09/01 Frank and Markus present first draft for Secs. 1 and 2.
09/01 Ilkka presents a detailed list of Rivet analyses and the corresponding plots that will be shown for each analysis.
09/01 Pythia and Sherpa collaborations present a draft for Secs. 3.2 and 3.3, which can be shared with other projects as an example.
09/?? MC4EIC meeting to provide a status update and invite the community to contribute to the article.
11/?? MC4EIC meeting to present the first full draft of the article and to discuss the timeline for soliciting community feedback and publication.

1 EIC Science - Overview of Key Measurements and Need for MCEGs

Comment: *Link the EIC Science program to the need for MCEGs, and underscore the importance of reviewing and validating the capabilities of existing MCEGs for EIC Science. (Frank, Markus, 2 pages)*

2 Goals for MCEG Development

Comment: *(Frank, Markus, 1 page)*

Is there a QCD-based computational framework that allows easy implementation of new theoretical developments, while also making MCEGs predictive and versatile enough to be used successfully by experiments?

- **Foundations**: Which type of QCD factorization is applicable when? Which assumptions can be used / should be avoided? Point to the goal of an universal description of strong interactions.
- **Benchmarks**: Which features of QCD theory must be reproduced? Are there well-defined limits to test EIC predictions?
- **Cross-cuts**: What synergies exist with MCEG development for other experiments? Highlight the strength of MCEGs in that they can be validated using data from other colliders and processes, linking to the universal description.

How can we make use of existing expertise, experience and technology to advance the construction of MCEGs for the EIC

- **Reuse**: Which components that are crucial to experimental success can be inherited from existing projects?
- **Generalize**: Are there new, well-defined and more or less universal components that will be required?
- **Cross-cut**: Which synergies exist with ongoing developments in other fields? Also here, point to validation using data from other colliders and processes.

Comment: *Condense Secs. 2.1-2.3 into a single page.*

2.1 Perturbative QCD in Monte Carlo Simulations

Comment: *The text is excerpted from Stefan Prestel's talk summary in the live notes from MC4EIC 2021.*

Precision perturbative QCD predictions in event generators provide trustworthy predictions of observables not previously discussed in the literature. As such, they ensure that reliable data analyses can be constructed, and are helpful in avoiding inconclusive measurements. Precision event generators rely on high-accuracy fixed-order calculations combined with reliable parton showers through matching. At present, the rate for unpolarized deep inelastic scattering is known to an impressive N3LO precision, whereas polarized DIS is known to NNLO precision. Meanwhile, all “LHC-hardened” general-purpose Monte-Carlo event generators (Herwig7, Sherpa, Pythia8) offer several parton-shower models applicable to DIS, which are matched to NLO or even NNLO calculations. All of these calculations seem to suggest that most of HERA data can be described by sophisticated calculations in collinear factorization. Despite this, there are still several improvements that are necessary for precision general-purpose event generators to truly become the backbone precision background predictions of the majority of EIC measurements: Higher-order showers must be considered to produce a closer link to TMD factorization: the latter may have to be revisited as well - precision shower evolution and factorization need to find a middle ground. Beyond this, a consistent framework to combine processes with different non-perturbative beam structure (DIS, photoproduction, diffraction) has to be constructed, and the factorization of the initial-state ion modeling and precision calculations for hardest scatterings will have to be reexamined. Thus, despite impressive progress, there are still exciting questions at the interface between factorization and numerical simulations to address.

Comment: *The text is excerpted from Yuri Kovchegov's talk summary in the live notes from MC4EIC 2021.*

The talk presents an overview of saturation physics and also describes the efforts to introduce spin into small-x physics. Saturation is described at two levels: (i) multiple rescatterings in the quasi-classical approximation (GGM/MV) and (ii) non-linear small-x evolution (BK/JIMWLK). The former dynamics is included in the Sartre generator. The latter evolution at large N_c is equivalent to Mueller's color dipole cascade and is possibly included in DIPSY, Pythia8, and Herwig7. Quark and gluon helicity dependence may be introduced into the dipole cascade as well, but it comes in at the sub-eikonal level (suppressed by a power of x), where the cascade is more involved. Future developments may include a dedicated MC simulator for BK/JIMWLK evolution, and a later extension of this MC to include helicity effects.

