University of New Hampshire

Comparison of Simulation Results

Rafayel Paremuzyan

University of New Hampshire

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Jefferson Lab

Generators and event selection

3 Generators for tridents

MadGraph4: Tridends and WABs
MadGraph5: Tridents
Luca's: based on Beranek, Merkel and Vanderhaegen arXiv:1303.2540

WABs are generated through Mad4 only

An attempt to compare to each other and data

Event selection

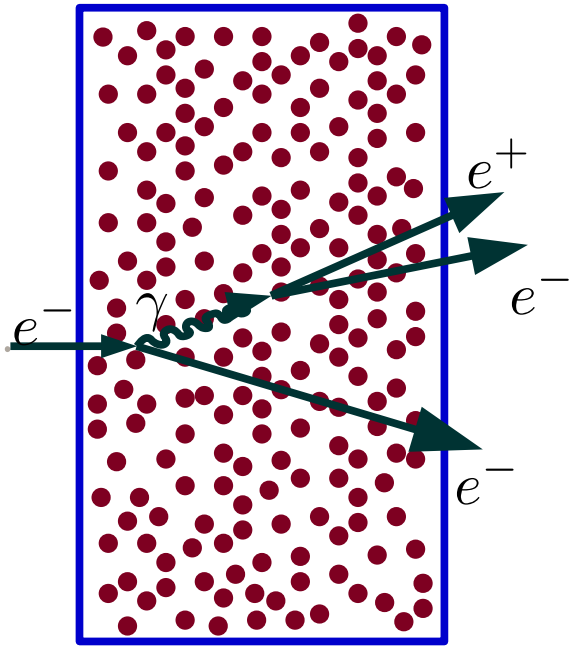
Track-cluster matching, if more than 1, pick the track that has best chi2

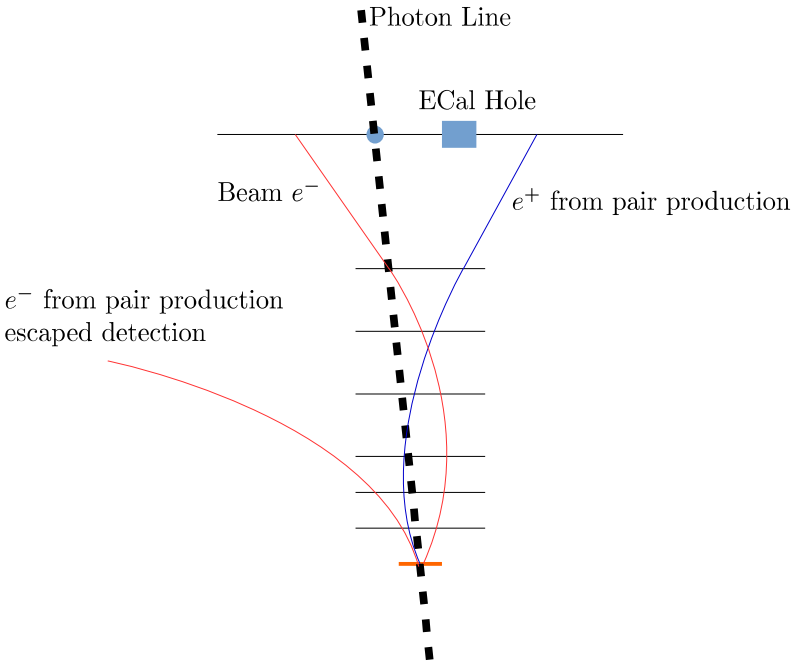
Esum dependent top/bottom coincidence

Events wit 1e+ and >=2 e-

Wide Angle Bremsstrahlung (WAB)

Two step process:
WAB then photon conversion





Photon conversions from the target, 1st and 2nd SVT layers can mimic trident signal

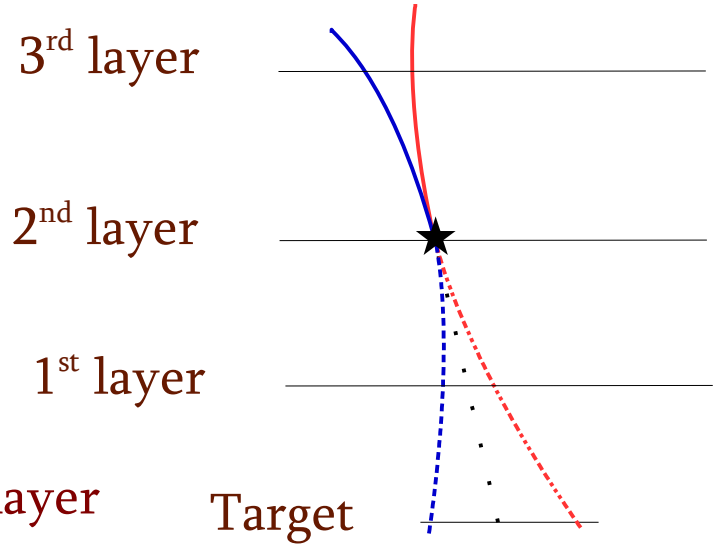
Both, WAB and photon conversion have large cross sections, so we have revised WAB contribution in the MC and data

The EGS5 program, that we are using for beam transport in the target, treats WABs incorrectly, resulting in the scattered electron escaping detection

