We hereby present our study of the single-bunch instabilities when considering different settings of the harmonic cavities. The benefits of an active harmonic system will also be discussed.

WEP2PT025 **Bunch Phase Measurement in Beam Phase Monitor System at SSRF Storage Ring**

***Y.M. Zhou****, Y.B. Leng (SSRF) H.J. Chen, L.W. Duan (SINAP)*

Bunch-by-bunch phase information is very important for beam instability study, which can be retrieved from BPM signals. A beam phase monitor system based on high sampling rate oscilloscope has been developed to measure the bunch phase precisely. The bunch phase is calculated by zero-crossing point fitting using four sampling points on the rising edge. Effective bandwidth of the internal digital low-pass filters in oscilloscope is selected to ensure enough samples. This procedure gives 1.1 ps resolution, and the system is also used to study the dependence of the longitudinal phase on bunch charge at SSRF storage ring.

WEP2PT026 **X-Ray Monochromatic System for Pinhole Camera at SSRF**

***B. Gao*** *(SINAP) J. Chen, Y.B. Leng (SSRF)*

Since 2009 an X-ray pinhole camera that has been used to present the transverse beam size and emittance on diagnostic beam line of the storage ring at SSRF. The real beam size however is a function of the image size of the CCD camera and point spread function (PSF) of the system. The performance of the measurement of the transverse electron beam size is given by the width of the PSF of X-ray pinhole camera. The contributions to the PSF width are the PSF of pinhole itself due to diffraction, and the PSF of the screen and camera. X-ray monochromatic can be used to measure the PSF accurately, and decrease the variation in the beam size between the theoretical values and the measured ones. An X-ray monochromatic system has been established at the X-ray pinhole camera system of SSRF. In this article, the setup of X-ray monochromatic system and beam-based calibration experiments will be presented in detail.

C - Compact Light Sources

WEP2PT027 **Experimental Progress of the Laser Plasma Accelerator Based Free-Electron Laser**

***T. Liu****, C. Feng, B. Liu, D. Wang (SINAP) J.S. Liu (Shanghai Institute of Optics and Fine Mechanics)*

The Laser Plasma Accelerator (LPA) test facility in SIOM has been successfully operation on 400 MeV electron beam generation with low emittance and high peak current. It aims at realization of free electron laser (FEL) amplification at a wavelength of 30 nm. To achieve the goal, a scheme based on transverse gradient undulator was proposed, and aligned to manipulate the beam transport and radiation. Currently, the preliminary beam manipulation has been done, and been transported to the entrance of the undulator. The drawback of the beam

jitter enhances the difficulty of experiment. Besides, another scheme based on coherent harmonic generation is also considered in this test facility.

D - Key Technologies

WEP2PT029 **Beam Diagnostic Beamlines Consideration for HEPS**

***D.C. Zhu**, J.S. Cao, Y.F. Sui, J.H. Yue (IHEP)*

HEPS is a 6 GeV synchrotron light source to be built in Beijing. The storage ring with multi-bend achromat (MBA) lattice has a natural emittance of 60 pm and a circumference of ~1.3 km. The electron beam sizes at the bend magnet sources may be reduced to 5~10 μm. It's difficult to measure such small sizes in both direction using conventional techniques. In this paper, we discuss the consideration of beam diagnostic beamlines design for HEPS, not only to measure the beam sizes, but also for beam length and energy spread measurement.

WEP2PT030 **Undulator Development Activities at DAVV-Indore**

***M. Gehlot**, R. Khullar, G. Mishra (Devi Ahilya University) H. Jeevakhan (NITTTR)*

Insertion Device Design Laboratory, DAVV has development activities on in-house design, fabrication and measurement of prototype undulators for synchrotron radiation and free electron laser application. The first prototype U50 was built with six periods, 50mm each period. It was PPM type. The next prototype U20 hybrid device based on NdFeB-Cobalt steel was built with aim to produce 0.24T to 0.05T in 10-20mm gap. The undulator is a 20mm period and there are 25 periods. The next one is U50-II PPM structure with 20 periods. In this paper we review the designs of all these undulators and briefly outline the user facilities of Hall probe bench, Pulsed wire bench and stretched wire magnetic measurement systems at IDDL.

B - Ring-based Light Sources

WEP2PT032 **Feasibility Study of High Energy X-Ray Source at PLS-II**

***J.H. Han**, J. Lee, S.B. Lee, S.J. Lee, T.-Y. Lee (PAL)*

PLS-II operates for user service with 34 beamlines since 2012. For engineering applications, especially for thick metal samples, a high energy X-ray beamline is under consideration to cover up to 100 keV photon energy or beyond. By comparing the radiation spectra from various insertion devices types, superconducting wiggler was found to be a most promising candidate. Then, we studied the feasibility to install the high field wiggler in the PLS-II ring. We present the electron beam dynamics study for a minimum impact on the electron beam parameters and engineering issues to add more magnets.

D - Key Technologies

WEP2PT033 **Transverse Gradient Undulators for PAL-XFEL**

***S.J. Lee**, J.H. Han (PAL)*

Transverse gradient undulators (TGUs) can be used for various applications that have not been satisfied with conventional undulators. Recently, various types of TGU were suggested. A canting pole TGU suggested for LPWA can provide a specific relative K-value gradient. On the other hand, planar or APPLE type undulators can be used as TGUs which can adjust relative K-value gradient. For a FEL, TGU has a possibility to replace the X-FEL injector laser heater or to generate ultra-large bandwidth radiation (up to 10% bandwidth, suggested by SwissFEL). In this poster, the possibility of using PAL-XFEL undulators as a TGU for ultra-large bandwidth radiation and replacing the laser heater system will be reviewed.

WEP2PT034 **Beyond Uniform Ellipsoidal Laser Shaping for Beam Brightness Improvements at PITZ**

***H.J. Qian**, J.D. Good, C. Koschitzki, M. Krasilnikov, F. Stephan (DESY Zeuthen)*

In the last decades, photoinjector brightness has improved significantly, driven by the needs of free electron lasers and many other applications. One of the key elements is photocathode laser shaping for reducing emittance growth from nonlinear space charge forces. At the photoinjector test facility at DESY in Zeuthen (PITZ), a uniform flattop laser was used to achieve record low emittance from 20 pC to 1 nC. Due to the ideal 3D space charge linearization in ellipsoidal bunches, uniform ellipsoidal laser pulse was proposed to further improve beam emittance by ~30% for 1 nC beam at PITZ. In this paper, we will show even further transverse emittance improvements from both flattop and ellipsoidal lasers pulses with parabolic spatial modulation, versus uniform distributions. The laser shaping effects on longitudinal phase space are also discussed.

B - Ring-based Light Sources

WEP2PT035 **Lattice Study for Ultimate Storage Ring at PAL**

***B.H. Oh**, T. Ha, I. Hwang, D.E. Kim, I.S. Ko, J. Lee, C.D. Park, S. Shin (PAL)*

Lattice study for ultimate storage ring have been carried out at Pohang Accelerator Laboratory. Two different types of lattices have been explored. One is hybrid-7BA lattice with 550 m circumference and the other is SLS-II type with 280 m circumference. In this poster, we present the major paramters and nonlinear optimization for both lattices. We also introduce new injection scheme for ultimiate storage ring in this poster.

