MOXAUD — Plenary I

08:30-08:50: Opening Remarks

H. Montgomery (Jefferson Lab)

Opening remarks for the EIC'14 Workshop.

08:50-09:20: HERA Experience or Lessons Learned at HERA, the Last e-p Collider

M. Bieler (DESY)

HERA, the Hadron Electron Ring Accelerator, was proposed in 1981 and delivered luminosity from 1992 to 2007. Protons of up to 920 GeV collided with polarized electrons or positrons of 27.5 GeV. This talk will review the design of this very asymmetric collider and focus on operational experience gained with this unique machine.

09:20-09:50: Overview of LHeC Project

O.S. Brüning (CERN)

The presentation provides an overview of the LHeC study at CERN and highlights upcoming milestones and R&D projects for a further development of the study. The LHeC aims at e-p collisions in the TeV Centre of Mass energy scale by colliding 60 GeV electrons coming from a recirculating Linac operating in Energy recovery Mode with one of the 7 TeV proton beams of the LHC.

09:50-10:20: eRHIC Accelerator Design

V. Ptitsyn (BNL)

MOYAUD — Plenary II

10:40-11:10: MEIC Project at Jefferson Lab

F. Lin (Jefferson Lab)

The polarized Medium-energy Electron-Ion Collider (MEIC) has been conceptually developed at Jefferson Lab as a new tool to explore the structure of nuclear matter on the basis of Quantum Chromodynamics at the center-of mass energy of up to 65 GeV. In the past few years, a steady machine conceptual design has been successfully progressing to achieve high luminosities (up to 10^{34} $cm^{-2}s^{-1}$ per interaction point), high polarizations, and unique detection capabilities. This talk will report recent progress on the conceptual design of MEIC in the following areas: electron and ion complex design, detector region design, optimization of non-linear dynamics, ion polarization control, electron polarization configuration, high-energy electron cooling based on an ERL-circulator-ring system and beam cooling simulations. Future studies will primarily focus on the design optimization, crucial accelerator R&D and technology development.

11:10-11:40: HIAF Accelerator Design

H.W. Zhao, J.W. Xia, J.C. Yang (IMP)

HIAF (High Intensity heavy ion Accelerator Facility) is a new accelerator project in China. The HIAF main scientific motivation includes the researches such as high energy density (HED) matter physics, the effective strong interaction binding atomic nuclide, the creation of the trans-iron elements in universe and intrinsic structure of nucleon by electron-ion collision (EIC). The EIC part will be in the second construction phase. The accelerator complex in the first phase consists of a 25MeV/u high current superconducting ion linac (iLinac) as an injector, a 34 Tm booster ring (BRing) for phase painting beam accumulation supported by electron cooling and beam acceleration, and a 43 Tm high energy storage ring for beam stacking and beam compression(CRing). The unique features of the first phase of HIAF are high current pulsed injection beams from the iLinac and high intensity heavy ion beams with ultra-short bunch from the CRing. The cooled rare isotope beams also will be prepared through projectile-fragmentation (PF) method. This talk will present an overview of the HIAF project with emphasis on concept design of the HIAF accelerator.

11:40-12:10: Accelerator R&D for Ring-Ring EIC

Y.S. Derbenev (Jefferson Lab)

In this talk we present a substantiation of the ring-ring scheme choice of EIC compared to a ERL-based linac-ring scheme in general as well as conformably to the fortunate conditions of Jefferson Laboratory where 12 GeV CEBAF can be used as full energy injector of polarized electron beam to the storage ring of the collider. A survey and current state of the related R&D items of the designed electron-ion accelerator complex and further developments plans of the medium energy EIC&Jefferson Lab (MEIC) project will be described.

12:10-12:40: Accelerator R&D for Linac-Ring EIC

I. Ben-Zvi (BNL)

The use of an electron ERL to collide with an ion storage ring (thus the name linac-ring) is a relatively new idea, and at the time being no such machine has been built. Presently, two Linac-Ring machines have been proposed: (*) LHeC (based on the LHC ion storage ring at CERN), presented at this workshop by O. Bruning. (*) eRHIC (based on the RHIC ion storage ring at BNL), presented at this workshop by V. Ptitsyn. Both machines rely on multi-turn acceleration and energy recovery. Why have these facilities chosen the linac-ring configuration? There are many reasons, but mostly: (*) High luminosity — remove the beam-beam limit of the electron machine. (*) High spin polarization, simple spin systems. (*) Upgradeability — it is easy to start at a lower energy, and then add voltage. Since no such machine is in operation, R&D is necessary, to be described in this presentation. The design and R&D efforts on either of these two machines can fill up a whole workshop. Only highlights will be covered in this 30 minutes presentation but I will point to more detailed presentations in the Working Group sessions.

MOCAUD — Working Group: Beam Physics

13:40-14:10: Accelerating Polarized He3 Beam in eRHIC

M. Bai, Y. Dutheil, H. Huang, F. Meot, T. Roser, V. Schoefer, A. Zelenski (BNL)

As the world's first high energy polarized proton collider, RHIC has made significant progresses in measuring the proton spin structure in the past decade. The quest to have deep understanding of the gluons seeks a high energy and high-luminosity electron ion collider (EIC). Current BNL design of eRHIC extends the current high energy polarized proton collision at RHIC to collisions of polarized He-3, which enables better understanding of the contribution of up quarks and down quarks to the proton spin structure. In this paper, we present studies of accelerating polarized He-3 in RHIC with three pairs of Siberian snake configuration. Scenarios of accelerating polarized He-3 through BNL RHIC complex is also reported.

14:10-14:40: Achieving Proton Polarization Goals for eRHIC

H. Huang, M. Bai, F. Meot, T. Roser (BNL)

As the first and only polarized proton collider in the world, RHIC has provided collisions from 31 GeV to 255 GeV in past decade. To preserve polarization through numerous depolarizing resonances through the whole accelerator chain, harmonic orbit correction, partial snakes, tune jump system and full snakes have been used. In addition, close attentions have to be paid to tune control, orbit control and beam line alignment. The polarization of 60% at 255 GeV has been delivered to experiments with 1.8×10^{11} bunch intensity. For the lower intensity in the eRHIC era, the polarization will be higher due to smaller transverse emittance. Since we only have one hadron ring in the eRHIC era, the spin rotators in one existing hadron ring can be converted to snakes. With six snake configuration, the polarization can be maintained at 70% at 250 GeV, even with future upgraded intensity. This paper summarizes the effort in the past to reach high polarization and the plan for the future eRHIC era.

14:40-15:10: Ion Polarization Control in Figure-8 Rings Using Small Magnetic Field Integrals

A.M. Kondratenko, M.A. Kondratenko (Science and Technique Laboratory Zaryad) Y.S. Derbenev, F. Lin, V.S. Morozov, Y. Zhang (Jefferson Lab) Y. Filatov (MIPT)

Figure-8 accelerators open new possibilities of beam polarization control in the region of zero spin tune for any particle species including deuterons. High-precision experiments with polarized beams become a reality. In contrast to conventional accelerators, use of small magnetic field integrals is sufficient to control the beam polarization. We present a scheme for preservation of polarization of light ions in all stages of the MEIC ion complex including the prebooster, large booster and collider ring. To control the deuteron polarization in the ion collider of MEIC, we propose a 3D rotator based on the use of three ``small'' solenoids placed between already existing structural arc dipoles and radial-field dipoles of the vertical dogleg sections. The 3D-rotator scheme allows one to obtain any polarization orientation at the beam interaction points including vertical and longitudinal. To obtain any proton polarization orientation in the ion collider ring of MEIC, we propose a scheme, which operates in the spin tune range from zero to one half allowing, in particular, implementation of multi-turn as well as one-turn spin-flipping systems.

MODAUD — Working Group: Beam Physics

15:30-16:00: Electron Polarization Dynamics in eRHIC

V. Ptitsyn (BNL)

16:00-16:30: Polarized Electron Beams in the MEIC Collider Ring at JLab

F. Lin (Jefferson Lab)

A highly longitudinally-polarized (over 70%) electron beam is required by the nuclear physics program of the Medium Energy Electron-Ion Collider (MEIC) at the Jefferson Lab. To achieve this goal, the polarization is designed to be vertical in the arcs to avoid spin diffusion and longitudinal at the collision points. The polarization rotation will be accomplished by using a total of four spin rotators, each of which consists of a set of solenoids and dipoles, placed at the ends of two arcs. In order to mitigate the Sokolov-Ternov depolarization effect, especially at higher energies, a continuous injection of polarized electron beam from the CEBAF is considered. In this talk, I will present the new-developed universal spin rotator design, address coupling compensation schemes for the solenoids, provide polarization configuration based on the spin rotators' layout, and explore the use of continuous injection of electrons from the CEBAF into the MEIC collider ring for maintaining high equilibrium polarization.

16:30-17:00: Development of Precise and Fast Spin-Orbit Tracking Codes

D.T. Abell (Tech-X)

Accurate spin-orbit tracking is a valuable, and often essential, tool for understanding and improving spin dynamics in particle accelerators. This talk presents a discussion of issues that affect the accuracy of spin-orbit tracking and then describes a method for speeding the convergence of spin tracking by orders of magnitude. This talk also presents a quantitative evaluation of the resulting integrators for both individual elements and the full RHIC lattice.