Evidence of fake (WAB) tridents in the data

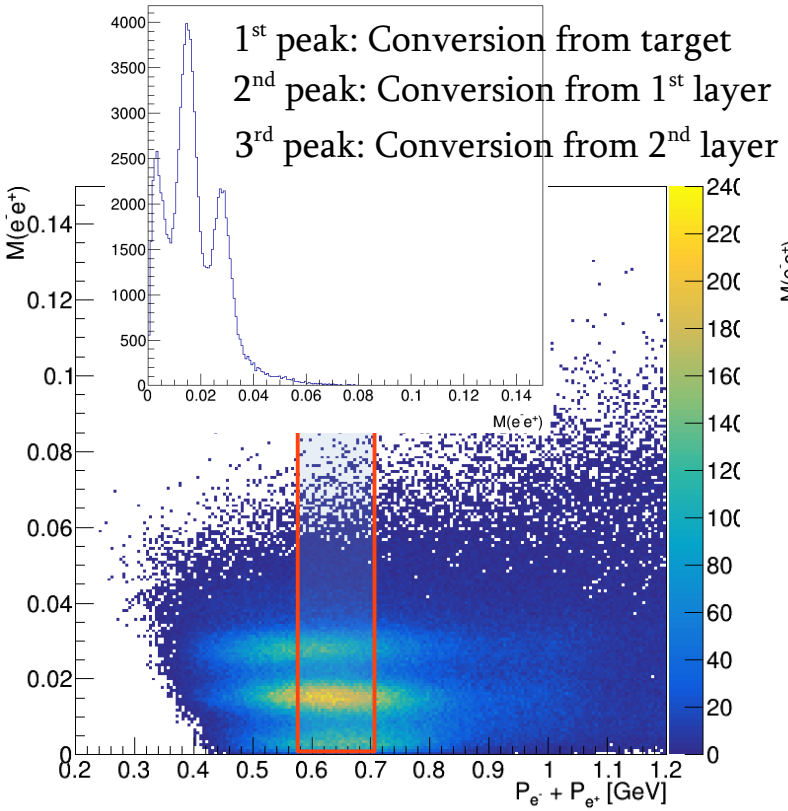
e^-e^+ pairs from WAB photon conversion have ~ 0 opening angle

- consequently ~ 0 invariant mass,
- and should be in the same detector half

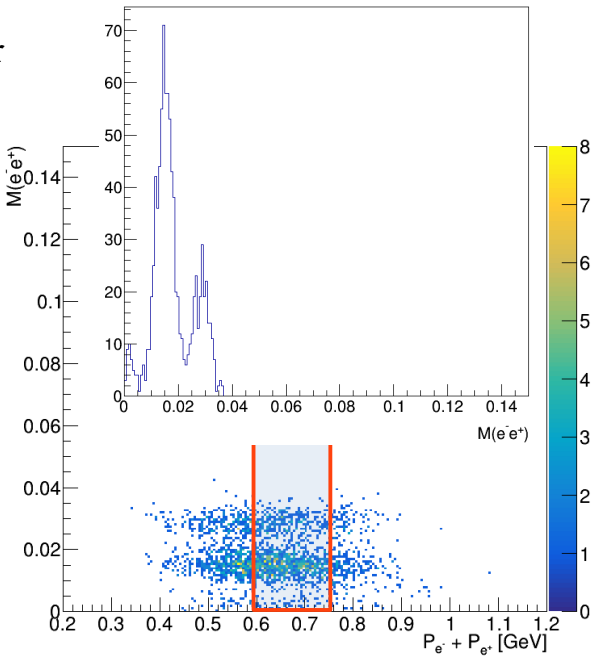


Peaks in the invariant mass spectrum correspond to the photon conversion in the target, 1st and 2nd SVT layer