WEP2PT036 **Preliminary Design Study of Vacuum System for the Ultimate Storage Ring at Pohang Accelerator Laboratory**

***T. Ha**, D.E. Kim, B.H. Oh, C.D. Park, S. Shin (PAL)*

Two different types of ultimate storage ring for 550 m (hybrid-7BA lattice) and 280 m (SLS-II type) circumferences are being studied at Pohang Accelerator Laboratory. The vacuum chambers for such an ultimate storage ring should have small aperture to fit in small-bore magnets without losing the ability to maintain the ultra-high vacuum and to dissipate high heat load of synchrotron radiation. Especially, the high heat load is a critical factor in designing vacuum system for the compact ring. In this poster we present the result of the preliminary design study of vacuum system for the ultimate storage ring with 280 m circumference.

A - Linac-based Light Sources

WEP2PT037 **Initial R&D Plan on Accelerator of a High Photon Energy and High Rep-Rate XFEL Facility**

***X. He** (CAEP/IFP)*

A hard X-ray FEL facility with photon energy of about 40 keV and very high burst mode rep-rate of about 400MHz , has been proposed by Chinese Academy of Engineering Physics (CAEP) to investigate material mainly in mesoscale under extremes. A project in CAEP is just initiated to identify the major physical risks and technical challenges, and develop key accelerator technologies approaching such a XFEL facility. A plan of injector test stand is undergoing to explore technology of high brightness electron beam generation with repetition rate of 433 MHz, address the issues of bunch by bunch beam position and emittance measurement, and study the impact on beam quality by long range transverse wakefield under repetition rate of hundreds MHz. Some design considerations of the injector test stand will be presented in this paper.

B - Ring-based Light Sources

WEP2PT038 **Conceptual Design for the SLS-2**

***M.M. Dehler***, *T. Garvey, M. Hahn, M. Negrazus, A. Streun, V. Vranković (PSI)*

After 17 years of user operation, we plan to do an upgrade of the Swiss Light Source (SLS) for the period of 2021-2024. The entire storage ring will be replaced with a new layout allowing operation at emittances lowered by factors of 40-50. This is made possible to one part by small aperture magnets allowing for a multi bend achromat design and to the other - a special feature for SLS-2 - reverse bends combined with longitudinal gradient bends (LGB) leading to zero dispersion at the maximum magnetic field, thus minimizing the quantum excitation of the beam due to synchrotron radiation. The compact magnet layout makes use of offset quadrupoles, combined function magnets and longitudinal gradient bends. The chamber with a cross section of 20 mm will be fully NEG coated to ensure good pumping and a quick vacuum conditioning. Numerical simulation of instability thresholds has been performed, we expect values in the order of 2 mA for the single bunch current.

D - Key Technologies

WEP2PT039 **Development of Permanent Magnet Helical Undulator for Ring- and Linac-Based Light Sources at TPS**

***T.Y. Chung***, *C.-H. Chang, C.H. Chang, C.-S. Hwang, C.Y. Kuo (NSRRC) C.-S. Hwang (NCTU)*

The helical undulator will play a key role in the emission of circularly polarized radiation or be used for the electron bunching in a linac-based light source. An APPLE-type undulator, therefore, already becomes a workhorse in the third generation light source. For a round beam in a linac-based and ultimate storage ring, we were inspired to create an exotic design of permanent magnet helical undulator. The work shows you the results of construction and commissioning of APPLE-type undulators and gives you the development of the narrow gap helical undulator at TPS.

C - Compact Light Sources

WEP2PT040 **The Dedicated Accelerator R&D Facility "SINBAD" at DESY**

***U. Dorda***, *R.W. Aßmann, F. Burkart, K. Galaydych, J. F. Jafarinia, W. Kuropka, F. Lemery, B. Marchetti, D. Marx, F. Mayet, G. Vashchenko, T. Vinatier, P.A. Walker, S. Yamin, J. Zhu (DESY) A. Fallahi, F.X. Kärtner, N.H. Matlis (CFEL)*

We present an overview of the dedicated accelerator R&D facility "SINBAD", currently under construction at DESY. It will host multiple independent experiments related to the generation and acceleration of ultra-short electron bunches and to the development of various advanced acceleration schemes. SINBAD will initially host two experiments: AXSIS and ARES. The AXSIS collaboration aims to generate fs to sub-fs electron bunches at 15-20 MeV using THz-driven dielectric structures, with the objective to generate ultrafast X-ray pulses by inverse Compton scattering. The first stage of the ARES experiment is to set up a 100 MeV Sband electron linac to produce ultra-short electron bunches with excellent arrival time stability. The RF-gun is currently being installed and will be commissioned in spring 2018, followed by the installation and commissioning of the accelerating structures. Thereafter in 2019, the electron bunches will be ideally suited for various experiments on advanced accelerator and diagnostics concepts (e.g. DLA experiments in the context of the ACHIP collaboration). In the long term, external injection into a laser driven plasma acceleration stage is also targeted.

WEP2PT041 **Simulations on a Potential Hybrid and Compact Ultrafast X-Ray Pulse Source Based on RF and THz Technologies**

***T. Vinatier**, R.W. Aßmann, U. Dorda, F. Lemery, B. Marchetti (DESY)*

We present beam dynamics simulations for a proposal of hybrid and compact ultrafast X-ray source based on Inverse Compton Scattering (ICS). The layout consists of an S-band gun as electron source and a dielectric-loaded circular waveguide (DLW) driven by a multicycle THz pulse to accelerate and longitudinally compress the bunch, which could then be used to produce ultrafast X-ray pulses through ICS with an infrared laser pulse. The challenge tackled by this hybrid scheme is to generate ultrashort electron bunches (single fs order to sub-fs rms length), at moderate energies (15 to 20 MeV), with a charge of at least 1 pC and focused to a transverse size around or below 10 µm rms while keeping a compact beamline, which has never been achieved using only conventional RF technologies. Simulations from the photocathode up to the ICS point are presented, looking at the influence of various parameters of the accelerating and transverse focusing devices. The properties of the simulated DLW and the requirements for the THz pulse driving it are also presented.

A - Linac-based Light Sources

WEP2PT042 **An Accelerator Scenario for CXFEL Facility**

***T. Wei** (CAEP/IFP)*

In order to study the dynamic response of the material and the physical mechanism of the fluid dynamics, it is suggested that there should be simultaneously three probe scales, theμlevel, meso level and macro level on which the detection of multi-spatial and multi-temporal phenomena can be made. Atμand meso scale, X-ray free electron laser (XFEL) is a unique diagnostic tool which can achieve the resolution ability from micron to sub-nanometer. The CXFEL facility is intended to provide pulse train ~$10^{10}$ 42keV photons, with a minimum bunch spacing of 2.3ns. In this article, an accelerator scenario for CXFEL is presented.

WEP2PT043 **Beamline & Endstation for High Frequency UV-FEL in China**

***Ran. An. An** (CAEP/IFP) L. Du (Institute of Fluid Physics,, China Academy of Engineering Physics)*
CAEP

B - Ring-based Light Sources

WEP2PT045 **Numerical Analysis of Brilliance and Transverse Coherence Properties of a Tandem Undulator Based on Wave Optics**

***H.W. Luo**, C.H. Lee (NTHU) T.Y. Chung, C.-S. Hwang (NSRRC) C.-S. Hwang (NCTU)*

There are eighteen short (7m long) and six long straight (12 m long) sections in Taiwan Photon Source (TPS). Three long straight sections are designed as the double mini-βy lattice to enhance the brilliance and transverse coherence flux. For this purpose, the brilliance and transverse coherent flux of the synchrotron radiation are evaluated by use of the Wigner distribution function and the overall degree of coherence, respectively, to examine the performance of tandem undulators in the double mini-βy sections. All the simulations are based on wave optics without Gaussian-approximated radiation profile. The effects of phase shifter and quadrupoles between the two undulatos are discussed and presented. This result also compared together with the single-undulator in the short and long straight section in TPS.