MOCF113 — Working Group: SRF/ERL

13:40-14:10: The LHeC ERL Cavity Development and Test Facility

E. Jensen (CERN) Oliver Sim Brüning, Rama Calaga, Karl Martin Schirm, Roberto Torres-Sanchez, Alessandra Valloni (CERN, Geneva), Kurt Aulenbacher (IKP, Mainz), Andrew Hutton (Jefferson Lab, Newport News, Virginia), Max Klein (The University of Liverpool, Liverpool)

The baseline electron accelerator for LHeC and also an option for the FCC-he (Future Circular Collider study, hadron-electron) is an energy recovery linac (racetrack, two anti-parallel 10 GeV linacs with 3 passes). To prepare and study the necessary key technologies, a proposal of a CERN-based ERL Test Facility has been made and is now under study. Core of the study, planned to be performed jointly with the international partners Jefferson Lab and Mainz University, are the superconducting cavity modules aiming at large Q0 and sufficient HOM damping to allow beam currents of about 50 mA; the frequency chosen is 802 MHz, compatible with CERN's existing and planned machines and filling schemes as well as the MESA facility in Mainz. This contribution will describe the goals and status of the cavity development.

14:10-14:40: Upgrade of SRF Systems for SuperKEKB

M. Nishiwaki, K. Akai, T. Furuya, A. Kabe, S. Mitsunobu, Y. Morita (KEK)

Eight superconducting accelerating cavities were operated for more than ten years at the KEKB. Upgrade to SuperKEKB is ongoing and those cavities are also used to accelerate the beam current of 2.6 A. There are some issues to address the large beam current and to realize stable operation. One issue is a large HOM power of 37 kW expected to be induced in a cavity module. In particular, the power emitted out to the downstream of the cavity is simulated to be large. To cope with the HOM power issue, we plan to install an additional HOM damper to the downstream of the cavity module. Another issue is degradation of Q values of the cavities during the ten years operation. Cause of the degradation was particle contamination. To clean the cavity surface, high pressure rinsing (HPR) is an effective way. Therefore we have developed a horizontal HPR. In this method, a nozzle for water jet is inserted horizontally into the cavity module without disassembly of the cavity. We applied the horizontal HPR to our degraded cavities. The RF performances of those cavities have been successfully recovered. In this report, present status of our cavity upgrade will be presented.

14:40-15:10: IMP SRF Technology R&D

Y. He (IMP)

IMP is involved in two projects, one is China ADS and the other is High Intensity Heavy Ion Accelerator Facility. The heavy ion superconducting linac is 25 MeV/u @ $238U^{34+}$. Both of the lianas employ 162.5 MHz HWRs and 325 MHz Spokes. Now, four kinds of superconducting cavities are developing in IMP. The prototypes of HWR010 have been tested in vertical. One of the cavity passed the horizontal testing in a test cryomodule with two solenoids and a cold BPM. Two spoke021 cavities have been fabricated, and it will be tested in March 2014. The spoke032 and multi-spoke 052 are designing. All the superconducting cavities are etching, high pressure resign ; cleaning and assembling in IMP. The SRF infrastructures, BCP, HPR,,HPW, and clean room will be presented too. Except for the common cavities, we also designed and is fabricating a superconducting CH cavity. The property and progress of CH cavity are shown in the presentation too.

MODF113 — Working Group: SRF/ERL

15:30-16:00: Developing SRF Cavities for eRHIC ERL

W. Xu (BNL)

The electron-ion collider (eRHIC) proposed at BNL requires high average current superconducting RF cavities. A high current 5-cell Nb SRF cavity, called BNL3 cavity, was designed. To achieve the high current application, the BNL3 cavity was optimzed to damp all the dangerious higher-order-modes (HOMs) to avoid inducing emittance degration and beam-break-up (BBU), through employing a large beam pipe to propagate all the HOMs but not fundamental mode. Additionally, as common SRF cavities' design, BNL3 cavity was also designed for an acceptal cryogenic loading and peak-surface-fields (Bpeak/Eacc, Epeak/Eacc). Two BNL3 cavties have been fabricated and undergoing preparation for the vertical tests at BNL. This presentation will address the development of the SRF cavities for eRHIC, including SRF cavity design, fabrication and test results. The HOM coupler design for this high current SRF cavity to well damp the HOMs was designed and tested with prototypes, which will also be addressed in the presentation.

16:00-16:30: SRF Cavity Design for MEIC High Current Electron Cooler ERL

H. Wang, Robert Rimmer, Shaoheng Wang (Jefferson Lab, Newport News, Virginia)

In this talk, an electromagnetic design survey for the Superconducting Radio Frequency (SRF) cavities for different Energy Recover Linac (ERL) projects will be given. A 748.5MHz, 5-cell, Jefferson Lab High Current (Low Loss) shape has been re-optimized for the ERL CW beam operation of 300mA. HOM power calculation based on the beam filling patterns and the wakefield/impedance simulation results will be presented. The ``Y'' shape waveguides next to cavity end cells will damp the HOM power to a few kilowatts level. Previous cavity prototype work at this frequency for the High Power Free Electron Laser (FEL) and its test result have proofed the success this original design. Taking the advantage of this R&D outcome and contingency of the cryomodule, power couplers and HOM load developments will demonstrate full feasibility of the high current ERL technology for the Electron Coherence Cooling Ring (CCR) need in the future Electron Ion Collider (EIC).

16:30-17:00: Preliminary Design of the CERN ERL Test Facility

A. Valloni, O.S. Brüning, E. Jensen, M. Klein, F. Zimmermann (CERN) S.A. Bogacz (Jefferson Lab)

A proposal for a scientific and technical R&D facility based on a recirculating superconducting linac is under active development at CERN. The conceptual design of this facility allows for a staged construction with a number of well-defined intermediate steps, leading to an ultimate beam energy of about 1 GeV. Aside from various other technical and physics goals and applications considered, this ERL facility, in particular, aims at investigating the ERL principle, including its specific beam dynamics, operational and reliability issues as relevant for the LHeC, and at providing a test stand both for superconducting (SC) RF cavity modules and for controlled beam induced quenches of SC magnets. In this contribution we describe the overall layout of the proposed complex and the specific requirements along with schematic staging options, including a multi-pass optics design for two linacs operated in energy recovery mode and for the various return arcs.

TUAAUD — Working Group: Beam Physics

08:30-09:00: Fermilab's 4.5 MeV Electron Cooling: Experience and Legacy

V.A. Lebedev, A.V. Shemyakin (Fermilab)

The Fermilab's Recycler ring employed a 4.3 MeV, 0.1A DC electron beam to cool antiprotons for accumulation and preparation of bunches for the Tevatron collider. The most important features that distinguished the Recycler cooler from other existing electron coolers are its relativistic energy, a low value of the longitudinal magnetic field in the cooling section, ~100 G, and the lumped focusing in the electron beam lines. The report will summarize the experience accumulated during designing, commissioning, and running of this unique machine.

09:00-09:30: Coolers with Magnetized Beam for Different Energies: Experience and Future Possibilities

V.B. Reva, M.I. Bryzgunov, A.V. Bubley, V.K. Gosteev, V.M. Panasyuk, V.V. Parkhomchuk (BINP SB RAS) J. Dietrich (HIM) V. Kamerdzhiev (FZJ)

In the present time the large experience of using magnetized cooling was collected. The first experiments in BINP and further experiments in the others scientific centers shows the usefulness of the idea of megnetized cooling. There are many electron cooler devices that operate now at low and middle energy (CSRm,,CSRe,,LEIR,,ESR, ...). The 2 MeV electron cooling system for COSY-Julich has the highest energy from all coolers that was made with idea of magnetized cooling and transport of the electron beam. The COSY cooler is designed on the classic scheme of low energy coolers like cooler CSRm, CSRe, LEIR that was produced in BINP before. It can be used for beam cooling at injection energy and for testing new features of the high energy electron cooler for HESR. This report deals with discussion of the COSY coolers, BINP's coolers for low energies and perspective for high-energy coolers.

09:30-10:00: Generation and Dynamics of Magnetized Beams for High-Energy Electron Cooling

P. Piot (Northern Illinois University)

Electron cooling of ion beams often requires the use of an angular-momentum-dominated (or magnetized) electron beam. In this paper we present an overview of the production and transport of magnetized beams focusing both on experimental and theoretical aspects. We review past and planned experiments and discuss new ideas toward the formation of high-current magnetized electron beams.

10:00-10:30: Overview of Beam Cooling for MEIC

Y.S. Derbenev (Jefferson Lab)

In this talk we present a concept and R&D issues of high energy and high current magnetized electron cooling based on use of SRF ERL with circulator -cooler ring and super-fast kicker (SRF or beam-beam). The concept promises to provide a required cooling rate and attain low emittance, very short, high repetition rate ion bunches in EIC collider required for high luminosity. In this way one can manage with a state of art level of pulsed and average current from a grid-operated magnetized DC or RF gun and in ERL at up to a few A current circulated in the cooler ring. This approach also allows one to implement staged cooling in order to significantly reduce cooling time of ion beam injected in the collider ring. We also study expedience to enhance the efficiency of staged approach to cooling and forming of ion beams by adding a classical 2 MeV DC electron cooling and stochastic cooling in prebooster.

