Accelerator Technical Forum (ATF) 2014 Meeting Abstracts

Development of RF Peak Detector and Phase Monitoring Unit at the Australian Synchrotron.

A. Michalczyk, K.L. Zingre, A. Starritt, R. LeGuen, G. LeBlanc, R. Dowd, B. Noel,

Australian Synchrotron, Melbourne, Australia

An RF peak detector and phase monitoring unit was developed as a part of the LINAC and Booster RF diagnostic system at the Australian Synchrotron (AS). The system captures a maximum of 16-pulsed or continuous RF signals to measure forward and reverse power levels. This unit has also I/Q demodulator, which provides phase information to assist with tuning and to diagnose instabilities. The design, development and testing problems of the system will be presented. This novel 'in-house' designed LINAC and Booster RF Peak Detector and Phase Monitoring unit has been operating successfully since May 2012. The compact system provides excellent performance, EMC, thermal stability using only convectional cooling. The system has already proven to be a great diagnostic tool for trouble-shooting.

An Overview of Recent Maintenance Issues on the Australian National Universities 14UD Accelerator

A. Muirhead, J. Bockwinkel, A. Cooper, G. Crook, C. Gudu, J. Heighway, L. Lariosa,

P. Linardakis, N. Lobanov, T. Tunninngley

Heavy Ion Accelerator Facility, Australian National University, Canberra, ACT, Australia

The past two years have presented some interesting challenges in operating the ANU 14UD Heavy Ion Accelerator. Mostly attributed to the initial modifications to the Terminal Gas Stripper system where we had an unintended SF6 leak into the tube.

A degradation of insulators in some of the column posts and tubes were found following as a consequence to improving our examination techniques.

A detailed report on this will be presented.

An Introduction to the New 8T (Tesla) Superconducting Solenoid Being Constructed at ANU

A. Muirhead, D. Weisser, D. Hinde, M. Dasgupta, I. Carter, T. Tunninngley

Heavy Ion Accelerator Facility, Australian National University, Canberra, ACT, Australia

The 8T superconducting solenoid is a powerful tool for the study of nuclear fusion.

A primary ion beam from the 14UD accelerator is put onto a target at the entrance to the magnetic spectrometer. The resulting residues from the fusion process are transported with influence from the magnetic field and detected or rejected.

Oxford Instruments, UK, designed and manufactured the superconducting coil and its vacuum enclosure to specifications supplied by ANU. The design of the soft iron magnetic field return yoke was undertaken by ANU in consultation with Oxford Instruments. The manufacture of the iron return yoke pieces was undertaken by the mechanical workshop at the Research School of Physics and Engineering, ANU.

A detailed report on the instruments design, manufacture and construction will be presented.

EPICS Qt Framework

A. C. Starritt

Australian Synchrotron Light Source, Clayton, Victoria, Australia

One vital part of any accelerator machine is the controls system, and an important component of the controls system is the operator interface. The Australian Synchrotron has developed a framework based on EPICS and Qt to enable rapid development of effective operator interfaces.

For this presentation, I will summarise how we got to where we are today, and over view of the current framework capabilities both basic synoptic control and monitoring together with wider application support, on-going collaboration with Lyncean and PSI, and potential future enhancements.

The Design and Manufacture of Particle Accelerator Systems at Buckley Systems Limited

C. Philpott, T. Jones

Buckley Systems Ltd, Auckland, New Zealand.

Buckley Systems Ltd (BSL) is a New Zealand based manufacturer of particle accelerator systems and associated equipment. BSL's capabilities range from Physics and Engineering design to full in house manufacture, integration and testing.

Examples of how BSL manufactures particle accelerator equipment through the innovative use of technologies such as friction stir welding and electrical discharge machining are presented. This is followed by a brief review of recently completed projects for Brookhaven National Laboratory, Taiwan's NSRRC, TRIUMF in Canada and GNS/ANSTO. Lastly a new partnership with D-Pace is announced and upcoming projects including an Ion source test facility and a vibrating wire magnetic measurement system are discussed.

Moving from a VME based system to EtherCAT

D. Lynch

Institute for Environmental Research, ANSTO, Lucas Heights, Sydney

The ANTARES computer control system has been based on VME hardware for almost two decades. This hardware is now hard to buy if possible at all. While the VME hardware has performed well it might no longer be the most cost effective or suitable platform. EtherCAT is being trialled as a replacement technology due to its cost effectiveness, being a remote I/O solution and real-time capabilities.

