Analysis workflow (NLO MC)

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What did we do ?

- NLO MC code from Pavia group is a Fortran code, producing events written to an ascii file
- C++ interface reading the events and writing to root file
  - Defined an Event class to contain the event fourvectors and event variables and weights
  - Defined a Setup class to contain all the parameters (MC settings, internals, counters and sums, cross section)
  - Every root file contains 2 root Trees (one for the parameters with only one entry, one for events): in this way it is self-contained, simplifying the book-keeping and making robust the analysis level.
  - The compression gain from ascii to root is 5 or better, currently it can be run on the fly using a pipe, the cpu time is very good.
  - Both unweighted and weighted generations are dealt with
  - This code should be usable, with small maintenance, also in future theory MC developments
  - Documentation to be produced

NLO MC samples

- Currently produced order 10^10 weighted events with 2 different selections (similar statistics) with mu+ beam of E=150 GeV (no smearing)
  - Inclusive: Ee > 0.2 GeV
  - Signal-like: Ee > 5 GeV
  - Using weights is convenient to assess the sensitivity to the running alpha (stored weights for full running, no running, only leptonic running)

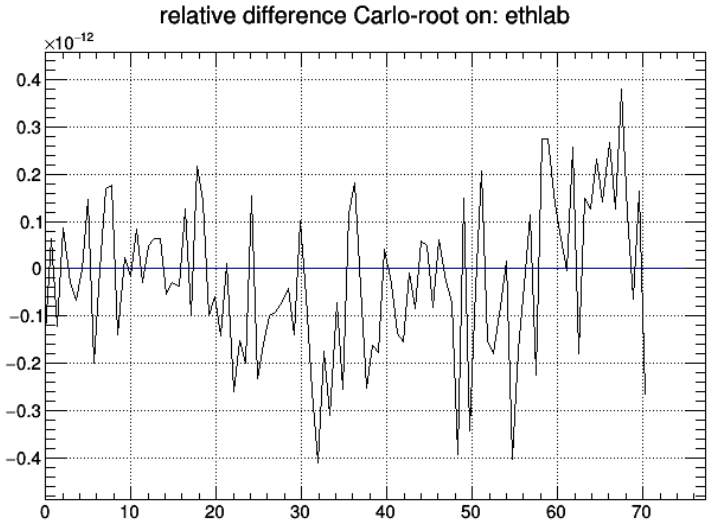
/eos/user/c/cacarlon/samples/muplus/
  - emin-0.2 directories from 1/ to 15/
  - emin-5 « « «

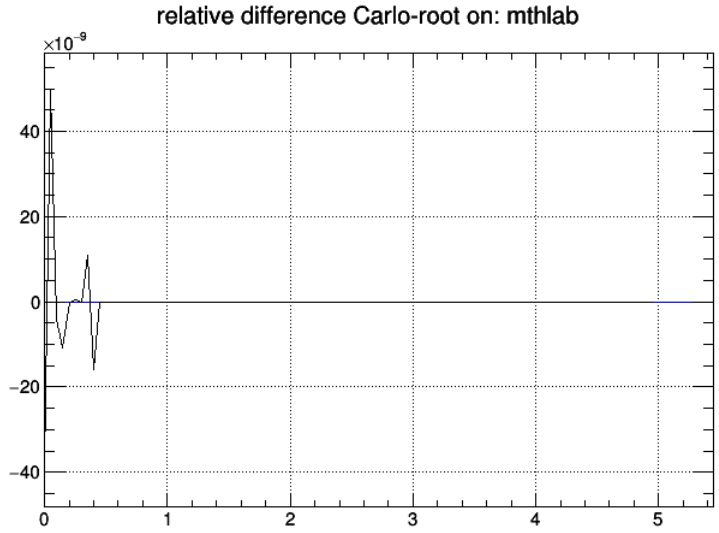
/eos/user/f/fpiccini/samples/
  - emin-0.2 directories from 16/ to 30/
  - emin-5 « « «

