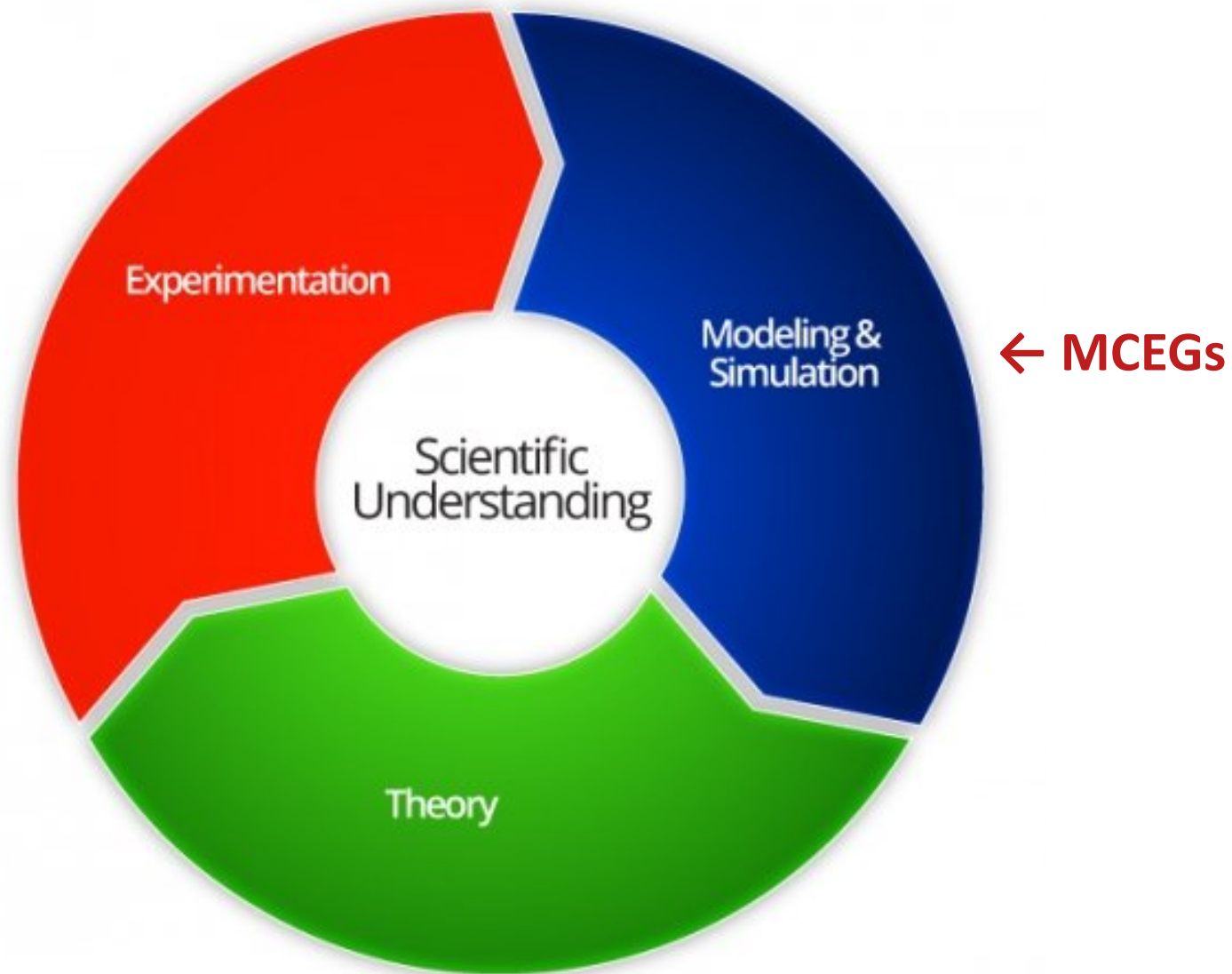


Discussion on Monte Carlo Event Generators for the EIC



Measurements and Simulations

Measurement



Simulation



Role of Simulations



Design Experiments Design and develop detectors and large-scale detector systems based on key measurements / physics reach and background estimates. Optimize the design.

Analysis Develop and verify analysis methods and tools: Does the analysis method or tool give the correct result? Estimate systematic uncertainties.

Verify Measurements Detailed simulations essential for commissioning experiments and verify analyses.

MCEGs for the EIC

Monte Carlo Simulation of

- electron-proton (ep) collisions,
- electron-ion (eA) collisions, both light and heavy ions,
- including higher order QED and QCD effects,
- including a plethora of spin-dependent effects.

Cross-Cutting Challenges: High-precision QCD measurements require high-precision simulations.

Unique Challenges: MCEGs for electron-ion collisions and spin-dependent measurements, including novel QCD phenomena (e.g., GPDs or TMDs).

