Adding HepMC3 output to the Toy MC generator

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Motivation

- We need to have a way to interface Pawel's Toy MC to other simulation software, i.e. eic-smear and Fun4All

- The simple way is to make the Toy MC output events in a format that can be used as input of other tools

- Better to rely on widespread file format and already available libraries

- HepMC can be one of these:

  - Eic-smear recently added support for HepMC3 files. From version 1.1.1

 - Fun4all should already support it

Implementation

- Pawel's Toy MC already produces a list of particles per event

- This list has been re-arranged with vertices and in/out particles

- HepMC allows to add attributes to each event: for the moment only the cross section has been added
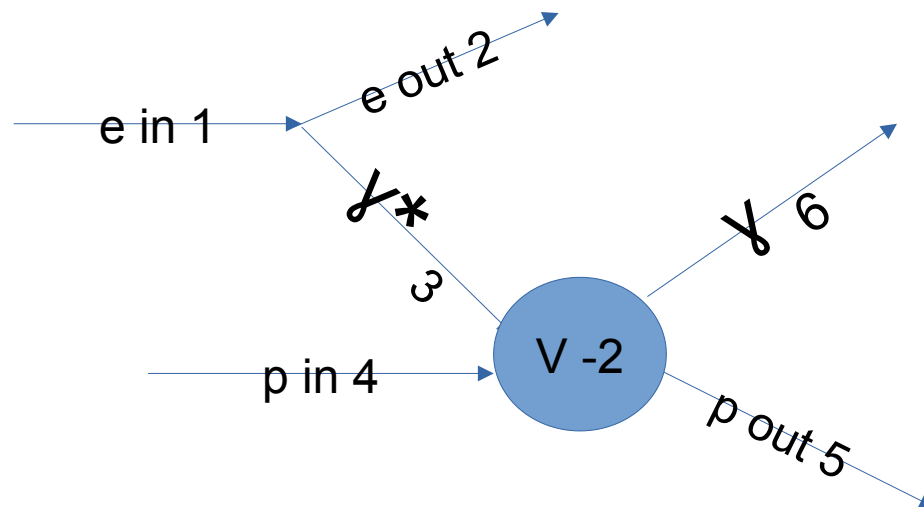
Examples

DVCS

```
HepMC::Version 3.02.02
HepMC::Asciiv3-START_EVENT_LISTING
E 0 2 6
U GEV MM
A 0 GenCrossSection 3.74278352e-04 0.00000000e+00 -1 -1
P 1 0 11 -0.0000000000000000e+00 0.0000000000000000e+00 -9.9999999869440064e+00 1.0000000000000000e+01 5.1099888971089147e-04 21
P 2 1 11 4.7937247452052981e-02 -1.0563986032908634e+00 -3.7942129935981939e+00 3.9388232367898581e+00 5.1103639874544636e-04 1
P 3 1 22 -4.7937247452052981e-02 1.0563986032908634e+00 -6.2057869932905305e+00 6.0611767632771958e+00 -1.7006482408571932e+00 21
P 4 0 2212 -0.0000000000000000e+00 0.0000000000000000e+00 9.9995598131265865e+01 1.0000000000000001e+02 9.3827201300135255e-01 21
V -2 0 [3,4]
P 5 -2 2212 9.7539316836493972e-02 -7.8044377289862366e-01 9.9783317419901692e+01 9.9790828216285604e+01 9.3827201300135255e-01 1
P 6 -2 22 -1.4547656428855077e-01 1.8368423761895680e+00 -5.9935062821314204e+00 6.2703485468189850e+00 -3.2814400550372487e-05 1
```
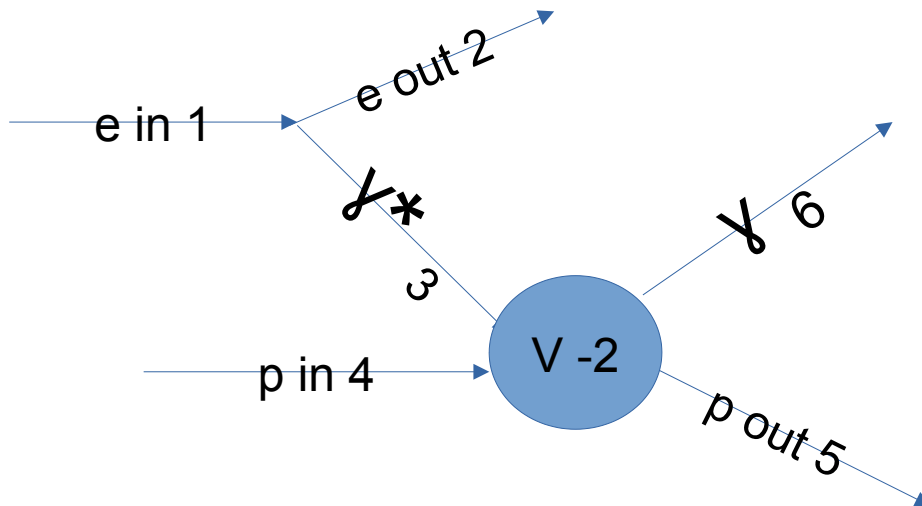
Examples

