Using muons from backscattered photons on targets for various studies at the EIC

Wednesday, 5 April 2023 - Wednesday, 5 April 2023

Remote

Book of Abstracts

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A Future Muon-Ion Collider at Brookhaven National Laboratory: Muon Accelerator Systems

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There has been significant discussion in the community regarding a future $\mu^+\mu^-$ collider. While such a facility is still decades away from realization, it is also understood that significant technological development and feasibility demonstrations are necessary at lower beam energies. Here we propose such a possibility coupled with a rich physics program. We propose a future Muon-Ion Collider that would serve as a natural extension to the EIC program currently planned in the 2030' s and 40's. We envision this collider would be implemented as an upgrade to the EIC, with μ beam energies between 18 GeV and 200 GeV and a luminosity of 1033 cm−2s−1. In this presentation we discuss the challenges of generating μ beams that satisfy the design requirements of such a collider, and review some current efforts in the field to design such beams. We discuss the physics reach of a future muon-ion collider and identify opportunities for synergy between the nuclear and particle physics communities.

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MuIC Phenomenology & Exploring QCD in extreme kinematic regions

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The MuIC will enable precision measurements across a broad kinematic region. This will allow us to extend our explorations into extreme areas of QCD, pushing our perturbative predictions into the non-perturbative regime. These investigations include dense quark and parton distributions at low x and Q, which exhibit recombination and

saturation. Such high-precision measurements will help us fully characterize the various manifestations of the QCD theory.

Morning Session / **5**

Gamma-Factory@CERN - status and perspectives

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In this talk, I shall present the status of the Gamma Factory studies. I shall briefly summarise the potential applications of the Gamma Factory tools in many branches of science, discuss the accelerator and laser system requirements, and present the status of the Gamma Factory proof-of-principle SPS experiment preparations.

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State of Laser Technology/Laser Focusing and Control

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This presentation will review the current state of the art of laser technology, spanning the extremes of both ultrafast and high power, that have the potential to be used laser based accelerator technology.

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Gamma Factory High Intensity Muon Source - Exploratory Studies

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One of the fundamental challenges for the future leptonic colliders and neutrino factories is to design and construct new high-intensity sources of muons. The next-generation sources should increase the intensity of the presently operating ones by at least three orders of the magnitude and include an important option of producing longitudinally polarized muons. The main effort to achieve this goal has been focused on the proton-beam-driven muon sources. We present exploratory studies of an alternative scheme which is based on high-intensity megawatt-class photon beams. Such beams can be delivered in the future by the Gamma Factory (GF) project. One of the GF multiple goals

is to increase the energy range and the intensity of the presently operating photon sources. Such a leap can be achieved by extending the present hadron-collider modus operandi of the LHC with the new GF-operation-mode, allowing to collide atomic beams with laser pulses. The exploratory studies demonstrate that more than 10^13 muons of both signs per second can be produced by the GF source.

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Production and Applications of Muons from Backscattered Photons at the EIC

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Most muon production mechanisms at nuclear particle facilities use protons on targets. At the EIC, there is an alternative, namely the possibility to use the high energy electron beam to backscatter laser photons onto targets to produce the muons. We describe this mechanism for the EIC electron kinematic regime and possible applications of the muons produced. In addition, we provide an overview of the Workshop, the relationship among the various ideas to be discussed, and comment on a path forward.

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Muon-Ion Collider: Physics Perspectives

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The development of muon accelerator and storage ring technology at the TeV scale provides enormous scientific potential not only for a mu+mu- collider, but also for deep inelastic scattering in a completely new regime when a TeV muon beam is brought into collision with a high-energy hadron beam. For example, if the Electron-Ion Collider at BNL were eventually upgraded with a TeV muon beam replacing its low energy electron ring, a Q^2 reach of up to 10^6 GeV^2 is accessible and a parton momentum fraction x down to 1.0×10^{-5} can be probed. Such a Muon-Ion collider provides a natural first science case for the development of high-energy muon accelerator technology. In this talk we summarize the science case for a muon-ion collider, which includes precision structure function measurements, QCD and electroweak measurements, standard model particle production and coupling measurements including the Higgs boson, and searches for beyond standard model physics in second-generation fermion couplings such as Z-prime and leptoquark production.

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Timescale for the EIC and Next Generation Systems, e.g., Muon Beams & Muon-Ion Collider

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Overview of Workshop and Production of Backscattered Photon Beams at the EIC

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State of Laser Technology/Laser Focusing and Control

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Accelerator-driven Compton gamma-ray sources: High Intensity Gamma-ray Source at TUNL

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Gamma Factory High Intensity Muon Source - Exploratory Studies

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Muon Production from Backscattered Photons on Targets at the EIC

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Status of PSI Muon Beams and Charged Lepton Flavor Violation

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Muon-Ion Collider: Accelerator Systems

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Muon-Ion Collider: Physics Perspectives

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Gamma-Factory@CERN - Status and Perspectives

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MuIC Phenomenology & Exploring QCD in extreme kinematic regions

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Morning Session / **21**

Accelerator-driven Compton gamma-ray source: High Intensity Gamma-ray Source

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A nearly monochromatic, polarized gamma-ray beam is a powerful tool
for nuclear physics research, ranging from collective motions to
strong interactions between nucleons, and to the dynamics of quarks and gluons.
Laser-driven Compton gamma-ray sources have been developed and operated
worldwide since the late 1970s. The High Intensity Gamma-ray Source (HIGS)
at the Triangle Universities Nuclear Laboratory is currently
the highest flux and most versatile source in operation.
Driven by a high peak power storage ring free-electron laser (FEL),
the HIGS produces highly polarized gamma-ray beams with energies
ranging from 1 to 120 MeV, with a peak performance of total flux up
to 3E10 g/s and a spectral flux of more than 1E3 g/s/eV in the 10 MeV region.
In this presentation, I will discuss the operation principle of the
HIGS facility, developments to achieve a wide energy range, maximum flux,
and high resolution, as well as new capabilities being developed such as
pulsed mode operation, two-color beams, and precision polarization control.

I will also comment on the possible directions for next-generation Compton gamma-ray sources driven by conventional charged particle accelerators.

Afternoon Session / **22**

Organization and Next Steps

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Muon Source Studies

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