Button BPMs for Synchrotron Light Sources

Report of Contributions

https://indico.cells.es/e/1542

Contribution ID: **3** Type: **Oral Presentation**

Electromagnetic design and Bench Testing of ALS-U BPM Buttons and Assemblies

The ALS Upgrade Project (ALS-U) consists in the replacement of the existing ALS storage ring and the addition of a new accumulator ring in order to decrease the horizontal beam emittance to about 70 pm rad, resulting in an increase of two orders of magnitude in the soft X-Ray brightness. The vacuum chambers of two new rings, and of the transfer lines connecting them, will include 327 new beam position monitors (BPM). About 1500 buttons (including prototypes and spares) are purchased from the commercial vendors and must be tested. In this report, we will present the electromagnetic design and the bench testing work for the ALSU BPM buttons and assemblies. Up to now, we have finished the assembling of all the BPMs for the Accumulator Ring (AR). We are now working on the BPMs for the new Storage Ring, which are more challenging than AR due to the smaller apertures and the ante-chambers.

Primary author: LUO, Tianhuan (Lawrence Berkeley National Laboratory)

Presenter: LUO, Tianhuan (Lawrence Berkeley National Laboratory)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **4** Type: **Oral Presentation**

2D BPM Simulation Codes: BEM and FEM fusion

In the world of 2D electromagnetic and electrostatic modeling the two prevalent approaches are the finite-element and boundary-element methods (FEM and BEM). BpmLab (FEM) developed in ALBA in 2017, and BEM (i.e. BEM) developed in Diamond in 2004, both made for Matlab, have been extensively used across synchrotron labs and accelerator machines for the last 10 years. These codes precisely meet the needs of the Accelerator community, offering rapid and precise simulations of BPM sensitivity function and other related effects. Other alternatives are not as straightforward and accessible (like the expensive codes CST, HFSS) or much older and limited (as Poisson, GdFidl, etc.). This work summarizes the capabilities and potential of these 2D codes: arbitrary geometry layout, wall current and sensitivity function calculation, 2D response maps and various non-linearity correction methods, showing the benefits of a possible fusion between both FEM and BEM

Primary authors: NOSYCH, Andriy; REHM, Guenther (Diamond Light Source)

Presenter: NOSYCH, Andriy

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **7** Type: **Oral Presentation**

Design, development and test experiences for the HEPS Button BPM

A button and stripline beam position monitor (BPM) were designed and fabricated. 3700 feedthroughs and 720 BPMs have been made and tested. The feedthroughs are sorted by the capacitance which was measured by the TDR. The position accuracy of the button and fiducial were measured by Coordinate Measuring Machine which shown an accuracy of dozens of μm. The characteristic impedances of the stripline were designed to be 50 Ω and confirmed by TDR measurements.

Primary author: Dr HE, Jun (Institute of High Energy Physics, CAS)

Presenter: Dr HE, Jun (Institute of High Energy Physics, CAS)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **8** Type: **Oral Presentation**

Development of High-Precision Beam Position Monitor for the Korea-4GSR project

The Korean 4th Generation Synchrotron Radiation (4GSR) storage ring project is currently under construction in Ochang, South Korea, with the goal of achieving the first beam commissioning in 2027. To achieve an emittance approximately 100 times smaller than that of third-generation synchrotron radiation storage rings, this project requires the development of several high-precision beam diagnostic devices. In particular, the Beam Position Monitor (BPM) aims to reduce longitudinal wake impedance to suppress heating and beam instability. A total of 440 BPMs are needed, spanning from the linear accelerator, LTB, booster, BTS to storage ring with 799.26m circumference, and all BPMs will be manufactured as button types. In this presentation, we will discuss the development of two types of 4GSR BPM pickup antennas: one utilizing a SiO_2 glass insulator and another designed in a cone shape using Al_2O_3. Additionally, we will describe the performance of these designs through beam tests.

Primary author: JANG, Siwon (Pohang Accelerator Laboratory)

Presenter: JANG, Siwon (Pohang Accelerator Laboratory)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **9** Type: **Oral Presentation**

Progress of the EIC HSR cryogenic BPM mechanical design

The Electron Ion Collider (EIC) Hadron Storage Ring (HSR) aims to leverage the hardware from the RHIC storage ring as much as possible. However, the RHIC stripline beam position monitors (BPM) used in the superconducting magnet cryostat will not be compatible with the planned EIC hadron beam parameters that include shorter bunches, higher beam current and operation of the beam with a radial offset in the vacuum chamber. A new cryogenic BPM design using button pick-ups integrated in a new interconnect bellow assembly will be installed adjacent to the decommissioned RHIC BPMs. This talk will review some of the challenges and the proposed design for the BPM buttons ahead of their procurement.

