LINAC2020
LIVERPOOL

30th International Linear Accelerator Conference 2020

LINAC2020.org

The Cockcroft Institute of Accelerator Science and Technology

UKRI Science and Technology Facilities Council

JAI John Adams Institute for Accelerator Science

Linac 2020 Chairs' Welcome

On behalf of the LINAC2020 Local Organizing Committee, we unfortunately need to make you officially aware that owing to the global Covid-19 pandemic, we have been forced to postpone the physical hosting of the 30th Linear Accelerator Conference (LINAC), which was due to be held at the Arena and Convention Centre (ACC) in Liverpool, UK from 30 August - 4 September 2020. The Linac International Organising Committee (IOC) has unanimously approved this decision, whilst also deciding that postponing the conference for a single-year to 2021 would not be favourable, owing to potential complications with other large conferences which are also scheduled for late-summer and Autumn in 2021, most notably FEL'21, IBIC'21, LLRF'21 and SRF'21 and so the preference therefore would be for a 2-year postponement to 2022.

Having now re-negotiated and confirmed our contractual arrangements with the ACC venue, we are able to announce that the re-arranged physical-hosting of the next Linac Conference will take place from Sunday 28th August to Friday 2nd September 2022 at the ACC in Liverpool, with its denotation becoming Linac2022. More information on its provisioning will be made available on the official conference web site in due course at: http://www.linac2022.org/. Subsequently, it must be noted that the original Linac2022 Conference being prepared, will now also adjust to 2024 in Chicago, with the same responsible Local Organising Committee.

Having to re-arrange hosting of the Linac2020 Conference by 2-years is obviously an incredibly difficult and disappointing decision that we have had to make under these tremendously challenging circumstances, particularly when there has been so many new and exciting developments in the field of Linear Accelerators over the past 2-years since the last Linac Conference in Beijing in 2018.

In order therefore to reduce the dramatic lack of visibility and promotion of new Linac activities and developments, we have worked in consultation with the Linac IOC and the Linac2020 Scientific Programme Committee, to identify a solution which would allow for a 'Virtual Linac Event' to be hosted, which could accommodate a significant fraction of the original Linac2020 scientific programme. Whilst details are still being developed and finalised, it is proposed to host a Zoom-based multi-day programme over the same original dates for Linac2020 i.e. Monday 31st August – Friday 4th September. The event will encompass afternoon (UK Time) sessions, in order to best capture North America and Asia participants. Information for registration, programme and logistics will be made available soon.

We therefore look forward to seeing you 'Virtually' in September 2020 and in person in Liverpool in September 2022!

Yours sincerely

Graeme Burt (Cockcroft Institute – Lancaster University)
Scientific Programme Committee Chair

Peter McIntosh (Cockcroft Institute – STFC ASTeC)
International Organising Committee Chair

Carsten P Welsch (Cockcroft Institute – Liverpool University)
Local Organising Committee Chair

Tuesday TUA Opening session 1:30pm

Chair: Graeme Burt (Cockcroft Institute)

The Compact Linear Accelerator for Research and Applications (CLARA) at Daresbury Laboratory
Susan Louise Smith - STFC/DL/ASTeC
CLARA is a FEL test facility currently under construction at Daresbury Laboratory. CLARA stands for Compact Linear Accelerator for Research and Applications. The maximum proposed electron beam energy is 250 MeV and the FEL wavelength range is 100-400 nm. Early stage, low-energy, non-FEL beam exploitation has been demsonstrated with a suite of novel acceleration and beam application experiments conducted. We present the priority mission of the CLARA accelerator, its construction status and its future programme at Daresbury.

FRIB construction, installation, SRF and beam commissioning: experience and lessons learned
Jie Wei - FRIB
The Facility for Rare Isotope Beams (FRIB) is a new scientific user facility under construction on the campus of the Michigan State University in USA for nuclear science research with beams of rare isotopes. With a total construction cost of $730 million, the project has passed the 94% complete mark and is managed toward completion in 2022. With design average beam power two orders of magnitude higher than operating heavy-ion facilities, FRIB stands at the power frontier of the accelerator family. Since 2017, the FRIB Linac has started phased commissioning with ion beams as heavy as A/Z~7. In spring 2020, heavy ion beams are accelerated to energies above 200 MeV/u using 270 superconducting radiofrequency (SRF) resonators contained in 39 cryomodules in the first two segments of the Linac. This talk summarizes the FRIB accelerator project status with focuses on SRF and beam commissioning and lessons learned during new technology developments including integrated design of cryogenics and cryomodules, liquid lithium charge stripping, and high power targetry and fragment separation.