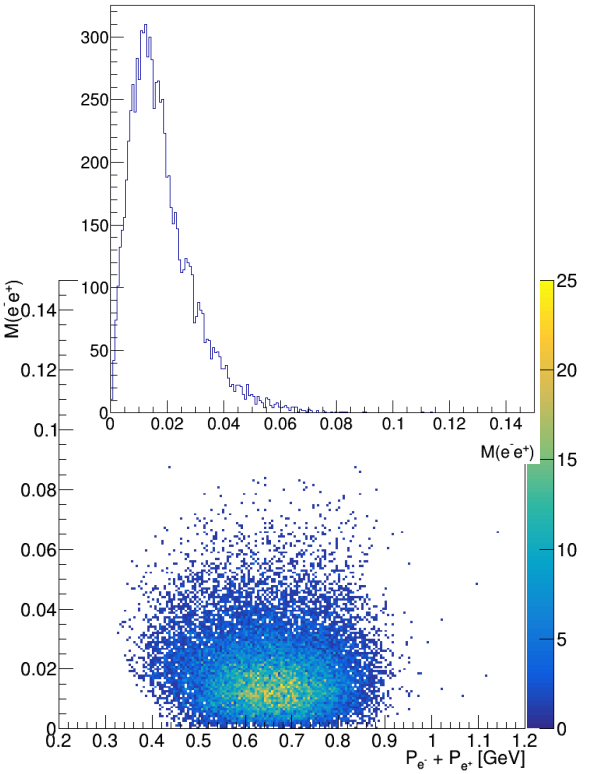
Data



WAB

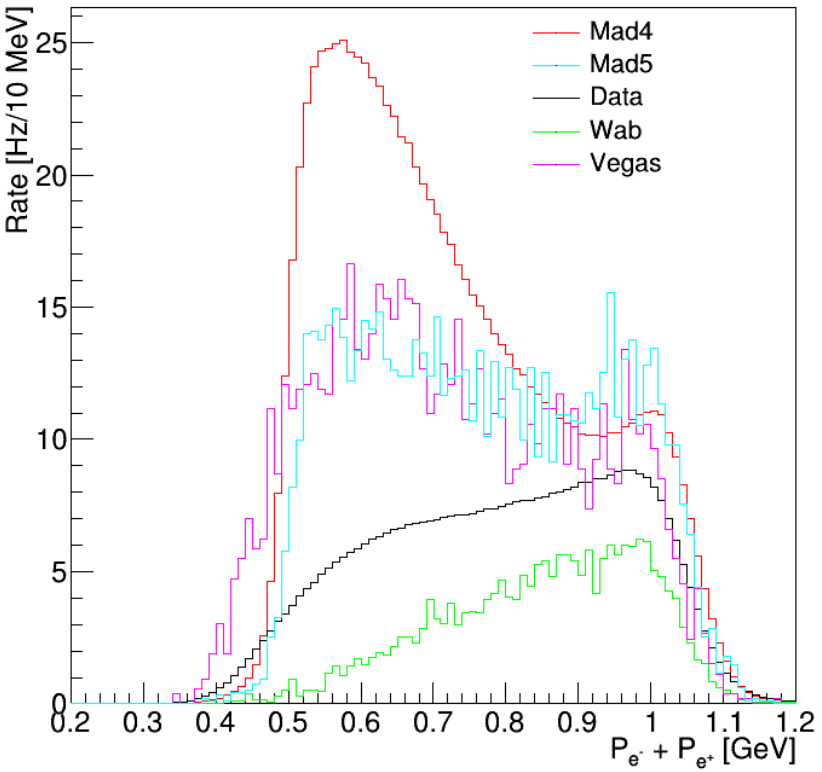


TriTrig



All together

Non scaled distributions



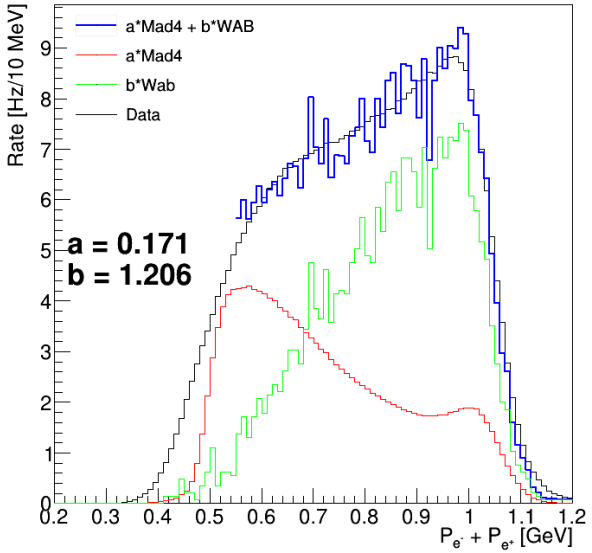
Mad4 and Mad5 are fit from Esum > 0.55 GeV

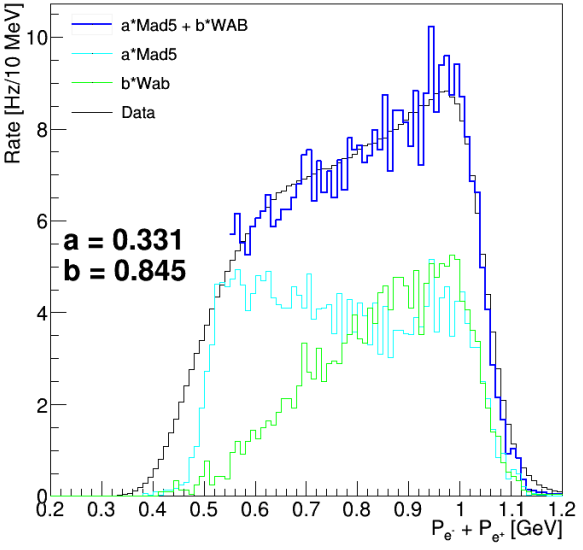
Interestingly all of them fit data data including WABs

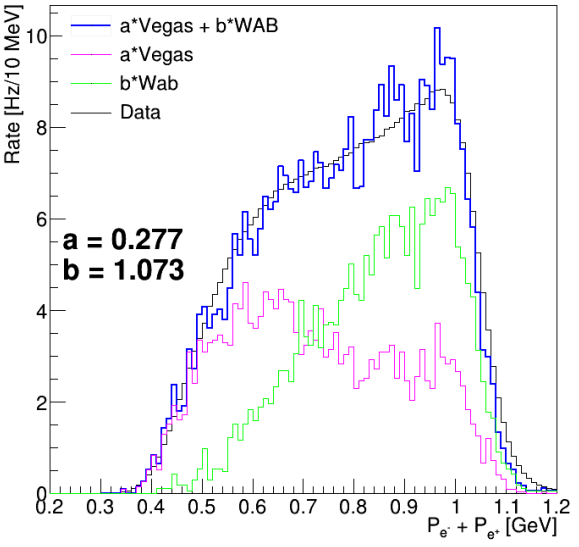
"a" and "b" factors are quite different in different fits

