October 25th – 28th, 2016

Campinas, Brazil

11th International Workshop on Personal Computers and Particle Accelerator Controls

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11th International Workshop on Personal Computers and Particle Accelerator Controls

October 25th-28th – Campinas, Brazil

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PCaPAC 2016
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PRESENTATION

Dear colleagues,

Welcome to Brazil and to CNPEM!

Thank you all for coming. This year we complete twenty years of the PCaPAC workshop series, and also twenty years of the first electron beam around the accelerator at LNLS (Brazilian Synchrotron Light Laboratory). These days in 2016 are a special time to celebrate!

For the first time, Brazil is the host of a workshop in the accelerators control field. Nevertheless, this country is well acquainted to the matter. The LNLS accelerator complex has produced its first electron beam in 1996. In order to reach this, ten years of preparation under severe conditions were necessary: a decade-long struggle for funding during an era of high inflation rates and of policies that aimed to limit the importation of IT goods. Brazilian young engineers and physicists faced the challenge and reached success. They created a whole system of data acquisition devices, which remain the basis of the LNLS accelerator control system, and which was made available to the local industry, at some extension.

We are here to exchange achievements and experience. But, in addition, we would like to proudly present to you the project and the construction works of SIRIUS, a fourth-generation accelerator, which involves enormous engineering challenges. The LNLS team, with many new-generation young engineers who joined us, will enjoy the opportunity to show and validate some of their ideas around the project.

I would like to thank you all for the contribution to the program, of course, through a talk, a poster or a tutorial session. I leave also my acknowledgment to the invaluable advices from the colleagues in the international Programme Committee. Last but not least, I leave my gratitude to the members of the Local Organisation Committee, from different areas of CNPEM. These months of intense planning and organizing for this PCaPAC workshop brought us even closer.

May we all have a great time!

James Rezende Piton
james@lnls.br

PCaPAC 2016 Programme Committee, chair
Beamline Software Group, LNLS/CNPEM

LNLS - Brazilian Synchrotron Light Laboratory
CNPEM - Brazilian Center for Research on Energy and Materials

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KEYNOTE SPEAKERS

LIGO: The dawn of gravitational wave astronomy
Jameson Graef Rollins
LIGO Interferometer Controls Scientist

Scientists have been searching for the elusive gravitational wave for more than half a century. On September 14, 2015, the Laser Interferometer Gravitational-wave Observatory (LIGO) finally observed the gravitational wave signature from the merger of two black holes.
This detection marks the dawn of a new age of gravitational wave astronomy, where we routinely hear the sounds emanating from deep within the most energetic events in the Universe. This talk will cover the basics of gravitational waves and interferometric gravitational wave detectors, LIGO and it's control systems, and details of the first direct detections of gravitational waves by LIGO.

Open Hardware and Collaboration
Javier Serrano
Leader of the Hardware and Timing section, which is part of the Controls group in the Beams Department at CERN

Open Source Hardware (OSHW) follows the lead of Free and Open Source Software (FOSS) and has similar goals: ensuring developers can share their work without artificial hurdles, improving quality through peer review, avoiding vendor lock-in and providing for a fair playground in which projects can thrive and accommodate contributions without compromising their long-term future. The talk will introduce OSHW and then attempt to answer a number of questions:
– What are the perceived benefits and issues of OSHW, in general and in the context of public research facilities?
– What is new with respect to FOSS?
– What makes OSHW projects succeed or fail?
The talk will use real examples of OSHW projects throughout, and will conclude with some thoughts about what the future holds in this domain.

Future Trends on Control Systems for Large Research Facilities
Mark Heron
Head of Controls Group at Diamond Light Source

Accurate predictions of the future are inherently difficult, nevertheless in this talk I will consider some of the developments in control systems at large research facilities and from these try to predict where they are heading. In doing so, the talk will consider software, hardware, people and the management of work. While this will largely be based on developments within our community, it will also look outward to consider what potential external influences there may be.

Contents

TUTT1 — Feedback / Control

Chair: D.O. Tavares (LNLS)

TUTT1T01 09:00 130

Feedback Control for Particle Accelerators - Part 1

R.J. Steinhagen *(GSI)*

This tutorial session will focus on fundamental aspects of feedback control systems in the particle accelerators field. It is not intended to be a general overview of the feedback control theory nor a collection of advanced topics on that matter, but rather a discussion about fundamental limiting factors on the tuning and implementation of feedback control loops. Some topics to be explored are conflicting figures of merit (disturbance rejection vs. reference tracking vs. noise attenuation), MIMO characteristics (static coupling, dynamics coupling), closed-loop performance limitation due to process/controller time delay and actuators saturation/limited slew rate, reliability issues (dealing with exceptions, failing sensors and actuators, operational non-conformities), model uncertainties and the robust control theory; and optimization-based control synthesis techniques beyond the traditional LQG approach. The session will be composed of lectures and a round table where a structured review of common design procedures and best practices will be developed in conjonction with the participants.

TUTT1T02 11:00 130

Feedback Control for Particle Accelerators - Part 2

R.J. Steinhagen *(GSI)*

Continuation of Feedback Control for Particle Accelerators Tutorial.

TUTT1T03 14:00 130

Feedback Control for Particle Accelerators - Part 3

R.J. Steinhagen *(GSI)*

Continuation of Feedback Control for Particle Accelerators Tutorial.

TUTT1T04 16:00 200

Feedback Control for Particle Accelerators - Part 4

R.J. Steinhagen *(GSI)*

Continuation of Feedback Control for Particle Accelerators Tutorial.

25-Oct-16 09:00 – 18:00 Tutorial Room 2

TUTT2 — Jupyter Notebook / SBC

Chair: G.B.M. Bruno (LNLS)

TUTT2T01 09:00 130

Python: Introduction to Jupyter Notebook - Part 1

***L. Ramalho**, A. Sivolella (ThoughtWorks Brasil)*

Jupyter Notebook is an Open Source alternative to Matlab and similar tools, providing scientists and engineers with an interactive environment capable of advanced numeric processing, graphing and data transformation, leveraging some of the best libraries available in domains as diverse as natural language processing and quantitative finance. Jupyter Notebook supports Python, R, Julia and dozens of other languages, but this tutorial will focus on Python. It will cover how to install and run Jupyter Notebook with Python, the structure of a Notebook (text, code and output cells of various formats), the Python syntax, array operations, data ingestion and transformation with Pandas, graphing and Basic simulation with interactive controls

TUTT2T02 11:00 130

Python: Introduction to Jupyter Notebook - Part 2

***L. Ramalho**, A. Sivolella (ThoughtWorks Brasil)*

Continuation of Python: Introduction to Jupyter Notebook Tutorial.

TUTT2T03 14:00 130

Data Analysis and Predictive Modeling in Python - Part 1

***A. Sivolella**, L. Ramalho (ThoughtWorks Brasil)*

Over the past few years, Python got a dedicated library for data analysis and predictive modeling, due to its strong community support. The main reason is because Python is easy to learn and can be well integrated with other databases and tools, such as Spark and Hadoop. This workshop will guide you through data science main steps, which includes, reading, analyzing, visualizing and making predictions, split into: 1) Exploratory analysis: first of all, it is needed to explore the available dataset. 2) Performing Data Munging: the available dataset probably contains some issues (as missing values or outliers, which are samples with dissonant values, for example). Before moving on, it is necessary to deal with these cases. 3) Building a predictive model: after data munging, the available dataset is clean and ready to build a predictive model. At this step, it is possible to train a classifier/regressor and evaluate its performance using Scikit Learn library.

TUTT2T04 16:00 200

Data Analysis and Predictive Modeling in Python - Part 2

***A. Sivolella**, L. Ramalho (ThoughtWorks Brasil)*

Continuation of Data Analysis and Predictive Modeling in Python Tutorial.

TUTT3 — Git / Py4Syn / OpenCL

Chair: L.M. Russo (LNLS)

TUTT3T01 09:00 130

Introduction to Git

J.V. Ferreira Filho *(LNLS)*

The success of software development depends on realistic planning and on proper organization. Version control is an essential activity in organizing the development, not only regarding the organization of how the software evolves and how the deliverables are tracked, but also regarding how the stakeholders collaborate. Git is a free and open-source tool that has become one of the leading version control tools. Still, its command-line interface and its abundance of features can make it intimidating. This session focuses on a hands-on approach to learning how to start to use the basics of Git effectively. It covers: Introduction to version control; A simple description of how Git organizes a repository internally; The basic commands necessary to use Git for version control; Organizing branches and performing merges; The benefits of collaboration using distributed version control; The power of interactive commands; The rebase command: a multi-purpose powerful command; and some extra useful commands.

TUTT3T02 11:00 130

Py4Syn and LNLS IOC Script

M.P. Donadio *(LNLS)*

Py4Syn is an open-source Python-based library for data acquisition, device manipulation, scan routines and other helper functions to interact with EPICS IOCs. It offers high customization level for scans and data output, covering distinct techniques and facilities. The LNLS IOC script is a Linux bash script responsible for starting, stopping and interacting with IOCs in a simple way. The tutorial will cover: How to use and configure the LNLS IOC script to easily interact with IOCs, putting them to run in the background as a service; How to control EPICS motors with Python; - How to create pseudo-motors based on real motors; How to control EPICS Scalers with Python; How to do scanning with motors, pseudo-motors, and counters with Py4Syn Python scripts. All examples will be presented using real equipment interacting with scripts live.