- Total disk size is about 2 TB for about 2x10^10 events -->> 0.1 KB/ev

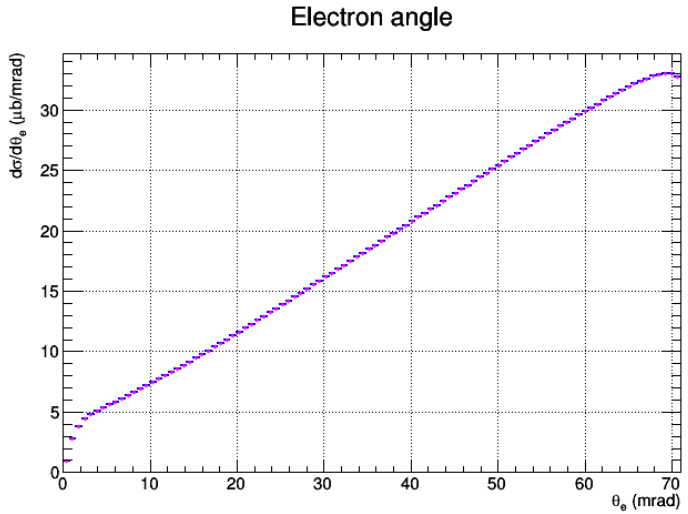
Tests of numerical precision

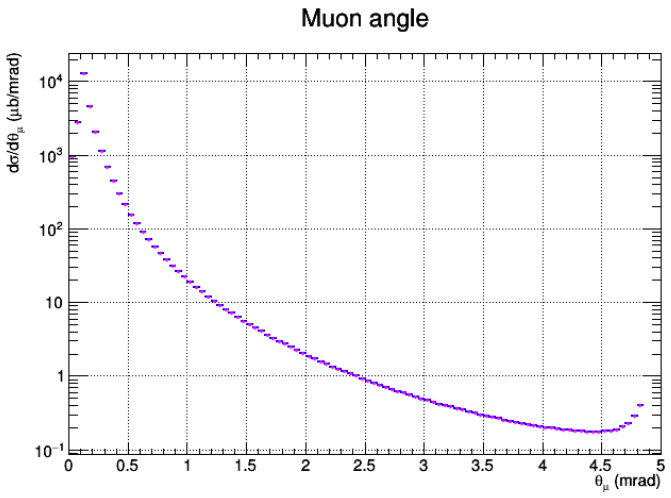
- The root implementation has been tested w.r.t. Carlo's original results from the Fortran code, defining a pool of reference distributions.
- The comparisons are tipically within 10^-12 for both the kinematical distributions and the errors. Muon angle is the worst case (max difference 4x10^-8)
  - While doing these tests we verified that we need to store the fourvectors in double precision to reach the necessary accuracy.

