Pluto input file updates and simulations

PWG dilepton meeting
April 24, 2020

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HGS-HIRe for FAIR
Helmholtz Graduate School for Hadron and Ion Research

Overview

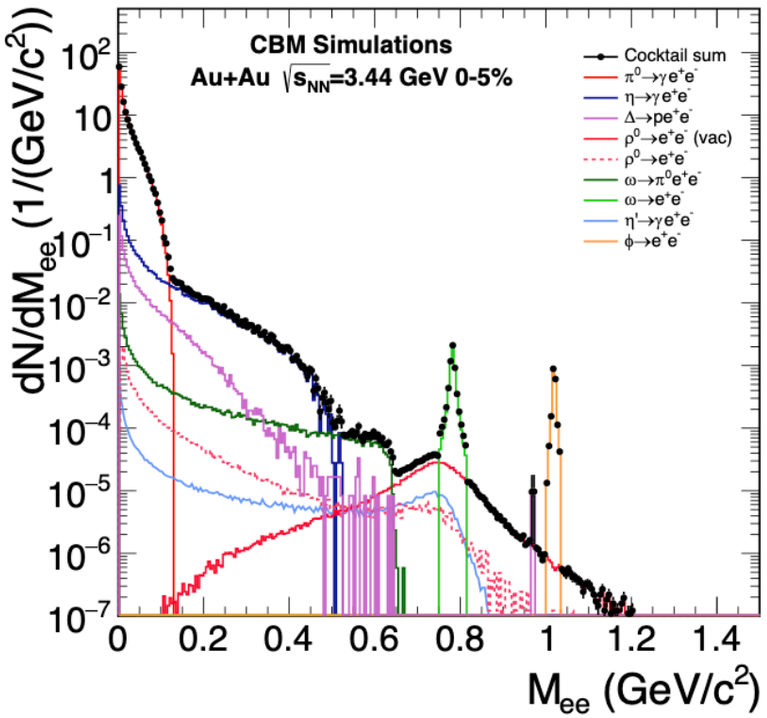
LMVM

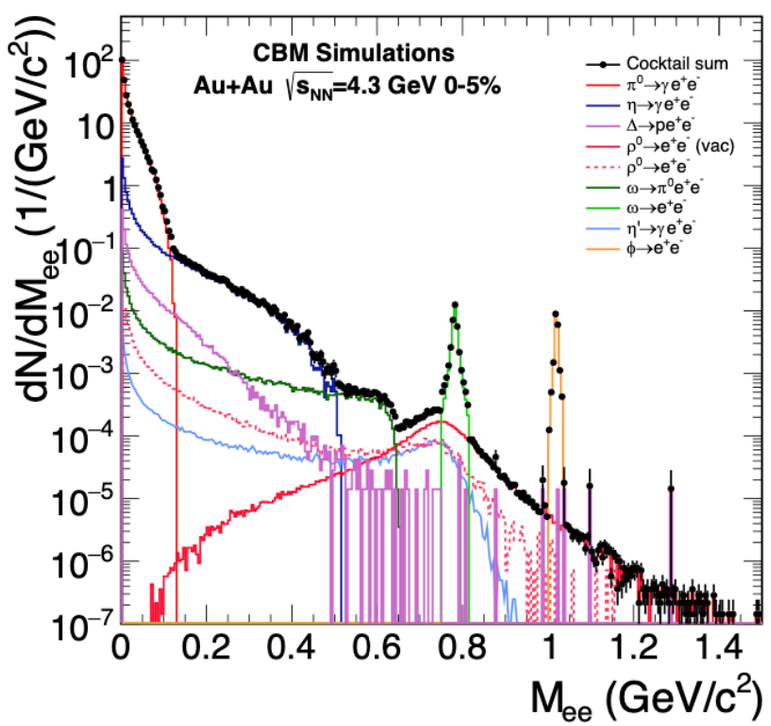
Thermal signals

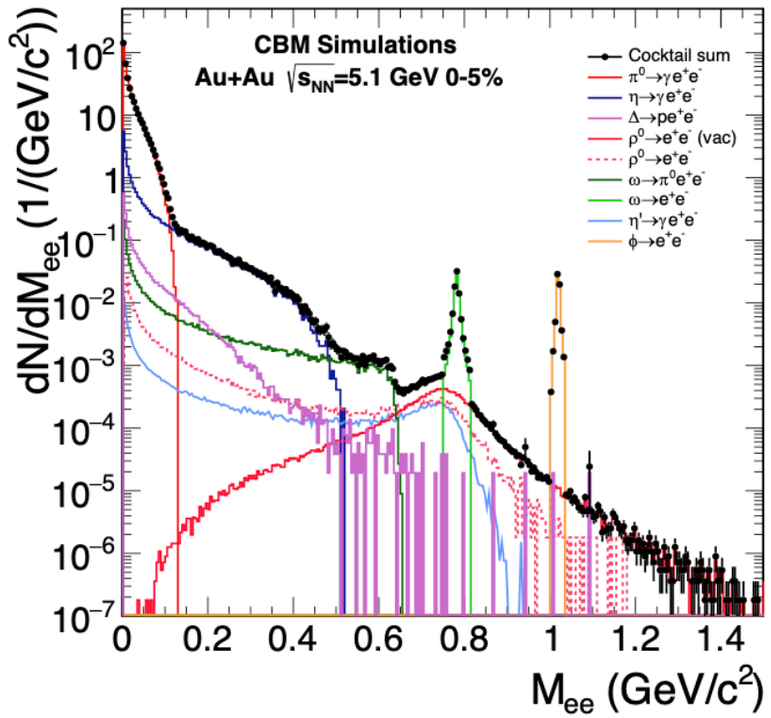
- how to improve the statistics at higher masses