WEP2PT046 **Design of the New Soft X-Ray Beamline for in Situ Analysis of Energy Materials at National Synchrotron Radiation Laboratory**

***L. Du*** *(Institute of Fluid Physics,, China Academy of Engineering Physics)*

A new bending magnet based soft X-ray beamline for in situ analysis of energy materials at National Synchrotron Radiation Laboratory will be constructed and the optical design is presented. This beamline will mainly focus on nanomaterials and their applications in energy conversion, storage, and catalysis studies. A varied-line-spacing plane grating monochromator is employed to cover the photon energy region of 60-1000 eV by two plane varied line spacing gratings with central groove densities of 840 l/mm and 1400 l/mm respectively. The designed energy resolution power $E/\Delta E$ is about 1300-3000. The calculated flux is higher than $1\times10^{10}$ phs/s under 300 mA ring beam current for the whole covered photon energy. This beamline will provide a powerful and efficiency instrument in the future for users doing research on nanomaterials, energy materials and catalytic science.

A - Linac-based Light Sources

WEP2PT047 **Proposal for Hybrid Beam Operation for X-Ray Light Sources and the Ilc Injector**

***M. Shimada*** *(KEK)*

We proposed the hybrid beam operation at a GeV-class CW superconducting linac for X-ray light sources and the injector of the International Linear Collider (ILC). Although the ILC main linac is operated with 1 ms pulse duration, a CW linac can be a better solution at the ILC injector to stretch out the pulse duration and decrease the peak current of the macro-pulse to reduce the thermal loading of the positron target. Because of the low average beam current and the blank interval of more than 100 ms for the damping time at the damping ring of ILC, the CW linac has ability to operate simultaneously high-quality electron beams for X-ray light sources such as a X-ray Free Electron Laser (XFEL) and an Energy Recovery Linac (ERL). XFEL is expected as the most high-brilliant and high-flux light source while ERL can provide 20-30 beamlines. It is close to the diffraction limit at the hard X-ray region, round beam, and short pulse duration. Each beams has different beam energy in order to separate the orbit without pulse magnet. In addition, the beam pulses don't overlap each other to maintain the fine energy stability, which is affected by the beam loading effect due to the other beams.

WEP2PT048 **Beam Commissioning at the Compact Energy Recovery Linac at KEK and Its Applications**

***M. Shimada****, T. Akagi, K. Haga, K. Harada, Y. Honda, E. Kako, R. Kato, H. Kawata, Y. Kobayashi, T. Konomi, A. Kosuge, H. Matsumura, T. Miura, T. Miyajima, N. Nakamura, T. Nogami, T. Obina, F. Qiu, H. Sagehashi, H. Sakai, S. Sakanaka, R. Takai, O. Tanaka, K. Umemori, M. Yamamoto (KEK) R. Hajima, R. Nagai (QST) T. Hotei (Sokendai) N. Nishimori (Tohoku University, Research Center for Electron Photon Science)*

Energy recovery linac (ERL) is expected as a future accelerator machine to provide a high quality electrons at high beam current. In order to demonstrate such a beam, we have conducted some upgrades and beam commissioning of the Compact ERL (cERL) at KEK, which is a 20 MeV test facility. Even though the severe radiation regulation for the cERL at the ground level, the average circulating beam current is gradually increased up close to 1 mA by additional shield and beam tuning to minimize the beam loss. To maintain the low emittance electron beam against the space charge effects, a unique scheme based on the Q-scan method is applied for beam optics optimization. Thanks to the high quality

beam, 7 keV narrow-band X-ray is obtained by the laser Compton scattering at a laser enhanced cavity and THz radiation is successfully observed from the 250 fs electron bunch achieved by the bunch compression. The combination of the energy recovery and free electron laser (FEL) leads to the most powerful light source. As one of the applications, we proposed the ERL-FEL at extreme ultra violet region (EUV) for the lithography dedicated to the semiconductor industry.

## THA1WA — WG-A

**Chair:** T.O. Raubenheimer (SLAC)

THA1WA01 09:00 30

### Fast Simulation of FEL Linacs with Collective Effects

***M. Dohlus*** *(DESY)*

The demands of FELs on beam quality are a challenge. From the source via accelerators, bunch compressors, collimation system to and through undulators, self effects play an important role for the design and operation of such machines. Unfortunately it is not possible to solve the coupled problem of Maxwell's equations and equations of motion for bunches of $10^{-6}$ to $10^{-3}$ meter length in machines with a dimension of 100 to 1000 meters. Therefore simplifying concepts as space charge fields, space charge optics, wakes and coherent synchrotron radiation are widely in use. There are even models for parasitic micro-bunch instabilities for wavelengths clearly below one micrometer. Although the individual models are well developed and efficient, it is still difficult to combine them in single program that simulates a machine from the source to the end.

THA1WA02 09:30 20

### Eliminating the Microbunching-Instability-Induced Sideband in a Soft X-Ray Self-Seeding Free-Electron Laser

***K.Q. Zhang****, C. Feng, D. Wang (SINAP)*

Soft x-ray self-seeding has been proved to be a feasible method to improve the longitudinal coherence of high gain free-electron laser. However, a pedestal-like sideband in the spectrum has been observed in the experiment, which generally limits the purity of the radiation pulse and the user's application. The previous theoretical study indicates that the pedestal-like sideband is mainly induced by microbunching instability generated from LINAC. In this paper, three dimensional simulations have been performed to confirm the analytical results and show the formation process of the spectral sideband. A probable method is proposed to eliminate the pedestal-like sideband by simply inserting a magnetic chicane before the self-seeding FEL undulator. Theoretical and numerical simulations have been performed and the results show that the proposed method can efficiently eliminate the microbunching-instability-induced sideband in a soft x-ray self-seeding FEL

THA1WA03 09:50 20

### GPT-CSR: A New Simulation Code for CSR Effects

***S.B. van der Geer****, M.J. de Loos (Pulsar Physics) I. Setija, P.W. Smorenburg (ASML Netherlands B.V.) P.H. Williams (STFC/DL/ASTeC)*

For future applications of high-brightness electron beams, including the design of next generation FEL's, correct correct simulation of Coherent Synchrotron Radiation (CSR) is essential as it potentially degrades beam quality to unacceptable levels. However, the long interaction lengths compared to the bunch length, numerical cancellation, and difficult 3D retardation conditions make accurate simulation of CSR effects notoriously difficult. To ease the computational burden, CSR codes often make severe simplifications such as an ultra relativistic bunch travelling on a prescribed reference trajectory. Here we report on a new CSR model, implemented in the General Particle Tracer (GPT) code, that avoids most of the usual assumptions: It directly evaluates the Lienard-Wiechert potentials based on the stored history of the beam, it makes no assumptions about reference trajectories, while also taking into account the transverse size of the beam. First results demonstrating microbunching gain in a chicane are presented.