Primary author: MICOLON, Frederic (Brookhaven national laboratory)

Co-authors: GASSNER, DAVID (EIC - Brookhaven National Lab); Mr MATSUSHIMA, Kentaro (Brookhaven national laboratory)

Presenter: MICOLON, Frederic (Brookhaven national laboratory)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **10** Type: **Oral Presentation**

Simulations, Design and Prototyping of the BPM buttons for SOLEIL II

SOLEIL II is the low emittance upgrade project for Synchrotron SOLEIL, targeting an emittance of ~80 pm.rad. The new lattice includes 180 Beam Position Monitors (BPM). Due to the different constraints on the magnet yokes, beam stay clear and synchrotron radiation, 3 different types of BPM will be installed on the storage ring with inner diameter distributed between 16 and 24 mm. Electromagnetic and thermal simulations have been conducted to validate the designs.
Manufacturing the feedthroughs is a challenge due to the conical shape of the button and the small thickness (200 µm) of the gap with the BPM body. Prototypes of the button have been made by two different manufacturers and have been installed on a test vacuum chamber.
This talk presents the designs, the simulations and summarizes the results of the metrology of the two batches of feedthroughs and their installation on the vacuum chamber.

Primary authors: Mr EL AJJOURI, Moussa (Synchrotron SOLEIL); HUBERT, Nicolas (SYNCHROTRON SOLEIL)

Presenter: HUBERT, Nicolas (SYNCHROTRON SOLEIL)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **11** Type: **Oral Presentation**

Is the production of UHV feedthroughs a mystery?

Indeed, sometimes it is the case. Ultra-high vacuum leak-tight electrical coaxial feedthroughs are used for various diagnostic devices in particle accelerators. In principle, these feedthroughs are currently manufactured using two different production processes because of different materials. Coaxial feedthroughs have always an inner conductor and an outer housing. Both are connected by an isolator to provide the vacuum tightness. This non-conductive material is either a type of glass or of ceramic. In the first case, both components will be interconnected by heating the glass in a continuous furnace up to the melting temperature, and the glass will be pressed using a specialized tool. In the second case, a metallized ceramic is brazed to the inner conductor and the housing at high temperatures in a vacuum furnace by using a filler material. Key challenges are the different expansion coefficients of the required materials. In my presentation I will give an overview of more than 30 years of experience in manufacturing UHV feedthroughs for various accelerators at DESY. I will report about good and bad examples.

Primary author: VILCINS, Silke (Deutsches Elektronen Synchrotron (DESY))

Presenter: VILCINS, Silke (Deutsches Elektronen Synchrotron (DESY))

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **12** Type: **Oral Presentation**

Optimization of beam coupling impedance of button and stripline BPMs

Beam position monitors (BPMs) are essential diagnostics tools in particle accelerators. Due to the large number of BPMs typically installed, their cumulative contribution to the beam coupling impedance cannot be neglected.
In this work, design optimization for both button and stripline BPMs aimed at reducing beam coupling impedance while maintaining or enhancing the signal transfer impedance is discussed.

Primary author: BILANISHVILI, Shalva

Co-author: Dr ZOBOV, Mikhail (Laboratori Nazionali di Frascati, INFN)

Presenter: BILANISHVILI, Shalva

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **14** Type: **Oral Presentation**

Pickups for High Bandwidth Applications

Like in a typical beam position monitor, the electro-optical bunch arrival-time monitor (EO-BAM) in an x-ray free-electron laser (XFEL) comprises pickups. Although the data acquisition is differing, both cases have some similar design requirements. Especially, in the case of the EO-BAM a strong demand for a wide bandwidth. The cone-shaped button-type pickups, implemented and used for many years in various XFEL, have a bandwidth of at least 40 GHz. In this presentation, we will show the 40 GHz pickups with special attention to the mechanical design of the pickup and its feedthrough. Additionally, we will introduce our current work on pickups realized on a printed circuit board with an integrated combination network, which are planned to surpass 100 GHz.