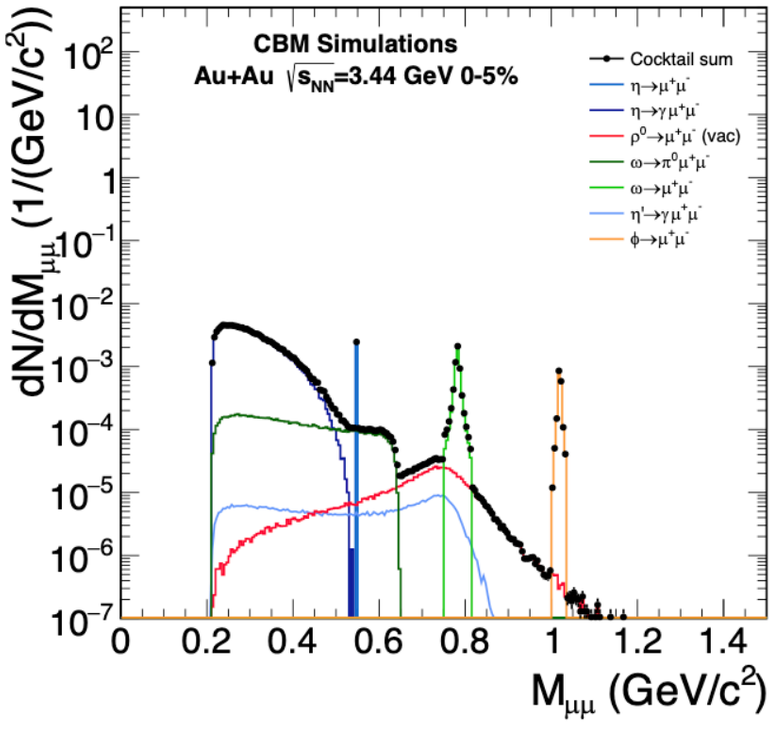
Short checks of the phase space and first looks in a small simulation