THA1WA04
10:10 20

**A Staged, Multi-User X-Ray Free Electron Laser & Nuclear Physics Facility Based on a Multi-Pass Recirculating Superconducting CW Linac**

***P.H. Williams***, *D. Angal-Kalinin, A.D. Brynes, J.A. Clarke, L.S. Cowie, D.J. Dunning, P. Goudket, F. Jackson, J.K. Jones, P.A. McIntosh, B.L. Militsyn, A.J. Moss, B.D. Muratori, S.L. Smith, M. Surman, N. Thompson, A.E. Wheelhouse (STFC/DL/ASTeC) J.A.G. Akkermans (ASML Netherlands B.V.) D. Angal-Kalinin, I.R. Bailey, A.D. Brynes, J.A. Clarke, L.S. Cowie, D.J. Dunning, P. Goudket, F. Jackson, J.K. Jones, P.A. McIntosh, B.W.J. M$^c$Neil, B.L. Militsyn, A.J. Moss, B.D. Muratori, H.L. Owen, S.L. Smith, M. Surman, N. Thompson, A.E. Wheelhouse,* ***P.H. Williams*** *(Cockcroft Institute) I.R. Bailey (Lancaster University) S.V. Benson, D. Douglas, Y. Roblin, T. Satogata, M. Spata, C. Tennant (JLab) T.K. Charles (The University of Melbourne) T.K. Charles (CERN) B.W.J. M$^c$Neil (USTRAT/SUPA) H.L. Owen (UMAN) R.C. York (FRIB)*

A multi-pass recirculating superconducting CW linac offers a cost effective path to a multi-user facility with unprecedented scientific and industrial reach over a wide range of disciplines. We propose such a facility to be constructed in stages. The first stage constitutes an option for a potential UK-XFEL; the linac will simultaneously drive a suite of short wavelength Free Electron Lasers (FELs) capable of providing high average power (MHz repetition rate) at up to 10 keV photons and high pulse energy (3 mJ) 25 keV photons. The system architecture is chosen to enable additional coherent sources at longer wavelengths, depending on community need. In later stages the scope of the project expands; we propose beam transport modifications to enable operation in Energy Recovery mode. This enables multi-MHz FEL sources, e.g. an X-ray FEL oscillator. Combining with lasers and / or self-interaction will provide access to MeV and GeV gamma-rays via inverse Compton scattering at high average power. Opportunities are also created for internal target and fixed target experiments. We explore possible system architectures and outline a path to confirm feasibility through experiments.

## THA2WA — WG-A

**Chair:** W. Decking (DESY)

THA2WA01 11:00 30

### Results From the Diamond Grating Multiplexing Study at LCLS (January) to Feed 3 Experiments Simultaneously

***A. Robert*** *(SLAC)*

This talk is about the results from the Diamond grating multiplexing study as LCLS (January) and Feed 3 experiments simultaneously.

THA2WA02 11:30 30

### Two-Bunch Operation With ns Temporal Separation at FERMI

***G. Penco*** *(Elettra-Sincrotrone Trieste S.C.p.A.)*

In the last decade a continuous effort has been spent to improve the capability of existing free-electron lasers (FELs) operating in the X-ray and VUV regimes. Together with the possibility to provide sub-ps and fs photon pulses with an intensity ten order of magnitude larger than the past generation light sources, new modes of operation have been conceived. In this framework, generation of two-color (or multi-colour) FEL pulses, temporally separated, had an unprecedented impact on the scientic community, pave the way for new pump-and-probe experiments. A number of two-color two-pulse schemes have been already implemented in several labs but with a limited time-separation from 0 to few hundreds of fs. We present a new design tested at the FERMI FEL machine, able to produce two independent electron bunches temporally separated from hundreds of ps to few ns. Measurements and characterisation of this two-bunch mode operation are presented, including trajectory control, impact of longitudinal and transverse wakefields, manipulation of the longitudinal phase space and finally a demonstration of suitability of the scheme to provide extreme ultra-violet light by using both bunches.

THA2WA03 12:00 20

### Optimizing of Electron Beam Distribution at European XFEL and FLASH

***B. Faatz*** *(DESY)*

As a rule, FELs have been single user machines. To distribute the electron beam with a fast kicker system between different undulators enables delivering beam to several users simultaneously. If it is done from RF pulse to RF pulse, it would decrease the number of bunches for each user. Therefore, it is planned at the European XFEL and already practice for several years at FLASH, to kick entire bunch trains within an RF pulse, thus delivering to both users the 10 Hz trains. It will be shown how the system has allowed long pulse trains for two users simultaneously and what has been done to keep the full flexibility within a bunch train not only in terms of wavelength, number of bunches and bunch separation, but also in bunch length needed to allow different users different FEL-pulse duration.

## THP1WB — WG-B

**Chair:** Q. Qin (IHEP)

THP1WB01 14:00 30

### Survey of Collective Effects in Next-Generation Light Source Rings

***R. Nagaoka*** *(SOLEIL)*

In this talk we shall attempt to make an overview the general trend in storage rings optimized for the next-generation light sources, in the context of having as a result an important impact on beam collective effects. Reduction of the beam chamber cross section to attain strong magnetic fields for the ultra-low emittance optics is particularly highlighted. A series of collective effects and beam instabilities that are likely to get enhanced shall be reviewed. Some of the recent related theoretical, numerical and experimental studies shall be introduced, along with methods that are considered to be effective in mitigating the former undesirable effects.

THP1WB02 14:30 30

### Impedance Evaluation of PF In-Vacuum Undulator (IVU) with Theories and Simulations and Experimental Confirmation of them by the Tune Measurement

***O. Tanaka****, N. Nakamura, T. Obina, K. Tsuchiya (KEK)*

Four IVUs were installed at KEK Photon Factory (PF) light source. Although the design of such insertion devices is widely known and discussed in numerous papers, it could be a major contributor to the total impedance of PF. The coupling impedance of the IVUs could lead to the beam energy loss, changes in the bunch shape, betatron tune shifts and, finally, to the various beam instabilities. The IVUs have a complex geometry including taper transitions between the undulator and the beam chamber, copper plates on the undulator magnets for RF shielding of the magnets from a beam, and step transitions between the octagon and the taper region. Their contributions to the total impedance should be separately treated and carefully estimated. The comprehensive study is done by comparing analytical predictions with computer simulations and finally with impedance measurements. The dipolar and quadrupolar kick-factors before the IVU installation were measured at PF ring by S. Sakanaka et al. using RF-knockout method. In present study the difference in the measured kick factors before and after the installation of the IVUs is compared with the simulation results and the theoretical estimates.

THP1WB03 15:00 20

### Theory of Longitudinal Multibunch Instabilities Including a Higher-Harmonic (Bunch-Lengthening) Cavity

***R.R. Lindberg*** *(ANL)*

The next generation of high-brightness storage rings typically require a higher-harmonic rf system to increase the bunch length and improve lifetime. The modified longitudinal dynamics has important implications for multi-bunch stability, since bunch lengthening also changes the synchrotron frequency both by lowering its mean (which reduces stability), and by increasing its variation with amplitude (which gives rise to Landau damping). To understand these competing effects, we present an analytic theory of longitudinal multi-bunch instabilities in the presence of a higher-harmonic cavity tuned to lengthen the bunch. The theory results in a relatively straightforward extension to the usual matrix-based multi-bunch analysis, and we show how the numerically determined growth rates can be used to understand the role of Landau damping. Finally, we compare predictions of the theoretical growth rates to those extracted from tracking simulations of the proposed APS Upgrade lattice.