Comment: *The text is excerpted from Ivan Vitev's talk summary in the live notes from MC4EIC 2021.*

In the past 30 years reactions with nuclei have produced spectacular results. The key to interpretation of production of hadrons, jets, heavy flavor, etc is in-medium parton showers. In-medium splitting functions have been derived using different methods. In-medium parton showers are softer and broader than the ones in the vacuum - experimentally verified. Transverse and longitudinal degrees of freedom do not factorize. In-medium splitting functions can be calculated and tabulated (integrating out the space-time information). Implemented very successfully in higher order and resumed calculations. Very significant effects on hadrons, jets and jet substructure at the EIC at forward rapidity. Monte Carlos that incorporate this physics properly do not exist. The problem is the coherent nature of the emission. Various approximations and prescriptions on how to mimic the LPM effect are proposed. The detailed shower characteristics are not incorporated. For serious implementation of in-medium showers in MC generators significant effort is needed (LUTs combined with modelling coherence).

Comment: *The text is excerpted from Tim Hobbs's talk summary in the live notes from MC4EIC 2021.*

Monte Carlo event generation occupies a critical space between theory and experiment, in a fashion mirrored by analyses of parton distribution functions (PDFs), which leverage experimental data and the fundamentals of perturbative QCD to extract the quark-gluon densities of hadrons and nuclei. An important point is the systematic dependence of generator output upon various nonperturbative settings and choices, including upon input PDFs. As the design and ultimate performance of the EIC will depend on these selections, it will be important to develop next-generation MCEGs for DIS collisions and complementary improvements to PDFs. The impact of these improvements is expected to be widespread given the significant PDF limitations in other areas, including, at higher energies, for LHC phenomenology — e.g., Higgs production, W-mass determinations, and constraints to fundamental SM couplings — and neutrino-nucleus scattering at low(er) energies (in the case of oscillation searches). The necessary improvements to PDFs span a number of areas, and include questions of higher perturbative accuracy; consideration of electroweak corrections; efforts to statistically unravel PDF uncertainties — especially at very high and very low x; and the role of nuclear corrections in global analyses. In the latter case, these encompass both fewbody effects typical of the deuteron as well as phenomenological heavy-nuclear corrections. Potential input from lattice QCD would also be very valuable. Given the cross-cutting nature of many of the issues in event generation, developments for DIS generators should be explored in a wider setting involving best practices learned within the LHC, neutrino, lepton collider, and other generator communities. Lastly, a number of specific complications like the question of whether dedicated PDFs for DIS generators should be determined must be addressed in consultation with experimentalists. The ongoing Snowmass exercises are an ideal avenue for establishing such exchanges and understanding.

Comment: *The text is excerpted from John Collins's talk summary in the live notes from MC4EIC 2021.*

Improved accuracy in MCEGs needs, among other things, the ability to use the higher-order perturbative corrections that are calculated for use with factorization theorems, and to use them at their full accuracy. In this talk I give an explicit and elementary account of the main difficulties in achieving this aim. Factorization theorems apply to a variety of inclusive and semi-inclusive reactions (e.g., SIDIS), whereas MCEGs generate complete events. Factorization theorems are obtained by making certain approximations to obtain tractable leading-power results. The approximations change the kinematics of the unobserved part of the final state in the processes treated. But the complete events generated by MCEGs must obey momentum conservation. Then the implementations of showering and hadronization lead to partonic 4-momenta that are different to those used in factorization. This mismatch makes it difficult to accurately apply results from perturbative calculations when going beyond a generalized leading-logarithm approximation.

Comment: *The text is excerpted from Andrea Signori's talk summary in the live notes from MC4EIC 2021.*

Transverse-momentum-dependent (TMD) PDFs encode all the possible spin-momentum correlations between the hadron and its constituents. A TMD-based description of physical observables such as cross sections and asymmetries relies on the so-called TMD factorization, namely the possibility of separating soft and hard scales (in particular transverse momenta). Currently, the majority of MC event generators does not rely exactly on this kind of factorization and distributions. Thus, in order to fully exploit the potential of TMD PDFs in terms of (non-)perturbative effects, polarization effects, etc. a dictionary between the main ingredients of MC event generators and TMD cross sections is highly desirable. Many of the aspects related to the impact of PDFs on MC simulations can be transposed to the case of TMD distributions. Moreover, one needs to keep in mind that our phenomenological knowledge of TMD PDFs is poorer than the one of collinear PDFs. This is due mainly to a lack of data sensitive to transverse momentum effects, but also to several complications in the formalism. For example, in the case of Semi-Inclusive Deep-Inelastic Scattering, there are still tensions in the description of existing data both at low and at high transverse momentum. The EIC is going to provide new data and crucial information to study these three-dimensional distributions. However, the development of its physics program (starting from the detector proposals) relies also on accurate description of transverse momentum effects. This requires a systematic inclusion of TMDs in existing MC event generators.