TUBAUD — Working Group: Beam Physics

10:50-11:20: HIRFL-CSR Electron Cooling and Challenge of HIAF Electron Cooling

L. Mao (IPM, Lanzhou)

The new facility HIAF (High Intensity heavy ion Accelerator Facility) is designed in China for heavy ion related researches, consists a high intensity heavy ion superconducting Linac (iLinac), a 34 T-m Booster storage Ring (BRing) and a multifunction Compression storage Ring (CRing). The heavy ion beam can be accumulated and accelerated to a maximum energy of 34 T-m at BRing, then extracted to CRing for experiments. Two electron coolers will be constructed at both storage rings, respectively. Electron cooling will assist the accumulated process by stacking in transverse phase space at BRing, and provide high quality beams for experiments at CRing. The general description of the electron cooling design is given in this article.

11:20-11:50: MEIC Electron Cooling Simulation

H. Zhang (Jefferson Lab)

Electron cooling is an essential element of an advanced design concept for reaching an ultra high luminosity up to 10^{34} $cm^{-2}s^{-1}$ per interaction point in Jefferson Lab s medium energy electron-ion collider (MEIC) proposal. A multi-phased electron cooling scheme, namely, an DC cooling in the MEIC pre-booster and a bunched high energy cooling in collider ring, has been proposed for achieving optimized cooling efficiency. In this talk, we present a detailed simulation study of electron cooling in MEIC using BETACOOL codes. Our simulations suggest that the MEIC nominal design parameters are achievable.

11:50-12:20: Beam Physics Issues Encountered During the Operation of CW SRF ERLs

D. Douglas (Jefferson Lab)

We review beam dynamics and performance issues encountered (or not) during the operation of five CW SRF ERLs at Jefferson Lab between 1991 and 2012. These issues included numerous performance-limiting ``surprises'', for which we will discuss work-arounds and solutions.

TUAF113 — Working Group: SRF/ERL

08:30-09:00: BNL Crab Cavity and Other Candidates for the LHC Luminosity Upgrade

Q. Wu (BNL)

09:00-09:30: Development of 750 MHz Crab Cavity for MEIC

A. Castilla (Jefferson Lab) J.R. Delayen (ODU)

There are several technical specifications imposed on a Medium Energy Electron-Ion Collider (MEIC) design by the nuclear physics program; the requirement for a high luminosity being one of them. The present talk will look at the crab crossing scheme as one of the proposed ways to achieve it. The basic concepts involved in designing an rf crabbing cavity will be discussed, and conclude with the results of both room temperature and preliminary cryogenic tests of the crab cavity prototype built for the MEIC. This talk is intended to communicate the results and status of the srf prototype design.

09:30-10:00: Experience with High Current Crab Cavity Development for APS Ring

J.D. Mammosser (Jefferson Lab)

TUBF113 — Working Group: SRF/ERL

10:50-11:20: Low Level RF Control of ERLS at High Average Currents

C. Hovater (Jefferson Lab)

In the last 20 years Energy Recovered Linacs (ERL) have been proposed and built for various scientific applications. In many of these projects superconducting (SC) cavities are used as the acceleration medium. As part of the growth of SC Linacs, RF control has been a challenge, especially as the field requirements have increased. Using them with in an ERL adds new challenges to Low Level RF (LLRF). This paper discusses LLRF techniques and issues for SC cavities, in particular ones in an ERL.

11:20-11:50: Advances in Beam Diagnostics for ERLs

P.E. Evtushenko (Jefferson Lab)

TUCAUD — Working Group: Beam Physics

13:30-14:00: Single-Pass Electron Cooling Simulations for MEIC and CeC Demonstration Experiment

I.V. Pogorelov, G.I. Bell, B.T. Schwartz (Tech-X) D.L. Bruhwiler (CIPS) V. Litvinenko, G. Wang (BNL)

Efficient cooling of ion beams that goes beyond the current state-of-the-art is needed to achieve the luminosity goals of the next generation of hadron-hadron and electron-ion colliders. We discuss our electron cooling simulations for the parameters of the coherent electron cooling (CeC) proof-of-principle (PoP) experiment at BNL and for the cooling system currently developed at Jefferson Lab for the proposed Medium Energy Electron-Ion Collider (MEIC). Simulations of a single pass through the CeC cooling system require a three-stage approach, with 1) delta-f PIC VSim (formerly Vorpal) simulations used for the modulator section, 2) GENSIS used for modeling the FEL amplifier, and 3) regular PIC VSim simulations for the kicker. For single-pass simulations of the MEIC cooler, we developed a binary collision model which treats the cooling process as the sum of a large number of two-body collisions, and a delta-f model, which treats the ion shielding as a small perturbation on the background distribution. The simulations are performed with VSim.

14:00-14:30: Advanced Theoretical Aspects of CEC

G. Wang, V. Litvinenko (BNL)

14:30-15:00: Stochastic Cooling and Its Limitations

V.A. Lebedev (Fermilab)

The theory of stochastic cooling was mostly created in the seventies and eighties of 20-th century in the application to the microwave stochastic cooling. Additional developments were carried out later in the course of Tevatron Run II. The only condition of theory applicability is a requirement to have sufficiently large number of particles in a sample where particles see each other. This condition is still justified for new stochastic cooling methods which are presently under development. The paper makes a short introduction to the stochastic cooling theory and considers its application to the optical stochastic cooling and the coherent electron cooling.

TUDAUD — Working Group: Beam Physics

15:50-16:20: Superferric Magnets: Nuclotron-NICA-FAIR Experience Plan

E.S. Fischer (GSI), H.G. Khodzhibagiyan (JINR)

The first heavy ion accelerator based on fast ramped superconducting magnets was commissioned at JINR Dubna in 1993. The superferric main magnets are of the window frame type, the dipoles are ramped up to 2 T with 4 T/s for a maximum repetition rate of 1 Hz. During the last decade the design of the magnets was optimized within a collaboration between JINR and GSI Darmstadt to improve their magnetic field quality, reduce the AC loss rate and to strengthen the mechanical stability of the coil. Finally the design of the improved magnets was adjusted to fulfill the requirements of the new SIS100 accelerator of the FAIR project as well as for the booster and collider facilities of NICA. We summarize the main design aspects of the magnets including their cooling conditions and present the current status of magnet production testing and project planning.

16:20-16:50: A New High-Order Adaptive Dynamics Code with Applications to Electron Cooling

B. Erdelyi (Northern Illinois University)

Algorithms for high fidelity simulation of beam physics phenomena are evolving significantly over the last few years. With limited computing power in the past, sophisticated methods have been developed in order to circumvent the basic fact that the underlying n-body problem cannot be solved efficiently with available resources. Approaching the era of extreme scale (exascale) computation, the situation changes significantly, and a rethinking of the appropriate algorithmic and data structures, and programming models become necessary. In this talk we present work in progress at NIU on a particle code with high-order adaptive dynamics (PHAD) aimed at looking towards the future computing needs. Electron cooling, whether traditional DC, high-energy bunched based on a re-circulator, or coherent will provide the ideal test beds for benchmarking and validating the code.

16:50-17:20: Challenges and Development of Superconducting Ion Linac

P.N. Ostroumov (ANL)

A pulsed multi-ion linear accelerator is required for the proposed Ion Accelerator Complex for a Jefferson Lab-based Electron Ion Collider (EIC). The proposed linac is capable of accelerating a wide variety of ions from proton (280 MeV) to lead (10^5 MeV/u). A relatively high ion injection energy into the pre-booster helps minimize space charge effects and maintain the low emittance of injected beams. The linac includes several types of ion injectors to produce negative hydrogen ions, polarized light ions, and heavy ion beams. The front end of the linac up to 5 MeV/u is a normal conducting fixed velocity structure while the main section of the linac consists of two types of superconducting (SC) cavities. A stripper at intermediate energies is required to increase the charge states of heavy ions. We discuss the available SRF technologies for such a linac and the challenges for a cost-effective design, construction and operation of a pulsed SC linac.

TUCL102 — Working Group: IR/Detector

14:00-14:30: MEIC Interaction Region Design for a Full Acceptance Detector

V.S. Morozov, P.D. Brindza, Y.S. Derbenev, R. Ent, F. Lin, P. Nadel-Turonski, M. Ungaro, Y. Zhang (Jefferson Lab) C. Hyde, K. Park (Old Dominion University) M.K. Sullivan (SLAC) Z.W. Zhao (UVa)

Jefferson Lab's Medium-energy Electron-Ion Collider (MEIC) is designed for high luminosities of up to 10^{34} $cm^{-2}s^{-1}$. This is achieved in part due to an aggressively small beta-star, which imposes stringent requirements on the collider rings' dynamical properties. Additionally, one of the unique features of MEIC is a full-acceptance detector, which relies on a number of design features including a 50 mrad beam crossing angle, large-aperture ion and electron final focusing quads and spectrometer dipoles as well as a large machine-element-free detection space downstream of the final focusing quads. We present an interaction region design developed with close integration of the detection and beam dynamical aspects. The dynamical aspect of the design rests on a symmetry-based concept for compensation of non-linear effects. The optics and geometry have been optimized to accommodate the detection requirements and to ensure the interaction region's modularity for easiness of integration into the collider ring lattices. As a result, the design offers an excellent detector performance combined with the necessary non-linear dynamical properties.