Pi0

```
HepMC::Version 3.02.02
HepMC::Asciiv3-START_EVENT_LISTING
E 0 3 8
U GEV MM
A 0 GenCrossSection 1.43624465e-04 0.00000000e+00 -1 -1
P 1 0 11 0.0000000000000000e+00 0.0000000000000000e+00 -9.9999999869440064e+00 1.0000000000000000e+01 5.1099888971089147e-04 21
P 2 1 11 -1.0286266579919647e+00 -1.6958571695098101e+00 -9.4210694023931865e+00 9.6275933278184223e+00 5.1013247309278354e-04 1
P 3 1 22 1.0286266579919647e+00 1.6958571695098101e+00 -5.7893058451008983e-01 3.7240667223651602e-01 -2.0323578014376458e+00 21
P 4 0 2212 0.0000000000000000e+00 0.0000000000000000e+00 9.9995598131265865e+01 1.0000000000000001e+02 9.3827201300135255e-01 21
V -2 0 [3,4]
P 5 -2 2212 7.2090995551822046e-01 4.0353407722649504e-02 9.8386889101561863e+01 9.8394012221348589e+01 9.3827201300135255e-01 1
P 6 -2 111 3.0771670247372684e-01 1.6555037617871884e+00 1.0297784450322069e+00 1.9783944507286144e+00 1.3497660000159195e-01 21
P 7 6 22 2.4485275747129764e-01 1.1317326555151745e+00 6.4496782558913790e-01 1.3254264115543748e+00 -2.1073424255447017e-08 1
P 8 6 22 6.2863944998801269e-02 5.2377110625249612e-01 3.8481061943092809e-01 6.5296803915091473e-01 0.0000000000000000e+00 1
```
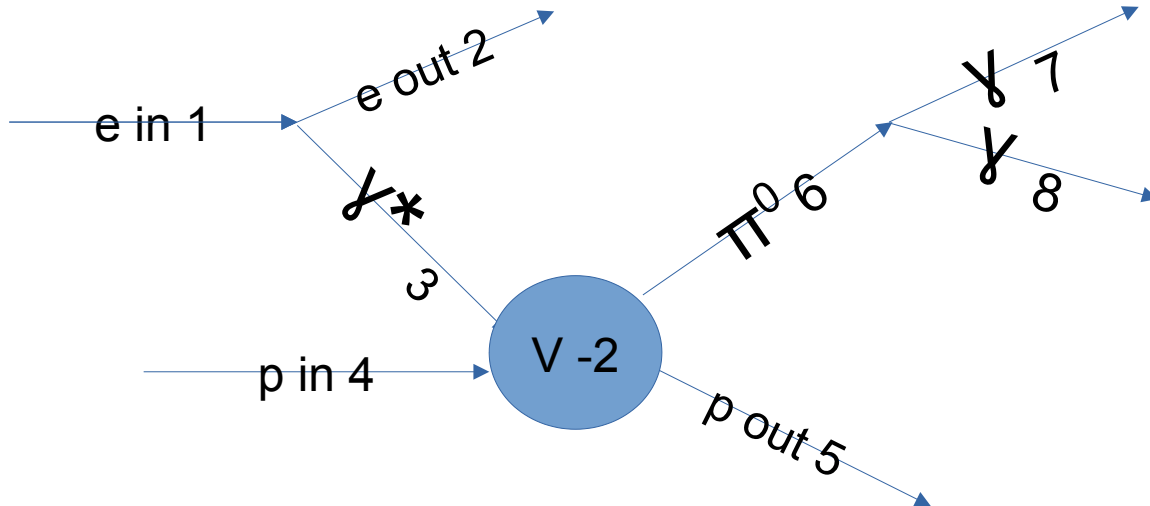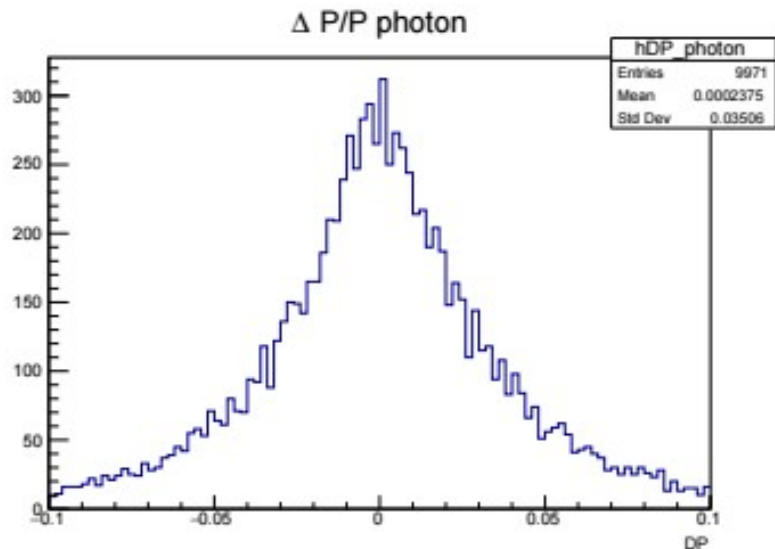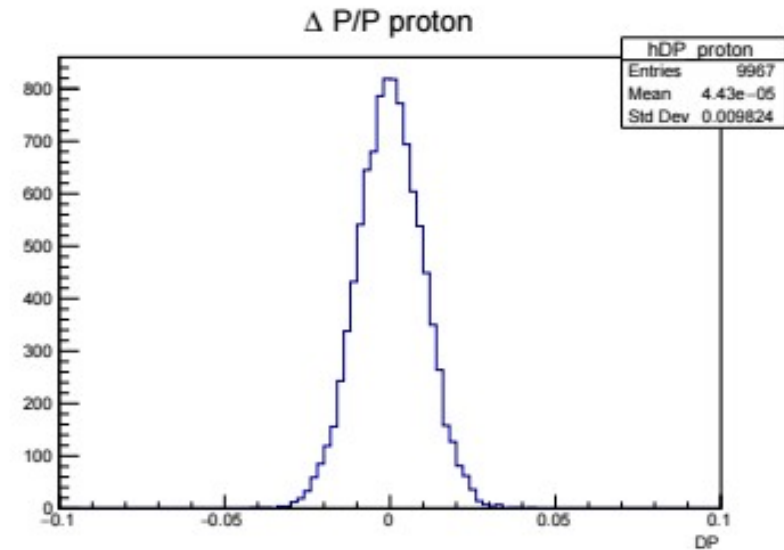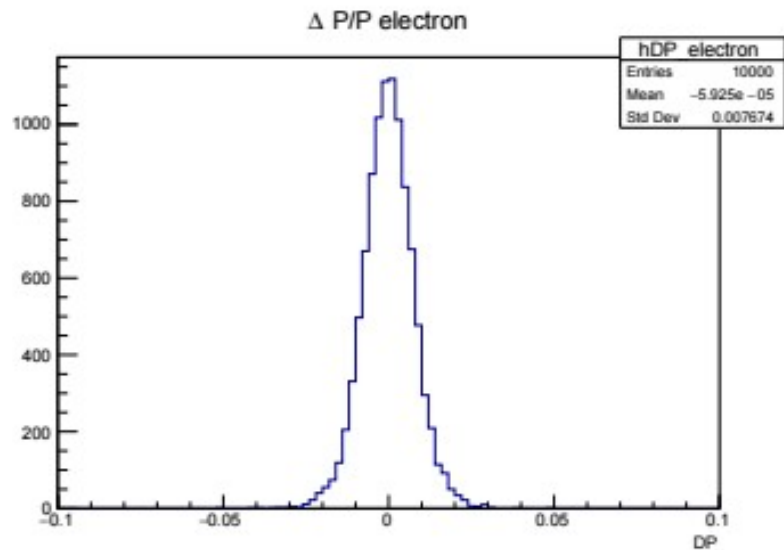
Reading the output with eic-smear

