WG1: Storage Ring Radiation Sources

Conveners: K. Harkay (APS) and A. Ropert (ESRF)

Tues 16 May

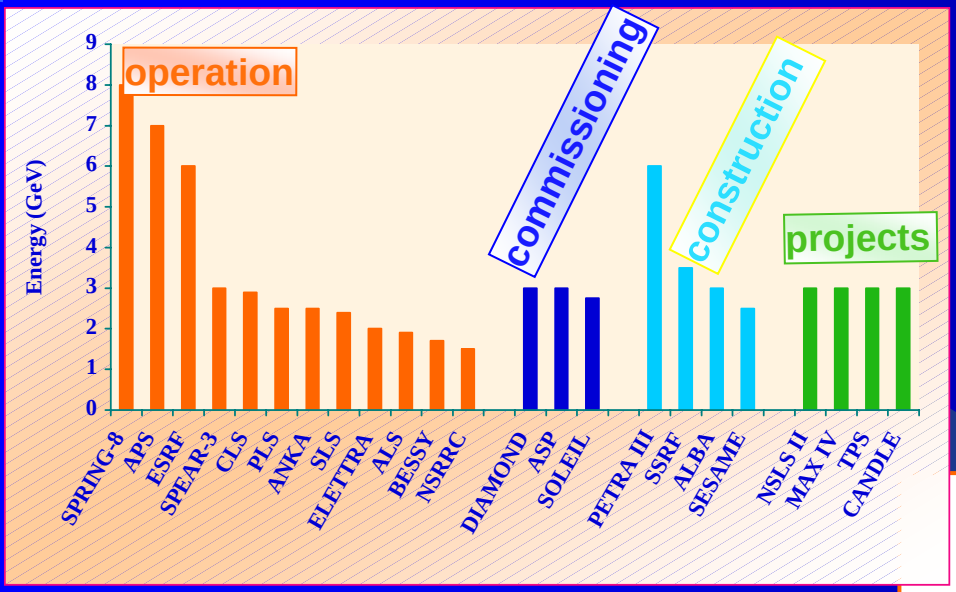
11:00-11:15	**Introduction**
11:15-11:35	S. Krinsky - Discussion of the Design of the NSLS-II Storage Ring
11:35-11:55	G.Geloni - Statistical Optics and Partially Coherent X-ray Beams in 3rd Gen Light Sources
11:15-12:30	**Discussion: What ring parameters may lead to new science ?**
lunch	
14:00-14:20	Y. Li - Study of Dynamic Aperture for PETRA III Ring
14:20-14:40	V. Tsakanov - Beam Physics Issues in CANDLE Synchrotron Light Source Project
14:40-16:00	**Discussion: Can we go beyond the present state of the art sources ?**
coffee break	
16:30-16:40	A. Streun - Compact low emittance lattices with longitudinal gradient bends
16:40:16:50	D. Robin - Bunch fill patterns and purification
16:50-17:10	B. Podobedov - High Current Effects in the NSLS-II Storage Ring
17:10-18:00	**Discussion: Can we go beyond the present state of the art sources ?**

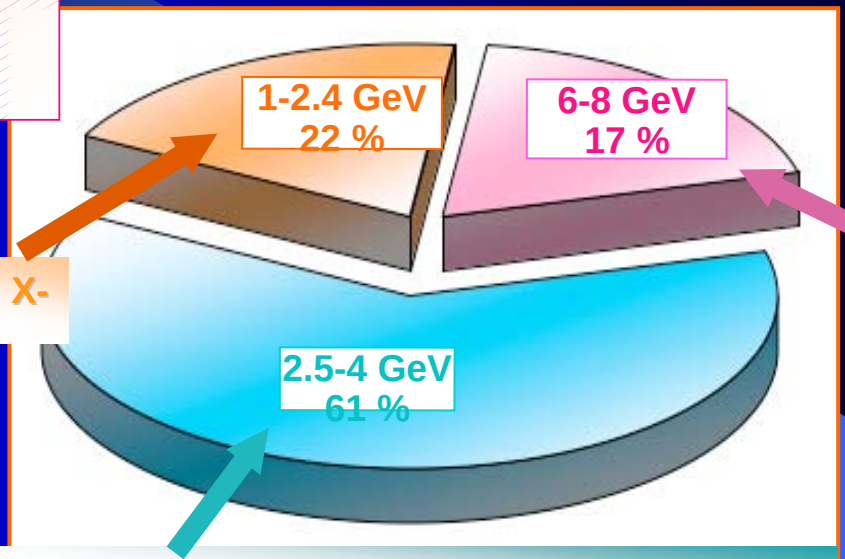
Thurs 18 May

9:00-9:20	J.Byrd - Observation of CSR from bunches following slicing at ALS
9:20-9:30	K. Harkay - Status of APS short pulse project
9:30-10:30	**Discussion: Can we go beyond the present state of the art sources ?**
coffee break	
11:00-11:10	G. Luo, P. Chou - Operation experience with SRF at NSRRC
11:10-11:20	E. Weihreter - HOM-free NC rf cavities
11:20-11:30	T.Weiss - HOM damped RF cavities
11:30-11:40	E. Gluskin - Insertion device R&D
11:40-12:30	**Discussion: What critical accelerator technologies require development ?**
lunch	
14:00-14:10	A. Ropert - Future possibilities at the ESRF
14:10-14:20	Y. Wu - Hallow beam instability in the Duke storage ring
14:20-16:00	**Discussion: Upgrade of existing sources: what is feasible ?**
coffee break	
16:30-16:50	H. Hama - Featuring the Characteristics of the Super Coherent THz Photon Ring
16:50-17:10	Y. Kawashima - Proposal of a Synch Rad Facility to Supply UV, X-ray, MeV photon, GeV photon, and Neutron
17:10-18:00	**Discussion: Is it worth building cost-effective but lower performing rings ? Should we build multipurpose or specialised sources ?**