14:30-15:00: Experience with Machine-Induced Backgrounds at LHC

H. Burkhardt (CERN)

The talk summarizes experience gained in the first long run of LHC, which started end of 2009 with proton-proton collisions and ended in spring 2013 with proton-lead collisions. This will be used to see what can be expected for the future operation and upgrade of the LHC and what may be relevant for future ring colliders. Some more general aspects of how the work is organized between experiments and machine, automatic signal exchange, and the use of computer codes will also be covered.

15:00-15:30: Machine-Detector Interface and Detector Background Issues

N.V. Mokhov (Fermilab)

The deleterious effects of background and radiation environment originated at particle colliders from the interaction point and from beam interactions with accelerator components are one of the key issues in the Interaction Region (IR), Machine-Detector Interface (MDI) and detector design and developments. Impact of radiation on the final focus magnets and the ways backgrounds affect the collider detector performance are described. Basic principles and specifics in MDI design at hadron and lepton colliders are considered. Examples of the MDI design and machine-induced background studies are given for the ATLAS and CMS detectors at LHC, e^+e^- linear collider ILC, and for the TeV and Higgs Factory muon colliders.

TUDL102 — Working Group: IR/Detector

15:50-16:20: DA Optimization for eRHIC Hadron Lattice

Y.C. Jing, Y. Luo, D. Trbojevic (BNL)

For a high luminosity collider (such as eRHIC), dynamic aperture (DA) in interaction region is a major concern in preserving integrated luminosity due to the large chromatic aberration induced by final focusing magnets. In addition, magnet field errors together with beam beam effect during beam interactions make the situation worse. In this presentation, the authors lay out their systematic approach to optimize DA under these considerations and point out possible upgrades needed for current RHIC operation to achieve such performance.

16:20-16:50: An eRHIC IR Design that Balances Experimental, Accelerator and Magnet Design Considerations

B. Parker (BNL)

16:00-17:20: Optical Functions and Chromatic Cancellation of the eRHIC IR Triplets

D. Trbojevic (BNL)

The future electron-ion (polarized protons and ^{3}He) will be detecting: neutrons of nuclear break up in the outgoing hadron beam direction, scattered protons of exclusive and diffractive reactions in the outgoing beam directions and detection of the spectator protons from the 3He and Deuterium. On the opposite side of the collision point - the direction of electrons there will be lepton polarimetry, luminosity monitor, detection of the Q^2 scattered leptons. The Interaction Region (IR) design and placement of the triplet ion and electron elements is obtained by direct interaction between the magnet designers and experimenters. Chromaticity cancellation of the triplets is obtained by the sextupoles placed neighboring arcs where the phase difference in the FODO cells is 90 degrees in both planes with 180 degrees between the last sextupole to the corresponding triplet quadrupole. The betatron squeeze from *=10 cm to *=5 cm is obtained by the Achromatic Telescoping Squeeze (ATS) previously developed at CERN.

TUCF113 — Working Group: SRF/ERL

13:30-14:00: RF Systems and Cavities for MEIC Booster and Collider Rings

S. Wang, R.A. Rimmer, H. Wang (Jefferson Lab)

The Medium-energy Electron Ion Collider (MEIC), proposed by Jefferson Lab, consists of a series of accelerators. Three rings, ion booster ring, ion and electron collider rings will be on top of each other in one tunnel. Ion booster ring accelerates long proton bunches from 3 to 25 GeV, then ion collider ring accelerates bunches to colliding energy and rebunches ions into a train of very short bunches before colliding. A set of low frequency RF system is needed for the long ion bunch energy ramping in ion booster ring and collider ring respectively. Another set of high frequency RF cavities is needed to rebunch ions. For the electron ring, superconducting RF (SRF) cavities are needed to compensate the synchrotron radiation energy loss. The impedance of the SRF cavities must be low enough to keep the high current electron beam stable. The preliminary design requirements of these RF cavities are presented.

14:00-14:30: The Commissioning Program of the SRF 703 MHz Gun

W. Xu (BNL)

The 704 MHz superconducting RF gun for R&D ERL project is under comissioning at BNL. Without cathode insertion, the SRF gun achieved its design goal: 2 MV of accelerating voltage in CW mode. The commissioning with cathode insertion reached 1.9 MV with 18% duty factor, which is limited by the mulitpacting at choke-joint cathode stalk. We continue to prepare for the first electron beam generated from the gun with current cathode stalk and are expect to have the first beam soon. At the meantime, a new cathode stalk has been designed to eliminate the multipacting in the choke-joint. Firstly, this presentation will address the main components of the SRF gun, such as the MW RF power coupler, cathode stalk, SRF cavity and so on. And then, we will present the recent commissioning results, including FPC conditoning, SRF commissioning w/o cathode stalk insert, and the design of a multipacting-free cathode stalk.

14:30-15:00: Development of 56 MHz Cavity and Compact Coaxial HOM Dampers for RHIC

Q. Wu (BNL)

TUDF113 — Working Group: SRF/ERL

15:50-16:20: The BERLinPro Energy Recovery Linac Project

A. Burrill (HZB)

The Helmholtz-Zentrum Berlin is designing and building a 100 mA, 50 MeV Energy Recovery Linac (ERL) for the purpose of demonstrating the CW LINAC technology and expertise required to drive next-generation accelerator facilities that are based on ERL principles. The ERL will utilize all SRF cavities, operating at 1.3 GHz, for the injector, booster and linac cryomodules. In this talk I will provide an overview of the technological choices that were made and the challenges the project faces in realizing these goals.

16:20-16:50: High-Power Magnetron RF Source for Intensity-Frontier Superconducting Linacs

G. Kazakevich, R. Johnson (Muons, Inc.), V. Yakovleyv, B. Chase, R. Pasquinelli (Fermilab)

A high-power magnetron transmitter, allowing a wideband dynamic phase and power control and intended to drive Superconducting RF (SRF) cavity of the intensity-frontier linacs, including linacs for Accelerator Driven System (ADS), has been proposed and experimentally modelled. The transmitter allows operation in CW or pulsed mode, using the vector addition of signals of Continuous Wave (CW) magnetrons, injection-locked by phase-modulated signals. The transmitter concept performances were verified in experiments with CW, S-Band, 1 kW magnetrons. Proof of principle of the proposed transmitter was demonstrated measuring the magnetron response on the phase-modulated injection-locking signal, measuring the magnetron transfer characteristic at the phase-modulated control, and measuring spectrum of carrier frequency of the magnetron, injection-locked by the phase-modulated signal. Analysis of the obtained results shows that the proposed concepts of the transmitter and its control will satisfy requirements of the superconducting linacs.

WEXAUD — Plenary III

08:30-09:00: Coherent Electron Cooling PoP Experiment

I. Pinayev (BNL)

The coherent electron cooling (CEC) is expected significantly boost the luminosity of high-energy, high-intensity hadron colliders [1]. We conduct a proof-of-the-principle experiment, which will provide longitudinal cooling of a single bunch circulating in RHIC. We present the current experiment layout along with the status of the experimental equipment. We describe the current status of the design and our near-future plans.
V.N. Litvinenko and Ya.S. Derbenev, Phys. Rev. Lett. 102 (2009) 114801.

09:00-09:30: Microbunched Electron Cooling for High-Energy Hadron Beams

D.F. Ratner (SLAC)

Electron and stochastic cooling are proven methods for cooling low energy hadron beams, but at present there is no way of cooling hadrons at the TeV scale. Derbenev and Litvinenko suggested that electron instabilities, such as the Free Electron Laser, could create collective space charge fields strong enough to correct the hadron energies.[1] This talk presents an alternative electron cooling scheme using the microbunching instability as the amplifier.[2] A simple analytical model illustrates the cooling mechanism and simulations show cooling rates for LHC-like parameters.
[1] V.N. Litvinenko and Y.S. Derbenev, Phys. Rev. Lett., 102, 114801 (2009)
[2] D. Ratner, Phys. Rev. Lett., 111, 084802 (2013)

09:30-10:00: High Gradient CW SRF: Operational Experience and Issues

G.A. Krafft (Jefferson Lab)

10:00-10:30: SRF Systems of the eRHIC ERL

S.A. Belomestnykh (BNL) **S.A. Belomestnykh** (Stony Brook University)

A future electron-hadron collider eRHIC, proposed at BNL, will consist of a sixteen-pass 21.2-GeV electron ERL and one of RHIC storage rings operating with energy up to 250 GeV. The collider design utilizes SRF technology for both ERL and RHIC as well as for the ERL injector and a coherent electron cooling system for the RHIC beam. The main ERL linac will operate at 413 MHz, and provide an energy gain of 1.322 GeV to a 50-mA electron beam circulating trough the linac up to 16 times. In addition to the main ERL linac, there will be two specialized SRF linacs: one to compensate the beam energy losses and another to compensate the energy spread due to curvature of the RF waveform. This paper describes the eRHIC ERL superconducting RF systems, their requirements and parameters.