TUTT3T03
14:00 130

Introduction to OpenCL

J.V. Ferreira Filho *(LNLS)*

Even though computers are becoming ever more parallel, the extra parallelism isn't always used due to the extra complexity required to develop software capable of taking advantage of it. This session offers a simple introduction to a tool that helps with the development of parallel software, with the focus on taking advantage of one of the most powerful and parallel devices available today: GPUs (Graphic Processing Units). It covers the basics necessary to start using OpenCL to improve highly parallel aspects of software, including why parallel software development is more complex, the different approaches to parallelism, the use of GPUs as co-processors, the abstraction of co-processors by OpenCL, management of the available co-processors and using the co-processors with kernels and the OpenCL C language

TUTT3T04
16:00 200

Effective OpenCL

J.V. Ferreira Filho *(LNLS)*

This session assumes a basic understanding of OpenCL. The main objective is to dive deeper into OpenCL, exposing more details and functionalities in order to make it easier to use OpenCL more effectively. OpenCL is a vast subject and this will be not a thorough course on OpenCL, but many common aspects of using OpenCL will be presented. It covers the different types of buffers, image processing with OpenCL, optimal selection of data types, planning for memory transfers, event synchronization, the simultaneous use of multiple co-processors and beyond basic OpenCL compiler usage,

26-Oct-16	09:00 – 09:30	Plenary Room

WEOPPL — Opening and Welcome Session

Chair: H. Westfahl Jr. (LNLS)

WELCOME 09:00 30 **Welcome and Opening**

Welcome from the Chairs and opening of the 11th International Workshop on Personal Computers and Particle Accelerator Controls.

26-Oct-16	09:30 – 10:30	Plenary Room

WEKTPL — Keynote Speaker - Jameson G. Rollins

Chair: H. Westfahl Jr. (LNLS)

WEKTPLK01 09:30 60 **LIGO: The dawn of gravitational wave astronomy**

J.G. Rollins *(CALTECH)*

Scientists have been searching for the elusive gravitational wave for more than half a century. On September 14, 2015, the Laser Interferometer Gravitational-wave Observatory (LIGO) finally observed the gravitational wave signature from the merger of two black holes. This detection marks the dawn of a new age of gravitational wave astronomy, where we routinely hear the sounds emanating from deep within the most energetic events in the Universe. This talk will cover the basics of gravitational waves and interferometric gravitational wave detectors, LIGO and it's control systems, and details of the first direct detections of gravitational waves by LIGO.

WECSPL — Control Systems

Chair: J.T.M. Chrin (PSI)

WECSPLIO01 11:00 20 **The Sirius Motion Control Report**

***M.P. Donadio**, F.P. Figueiredo, H.D. de Almeida (LNLS)*

Sirius is the new 4th generation synchrotron light source being built in Campinas, Brazil. The motion control report was created to describe all the steps taken to choose the set of motors, motor drives and controllers that the hardware (GAE) and software (SOL) support groups will recommend. The steps include researching motion control systems in other Synchrotron laboratories, talking to the Sirius beam line designers, defining requirements and testing. This presentation describes the report, showing the information gathering process and latest results.

WECSPLCO02 11:20 15 **Control System Evolution and the Importance of Trial and Error**

***P. Duval**, M. Lomperski (DESY)*

We address the importance and benefits of trial and error in control system evolution. Our focus is on particle accelerators and large machines, whose control systems, although complex, will not lead to catastrophe in case of failure. In particular we focus on the evolution of control system software. We shall contrast classical Darwinian evolution via natural selection with control system evolution, which proceeds rather via artificial selection, although there are numerous software memes which tend to replicate according to their 'fitness'. The importance of general trial and error, i.e. making mistakes and learning from them, in advancing the capabilities of a control system will be explored, particularly as concerns decision making and overcoming 'Einstellung', i.e. the predisposition to solve a given problem in a specific manner even though better or more appropriate methods of solving the problem exist.

WECSPLCO03 11:35 15 **Software Tests and Simulations for Control Applications Based on Virtual Time**

***M. Hierholzer**, M. Killenberg, T. Kozak, N. Shehzad, G. Varghese, M. Viti (DESY)*

Ensuring software quality is important, especially for control system applications. Writing tests for such applications requires replacing the real hardware with a virtual implementation in software. Also the rest of the control system which interacts with the application must be replaced with a mock. In addition, time must be controlled precisely. We present the VirtualLab framework as part of the Chimera Tool Kit (formerly named MTCA4U). It has been designed to help implementing such tests by introducing the concept of virtual time, and combining it with an implementation basis for virtual devices and plant models. The virtual devices are transparently plugged into the application in place of real devices. Also tools are provided to simplify the simulated interaction with other parts of the control system. The framework is designed modularly so that virtual devices and model components can be reused to test different parts of the control system software. It interacts seamlessly with

the other libraries of the Chimera Tool Kit such as DeviceAccess and the control system adapter.

WECSPLCO04 11:50 15 **Development and Current Status of a Carborne Gamma-Ray Survey System, Kurama-II**

M. Tanigaki, *Y. Kobayashi, R. Okumua, N. Sato, K. Takamiya, H. Yoshinaga, H. Yoshino (Kyoto University, Research Reactor Institute)*

A carborne gamma-ray survey system, named as KURAMA (Kyoto University RAdiation MApping system), was developed as a response to the nuclear accident at TEPCO Fukushima Daiichi Nuclear Power Plant in 2011. A CompactRIO-based system KURAMA-II has been developed as the successor of KURAMA, and served for various activities on the radiation monitoring in the east Japan. We continue developing KURAMA-II as a tool not only for the current monitoring activities, but also for the immediate responses in nuclear incidents in future. The current status and on-going developments of KURAMA-II will be introduced along with the recent status of the east Japan.

WECSPLCO05 12:05 15 **The !Chaos Framework for Control Systems: Recent Progress and Multi-Disciplinary Applications**

L. Catani *(INFN-Roma II) C. Bisegni, S. Caschera, P. Ciuffetti, A. D'Uffizi, G. Di Pirro, L.G. Foggetta, F. Galletti, R. Gargana, E. Gioscio, A. Michelotti, A. Stecchi (INFN/LNF) D.G.C. Di Giulio (INFN - Roma Tor Vergata)*

We report on the progress of !CHAOS, the framework for control systems designed for the development of control and data acquisition services for particle accelerators and large experimental apparatuses. The !CHAOS framework is based on software technologies developed for high performance web services offering a high level of abstraction of services and components that make the !CHAOS architecture suitable for a wider spectrum of applications than HEP. Recent developments of !CHAOS were aimed at completing the controls of the DAΦNE Beam-Test Facility (BTF) transfer line, which is now running all the services provided by the framework, and the deployment of other stand-alone !CHAOS installations in the LNF accelerators complex. During the same period the !CHAOS collaboration completed and deployed an application of !CHAOS to building automation. This implementation is the prototype of a nation-wide infrastructure aimed at offering high performance services for the data collection and control of distributed devices, multifunctional sensors and local controllers.

26-Oct-16 12:20 – 12:40 Pool Space

WEPSPS — Official Conference Photo Session

Chair: I.M. Santos (CNPEM)

26-Oct-16 14:00 – 14:35	Plenary Room
WEUIPL — User Interface & Tools	
Chair: P. Duval (DESY)	

WEUIPLIO01 14:00 20 **Augmented User Interaction**

R. Bacher *(DESY)*

The advent of advanced mobile, gaming and augmented reality devices provides users with novel interaction modalities. Speech, finger- and hand gesture recognition or even gaze detection are commonly used technologies, often enriched with data from embedded gyroscope-like motion sensors. This paper discusses potential use cases of those technologies in the field of accelerator controls and maintenance. It describes the conceptual design of an intuitive, single-user, multi-modal human-machine interface which seamlessly incorporates actions based on various modalities in a single API. It discusses the present implementation status of this interface (Web2cHMI) within the Web2cToolkit framework. Finally, an outlook to future developments and ideas is presented.

WEUIPLCO04 14:20 15 **A Cython Interface to EPICS Channel Access for High-level Python Applications**

J.T.M. Chrin *(PSI)*

Through the capabilities of Cython (a python-like programming language with the performance of C/C++), a Pythonic interface to an in-house C++ Channel Access (CA) library, CAFE, has been developed, thereby exposing CAFE's numerous multifaceted and user-friendly methods to Python application developers. A number of particularities of the PyCafe API are revealed. These include support for (i) memoryview and other data types that implement the python buffer protocol (allowing data to be shared without copying) (ii) pointers to callback functions from wherein CA methods may be effortless executed in asynchronous interactions, and (iii) native thread parallelism. A significant performance improvement is achieved when compared with conventional Pythonic CA libraries. The PyCafe interface has been realized within the context of high-level application development at SwissFEL, Switzerland's X-ray Free-Electron Laser facility.

26-Oct-16 14:35 – 15:15	Plenary Room
WEISPL — Interactive Session - Wednesday	
Chair: R. Bacher (DESY)	

26-Oct-16 15:15 – 15:30	Plenary Room
WEPPPL — Poster in Pills - Wednesday	
Chair: R. Bacher (DESY)	

WEPOPRP003 **Recent Beamline Interlock System and STARS at the Photon Factory**
T. Kosuge *(KEK)*
Over 20 beamlines are installed at the Photon Factory for using synchrotron radiation. Each beamline is equipped with the BLIS(Beam Line Interlock System) to protect the users from radiation hazards and avoid vacuum troubles of the beamline. Each BLIS is controlled by a PLC(Programmable Logic Controller). Currently, touch panels and their own communication protocol are used as user interface and work sufficiently, but they have a few problems such as cost etc. We have developed new type of BLIS which has PC and STARS based user interface. We will describe detail of new type BLIS and STARS.

WEPOPRP004 **Upgrade of Immediately Beam Abort System in J-PARC MR MPS**
T. Kimura *(KEK)*
J-PARC Main Ring Machine Protection System (MR-MPS) stops the beam operation and the delivery of the beam to Neutrino experimental Facility (NU) or Hadron experimental Facility (HD), when MPS events occurred. Then, the beam is extracted to the abort dump at scheduled timing. We need the immediately beam abort system for high safety of accelerator and facilities. Therefore, we designed an improvement of MR-MPS to accept two interlock levels. On one hand level is conventional scheduled timing beam abort, on the other hand level is additional immediately beam abort. This paper reports the upgrade of MR-MPS during the summer shutdown period in 2016

WEPOPRP005 **Embedding MATLAB Applications into EPICS Process Control Computers (IOC)**
P. Chevtsov*, T. Pal (PSI) M. Dach (Dach Consulting GmbH)*
A new automated tool converting MATLAB based controls applications into codes executable on EPICS IOCs was created at the Paul Scherrer Institute (PSI). Based on this tool the majority of typical high level closed loop control applications can easily be embedded into the IOCs, which are directly connected to control system sensors and actuators. Such embedded applications significantly reduce the network traffic and increase the reliability of the control system. The paper describes main components of the MATLAB converting tool and its performance.