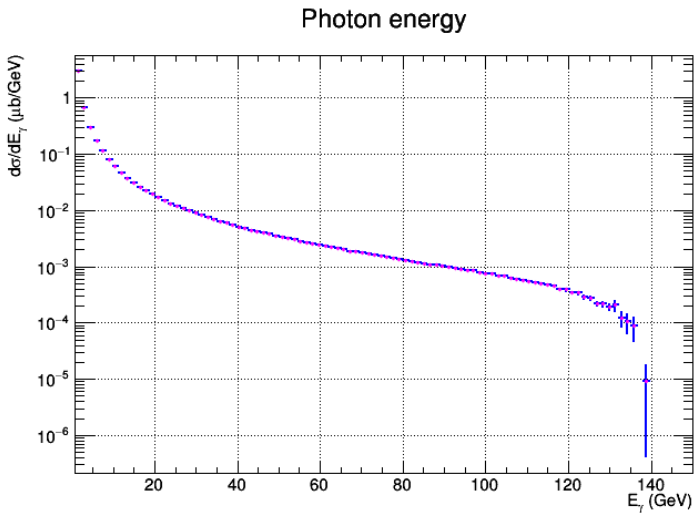


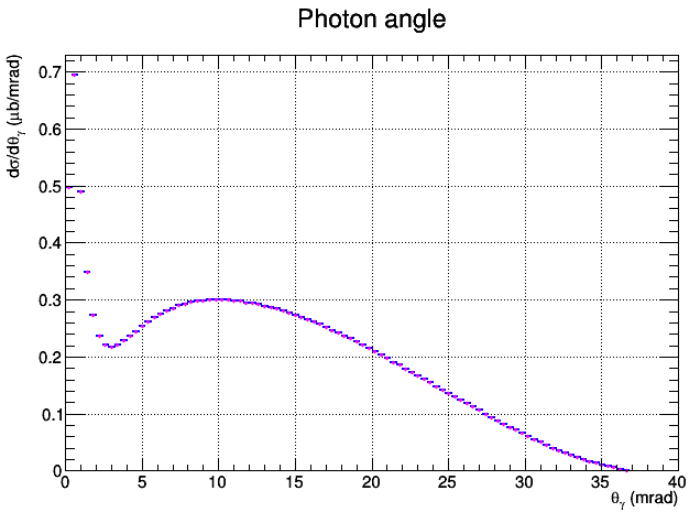


Kinematical distributions



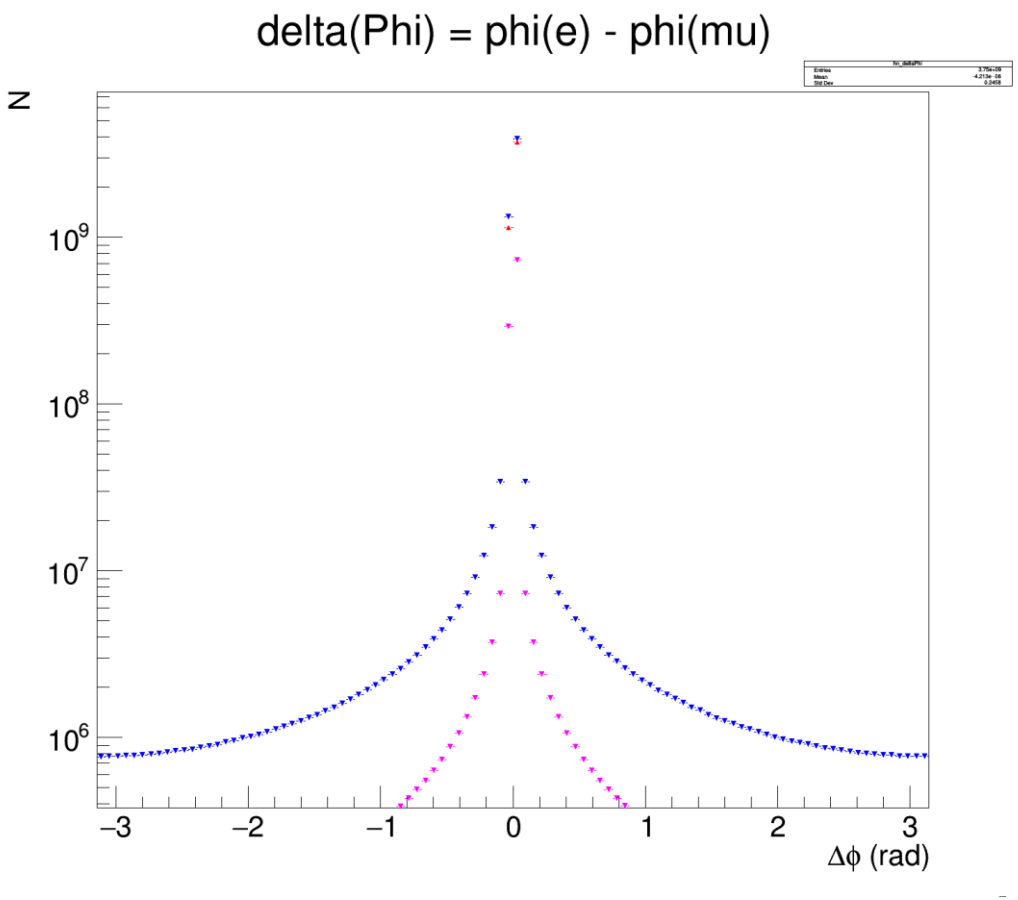






Acoplanarity

- Incoming muon is along z with fixed p=150 GeV. Look at the phi difference between the final electron and muon