- eic-smear version 1.1.1

- Using SmearMatrixDetector_0_1, but it is missing the very forward region, i.e. roman pots and so

- Therefore, I added a 1%*P smearing for eta > 4.5

Reading the output with eic-smear
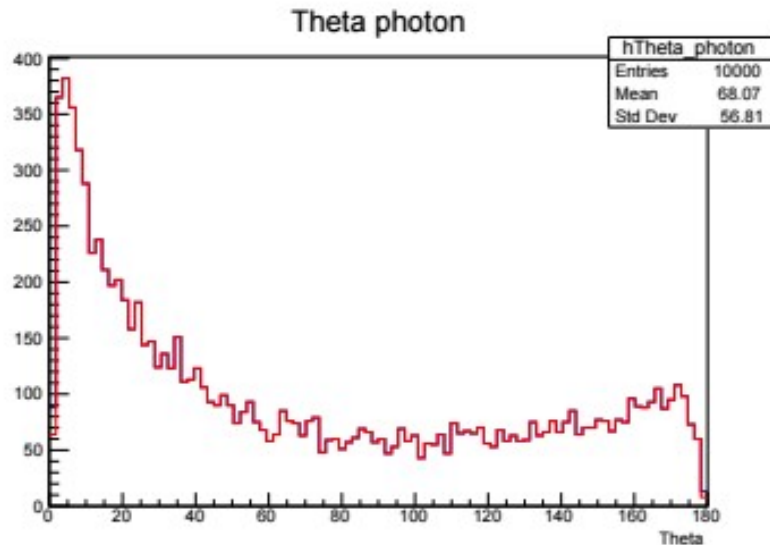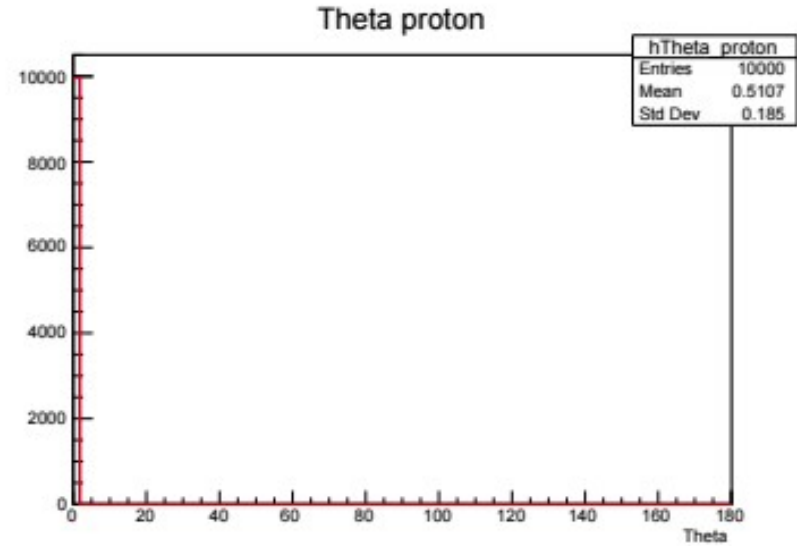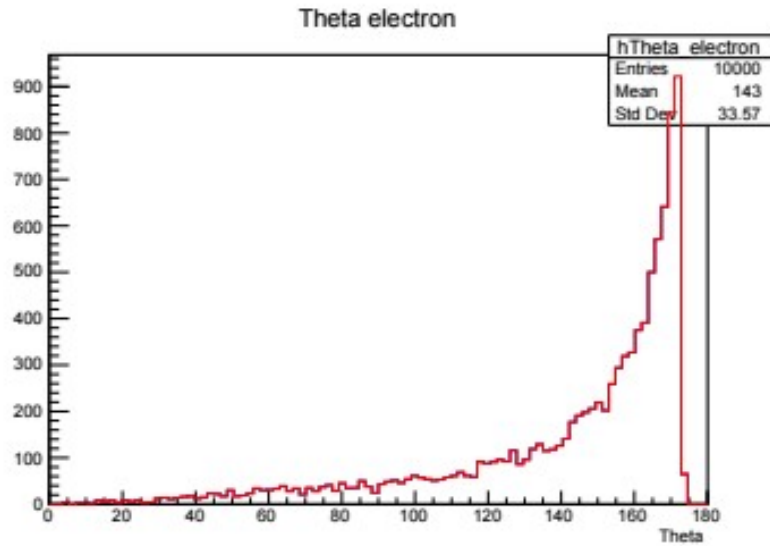
Reading the output with eic-smear