## THP2WB — WG-B

**Chair:** M. Borland (ANL)

THP2WB01 16:00 30

### Survey and Outlook for Short-Pulse Schemes in Storage Rings

***A. Jankowiak*** *(HZB)*

Whereas the generation of photon pulses in the fs or even sub-fs regime is governed by single pass accelerators, the usage of short photon pulses in the ps to sub-ps regime with high repetition rates up to the MHz level and the very high stability provided by storage rings is still of growing interest. In this talk an overview of schemes to generate adequate phase space distributions of the electron bunches for the generation of short photon pulses is given. In particular electron-laser and electron-electron interactions for slicing , as well as manipulation schemes of the transversal and longitudinal beam dynamics, as low alpha-operation, the variable pulse length storage ring scheme, or two-frequency crab cavities, are addressed.

THP2WB02 16:30 30

### An Overview of the Progress on SSMB

***C.-X. Tang*** *(TUB) on behalf of the SSMB team*

SSMB (Steady State Micro-Bunching) is one of the promising schemes for high average power EUV light source, which is the key bottleneck of the mass production of next generation chips. After the SSMB scheme was put forward by Ratner and Chao, it has attracted much attention. With the promote of Chao, in collaboration with colleagues from other institutes, an SSMB task force was established in Tsinghua University. The experimental proof of the SSMB principle and a feasible SSMB lattice for EUV, are the two main tasks at this moment. SSMB related physics for the formation and maintaining of micro-bunches will be explored in the first optical principle-of-test experiment. A storage ring with a circumference of 94 meters consisting of isochronous cells is under design. The progress of the experiment and the lattice design will be given in this paper. And some challenges from physical and technologic aspects for a real SSMB light source will also be introduced, such as the isochronicity problem (including higher order isochronous lattice and partial momentum compaction).

THP2WB03 17:00 20

### Transparent Lattice Characterization with Gated Turn-by-Turn Data of Diagnostic Bunch-Train

***Y. Li****, W.X. Cheng, K. Ha, R.S. Rainer (BNL)*

Methods of characterization of a storage ring's lattice have traditionally been intrusive to routine operations. More importantly, the lattice seen by particles can drift with the beam current due to collective effects. To circumvent this, we have developed a novel approach for dynamically characterizing a storage ring's lattice that is transparent to operations. Our approach adopts a dedicated filling pattern which has a short, separate Diagnostic Bunch-Train (DBT). Gated functionality of a beam position monitor system is capable of collecting turn-by-turn data of the DBT, from which the lattice can then be characterized after excitation. As the DBT comprises only about one percent of the total operational bunches, the effects of its excitation are negligible to users. This approach allows us to localize the distributed quadrupolar wake fields generated in the storage ring vacuum chamber during beam accumulation. While effectively transparent to operations, our approach enables us to dynamically control the beta-beat and phase-beat, and unobtrusively optimize performance of National Synchrotron Light Source-II accelerator during routine operations.

THP2WB04
17:20 20

**Laser Seeding of Electron Bunches for Future Ring-Based Light Sources**

***S. Khan**, B. Büsing, N.M. Lockmann, C. Mai, A. Meyer auf der Heide, B. Riemann, B. Sawadski (DELTA)*

In contrast to free-electron lasers (FELs), ring-based light sources are limited in intensity by incoherent emission and in pulse duration by the bunch length. However, FEL seeding schemes can be adopted to generate intense and ultrashort radiation pulses in storage rings by creating laser-induced microbunches within a short slice of the electron bunch. Microbunching gives rise to coherent emission at harmonics of the seed wavelength. In addition, terahertz (THz) radiation is coherently emitted over many turns. At DELTA, a storage ring operated by the TU Dortmund University, coherent harmonic generation (CHG) with single and double 40-fs pulses is routinely performed at seed wavelengths of 800 and 400 nm. Seeding with intensity-modulated pulses to generate tunable narrowband THz radiation is also studied. As a preparation for echo-enabled harmonic generation (EEHG), simultaneous seeding with 800/400-nm pulses in two undulators has been demonstrated. The DELTA storage ring is an excellent testbed to study many aspects of laser seeding and related diagnostics. In addition to short-pulse generation, steady-state microbunching at ring-based light sources will be discussed in the paper.

## THA1WC — WG-C

**Chair:** H. Zen (Kyoto University)

THA1WC01 09:00 30

### Compact Arc Compressor for FEL-Driven Compton Light Source and ERL-Driven UV FEL

***S. Di Mitri*** *(Elettra-Sincrotrone Trieste S.C.p.A.) J.A.G. Akkermans, I. Setija (ASML Netherlands B.V.) D. Douglas (JLab) C. Pellegrini (SLAC) G. Penn, M. Placidi (LBNL)*

Many research and applications areas require photon sources capable of producing extreme ultra-violet (EUV) to gamma-ray beams with reasonably high fluxes and compact footprints. We explore the feasibility of a compact energy-recovery linac EUV free electron laser (FEL), and of a multi-MeV gamma-rays source based on inverse Compton scattering from a high intensity UV FEL emitted by the electron beam itself. In the latter scenario, the same electron beam is used to produce gamma-rays in the $10^{-20}$ MeV range and UV radiation in the $10^{15}$ eV range, in a ~4x22 $m^2$ footprint system.

THA1WC02 09:30 30

### Inverse Free-Electron-Laser Based Inverse Compton Scattering: An All-Optical 5th Generation Light Source

***J.B. Rosenzweig*** *(UCLA)*

Compact monochromatic X-ray sources based on very high field acceleration and very short period undulators may revolutionize diverse advanced X-ray applications ranging from novel X-ray therapy techniques to active interrogation of materials, by making them accessible in cost and size. Such compactness may be obtained by an all-optical approach, which employs a laser-driven high gradient accelerator based on inverse free electron laser (IFEL), followed by an inverse Compton scattering (ICS) IP, a scheme where a laser is used as an undulator. We discuss experimental progress in understanding high-intensity effects in ICS, as well as the development of an efficient IFEL. We then describe the proof-of-principle of an all-optical IFEL-based system , where a TW-class CO2 laser pulse is split in two, with half used to accelerate a high quality electron beam up to 84 MeV through the IFEL interaction, and the other half acts as an electromagnetic undulator to generate up to 13 keV X-rays via ICS. These results demonstrate the feasibility of this scheme, which can be joined with other techniques such as laser recirculation to yield very compact, high brilliance, keV to MeV photon sources.

THA1WC03 10:00 20

### Current Status and Perspectives of ERL-based Compton Sources

***R. Hajima*** *(QST)*

Energy-recover linacs (ERLs) have been developed mainly for high-power free electron lasers and future synchrotron light sources but have advantages in Compton sources as well, because the electron beam of high-average current and small emittance in ERLs contribute directly to generation of high-flux and narrow-bandwidth photons via Compton scattering. For demonstrating feasibility of ERL-based Compton sources, we conducted an experiment at the Compact ERL (cERL), where 7-keV X-ray photons with narrow bandwidth, 0.4% (rms) with an opening angle of 0.14 mrad, were generated by colliding an electron beam of 20 MeV with a laser of $10^{64}$ nm wavelength. In this talk, we overview the status of ERL-based Compton sources including relevant accelerator and laser components and discuss future perspectives of ERL-based Compton sources for keV and MeV photons.