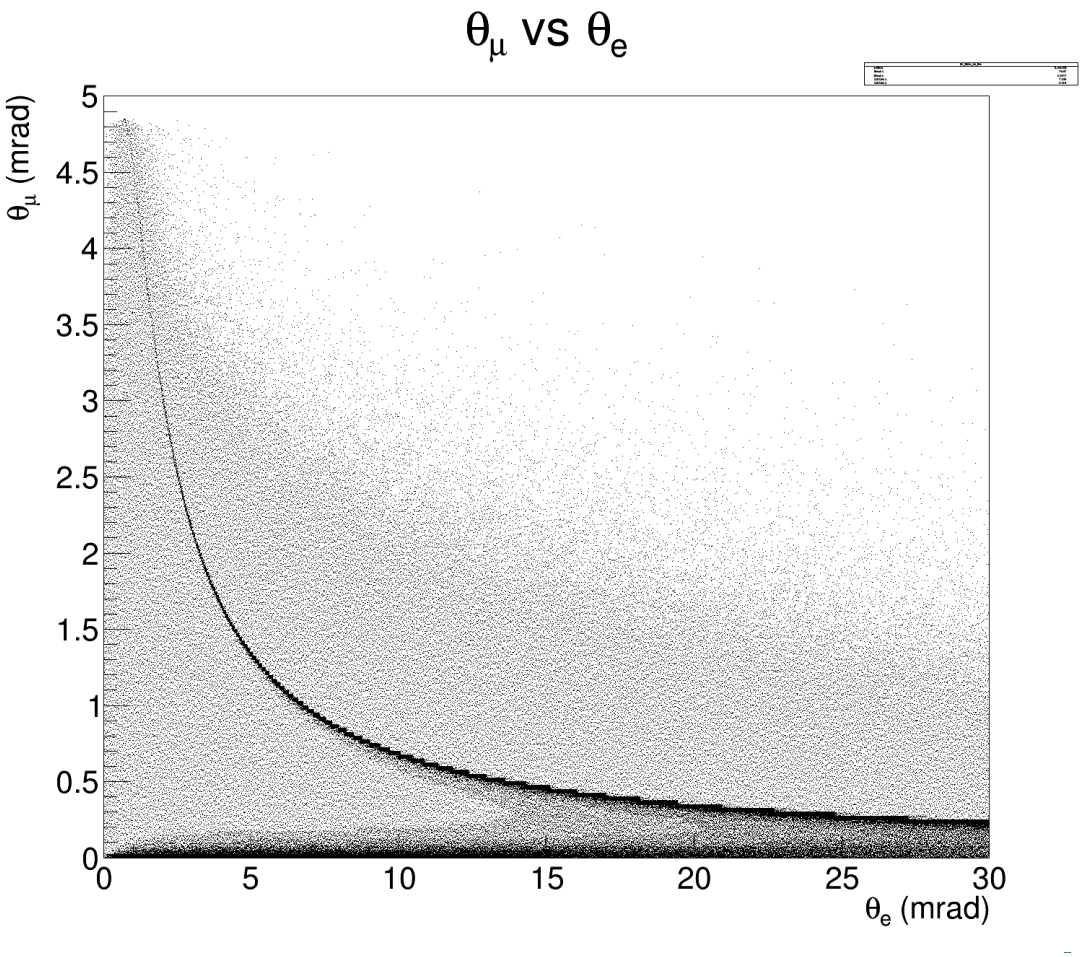


Blue points: Ee > 0.2 GeV