WEYAUD — Plenary IV

10:50-11:20: ALICE Experience with Heavy-Ion Operation

M. Gagliardi (CERN)

ALICE is a dedicated heavy-ion experiment at the CERN Large Hadron Collider (LHC), devoted to the study of Quark-Gluon Plasma. During the first data taking period (RUN1), concluded in early 2013, ALICE experienced quite different beam conditions in terms of collision schemes, luminosity, and machine induced background (MIB) since data were collected not only in Pb-Pb but also in proton-proton (pp) and proton-Pb (p-Pb) LHC operation modes. An overview of the ALICE detector design will be provided, and the impact of sub-detectors geometry requirements on collider layout will be discussed. Finally, the effect of MIB and beam losses on detector operation and performance, observed during RUN1, will be presented and compared to results of FLUKA and GEANT-based MC simulation models.

11:20-11:50: Operation of Jefferson Lab Polarized Electron Sources at High Currents

R. Suleiman, P.A. Adderley, J. Clark, S. Covert, J.M. Grames, J. Hansknecht, M. Poelker, M.L. Stutzman (Jefferson Lab)

Two DC high voltage GaAs photoguns have been built at Jefferson Lab based on a compact inverted insulator design. One photogun provides the polarized electron beam at the Continuous Electron Beam Accelerator Facility (CEBAF) up to 200 A. The other gun is used for high average current photocathode lifetime studies at a dedicated test facility up to 4 mA of polarized beam and 10 mA of un-polarized beam. GaAs-based photoguns used at accelerators with extensive user programs must exhibit long photocathode operating lifetime. Achieving this goal represents a significant challenge for proposed facilities that must operate in excess of tens of mA of polarized average current. This talk describes techniques to maintain good vacuum while delivering high beam currents, and techniques that minimize damage due to ion bombardment, the dominant mechanism that reduces photocathode yield. Advantages of higher DC voltage include reduced space-charge emittance growth and the potential for better photocathode lifetime. Highlights of R&D to improve the performance of polarized electron sources and prolong the lifetime of GaAs Superlattice will be presented.

11:50-12:20: Sub-Percent Electron Polarimetry for the EIC

W. Deconinck (The College of William and Mary)

WECAUD — Working Group: Beam Physics

13:30-14:00: The Early Studies of Beam-Beam Effects in a Linac-Ring Collider

R. Li (Jefferson Lab)

14:00-14:30: Overview of Beam-Beam and Space Charge Compensation Schemes

V.D. Shiltsev (Fermilab)

14:30-15:00: Beam-Beam Effects in the Linac-Ring Scheme

Y. Hao (BNL)

Study of asymmetric beam-beam interaction is one of the key R&D topic in the future ERL based electron ion collider (EIC) at BNL, eRHIC. The significant difference of the beam-beam related parameter range distinguishes the beam-beam effects in the ERL based eRHIC from the traditional ring-ring scheme hadron or lepton collider. The full understanding of such effects is the step stone towards the promised high luminosity of eRHIC. This talk will review the special effects in ERL based EIC and possible countermeasures to the harmful effects.

15:00-15:30: Crab Crossing in KEKB and Nano-Beam Scheme in Super-KEKB

K. Ohmi (KEK)

KEKB had been operated since 1999 to 2010. Operation using crab cavity was performed since 2006 to boost higher luminosity. Maximum peak luminosity 2.110^{34} $cm^{-2}s^{-1}$ was achieved in 2009. SuperKEKB, which is designed with base of nano-beam scheme, starts in 2015. We review crab crossing and nano-beam scheme from the view of accelerator physics of beam-beam interaction.

WEDAUD — Working Group: Beam Physics

15:50-16:20: MEIC Ion Beam Formation

T. Satogata (Jefferson Lab)

16:20-16:50: Practical Experience on Topping Up an Electron Storage Ring for e^+e^- Collider

U. Wienands, M.K. Sullivan (SLAC)

16:50-17:20: Ion Beam Accumulation and Short Bunch Formation with Beam Cooling

T. Katayama (CNS)

The ion beam injection and accumulation in the storage ring or collider can be accomplished with use of the barrier voltage and beam cooling, stochastic and/or electron cooling. This method is especially useful in the case that the injector synchrotron can provide only the relatively long bunch and the circumferences of the injector synchrotron and the storage ring/collider are similar sizes. This barrier bucket accumulation method is planned to be used at the HESR FAIR project for the 3 GeV antiproton beam from the Collector Ring as well as the heavy ion beam accumulation in NICA collider from the Nuclotron. The Proof Of Principle experiment of this idea was successfully performed at GSI ESR with use of 400 MeV/u Ar ion beam from SIS 18. Applying the high RF voltage of the harmonic number equal to the required bunch number, the accumulated coasting beam could be bunched again with the assistance of beam cooling. This bunching experiment has been carried out at COSY, FZJ with stochastic cooling and electron cooling. In the present paper the simulation and experimental results of barrier bucket accumulation and short bunch formation are presented.

WECF113 — WG: Sources/Polarimetry

13:30-14:00: Gatling Gun: the Quest for a High Polarized Electron Current Source

E. Wang, I. Ben-Zvi, D.M. Gassner, W. Meng, A.I. Pikin, O.H. Rahman, T. Rao, E.J. Riehn, B. Sheehy, J. Skaritka, Q. Wu (BNL)

The future electron ion collider (eRHIC) at Brookhaven National Laboratory requires a high polarized electron current source with short bunch length and small emittance. The state-of-the art single GaAs-based electron source is far from delivering the required 50mA current due to ion back-bombardment and the limit on surface charge. Currently, we are designing and constructing a high-average current, polarized electron-source based on the principle of the Funneling gun. Our funneling gun is designed such that the electron bunches generated from 20 photocathodes in a 220 kV DC gun, funnel to one common beam-axis. This talk describes our design of a high-average-current polarized electron source, encompassing its sub-section design such as the preparation of the cathode, the beam's dynamics and diagnostics, and the laser system. We also report our recent progress in building and testing the gun.

14:00-14:30: Status of High Intensity Polarized Electron Gun Project

E. Tsentalovich (MIT)

MIT-Bates in collaboration with BNL investigates the possibility to build a polarized electron gun with extremely high intensity. The design implements a separate preparation chamber, load lock, ring-shaped beam and active cathode cooling. Very good vacuum conditions have been achieved in both the gun chamber and the preparation chamber. Reliable cathode transfer between the load lock, the preparation chamber and the gun chamber has been demonstrated. Several cathode activation have been performed, and the low-intensity beam was transported through the beam line.

14:30-15:00: The TRIUMF-ARIEL RF Modulated Thermionic Electron Source

F. Ames, Y.-C. Chao, K. Fong, N. Khan, A. Laxdal, L. Merminga (TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics) C.K. Sinclair (Cornell University (CLASSE), Cornell Laboratory for Accelerator-Based Sciences and Education) D.W. Storey (Victoria University)

Within the ARIEL (Advanced Rare IsotopE Laboratory) at TRIUMF a high power electron beam is used to produce radioactive ion beams via photofission. The electron beam is accelerated in a superconducting linac up to 50 MeV. The electron source provides electron bunches with charge up to 16 pC at a repetition frequency of 650 MHz. The kinetic energy of the electrons has been chosen to be 300 keV to allow direct injection into an accelerator cavity. The main components of the source are a gridded dispenser cathode (CPI –Y845) in a SF6 filled vessel, and an in-air HV power supply. The beam is bunched by applying dc and rf fields to the grid. Unique features of the gun are its cathode/anode geometry to reduce field emission, and transmission of RF modulation via a dielectric (ceramic) waveguide through the SF6. The latter obviates the need for an HV platform inside the vessel to carry the RF generator, and results in a significantly smaller/simpler vessel. The modulation concept has first been implemented and tested on a 100 keV prototype source before it was installed on the final source. Results from the prototype and the commissioning of the final 300 keV source will be presented.

15:00-15:30: BNL SRF Gun Program Update

S.A. Belomestnykh (BNL) **S.A. Belomestnykh** (Stony Brook University)

Two SRF photoemission electron guns are under development at BNL. The first gun operates at 704 MHz and is design to deliver high bunch charge and high average current beams for the R&D ERL accelerator. Its cavity is of an elliptical geometry. The gun cryomodule has been commissioned without a cathode up to the design voltage of 2 MV. Commissioning with a copper cathode revealed that the gun performance is limited due to multipacting in the cathode choke joint. This limitation will be mitigated in the existent choke joint by applying anti-multipacting coating. To suppress multipacting completely, a new cathode choke joint is being designed. The second gun utilizes a quarter wave resonator geometry with a coaxial cathode insert and beam tube RF power coupler. It will be used to produce high bunch charges, but low average beam currents for the coherent electron cooling proof-of-principle experiment. This 112 MHz SRF gun was cryogenically tested, reaching an accelerating gap voltage of 0.9 MV. The gun is installed in the RHIC tunnel and being prepared for commissioning. This paper describes main design features of the two SRF guns, presents test results and discusses future plans.