Performance and Operational Experience with the European X-FEL Linac
Nicholas Walker - DESY
The European X-Ray Free-Electron Laser (EUROPEAN XFEL) has been successfully and routinely delivering typically 0.6- to 14-KeV (up to 20-KeV) X-rays to users for almost three years, and has demonstrated 30 KeV. At the heart of the machine is the ~1.3 kilometre-long 1.3 GHz SCRF linac which has demonstrated a maximum electron energy of 17.6 GeV, and is capable of accelerating up to 2700 bunches per RF pulse at a repetition rate of 10 Hz. The linac now routinely and reliably delivers beam to three SASE undulators. In this short paper we will briefly review linac operational experience, and also highlight some important developments in the last year which have improved linac operations.

Update on Fermilab's PIP Project
Lia Merminga - Fermilab

The Proton Improvement Plan II (PIP-II) project is an essential upgrade to Fermilab's particle accelerator complex to enable the world's most intense neutrino beam for the international Long Baseline Neutrino Facility (LBNF)/Deep Underground Neutrino Experiment (DUNE), and a broad particle physics program for many decades to come. PIP-II will deliver 1.2 MW of proton beam power from the Main Injector upgradeable to multi-MW capability, and will provide capabilities for Continuous Wave (CW) beam operation, and multi-user delivery.

The central element of PIP-II is an 800 MeV linac, which comprises a room temperature front end, up to 2.1 MeV, followed by a SRF section. The front end up to ~25 MeV has been constructed and is being commissioned now in the PIP-II Injector Test facility. The SRF accelerator consists of five different types of cavities/cryomodules, including Half Wave Resonators, Single Spoke and elliptical resonators operating at state of the art parameters.

PIP-II is the first U.S. accelerator project to be constructed with significant contributions from international partners, including India, Italy, France, the United Kingdom and Poland. DOE's Argonne, Berkeley and Jefferson laboratories are also contributing key technologies. The project received CD-1 approval in July 2018. Start of construction started in August 2020. The project will be completed in 2028.

Tuesday TUP 3:50pm

Chair: Sami Tantawi (SLAC)

Status and Perspectives of the ESS Linac
Hakan Danared - ESS
Construction of the European Spallation Source, ESS, started in 2013, and linac components are now being received from partners in Europe. The ion souce and LEBT have been installed and beam commissioning took place in 2018-2019. The RFQ and MEBT are also installed, DTL assembly has started, and the first series-produced cryomodules will arrive this month. The presentation will review the status of the different linac systems, and an outlook for the coming years, until the end of the construction project, will be given.

Overview of High Power RFQ issues and solutions
Andrea Pisent - INFN/LNL
Review talk on high power RFQs world wide with emphasis on performance limitation issues and solutions.

Transition between different acceleration sections of Hadron Linacs
Michele Comunian - INFN/LNL
Hadron Linacs are usually given by a composition of different acceleration sections and the energy transition points are related to technologies, duty cycle and sensitivity to beam quality. The main border is of course the normal conducting to super conducting point, but also the choices about other sections have an effect on the main linac performances. The beam physics associated to the transition is a crucial factor to preserve the beam quality and guarantee the Linac efficiency. Starting from the analysis of the IFMIF very high power linac and the ESS very high energy linac, this paper studies reasons, benefits and contraindications of linac designs and tries to give some trends for future projects.

MYRRHA superconducting linac and fault-tolerant Design
Frederic Bouly - LPSC
The MYRRHA facility requires a 600 MeV accelerator delivering a maximum proton current of 4 mA in continuous wave (CW) mode. Driven by SCK-CEN and supported by the Belgium government, the phase I (MINERVA) of the project consists in the construction of the accelerator first part, up to 100 MeV. The CW beam will be delivered by a superconducting linac which must fulfil very stringent reliability requirements to ensure the safe ADS operation with a high level of availability. In this purpose, the accelerator design is based on a redundant and fault-tolerant scheme to enable rapid failures mitigations. The design updates of the superconducting linac, at 100 MeV (Phase I) and 600 MeV (ADS operation) will be exposed. Then beam dynamics studies on the fault tolerance capability of the MYRRHA superconducting linac will be presented. The results will be focussed on cavity failure compensation and the impact on R&D to enable fast retuning procedures.

High Power normal-conducting linacs upgrade in US
Deepak Raparia - BNL
Overview of the two upgrade projects in US aiming to keep rather aged NC linacs at still competitive performance.

Overview of linacs for compact neutron sources
David Baxter - IUCF
Review talk introducing the needs for neutron sources as an alternative to research reactors and for novel neutron technologies. The body of the talk will present the existing and required linacs to cover the neutron needs, the different alternatives to produce the neutrons and the drived requirements from the linac: particle spices (e,p,d ¿), particle energy and current, pulse or CW mode of operation etc.

SNS Proton Power Upgrade (PPU) and Operational Experience
Mark Champion - ORNL
Upgrade project overview with emphasis on operational experience and strategy for beam losses minimization.