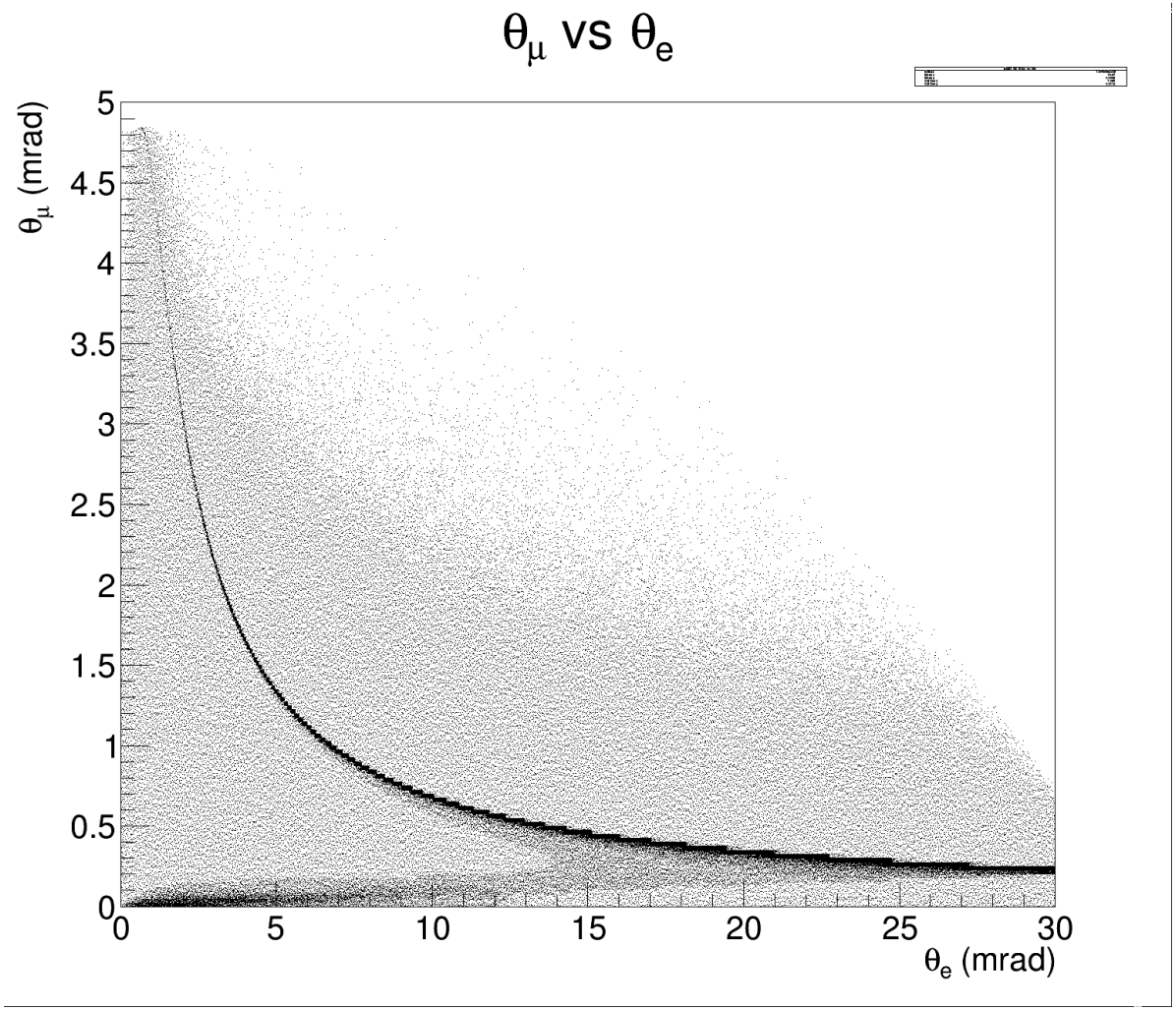
Magenta points: Ee > 1 GeV

Red points: |Dphi|<3.5 mrad