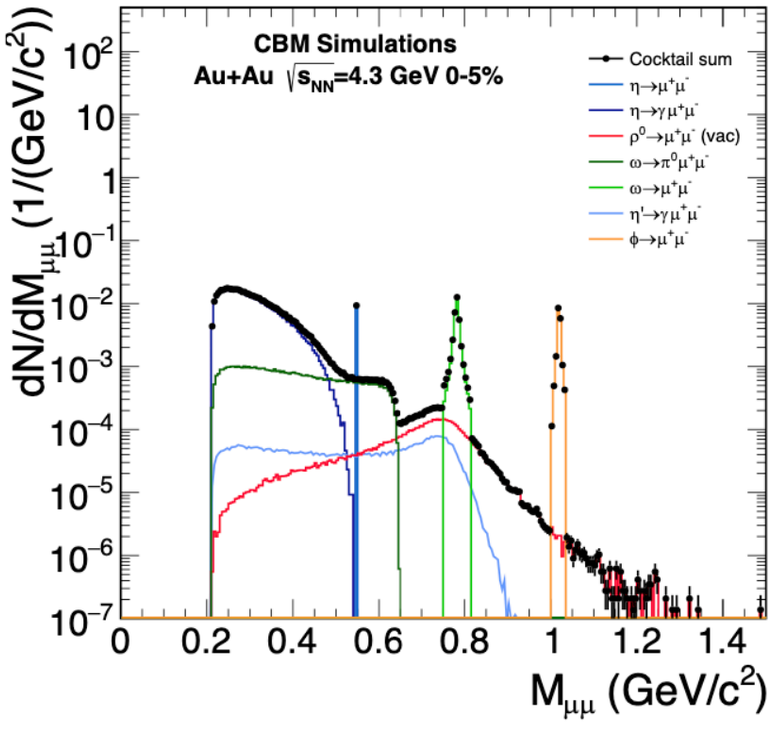
Inputs presented in the collab. meeting

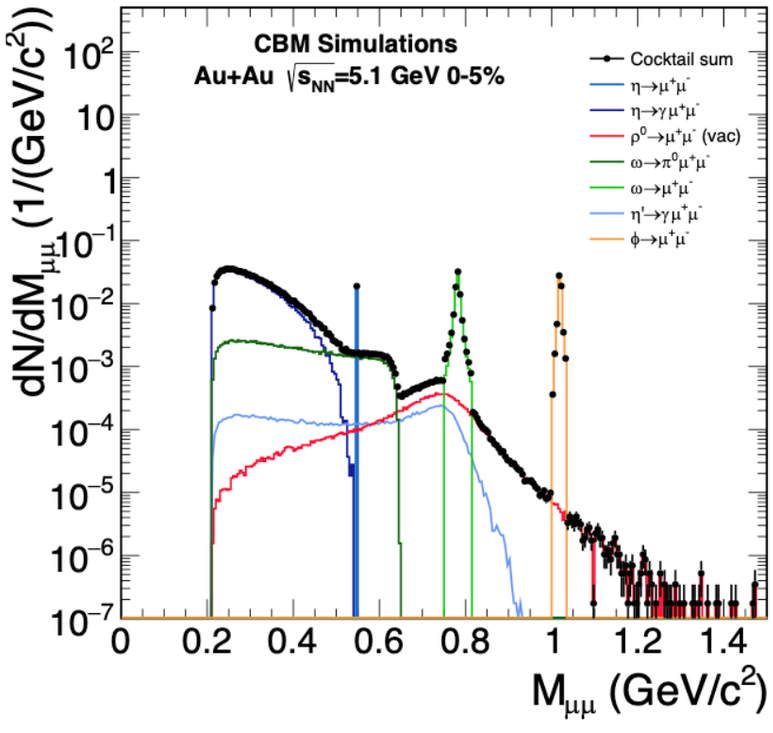








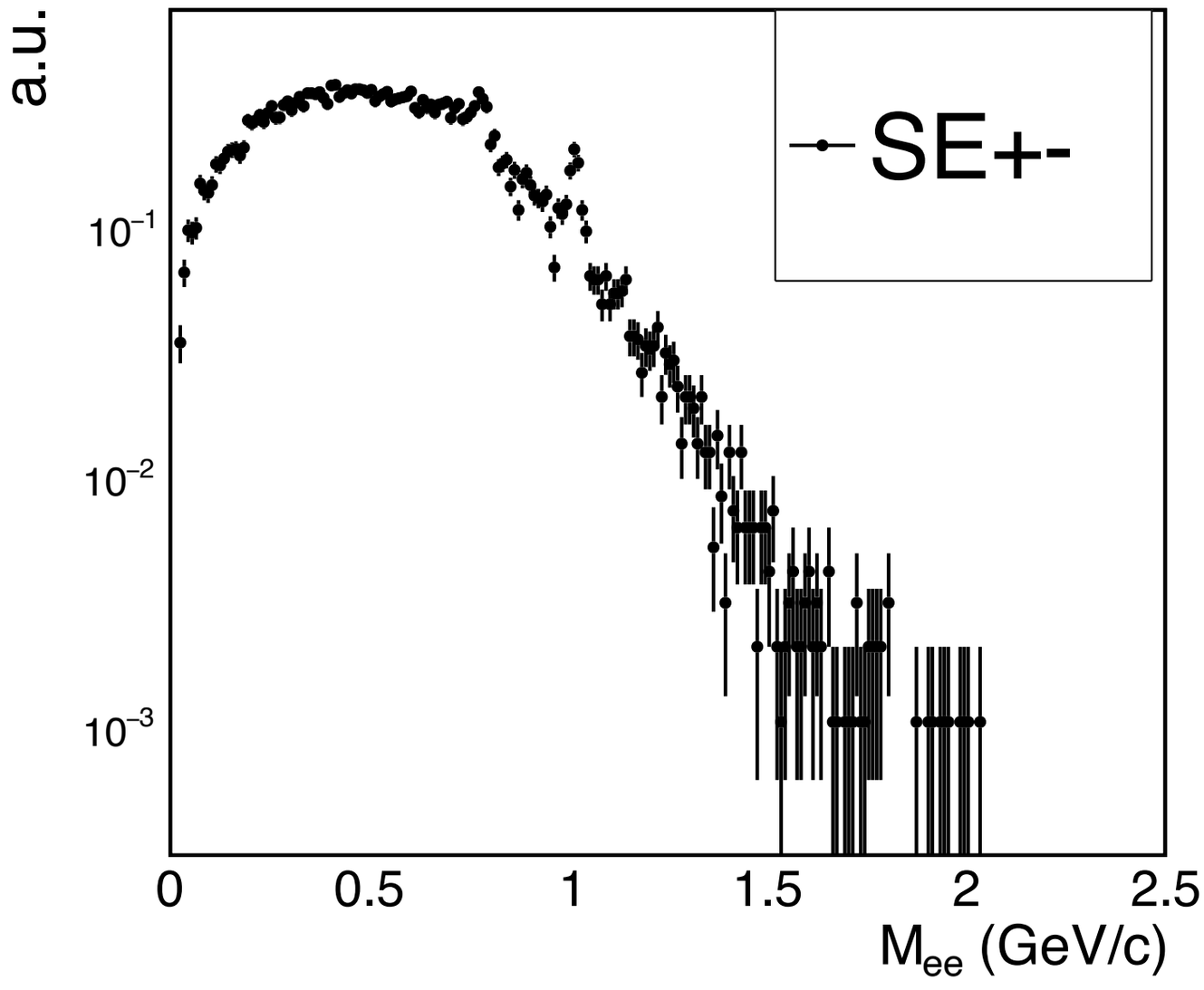




Check simulation with embedded omega and phi

With the usual PAPA runchain I get a “normal” looking invariant mass distribution, but I can not identify the decays with their PDG codes

-> problems with the weighting of the injected particles



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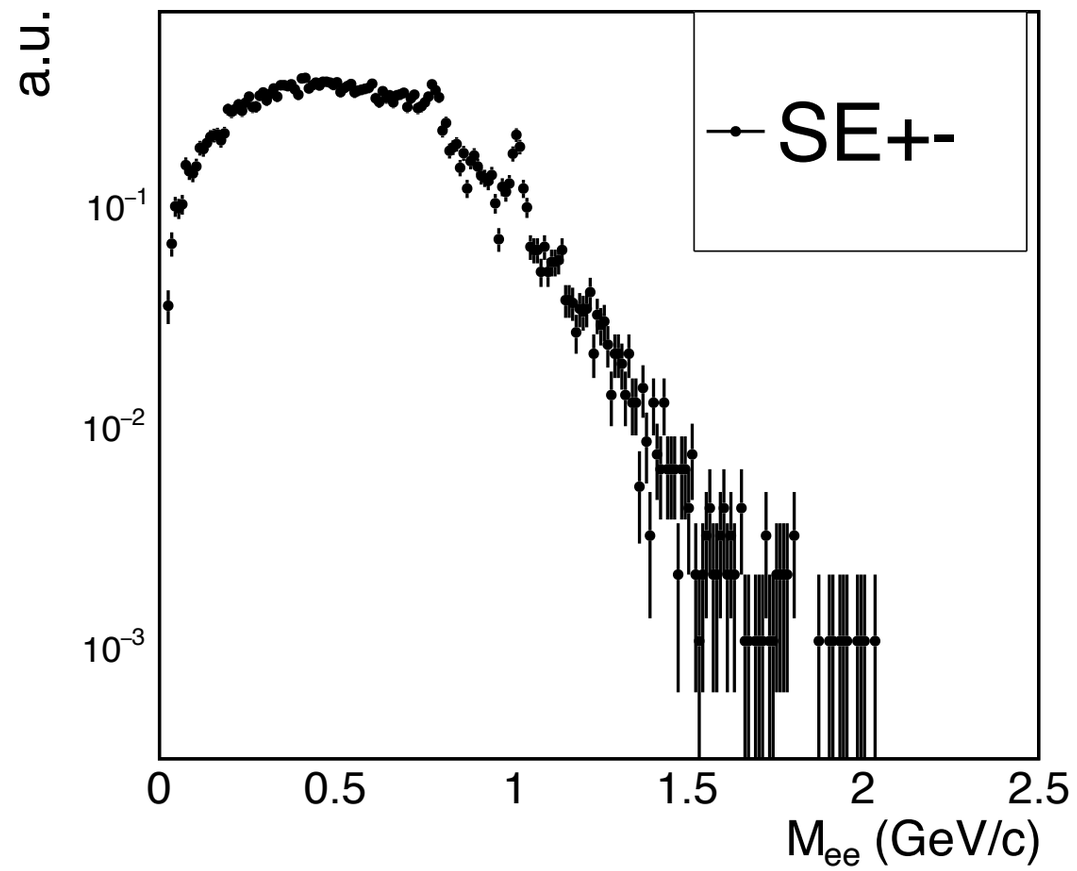

I checked the MC tracks of the e^+e^- pairs

There was no MC track for the omega itself

```
0 pdg: -11  mother: -1   geant: 0
1    pdg: 11  mother: 0  mother pdg: -11   geant: 0
0 pdg: -11  mother: -1   geant: 0
1    pdg: 11  mother: 0  mother pdg: -11   geant: 0
```