2.2 Non-Perturbative QCD in Monte Carlo Simulations

Comment: *The text is excerpted from Leif Lönnblad's talk summary in the live notes from MC4EIC 2021.*

The use of General Purpose Event generators is important in order to have the connection to other collider experiments and the wealth of data collected there. Unfortunately the three main generators, Herwig, Pythia and Sherpa, are currently not well suited to simulate eA collisions, and quite a lot of work is needed to get them in shape for EIC. In this talk I brought up some of these issues.

The transition between DIS to photo-production and Vector Meson Dominance (VMD) is not well modeled. This is especially problematic for eA, as any Glauber calculation will need to consider the quark degrees of freedom of the (virtual) photon when modeling the number of wounded nucleons in the γ-N process. Also, we have learned from pA collisions at the LHC that the fluctuations in the nucleon wave functions are important to consider in a Glauber calculation, and especially for DIS we expect large effects from the fluctuations in the photon. The LHC has also taught us that there are collective effects even in pp collisions (e.g. flow and strangeness enhancement), and these are so far not very well modeled by the general purpose event generators. Whether these will be important also at the EIC remains to be seen, but at least it would be necessary to have good models that can show the effect.

One thing that will be studied at the EIC is polarization effects, and again, this is something that is not very well modeled in general purpose event generators.

I ended the talk on a somewhat more positive note by describing the ongoing work within the Pythia collaboration to address many of these issues, eg. including dipole-nucleon scatterings in Angantyr, new models of collective effects, nuclear and photon PDFs, polarized string fragmentation, and TMD-based parton showers.

2.3 Hadronization and Nuclear Effects

Comment: *The text is excerpted from Anselm Vossen's talk summary in the live notes from MC4EIC 2021.*

Fragmentation Functions (FFs) are non-perturbative objects that appear in QCD factorization formulas to describe the hadronization of partons to hadrons. Interest in measuring fragmentation functions stems mainly from the need for their precise determination to extract the nucleon structure from semi-inclusive measurements. But they are also interesting in their own right, as they describe non-perturbative hadronization dynamics. Their field theoretical structure is analogue to PDFs and their measurement can therefore probe analogue QCD dynamics. The cleanest environment to measure FFs is in e+e- annihilation, where they are the only non-perturbative objects entering the cross-section. However, single-inclusive annihilation does not provide sufficient access to their flavor structure or gluon FFs. For these aspects, data from pp collisions and SIDIS are needed. However, due to the more complex environment, pp collision data is not described as well in global fits and SIDIS fixed target data suffers from limitations in the application of factorization theorems, in particular when accessing the transverse momentum dependence. Recently, a strong focus has been on jet and in-jet fragmentation, in particular at the LHC, but also using existing ALEPH data. Originally the purpose of these efforts was to tag jets by their structure but a rich program has developed since to explore the correlation of produced hadrons in relation to jet directions. Jet clustering algorithms also provide opportunities to separate soft/hard and collinear/wide angle emission in the jet formation, leading to an exploration of the Parton shower. Similarly, different jet axes, like WTA compared to the standard axis, provide differing sensitivity to soft emissions. The field of jet substructure in general therefore seems to be a promising avenue to learn about correlations in hadronization described by MCEGs. In general, the difference between 'traditional' FF measurements and MCEGs is the focus in FF measurements on inclusive final states, which is needed for factorization theorems to hold. On the other hand, MCEGs are focused on the exclusive event description. Those differences are beginning to be bridged by the interest in the experimental community in jet structure, or objects like di-hadron FFs which naturally describe correlations in hadronization. A focus in fragmentation function measurements have been the B-factories, due to their hermetic detectors, providing good PID and their large collected datasets. They have been in particular instrumental in the measurement of polarization dependent and polarizing FFs which are needed to access the spin structure of the nucleon in SIDIS. The next generation B factory, Belle II started taking data in 2018 and is projected to reach the Belle dataset in 2022, and collect a dataset about 50x larger within the decade. Currently, a program for fragmentation measurements with a focus on jet observables is developed. A discussion with MCEG developers in the context of the snowmass process was initiated with the desire to define analyses that help develop MCEG hadronization models e.g. for the EIC as well as discussing the need for precise MCEGs for the extraction of hadronization observables from the Belle II data. With a maximum jet energy of about 5.5 GeV, jets at B-factories are much closer to jets at the EIC, albeit at the lower end. Since hadronization effects at these energies are relatively stronger, a jet program at Belle II will be very valuable for their determination.