Fits with WABs to match data

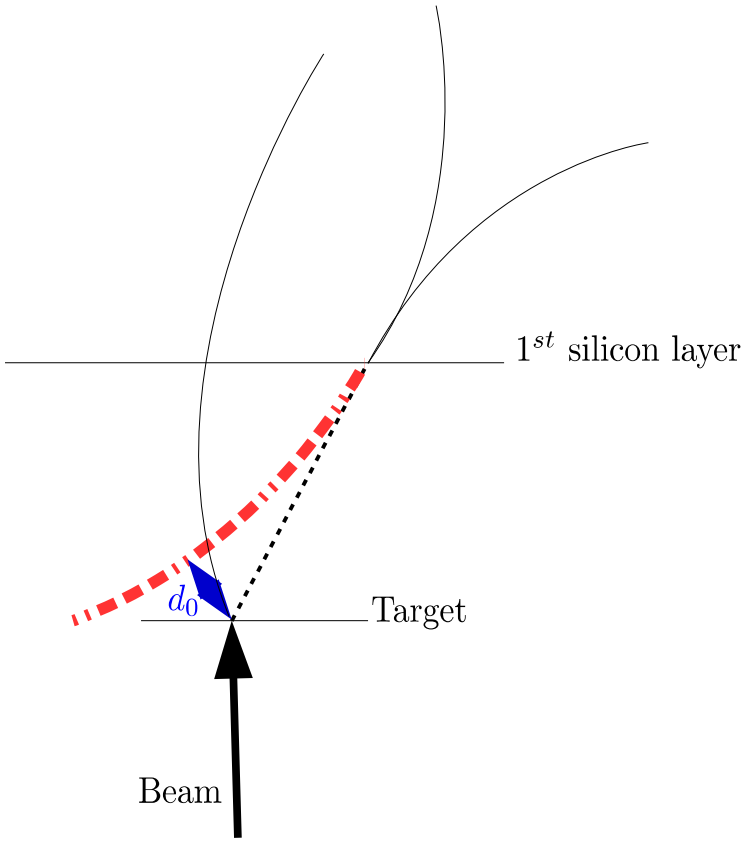
Needs confirmation



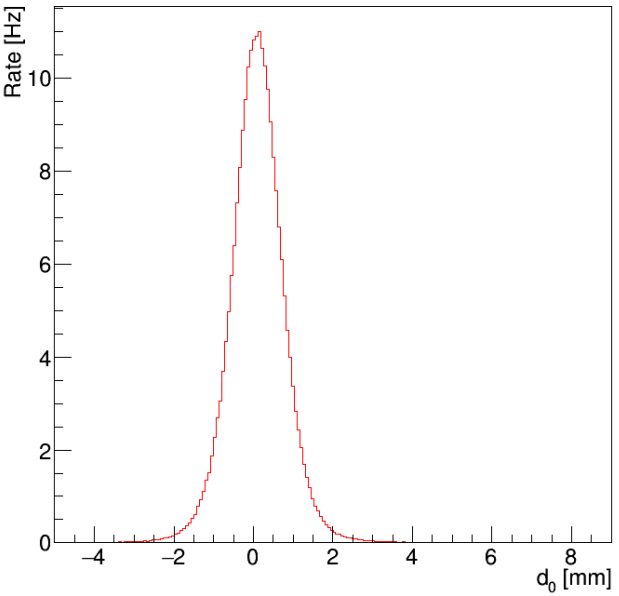




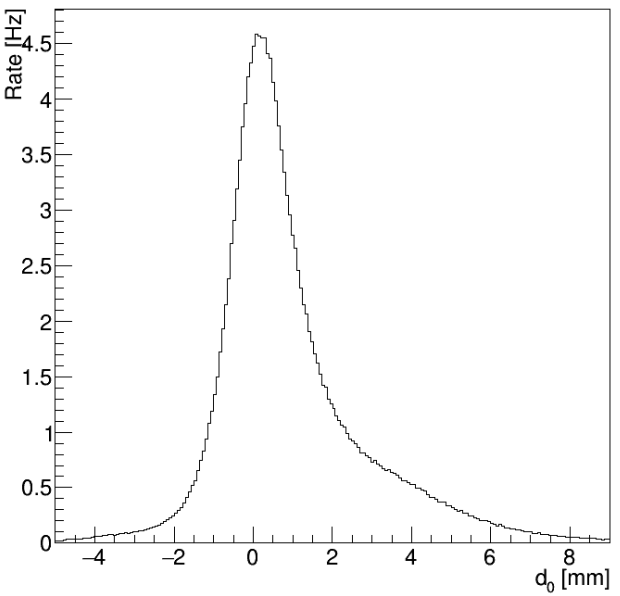
d_0 for 5 hit tracks



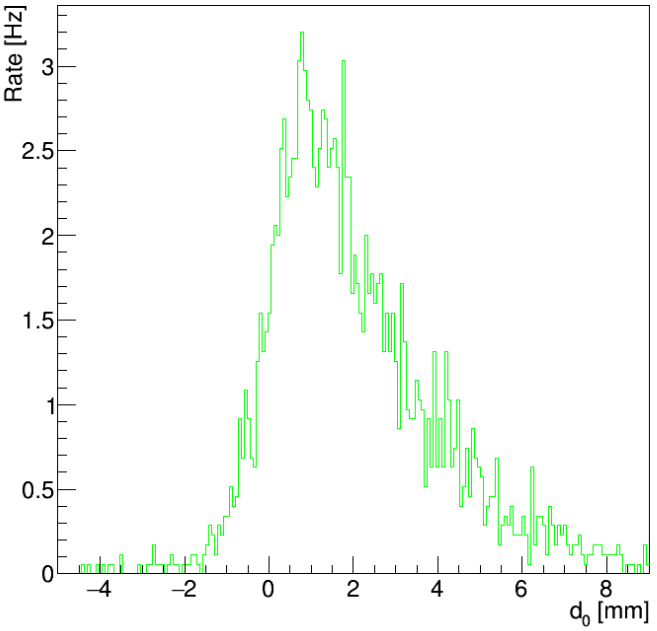
Tritrig



Data



WAB



Converted pairs originated in the 1^{st} and 2^{nd} layers os SVT shold have a positive d_0

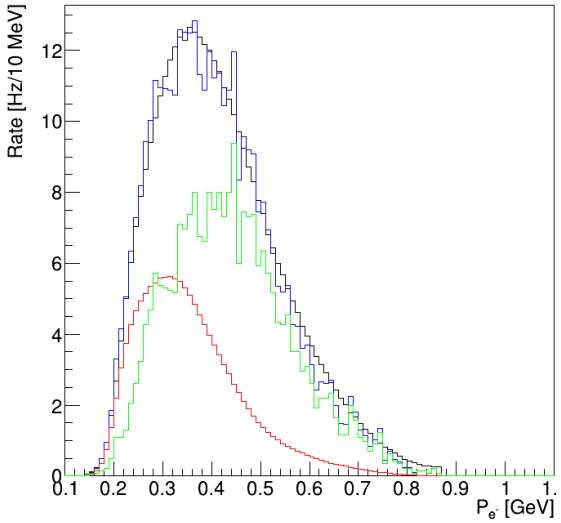
Events at $d_0 > 2\ mm$ are all (almost) WAB events