Wednesday WEA 1:30pm

Chair: Frank Gerigk (CERN)

Development of Superconducting Linac Technology in India
Purushottam Shrivastava - RRCAT
India has ambitious plans for a linac based neutron spallation source and a linac-based ADS facility. In recent years the expertise on manufacturing, chemical treatment, and cold-testing has translated into infrastructure and numerous prototypes. A development that benefited from the close collaboration with the PIP-II project at FNAL. This talk will give an overview of the technical developments which have taken place and will show a roadmap towards a high-power superconducting proton linac in India.

Dislocation dynamics their role in high-gradient phenomena
Jan Paszkiewicz - Oxford/CERN
Overview of surface physics for high-gradient normal conducting cavities with a focus on dislocation dynamics. Dislocation dynamics plays a crucial role in many aspects of material science. In recent years the importance of dislocation dynamics in metal surfaces under high electromagnetic fields like those encountered in high-gradient rf cavities has been studied and understood. Theoretical and experimental results including those high-gradient rf cavities are summarized.

Collaborative developments with industry for advanced accelerator applications
Anthony Gleeson - STFC/DL
Elaboration of Daresbury's industrial collaboration activities with Teledyne e2v, Rapiscan systems, Advanced Oncotherapy and The Welding Institute will be presented, all of which focussed on Linac based accelerator technologies for applications in science, health, security and environment.

Design and experimental validation of a mm-wave woodpile-based dielectric structure for accelerators
Giuseppe Torrisi - INFN/LNS
All-dielectric electromagnetic band gap (EBG) waveguides structures promise significant improvement of accelerating gradient with the potential to miniaturize the high energy accelerators. In this work we explore the performance of a 3D photonic Woodpile Structure including the coupling transition from a standard waveguide to the dielectric-woodpile accelerating structure. The experimental results obtained on a silicon woodpile assembled by stacking micromachined silicon wafers in a layer-by-layer structure and comparison with numerical simulation are shown. A simplified evaluation of the advantages in terms of the accelerators' cost will be also presented.

Technological Advancements in Material Handling for High-Gradient Operation of an innovative braze-free accelerating structures
Luigi Faillace - INFN/LNF
High energy physics experiments using particle accelerators as well as industrial and medical applications are continuously seeking more compact, robust and cheaper accelerating structures. As of today, stable operating gradients, exceeding 100 MV/m, have been demonstrated by the SLAC group in the X-Band (11.424 GHz). These experiments show that hard structures, fabricated without high-temperature processes, achieve a better high gradient performance in terms of accelerating gradients. An innovative and compact type of accelerating cavity is proposed that avoids any high-temperature process like brazing or diffusion bonding. All cells are joined together by means of specifically designed and proprietary screws which ensure good vacuum and RF contacts. Two three-cell standing-wave accelerating structures, designed to operate in the pi-mode at 11.424 GHz, have been successfully built and cold tested. In order to guarantee a vacuum envelope and mechanically robust assembly, Electron Beam Welding (EBW) and the Tungsten Inert Gas (TIG) processes is used. Temperature and stress tests during the welding process are shown, together with high power RF tests performed at SLAC.

Innovative Radiometric Diagnostics for Future Linear Accelerators

Joseph Wolfenden - Cockcroft Institute

A radiometric diagnostic measures the properties of electromagnetic radiation produced by a particle beam to measure properties of the beam. The spectra of this radiation can range anywhere from UV, through optical, to THz. The extreme beam properties produced in modern linear accelerators are beginning to push the capabilities of such diagnostics to their resolution and operational limits, and future machines will likely continue this trend. Recent innovations in this field push these impending limits back and will maintain the diagnostic capabilities of future accelerators. This talk will give an overview of several of these techniques which fall into the categories of transverse profile diagnostics, longitudinal profile diagnostics, and machine protection. These range from fully developed methodologies, to proof of concept results with a potential to influence future techniques.

Wednesday WEP 3:35pm

Chair: Fulvia Pilat (ORNL)

Women in Science and Engineering (WISE): Should I stay or should I go now?
Join us on Wednesday 2nd September 2020 for a panel discussion on improving retention and career advancement for women working in the field of particle accelerators. We will explore the role the organisation, and workplace culture, can play in addressing the retention and advancement issue in STEM. The panel discussion will be followed by a moderated real-time question and answer session. Participants of all genders and career stage are welcome to attend.
The current confirmed panellists are:

- Camille Ginsburg, Director of Accelerator Operations at Jefferson Lab
- Manjit Dosanjh, Senior Advisor for Medical Applications at CERN
- Ling-an Wu, Chinese Academy of Sciences
- Susan Smith, Director Daresbury laboratory and STFC Accelerator Centre
- Claire David, Assistant Professor at York University (Canada) and Associate Scientist at FNAL.

Session chair and discussion moderator is Fulvia Pilat, Research Accelerator Division Director at Oak Ridge National Laboratory.