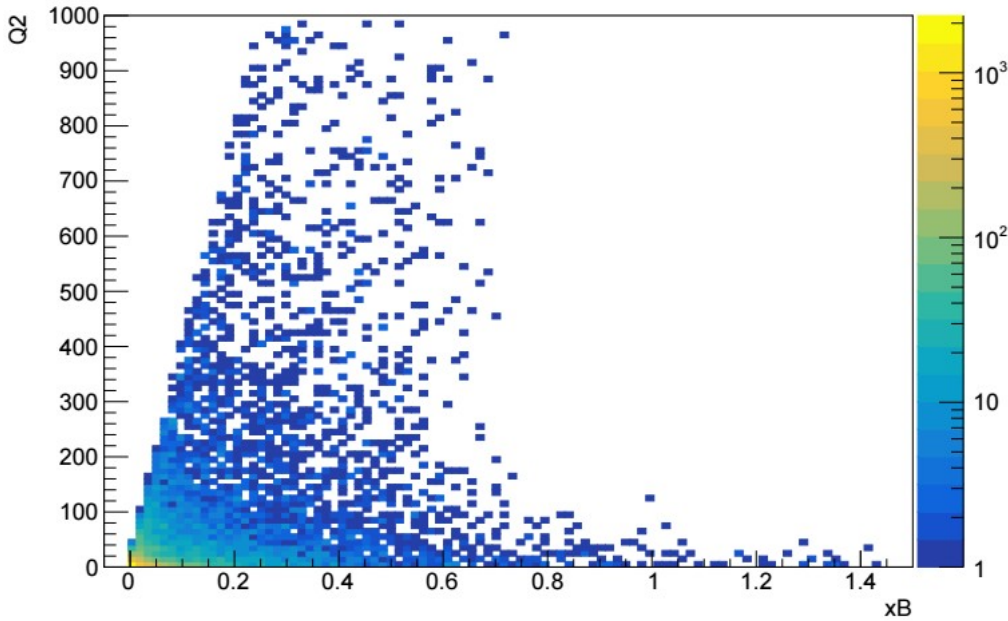
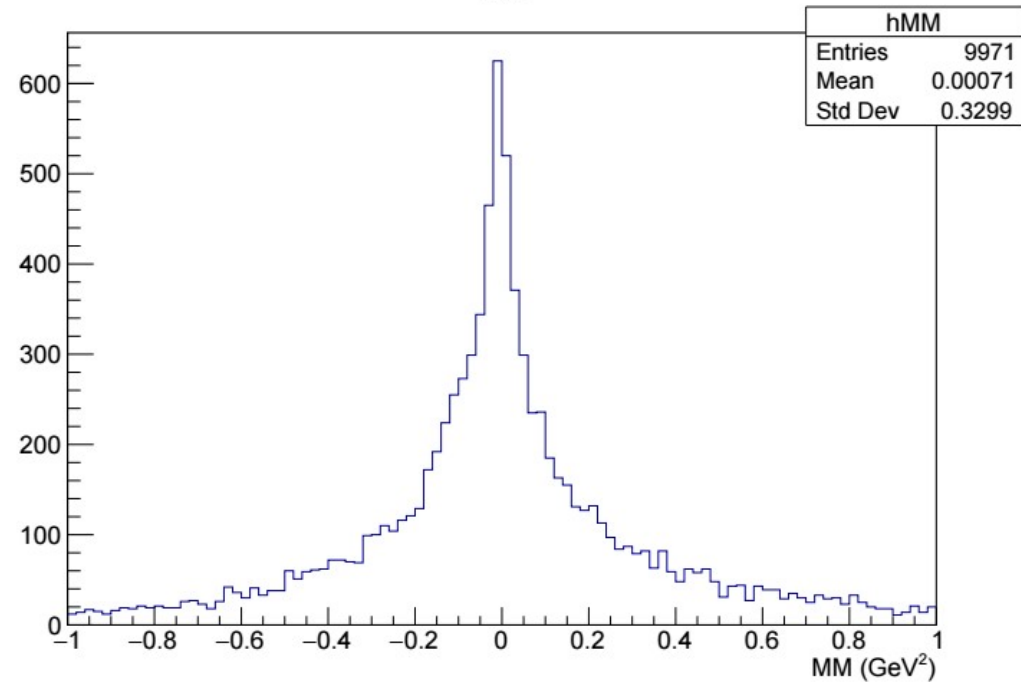CAVEAT: for the photon I've used the energy instead of the momentum

Reading the output with eic-smear

Summary

- Now the Toy MC can output HepMC3 files

- These output files can be easily read by eic-smear

- This addition can help the realization of a new full DVCS/DVMP MC event generator