The Trials and Tribulations of High Voltage Insulators

D. Garton

Institute for Environmental Research, ANSTO, Lucas Heights, Sydney

Holding electrons in place is an age old problem and one fraught with ire when they escape. At ANSTO several different high voltage breakdown problems have been experienced from using insulating materials that in their own right shouldn't have failed. This talk discusses the materials, how they have been used, and why they may have failed. It is hoped that this information will save others from repeating the same mistakes and help them avoid expensive repairs and lost running time.

The New Computer Control System of the 14ud Accelerator at the Australian National University

D. Tsifakis, P. Linardakis

Department of Nuclear Physics, The Australian National University, Canberra, ACT, Australia

This presentation will introduce the new, EPICS based, computer control system of the 14UD accelerator at the Australian National University. The new control system replaces the previous, VAX/VMS, Fortran based, control system which has served the accelerator for nearly two decades.

The presentation will cover the strategy for the upgrade, the implementation, the new features, and the experience of using the new system for the last two years.

Improvements to the Injection Efficiency Monitor at the Australian Synchrotron

D. McGilvery, M. Atkinson

Australian Synchrotron Light Source, Clayton, Victoria, Australia

Topup operation at the Australian Synchrotron Light Source requires interlock protection based on the efficiency of the injection of sub nanosecond pulses of electrons into the electron storage ring. This requires the precise measurement of pico-coulomb pulses of electrons in the neighbourhood of fast, high current pulsed magnets and pulsed RF systems. Shot to shot variations in the large background noise signals limited the effectiveness of digital background subtraction techniques. The development and operation of simple analog pre-filters, based on inexpensive, off the shelf modules, will be described. The use of these narrow bandwidth filters enabled the signal to noise, dynamic range and reliability of the measurements to be improved by more than an order of magnitude.

Development of Embedded Shutter Controller for IMBL Beamline at the Australian Synchrotron

E. Joseph Vettoor, D. Hausermann, C. Hall, J. McKinlay, A. Michalczyk, P. Martin, N. Basten

Australian Synchrotron Light Source, Clayton, Victoria, Australia

The embedded Shutter controller was developed in-house for controlling the sample exposure to X-Rays at the IMBL Beamline, at the Australian Synchrotron. This system which was designed to communicate with EPICS (Distributed Control system at the facility), can be used for experiments where the exposure times can vary between 1ms to tens of seconds with high accuracy. The system has been designed to report back errors in case of failures of mechanical blade movement, and rise of temperature of the on board power transistors that control the coils. The system can also communicate with the Personnel Safety System (PSS) at the beamline. The system has 4 solid state outputs, 4 TTL inputs and 4 thermocouple inputs and was designed to work as a universal solution with other possible shutters.

Control Electronics for AMS on ANTARES at ANSTO

G. Watt

ANSTO Engineering & Capital Projects,

Electrical & Control Services Unit, ANSTO, Lucas Heights, Sydney

Developments in electronic control of the AMS facility on ANTARES at ANSTO will be described.

ANTARES is used routinely to perform carbon dating using fast cycling AMS – sequentially switching between measuring ^{12}C, ^{13}C, & ^{14}C, typically at a 1 – 10 Hz rate. This method minimises systematic error by averaging out longer-term machine drift.

A digital pulse generator is required to generate control signals for beam chopping (for ^{12}C and ^{13}C) immediately after the ion source, isotope selection (high voltage bouncing) at the injection magnet, and gating of current-frequency electrometers for isotopic current measurement at end-stations

The timing requirements are µs-level resolution, sub-µs-level determinism (synchronism) and durations in the range of 10s ms – seconds.

The original 1992 hardware took the form of a counter-based state machine ('Sequencer'), based upon a lookup table implemented by a 65k x 16 bit static RAM and discrete digital logic. The 16 bit address lines represent 'time', and the 16 data lines represent 16 independent output signals.

After a long period of trouble-free operation, a number of factors prompted a redesign in the period 2010 – 2011, focused on utilising a programmable logic device (FPGA) to implement the entire system, at the same time providing an obsolescence-proof platform for further development.

The particular card selected was the National Instruments NI PCI-7811R, featuring:

- 160 I/O lines
- 720 kbits user memory
- 40 MHz clock
- 1M gate Xilinx Virtex 2 FPGA
- PCI interface
- Programmed using LabVIEW
- Cost ~ $2000

If used to its maximum capability, this card has 160 lines of I/O capacity, and a 25 ns time resolution.

With a 10 MHz clock frequency, the duration of ANY isotope counting period can be set within the range 100 ns (min) to 100 ns x (232 -1) = >429 sec = >7 min (max).

We are anticipating at some time in the future extending the functionality to 8 separate isotopic species, which will involve an additional 8 gating lines, 1 additional multiplexer select line (increase from 2 to 3), 4 additional DACs for providing the additional bouncer voltages, and with 100 ns time resolution, more accurate modelling of the ion transit time through the accelerator will be possible.