This fact can be utilized to check how "Good" is WAB normalization

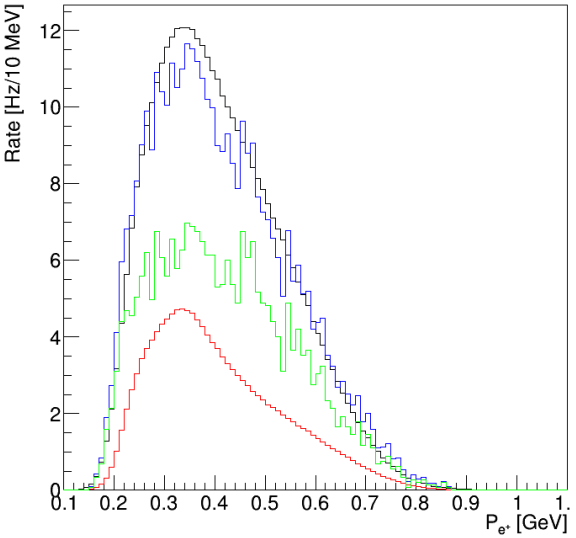
d0 and other distributions

Parameters “a” and “b” are taken from Psum fit

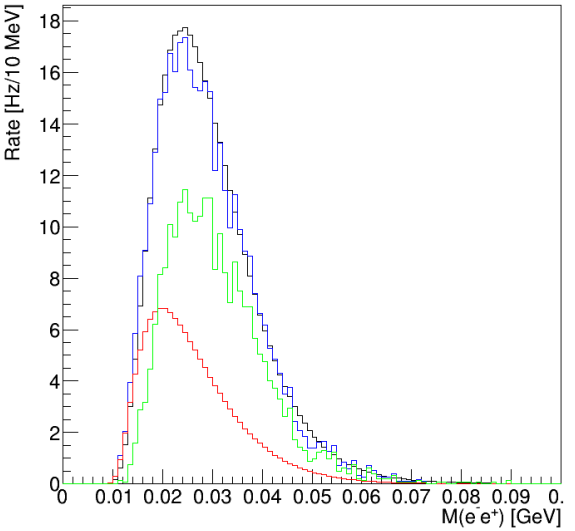
e- momentum



e+ momentum

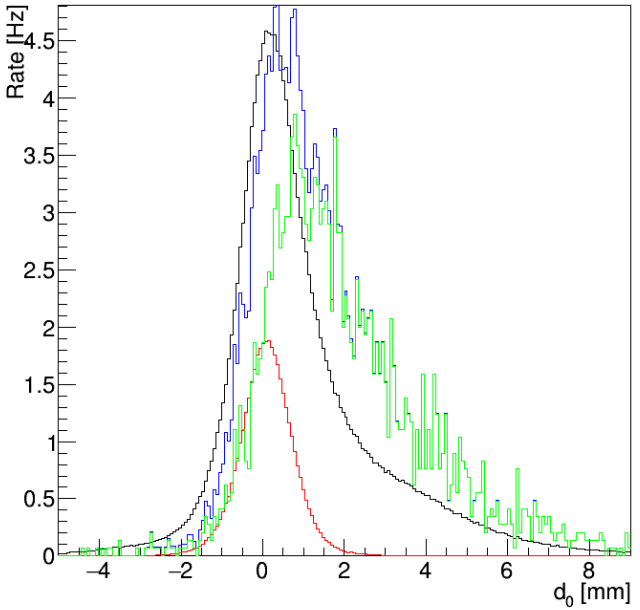


Inv mass

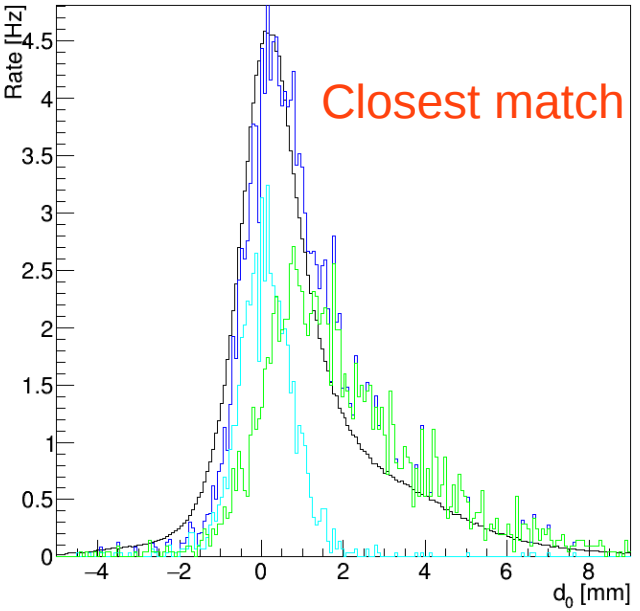