CBETA: The First Multipass Srf Based ERL
Colwyn Gulliford - Cornell University (CLASSE)
Energy recovery has been demonstrated in the multi-pass (4 accelerating, 4 decelerating) configuration of the CBETA machine. High (single particle) energy recovery efficiency has been achieved through the use of SRF cavities and permanent magnets in a fixed field alternating gradient (FFA) return loop. The FFA arc successfully transported electron bunches with 42, 78, 114, and 150 MeV beam energy in a common vacuum chamber. This new kind of accelerator, and 8 pass ERL, has the potential to accelerate much higher currents than existing linear accelerators while maintaining small beam dimensions and consuming much less energy per electron.

First linear acceleration of relativistic electrons using THz waveguides
Darren Mark Graham - The University of Manchester
Experiments performed at the CLARA accelerator have demonstrated for the first-time linear acceleration of relativistic electrons (35 MeV). The experiment used a few-cycle nonlinear crystal THz source at 10 MV/m to drive a dielectric lined rectangular waveguide. Both long bunches for modulation and short bunches for acceleration have been demonstrated. Beam measurements as well as beam dynamics simulations will be presented.

Attosecond Microbunching with On-Chip Accelerators
Dylan Savage Black - Stanford University
The Accelerator on a Chip (ACHIP) Collaboration is developing miniaturized MeV-scale accelerators using state-of-the art nanofabrication on silicon and silica wafers, powered by near-IR femtosecond lasers. ACHIP has demonstrated high-gradient, compact sub-relativistic and relativistic accelerators, as well as compact injectors and attosecond-scale microbunching. This talk will highlight the recent work done at Stanford and FAU Erlangen creating and measuring sub-femtosecond electron pulse trains, and explore a few potential applications for these ultrashort bunches.

Thursday THA 1:30pm

Chair: Lars Groening (GSI)

Commissioning of simultaneous top-up injections into 4 + 1 storage rings at KEK injector linac
Fusashi Miyahara - KEK
The electron-positron injector linac at KEK has delivered electrons and positrons for particle physics and photon science experiments for 40 years. The linac has been rejuvenated for the SuperKEKB asymmetric-energy collider project since 2010 after a decade of successful operation of the previous KEKB project. This project aims at a 40-fold increase in luminosity over KEKB, in order to increase our understanding beyond the standard model of elementary particle physics. The SuperKEKB collider, with its extremely high luminosity, requires injection beams with high current and low emittance in the transverse and longitudinal directions. It should also perform simultaneous top-up injections into four storage rings and a damping ring by pulse-to-pulse modulations (PPM) at 50 Hz to avoid interference between three facilities: SuperKEKB, Photon Factory (PF), and PF Advanced Ring (PF-AR). It is especially important because the beam lifetime would become very short like 5 minutes. The first full operation was tested with hundreds of pulsed devices, and it was successfully deployed in the routine operation.

High-efficiency ultra-short pulses from infrared FEL oscillators for an attosecond X-ray source with high-harmonic generation
Ryoichi Hajima - QST
High-harmonic generation (HHG) to produce attosecond VUV and X-ray pulses is now utilized for studying ultrafast dynamics in atoms and molecules. However, the generation of photons above 1 keV from HHG has not been realized mainly due to the lack of mid-infrared lasers satisfying conditions for HHG, wavelength, pulse energy, pulse duration, and repetition. Thanks to wavelength tunability and high-repetition availability, a FEL oscillator is a potential driver of HHG complementary to conventional solid-state femtosecond lasers [1]. We recently launched a research program to establish technologies for the FEL-HHG. Exploiting two FEL facilities, KU-FEL at Kyoto University and LEBRA-FEL at Nihon University, we will conduct generation of few-cycle IR pulses in a FEL oscillator with a high efficiency (> 20%), stacking of FEL pulses in an external cavity, stabilization of carrier-envelope phase in a FEL oscillator, and a proof-of-concept experiment of the FEL-HHG. After the program is completed, we can proceed to a full-scale FEL-HHG facility with a superconducting linac. In this talk, we present up-to-date results from the research program and future perspectives of the FEL-HHG.

A high brightness RF gun development for the SuperKEKB collider
Xiangyu Zhou - KEK
A high-current low-emittance electron beam source is indispensable to realizing nano-beam scheme for higher collision rates at SuperKEKB electron positron collider. A photo-cathode high-current RF gun was developed. The primary target of the gun is a bunch charge of 4 nC and an emittance of 10 mm.mrad to allow for minor emittance blow-up along the linac. Each component of the RF gun, such as the laser, photo cathode, and cavity, was examined carefully for stable long-term operation. A laser system with a Yb-doped fiber oscillator, a fiber amplifier, a thin-disk multipass amplifier, and two-stage frequency doublers was installed to realize high-power and shaped laser pulses. A combination was chosen for a baseline, with an Nd:YAG laser for higher power, IrCe cathode for longer lifetime and reasonable quantum efficiency, and a quasi-traveling-wave side-couple cavity (QTWSC) for higher accelerating gradient and space-charge-effect mitigation. A stable beam with lower current is already applied for the beam commissioning. Further improvements are investigated carefully with temporal shaping of laser pulses to mitigate energy spread.