A Study of Ion Beam Optics on SIBA2 Beam line on the STAR Accelerator at ANSTO

J. Wang, M. Ionescu

Institute for Environmental Research, ANSTO, Lucas Heights, Sydney

SIBA 2 beam line on the STAR accelerator is currently used for variable angle RBS with H, He and C, ERDA with He and C, and materials irradiation with H and He. The current design of this beam line is adequate for low current measurements (RBS, ERDA), but for high current applications (irradiation) the delivery of the highest possible currents is restricted by the beam line instruments leading up to the switch magnet. This precludes achieving a high throughput for sample irradiation experiments, which has been 34 days in 2010, and 37days in 2011, but the demand is anticipated to grow in the next few years.

In order to enhance the H, He, C irradiation capacity of STAR accelerator, a re-design of SIBA 2 is necessary, and this is the objective of this study.

To this end, we have started with the optimisation of the He injection system. Followed by He beam transport from the low energy end to the switch magnet, and onwards to the SIBA 1 end station. We used the existing SIBA 1 configuration to validate our beam transport simulation for He. Finally, we have used this information to validate the beam transport simulation to propose a new configuration for SIBA 2 beam line.

The Australian Particle Therapy and Research Facility

J. W. Boldeman

ANSTO, Lucas Heights, Sydney

A proposal has been prepared for the construction in Australia of a high performance Particle Therapy and Research Facility. The proposed will be finalised for wide scale review by the end of May. This presentation will present the compelling reasons for the construction of the facility. The design details and cost structure will also be presented.

"How big, how thick, how strong" Guidelines for Vacuum Vessel Design at ANSTO

M. Mann

Institute for Environmental Research, ANSTO, Lucas Heights, Sydney

ANSTO have produced a document titled "Design & Fabrication of Vacuum Vessels- Hazard Level E (below 300L)".

This presentation is a brief look at the development of this document and how it can be applied to vacuum vessel design for typical vessel geometries used in the accelerator area.

Progress Report on the Accelerators Upgrade at ANU

N. Lobanov, J. Bockwinkel, A. Cooper, G. Crook, K. Fifield, C. Gudu, J.Heighway, L. Larioza,

P. Linardakis, A. Muirhead, D. Tsifakis, T. Tunningley, D. Weisser

Nuclear Physics Department, Research School of Physics and Engineering,

Australian National University, Canberra, Australia

Super Science Grant has been awarded for the enhancement of heavy ion accelerator facilities (HIAF) at ANU. In this presentation we will highlight latest developments including significant upgrade of accelerator infrastructure, including the ion source, EPICs accelerator computer control system, SF6 gas handling, low energy tube entrance focusing, enhancement of beam pulsing systems and LINAC beam time structure diagnostics, implementation of new beam-lines and improvement of AMS and RIB capabilities.

An update on the ANSTO Alphatross Operations

P. Drewer

Institute for Environmental Research

Australian Nuclear Science and Technology Organisation

Lucas Heights, Sydney

Working with an Alphatross Ion Source. Progress and lessons learned managing operational and servicing constraints on the ANSTO Alphatross system. New challenges and ways forward.

ANU 14UD Three-Frequency Buncher Upgrade

P. Linardakis, N. Lobanov, G. Crook, D. Tempra

Heavy Ion Accelerator Facility, Australian National University, Canberra, ACT, Australia

The Australian National University's Heavy Ion Accelerator Facility is designing and installing a new low-energy, three-frequency bunching system. The existing system has been operating successfully in various forms since the early '80s, but age and an inflexible design have demanded improvements to be made. The new system incorporates two new helical resonators for f0 = 9.375 MHz, a new vacuum system featuring removable bunching grids and a new radiofrequency (RF) control system based on modern direct digital synthesis methods to maintain ideal amplitude and phase relationships between f0, f2 and f3. Improvements in design compared to the existing system will enable better RF performance, increased flexibility of accelerator applications, more opportunity to test and improve individual components and most importantly, user friendly operation. The project also highlights the multidisciplinary approach in modern accelerator sub-system design where, in this case, integration and consideration of RF, mechanical, and EPICS computer control issues are required.

UoM, School of Physics 5U Pelletron Accelerator Facility

R. Szymanski

University of Melbourne, School of Physics, Melbourne, Victoria

Over the last number of years the School of Physics 5U Pelletron has gone thru a second upgrade funded under the EIF and NUCRIS scheme. This presentation will outline the developments and upgrade of this accelerator facility including the CSIRO Nuclear Microprobe line.