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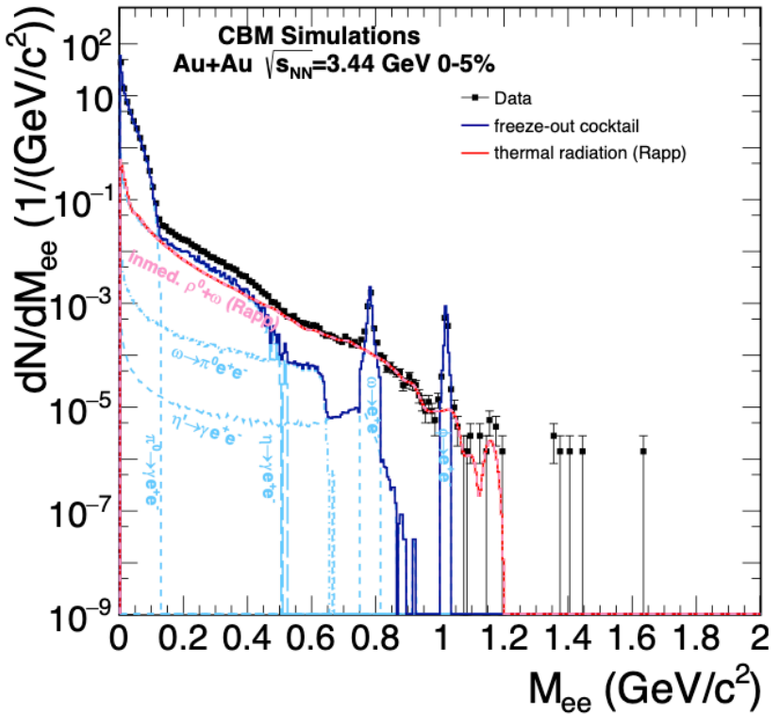
Check of the pluto scripts

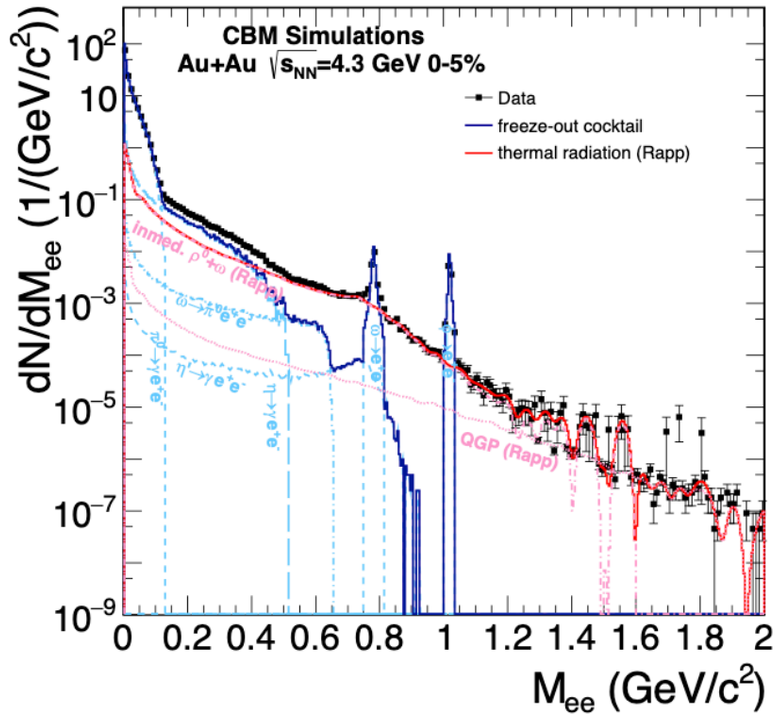
```
PReaction::PReaction(PChannel **pchannel, const char *file_name, int n,
                     int f0, int f1, int f2, int f3, TTree *ttree) {
    // Reaction constructor by pointer to array of pointers to Channels,
    // output file name (see below), options (see below), pointer to external event tree
    // (if called from the decay manager).
    // Options:
    //   f0: 0=Tracked, 1=All particles in ROOT output file_name.root
    //   f1: unused
    //   f2: 0=Do not calculate, 1=Calculate production vertices for product particles
    //   f3: 0=Do not produce, 1=Produce GEANT ascii output file_name.evt (tracked particles always)
    //   ------------------------------------------------------------------
    //   Format of the ASCII output in file_name.evt:
    //   EvSeqNb NumPart Ebeam bPar phiEv flag <== number of particles in event
    //   E1 px1  py1  pz1  ID1  weight1      <-- 3-momentum components in GeV/c,
    //   E2 px2  py2  pz2  ID2  weight2        <-- GEANT particle ID,
    //   E3 px3  py3  pz3  ID3  weight3          <-- weight
    //   .    .    .    .    .    .    .    .    .    .    .    .
    //   ------------------------------------------------------------------
    // See also PProjector/PBatch for additional conventions if filters are used.
    //   ------------------------------------------------------------------
```

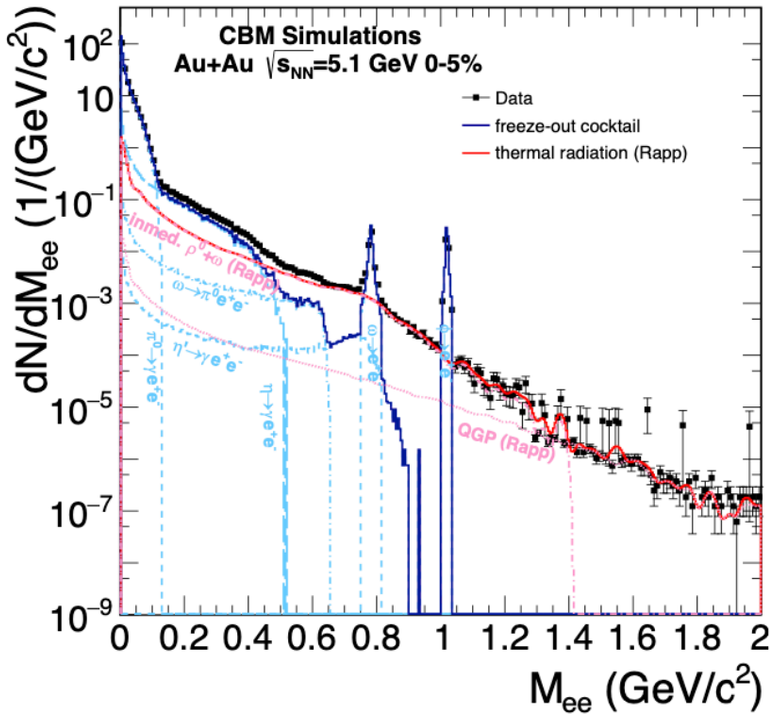
Simple solution lies in the constructor of the Reaction in pluto (f0 should be set to one)