WEPOPRP006 **Upgrade to the Control System Based on EPICS for the Beam Transport in SPES Project**

***M.G. Giacchini**, G. Bassato, M. Montis (INFN/LNL)*

Beam diagnostics and magnet control systems of ALPI-PIAVE accelerators have been recently upgraded by migrating the control software from a custom solution to EPICS. While for the diagnostics hardware, based on VME solution, has been left unchanged to reduce the upgrade costs and software has been rewritten from the scratch, the new magnet system has been totally re-implemented using different hardware solution based on Intel $x68_64$ and ARM architectures, Linux OS and the EPICS framework. Particular attention has been paid for the Human-Machine Interface realized with Control System Studio framework in order to satisfy the end user requirements from the "look and feel" point of view and, at the same time, exploit all the featured provided from a distributed control system framework like EPICS.

WEPOPRP007 **Rf System and Calibration Tool for RFQ Ifmif Project**

***M. Montis**, L. Antoniazzi, A. Baldo, M.G. Giacchini, A. Pisent (INFN/LNL)*

Legnaro National Laboratories is involved in IFMIF EVEDA Project in order to realize the Radio Frequency Quadrupole (RFQ) required to bunch and accelerate a 130 mA steady beam to 5 MeV. Because of the high performances required by this part of apparatus, one of the most critical task is the RF signals acquisition and the mathematics required to provide correct parameters for closed loop controls, which are coordinated with other sub-systems composing the RFQ ancillary equipments, the interlocks required by the Machine-Protection System (MPS) and the data for post-analysis. The RF acquisition and calibration tool have been implemented with VME based hardware equipped with VxWorks OS and EPICS framework while the numerical elaboration has been entrusted to an EPICS softIOC runnig on KVM virtual machine.

WEPOPRP008 **Industrial Control System for IFMIF EVEDA RFQ**

***L. Antoniazzi**, A. Baldo, M.G. Giacchini, M. Montis, A. Pisent (INFN/LNL)*

In the IFMIF EVEDA project, normal conducting Radio Frequency Quadrupole (RFQ) is used to bunch and accelerate a 130 mA steady beam to 5 MeV. RFQ cavity is divided into 18 modules. The final three modules were tested at high power (100kW/m) to validate the most critical RF components of RFQ cavity and, on the other hand, to test performances of the main ancillaries that will be used for IFMIF EVEDA project (vacuum system, cooling system and control system). The RFQ Local Control System (LCS) is based on the Experimental Physics and Industrial Control System (EPICS) framework. Industrial controls, automation and safety functions (e.g. Vacuum, Cooling, tuning system and MPS) are in charge of SIEMENS PLCs and SIEMENS Modular Safety System (MSS). LCS was successfully used during the RFQ power test at Legnaro National Laboratories. This paper reports configuration and functionalities related to the industrial part used for both RFQ power test and final installation in Rokkasho

WEPOPRPO09 **Progress of the ELINP GBS High Level Applications Development Based on MATLAB**

G. Campogiani *(Rome University La Sapienza)*

The Gamma Beam system (GBS) is a high brightness LINAC to be installed in Magurele, Bucharest, at the ELI-NP (Extreme Light Infrastructure - Nuclear Physics) newly build laboratory. The accelerated electrons, with energies ranging from 280 to 720 MeV, will be made to collide with a high power laser to produce tunable high energy photons (0.2 MeV Ev20 MeV) with high intensity (10^{13} photons/s), high brilliance and spectral purity (0.1 % bandwidth), through the Compton backscattering process. This innovative light source facility will be open to users for nuclear photonics and nuclear physics advanced experiments. In order to develop reliable and user friendly high level applications, MatLab Middle Layer has been chosen as the platform to use. In this paper we report on the sdevelopment of the dedicated high level applications for performance stabilization.

WEPOPRPO10 **SESAME Personal Safety System**

A.A. Abbadi*, A. Hamad, I. Saleh (SESAME)*

SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East) is a synchrotron light source under construction in Allan, Jordan. The personal safety system (PSS) at SESAME is a PLC based protection system which aims to protect the personnel from radiation hazards coming from accelerator's operation. SIL3 PLC is used to control the access to the tunnel and to interlock the operation of accelerator's sub-systems according to the tunnel status. Phase 1 of SESAME PSS has been installed and commissioned successfully for Microtron and Booster which was based on Rockwell L72s SIL3 PLC. Phase 2 includes the Installation of the storage ring's PSS which is in progress now; two new PSS cabinets with remote safety IO modules have been installed for the storage ring PSS and connected to the booster PSS PLC via Ethernet safety CIP. Phase 3 is the personal Safety System for SESAME day one beam-lines. Many procedures and interlocks have been implemented in order to allow SESAME Storage Ring and Beam-lines personal safety to be managed in a systematic, risk based manner.

WEPOPRPO11 **Recent Improvements of the RIKEN RI Beam Factory Control System**

M. Komiyama*, N. Fukunishi, A. Uchiyama (RIKEN Nishina Center) M. Hamanaka, T. Nakamura (SHI Accelerator Service Ltd.)*

RIKEN Radioactive Isotope Beam Factory (RIBF) is a cyclotron-based heavy-ion accelerator facility for producing unstable nuclei and studying their properties. Many components of the RIBF accelerator complex are controlled by using the Experimental Physics and Industrial Control System (EPICS). We will here present recent progress of the EPICS-based RIBF control system. One is the improvement of the alarm system to support a stable beam delivery during a long-term experiment. We introduced the Control System Studio (CSS) to our control system and started to monitor the vacuum systems and magnet power supplies in order to avoid the interruption of the beam supply due to the accident. The other

is renewal of the system for controlling up to 900 magnet power supply units with several different types of controllers at once by a simple program. Since the configuration of the magnet power supplies has become very complicated in accordance with the several kinds of extensions and updates of the RIBF accelerator complex, we have developed the new control programs in order to simplify the recording and the setting data of the magnet power supplies.

WEPOPRP012 **Control System Integration for Standalone Systems at RIKEN RIBF**
***A. Uchiyama**, M. Fujimaki, N. Fukunishi, M. Komiyama (RIKEN Nishina Center)*
RIKEN RI Beam Factory (RIBF) is an upgraded project by extending RIKEN Accelerator Research Facility (RARF) in a previous project. Along with the expansion of the RARF, RIBF control system has also been extended. Therefore, some stand-alone control systems, for example RF, ECRIS, and etc., are not integrated, though almost all control systems have integrated by EPICS for RIBF operation. These non-integrated systems are grouped into two major categories. One is a group of hard-wired control system, and another is a group based on a two-layer remote control system without middle layer. On the other hand, whole control systems should be integrated by middleware from the view point of efficient accelerator operation. For this reason, we have replaced hard-wired devices with EPICS-available devices, which are N-DIM (originally designed by Nishina Center), and Yokogawa FA-M3. Additionally, to access the data in the two-layer systems from EPICS, we have introduced a MySQL-based system as middle layer, and developed a feature to connect the database through CA protocol. As a result, it is available to obtain all of the data via EPICS and we have succeeded the system integration.

WEPOPRP013 **Continuous Scan Deployment for an EPU Beamline at the LNLS**
***N.B. Pereira**, J.C. Cezar, F.P. Figueiredo, G.B.Z.L. Moreno, G.L.M.P. Rodrigues, L. Sanfelici, H.D. de Almeida (LNLS)*
The PGM (Plane Grating Monochromator) beamline relies on an Apple II-type EPU (Elliptically Polarizing Undulator) and is dedicated to ultraviolet and soft X-rays spectroscopy. A hardware-controlled continuous scan mode was recently deployed leading to the synchronization of EPU, PGM and detector electronics. Such approach allowed staying away from critical dead times in the existing step-scan mode, dramatically reducing the experiment duration in one order of magnitude. This work describes the dead time assessment of the existing step-scan solution, in addition to architecture, implementation details and results of the new continuous scan mode.

WEPOPRP014 **ChimeraTK: A Toolkit for Modular Control Applications**
***M. Hierholzer** (DESY)*
The DESY ChimeraTK (formerly called MTCA4U) is a collection of C++ libraries which facilitate the development of control applications. Special importance has been placed on abstraction from communication layers to simplify writing applications in heterogenous environments or reusing

applications in a different facility. Access to hardware is realised with the deviceaccess library through an extensible register-based interface. Starting from PCI Express (e.g. used inside MicroTCA.4 crates) a growing number of backends allow to communicate also through network protocols and even access other control applications. Features like register name mapping and automatic type conversion make the software robust against firmware and hardware changes. The control system adapter allows to write applications which can be used in different SCADA systems such as DOOCS, EPICS or OPC-UA with little to no changes in the source code. We give an update on status of the toolkit and present new features which have recently been implemented or are currently being developed.

WEPOPRP015 **The Control System Technological Activities for Five Accelerator Projects**

Q.R. Mi *(SSRF) G.H. Chen, J.F. Chen, J.G. Ding, G.Y. Jiang, Y.J. Liu, H.F. Miao, L.R. Shen, Y.B. Yan, C.L. Yu, H. Zhao, H.J. Zhu (SINAP)*

In SSRF control group, the general control system architecture and technology sharing are adopt for five accelerator projects (Shanghai Synchrotron Radiation Facility Phase II, Shanghai Soft X-Ray Free Electron Laser Test Facility, Dalian Coherent Light Source, Shanghai Proton Therapy Facility and Sirius Linac Accelerator). The control system with the architecture is reliable, stable and effective to develop. EPICS is used to monitor and control the machine devices. A number of software is designed for collecting and handling the data from EPICS . In the bigger projects, the application software, the SQL database and the network services run on a virual machine system that consists of several servers and network storage devices.