High repitition rate RF guns
Boris Leonidovich Militsyn - Cockcroft Institute
The next generation of linear accelerator designed to drive FELs, used in experiments on new acceleration techniques, Electron Diffraction experiments and other new applications require electron injector which provides high brightness electron bunches at high repetition rate, which will require RF guns operating at higher average powers. State of the art normal conducting RF guns operating above 400 Hz will be reviewed as well as presenting the development of a high repetition rate RF gun at Daresbury Laboratory. Photocathode development, thermal issues and RF performance will be discussed as well as discussing phase transients caused by pulsed RF heating.

Novel Experiments at CLARA
Deepa Angal-Kalinin - STFC/DL/ASTeC
CLARA phase1 provides 35 MeV ultra-high brightness electron beam to test new ideas in wide range of areas such as cancer treatment, novel ideas to accelerate and deflect electron beams as well as development of state-of-the-art diagnostics by industry and academic users. The first run has achieved several key experimental results. The capabilities of CLARA phase 1, the experimental results from first run and plans for CLARA phase 2 250 MeV beam exploitation beam line will be presented.

Thursday THP 3:50pm

Chair: Marion White (ANL)

Superconducting Twin-Axis Cavities - Development and Applications
HyeKyoung Park - ODU
Superconducting cavities with two beam pipes have been proposed in the past for a number of applications, including energy recovery linacs. The relatively complex geometry of those cavities presented a serious challenge for fabrication and surface processing. Main concerns have now been overcome with the design, production, and successful RF testing of a new "elliptical" twin-axis cavity. this was performed as a collaboration between Jefferson Lab and the Center for Accelerator Science at Old Dominion University as part of the DoE Accelerator Stewardship Program. The cavity design provides uniform accelerating or decelerating fields for both beams. This paper describes the cavity design, fabrication experience, and the first cold RF test results; and explores potential applications.

Particulate field emitters in CEBAF: from root-cause studies to mitigation solutions
Rong-Li Geng - JLab
Root-cause studies of particulate studies started in 2014 is concluding. Its outcome is to guide the selection of mitigation solution including effective off-line particulate reversal and in-line particulate interception. This effort is further enhanced by two UHV particle counters, one being a commercial unit and the other being a novel design which is prototyped by JLAB in collaboration with industry.
Overview of Plasma Processing programs in the SRF community Marc Doleans ORNL
Successful Plasma processing R&D and deployment has been achieved at the SNS and other institutes are actively pursuing similar technique for their applications. This talk will summarize the results, statuses and plans for plasma processing programs around the world.

Progress in Nb3Sn: on the edge of the technology revolution in SRF cavity performance
Sam Posen - Fermilab
Nb3Sn SRF cavities can achieve higher Q than traditional niobium cavities over a wide temperature range due to their higher critical temperature. If sufficiently strong performance can be shown, this material could be an enabling technology for linacs in which cryogenics are a cost driver, including compact accelerators and large CW facilities. This contribution overviews significant recent progress in demonstrating the practicality of Nb3Sn cavities for accelerator applications, including a) reaching a maximum cw accelerating gradient of 24 MV/m, a record for an SRF cavity made from a material other than niobium; b) demonstrating cold tuning of a cavity without degradation; and c) the first 9-cell 1.3 GHz Nb3Sn cavity. We also highlight a recent demonstration of 'cryogen-free' operation of a Nb3Sn cavity with conduction cooling by a cryocooler, and discuss the potential for industrial accelerators.

SRF R&D for the LCLS-II High Energy Upgrade
Daniel Gonnella - SLAC
The LCLS-II X-ray FEL is being constructed from 1.3 GHz SRF cavities oprating at 16 MV/m and with Q0's of roughly 2.7e10, roughly double that of the technology. The LCLS-II High Energy (LCLS-II-HE) upgrade will increase the LCLS-II CW SRF linac from 4 to 8 GeV. To enable this upgrade in the available space in the SLAC linac tunnel, R&D is being performed to improve the SRF cavity gradients while maintaining the very high Q0's. This talk will describe the R&D toward advanced cavity processing techniques that will enable the LCLS-II-HE.

Distributed coupling Linacs from room temperature to Superconducting
Mamdouh H. Nasr - SLAC (Linac20 Student Prize Winner)
We present Theory, simulations and related external results for new concepts being explored at SLAC for high-gradient RF accelerators, namely the distributed coupling accelerator structure. We utilize a novel power-feeding technique that feeds every accelerating cell independently using a distributed feeding network. This eliminates the need for excessively large coupling holes between adjacent cells, which gives a large optimization flexibility for the accelerator geometry. We are also developing a novel approach to multi-mode acceleration, where we propose a design for which frequencies are not necessarily harmonically related, but rather have a common sub-harmonic. This provides a wider design space and results in much-enhanced properties. Finally, we are currently experimentally investigating the operation of normal conducting (NC) linacs at cryogenic temperatures for its enhanced material properties in terms of surface hardness and reduced surface losses. As a result, the cryogenic operation for NC linacs reduces breakdown rates compared to room temperature operation and pushes the structure to record accelerating gradient.