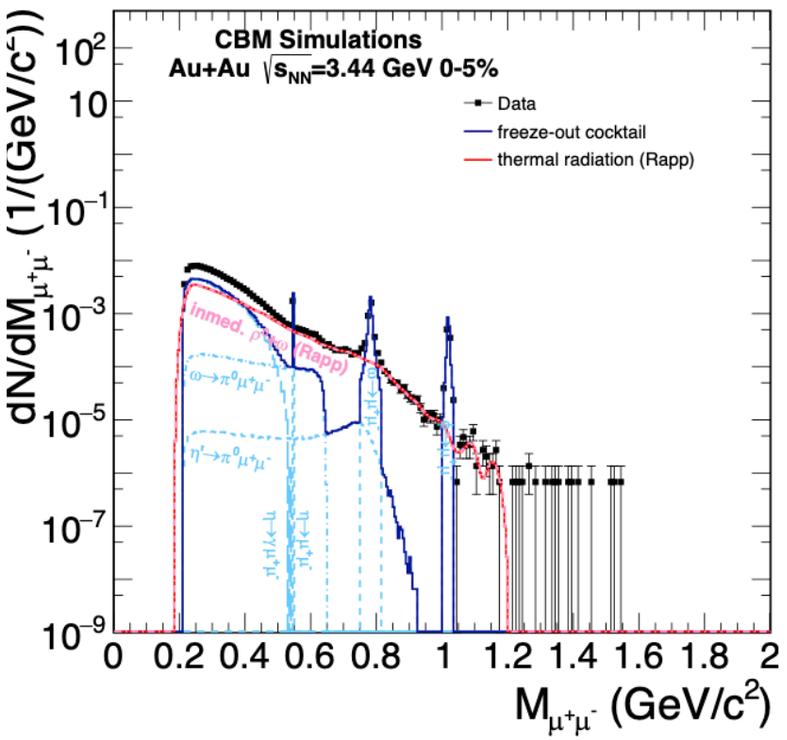
Everything else is exactly the same

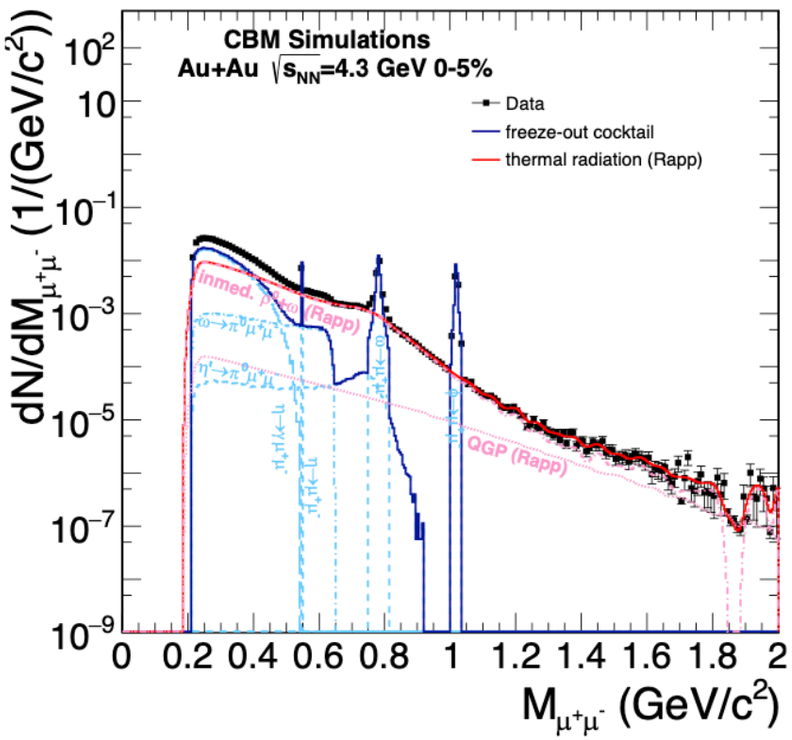
Thermal inputs

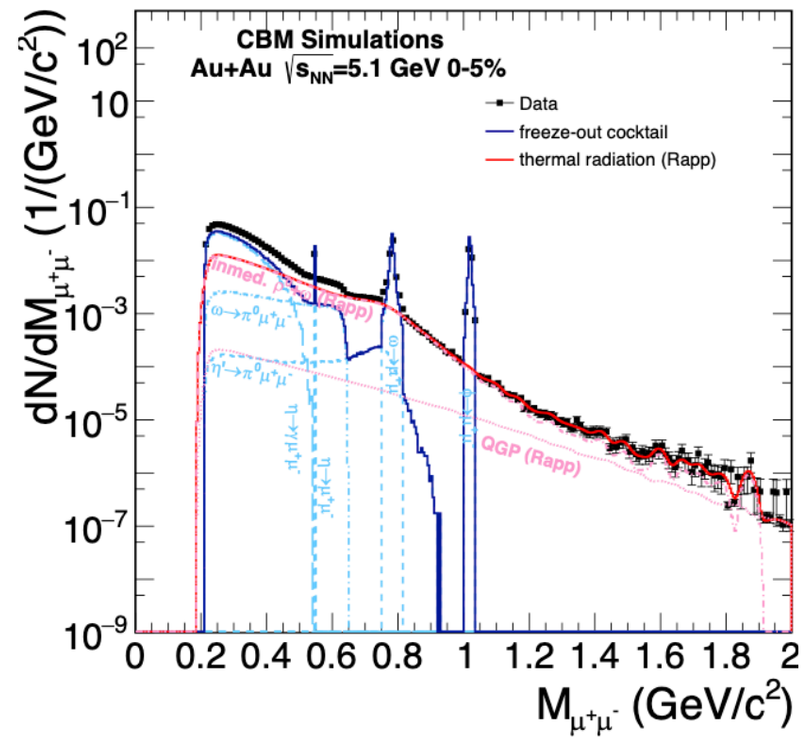






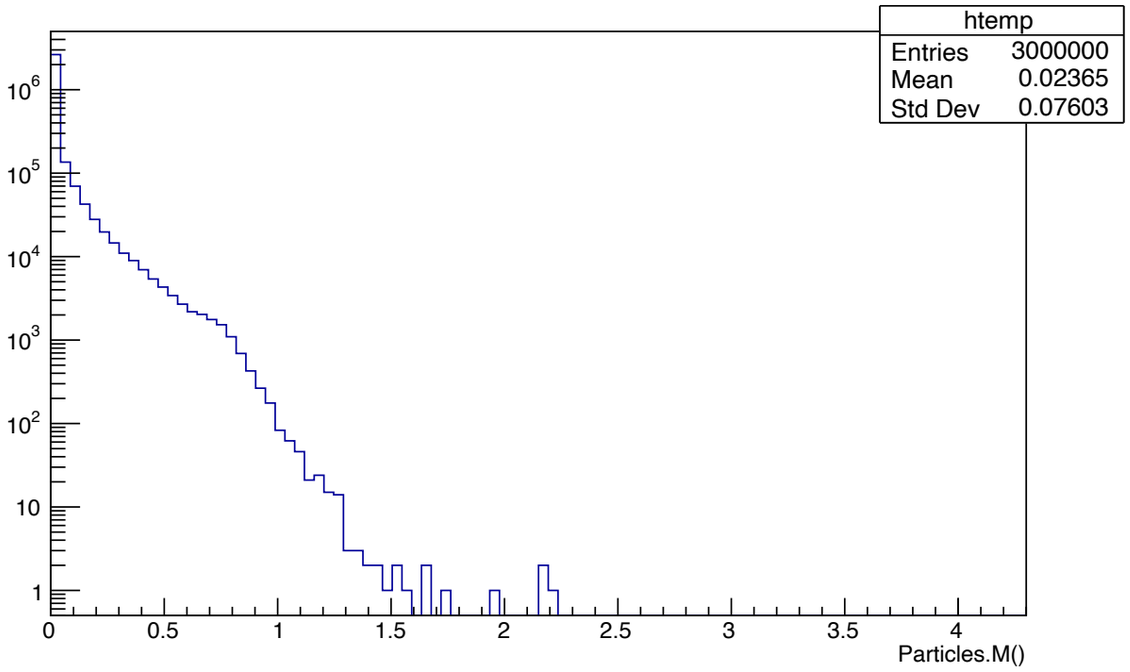




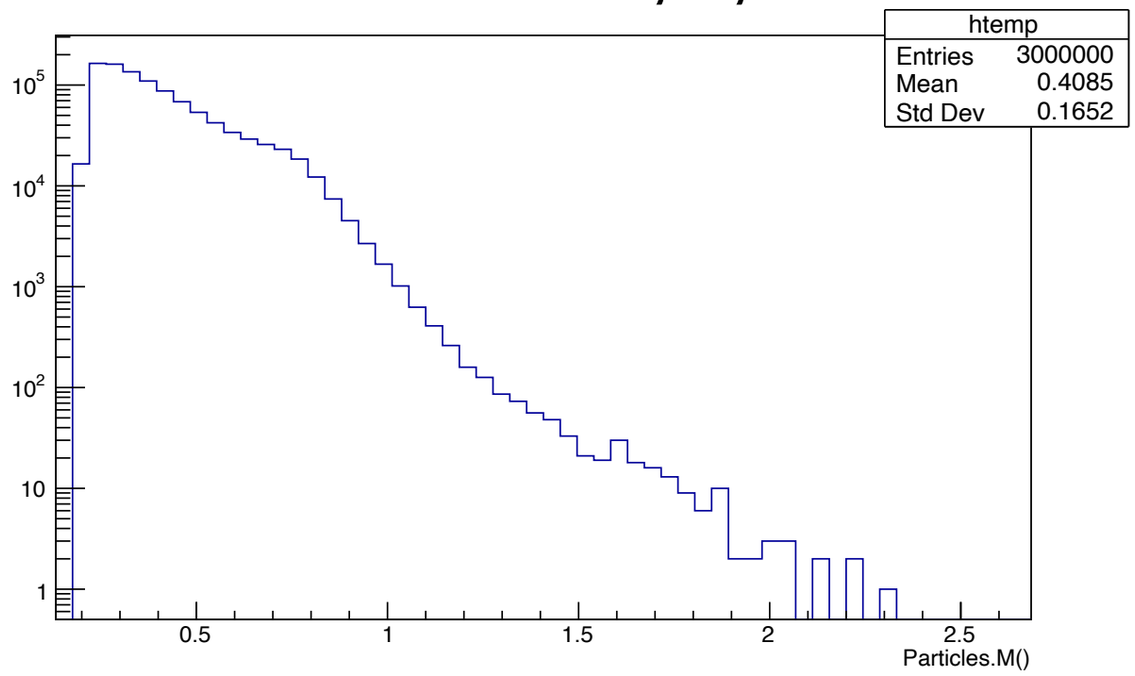