## THA2WC — WG-C

**Chair:** C.-J. Jing (Euclid TechLabs, LLC)

THA2WC01 11:00 30 **Ultra-short Period High Field Undultators for Compact Light Sources**

***T. Kii*** *(Kyoto University)*

Generation of strong periodic magnetic field in short period is important technology for future advanced light sources such as free electron lasers and synchrotron radiation facilities. However, the period length and K-value of undulators are limited by the maximum energy product of permanent magnet or engineering critical current density of superconducting wire in general. In order to overcome these technological limit, use of bulk superconductor has been proposed. The critical current densities of rare earth barium copper oxide (REBCO) exceeds 10 kA/mm$^2$ at low temperature. This value is about 10 times higher than the engineering critical current density of superconducting wire. The maximum trapped magnetic field by REBCO bulk superconductor exceeds 17 T. If this high density supercurrent are fully handled, ultra-short period high field undulator is realized. In this presentation, I will introduce several approaches of bulk superconductor undulators and summarize the merit and the drawback of them, then the potential of the bulk superconductors will be discussed.

THA2WC02 11:30 30 **Generation of a Wakefield Undulator in Plasma With Transverse Density Gradient**

***G. Stupakov*** *(SLAC)*

We show that a short relativistic electron beam propagating in a plasma with a density gradient perpendicular to the direction of motion generates a wakefield in which a witness bunch experiences a transverse force. A density gradient oscillating along the beam path would create a periodically varying force'an undulator, with an estimated strength of the equivalent magnetic field more than ten Tesla. This opens an avenue for creation of a high-strength, short-period undulators, which eventually may lead to all-plasma, free electron lasers where a plasma wakefield acceleration is naturally combined with a plasma undulator in a unifying, compact setup.

THA2WC03 12:00 20 **A Beam-Driven Short Wavelength Undulator for FEL**

***C.-J. Jing*** *(Euclid TechLabs, LLC)*

The idea of the beam-driven accelerators where intense electron beams are used directly to drive electromagnetic fields that accelerate probe or 'witness' electron beams has been known as the wakefield acceleraion for decades. This technology presents significant possibilities to accelerate electron beams in a multiGeV scale in a compact footprint. Here we unveil the next logical step in the application of wakefields, using intense electron beams to create fields that directly guide and periodically deflect 'witness" electrons, causing them to radiate photons. This is a new application of wakefield principles that may be used in the near future to develop compact undulators. The combination of a compact accelerator and a compact undulator could lead to a very compact x-ray free-electron laser in the future.

## THP1WD — WG-D

**Chair:** J.M. Byrd (ANL)

THP1WD01 14:00 30 **Review of CW Guns for XFEL**

***F. Zhou*** *(SLAC)*

Normal conducting RF gun as well as DC gun and superconducting RF gun are the potential technologies for generation of high-brightness beam for the CW XFELs. This talk will firstly review the three gun technologies in term of beam performances, advantages and disadvantages. LCLS-II has chosen normal conducting RF gun for the CW photoinjector. We will then update LCLS-II injector design, construction, and commissioning which is expected to start in March 2018.

THP1WD02 14:30 30 **LCLS-II Beam Containment System for Radiation Safety**

***C.I. Clarke****, J. Bauer, M. Boyes, Y. Feng, A.S. Fisher, R.A. Kadyrov, J.C. Liu, E. Rodriguez, M. Rowen, M. Santana-Leitner, F. Tao, S. Xiao (SLAC) T.L. Allison, J. Musson (JLab)*

LCLS-II is a new xFEL facility at SLAC National Accelerator Laboratory with a superconducting linac designed to operate up to 1.2 MW of beam power. This generates more serious beam hazards than the typical sub-kW linac operation of the existing xFEL facility, Linac Coherent Light Source (LCLS). SLAC uses a set of credited safety controls termed the Beam Containment System (BCS) to limit beam power and losses to prevent excessive radiation in occupied areas. The high beam hazards of LCLS-II necessitate the development of new devices and a larger scale deployment for beam containment than previously done at SLAC. We present the new radiation hazards introduced by LCLS-II to SLAC and the design for the BCS.

THP1WD03 15:00 30 **The High Brightness Photoinjector Electron Beam of the APS Linac**

***Y. Sun****, W. Berg, J.M. Byrd, J.C. Dooling, D. Hui, A. Zholents (ANL) S. Shin (PAL)*

The Advanced Photon Source (APS) linac is mainly used to accelerate electron beams generated by a thermionic RF gun for APS storage ring operation. In 2014, a high-gradient S-band Photo-Cathode Gun (PCG) was installed at the front end of the linac, expanding the linac's capability to include high brightness photo-electron beams. In 2017, the interleaving operation of the thermionic and PC gun beams in the linac during the storage ring top-up operation was successfully commissioned. The interleaving operation enabled the PCG beam's availability to year-round. For the R&D towards future light sources, a new beam line at the Linac Extension Area (LEA) is being designed and constructed to support advanced accelerator technology and beam physics experiments. In this paper, we report our photo-cathode injector design, present the experimental measurements of beam properties at the APS linac, and compare the results with numerical simulations. Optimization for the first experiment at LEA using the high brightness photo-cathode electron beam is discussed, as well as an outlook for future potential experiments at LEA.

## THP2WD — WG-D

**Chair:** J. Pflueger (DESY)

THP2WD01 16:00 30

### Construction and Optimization of Cryogenic Undulators at SOLEIL

***M. Valléau**, P. Berteaud, F. Blache, F. Briquez, N. Béchu, M.-E. Couprie, J. Da Silva Castro, J.M. Dubuisson, A. Ghaith, C. Herbeaux, C.A. Kitegi, M. Louvet, O. Marcouillé, F. Marteau, A. Nadji, P. Rommeluère, K.T. Tavakoli, M. Tilmont, J. Vétéran (SOLEIL)*

With permanent magnets undulator operation at cryogenic temperature, the magnetic field and the coercivity can be enhanced, enabling shorter periods with high magnetic fields. The first full scale (2 m long, 18 mm period) hybrid cryogenic undulator using PrFeB magnets operating at 77 K was installed at SOLEIL in 2011. Photon spectra measurements, in good agreement with the ex-pectations from magnetic measurements, were used for precise alignment and taper optimization. The second and third 18 mm PrFeB cryogenic undulators, modified to a half-pole/magnet/half-pole structure, were optimized without any magnet or pole shimming after assembly but mechanical sortings and some geometrical corrections had been done before assembly. A systematic error on individual magnets on the third U18 was also compensated. In-situ measurement benches, including a Hall probe and a stretched wire to optimize the undulator field at room and cryogenic temperature are presented. An upgrade of these in-situ benches will be detailed with the fabrication of a 15 mm 3 m long PrFeB cryogenic undulator at SOLEIL.

THP2WD02 16:30 30

### Optimisation of Superconducting Undulators for X-ray FELs

***J.A. Clarke** (STFC/DL/ASTeC)*

When superconducting undulators (SCUs) are optimised specifically for Free Electron Lasers (FELs) rather than storage rings a number of interesting implications emerge. In particular these relate to the vacuum requirement, the heat deposition within the SCU due to wakefield effects, and the undulator geometry itself. The impact of these considerations is that the peak field level achievable in an SCU specifically optimised for an FEL is significantly enhanced. For example, a planar SCU, utilising NbTi, with a 15mm period and 5mm aperture optimised for an FEL instead of a storage ring will generate a peak field of 2.1T compared to 1.4T. This radical increase in undulator performance will have a major impact on the optimisation of future X-ray FELs. This paper describes how an SCU for an X-ray FEL will be able to generate magnetic field levels far beyond those currently foreseen by any other magnet technology. It will also describe the prototype SCU being assembled now in the UK and the planned demonstration with beam on the CLARA test accelerator in early 2018.