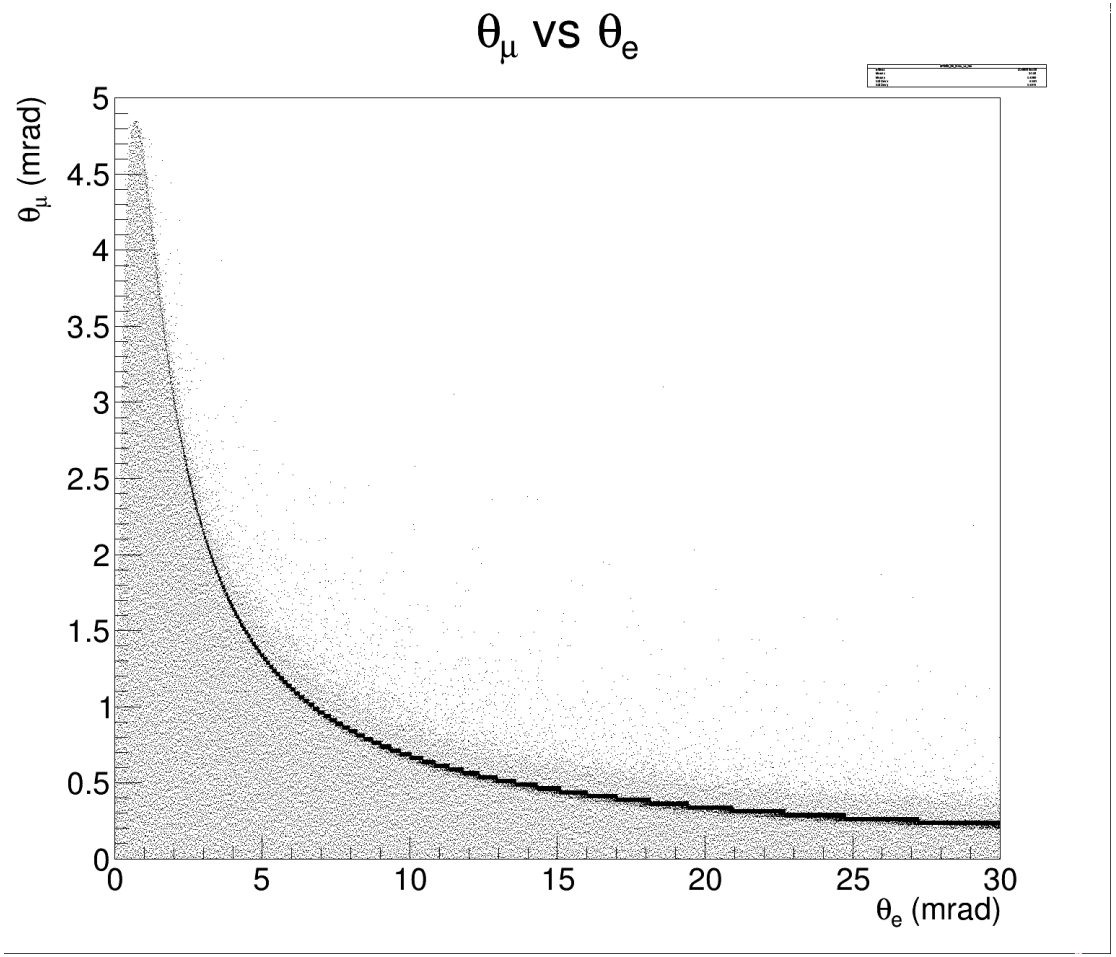
Inclusive events (Ee>0.2 GeV)