Mass distribution in the thermal files

In-med. Rho. e^+e^-



In-med. Rho $\mu^+\mu^-$

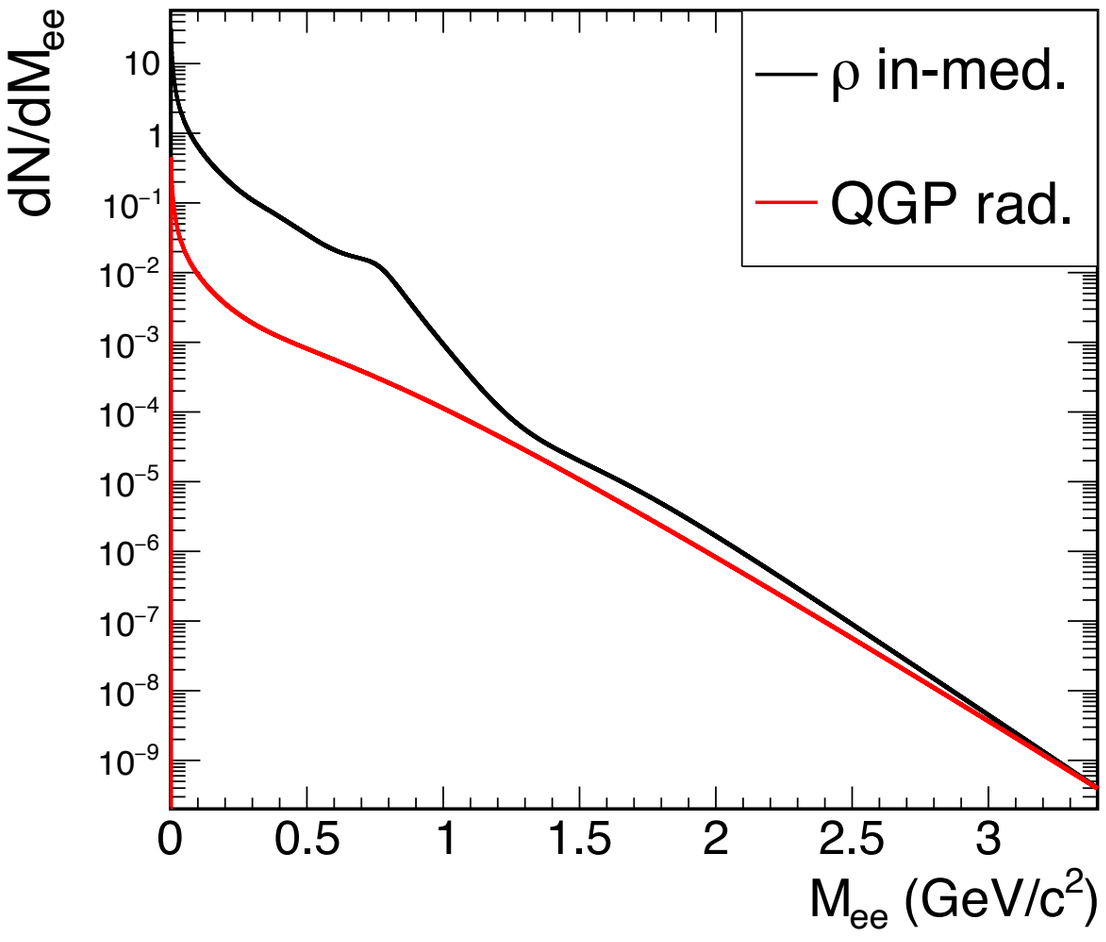


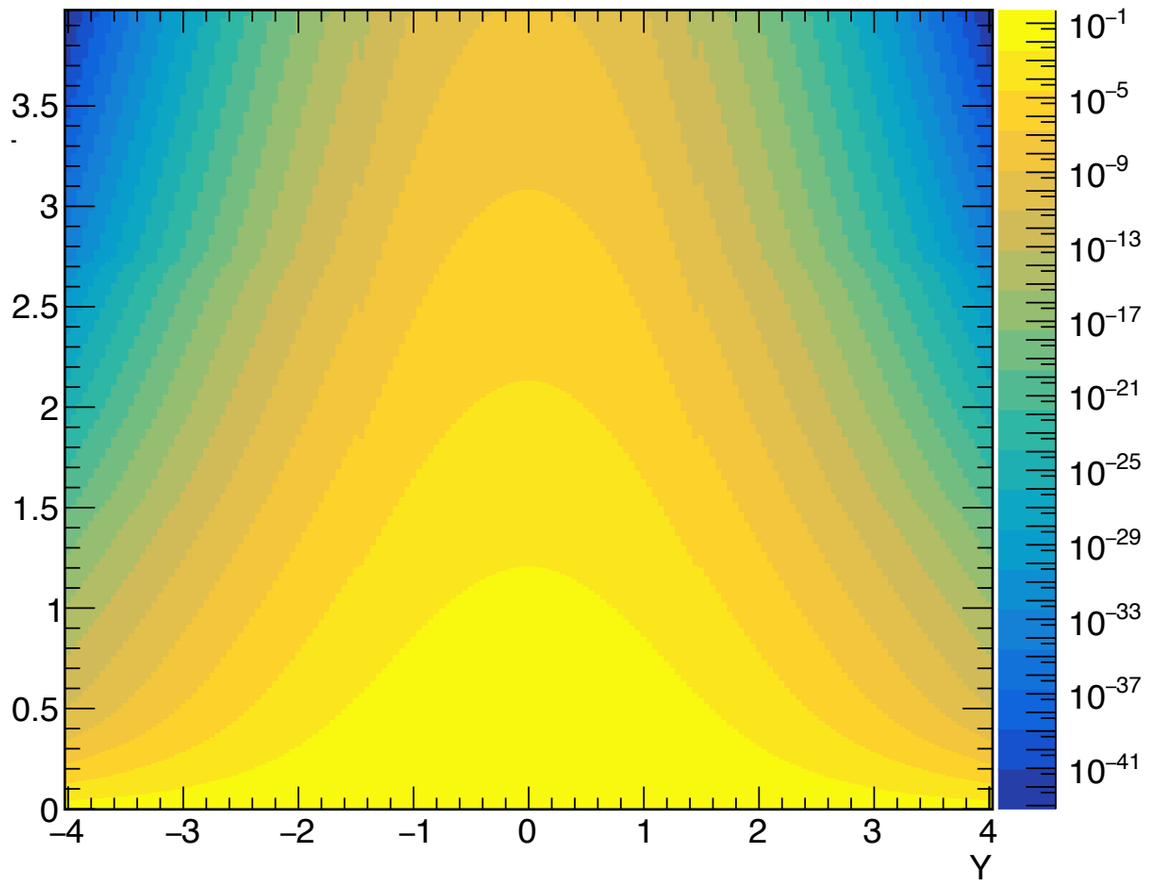
These are the mass spectra that would be visible, if all 3 million particles are perfectly measured

In practice we expect a detection efficiency of about 1 - 5 %

Therefore, we would need up to 300 million events to even measure these mass spectra

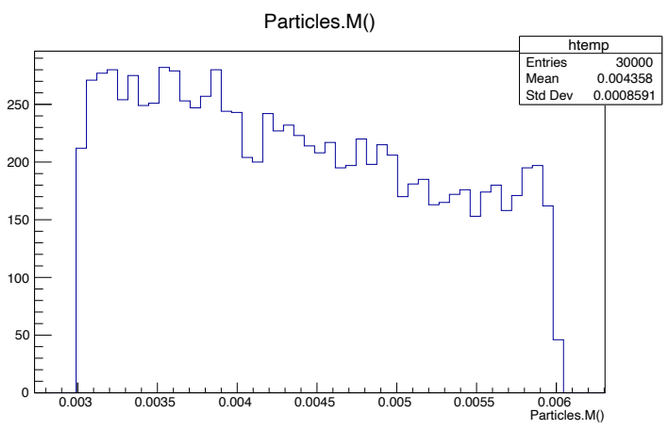
Properties of the 11 A GeV ee calculations