Comment: *The text is excerpted from Mark Baker's talk summary in the live notes from MC4EIC 2021.*

The BeAGLE (Benchmark eA Generator for LEptoproduction) simulation code has been used extensively in recent years to enable the design and optimization of the IRs and detectors (especially forward detectors) for eA physics. The ability to model the nuclear response is a particularly unique feature of this code, especially the modeling of the excited nuclear remnant and it's decay, including photonic de-excitation. We want to preserve the best features of this code/model into the future, but the exact path forward is unclear due to the fact that the code is in

FORTRAN and links to other FORTRAN code (e.g. Pythia 6 rather than 8). Short-term, it will still be needed for study and optimization of the 2nd IR (IP8) at the EIC. It would also be valuable to apply it to existing and soon-to-come tagging data from JLAB12, both for physics interest and to help validate the model (e.g. better tuning the intranuclear cascade). Medium-term, BeAGLE can be used as an afterburner to another primary model to apply the nuclear breakup model to the spectator nucleons. This has already been done for the GCF (Generalized Contact Formalism) model of Short-Range Correlations. GCF handles the electron + 2-nucleon hard interaction and leaves the rest to BeAGLE. Longer-term we could take Alfredo Ferrari up on his offer to make a (C++ I think) interface to FLUKA which could effectively replace BeAGLE. It will need collaboration as it is more complicated than the neutrino version they already implemented primarily due to the less point-like nature of virtual photons compared to the weak bosons.

Comment: *The text is excerpted from Christian Bierlich's talk summary in the live notes from MC4EIC 2021.*

Angantyr is the extension of the PYTHIA model for multiparton interactions to heavy ion collisions. It gives special emphasis to coherence effects, by incorporating a dynamical model for shadowing effects, and cross section colour fluctuations. The latter is seem to have a large impact on Glauber calculations for $\gamma^* A$ collisions. Next steps: For the succesul simulation of full eA events, a suitable model for covering the VMD region is needed, ideally both at the cross section level and particle production level. Furthermore, attention should be given to fragmentation of the beam region. Best venue for collaboration is Rivetization of HERA analyses and fixed target analyses (possibly LHCb SMOG).

3 General-Purpose Monte Carlo Event Generators

3.1 Herwig

Comment: *This section will draw on the presentations from MC4EIC2025. (1 page)*

3.2 Pythia

Comment: *This section will draw on the presentations from MC4EIC 2025. (1 page)*

3.3 Sherpa

Comment: *This section will draw on the presentations from MC4EIC 2025. (1 page)*

4 Specialized Monte Carlo Event Generators for the EIC

Comment: *We aim to produce a concise yet comprehensive report. To that end, we invite all MCEG projects related to EIC Science to contribute a subsection on their work. Each submission should be no more than half a page and should describe the purpose and accuracy of the MCEG, including references to relevant data comparisons. The text should also include a link to the code repository and specify the output format(s).*

4.1 Cascade

Comment: *The text is excerpted from Armando Bermudez Martinez's talk summary in the live notes from MC4EIC 2022.*

The Cascade3 Monte Carlo event generator is based on Transverse Momentum Dependent (TMD) parton densities evolution. Hard processes which are generated in collinear factorization with LO multileg or NLO parton level generators are extended by adding transverse momenta to the initial partons according to TMD densities and applying dedicated TMD parton showers and hadronization. The generator offers the possibility of multijet merging for the handling of the hard regions of phase space. Processes with off-shell kinematics within kt-factorization, either internally implemented or from external packages via LHE files, can be processed for parton showering and hadronization. The initial state parton shower is tied to the TMD parton distribution, with all parameters fixed by the TMD distribution.

4.2 eHIJING

Comment: *The text is excerpted from Weiyao Ke's talk summary in the live notes from MC4EIC 2022.*

I will talk about the current status and plans of the electron-Heavy-Ion-Jet-INteraction-Generator (eHIJING). The eHIJING generator aims to describe the modification and hadronization of jets propagating in the cold nuclear matter in e-A collisions. The hard production and vacuum parton shower dynamics are handled by the Pythia8 event generator. Medium-modified splitting functions obtained from the generalized higher-twist approach are added to Pythia8 to generate the in-medium parton shower. A model for pure medium-induced emissions and modifications to hadronization is developed independently after the parton shower simulation. I will review the comparison of eHIJING simulations to both semi-analytic calculations and data in fixed target DIS experiments.