WEPOPRP016 **Control System of Stochastic Cooling in HIRFL-CSRe**

W. Wei *(IMP/CAS)*

Abstract: Stochastic cooling is one of methods used for Cooler Storage Ring (CSR), which can cool the beam, decrease the emittance of beam and improve the beam quality. In this paper, a control system of stochastic cooling in HIRFL-CSRe will be presented. This control system is based on Programmable Logic Controller. The controlling aim is to realize that the signal from Pick-Up (PU) can be quickly transmitted to Kicker when keeping the same arriving time of the beam to Kicker. Using PLC, different RF electronics such as phase-shifter, attenuator and amplifier and so on, can be controlled in a suitable situation to ensure the signal to Kicker with the enough power and proper time for cooling beam. In this System. PLC is used for changing voltage of electronic components and adjusting the time delay and phase of the signal. The Graphic User interface (GUI) is designed based on platform of WINCC software to ensure the operate process more simple and intuitive.. Experimental results have proven that this Stochastic cooling system can achieve good cooling effects in HIRFL-CSRe. The controlling system is stable, reliable and convenient for the users.

WEPOPRP017 **Vacuum Control System of SSC-Linac**

***X.J. Liu**, J.J. Chang, K. Gu, A. Shi (IMP/CAS)*

SSC-Linac is a linear accelerator injector of SSC in HIRFL. The vacuum control system is based on EPICS which is a real-time distributed control software. The Labview real-time VIs and EPICS VIs were used to design Input/Output Controller(IOC). The different kinds of CRIO modules were adopt in device layer,which can monitor the serial port data from vacuum gauges and contol vacuum valves. The whole control system can acquire vacuum data,control vacuum devices remotely,make the pressure value of the vacuum gauge and vacuum valve interlocked. It also keep the equipment work stable and the beam has a high quality.

WEPOPRP018 **Automated Availability Statistics**

***P. Duval**, H. Ehrlichmann, M. Lomperski (DESY) J. Bobnar (Cosylab)*

The availability of any large machine with users is not only of paramount importance but is also an oft quoted number, taken to represent the overall health of the facility, reflecting on the maintenance, operation, and engineering of the machine. The officially quoted availability is typically generated by hand after perusing the operation statistics over the time period in question. When humans are involved in such calculations there might be a subtle tendency to avoid the stigma of low availability or otherwise inflate performance. This could lead to skepticism at 'impossibly high' availability, as well as render the comparison of availability from one machine with another moot. We present here a method for calculating the machine availability automatically, based on the known machine states and the known alarm states of the machine. Although sufficient, in order to be accurate and useful, the method requires a perfect representation of all possible machine states and of all possible fatal alarms. As achieving perfection is an ongoing affair, the ability for a human to 'post-correct' the automated statistics is also described.

WEPOPRP019 **The Tine Based Embl Beamline Control Framework Bicfrok**

***U. Ristau**, S. Fiedler, A. Kolozhvari (EMBL)*

The EMBL Hamburg operates 3 Beamlines at the DESY Petra3 Synchrotron. The in house developed Beamline control framework BICFROK provides services for the hardware control and middle layer server control with TINE as Control System. The access to all server layers is granted via the BICFROK GUI Container programed with LabView. Presented will be the Framework Status and new features like the EtherCat fieldbus based Timinig system for time resolved measurements and the energy server implementation.

WEPOPRP020 **Multipurpose Vacuum Chamber - Automation, Interlock-System and Self-Operating Vacuum Routines**

***R.M. Caliari**, G.L.M.P. Rodrigues, C.H. Tho, H.G.P. de Oliveira (LNLS)*

The LNLS' Beamlines Engineering Group is developing new technologies for SIRIUS Beamlines. To validate and test those technologies, the group has previously worked in a Multipurpose Vacuum Chamber (MPVC). This chamber has a powerful pumping system, several view-

ports, feedthroughs, RGA and a cryocooler system installed. This configuration delivery a very flexible test environment and relative short pump time to achieve UHV conditions, essential to reduce the test and validation time. This paper will detail the MPVC automation structure, presenting the state machines, interlock logic and other diagrams that exemplify the automatic routines concepts. Operations like pumping from atmospheric pressure to HV, ionic pump flash and ventilation routines are automatic. The automated system was developed in LabVIEW, using a cRIO and Touch Panel interface. Based in Ethernet connection and published shared variables, the system has a friendly user interface and archiving for the main variables. The system was developed in a multi user collaborative ambient. The paper will show the advantages and disadvantages we faced working with LabVIEW as multiuser development tool.

WEPOPRP021 **Development of a Virtual Accelerator for Sirius**

***X.R. Resende**, A.H.C. Mukai, I. Stevani, L.N.P. Vilela (LNLS)*

A virtual accelerator with an EPICS interface is being developed for Sirius, the new 3 GeV 4th generation synchrotron light source being built in Campinas, Brazil. The virtual accelerator is an on-line beam simulator which will be integrated in to the control system. It consists on a python-based front-end server using an in-house developed back-end tracking code library written in C++ for efficiency purpose. The access to virtual parameters is provided by EPICS portable channel access server (PCAS) through process variables, which allows for easy switching between virtual and real machines. Such a system facilitates the early development and testing of high level applications for the control system.

WEPOPRP022 **High Level Applications for Sirius**

***I. Stevani**, N. Milas, X.R. Resende, L.N.P. Vilela (LNLS)*

In this work we present the High Level Applications (HLAs) that have been developed by the Accelerator Physics group for the commissioning and operation phases of Sirius. The main purpose of these HLAs is to monitor process variables and to allow machine operators to act over the storage ring. The development platform and methods that have been used to create those user interfaces will be the center of this discussion.

WEPOPRP023 **Beamline Supervisory System Using a Low-Cost Single-Board Computer**

***G.T. Semissatto**, H.F. Canova, F.H. Cardoso, J. Souza (LNLS)*

Sirius is a new 3 GeV synchrotron light source proposed to meet the demand for a high brightness and high flux photon source in Brazil and Latin America. The new facility is under construction at the LNLS (Brazilian National Synchrotron Light Laboratory) site, in Campinas, São Paulo, Brazil. The new machine will be able to have maximum of 40 beamlines, each one handles hundreds of equipments to perform high demanding scientific experiments. In this context, Supervisory systems are an essential tool to provide users information about machine status and beamline operation modes (photon beam status). A modern TV based system was developed to meet this application, using low cost single board computers and hardware interface to EPS and PPS system. The details of the

hardware and software configurations, users requirements as well suggestions on further improvements, will be presented.

WEPOPRP024 **VDE - Virtual Documentation Environment**

***H.F. Canova**, D.H.C. Araujo, M.P. Donadio, R.R. Geraldes (LNLS)*

At LNLS hundreds of motors are used on the beamlines to perform movements from the simplest to the more complex and accurate. Historically the axes documentation of the LNLS beamlines was done only at the moment of the beamline construction. When years have gone, motorized systems were changed and documentation became obsolete. Then the need of some system to ensure that every change in motors would be reflected in its documentation become present. The migration of the beamlines control system to the EPICS platform pushed the development of a new documentation system. In a first version, a spreadsheet generated the EPICS IOCs configuration files automatically. In a second version an evolution from the spreadsheet to a web-based system originated the VDE - Virtual Documentation Environment. VDE allows the beamlines staff to change the motion axis parameters without the need of a deep knowledge in EPICS and ensure the complete motion axis documentation intuitively. Also, changes in motors will not work in EPICS if the documentation is not updated, guaranteeing the link between documentation and the physical system.

WEPOPRP025 **Using Tkinter of Python to Create Graphical User Interface (GUI) for Scripts in LNLS**

***D.B. Beniz**, A.M. Espindola (LNLS)*

Python is being widely used to create scripts which cover different necessities in computational scenario. At LNLS we successfully developed Python scripts to control beamlines operations, including a case of Graphical User Interface (GUI) creation using Tkinter, which is the standard GUI programming toolkit of Python, for one of our beamlines, DXAS (Dispersive X-ray Absorption Spectroscopy). Tkinter offers the basic components necessary to build a GUI that help users to quickly inform a set of parameters defining which device to use, its configuration to set, among others, and to easily start or stop operations. Such components include widgets like (text) entry, radio button, check button, and (action) button. Using text entries we developed a custom table widget for input of parameters. Tkinter also allows us to inform and to guide users by label and message boxes, and to organize the window components by frames, paned windows and geometry managers, pack or grid. It is also available notebook and menu widgets to organize tabs and call other windows. Finally, all the interface construction was done using ordinary text editors and no extra library was needed to install for python.

WEPOPRP026 **Developments of the 'Cerberus' Laser Interlock and Hazard Display System**

***D.A. Pepler**, R.C. Bickerton, A.J. Tylee (STFC/RAL)*

Following on from the successful implementation of 'Cerberus' a comprehensive laser interlock / control and hazard display system, on the

Vulcan High-Power Laser at the Central Laser Facility (CLF), the last few years have seen the safety system become a CLF standard and its use extended to many different laser systems and laboratories within the department. This paper will provide an overview of the system, its enhancements and in particular the most recent developments of a design tool and the potential for this system to be used in other fields.

WEPOPRP027 **Development of Visualization Software Deepti for X-Ray Fluorescence (XRF) Using Xray Library for Interactions With Matter**

R. Jain, *H.S. Vora (RRCAT)*

XRF Microprobe beamline of Indus-2 is available to users from various institutes and universities of the country. To assist them in XRF data analysis, an interactive, GUI based, user friendly application named Deepti is developed to visualize x-ray fluorescence spectra. Further it also analyzes fluorescence peak intensities of different elements using spectra unfolding. Deepti has been facilitated with features to retrieve, generate and export fluorescence spectrum data in various formats of international standard to align with other beamlines. This application is developed in VB.NET with inclusion of xraylib, Special features of non-linear background subtraction algorithm were also introduced. Polynomial of order 3 to 11 can be fitted while applying non-linear subtraction. In addition, Deepti also provide gross and net area of region of interest of the spectrum. In analysis mode, it provides measurements of Full Width Half Maxima (FWHM), rise or fall of any peak in terms of channel or energy. To enhance quality of measurement, a variety of noise removal techniques are developed and implemented along with numerous averaging options.