Momentum, and mass distributions match to data other, while d_0 differs

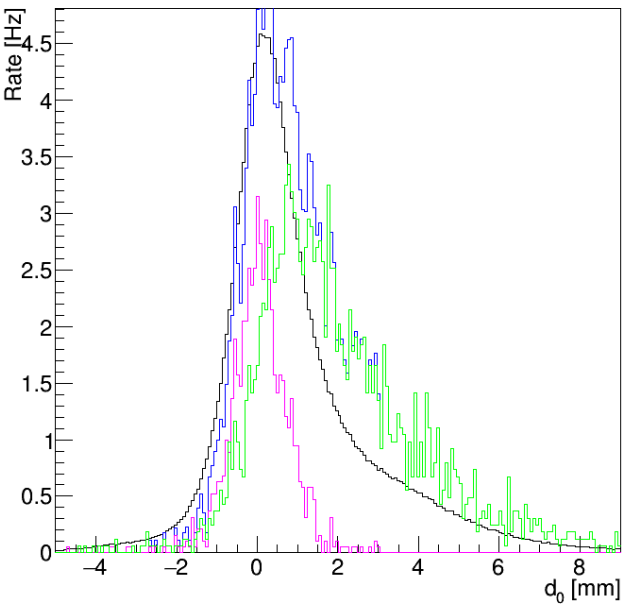
a*Mad4 + b*Wab



a*Mad5 + b*Wab



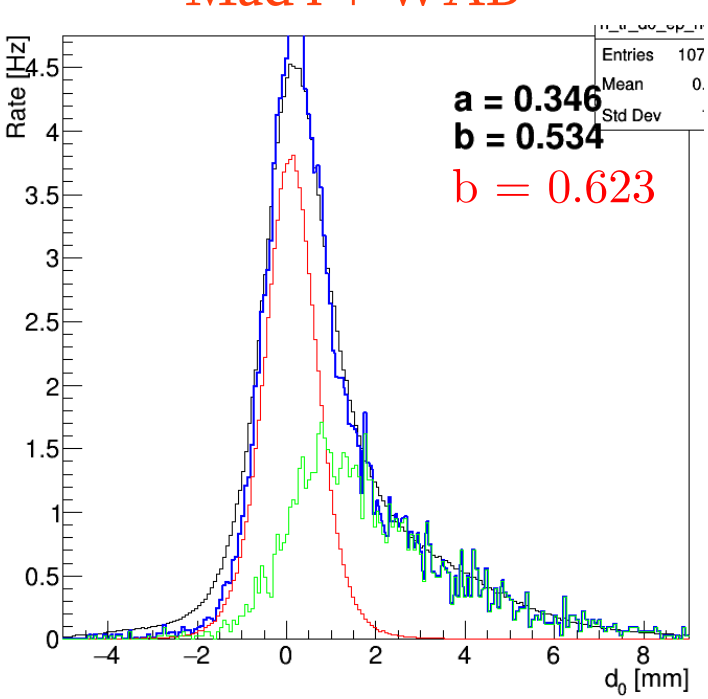
a*Vegas + b*Wab



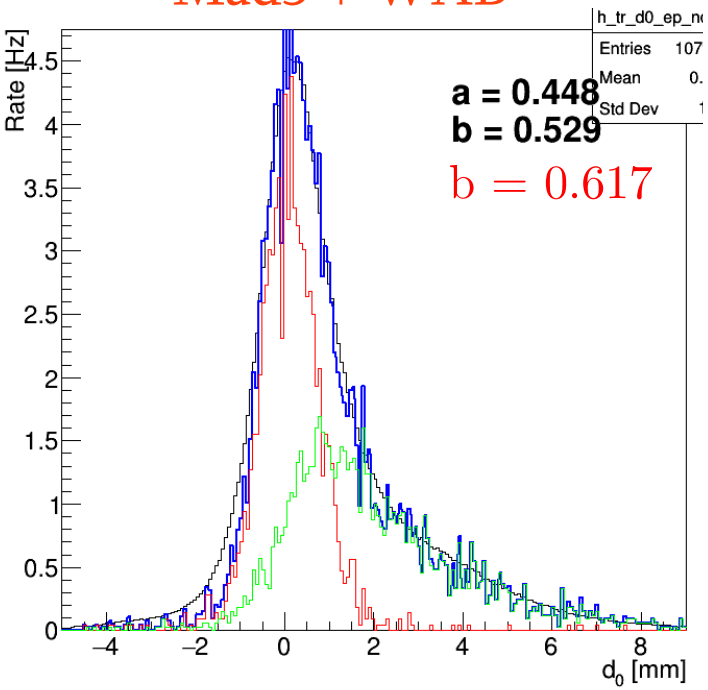
Fitting d0

Fit d0 and look other distributions