The Innovations in Dry Vacuum Technology

S. Nagarajan

Ezzi Vision, Scoresby, VIC, Australia

Dry pump technologies have become routinely utilized in, and for, a wide range of vacuum based applications. Some of the most recent significant developments in dry technologies, including scroll, screw, roots-claw and turbo-molecular, will be discussed with reference to improved operation and productivity, maintenance and minimised environmental impact and cost of ownership.

Super E Target Loading System

T. Tunningley, T. Kibedi, A. Gratton, D. Tsifakis

Australian National University, Canberra, ACT, Australia

The ANU Superconducting Solenoidal Electron Spectrometer (Super-e), has been operating since the 1980s. The target loading system had long been a problem, with changing a target not only endangering fragile targets, but also workers who were required to bend in to awkward positions and manoeuvre a large unwieldy actuator. It was decided to redesign the system with targets and users in mind, reducing risks to both. The new target system utilises some basic mechanical linkages and cams to allow the user to safely access, remove and install targets.

The design process presented several challenges. Due to the pre-existing apparatus, there were considerations of available space, restricted mounting points, and required target travel in the vacuum space. Other specific challenges were the accuracy and repeatability of the target position, requirement for angular rotation of targets, vacuum procedures, and safety interlocks.

The finished design was manufactured, installed and currently in operation. This presentation will detail the design process, the challenges, the finished product and upgrades made to the system since installation.

The ANU Alphatross Ion Source – Reliability and Development Questions

T. Kitchen

Australian National University, Canberra, ACT, Australia

The ANU Alphatross Ion source has proved to be a problematic source. The major problem been the short operating period before the ion source fails due to low beam output and or an instable beam. Attempts have been made to increase the ion source operating period by controlling and monitoring various temperatures of the ion source and changes to the geometry to improve the returning flow of Rubidium. Unfortunately these modifications have not yet solved the problem of a short source life.

ANU HIAF 14UD Laboratory Report For ATF2014 – Activity Period of July 2012 to April 2014

Cooper A., Muirhead A., Harding A., Bockwinkel J., Heighway J., Crook G., Lariosa L., Linardakis P., Tsifakis D., Gratton A., Gudu C., Tunningley T., Weisser D., Lobanov N., Fifield K. and Hinde D.
Heavy Ion Accelerator Facility, Australian National University, Canberra, ACT, Australia

Conference paper….

Vacuum Interlocking and Accelerator Control with

NI Labview and Compactrio

T. Steele

Research School of Physics & Engineering

The Australian National University, Canberra, ACT, Australia

The High Energy Ion Implanter is a 1.7 MV Tandem Accelerator operated by the Department of Electronic Materials Engineering (EME) within the Research School of Physics & Engineering (RSPE). Recently, a new vacuum monitoring, control and interlock system has been implemented as part of ongoing upgrades to the machine.

The new vacuum system entirely replaces the previous generation National Electrostatics interlock system with a National Instruments (NI) CompactRIO controller, a rugged, reconfigurable embedded computer that includes a Field Programmable Gate Array and runs a real time operating system.

Many modern features are included in this new system such as an intuitive touch panel interface and the capability to facilitate user level access control whilst maintaining a highly reliable interlock through the use of programmable hardware. This approach to interlocking ensures that there is no software in the control loop that could jeopardise system safety.

System automation has been completed to a sufficient degree that facility users have “two button” vacuum control of target chambers. This automation ensures that vacuum vent and pump down procedures are easy to achieve and subsequently improve long term vacuum reliability.

An overview of the system hardware and software will be presented along with a discussion of the development process, with a particular focus on the use of the National Instruments product ecosystem.

Technology and product updates from

John Morris Scientific Vacuum Division.

V. Polonski

John Morris Scientific

In this talk, the Vacuum Division of John Morris Scientific will update the end users on the latest development of vacuum-related products and technology. The portfolio of vacuum equipment suppliers include MKS Instruments, Vacuubrand, Ebara, and Kurt J. Lesker Company.

Development of a New LINAC RF Peak Detector Unit At The Australian Synchrotron

K.L. Zingre, A. Starritt, R. LeGuen, G. LeBlanc, R. Dowd, A. Michalczyk,

Australian Synchrotron, Melbourne, Australia

An RF peak detector unit forms part of the LINAC at the Australian Synchrotron (AS). The system captures a maximum of 12 pulsed RF signals from six bi-directional couplers to measure forward and reverse powerlevels. This unit has been successfully replaced with an I/Q demodulator, which also provides phase information to ease tuning and to diagnose instabilities. The new system now has 16 channels with enhanced performance. Data acquisition has also been upgraded to a high accuracy PCI board with EPICS interface for consistency with our control system.
Conference paper …