THP2WD03
17:00 30

**Partial Coherence in Undulator Beamlines at Ultra-low Emittance Storage Rings**

***M. Sanchez del Rio*** *(ESRF)*

The modelling of the radiation through the beamline is essential when dealing with synchrotron beamlines. Incoherent radiation from synchrotron can be analyzed using methods such as Monte Carlo ray tracing. Coherent radiation is analyzed by physical optics. None of these methodologies can be directly applied to partial coherence without some approximations. We introduced a new exact numerical method based on its decomposition in coherent modes for fully calculating the cross spectral density of the synchrotron radiation. All parameters of the beam can be calculated from the numeric decomposition using COMSYL. Moreover, the spectrum of the modes along the beamline gives additional precious information, as it is a direct measure of how much coherence has the beam. Coherent fraction becomes a natural measure of the amount of coherence in the beam. Some examples of simulations for the EBS (Extreme Brilliant Source) under construction at ESRF are shown.

09-Mar-18 09:00 – 10:30 Hua Xia Room

**FRA1PL — Summary Session A**

**Chair:** Z.T. Zhao (SINAP)

09-Mar-18 11:00 – 12:00 Hua Xia Room

**FRA2PL — Summary Session B**

**Chair:** Z.T. Zhao (SINAP)

**Boldface** papercodes indicate primary authors

**— I —**



**— J —**



**— K —**

**— L —**

**— M —**

**— Z —**

Zeng, L. **MOP2WA03**
Zhai, J.Y. WEP2PT002
Zhang, J.R. WEP2PT002
Zhang, K.Q. **THA1WA02**
Zhang, W.Q. **WEP2PT004**
Zhao, Z.T. WEP2PT004, WEP2PT017
Zholents, A. THP1WD03
Zhou, F. **THP1WD01**
Zhou, T.Y. TUP1WD02
Zhou, W.M. TUP1WD03
Zhou, Y.M. **WEP2PT025**
Zhou, Z.R. TUP1WD02
Zhu, D.C. **WEP2PT029**
Zhu, J. WEP2PT040

# NEARBY RESTAURANTS

## Catering

There are many places to have meals around Jing'an temple subway station within 500 meters-walk, if not to your taste, there are still many fancy places to eat around. Pay attention not to miss your afternoon meeting while you enjoy the amazing food at the same time.