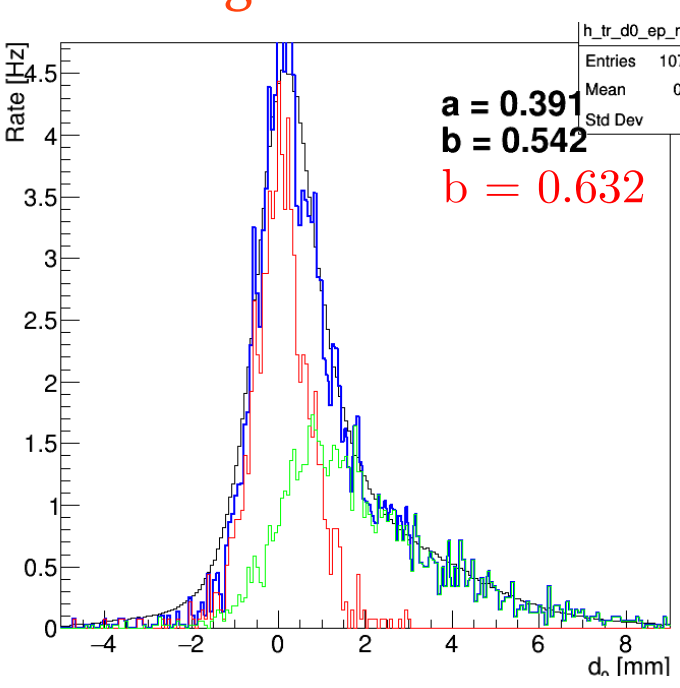
Mad4 + WAB



Mad5 + WAB



Vegas + WAB



"b" in Red takes into accoun the factor 7./6. in the WAB cross section

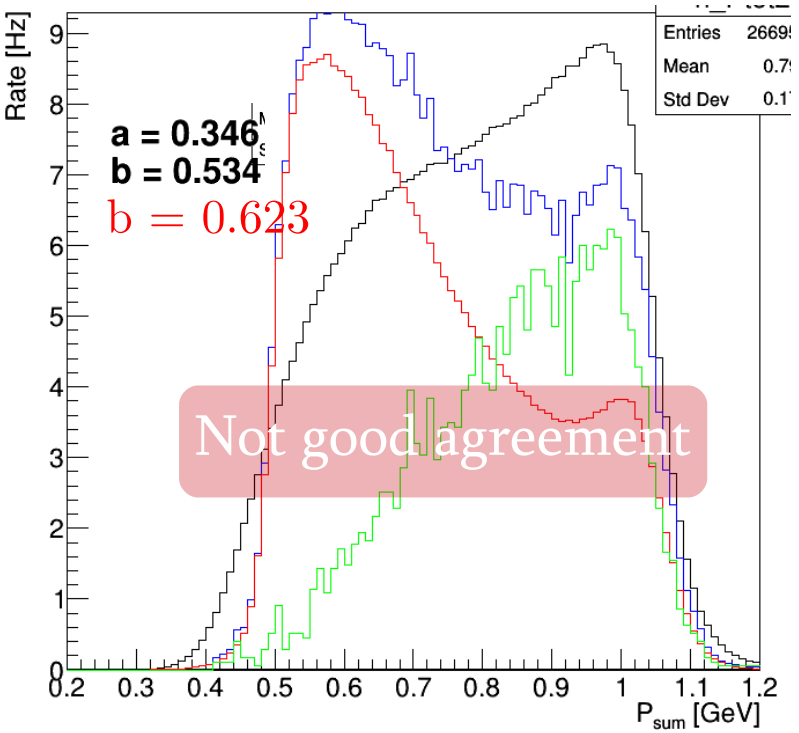
As it was expected "b" has no much freedom

WAB scaling close to the one obtained with Ecal only
Data/MC ratio ((6./7.)*0.49mb/1.25mb = 0.456) Talk tomorrow