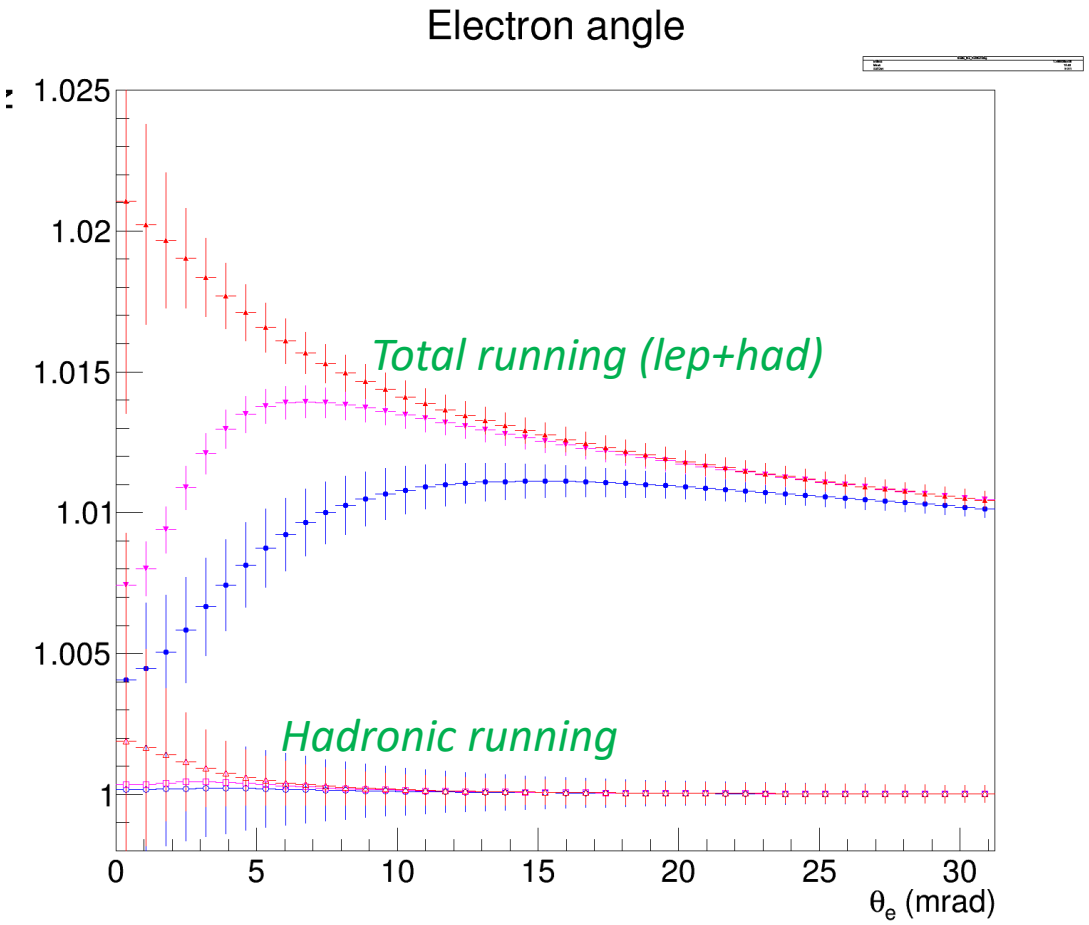
Ee > 1 GeV



Acoplanarity (Dphi) < 3.5 mrad



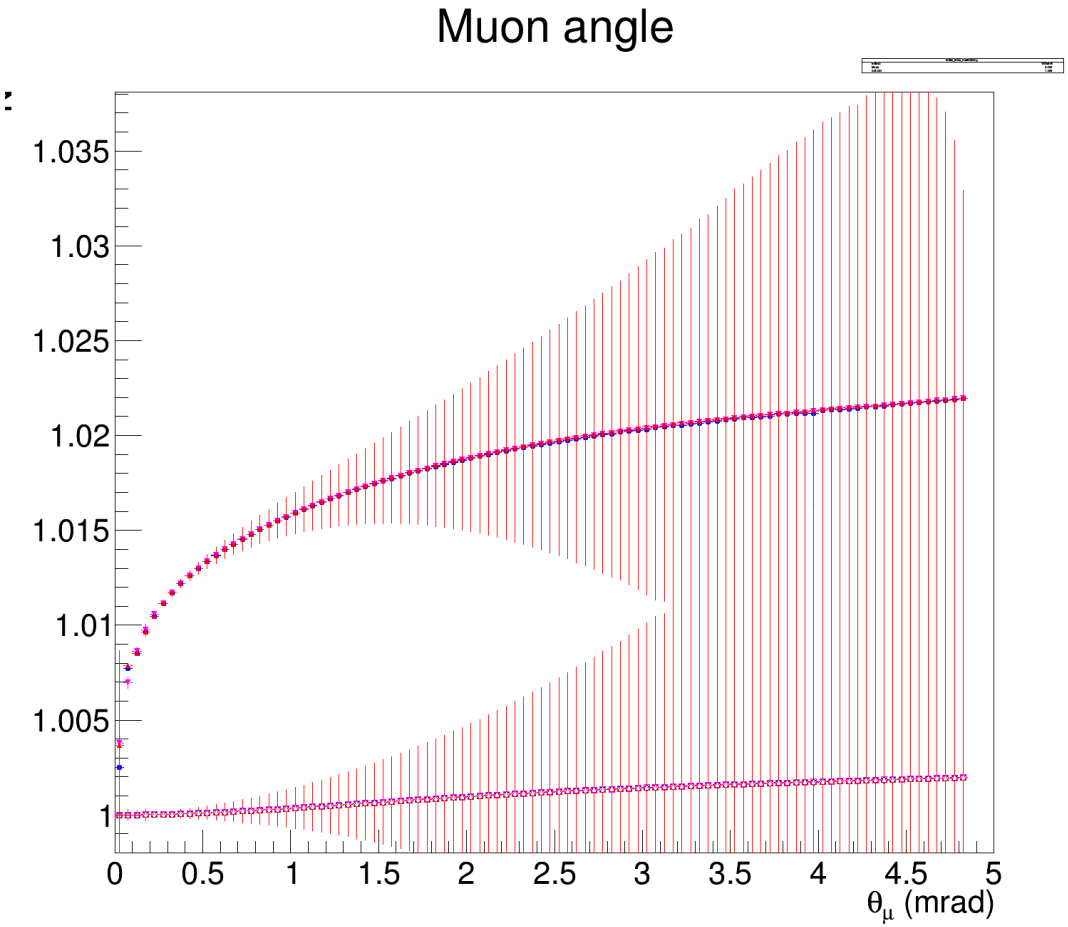
Effect of the selection on the observable α running: electron angle



Blue points: Ee > 0.2 GeV
Magenta points: Ee > 1 GeV
Red points: |Dphi|<3.5 mrad

Agrees with Carlo's results @Mainz : the electron angle is quite sensitive to the radiative corrections and hence the result depends strongly on the selection.
Inclusive selections wash out the sensitivity to the running

Effect of the selection on the observable α running: muon angle



Blue points: Ee > 0.2 GeV
Magenta points: Ee > 1 GeV
Red points: |Dphi|<3.5 mrad

Agrees with Carlo's results @Mainz : muon angle is robust against radiative corrections and hence the result is stable with different selections

Computing

- Discussed with Claudio Grandi (Bologna)
- Perspective solution: MC production and storage at CNAF (Bologna)
  - Usual policy: request by the INFN coordinator (N.Pastrone) to CNAF could gain us initial (limited) resources free of charge (few TB of disk storage, few cores as user interface and access to batch system LSF or similar). Exceeding requests should come with some funding to buy the necessary HW.
  - Obviously the requests have to be justified. At the moment we can’t quantify the needs in terms of cpu and storage. To be discussed.

To-Dos

- Still missing few ingredients, e.g. a definition of elasticity has to be implemented. Until now only approximate definitions have been used.
  - The NA7 definition is the first obvious candidate: but we lack an analytical expression (possible?), eventually a numerical approach has to be taken.
  - Other definitions could be helpful, in particular if the electron energy is measured.
- The detector effects should be entered as parametrizations smearing/distorting the observable kinematics. In this way we will have a Fast-Simulation approach, where we start from the generated four vectors and then we will apply the detector effects on the fly, eventually producing a final rootuple or histograms.
- Final analysis level to be thought and developed
- Ideally everything should fit in a modular scheme, where building blocks can be entered at different moments without perturbing everything else.