Primary author: SCHEIBLE, Bernhard (Technische Hochschule Mittelhessen)

Co-authors: Prof. PENIRSCHKE, Andreas (Technische Hochschule Mittelhessen); VILCINS, Silke (Deutsches Elektronen Synchrotron (DESY))

Presenter: SCHEIBLE, Bernhard (Technische Hochschule Mittelhessen)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **15** Type: **Oral Presentation**

Button BPMs for the cSTART project: design and challenges

The KIT cSTART project (compact storage ring for accelerator research and technology) aims to demonstrate injection and storage of a high intensity ultra-short bunch using the FLUTE LINAC, as well as a laser-plasma accelerator (LPA).
cSTART is planned to operate with a wide range of demanding parameters, such as bunch charge, bunch length and energy spread (from the LPA); making it extremely challenging for the choice of beam diagnostics with large dynamic ranges that are capable of operating within specifications.
Moreover, turn-by-turn measurements are of great interest since for some ring lattices the bunch characteristics are expected to dramatically change within a single turn.
In this talk, we will address the challenges encountered while choosing among available Button BPM designs, how we envisage these choices will affect the measurement resolution and the effects these choices may have on the measurable beam dynamics.

Primary authors: Dr EL KHECHEN, Dima (Karlsruhe Institute for Technology); SMALE, Nigel (KIT IBPT)

Presenter: Dr EL KHECHEN, Dima (Karlsruhe Institute for Technology)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **16** Type: **not specified**

The SLS 2.0 button BPM

The upgrade of the Swiss Light Source (SLS), called SLS 2.0, involves, among other things, a complete replacement of the storage ring, which started in September 2023 and is currently nearing completion. The commissioning of the new ring is scheduled to begin next January.
In the approximately 290 meters of circumference of the new ring, 134 button BPMs have been placed, having, like the rest of the vacuum chamber, much smaller cross section.
The button pickup was designed using borosilicate glass as a dielectric insulator and features an original solution that allows suppression of the trapped mode TE11.
The entire production (over 900 units including spares and prototypes) was carefully supervised, tested, and measured. To minimize the electrical offset of the BPMs, the buttons were sorted according to their measured transfer impedance, thus limiting the effects due to dimensional tolerances.

Primary author: MARCELLINI, Fabio (Paul Scherrer Institut)

Co-authors: FORTUNATI, Reto (PSI); KEIL, Boris (PSI)

Presenter: MARCELLINI, Fabio (Paul Scherrer Institut)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **17** Type: **Oral Presentation**

Home Made Button Type BPMs: demo antennas or real diagnostics tools?

The electromagnetic (EM) design of button type beam position monitor (BPM) devices for fourth-generation storage rings is only the first step, and in certain respects the simplest one, of the full path to get a manufacturable, reliable and "cheap" diagnostic tool. Once completed, such EM design has to be reviewed and modified together with the potential BPMs manufacturers in order to match all the technological aspects involved in the proprietary sealing materials and manufacturing processes. To further complicate things, prototypes manufacturing and ancillary validation tools development could require long term efforts and iterations between the involved players before finding the formal agreement for the BPMs series production. In this report are described some in house developed, manufactured and assembled BPMs aimed to "quick&dirty" rapid prototyping some samples of button type pick-ups in view of Elettra 2.0.

Primary author: CLEVA, Stefano (Elettra Sincrotrone Trieste)

Presenter: CLEVA, Stefano (Elettra Sincrotrone Trieste)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **18** Type: **Oral Presentation**

Learning how to get EBPM buttons manufactured

Some years ago a similar workshop was hosted at Diamond. At the time there was a concern about the availability of suitably proficient manufacturers for the construction of EBPM buttons. Much best practice and experience was shared. Since then Diamond have run a prototype button project to identify possible manufacturers as well as pain points in the manufacturing and material procurement.
We have recently awarded the tender for the EBPM button contract for the Diamond-II upgrade.
I will summarise our experience in putting the learnings from the first workshop into practice, and some of the additional things we have learned during the prototype button project. I will also include plans to implement some of the ideas presented in the first workshop as the EBPM button contract is fulfilled.

Primary author: MORGAN, Alun (Diamond Light Source)

Presenter: MORGAN, Alun (Diamond Light Source)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **19** Type: **Oral Presentation**

Electron-Ion Collider BPM Button Design Progress

The Electron-Ion Collider will be constructed at Brookhaven National Laboratory, utilizing the existing infrastructure and accelerator complex of the Relativistic Heavy Ion Collider (RHIC). The existing superconducting yellow RHIC ring will be upgraded to become the hadron storage ring (HSR) with a maximum energy of 275 GeV, and beam current up to 1 Amp. Upgrades include new button BPMs. A new electron storage ring (ESR) with a maximum energy of 18 GeV, and beam current up to 2.5 Amps will be installed in the existing RHIC tunnel, where it will provide polarized electrons for beam collisions with the HSR hadron beam in up to two interaction regions. Polarized electron bunches will be provided to the ESR by a new rapid-cycling synchrotron (RCS). The preliminary design progress of the RCS and ESR BPM buttons, and more advanced design of the HSR BPM buttons, will be presented.