CW RF Gun Development
Bruce Dunham - SLAC
Many linear accelerators e.g. those for FELs require CW operation as well as highest possible beam quality. Since brightness of the electron source is a key issue, high accelerating gradient in the RF gun is required although difficult to achieve especially in CW mode. Different types of RF guns have been developed in the last years. The presentation will give an overview of the different types CW RF guns, both normal and superconducting.

Friday FRA 1:30pm

Beam reliability and stability studies at 25 MeV CW superconducting proton linac in Lanzhou
Yuan He - IMP/CAS
IMP built the world first 25 MeV CW proton superconducting linac as a front-end demo for ADS linac. This machine was operated at CW 2 mA with proton beam energy 16 MeV continuously for more than 100 hours to study beam stability and reliability. Recently another test operation with higher beam power and continuously longer operation time have been conducting in order to achieve better performance and better long-term reliability. This talk will present the beam reliability and stability studies at 25 MeV CW superconducting proton linac.

Commissioning of Superconducting Linac Booster for Heavy-Ion Linac at RIKEN Nishina Center
Osamu Kamigaito - RIKEN Nishina Center
At RIKEN Nishina Center, the RIKEN Heavy-Ion Linac (RILAC) is undergoing an upgrade of its acceleration voltage and beam intensity in order to allow it further investigation of new super-heavy elements. In this project, a new superconducting booster linac, so-called SRILAC, and a new superconducting ECR ion source have been developed and constructed. The SRILAC consists of ten quarter-wavelength resonators made of pure niobium sheets which operate at 4 K. The target performance of each cavity is set as Q0 of 1×10^9 with its accelerating gradient of 6.8 MV/m. The cryomodules were installed in the beam line in March 2019, and the first cool-down test was carried out successfully in September 2019. The installation of the beam line components such as BPMs and the differential pumping system was completed. In parallel, beam test of the new superconducting ECR ion source and its LEBT is being carried out. It has been confirmed that intense metallic ion beam is produced for a long time with a designed beam emittance. The acceleration test with RILAC will be started by the end of FY2019. This contribution makes a report on the commissioning status of the upgrade project of RILAC.

Demonstration of High Current Deutron Acceleration for the LIPAc 5MeV RFQ
Sakamoto Keishi - QST
The Linear IFMIF Prototype Accelerator (LIPAc) is under construction as a collaboration between Europe and Japan for challenging the technical validation of the low energy part up to 9MeV of IFMIF deuteron accelerator unit with 40MeV-125mA CW. The staged installation and commissioning activities are ongoing at the BA site in Rokkasho Fusion Institute of QST, and the commissioning of RFQ is underway. A deuteron beam acceleration at 5 MeV, 125mA was achieved at short pulse (~1 ms pulse duration) at ~1 Hz repetition. Here, ~90 % beam transport was obtained. Here, 8-chains of 175 MHz CW RF sources are connected to the RFQ in parallel. After that, MEBT, D-plate, HEBT and high power beam dump were connected to the RFQ in series, and high duty cycle beam commissioning will be implemented.

Beam commissioning of SPIRAL2 linac
Robin Ferdinand - GANIL
On July 8th, 2019 the French nuclear safety authority gave the administrative authorization to start up the full SPIRAL2 facility at GANIL. This opens the way for the various steps involved in the commissioning of the accelerator. The superconducting LINAC will be first commissioned with light ion beams and with gradually increasing beam power. The high beam power (up to 200kW) makes it the most powerful accelerator for nuclear physics in this energy domain. So far, a first proton beam has been successfully accelerated to the nominal energy of 33MeV. All cavities showed nominal performances with the small beam power used for this first step. The talk will present the project status report with emphasis on SRF achievement and beam commissioning and the expectation for the next months.

Brilliant beam acceleration at longitudinal phase advances far beyond 90°
Anna Rubin - GSI
Low rigidity ions (protons) may be requested from a linac that has been designed explicitly for high rigidity beams (uranium). To avoid operation of the rf-power systems at the lower edge of stability or even below, the rf-phase can be lowered considerably hence operating with sufficiently high rf-power and high longitudinal phase advance. Such scenarios were studied in simulations revealing that the phase advance limit of 90°, being experimentally proven and respected in the transverse case, does not apply in the longitudinal plane. High quality beams can be delivered by longitudinal focusing far beyond 90°. Instead a new restriction for sum of longitudinal and transverse phase advances is to be taken into account for provision of low emittance growth operation.

