

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

**Report of Contributions**

Contribution ID: 1

Type: **not specified**

# Welcome and Overview

*Wednesday, April 5, 2023 9:00 AM (10 minutes)*

**Session Classification:** Morning Session

Contribution ID: 2

Type: **not specified**

## Closeout

*Wednesday, April 5, 2023 5:00 PM (10 minutes)*

**Session Classification:** Afternoon Session

Contribution ID: 3

Type: **not specified**

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

*Wednesday, April 5, 2023 1:40 PM (30 minutes)*

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  $\mu$  beam energies between 18 GeV and 200 GeV and a luminosity of  $10^{33} \text{ cm}^{-2}\text{s}^{-1}$ . In this presentation we discuss the challenges of generating  $\mu$  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.

Funding acknowledgment: This material is based upon work supported by the National Science Foundation under Grant No. PHY 2012114, and the Center for Frontiers in Nuclear Science at Stony Brook University.

**Author:** CLINE, Ethan (Stony Brook University)

**Presenter:** CLINE, Ethan (Stony Brook University)

**Session Classification:** Afternoon Session

Contribution ID: 4

Type: **not specified**

## MuIC Phenomenology & Exploring QCD in extreme kinematic regions

*Wednesday, April 5, 2023 3:10 PM (30 minutes)*

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.

**Author:** OLNESS, Fredrick (SMU)

**Presenter:** OLNESS, Fredrick (SMU)

**Session Classification:** Afternoon Session

Contribution ID: 5

Type: **not specified**

## **Gamma-Factory@CERN - status and perspectives**

*Wednesday, April 5, 2023 11:40 AM (30 minutes)*

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.

**Author:** KRASNY, Mieczyslaw Witold (Mieczyslaw.Witold.Krasny@cern.ch)

**Presenter:** KRASNY, Mieczyslaw Witold (Mieczyslaw.Witold.Krasny@cern.ch)

**Session Classification:** Morning Session

Contribution ID: 6

Type: **not specified**

## State of Laser Technology/Laser Focusing and Control

*Wednesday, April 5, 2023 10:40 AM (30 minutes)*

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.

**Author:** DELFYETT, Peter (CREOL, The College of Optics & Photonics, Univ. Central Florida)

**Presenter:** DELFYETT, Peter (CREOL, The College of Optics & Photonics, Univ. Central Florida)

**Session Classification:** Morning Session

Contribution ID: 7

Type: **not specified**

## Gamma Factory High Intensity Muon Source - Exploratory Studies

*Wednesday, April 5, 2023 2:40 PM (30 minutes)*

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.

**Authors:** APYAN, Armen (A. Alikhanyan National Laboratory (ANL) Yerevan, Armenia); KRASNY, Mieczyslaw Witold (LPNHE, Sorbonne Université, Université de Paris, France); PLACZEK, Wieslaw (Jagiellonian University Krakow, Poland)

**Presenter:** APYAN, Armen (A. Alikhanyan National Laboratory (ANL) Yerevan, Armenia)

**Session Classification:** Afternoon Session



Contribution ID: 8

Type: **not specified**

## Production and Applications of Muons from Backscattered Photons at the EIC

*Wednesday, April 5, 2023 10:10 AM (30 minutes)*

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.

**Authors:** Mr HARRIS, Letrell (Michigan State University); Prof. GUEYE, Paul (Michigan State University); MTINGWA, Sekazi

**Presenter:** MTINGWA, Sekazi

**Session Classification:** Morning Session

Contribution ID: 9

Type: **not specified**

## Muon-Ion Collider: Physics Perspectives

*Wednesday, April 5, 2023 2:10 PM (30 minutes)*

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  $10^6 \text{ GeV}^2$  is accessible and a parton momentum fraction  $x$  down to  $1.0 \times 10^{-5}$  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.

**Author:** ACOSTA, Darin (Rice University)**Presenter:** ACOSTA, Darin (Rice University)**Session Classification:** Afternoon Session

Contribution ID: **10**

Type: **not specified**

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

*Wednesday, April 5, 2023 9:10 AM (30 minutes)*

**Presenter:** DESHPANDE, Abhay (Stony Brook University)

**Session Classification:** Morning Session

Contribution ID: 11

Type: **not specified**

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

**Presenter:** MTINGWA, Sekazi

**Session Classification:** Morning Session

Contribution ID: 12

Type: **not specified**

## **State of Laser Technology/Laser Focusing and Control**

**Presenter:** DELFYETT, Peter (CREOL, The College of Optics & Photonics, Univ. Central Florida)

**Session Classification:** Morning Session

Contribution ID: 13

Type: **not specified**

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

**Presenter:** WU, Ying (Duke University)

**Session Classification:** Morning Session

Contribution ID: 14

Type: **not specified**

## **Gamma Factory High Intensity Muon Source - Exploratory Studies**

**Presenter:** APYAN, Armen (A. Alikhanyan National Laboraory (AANL))

**Session Classification:** Afternoon Session

Contribution ID: 15

Type: **not specified**

## **Muon Production from Backscattered Photons on Targets at the EIC**

*Wednesday, April 5, 2023 1:10 PM (30 minutes)*

**Presenter:** GUEYE, Paul (FRIB)

**Session Classification:** Afternoon Session



Contribution ID: 16

Type: **not specified**

## **Status of PSI Muon Beams and Charged Lepton Flavor Violation**

*Wednesday, April 5, 2023 9:40 AM (30 minutes)*

**Presenter:** PAPA, Angela (PSI and UniPi-INFN)

**Session Classification:** Morning Session

Contribution ID: 17

Type: **not specified**

## **Muon-Ion Collider: Accelerator Systems**

**Presenter:** CLINE, Ethan (Stony Brook University)

**Session Classification:** Afternoon Session

Contribution ID: **18**

Type: **not specified**

## **Muon-Ion Collider: Physics Perspectives**

**Presenter:** ACOSTA, Darin (Rice University)

**Session Classification:** Afternoon Session

Contribution ID: 19

Type: **not specified**

## **Gamma-Factory@CERN - Status and Perspectives**

**Presenter:** KRASNY, Mieczyslaw Witold (Mieczyslaw.Witold.Krasny@cern.ch)

**Session Classification:** Morning Session

Contribution ID: 20

Type: **not specified**

## **MuIC Phenomenology & Exploring QCD in extreme kinematic regions**

**Presenter:** OLNESS, Fredrick (SMU)

**Session Classification:** Afternoon Session

Contribution ID: 21

Type: **not specified**

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

*Wednesday, April 5, 2023 11:10 AM (30 minutes)*

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  $3 \times 10^{10}$  g/s and a spectral flux of more than  $1 \times 10^3$  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.

**Author:** Prof. WU, Ying (Duke University)

**Presenter:** Prof. WU, Ying (Duke University)

**Session Classification:** Morning Session

Contribution ID: 22

Type: **not specified**

## Organization and Next Steps

*Wednesday, April 5, 2023 4:10 PM (50 minutes)*

**Presenter:** MTINGWA, Sekazi

**Session Classification:** Afternoon Session

Contribution ID: 23

Type: **not specified**

## Muon Source Studies

*Wednesday, April 5, 2023 3:40 PM (30 minutes)*

**Presenter:** BERG, J. Scott (Brookhaven National Laboratory)

**Session Classification:** Afternoon Session