Primary author: GASSNER, DAVID (EIC - Brookhaven National Lab)

Co-authors: BLEDNYKH, Alexei (EIC - Brookhaven National Lab); HETZEL, Charles (EIC - Brookhaven National Lab); MICOLON, Frederic (Brookhaven national laboratory); PINAYEV, Igor (EIC - Brookhaven National Lab); MATSUSHIMA, Kentaro (EIC - Brookhaven National Lab); PANICCIA, Matthew (EIC - Brookhaven National Lab); SANGROULA, Medani (EIC - Brookhaven National Lab)

Presenter: GASSNER, DAVID (EIC - Brookhaven National Lab)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **20** Type: **Oral Presentation**

non linear beam response meets machine learning

For the 2D simulation of a beam position monitor (BPM) in a synchrotron light source there is a Matlab Code using the Boundary Element Method (BEM) developed in 2004 [1]. We are using this simulation at BESSY II for determining the induced charge on the buttons and studying non linear effects of the BPMs and their different geometries.
We decided to convert that code into Python to add new features.
By that we are able to apply a machine learning approach to extract beam position information at large displacements in the non linear regime. Eventually this can be deployed to the FPGA of the BPM electronics to supply real time data evaluation.

[1] A. Olmos, F. Perez, and G. Rehm, "Matlab Code for BPM Button Geometry Computation", in Proc. DIPAC'07, Venice, Italy, May 2007, paper TUPC19, pp. 186-188.

Primary author: SELBACH, Nicola (Helmholtz Zentrum Berlin)

Presenter: SELBACH, Nicola (Helmholtz Zentrum Berlin)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **21** Type: **not specified**

Welcome

Wednesday, 11 December 2024 09:00 (20 minutes)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **22** Type: **Oral Presentation**

Is the production of UHV feedthroughs a mystery?

Wednesday, 11 December 2024 09:50 (30 minutes)

Presenter: VILCINS, Silke (Deutsches Elektronen Synchrotron (DESY))

Session Classification: Introduction

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **23** Type: **Oral Presentation**

Learning how to get EBPM buttons manufactured

Wednesday, 11 December 2024 09:20 (30 minutes)

Presenter: MORGAN, Alun (Diamond Light Source)

Session Classification: Introduction

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **24** Type: **not specified**

The SLS 2.0 button BPM

Wednesday, 11 December 2024 15:00 (30 minutes)

Presenter: MARCELLINI, Fabio (Paul Scherrer Institut)

Session Classification: Definitive design

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **25** Type: **Oral Presentation**

Design, development and test experiences for the HEPS Button BPM

Wednesday, 11 December 2024 16:00 (30 minutes)

Presenter: HE, Jun (Institute of High Energy Physics, CAS)

Session Classification: Definitive design

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **26** Type: **Oral Presentation**

Electromagnetic design and Bench Testing of ALS-U BPM Buttons and Assemblies

Wednesday, 11 December 2024 10:50 (30 minutes)

Presenter: LUO, Tianhuan (Lawrence Berkeley National Laboratory)

Session Classification: Prototyping for SLS (I)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **27** Type: **Oral Presentation**

Development of High-Precision Beam Position Monitor for the Korea-4GSR project

Wednesday, 11 December 2024 11:20 (30 minutes)

Presenter: JANG, Siwon (Pohang Accelerator Laboratory)

Session Classification: Prototyping for SLS (I)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **28** Type: **Oral Presentation**

Simulations, Design and Prototyping of the BPM buttons for SOLEIL II

Presenter: HUBERT, Nicolas (SYNCHROTRON SOLEIL)

Session Classification: Prototyping for SLS (II)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **30** Type: **Oral Presentation**

Home Made Button Type BPMs: demo antennas or real diagnostics tools?