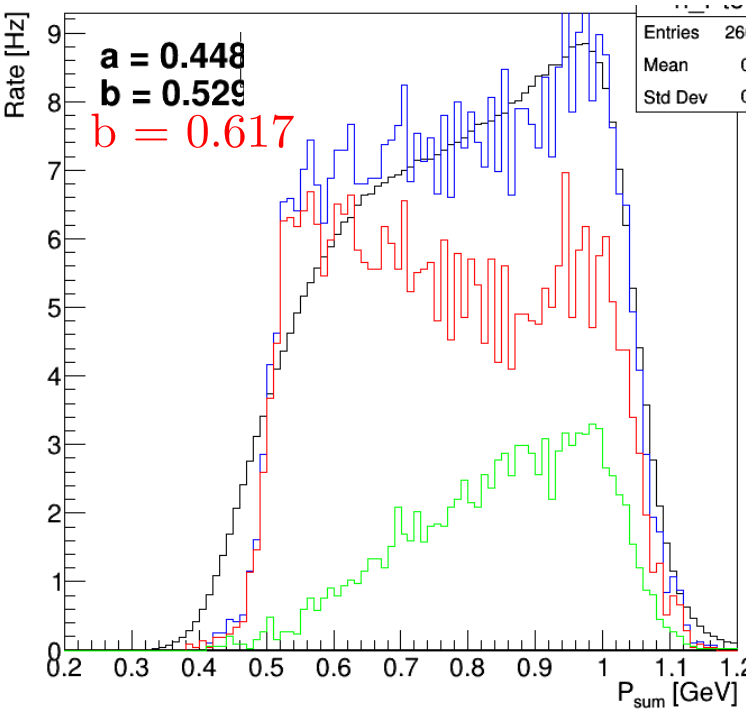
Next: having simulations to start Esum > 0.3 GeV can put stronger constrain on the parameter "a"

Psum and other distributions

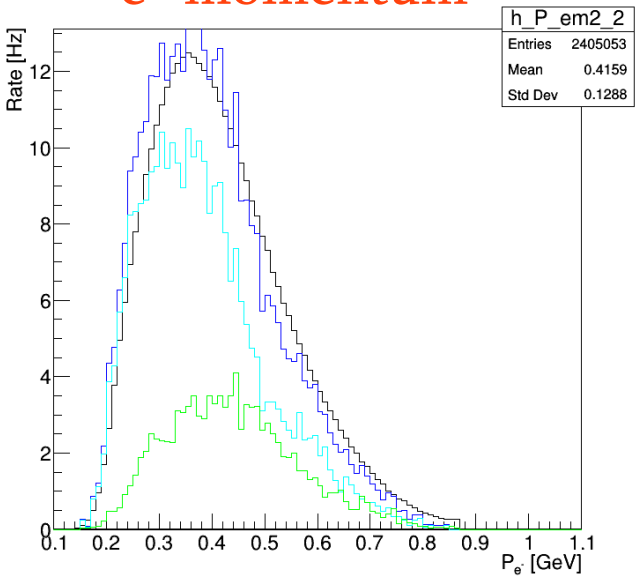
Mad4 with WABs



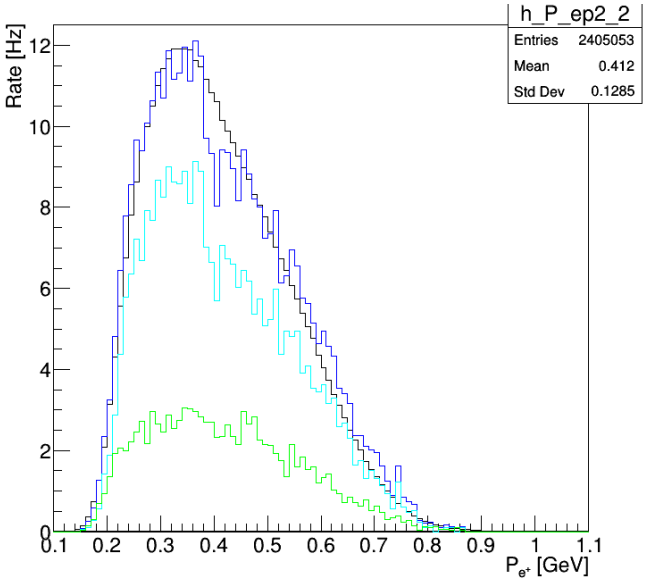
Mad5 with WABs



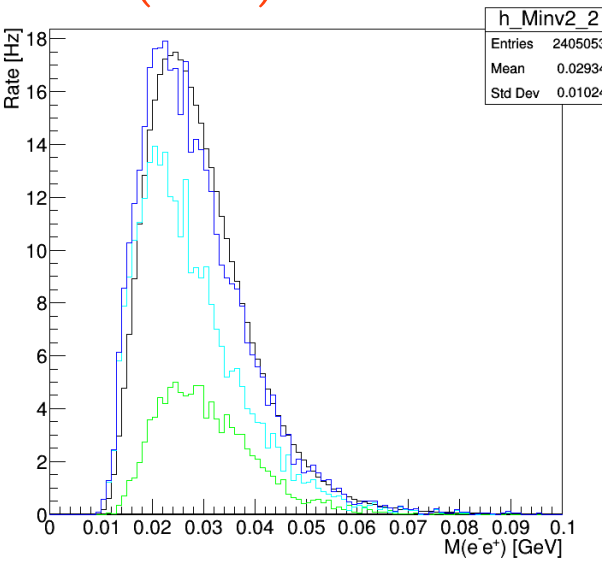
e- momentum



e+ momentum



M(e-e+) momentum



Summary

There are currently three Trident generators, giving not same results

With scaling Wabs and Tridents, all are able to fit the Esum, distribution, but Mad4 and Vegas fail to describe d_0

Mad5 is able to fit Esum, d0 and other parameters simultaneously, however scaling factors “a” and “b” are not the same

The 85% lifetime and close to 100% trigger efficiency, suggests that this discrepancy is not in the hardware side.

Takashi’s Fast Monte Carlo also shows similar discrepancies between generators, this suggests that the priority will be to get an agreement between these generators.