THKTPL — Keynote Speaker - Javier Serrano

Chair: J.R. Piton (LNLS)

THKTPLK01
09:00 60

Open Hardware and Collaboration

J. Serrano *(CERN)*

Open Source Hardware (OSHW) follows the lead of Free and Open Source Software (FOSS) and has similar goals: ensuring developers can share their work without artificial hurdles, improving quality through peer review, avoiding vendor lock-in and providing for a fair playground in which projects can thrive and accommodate contributions without compromising their long-term future. The talk will introduce OSHW and then attempt to answer a number of questions: (i) what are the perceived benefits and issues of OSHW, in general and in the context of public research facilities?; (ii) what is new with respect to FOSS?; (iii) what makes OSHW projects succeed or fail?; (iv) the talk will use real examples of OSHW projects throughout, and will conclude with some thoughts about what the future holds in this domain.

THHWPL — Hardware

Chair: D.O. Tavares (LNLS)

THHWPLIO01 **The PandA Project**
10:00 20

Y.-M. Abiven *(SOLEIL) I.S. Uzun (DLS)*

Synchrotron SOLEIL and Diamond Light Source are two third generation light sources located respectively in France and the UK. In 2015, both facilities initiated the collaboration project 'PandA' to overcome technical limitations of SPIETBOX at SOLEIL and Zebra at Diamond as well as to manage obsolescence of the products. The collaboration enables both institutes to share the technical leadership on hardware, firmware and software developments. The initial objective is to achieve multi-channel encoder processing to synchronize motion systems and acquisition during experiments addressing simultaneous and multi-technique scanning. However, its design based on Xilinx Zynq SoC is thought to be powerful and modular in terms of firmware as well as for hardware. This flexibility permits envisaging derivative applications and interfacing to different third party hardware. This paper details the organization of this collaboration, status of the ongoing project in terms of hardware and firmware capabilities and the results of the first tests at both sites.

THHWPLCO02 **New Controls Platform for SLAC High-Performance Systems**
10:20 40

T. Straumann*, J.M. D'Ewart, J.C. Frisch, G. Haller, R.T. Herbst, U. Legat, B.A. Reese, R. Ruckman, E. Williams (SLAC)*

The 1MHz beam rate of LCLS-2 precludes the use of a traditional software solution for controls of "high-performance systems" which operate at this rate, such as BPMs, LLRF or MPS. Critical algorithms are ported into FPGA logic and administered by ordinary PCs via commodity ethernet. SLAC has developed a controls architecture which is based on FPGA technology interconnected by 10G ethernet and commercially available ATCA shelves. A proprietary ATCA carrier board hosting an FPGA, memory and other resources provides a "common platform" for many applications which can be implemented on AMC cards which are plugged into the carrier. A library of firmware modules including e.g., timing, history buffers and reliable network communication together with corresponding software packages complement the common platform hardware and provide a standardized environment which can be employed for a variety of high-performance applications across the laboratory.

THHWPLIO03 11:00 20 **Network-Attached Device Model Using Field-Programmable Gate Arrays**

W.E. Norum *(LBNL)*

The high speed serial transceivers available on modern Field-Programmable Gate Arrays provide a convenient mechanism for communicating with FPGA firmware using standard network equipment and protocols. This presentation highlights some of the techniques used including systems incorporating embedded processors as well systems based on direct firmware implementations. Such firmware-only implementations exhibit deterministic low-latency response. Results of latency measurements will be presented.

THHWPLCO04 11:20 15 **Open Hardware Experience on LNLS' Beam Diagnostics**

G.B.M. Bruno*, J.L. Brito Neto, S.R. Marques, L.A. Martins, L.M. Russo, F.C. Sant'Anna, H.A. Silva, D.O. Tavares (LNLS)*

LNLS' diagnostics group has decided on adopting open hardware technologies for most of its projects, partnering with other institutes and companies to design and build its RF BPM electronics, from the analog front-end to the FPGA board. This decision resulted in advancements and learning, bringing new technologies, flexibility and knowledge, but also brought some hardships and new challenges. This talk details the history, advantages and difficulties of this open-hardware approach to beam diagnostics electronics.

THDAPL — Data Acquisition & Analysis

Chair: T. Straumann (SLAC)

THDAPLCO01 11:35 15

Embedded Control System for Programmable Multi-Purpose Instruments

***M. Broseta**, J.A. Avila-Abellan, S. Blanch-Torné, G. Cuní, D. Fernández-Carreiras, O. Matilla, J. Moldes, M. Rodriguez, S. Rubio-Manrique, J. Salabert, X. Serra-Gallifa (ALBA-CELLS Synchrotron)*

At ALBA's Computing Division, we have started the development of a high-performant electrometer (Em# project) as a versatile and customizable equipment. It is based on a SPEC board (simple PCIe FMC carrier) with customizable FMC cards and an Single Board Computer, altogether built in a single cost-optimized instrument. The whole device is designed to provide a wide range of functionalities to fulfill unique and complex experiments by means of configuration changes instead of having specific instruments. Within the controls software development group, we started the development of a full embedded control software, based on a Linux OS that communicates with the SPEC's FPGA using the PCIe bus. This approach allows the integration of complex operations and functions in real time to higher software layers, as well as the local control, setup and diagnostics via integrated touch-screen display controlled by I2C. The system provides also SCPI (Standard Commands for Programmable Instruments) allowing an easy integration to any control system. This paper describes the design process, main aspects of the data acquisition and the expected benefits during the integration in the Control System.

THDAPLCO03 11:50 15

Gateware and Software Frameworks for Sirius BPM Electronics

***L.M. Russo**, J.V. Ferreira Filho (LNLS)*

The Brazilian Synchrotron Light Laboratory (LNLS) is developing a BPM system based on the MicroTCA.4 standard comprised of AMC FPGA boards carrying FMC digitizers and an AMC CPU module. In order to integrate all of the boards into a solution and to support future applications, two frameworks were developed. The first one, gateware framework, is composed of a set of Wishbone B4 compatible modules and tools that build up the system foundation, including: PCIe Wishbone master; FMC digitizer interfaces; data acquisition engines and trigger modules. The gateware also supports the Self-Describing Bus (SDB), developed by CERN/GSI. The second one, software framework, is based on the ZeroMQ messaging library and aims to provide an extensible way of supporting new functionalities to different boards. To achieve this, this framework has a multilayered architecture, decoupling its four main components: (i) hardware communication protocol; (ii) reactor-based dispatch engine; (iii) business logic, comprising of the specific board functionalities; (iv) standard RPC-like interface to clients. In this paper, motivations, challenges and limitations of both frameworks will be discussed.

THDAPLCO05 12:05 15 **Development of PXI Based DAC System for ECRH Systems in SST1**

***J. Patel**, N. N., H.P. Patel, P.J. Patel, D. Purohit, B.K. Shukla (Institute for Plasma Research)*

Electron Cyclotron Resonance Heating (ECRH) is one of the RF heating sub-systems used for plasma heating experiments in Steady State Superconducting(SST-1) tokamak. It is used for pre-ionization and current drive experiments in nuclear fusion related experiments in tokamaks worldwide. The 42-GHz gyrotron based ECRH system is in operation with SST1 plasma experiments and delivers 500kW of microwave power for 500ms. Gyrotron based ECRH system consists of different power supplies like Regulated High Voltage Power Supply(CathodePS -80kV,15A), Anode (+30kV,100mA), Filament(~35V,25A), Cryomagnet (+5V,100A) and operates systematically through DAC to generate microwave power output. The dedicated PXIe based Data acquisition and control (DAC) system is designed with the enhanced features for different conditional operation of gyrotron. Both the Host and RT-target application softwares are developed with LabView-2014 platform and Labview RT (real time) on HostPC. Hardwire interlock circuitary is implemented with FPGA board. Ignitron based 70kV crowbar system with triggering circuit is installed for the safety of the gyrotron. The Details of DAC system would be presented in the talk.

THDAPLCO06 12:20 15 **A Framework for Development and Test of xTCA Modules With FPGA Based Systems for Particle Detectors**

***M. Vaz**, A. M. Cascadan, V. Finotti, T. Paiva, L.A. Ramalho, A.A. Shinoda (NCC UNESP)*

FPGA modules are presently the basic blocks for acquisition of data and control for particle detectors. Large DAQ systems are increasingly using xTCA modules connected by Ethernet links at hundreds of Gbps. A framework is done to develop xTCA modules, with their FPGA being configured and tested remotely from a computer. In this framework, configuration and JTAG tests are done with XVC services under IPMI protocol, and proprietary software tools. The Outer Tracker detector is emulated by the same hardware its trigger system is made, configured as event signals generator, with simulation data from CMSSW software. Event data is sent to the trigger boards configured with the trigger scheme being tested. Each emulator board transmit data through 40 channels of 10-Gbps optical links, controlleficd by computer. The goal is to demonstrate by the end of 2016 a proof-of-concept for the three proposed trigger schemes presently under development for the upgrade of the CMS Level 1 Tracker Trigger System. It will be done in an ATCA crate with 10 boards, corresponding to one of the 48 nodes of the proposed Outer Tracker Trigger entire system.

27 October

27-Oct-16 12:35 – 12:50	Plenary Room
THPPPL — Poster in Pills - Thursday	
Chair: T. Straumann (SLAC)	

THPOPRP003 **UVX Control System: An Approach With Beaglebone Black**
S. Lescano *(INSA Lyon) , E.P. Coelho, J.G.R.S. Franco, P.H. Nallin, G.C. Pinton (LNLS)*
The UVX is a 1.37 GeV synchrotron light source that has been in operation by the Brazilian Synchrotron Light Laboratory (LNLS) since 1997. The Control System, which was completely developed in-house, has received some upgrades lately in order to get around issues from aging, to improve performance and to reduce maintenance costs. A new crate controller, which is based on Beaglebone Black single board computer, has been under tests and is a great candidate to substitute both Advantech single board computers and old CPUs. The current crate communication topology (through LOCO backplane) will be maintained and software is based on PROSAC, implemented for Advantech SBCs. Beaglebone platform, which is open hardware and community-supported, is also chosen to be a branch of Sirius Control System. An overview will be presented as well as first experimental and practical results.