Presenter: CLEVA, Stefano (Elettra Sincrotrone Trieste)

Session Classification: Prototyping for SLS (II)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **31** Type: **Oral Presentation**

Guided discussion

Wednesday, 11 December 2024 16:30 (30 minutes)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **32** Type: **not specified**

HL-LHC BPM development

Thursday, 12 December 2024 09:00 (30 minutes)

Presenter: KRUPA, Michal

Session Classification: Not light sources

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **33** Type: **Oral Presentation**

Electron-Ion Collider BPM Button Design Progress

Thursday, 12 December 2024 09:30 (30 minutes)

Presenter: GASSNER, DAVID (EIC - Brookhaven National Lab)

Session Classification: Not light sources

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **34** Type: **Oral Presentation**

Progress of the EIC HSR cryogenic BPM mechanical design

Thursday, 12 December 2024 10:00 (30 minutes)

Presenter: MICOLON, Frederic (Brookhaven national laboratory)

Session Classification: Not light sources

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **35** Type: **Oral Presentation**

Button BPMs for the cSTART project: design and challenges

Thursday, 12 December 2024 11:30 (30 minutes)

Presenter: EL KHECHEN, Dima (Karlsruhe Institute for Technology)

Session Classification: Special designs

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **36** Type: **Oral Presentation**

Optimization of beam coupling impedance of button and stripline BPMs

Thursday, 12 December 2024 11:00 (30 minutes)

Presenter: BILANISHVILI, Shalva

Session Classification: Special designs

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **37** Type: **not specified**

Pickups for High Bandwidth Applications

Thursday, 12 December 2024 12:00 (30 minutes)

Presenter: SCHEIBLE, Bernhard (Technische Hochschule Mittelhessen)

Session Classification: Special designs

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **38** Type: **Oral Presentation**

2D BPM Simulation Codes: BEM and FEM fusion

Thursday, 12 December 2024 13:30 (30 minutes)

Presenter: NOSYCH, Andriy

Session Classification: Codes

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **39** Type: **Oral Presentation**

Non linear beam response meets machine learning

Thursday, 12 December 2024 14:00 (30 minutes)

Primary author: SELBACH, Nicola (Helmholtz Zentrum Berlin)

Co-authors: SCHÄLICKE, Andreas; HARTMANN, Gregor; REHM, Günther; RIES, Markus; MCATEER, Meghan

Presenter: SELBACH, Nicola (Helmholtz Zentrum Berlin)

Session Classification: Codes

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **40** Type: **Oral Presentation**

Final remarks

Thursday, 12 December 2024 14:30 (30 minutes)

Contribution ID: **41** Type: **Oral Presentation**

Design and fabrication of Button BPM prototypes for HALF

The Hefei Advanced Light Facility (HALF) is a 4th generation low energy diffraction-limited synchrotron radiation light source currently under construction in China. The storage ring contains 240 sets of button electrode type Beam Position Monitor (BPM) probes for orbit measurement and feedback. To select the most suitable probe manufacturer, five identically designed button electrode probe prototypes were delivered to five different companies both domestically and internationally for parallel processing. This talk will introduce the basic situation of the HALF project as well as the processing and testing of the button electrode prototypes.

Primary author: LENG, Yongbin (USTC/NSRL)

Presenter: LENG, Yongbin (USTC/NSRL)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **42** Type: **Oral Presentation**

Home Made Button Type BPMs: demo antennas or real diagnostics tools?

Wednesday, 11 December 2024 14:30 (30 minutes)

Presenter: CLEVA, Stefano (Elettra Sincrotrone Trieste)

Session Classification: Prototyping for SLS (II)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **43** Type: **not specified**

Simulations, Design and Prototyping of the BPM buttons for SOLEIL II

Wednesday, 11 December 2024 11:50 (30 minutes)

Presenter: HUBERT, Nicolas (SYNCHROTRON SOLEIL)

Session Classification: Prototyping for SLS (I)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **44** Type: **Oral Presentation**

Advancements in BPM Development for PETRA IV

Wednesday, 11 December 2024 12:20 (30 minutes)

Presenter: STROKOV, Sergey (DESY)

Session Classification: Prototyping for SLS (I)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **45** Type: **Oral Presentation**

Design and fabrication of Button BPM prototypes for HALF

Wednesday, 11 December 2024 14:00 (30 minutes)

Presenter: LENG, Yongbin (USTC/NSRL)

Session Classification: Prototyping for SLS (II)

Track Classification: Button BPMs for Synchrotron Light Sources

Contribution ID: **46** Type: **Oral Presentation**

HL-LHC BPM development

As part of the High Luminosity upgrade of the LHC, 52 new stripline and button BPMs as well as 38 collimators with embedded button BPMs will be installed. This requires production of various types of button electrodes and RF feedthroughs for both cryogenic to high-temperature environments. This contribution will present the design, manufacturing challenges and testing procedures for the buttons and feedthroughs.

Primary author: KRUPA, Michal

Presenter: KRUPA, Michal

Session Classification: Not light sources

Track Classification: Button BPMs for Synchrotron Light Sources