25 participants

Present and future third generation light sources





UV and soft X-rays

Hard X-r

Hard X-rays thanks to the development of Insertion Device technology

What ring parameters may lead to new science? (1)

Figures of merit are strongly facility dependent

- **Providing filling pattern options and short pulses with excellent bunch purity for those having a strong time-structure user community (5 to 33 %), has a strong priority**

Challenge is to satisfy them and flux users simultaneously

D. Robin's idea of kicking single bunch

- **For a large number of beamlines, flux is the important figure of merit**

Not a strong demand for beam current increase

Some obstacles on the machine side

What ring parameters may lead to new science? (2)

- There is a demand for low emittance, depending on the facility (1 nm at NSLS II and PETRA 3 for nanoscience)

- High stability of the photon beam has the highest priority for users

Good synergy between machine physicists and users

Can we go beyond state of the art sources ? (1)

Overall challenges to answer:
How small an emittance is achievable practically in rings ?
How short a pulse length and high a photon flux ?
What is compromised ?

- **Lower emittance: Ways of achieving 1 nm**
  - ✓**Longitudinal gradient in dipoles (feasible magnets could provide a significant reduction) but the dynamic aperture is an issue**
  - ✓**Damping wigglers proposed for NSLS II (S. Krinsky talk) and PETRA 3 (up to 4 times reduction)**
  - ✓**MAX-IV approach (1.4 nm at 3 GeV)**

- **Flexibility**

Some flexibility in the lattice and operating modes is required

Can we go beyond state of the art sources ? (2)

- Dynamic aperture

Serious issue for lattices with reduced emittance
Less challenging when using damping wigglers (Y. Li)

Ideas for coping with small dynamic aperture at injection:
on-axis injection with very fast kicker, quadrupole kicker

- Maximum beam current
  - ✓Single bunch instabilities are the hardest to overcome

ID chamber impedance is the major contributor to TMCI

  - ✓Microwave instability is also an issue

Discrepancy between experimental results and simulations needs to be understood (B. Podobedov talk)

Can we go beyond state of the art sources ? (3)

- Short pulses
  - ✓ Low α operation
    Sub-ps bunches expected with increasing the RF gradient by a factor of 20 (G. Wüstefeld talk)
  - ✓ Crab cavity scheme
    1 ps pulses achievable at APS (K. Harkay talk)
    issues on the SC cavity design and vertical emittance blow-up (tolerances on rf errors)
  - ✓ Seeded CSR at ALS (J. Byrd)
    Bursting mode CSR possible source of THz radiation with seeding
  - ✓ Isochronous beam transport (H. Hama)
    Preserves linac pulse length (~100 fs)

What are the critical accelerator technologies that require R&D ? (1)

- RF systems SC versus room temperature

SRF developed for SOLEIL, CESRB (selected for several new rings)

- ✓Operational experience with SC cavities (G. Luo talk)
  1 trip / week, 30 minutes to recover
- ✓Pro and cons of SC and NC (E. Weihreter talk)
  - SC more gradient and better HOM damping
    operational experience more limited
  - NC simple technology
    cost effective

Room temperature HOM damped cavity (EU design, T. Weis talk) meets CBI thresholds requirements for our rings

What are the critical accelerator technologies that require R&D ? (2)

- What are the trends in ID development ? (E. Gluskin)
  - ✓Technology is mature
  - ✓Facility related approach (APS industrial-type experience of standard IDs versus a series of unique IDs at ESRF)
  - ✓Dramatic improvement of magnet quality over years
  - ✓Challenging developments of short period SC undulators (shimming and field measurements)
  - ✓Strong concern for intermediate and high energy machines about radiation damage likely due to bad injection. Installation of scrapers strongly advised

- Statistical optics method for ID radiation calculation in VUV-soft x-ray wavelength regime (G. Geloni talk)

Upgrades of existing sources, what is feasible?

- Boundary conditions: cost, infrastructure, interferences with users….
- Most often considered: low emittance, top-up, canted undulators, leave enough room for future enhancements

Examples:

ESRF (A. Ropert talk)
SLS (canted undulators with extra quadrupoles)
Proposed new 3 GeV ring at Taiwan
NSLS II: keep enough room for an ERL

Is it worth building cost-effective, lower performing rings ?

- Low-cost, medium performance 3rd generation sources
- What is affordable at small institutions and countries (CANDLE, V. Tsakanov talk), availability of UV research facility for local emphasis, training ground for large x-ray facilities ?
- "Turn-key" linac, Booster (CLS, ASP examples) in case of staffing issues
- Multipurpose vs. special purpose rings
  - ✓Generating multiple wavelength photons, neutrons from 1-10 GeV ring (Y. Kawashima talk)
  - ✓MAX-IV (UV and VUV production in 2 superimposed rings)
  - ✓Compact inverse compton scattering sources

Conclusions

- Active and fruitful participation in WG1
- Ring technology is mature
- The experience gained from existing facilities benefits new sources
- Innovations are continuing: emittance, RF, magnets, IDs…..
- Upgrades at each facility are driven by the local user community
- No end in sight for new ring installation around the world