WEDF113 — WG: Sources/Polarimetry

15:50-16:20: High Average Brightness Electron Beam Production at Cornell University

A.C. Bartnik, B. Dunham, A. Bartnik, I. Bazarov, J.M. Maxson (Cornell University / CLASSE)

Cornell University operates a high average brightness electron photoinjector, using a 350 kV DC photogun and a 1.3 GHz, 5-15 MeV booster linac, as a prototype injector for a proposed 5 GeV Energy Recovery Linac (ERL) based light source. In this talk, some of our most recent achievements will be described, including the production of world record high-average current from a photoinjector, and demonstration of low emittance. Both GaAs and multialkali photocathodes are used, and the talk will describe our experience with photocathode growth, lifetime in high current conditions, and thermal emittance for each cathode type. In addition, we will also discuss the construction of a new photoelectron gun, which is currently in commissioning. The segmented insulator design, construction, and high voltage processing results will be described. Finally, we will also show some initial results of a beam-based experiment used to test for higher-order modes in a prototype high-Q cavity, emphasizing its impact on the threshold for beam-breakup instability in an ERL.

16:20-16:50: Status of the 500 kV DC Photocathode Gun at the Compact ERL

N. Nishimori, R. Hajima, S. Matsuba, R. Nagai (JAEA) Y. Honda, T. Miyajima, M. Yamamoto (KEK) M. Kuriki (HU/AdSM)

The next generation ERL light sources require a high brightness and high current electron gun. We have developed a DC photoemission electron gun for the Japanese ERL light source project. This DC gun employs a segmented insulator with guard rings to protect the insulator from field emission generated from central stem electrode. We have successfully applied 500kV on the ceramics with a cathode electrode in place and generated beam from the 500kV gun at Japan Atomic Energy Agency (JAEA) in October 2012. The gun was transported to the compact ERL (cERL) at KEK for commissioning of the cERL. Details of the 500keV beam generation at JAEA as well as beam operational experience at the cERL will be presented.

16:50-17:20: Status of the Jefferson Lab 500 kV Inverted Gun

C. Hernandez-Garcia, J. Hansknecht, M. Poelker (Jefferson Lab)

Jefferson Lab operates two DC electron guns based on compact inverted-geometry ceramic insulator designs in place of conventional cathode support structures inside cylindrical insulators, which are prone to damage from field emission. In the inverted insulator gun designs, the combination of cathode placement and reduced cathode area make the insulator less prone to field emission damage. The CEBAF DC gun provides polarized electron beam at 130kV for the Nuclear Physics program. A second DC gun operates at 200 kV for dedicated high average current photocathode lifetime studies. A third DC gun is under development with the objective to operate at 350kV and higher. At that voltage, there is no need for a capture cavity nor for RF choppers, shortening the beam line between the gun and the SRF booster by a factor of three and significantly reducing the complexity of the injector. Connecting the power supply to the inverted insulator via commercially available cabling without catastrophic electrical breakdown at 350kV has been technically challenging. Recent progress testing various configurations will be described.

THAAUD — Working Group: Beam Physics

08:30-09:00: The Correction Methods for eRHIC FFAG Lattice

C. Liu, V. Litvinenko, M.G. Minty, D. Trbojevic (BNL)

The unique feature of the orbits in the eRHIC FFAG design is that multiple accelerating and decelerating bunches pass through the same magnets with different horizontal offsets for beams of various energies. Therefore, it is critical for the eRHIC FFAG to correct multiple orbits in the same vacuum pipe for better spin transmission and alignment of colliding beams. In this report, the effects on orbits from multiple error sources will be studied. The orbit correction method will be described and results will be presented. In addition, an orbit response based correction method for quadrupole errors will be demonstrated.

09:00-09:30: End-to-end, 9-D, Radiative Polarized Bunch Dynamics Simulations in eRHIC and LHeC FFAG ERL's

F. Meot (BNL)

BNL C-AD is studying an FFAG version of the eRHIC ERL. Nine-dimensional end-to-end tracking simulations of the acceleration-deceleration cycle of polarized electron bunches are being performed in that frame, aimed at quantifying in detail the dynamical effects of synchrotron radiation on bunch and polarization. The present contribution discusses the methods employed and the results so obtained up to now. The exercise is applied to polarized electron bunches in the LHeC ERL.

09:30-10:00: FFAG Lattice Design of eRHIC and LHeC

D. Trbojevic (BNL)

The future electron ion-collider in BNL-eRHIC and CERN-LHeC proposals will collide electrons with ions in both facilities but at BNL electrons, protons and 3He ions will be polarized. Electron acceleration, in both proposals, is done by Energy Recovery Linacs (ERL). Electron beam is brought back to the linacs by multiple passes in arcs in both proposals. The major limitation in electron acceleration is the synchrotron radiation in the arcs. The radius of the arcs in the LHeC proposal is 1000 m, with the maximum electron energy of 60 GeV, while the radius of the eRHIC arcs is equal to the RHIC tunnel radius of ~378 m. The latest eRHIC proposal for the lattice in the arcs replaced six separate arcs with two Non-Scaling Fixed Field Alternating Gradient (NS-FFAG) beam lines, one covering energy range 1.3 - 6.62 GeV and the other 7.94 - 21.1 GeV. The present design of the LHeC ERL is a racetrack, where the two linac energies are of 10 GeV with three rings in the arcs covering energy range 10 - 60 GeV. It might be possible to reduce the energy of the linacs and remove at least one of the beam lines in the arcs by using the NS-FFAG. We are showing one of possible examples.

10:00-10:30: Beam Position Monitoring in the eRHIC FFAG

M.G. Minty, D.M. Gassner, R.L. Hulsart, C. Liu, K. Mernick, R.J. Michnoff, I. Pinayev, I. Pinayev, P. Thieberger, P. Thieberger (BNL)

In the eRHIC FFAG, bunches of different beam energies will be accelerated and decelerated using the energy recovery linac (ERL) while sharing a common vacuum chamber over the majority of the ring circumference. In each FFAG cell the horizontal position of the bunches is energy-dependent spanning a range of up to about 30 mm in the low energy FFAG ring and about 10 mm in the high energy FFAG ring. The longitudinal separation between bunches depends on the desired collision energy and the acceleration frequency f_rf of the ERL. For efficient energy recovery, the minimum bunch spacing is 1/2 the rf wavelength or ∼ 1.2 ns with f_rf = 412.9 MHz. This spatial and temporal structure poses unique challenges for beam diagnostic designs. Fortunately, the bunch fill pattern includes a gap for ion clearing within which a single bunch, well separated temporally from other bunches, will be placed and used for diagnostic purposes. In this we report present designs for beam position monitoring using ``diagnostic'' bunches as well as developments for bunch-by-bunch measurements using an alternative BPM design and fast time-based gating of synchrotron radiation generated in the FFAG cells.

THBAUD — Working Group: Beam Physics

10:50-11:20: HIAF Lattice and Beam Dynamics Design

J.C. Yang (IMP)

11:20-11:50: CSR Induced Micro-Bunching Instabilities in a Circulator Electron Cooler

E.W. Nissen (Jefferson Lab)

11:50-12:20: Electron Cloud Instabilities in Positron and Proton Rings

K. Ohmi (KEK)

Electron cloud instability has been observed many positron rings. We present the instability phenomena and mechanism in each machine. The electron cloud instability observed in LHC is discussed.

THAF113 — WG: Sources/Polarimetry

08:30-09:00: Precision Test of Mott Polarimetry in the MeV Energy Range

J.M. Grames (Jefferson Lab)

A Mott polarimeter with a design optimized for 5.0 MeV has been in routine use at the CEBAF accelerator for nearly two decades, providing measurements of the electron beam polarization approaching 1% accuracy. Measurements with different target elements (Au, Ag, Cu) over decades of target thicknesses (100 – 10,000 Angstroms), and beam energies between 2 and 8 MeV have been made previously to determine the effective analyzing power with a high degree of certainty. More recently renewed experimental, simulation and theoretical efforts have been made to re-test the effective analyzing power. Improvements in the polarimeter configuration along with a 31 MHz repetition rate beam allow to distinguish and suppress electrons that do not originate from the target foil. This coupled with a detailed GEANT4 model of the polarimeter to address plural scattering in the target foil is part of the strategy to test systematic uncertainties at the level of the theoretically calculated single atom Sherman function. The CEBAF Mott polarimeter, recent activities and planned measurements to test the precision of this MeV electron polarimeter will be presented.

09:00-09:30: Percent-Level Polarimetry in Jefferson Lab Hall A

G.B. Franklin (CMU)

The Jefferson Lab Hall A Compton Polarimeter is used to measure the polarization of the electron beam as it enters the experimental hall. When the polarimeter is in use, the electron beam passes through a Fabry-Perot resonant cavity excited by a laser, allowing the electrons to scatter off the photons. The Compton scattering events can be measured by detecting the scattered electrons in a silicon microstrip detector or by detecting the back-scattered photons in a calorimeter consisting of a single 6 cm diameter by 15 cm long Ce-doped Gd2SiO5 (GSO) cylindrical crystal. Recent polarimetry measurements have obtained a precision of better than 1% using only the photon calorimeter. This talk will start with a review of the features of Compton scattering as they pertain to the polarimeter's statistical and systematic errors. Properties of GSO crystal will be discussed along with benchmark comparisons between GEANT4-based simulations and actual measurements. Features of the custom flash-ADC used to provide dead-timeless integrated photon calorimeter data, along with data calorimeter-triggered pulse data, will be reviewed. Future 12-GeV era configurations and expectations will be presented.