Recent development of medical linacs for high income and low-middle income countries
Manjit Dosanjh - CERN
In the lowest income counties within Africa only 4% of cancer patients that need radiotherapy receive RTT. There are currently 385 radiotherapy machines on the continent of 54 countries and 1 billion people. About 60% of the machines are found in just three countries: South Africa, Egypt and Morocco. The next 20% are also in just three countries: Tunisia, Nigeria and Algeria. Even though high cost of these machines is an issue, downtime is a major issue in African radiotherapy centres which can affect treatment outcomes and severely limits the number of radiotherapy facilities. In 2016 Ghana¿s only linac failed, having been in operation since 1995, while most radiotherapy machines are only meant to last 10-15 years with proper maintenance by the manufacturer. If these machines were to be optimised to make maintenance easier while extending the life of a linac it could have a major impact on availability of radiotherapy in developing countries. In this talk the scale of the problem and what we can do to address it is presented.

Friday FRP Closing session 3:50pm

Chair: Graeme Burt (Cockcroft Institute)

ERLs for Cooling High Energy Electron-Ion Colliders
Stephen Vincent Benson - JLab
Future electron-ion colliders such as the recently approved eRHIC collide high-intensity ion beams with high current electron beams. The electron beams take advantage of synchrotron radiation to damp emittances but the ion beams must be cooled via some beam-cooling mechanism, including electron cooling. The ion energies are typically a few hundreds of GeV per nucleon. At this energy, a DC cooler powered by an electrostatic accelerator, the conventional cooling approach, is not feasible. An ERL can provide the high current and brightness to cool these high-brightness ion beams. The beam quality requirements are much different from previous ERLs designs used for FELs. The cooling bunch must be very long to match the ion beam and the relative energy spread must be very small. Incoherent cooling can be enhanced with magnetized beams, but the magnetization must be maintained throughout the ERL. An alternate cooling mechanism, Coherent Electron Cooling can be stronger and does not need a magnetized beam. We will present two applications of an ERL to high energy electron cooling and describe some of the technical challenges that must be overcome to operate such an ERL.

S30XL (aka DASEL): a new beamline for dark sector exploration
Thomas Markiewicz - SLAC
Many experiments are being proposed that require high quality, low current, GeV-class electron beams. A new beamline is being constructed that will connect the LCLS-II SRF linac to the SLAC End Station A that will be used to extract 'dark current' from the SRF linac without impacting the X-ray FEL program. The beams are extracted using a fast kicker operating at 929 kHz with a ~50% duty cycle. This talk will describe the new beamline and the diagnostics, kickers, and controls that are required to successfully deliver sub-pA beams to ESA.

Status of the LCLS-II CW X-ray FEL
Yuantao Ding - SLAC
The LCLS-II is an upgrade of the LCLS X-ray FEL at SLAC that consists of two new undulators, a 4 GeV CW SRF linac, and roughly 3 km of new transport lines. Installation of the SRF linac is still in progress but the new undulators and much of the new transport lines will be commissioned in the Spring of 2020. The new undulators and transport lines will double the spectral reach of the LCLS to >25 keV and will support all of the beam manipulation technqiues that have been developed at the LCLS to produce unique X-ray pulses. This talk will review the operational status the X-ray sources as well as the construction status of the SRF linac.

Student Prize Talk (Sponsored by the IET)

This year the Linac20 student prize was decided by video presentations submitted to the panel. The students with the best four presentations were then asked to attend a Q&A session. The results are as follows
1st Prize: Mamdouh Nasr (SLAC)
2nd Prize: Lee Millar (Lancaster/CERN)
Runners up: Laurence Nix (Strathclyde) & Iresha Senevirathne (ODU)
As Mamdouh Nasr was already giving an invited talk this slot will now be a presentation by the 2nd Prize winner

High Power Conditioning and Breakdown Studies in Coupled Accelerating structures: Lee Millar (Lancaster)

Science case for FELs
Jonathan Philip Marangos - Imperial College of Science and Technology
As the first science from the X-ray FEL's have been coming out over the last few years, there has been a flurry of new X-ray FEL's been proposed around the world. In this talk we look at the science output from existing FEL's and look at the science case for new machines to complement existing machines.

Overview of machine learning effort for particle accelerators.
Andreas Adelmann - PSI
Summary of latest developments and application of machine learning for charged particle accelerators including RF conditioning, fault detection and classification and beam optimisation

TUA	Chair: Graeme Burt
13:30	**Introduction and Welcome** Peter McIntosh, STFC, *Chair IOC* Carsten Welsch, U Liverpool, *Chair LOC* Graeme Burt, U Lancaster, *Chair SPC*
13:50	**The Compact Linear Accelerator for Research and Applications (CLARA) at Daresbury Laboratory: Susan Smith (STFC)**
14:20	**FRIB construction, installation, SRF and beam commissioning: experience and lessons learned: Jie Wie (FRIB)**
14:50	Performance and Operational Experience with the European X-FEL Linac: Nick Walker (DESY)
15:10	Update on Fermilab's PIP-II Project: Lia Merminga (FNAL)
15:30	Coffee