THPOPRP004 **openMMC: An Open-Source Modular Firmware for Board Management**
H.A. Silva*, G.B.M. Bruno (LNLS)*
openMMC is an open-source firmware designed for board management in MicroTCA systems. It has a modular architecture providing decoupling between application, board and microcontroller-specific routines, making it useful as a base for many different designs, even the ones using less powerful controllers. Despite being developed in a MicroTCA context, the firmware can be easily adapted to other hardware platforms and communication protocols. The firmware is based on the FreeRTOS operating system, over which each module (sensors, LEDs, Payload management, etc) runs its own independent task. The OS, despite its reduced footprint, also provides numerous tools for reliable communication among the tasks, controlling the board efficiently.

THPOPRP005 **Precision and Low Cost Logarithmic Picoammeter**
W.R. Araujo*, M.B. Errada (LNLS) A.O. Alonso, R. Arthur, G. Paulino, Surita,G. Surita (UNICAMP) G.F. Franchi (Age Scientific)*
A precision and low cost picoammeter is in development for the acquisition of sensor signals such as photodiodes, gold mesh (by photoelectron effect) and ionization chambers on the VUV. One of the problems of conventional picoammeters is the automatic scale selection, which hinders many measurements performed in ample energy range. The picoammeter in development is based on a different methodology than present on most commercial systems, using a logarithmic amplifier. This choice of can provide a linear response output in the range of pico to milliamperes. In addition, the system will have a trigger input for synchronism with external events and a Ethernet interface with EPICS driver. The electronic board is in development as a collaboration of the AGE Scientific company, and it will be commissioned and installed at the TGM Beamline of LNLS.

THPOPRP006 **FPGA-Based Motion Control System for Medical Linear Accelerator Development at SLRI**

R.R. Rujanakraikarn *(SLRI)*

Linear accelerator technology has been widely applied to radiotherapy machines. The increasing demand of the machines in Thailand has been reported over the recent years. An attempt to increase the availability of the low-cost machines has been proposed for the domestic use purposes. Currently, the prototype of the 6 MeV medical linear accelerator is under development at Synchrotron Light Research Institute (SLRI) in Nakorn Ratchasima, Thailand. For beam shaping purposes a so-called secondary collimator is utilized with different arrangement of the collimator jaws. The collimator motion control is one of the necessary subsystems for controlling the machine to produce the desired field size of the beam. In this paper the FPGA-based motion control system design of the medical linac prototype is presented. The programmable logic part of the hardware is designed in VHDL for digital processing. The main motion control algorithm is implemented in the main processor ARM cortex A9 processor present in Zedboard FPGA. Communication between the motion control subsystem and the main control system software of the machine is also described and will be implemented using Ethernet protocol.

THPOPRP007 **FPGA Phase and Amplitude Detector Development for Pulsed-RF at SLRI**

R.R. Rujanakraikarn *(SLRI)*

In this paper the prototype of phase and amplitude detector system for pulsed-RF is described. The hardware is designed in VHDL and implemented using Xilinx Field Programmable Gate Array (FPGA) for digital processing. The main phase and amplitude detection algorithm is designed using state machine and implemented in the MicroBlaze softcore processor. The system is designed to measure the phase and amplitude of a 5-microsecond wide 2,856 MHz pulsed-RF at a repetition rate of 0.5 Hz. The front-end hardware for the pulsed-RF signal acquisition is described with the interface to the FPGA-based part. Some initial test results of the prototype are also presented.

THPOPRP008 **Development of Hardware of the Fast Orbit Feedback FPGA Controller Unit at the Australian Synchrotron**

A. Michalczyk*, N.J. Basten, S. Chen (ASCo) R.B. Hogan, Y.E. Tan (SLSA)*

Development of hardware of the Fast Orbit Feedback FPGA controller unit at the Australian Synchrotron. The design, construction and test results of a controller unit implemented on a HTG-V6-PCIE Virtex-6 Xilinx FPGA platform for the fast Orbit Feedback system will be presented in this poster. The controller will receive data from Libera electron beam position processors, will connect with the control system via Ethernet interface and communicate with corrector magnets power supplies via fibre optic links. Base controller will have additional interfaces and ports for possible developments of new diagnostic systems. It will allow for unification of the controls interfaces, saving future development time.

THPOPRP009 **Operation Experience and Migration of I/O Controllers for J-PARC Main Ring**

N. Kamikubota *(KEK) T. Aoyama, T. Iitsuka, S.Y. Yoshida (Kanto Information Service (KIS), Accelerator Group) H. Nemoto (ACMOS INC.) K.C. Sato, S. Yamada, N. Yamamoto (J-PARC, KEK & JAEA)*

The control system for J-PARC Main Ring (MR) was constructed in 2007-2008, followed by the first beam in May, 2008. In 2007, the VME-bus computers were selected as I/O controllers (Epics IOC). The number of them in 2008 was about 80. In 2016, addition to the VME controller, we have non-VME controllers: a) Yokogawa F3RP61 (Linux-based controller with PLC IO modules), b) vioc (Epics IOC on a virtual machine), and c) commercial micro-server (Pinon Type-P). The total number of controllers in 2016 has reached 170. Based on operation experience since 2008, following issues are discussed. (1) We decided to use VME-bus computers as highly reliable front-end controllers. Failures of them are reviewed, and judge to the past decision is given. (2) Specific characteristics of three non-VME controllers, proper use of them, and present status in the MR controls, are explained. (3) Recently, a few pieces of commercial micro-server have been introduced and inspected. It is compact, low-cost, but seems reliable enough as an I/O controller. Details are shown. Finally, future perspective of I/O controllers for J-PARC MR will be given.

THPOPRP010 **Timing and Synchronization at FRIB**

M.G. Konrad *(FRIB)*

The Facility for Rare Isotope Beams (FRIB) requires a timing system for distributing a common time base for time-stamping data as well as for triggering actions of multiple devices distributed over the machine. Three different technologies are used to accomplish these goals. An event system based on COTS hardware from Micro-Research Finland provides time-stamps and triggers to more than 500 fast data-acquisition devices like beam diagnostics electronics, LLRF controllers, and machine protection nodes. This system is also used to generate and distribute FRIB's complex beam pulse patterns with event rates of more than 50,000 events per second in a flexible and reproducible way. For many hundred devices which require a lower timing accuracy like programmable logic controllers and EPICS IOCs the Precision Time Protocol (PTP) is used. Additionally the Network Time Protocol is used for legacy devices that do not support PTP, yet. We will describe the architecture of the FRIB timing system and how the different timing subsystems are synchronized. We will also describe how FRIB's complex beam pulse patterns are generated.

THPOPRP011 **Processing SPE Files From Princeton Instruments During Data Acquisition in LNLS**

D.B. Beniz *(LNLS)*

The beamline of Dispersive X-ray Absorption Spectroscopy, DXAS, in LNLS uses a Princeton Instruments CCD, PyLoN, to acquire spectra of materials under analysis. Such camera produces an SPE binary file. Some Python scripts were developed to display absorbance and x-ray magnetic circular dichroism (XMCD) during the experiment. Firstly, using Winspe-

cUtils.py module we extract the data in a 2D array (intensities by pixels) from an SPE file of radiant flux received by a material (I0), then, while spectra of radiant flux transmitted by that material (I), is being acquired, their data are extracted from a temporary SPE file. With I and I0 we calculate absorbance (mu) = ln(I0/I) and plot it with matplotlib of Python . For XMCD same data extraction is performed, but each cycle has eight spectra with magnet field varying its orientation: + - - + - + + -; and the calculation is XMCD = AVG[mu(norm)(+)] - AVG[mu(norm)(-)]. Calculated XMCD is also plot. So, with such information of absorbance and XMCD being displayed during the experiment the users could quickly act to fix any problem.

THPOPRP012 **An Image-Processing-Based Hydrostatic Leveling System (HLS)**
***H.L. Rocha**, M. Bacchetti, A.R.D. Rodrigues (LNLS)*
The construction of Sirius, the upcoming Brazilian synchrotron light source, involves many engineering challenges for meeting the conceptual design requirements. Due to its storage ring length, about 500 m in circumference, measuring level of different equipments and floor areas is a necessary diagnostic to achieve the desired ultra-low emittance. We propose an image-processing-based Hydrostatic Leveling System. The easurement is performed by processing the images acquired by a CCD/CMOS camera, resulting in a low cost and accurate setup. This work presents an overview of the methods used for image analysis and initial experimental results.

THPOPRP013 **High Level Software for the Commissioning of the European XFEL**
***L. Fröhlich**, C. Behrens, B. Beutner, M.E. Castro Carballo, W. Decking, O. Hensler, R. Kammering, T. Limberg, S.M. Meykopff, J. Wilgen (DESY)*
The European X-Ray Free-Electron Laser (XFEL) will generate extremely short and intense X-ray flashes from the electron beam of a 2.1 km long superconducting linear accelerator. The commissioning and operation of the accelerator relies heavily on high level software for the automatization of measurements and procedures. The paper gives an overview of the ongoing work and highlights some new measurement techniques.

THPOPRP014 **Automation of the Magnetic Field Measurements of Air Coils by Means of the Mowing Wire System**
***M. Yakopov**, S. Abeghyan, S. Karabekyan, J. Pflüger (XFEL. EU) Z. Zhao (USTC/NSRL)*
To ensure self-amplified spontaneous emission process an undulator used for this must not deflect the electron beam from its orbit. The possible deflection of the electron beam, introduced by undulator, must be corrected by means of two air coils. These air coils, which are installed from both sides of the undulator, must eliminate not only the deflection angle, but also the displacement between electron beam trajectory and the orbit. For European XFEL 182 air coils are necessary. To minimize the measurement time an automated procedure has been developed and implemented. This paper describes the measurement setup, technical implementation method and automation procedure.