09:30-10:00: Percent-Level Polarimetry in Jefferson Lab Hall C

D. Gaskell (Jefferson Lab)

The electron beam polarization in Hall C at Jefferson Lab is measured using both Moller and Compton polarimetry. The Hall C/Basel Moller Polarimeter makes use of a 3-4 Tesla superconducting solenoid to brute-force polarize a pure iron foil out of plane. This Moller Polarimeter has been used quite successfully since the initial experiments in Hall C. A new Compton Polarimeter was installed in 2010 just prior to the Q-Weak experiment. The Hall C Compton Polarimeter uses a high power CW, green laser coupled to a moderate-gain Fabry-Perot cavity to provide an intense source of target photons. Both the scattered electrons and back-scattered photons from the Compton scattering process provide semi-independent measurements of the electron beam polarization. Results from the large body of Moller and Compton polarimetry data acquired during the Q-Weak experiment will be presented, with a special emphasis on the systematic uncertainties of both devices.

10:00-10:30: Spin-Light Polarimetry at the EIC

D. Dutta (Mississippi University)

Polarized electrons and ion beams are an essential part of the EIC program to address fundamental questions in QCD and also to search for new interactions beyond the Standard Model. These experiments require precision electron polarimetry with an uncertainty of $< 0.5\%$. The spin dependent Synchrotron radiation (SR), called ''spin-light,'' can be used to monitor the electron beam polarization. We will present a conceptual design for a ``spin-light'' polarimeter that can be used at a high intensity, multi-GeV electron accelerator. We will report results from simulations of the polarimeter. We have also identified a possible lattice location for such a polarimeter within the MEIC scheme.

THBF113 — WG: Sources/Polarimetry

10:50-11:20: RHIC Hadron Polarimetry

Y. Makdisi (BNL)

I will present the possible spin sensitive processes that can be utilized for high energy proton beams and delineate the considerations that led to the choices for RHIC. I will describe the polarized Jet target effort, its role in RHIC polarimetry, the statistical and systematic precision achieved, the shortcomings and proposals to improve the situation. I will then discuss potential ideas for EIC polarimetry for both polarized proton as well as He3 polarimetry.

11:20-11:50: Proton Polarimetry with Carbon Target

O. Eyser (BNL)

The Relativistic Heavy Ion Collider (RHIC) has provided polarized proton-proton collisions to experiments for the past decade with beam polarizations of P=55% at beam energies of up to 255 GeV. The polarization of the proton beams is measured through spin dependent elastic scattering off a polarized hydrogen jet target and similarly monitored with Carbon fiber targets several times throughout the duration of a stored RHIC fill. With recent advancements in beam luminosities, the largely increased data sets have enabled unprecedented possibilities to study systematic effects in the polarimeters. We will discuss details of the background contributions, properties of the bunched and polarized beams, and their implications on systematic uncertainties. We will also discuss the challenges of this measurement in an envisioned Electron Ion Collider in the future.

THCAUD — Working Group: Beam Physics

13:30-14:00: Lattice Design Choices for LHeC ERL

S.A. Bogacz (Jefferson Lab)

High current, 60 GeV operation of the electron recirculator for LHeC, solely relies on the Energy Recovery (ER) process. A conceptual design of a 3-pass Recirculating Linear Accelerator (RLA) with ER is presented. It includes a complete multi-pass optics design for two superconducting linacs in ER mode and linear lattices for 6 return arcs. Synchronization between the arcs and linacs for chromatic beams requires very small values of momentum compaction. Furthermore, synchrotron radiation effects on emittance dilution (quantum excitation) are of paramount importance. To address both issues, here we propose a quasi isochronous arc optics based on the Flexible Momentum Compaction lattice, which simultaneously ensures a small value of emittance dispersion, H, and therefore mitigates both transverse emittance growth and bunch length increase.

14:00-14:30: Grand Central Station: eRHIC Spreader/Combiner Design

N. Tsoupas, V. Litvinenko, V. Ptitsyn, D. Trbojevic (BNL)

The proposed FFAG based electron accelerator of the e-RHIC complex utilizes a single Energy Recovery LINAC (ERL), placed at the 2 o'clock area of the RHIC tunnel. The ERL will accelerate and decelerate the circulating electron bunches in the two FFAG arcs placed alongside the hadron accelerator. The beam transport and matching of the electron bunches between the FFAG arcs and the ERL is accomplished with the Spreaders/ Combiners which are a set of individual beam lines connecting the FFAG arcs and the ERL. In this talk we will present: a) a layout of the beam lines which minimizes the path increase introduced by the individual lines of the spreader/combiner, b) the method we will use in the beam lines to compensate for the relative path increase between the high and low energy bunches and c) the beam optics of one of the lines which is equipped with the compensation scheme for the path increase.

THCF113 — WG: Sources/Polarimetry

13:30-14:00: Conceptual Development of a Unified Polarized Ion Source

V.G. Dudnikov (Muons, Inc)

High beam polarization is essential to the scientific productivity of a collider. Polarized H and D ions are an essential part of the nuclear physics programs at existing and future ion-ion and electron-ion colliders such as the BNL RHIC and eRHIC and Jefferson Lab's ELIC. In this report one unified H-/D-, H^+/D^+ ion source design is proposed, which combines the most advanced developments in the field of polarized atoms and, in particular, a new resonance charge exchange ionizer to provide high-current high-brightness ion beams with greater than 90% polarization and improved lifetime, reliability and power efficiency. The new source design is based on the atomic beam polarized ion source (ABPIS) with resonant charge-exchange ionization of neutral atoms by negative and positive ions generated by the interaction of plasma with a ``cesiated'' surface. The ABPIS design is improved by using new materials, an optimized magnetic focusing system, and novel designs of the dissociator, plasma generator, surface-plasma ionizer, new mode of cesiation, which are expected to provide greater beam polarization by suppressing parasitic generation of unpolarized H-/D-, H^+/D^+ ions.

14:00-14:30: Polarized Ion Sources with Nearly Resonant Charge-exchange Plasma Ionizer: Parameters and Possibilities for Improvements

A. Belov (RAS/INR)

Parameters of polarized ion sources with nearly resonant charge-exchange plasma ionizer are summarized. Pulsed beams of polarized protons with peak intensity up to 11 mA and polarization of 80% and polarized negative hydrogen ions with peak current of 4 mA and polarization of 91% have been obtained. While no progress of parameters during recent past years has been obtained, possibilities for further improvements still exist. Both atomic beam parts of the sources can be improved as well as efficiency of conversion of polarized atoms into polarized ions. The possibilities are discussed in the paper.

14:30-15:00: OPPIS: High Intensity Source of Polarized Protons

A. Zelenski (BNL)

A novel polarization technique had been successfully implemented for the RHIC polarized H^- ion source upgrade to higher intensity and polarization. In this technique a proton beam inside the high magnetic field solenoid is produced by ionization of the atomic hydrogen beam (from external source) in the He-gas ionizer cell. Further proton polarization is produced in the process of polarized electron capture from the optically-pumped Rb vapor. Polarized beam intensity produced in the source exceeds 4.0 mA. Strong space-charge effects cause significant beam losses in the LEBT (Low Energy Beam Transport, 35.0 keV beam energy) line. The LEBT was modified to reduce losses. As a result 1.4 mA polarized beam was transported to the RFQ and 0.7 mA was accelerated in linac to 200 MeV. Maximum polarization of 84% (in a 200 MeV polarimeter) was measured at 0.3 mA beam intensity and 80% at 0.5 mA. The source reliably delivered beam for 2013 polarized run in RHIC at $\sqrt{S}$=510 GeV. This was a major contribution to the RHIC polarization increase to over 60% for colliding beams.

15:00-15:30: Polarized He3 Ion Source for RHIC and eRHIC

J.D. Maxwell, R. Milner (MIT) J.G. Alessi, E.N. Beebe, A. Zelenski (BNL)

The addition of a polarized neutron beam source to the Relativistic Heavy Ion Collider at Brookhaven National Laboratory would present promising opportunities for the study of nucleon structure. Polarized neutron collision measurements of transverse spin asymmetries in Drell-Yan scattering would allow a search of the predicted sign switch for u and d quark flavors in the Sivers function. In a future electron-ion collider, precision tests of the Bjorken sum rule could be carried out with both proton and neutron beams. Polarized 3He off ers an eff ective polarized neutron beam which is accessible with RHIC spin manipulation. We are developing such a source leveraging metastability exchange optical pumping of 3He and utilizing the existing Electron Beam Ionization Source at RHIC. We aim to deliver approximately $1.5\text{x}10^{11}$ doubly ionized 3He atoms per pulse at 70% polarization into RHIC. The source is under development at MIT and an initial test of the principle at BNL is under construction. The source design will be described and the status of the test summarized.