# CONFERENCE AGENDA

| Sunday | | Monday | Tuesday | | Wednesday | | Thursday | | Friday |
|---|---|---|---|---|---|---|---|---|---|
| | | **Imperial Hall** | **Imperial Hall I** | **Imperial Hall III** | **Imperial Hall II** | | **Imperial Hall I** | **Imperial Hall III** | **Huaxia Room** |
| | | Plenary -A: *Y. H. Chin* | WG-B: *R. Walker* | WG-C: *C. Jing* | Plenary -C: *H. Braun* | | WG-A: *T. Raubenheimer* | WG-C: *H. Zen* | Summary Session: *Z. Zhao* |
| | 9:00 | Opening Welcome: Zhentang Zhao (SINAP) | Survey of injection schemes for next-generation light source rings: Zhe Duan (IHEP) | Progress on laser plasma electron acceleration: Ulrich Schramm (HZDR) | Status and prospects for plasma accelerator based light sources: Wei Lu (Tsinghua Univ.) | | Fast simulation code including collective effects : Martin Dohlus (DESY) | Compact Arc Compressor for FEL-Driven Compton Light Source and ERL-Driven UV FEL: Simone Di Mitri (ELETTRA) | WG-A |
| | | Latest developments in X-ray FELs and future perspectives: Winfried Decking (DESY) | Compensation of transient rf voltage in a double RF system using a kicker cavity: Naoto Yamamoto (KEK) | A Conceptual Design of a Compact Wakefield Accelerator for a High Repetition Rate Multi User X-ray Free-Electron Laser Facility: John Power (ANL) | Dielectric accelerators and other non-plasma accelerators based compact light sources: R. Joel England (SLAC) | | Eliminating the microbunching-instability-induced sideband in a soft x-ray self-seeding free-electron laser: Kaiqing Zhang (SINAP) | Inverse Free-Electron-Laser based Inverse Compton Scattering: an All-Optical 5th Generation Light Source: James Rosenzweig (UCLA) | WG-B |
| | | | | | | | GPT-CSR: a new simulation code for CSR effects: Bas van der Geer (Pulsar Physics, Eindhoven) | | |
| | | Review of schemes for improved peak power and coherence in X-ray FELs: Eduard Prat (PSI) | Injection Transient Observation via Bunch-by-Bunch Beam Size Measurement System: Hanjiao Chen (SINAP) | The SPARC lab activity and Eupraxia European program: Massimo Ferrario (LNF INFN) | Attosecond timing: Franz Kaertner (DESY) | | A Staged, Multi-User X-Ray Free Electron Laser & Nuclear Physics Facility based on a Multi-Pass Recirculating Superconducting CW Linac: Peter Williams (STFC/DL/ASTe) | Current Status and Perspectives of ERL-based Compton Sources: Ryoichi Hajima (QST) | WG-C |
| | 10:30 | | Discussion | | | | | Discussion | |
| | | Coffee Break 10:30-11:00 | | | | | | | |
| | | **Imperial Hall** | **Imperial Hall I** | **Imperial Hall III** | **Imperial Hall I** | **Imperial Hall III** | **Imperial Hall I** | **Imperial Hall III** | **Huaxia Room** |
| | | Plenary -B: *R. Walker* | WG-B: *Q. Qin* | WG-C: *C. Marie-Emmanuelle* | WG-C: *H. Zen* | WG-D: *J. Pflueger* | WG-A: *W. Decking* | WG-C: *C. Jing* | Summary Session: *Z. Zhao* |
| | 11:00 | Trends and challenges in the future storage ring light sources: Hitoshi Tanaka (Spring-8) | Future Synchrotron Light Source in Thailand: Thakonwat Chanwattana (SLRI) | Undulator Radiation After Coxinel Transport Line With a Laser Plasma Acceleration Source: Amin Ghaith (SOLEIL) | CEP stabilized few cycle MIR-FEL for Driving High Repetition Rate (>10 MHz) attosecond X-ray Source based on HHG: Ryoichi Hajima (QST) | Variable High Gradient Permanent Magnet Quadrupoles: Amin Ghaith (SOLEIL) | Results from the diamond grating multiplexing study at LCLS (January) to feed 3 experiments simultaneously: Aymeric Robert (SLAC) | Ultra-short Period High Field Undultators for Compact Light Sources: Toshiteru Kii (Kyoto Univ.) | WG-D |
| | | | Multi-bend lattice analysis towards a diffraction limited ring based light source:Emanuel Karantzoulis (ELETTRA) | | | | | | |
| | | Round beam related challenges in storage ring light sources: Peter Kuske (HZB) | Modeling Ion Effects for the APS-U: Joseph Calvey (ANL) | LWFA-driven free electron laser for ELI-Beamlines: Alexander Molodozhentsev ( ELI) | High-Efficient XFELO Based on Optical Resonator with Self-Modulated Q-Factor: Chunguang Jing (Euclidtechlabs) | Design study of the high gradient magnets for a future: Alexey Vorozhtsov (MAX-IV) | Two-bunch operation with ns temporal separation at FERMI: Giuseppe Penco (ELETTRA) | Generation of a wakefield undulator in plasma with transverse density gradient: Gennady Stupakov (SLAC) | Closing |
| | | | | Progress and Roadmap of the Laser driven plasma wakefield acceleration for FEL application at BELLA:Jeroen van Tilborg (LBNL) | Theoretical studies on XFELO: Kai Li ( SINAP) | | | | |
| | | Review of new developments in superconducting undulator technology at the APS: Joel Fuerst (ANL) | Ion Instability in the HEPS Storage Ring: Saike Tian (IHEP) | Discussion | Discussion | Analysis of Electron Trajectories in Harmonic Undulator with SCILAB's model based design codes/Harmonic Undulator Radiation with Dual Non-Periodic Magnetic Components: Hussain Jeevakhan (Bhopal) | Optimizing of electron beam distribution at European XFEL and FLASH: Bart Faatz (DESY) | Beam-driven short wavelength undulator: Chunguang Jing (Euclidtechlabs) | |
| | 12:30 | | Discussion | | | | Discussion | Discussion | |
| | | Lunch Break 12:30 - 14:00 | | | | | | | |
| | | **Imperial Hall I** | **Imperial Hall III** | **Imperial Hall I** | **Imperial Hall III** | **Imperial Hall I** | **Imperial Hall III** | **Imperial Hall I** | **Imperial Hall III** |
| | | WG-A: *W. Decking* | WG-B: *Q. Qin* | WG-D: *Y. Leng* | WG-A: *T. Raubenheimer* | WG-C: *C. Marie-Emmanuelle* | WG-D: *J. Byrd* | WG-B: *Q. Qin* | WG-D: *J. Byrd* |
| | 14:00 | The Shanghai Hard X-ray Free Electron Laser Project: Dong Wang (SINAP) | Lattice design for the PETRA-4 towards a diffraction limited storage ring: Ilya Agapov (DESY) | Comparative study of RF BPM performance via beam measurements at NSLS-II: Danny Padrazo (BNL) | Generation of atto-second FELS: James MacArthur (SLAC) | The CompactLight Project: towards compact accelerators and beyond: Gerardo D'Auria (ELETTRA) | Fast Injection kicker and pulser development for ALS-U: Will Waldron (LBNL) | Survey of collective effects in next-generation light source rings: Ryutaro Nagaoka (SOLEIL) | Review of CW guns for XFELs: Feng Zhou (SLAC) |
| | | Progress on the LCLS-II and the High Energy Upgrade of LCLS-II: Tor Raubenheimer (SLAC) | Overview of the APS-U project: Michael Borland (ANL) | A Study on the Improved Cavity Bunch Length Monitor for FEL: Qian Wang (USTC) | Ultrashort pulse generation and superradiance in FELs: Xi Yang (BNLk) | CompactLight Design Study: Andrea Latina (CERN) | High Power RF Solid State Amplifiers for Accelerators and Storage Rings: Jorn Jacob (ESRF) | Impedance Evaluation of the PF In-Vacuum Undulator: Theory, Simulation, and Experiment: Olga Tanaka (KEK) | LCLS-II Beam Containment System for Radiation Safety: Christine Clarke (SLAC) |
| | | PAL-XFEL and its time-resolved experiment with sub-20-fs timing jitter: Chang-Ki Min (PAL) | Current and Future of Storage Ring Based Light Sources in KEK: Nao Higashi (KEK) | The development and applications of the Digital BPM signal processor at SINAP: Longwei Lai (SSRF) | Free-Electron Laser R&D in the UK - steps towards a national X-FEL facility: Neil Thompson (STFC/DL/ASTeC) | Design of a Very Large Acceptance Compact Storage Ring: Alexander Papash (KIT) | RF System for the Storage Ring and Linac of the Future Synchrotron Light Facility in Thailand: Nawin Juntong (SLRI) | Theory of longitudinal multibunch instabilities including a higher-harmonic (bunch-lengthening) cavity: Ryan Lindberg (ANL) | High Brightness Photo-Cathode Electron Beam of the APS Linac: Yine Sun (APS) |
| | 15:30 | | Discussion | Discussion | Discussion | Discussion | Discussion | Discussion | |
| | | Coffee Break 15:30- 16:00 | | | | | | | |
| Hotel Equatorial | | **Imperial Hall I** | **Imperial Hall III** | **Imperial Hall I** | **Imperial Hall III** | **Entrance Hall** | **Imperial Hall I** | **Imperial Hall III** | |
| | | WG-A: *L. Giannessi* | WG-B: *R. Walker* | WG-D: *Y. Leng* | WG-A: *L. Giannessi* | Poster Session | WG-B: *R. Walker* | WG-D: *J. Pflueger* | |
| | 16:00 | Report on an ICFA BD mini-workshop: Daniel Ratner (SLAC) | Accelerator physics studies for the High Energy Photon Source (HEPS) in Beijing:Yi Jiao (IHEP) | Next generation X-ray Beam Position Monitors: Bingxin Yang (ANL) | EEHG experiment at FERMI:Enrico Allaria (ELETTRA) | | Survey and outlook for short-pulse schemes in storage rings: Andreas Jankowiak (HZB) | Construction and optimization of cryogenic undulators at SOLEIL: Mathieu Valleau (SOLEIL) | |
| | | Automated Optimization of Machine Parameters at the European XFEL: Lars Fröhlich (DESY) | Status of construction for ESRF EBS: Thomas Perron (ESRF) | Emittance measurements on future ring light sources: Ake Andersson (MAX-IV) | An X-Ray FEL Oscillator for Novel Sciences: Kwang-Je Kim (ANL) | | An overview of the Steady State Microbunching (SSMB) R&D effort initiated at Tsinghua University: Chuanxiang Tang (TUB) | Optimization of Superconducting Undulators: James Clarke (STFC, AsTEC) | |
| Registration | | The Feasibility of Neuron Network-Based Beam-Based Alignment: Li Zeng (SINAP) | Baseline lattice for the upgrade of SOLEIL:Alexandre Loulergue (SOLEIL) | Turn-by-Turn Measurements for Systematic Investigations of the Micro-Bunching Instability: Johannes Steinmann (KIT) | Harmonic lasing in XFELs: theory and experiment: Evgeny Schneidmiller (DESY) | | Transparent Lattice Characterization with Gated Turn-by-Turn Data of Diagnostic Bunch-Train: Yongjun Li (BNL) | Partial coherence in undulator beamlines at ultra-low emittance storage rings: Manuel Sanchez del Rio (ESRF) | |
| | | FEL optimization through BBA with undulator spectrum analysis and undulator optics matching:Haeryong Yang (PAL) | | | Simulations and performance study of an optimized longitudinal phase space for the hard X-ray self-seeding at the European XFEL: Shan Liu (DESY) | | Laser seeding of electron bunches for future ring-based light sources: Shaukat Khan (TU-Dortmond) | | |
| | | Discussion | Study of Multi-Bend Achromat Lattices for the HALS Diffraction-Limited Storage Ring: Zhenghe Bai(USTC) | The design of HEPS vacuum chambers: Ping He (IHEP) | Discussion | | Discussion | Discussion | |
| | 18:00 | | Discussion | Discussion | | | | | |
| Reception | | | | | | | | | |
| | 19:00 | | | | | | | | |
| | 20:00 | | | | | | Banquet | | |
| | 21:00 | | | | | | | | |

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