THPOPRP015 **Beam Arrival Time Monitor Control Setup for SwissFEL Applications**
***P. Chevtsov**, V.R. Arsov (PSI) M. Dach (Dach Consulting GmbH)*
Beam Arrival time Monitor (BAM) is a precise beam diagnostics instrument assessing the accelerator stability on-line. It is one of the most important components of the SwissFEL facility at the Paul Scherrer Institute (PSI). The overall monitor complexity demands the development of an extremely reliable control system that handles basic BAM operations. A prototype of such a system was created at PSI. The system is very flexible. It provides a set of tools allowing one to implement a number of advanced control features such as tagging experimental data with a SwissFEL machine pulse number or embedding high level control applications into the process controllers (IOC). The paper presents the structure of the BAM control setup. The operational experience with this setup is also discussed.

THPOPRP016 **Diagnostics at JINR LHEP Photogun Bench**
***M.A. Nozdrin**, N. Balalykin, V.F. Minashkin, G. Shirkov (JINR) S. Weisse (DESY Zeuthen)*
The photoinjector electron beam quality strongly depends on the laser driver beam quality. For laser beam diagnostics, a "virtual cathode" system was realized at the photogun bench located in the Veksler and Baldin Laboratory of High Energy Physics (LHEP) of the Joint Institute for Nuclear Research (JINR). The system allows one to image laser beam profile at the cathode. For imaging, the AVINE software suite developed in DESY Zeuthen is used. Equipment for emittance measurement using the slit method was installed. The original emittance calculation software EmCa was created and tested with laser beam.

THPOPRP018 **On Feedback Control of Multi-Cell Superconducting Cavities**
***C.H. Rivetta** (SLAC)*
Superconducting cavities have a structure where electromagnetic fields couple with mechanical resonances defining an arrangement such that the ponderomotive forces and cavity deformation interaction sets an open loop unstable system. Actuator signals for this system are provided by the power RF amplifier and the piezo-actuator setting the tune of the cavity. The control feedback of the cavity has to include in the design the combination of those actuator signals based on the input that is the accelerating voltage error signal. In this work, the design conditions for the LLRF control of a RF system composed by a single superconducting cavity and a RF driver is analyzed considering a full model of the cavity including the mechanical structure. Based on this full cavity model, the stability of the system is assessed and general control design guides for the LLRF controller are presented assuming the LCLS-II conditions and specifications.

THPOPRP019 **Firmware Development of the Fast Orbit Feedback FPGA Controller Unit at Australian Synchrotron**

S. Chen, *A. Michalczyk, Y.E. Tan (ASCo) B. Dickson, P.F. Savage (Arrayware Pty Ltd)*

A Fast Orbit Feedback (FOFB) controller firmware is under development on the Virtex-6 Xilinx FPGA platform at Australian Synchrotron. The controller firmware receives aggregated position data from a Libera Electron, extracts the beam position information, and computes the correction for the fast response power supplies based on dedicated algorithms. The PID handler, harmonic suppressors and a pre-emphasis filter are to be designed in Simulink and their HDL code will be generated by MATLAB HDL coder for better flexibility. In addition it provides an interface to the facility's EPICS control system to control the operation modes of the FOFB controller, send configuration data and algorithm matrices, and receive diagnostic information and status reports of data integrity checks. The aim of the FOFB system is to damp the RMS transverse beam position motion to less than 10% of one sigma of the transverse beam size up to 100Hz.

THPOPRP020 **Multibunch Feedback System Experience at LNLS**

H.O.C. Duarte, *S.R. Marques, L. Sanfelici (LNLS)*

The UVX Light Source is available for users since 1997 in the Brazilian Synchrotron Light Laboratory (LNLS) and is constantly under improvement throughout the years. One of the most recent implementations regards the multibunch feedback system, which is required for the low emittance operational mode of the machine and, furthermore, serves as benchmark for Sirius, the new light source under construction in Brazil. In this paper we describe the LNLS experience with such system, from operational aspects to the overall performance in the UVX storage ring.

THPOPRP021 **Fast Orbit Feedback Control System of Indus-2**

R.P. Yadav, *P. Fatnani, R. Rana (RRCAT)*

India's 3rd generation synchrotron radiation source, Indus-2 has been updated with Fast Orbit Feed Back (FOFB) correction for stabilising beam orbit against beam position perturbations upto 100 Hz. In first phase of implementation, 16 digital BPIs are used for acquiring beam position variations and 16 fast correctors each in vertical and horizontal plane are used for correction in respective planes with a correction loop rate of about 3kHz. PXI based controller is used for data acquisition from BPI server over ethernet and correction calculation using PID. A communication protocol is implemented into FPGA card of PXI unit for parallel transmission of corrections and other commands to all power supplies. Optical communication interface has been used for communication with power supply interface over fiber optic cable. Significant improvement in the beam stability has been observed with the implementation of FOFB. This paper presents the progress of implementation of FOFB in Indus-2.

THP0PRP022 **Orbitkorrektur, a Java Client for Transverse Orbit Correction in PETRA-III**

***G.K. Sahoo**, F. Brinker, F. Wedstein (DESY)*

PETRA-III is a 3rd generation synchrotron light source dedicated to users at 14 beam lines with 30 instruments in the Max von Laue Hall and 10 beamlines in newly constructed Extensions in North and East which are under installations. PETRA-III is operated with several filling modes such as 60, 480 and 960 bunches with 100mA or 40 bunches with 90 mA at an electron beam energy of 6 GeV. Transverse orbits are corrected to a reference orbit, which is based on BBA measurements taking into account requirements of the beamlines and results of the dispersion correction. Histograms from 244 BPMs are displayed by means of this Java Client OrbitKorrektur. The orbits may be corrected using the Effective Correction Method with a few correctors or can be corrected using the SVD Method with proper singular Eigen values using theoretical response matrices from an Optic Server of used Optics. In this application additional features are implemented for better observation and analysis of orbits. Furthermore it can also be used to do many additional jobs, such as showing corrector set currents, loading golden and reference orbits, local bumps, displaying the first turn data during commissioning etc.

THP0PRP023 **Fast Orbit Feedback at DELTA**

***P. Hartmann**, A. Althaus, S. Khan, D. Schirmer, G. Schünemann, T. Weis (DELTA) P. Towalski (Ampegon PPT GmbH)*

At the electron storage ring DELTA, studies of a fast orbit feedback integrating Libera Electron and Bergoz MX-BPM electronics were conducted. An overview of the project and its results is given.

THP0PRP024 **Further Development of Synchronous Gap Change for an Undulator and a Phase Shifter in One Undulator Cell Using an Ethercat Fieldbus**

***S. Karabekyan**, S. Abeghyan, J. Pflüger, M. Yakopov (XFEL. EU) B.E. Evenburg, J. Kuhn (Beckhoff Automation GmbH)*

Synchronization of movement between undulator and phase shifter is important to allow "on the flight" photon energy scan experiments. A proof-of-principle study, regarding synchronous movement of an undulator and phase shifter, has been performed earlier and presented on the ICALEPCS 2013 conference. Those measurements showed permanent following delay between undulator and phase shifter actual gap. This following delay was much bigger than the measurement accuracy of the encoder of phase shifter. Our latest development allows synchronization of the movement between undulator and phase shifter gap within the accuracy of the phase shifter encoder. This paper presenting the method used to achieve this result.

THPOPRP027 **High-Level Application Development and Production Infrastructure at TRIUMF**

E. Tikhomolov, *I.V. Bylinskii, J. Lee, T. Planche, T.M. Tateyama (TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics) P. Jung (UW/Physics) A.C. Morton (FRIB)*

TRIUMF users and operators use a number of high-level applications (HLAs) written in different languages, having rather complicated graphics user interfaces, to carry out tasks related to delivering ion beams with required characteristics and to process data from TRIUMF's EPICS-based and legacy cyclotron control systems. Some applications have been developed by the EPICS community, and some at TRIUMF. These applications run on different production computers and are developed on different machines. This model no longer satisfies TRIUMF's needs because of the growing number of applications, the long times required for data processing on current machines, the lack of real- time visualization of beam properties and so on. New infrastructure for HLA development has been implemented to address these issues and is working reliably with room for further expansion.

FRKTPL — Keynote Speaker - Mark Heron

Chair: J.R. Piton (LNLS)

FRKTPLK01
09:00 60

Future Trends on Control Systems for Large Research Facilities

M.T. Heron *(DLS)*

Accurate predictions of the future are inherently difficult, nevertheless in this talk I will consider some of the developments in control systems at large research facilities and from these try to predict where they are heading. In doing so, the talk will consider software, hardware, people and the management of work. While this will largely be based on developments within our community, it will also look outward to consider what potential external influences there may be.

FRFMPL — Feedback & System Modelling

Chair: D.O. Tavares (LNLS)

FRFMPLCO01 10:00 15 **Status of the NSLS-II LLRF System**

***C. Marques**, F. Gao, B. Holub, J. Rose, N.A. Towne, G.M. Wang (BNL)*

The NSLS-II RF system uses an in-house FPGA based low level RF (LLRF) solution called the Cavity Field Controller (CFC). The CFC directs the amplitude and phase for the high power RF and directly influences beam acceleration and stability. In this paper we discuss a logically embedded Network Analyzer (NA) in situ with the digital feedback loop controlled via a MATLAB or EPICS interface. The embedded NA was used to evaluate the RF feedback stability and influence of the feedback parameters on the beam. We will also discuss diagnostics tools to investigate longitudinal beam dynamics and other functionality embedded into the FPGA fabric. Future development of the CFC implementation and hardware upgrades will also be discussed.