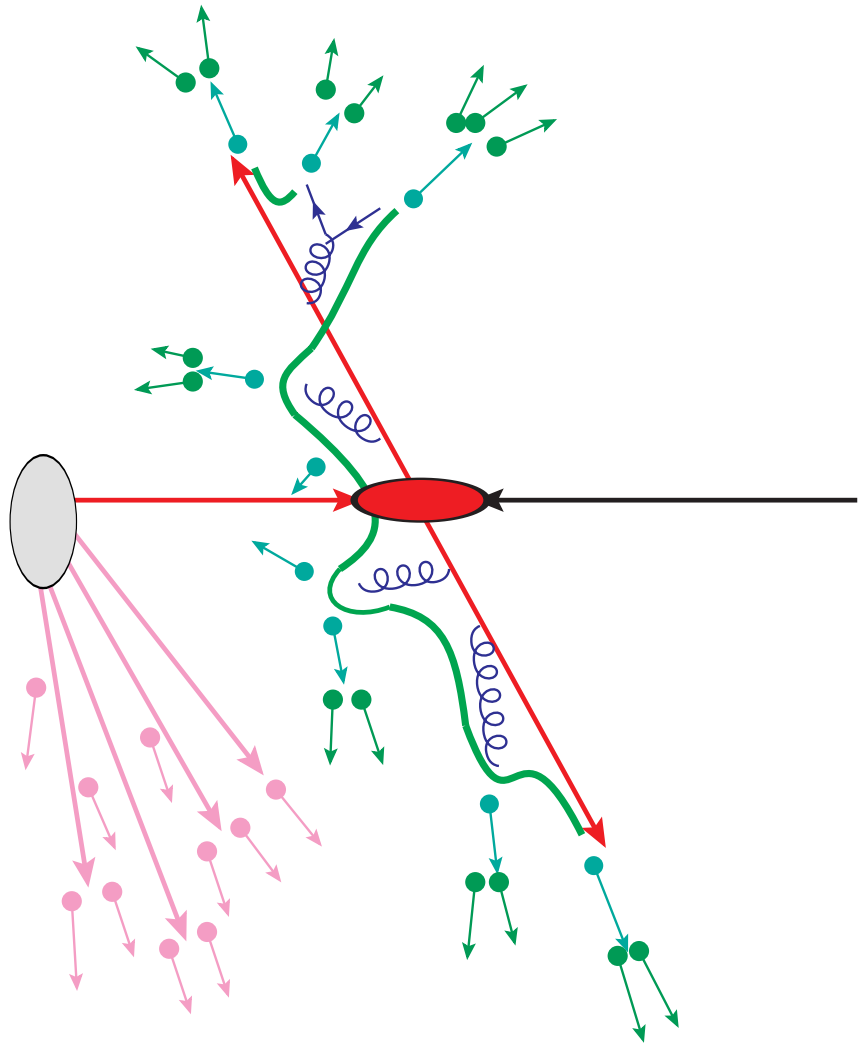
Recent discussion on physics processes and related MC samples in ePIC: <https://indico.bnl.gov/event/21772/>

The screenshot shows a meeting page for 'ePIC Software, Computing and Physics Discussion' on Wednesday, Feb 14, 2024, from 11:00 AM to 12:00 PM US/Eastern. The meeting is hosted by Markus Diefenthaler (Jefferson Lab), Rosi Reed (Lehigh University), Salvatore Fazio (University of Calabria and INFN-Cosenza), Sylvester Joosten (Argonne National Laboratory), Torre Wenaus (BNL), and Wouter Deconinck (University of Manitoba). The description states that the meeting will discuss physics processes and generators for simulation campaigns and will use Zoom for remote participation. Zoom details include: <https://jlab-org.zoomgov.com/j/1614875218?pwd=RFRRPcGINM3BaS0pQaDhxS3JURkdJZz09>, Meeting ID: 1614875218, and Password: 925723. A 'Live Notes' button is visible.

The agenda includes:

- 11:00 AM → 11:45 AM Physics Processes and MC Samples for Simulation Campaigns**
 - 11:00 AM Physics Processes and MC Samples in Current Simulation Campaign** (5m) by Sakib Rahman (University of Manitoba). Includes 'Generators and Dat...'
 - 11:05 AM Input from Physics WGs** (25m) by Brian Page (Brookhaven National Laboratory), Charlotte Van Hulse, Ciprian Gal (Jefferson Lab), Claire Gwenlan (Oxford), Michael Nycz (University of Virginia), Olga Evdokimov (UIC), Rachel Montgomery, Raphael Dupre (IJCLab, CNRS, Univ. Paris-Saclay), Stefan Diehl (JLU Giessen and UCONN), and Tyler Kutz (MIT). Includes 'ePIC MCEG Needs'.
 - 11:30 AM Discussion** (15m)

Role of Theory



MCEG:

- faithful representation of QCD dynamics
- based on QCD factorization and evolution equations **Links to theory: Advance QCD factorization and evolution. Understand mismatches.**

MCEG Algorithm:

1. Generate kinematics according to fixed-order matrix elements and QCFs. **Links to theory: Theoretical calculations and global QCD analysis.**
2. QCD Evolution via parton shower model (resummation of soft gluons and parton-parton scatterings). **Links to theory: QCD Evolution. Merging of higher order QED and QCD.**
3. Hadronize all outgoing partons including the remnants according to a model. **Links to theory: Hadronization models.**
4. Decay unstable hadrons.

Priorities

- Training of the EIC community.
- **Validation of existing MCEGs using Rivet:**
 - Rivet analyses from HERA and CEBAF. Rivet for physics analyses from ePIC simulations?
 - Build automated workflows (CI).
- Development of a DIS tune.
- **Merging of higher order QED and QCD effects.**
- **Feasibility of shared elements between general-purpose MCEGs.**
- Roadmap for spin-dependent parton showers .
- Roadmap for spin-dependent hadronization models.
- Roadmap for eA, both light and heavy ions.
- Guidance on how to compare EIC measurements with theory: Folding and unfolding approaches.

Involvement from ePIC as well as the MCEG and the theory community essential. Need to consider organization and funding opportunities.