THDF113 — WG: Sources/Polarimetry

15:50-16:20: Highly Charged Ion Source Development at IMP

L.T. Sun (IMP)

Electron Cyclotron Resonance (ECR) ion sources have been developed and used for routine operation at IMP for over 25 years. The driving force for the continuous efforts on ion source development at the institute is the strong needs from the development of ion accelerators. For different purposes, various types of ECR ion sources have been developed, such as permanent magnet ion sources, room temperature ion sources, and fully superconducting ion source. Permanent magnet LAPECR series ECR ion sources have been developed at IMP for more flexible applications, such as cancer treatment machine and high voltage multi-discipline research platform. Room temperature ECR ion sources have been developed mostly for the routine operation of the cyclotrons. A fully superconducting ECR ion source SECRAL had been successfully built in 2005 with a unique magnet configuration. SECRAL were designed for the optimum operation at the frequency of 18~28 GHz. Recent work with the source has greatly improved the performances. In this presentation, after a general introduction of the accelerator facility at IMP, the detailed information on highly charged ECR ion source development at IMP will be presented.
Email: sunlt@impcas.ac.cn

16:20-16:50: PEPPo: The Jefferson Lab Polarized Positron Program

J.M. Grames (Jefferson Lab)

Polarized positron beams are identified as either an essential or significant ingredient for the experimental program at present or next generation lepton accelerators (Jefferson Lab, Super KEK B, ILC, CLIC). A proof-of-principle experiment for a new method to produce polarized positrons has recently been performed at the Continuous Electron Beam Accelerator Facility at Jefferson Lab. The PEPPo (Polarized Electrons for Polarized Positrons) concept relies on the production of polarized electron/positron pairs from the bremsstrahlung radiation of a longitudinally polarized electron beam interacting within a high Z conversion target. The experiment was performed at the injector of the CEBAF accelerator at Jefferson Lab and investigated the polarization transfer of an 8.2 MeV/c polarized electron beam to positrons produced in varying thickness tungsten production targets, and collected and measured in the range of 3.1 to 6.2 MeV/c. This technique potentially opens a new pathway for both high energy and thermal polarized positron beams. This presentation will discuss the PEPPo concept, the motivations of the experiment and the experimental results so far obtained.

THCL102 — Working Group: IR/Detector

13:30-14:00: The LHeC IR and Its Compatibility with HL-LHC

E. Cruz Alaniz, D. Newton (The University of Liverpool) **E. Cruz Alaniz**, D. Newton, L.N.S. Thompson (Cockcroft Institute) L.N.S. Thompson (UMAN)

The LHeC is a proposed upgrade to the LHC to provide electron-proton collisions and explore the new regime of energy and intensity for lepton-nucleon scattering. This work on the interaction region of the LHeC investigates the optics design needed to integrate the LHeC into the existing HL-LHC lattice, allowing simultaneous nucleon-nucleon and lepton-nucleon collisions at different interaction points. In the nominal design, an electron beam collides with one of the proton beams while the other proton beam bypasses the interaction. The colliding proton beam has a value of * (beta function in the interaction point) of 10 cm achieved with the implementation of a new inner quadrupole triplet located at L^*=10 m from the interaction point utilizing the Achromatic Telescopic Squeezing (ATS) scheme. This work explores the variation of these two parameters, * and L^*, along with its magnet design options, in order to achieve the optimal solution that would maximize the luminosity of the collision while controlling the natural chromaticity and the synchrotron radiation of the electron beam.

14:00-14:30: Beam Related Backgrounds at the Flavour Factories

M. Boscolo (INFN/LNF)

The main effects inducing backgrounds at the B factories will be reviewed and discussed. Touschek effect, beam-gas scattering, radiative Bhabha have been carefully taken into account both at SuperB and Superkekb. It will be discussed how these sources of backgrounds have been handled. The criteria used to design an efficient collimation system in the Final Focus will be described, both for SuperB and Superkekb. The primary lost particles have been tracked through the SuperB detector allowing optimization of the interaction region design, of the proper shieldings and masks and assuring acceptable detector occupancies. The experience gathered at DAΦNE in many years of running operation has been very useful for the SuperB design study. The method used to minimize the impact of the Touschek effect at DAΦNE is reviewed.

14:30-15:00: Radiation Environment and Shielding Design Optimization at EIC

P. Degtiarenko (Jefferson Lab)

The report discusses the radiation environment at the future EIC, and the limitations/constraints/features of the machine and detector design that will be influenced by the radiation considerations. Environmental radiological controls required to allow Jefferson Lab's CEBAF operations in the middle of a densely populated area of Newport News, VA are presented, and historical radiological performance shown. The process of business and residential area build up in the vicinity of our site continues, and the location of the future EIC project at Jefferson Lab will be close to the newly planned city development zones. Jefferson Lab's Radiation Control Department policy governing the new shielding design on site, together with the list of most critical radiological problems and possible strategies directed at their solution, are presented. Discussion of the radiation source terms, and methods to calculate them in High Energy interactions at EIC is included. The need to provide reliable and sensitive environmental radiation monitoring around the new site is also discussed, and illustrated using current radiation measurements at Jefferson Lab.

THDL102 — Working Group: IR/Detector

15:50-16:20: MEIC Detector and Its Impact on IR Design

P. Nadel-Turonski (Jefferson Lab)

The Medium-energy EIC (MEIC) is the first stage of the EIC at Jefferson Lab, which is designed to support the full program for the generic EIC, aimed at mapping the spin- and spatial structure of the quark and gluon sea in the nucleon, understanding the emergence of hadronic matter from color charge, and probing the gluon fields in nuclei. The kinematic coverage of the MEIC will on one end connect to Jefferson Lab 12 GeV CEBAF, and on the other to HERA (or a future LHeC). In order to achieve these goals, the accelerator will provide deliver beams with polarized protons, deuterons, and other light ions, as well as different species of heavy ions, and accommodate a full-acceptance detector able to measure the complete final state. In particular, it will tag spectators with a resolution much less than the Fermi momentum, catch all nuclear and partonic target fragments, and to provide a wide coverage in -t for recoil baryons from exclusive (diffractive) reactions at all beam energies. The combination of a high luminosity, polarized lepton and ion beams, and detectors fully integrated with the accelerator will make the EIC a quantum leap in our understanding of the fundamental structure of matter.

16:20-16:50: Next-generation Nuclear Physics with Forward Proton/Neutron Detection at MEIC

C. Weiss (Jefferson Lab)

FRXAUD — Plenary V

08:30-09:00: The EIC Science Program

R. Milner (MIT) R.J. Holt (ANL)

The talk will describe the scientific motivation for an electron-ion collider to study QCD with precision. It must allow the detailed study of the virtual particles of QCD, namely the sea quarks and gluons in both the nucleon and nuclei. The science program defines the characteristics of the new collider and these will be explained. Some of the important measurements will be highlighted.

09:00-09:30: Beam Physics Working Group Report (Part A)

TBA

A report from the Beam Physics Working Group .

09:30-10:00: Beam Physics Working Group Report (Part B)

TBA

A report from the Beam Physics Working Group .

10:00-10:30: IR/Detector Working Group Report

TBA

A report from the IR/Detector Working Group .

FRYAUD — Plenary VI

10:50-11:20: SRF/ERL Working Group Report

TBA

A report from the SRF/ERL Working Group .

11:20-11:50: Source/Polarimetry Working Group Report

TBA

A report from the Source/Polarimetry Working Group.

11:50-12:20: PEP-II: The Making of a Successful Project

J.T. Seeman (SLAC)

The PEP-II accelerator was an e^+e^- collider built as a three laboratory construction project in the SLAC PEP tunnel to study C-P violation in the b-quark sector and successfully operated from 1999 to 2008. The project went though six fundamental phases: Accelerator design, construction and project management, accelerator-detector interfacing, commissioning, production operation, and D&D. All six of these aspects had distinct requirements and outcomes. The project evolution, execution, and lessons learned will be evaluated.

MOPCCL — Poster Session

Effects of Nonlinear Decoherence on Halo Formation

S.D. Webb, D.T. Abell, J.R. Cary (Tech-X) , D.L. Bruhwiler (RadiaSoft LLC) J.R. Cary (CIPS) K. Danilov (Colorado University at Boulder) V.V. Danilov, A.P. Shishlo (ORNL) S. Nagaitsev, A. Valishev (Fermilab)

High intensity proton linacs and storage rings are central for the development of advanced neutron sources, extending the intensity frontier in high energy physics, as drivers for the production of pions in neutrino factories or muon colliders, and for the transmutation of radioactive waste. Such high intensity beams are not attainable using conventional linear lattices. It has been shown in the single particle limit that integrable nonlinear lattices permit much larger tune spreads than conventional linear lattices, which would mitigate many of the space charge restrictions that limit intensity. In this paper, we present numerical studies of space charge e ects on a trial nonlinear lattice with intense bunches. We observe that these nonlinear lattices and their accompanying tune spreads strongly mitigate halo formation using a result from the particle-core model known to cause halo formation in linear lattices.[1]

[1] S.D. Webb, D.L. Bruhwiler, D.T. Abell, A. Shishlo, V. Danilov, S. Nagaitsev, A. Valishev, K. Danilov and J.R. Cary, Phys. Rev. ST/AB (2014), submitted.

Growth of Density Modulation in MEIC CCR Due to Coherent Synchrotron Radiation

C.-Y. Tsai (Virginia Polytechnic Institute and State University) D. Douglas, R. Li, C. Tennant, **C.-Y. Tsai** (Jefferson Lab)

We studied the coherent synchrotron radiation (CSR) effects of MEIC Circulator Cooling Ring (CCR). Due to its high peak current and low beam energy, there would make a possible concern of the CSR-induced microbunching instability. The simulation results show that the CSR effect indeed features its high gain (~3000) at ~350 m. By iterating the solutions, it is found up to 6-stage amplifications dominate the process. We also present the lattice designs of TEST ARCs for possible mitigation of CSR.