FRFMPLCO02 10:15 15 **Design Criteria for LLRF Feedback Systems Stabilizing Superconducting RF Stations**

***C.H. Rivetta**, J.C. Frisch, S.R. Smith (SLAC)*

The LCLS-II RF system is composed by multi-cell superconducting cavities operating in continuous-wave (CW) mode. Multiple external perturbations affecting the RF system are rejected by low-level RF (LLRF) feedback system in order to achieve the specified stability in the accelerating voltage. In this paper, based on the specification of the accelerating voltage performance and the analysis of the external perturbations, the parameters for the LLRF are estimated and optimal designs are proposed in order to stabilize and achieve the performance of the system. Trade offs between different design parameters of the LLRF are analyzed and the robustness of the design in steady-state and during transients are evaluated.

FRFMPLIO03 11:00 20 **Overview of Some Feedback & Control Systems at Synchrotron Soleil**

***C. Engblom**, Y.-M. Abiven, F. Blache, D.C. Corruble, N. Hubert, G. Renaud (SOLEIL)*

This paper gives an overview of some feedback & control systems in Synchrotron SOLEIL that are in use or in development today. Electron Beam stability is something that is being addressed in several SOLEIL applications; Fast Orbit Feedback is a multi-input multi-output control system made to stabilize beam position perturbations with slow and fast corrections. In addition, active RF cavities are used to maintain stable beam energy & spread as well as keeping electron density even throughout the storage ring. Beam stability also comes from feedforward non-linear control in particle trajectory compensation on both sides of electromagnetic undulators. On beamlines, multi-actuator piezos or pneumatics are used to regulate photon flux to keep within detector operating range; a method to maximize the photon flux while keeping detector below damage thresholds. Currently in development at the sample stage level, the

Nanoprobe Project (collaboration MAXIV & Soleil) focuses on sample stabilization during step- & fly- scans which is realized through multi-axis nano-positioning with high- & low- frequency closed-loop control implementing interferometer feedback &/or compensation tables.

FRFMPLCO04 11:20 15 **Model Predictive Control for Slow Orbit Feedback System of Indus-2**

***R. Rana**, P. Fatnani, R.P. Yadav (RRCAT)*

Indus-2 is India's 3rd generation synchrotron radiation source. To provide stable photon beam for user experiments, two types of orbit feedback correction schemes viz. Slow Orbit Feed Back (SOFB) and Fast Orbit Feed Back (FOFB) are provided in the machine. These schemes restrict the perturbations occurring in the electron beam due to various noise sources to the acceptable levels. Earlier the SOFB system was using PID based feedback controller with corrections applied every 20 seconds. To provide advanced features like: predictive and interactive orbit manipulation, predictive orbit movement - simulation, reference tracking, move reverting and constraint model predictive control (MPC) for disturbance rejection, a new controller is implemented and the SOFB system architecture is enhanced to improve the correction rate to 1/3 Hz. This newly developed system not only improves the system operability but also guarantees a stable controller operation. The paper discusses the implementation of MPC in the orbit feedback systems of the synchrotron radiation sources and brings out its advantages towards the constrained orbit corrections.

FRFMPLCO05 11:35 15 **A Fast, Custom FPGA-Based Signal Processor and Its Applications to Intra-Train Beam Stabilisation**

***G.B. Christian**, N. Blaskovic Kraljevic, R.M. Bodenstein, T. Bromwich, P. Burrows, C. Perry, R.L. Ramjiawan, J. Roberts (JAI) P. Burrows, C. Perry (Oxford University, Physics Department) J. Roberts (CERN)*

A custom 9-channel feedback controller has been developed for low-latency applications in beam-based stabilisation. Fast 14-bit ADCs and DACs are used for high-resolution signal conversion and a Xilinx Virtex-5 FPGA is used for core high-bandwidth digital computation. The sampling, and fast digital logic, can be clocked in the range 200 to 400 MHz, derived from an external or internal source. A custom data acquisition system, based around LabVIEW, has been developed for real-time control and monitoring at up to 460 kbps transfer rates, and is capable of writing and reading from EPICS data records. Details of the hardware, signal processing, and data acquisition will be presented. Two examples of applications will also be presented: a position and angle bunch-by-bunch feedback system using strip-line beam position monitors to stabilise intra-train positional jitter to below the micron level with a latency less than 154 ns; and a phase feedforward system using an RF cavity-based phase monitors to stabilise the downstream rms phase jitter to below 50 fs with a total latency less than the 380 ns beam time-of-flight.

FRFMPLCO06
11:50 15

Harmony: A Generic FPGA Based Solution for Flexible Feedback Systems

X. Serra-Gallifa*, J.A. Avila-Abellan, M. Broseta, G. Cuní, D. Fernández-Carreiras, O. Matilla, A. Ruz (ALBA-CELLS Synchrotron)*

Feedback and complex acquisition systems usually need real-time interaction among instruments with microseconds time response. These implementations are hard to achieve with processors but feasible using FPGAs. There are some cases where high flexibility and continuous tuning is also required, as in synchrotron beamlines, but the implementation of multiple full-custom FPGA designs are extremely time-consuming. Harmony is a solution based in FPGA that offers, via high level programming, a unique framework with common time base, data acquisition, storage, real-time processing, data sharing and diagnostic services designed to implement flexible feedback systems. It is based in two interconnected buses: Self-Describing Bus, developed at CERN/GSI under OHWR license, that communicates with Controls System; and Harmony Bus which creates a bus framework where different modules can share timestamped data capable of pre-programed events generation. The first version of Harmony is already successfully being used in Em# project which objective is the development of a performant four-channel electrometer.

FRDBPL — Database

Chair: T. Kosuge (KEK)

FRDBPLIO01 12:05 20

A Database to Store EPICS Configuration Data

M. Ritzert *(Heidelberg University)*

The operation of extensive control systems cannot be performed by adjusting all parameters one by one manually. Instead, a set of parameters is loaded and applied in bulk. We present a system to store such parameter sets in a type-safe fashion into and retrieve them from a configuration database. The configuration database is backed by an SQL database. Interfaces to store and retrieve data exist for the C++, Java and Python programming languages. GUIs are available both as a standalone program using C++ and Qt, and integrated into Control System Studio (CSS). The version integrated into CSS supports data validators implemented as Eclipse plugins that are run before each commit. The format of the configuration data that can be stored is XML-like, and export and import to/from XML is implemented. The database can hold several completely independent "files" of configuration data. In each file, several branches can be stored, each branch consisting of a chain of commits. Each commit can easily be retrieved at any time. For each entry, the modification history can easily be queried.

FRITPL — Management of IT Projects

Chair: Y.-M. Abiven (SOLEIL)

FRITPLCO01 14:00 15

Continuous Integration and Continuous Delivery at FRIB

***M.G. Konrad**, D.G. Maxwell (FRIB)*

Development of many software projects at FRIB follows an agile development approach. An important part of this practice is to make new software versions available to users frequently to get feedback in a timely manner. Unfortunately building, testing, packaging, and deploying software can be a time consuming and error prone process. We will present the processes and tools we use at FRIB to standardize and automate this process (mainly for C/C++/Java code and Debian Linux as a target). This includes use of a central code repository, a continuous integration server performing automatic builds and running automatic test, as well as automated software packaging. For each revision of the software in the code repository our continuous delivery pipeline automatically provides us with a software package that is ready to be released. The decision to deploy this new version of the software into our production environment is the only manual step remaining. The high degree of reproducibility as well as extensive automated tests allow us to release more frequently without jeopardizing the quality of our production systems.

FRITPLCO02 14:15 15

Experience, Best Practices, Trends and Path Taken in the Field of Control System Integration

***R. Modic** (Cosylab)*

The talk presents the experience, best practices, trends and path Cosylab has taken in the field of Control System integration to serve the accelerator community, improve standardization, deliver turn-key solutions and streamline services. The presentation would traverse control system platforms as EPICS, TANGO, LabVIEW and put the aspect of timing in the spotlight. As Accelerator timing binds to many ACC components it also orchestrates device responses and their interplay. It has intrinsic role of machine "heart beat". Several real projects and use-cases will be presented utilizing White Rabbit, MRF and customized platforms to achieve machine behavior. An applicable "cocktail" of HW platforms, our architectural and functional experiences, specific challenges and pit-falls, long term support and EOL, maturity considerations shall be conducted. Real cases where concurrent operation modes, beam synchronous acquisition, dynamic timing reconfiguration is needed will be elaborated. Contribution can serve as an overview and de-mystifier of timing-related challenges.

FRITPLCO04 14:30 15 **Experience Gathered During the Commissioning of the Undulator Control System at European XFEL**

S. Karabekyan, *S. Abeghyan, J. Pflüger, M. Yakopov (XFEL. EU)*

The European XFEL is a fourth-generation light source, which will start the operation in spring 2017. Three undulator systems, SASE 1, SASE 2 and SASE 3 will be used to produce photon beams. For operation of all undulator systems a total amount of 91 undulators has been produced and commissioned. SASE 1 undulator system, consisting of 35 undulator cells, has been installed and prepared for the operation in the tunnel in spring 2016. SASE 3 and SASE 2 will be installed until the end of 2016. This paper describes the commissioning process of the whole undulator control system and reports about the experience gathered over the entire time of undulator control system commissioning.

28-Oct-16 14:50 – 15:20 Plenary Room

FRISPL — Interactive Session - Friday

Chair: M.R. Clausen (DESY)

FRCLPL — Isamu Abe Prize and Closing Session

Chair: R. Bacher (DESY) and J.R. Piton (LNLS)

FRCLPL01 15:20 15

Isamu Abe Prize

R. Bacher *(DESY)*

The Isamu Abe Prize recognizes innovative ideas, achievements and applications in the field of accelerator controls and it is granted every two years by PCaPAC.

The main purpose of the Isamu Abe Prize is to encourage people in the early stages of their career. The prize awarded by the International Program Committee seeks to recognize innovative ideas, achievements and applications presented at PCaPAC.

The prize is named in recognition of Isamu Abe, from KEK, one of the co-founders of PCaPAC, who suddenly passed away in June 2002.

CLOSING 15:35 15

Closing PCaPAC2016

J.R. Piton *(LNLS)*

This session will discuss and close the 11th International Workshop on Personal Computers and Particle Accelerator Controls.

Boldface papercodes indicate primary authors