TUP	Chair: Sami Tantawi
15:50	Status and perspectives of ESS linac: Hakan Danared (ESS)
16:10	Overview of High Power RFQ issues and solutions: Pisent (INFN)
16:30	Transition between different acceleration sections of Hadron Linacs: Michele Comunian, INFN
16:50	Status of MYRRHA fault tolerant linac project: Frederic Bouly (LPS)
17:10	High Power normal-conducting linacs upgrade in US: Deepak Raparia,BNL
17:30	Overview of linacs for compact neutron sources: David Baxter (IU)
17:50	SNS Proton power upgrade (PPU) and operational experience: Mark Champion (ORNL)
18:10	

WEA	Chair: Frank Gerigk
13:30	Development of Superconducting Linac Technology in India: Purushottam Shrivastava, RRCAT
13:50	Dislocation dynamics their role in high-gradient phenomena: Jan Paszkiewicz (Oxford/CERN)
14:10	Collaborative developments with industry for advanced accelerator applications: Anthony Gleeson (STFC)
14:30	Design and experimental validation of a mm-wave woodpile-based dielectric structure for accelerators: Giuseppe Torrisi (INFN)
14:50	Technological Advancements in Material Handling for High-Gradient Operation of an innovative braze-free accelerating structures: Luigi Faillace (INFN)
15:10	Innovative Radiometric Diagnostics for Future Linear Accelerators: Joe Wolfenden (ULIV)
15:30	Coffee

WEP	Chair: Fulvia Pilat
15:35	Women in Science and Engineering (WISE): Should I stay or should I go now?
17:10	CBETA: The first Multipass SRF Based ERL: Colwyn Gulliford (Cornell)
17:30	First linear acceleration of relativistic electrons using THz waveguides: Darren Graham (UMAN)
17:50	Accelerator on a CHIP: Dylan Black, Stanford University
	Close

THA	Chair: Lars Groening
13:30	Commissioning of simultaneous top-up injections into 4 +1 storage rings at KEK injector linac: Fusashi Miyahara, KEK
13:50	High-efficiency ultra-short pulses from infrared FEL oscillators for an attosecond X-ray source with high-harmonic generation: Ryoichi Hajima (QST)
14:10	A high brightness RF gun development for the SuperKEKB collider: Xiangyu Zhou, KEK
14:30	High repitition rate RF guns: Boris Militsyn (STFC)
14:50	Commissioning of high power linear induction accelerator for X-ray flash radiography at BINP: Danila Nikiforov, BINP SB RAS
15:10	Novel experiments at CLARA: Deepa Angal_Kalinin (STFC)
15:30	Coffee

THP	Chair: Marion White
15:50	Superconducting Twin-Axis Cavities - Development and Applications: HyeKyoung Park (ODU)
16:10	Particulate field emitters in CEBAF: from root-cause studies to mitigation solutions: Rong-Li Geng (Jlab)
16:30	Overview of Plasma Processing programs in the SRF community: Marc Doleans (ORNL)
16:50	Progress in Nb3Sn: on the edge of the technology revolution in SRF cavity performance: Sam Posen (FNAL)
17:10	SRF R&D for the LCLS-II High Energy Upgrade: Daniel Gonnella (SLAC)
17:30	Distributed coupling Linacs from room temperature to Superconducting: Mamdouh H. Nasr, SLAC **(Linac 20 student prize winner)**
17:50	CW RF Gun Development: Bruce Dunham (SLAC)

FRA	Chair: Hongwei Zhou
13:30	Beam reliability and stability studies in superconducting high power protonlinacs: Yuan He (IMP)
13:50	Commissioning of Superconducting Linac Booster for Heavy-Ion Linac at RIKEN: Osamu Kamigaito (RIKEN)
14:10	Demonstration of High Current Deuteron Acceleration for the LIPAc 5MeV RFQ: Keishi Sakamoto, QST
14:30	Beam commissioning of SPIRAL2 linac: Robin Ferdinand (CEA)
14:50	Brilliant beam acceleration at longitudinal phase advances far beyond 90°: Anna Rubin (GSI)
15:10	Recent development of medical linacs for high income and low-middle income countries: Manjit Dosanjh (CERN)
15:30	Coffee

FRP	Chair: Graeme Burt
15:50	High Energy ERLs for Electron Cooling: Stephen Benson (Jlab)
16:10	S30XL (aka DASEL): a new beamline for dark sector exploration: Thomas Walter Markiewicz, SLAC
16:30	Status of the LCLS-II CW X-ray FEL: Yuantau Ding (SLAC)
16:50	High Power Conditioning and Breakdown Studies in Coupled Accelerating structures: Lee Millar (Lancaster) **(Linac20 2nd prize winner talk)**
17:10	**Science case for FELs: Jon Marangos (Imperial)**
17:40	**Overview of machine learning effort for particle accelerators: Andreas Adelmann (PSI)**
18:10	Closing session

Opening/Closing

Electron Machines

Proton & Ion machines

LINAC2020

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