The dominant medium effects come from the medium-modified hadronization model of eHIJING. To analyze the systematics of the modeling, one needs a better understand- ing of multiple medium-induced emissions (in the kinematic region relevant for the EIC). I will talk about ongoing theoretical efforts in this respect that motivates a formation- time-ordered picture of medium-induced emissions as implemented in eHIJING. Finally, I will talk about plans for mass effects in medium modifications, amid the increasing interest in studying heavy flavor productions at the EIC.

More Details on eHIJING: eHIJING simulates the propagation and hadronization of the jet shower in the cold nuclear matter in electron-ion collisions. The event generator relies on Pythia8 for the triggering of hard processes and the development of the parton shower in the vacuum. The eHIJING generator includes multiple collisions between jet partons and small-x gluons in the nuclear target, which not only broadens the transverse momentum of the jet parton but also modifies the splitting functions and hadronization in the medium.

Focus on the medium effects in eHIJING: Multiple collisions of jet partons with the nucleus are sampled according to a differential probability calculated using a saturation-motivated model for the transverse- momentum-dependent (TMD) gluon distribution function at small x. These multiple collisions modifies the vacuum QCD splitting functions. High-transverse-momentum corrections to the splitting function are added to Pythia8 to generate in-medium parton shower. The shower parton, small-transverse-momentum medium-induced gluons, and recoiled nuclear remnants are hadronized via Lund-string fragmentation.

The figure below shows preliminary results of eHIJING simulation of the nuclear modified transverse-momentum-dependent fragmentation of $\pi^{\pm}$) in e-Xe collisions as compared to HERMES data. The physics of multiple collisions and modified splitting/fragmentation implemented in eHIJING well describe the existing fixed target measurements. One can then project modifications at future collider energies at the EIC and examine the connection of the observed modifications to the gluon distribution in the nuclear target.

4.3 ePIC

Comment: *The text is excerpted from Kemal Tezgin's talk summary in the live notes from MC4EIC 2022.*

Exclusive processes have gained increasing attention in recent years. Part of this interest stems from the open questions of how the spin of the proton is decomposed into its intrinsic spin and orbital motions, along with the possibility of gaining energy-momentum densities through exclusive processes. In this presentation, we will introduce the EpIC Monte Carlo event generator. The EpIC generator utilizes the PARTONS framework to provide a variety of model options and a flexible structure. A further feature of the EpIC generator is the integration of first-order radiative corrections into its architecture. As a consequence, EpIC offers a comprehensive set of features that will enable nucleon structure to be studied more deeply through impact studies on future electron-ion colliders.

4.4 eSTARlight

Comment: *The text is excerpted from Spencer Klein's talk summary in the live notes from MC4EIC 2022.*

eSTARlight is a Monte Carlo that simulates exclusive vector meson production in electron-ion collisions. It is experimentally oriented, designed to be easily extensible as the EIC physics program expands. It uses a variety of parameterizations of HERA and fixed-target data to simulate the production of a wide range of vector mesons, on a wide range of nuclear targets, for arbitrary Q^2 ranges. In this talk, I will discuss eSTARlight, with a focus on recent improvements and additions, and show selected comparisons with HERA data.

4.5 MadGraph5 aMC@NLO

Comment: *The text is excerpted from Laboni Manna's talk summary in the live notes from MC4EIC 2022.*

In the coming years, the Electron-Ion-Collider (EIC) in the United States will enable researchers to study lepton-hadron collisions with unprecedented precision. To consolidate figures of merit of a variety of measurements at the EIC, it is essential to include radiative corrections in simulations of electron-proton and electron-nucleus collisions. For the time being, there do not exist any automated simulation tools for such reactions, including even only next-to-leading order (NLO) radiative corrections.

In this talk, I will present our recent progress in implementing electron-proton and electron- nucleus collisions within MadGraph5 aMC@NLO, a framework for (N)LO computation, intensively used at LHC. Additionally, I will present our work to modernize MadGraph5 aMC@NLO to make it more efficient to use in future hardware.

4.6 MLEG

Comment: *The text is excerpted from Astrid Hiller Blin's talk summary in the live notes from MC4EIC 2022.*

Monte Carlo event generators (MCEG) in high-energy nuclear and particle physics are crucial for experimental preparation and simulation. While the theory assumptions of traditional MCEG are usually well justified, mixing data with a model for the physics we want to infer potentially leads to biased results. The scope of applications is limited, since the theory description of modern collider experiments can become highly cumbersome, and the need to correct for detector effects typically becomes increasingly difficult.

I give an overview of the state-of-the-art alternative means of machine learning event generators (MLEG). After training, the MLEG serve as extremely fast and highly compact interpolation tools at event level, offering the possibility to regenerate large amounts of data collected from multiple experiments. The nature of the MLEG training offers the advantage of event generation that can be free of theory and detector correction biases. The question of how to unfold vertex-level from detector-level events is currently a hot topic of exploration, and I present possible approaches towards this goal

In this setting, I finally discuss the important topics of physics validation, uncertainty quantification, and closure tests, which are of high relevance in the context of precision physics extraction.

4.7 Sartre

Comment: *The text is excerpted from Tobias Toll's talk summary in the live notes from MC4EIC 2022.*

Sartre is an event generator specifically designed for generating exclusive diffractive vector meson and DVCS production in electron-ion (eA) collisions at small momentum fractions x. Sartre calculates the coherent and incoherent cross sections independently in the Good-Walker picture. It can also be used in ep, and for ultra-peripheral pA and AA collisions, all for exclusive diffraction. Sartre is using the bSat (also known as the IP-Sat) dipole model for calculating cross sections as well as the linearised version bNonSat, which is useful for studying saturation effects. It can in principle be used for any initial state nucleus species. Nuclear breakup is handled by the Gemini package. Functionally Sartre stores all the computing-heavy cross section calculations into 3D lookup tables in W2, Q2, and t (2D for UPC), which are then used for event generation. The drawback of this is that it makes changes in the model slow to implement, but the benefit is that it is a very fast event generator for the user (a few ms/event).

5 MC-Data Comparisons for the EIC

Comment: *This section will present results from Rivet analyses for the MCEGs listed in the article. The goal is to provide a limited set of relevant examples for EIC-related measurements. A more detailed validation can, and likely will, be addressed in future work. Ilkka will coordinate this effort. Each MCEG project included in the report will be invited to contribute their Rivet results for the selected analyses.*

5.1 Rivet

Rivet [**?**, **?**] is a mature and widely adopted toolkit for the validation and preservation of particle-physics analyses in terms of generator-level observables. Originally developed ahead of the LHC as a modern successor to the `HZTool` system used at HERA, Rivet builds on the idea of using stable, generator-independent event interfaces to preserve analysis logic in a portable and reusable way, enabling meaningful comparisons between experimental measurements and theoretical predictions. Particular emphasis is placed on support for *fiducial* cross-section measurements, in which well-defined final-state observables – rather than inferred parton-level quantities – form the basis for comparison, aligning with modern best practices in both experimental publication and MC model development. Rivet now includes over 2000 published routines from experiments at the LHC, Tevatron, LEP, RHIC, HERA and many others, alongside many MC-only validation routines.

Recent developments have made Rivet increasingly relevant beyond the LHC context, including for heavy-ion and lepton–hadron physics. Support for flow observables, centrality calibrations, and detector-level smearing have enabled new applications in heavy-ion analysis and reinterpretation. The current series also includes enhanced HPC support via serialisation features in the YODA2 [**?**] histogramming backend, enabling efficient memory and communication patterns in distributed workflows. The migration of many previously `HZTool`-only HERA analyses into Rivet, along with ep-specific refinements, marks a strategic broadening of scope towards future EIC physics. Ongoing efforts aim to further streamline Rivet's use with EIC-oriented event generators, enhance support for observables relevant to TMD and nPDF studies, and foster community adoption as a standard for reproducible and generator-independent MC analysis. An EIC-specific Rivet tutorial has been developed for the MC4EIC workshop series to support new users in this context.[1]

5.2 Analyses

Comment: *Keep the number of analysis finite (around 5) such that these would reflect the advances in the event generators and address experimental requirements outlined in section 3. One plot from each generator, add scale uncertainties.*

- photoproduction
  - multiplicity distribution: ZEUS 2021 analysis (to be published)
  - diffractive dijets: H1_2015_I1343110

[1] See gitlab.com/hepcedar/tutorials/mc4eic25

  - inclusive dijets: ZEUS_2001_I568665
- DIS
  - multiplicities, HERMES or COMPASS: HERMES 2012 analysis (to be published)
  - energy flow, H1 or ZEUS: H1_2000_I503947
  - low energy jets: H1_2002_I588263, H1_2016_I1496981, ZEUS_2010_I875006