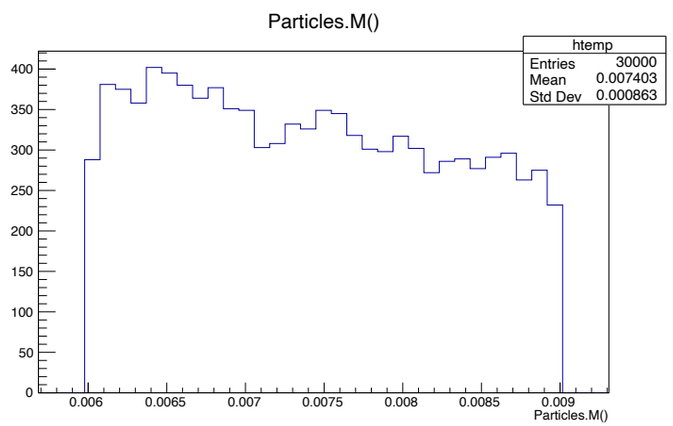




The mass distribution shows the relevant mass scaling of the particle production in the regular pluto script

Mass scanning of thermal files





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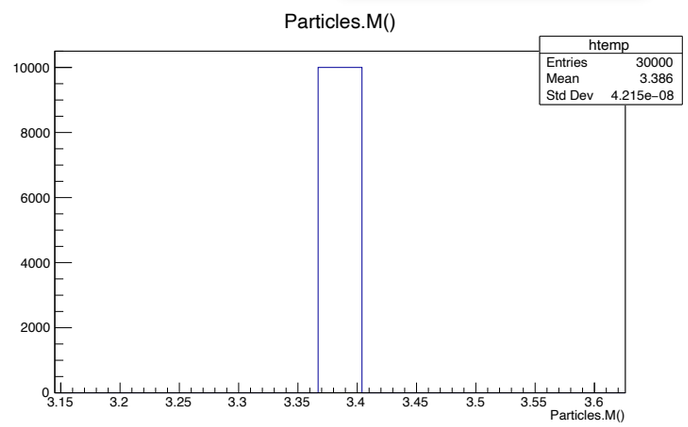

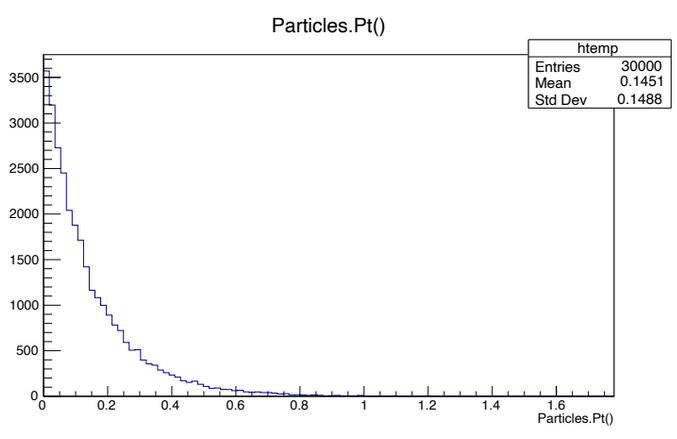

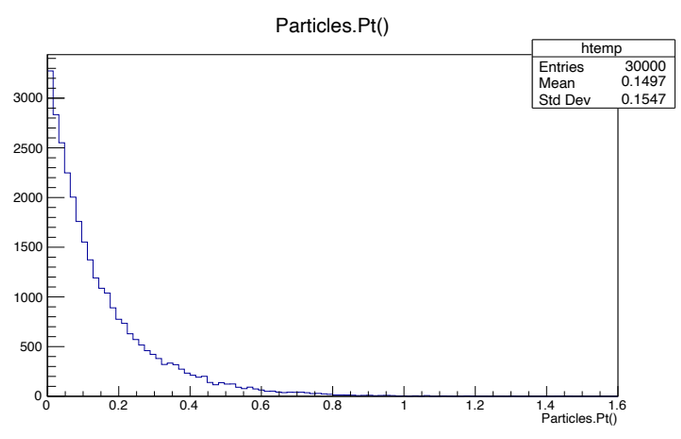

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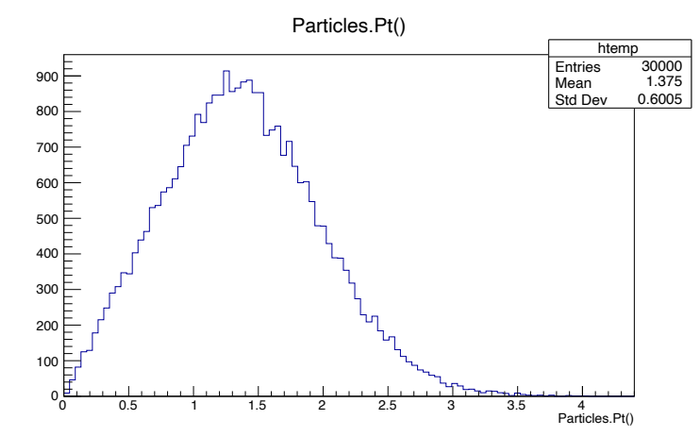

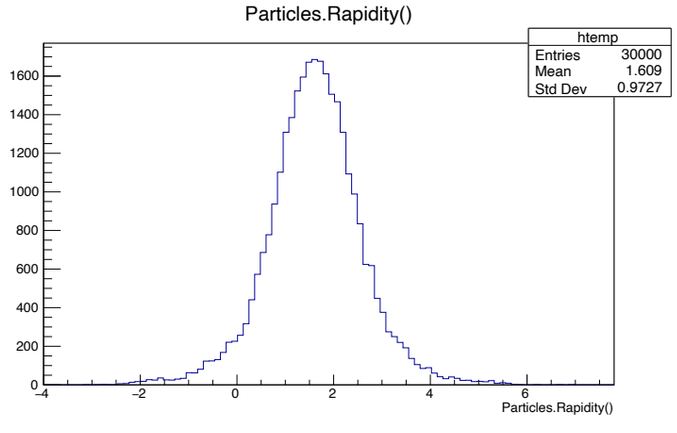

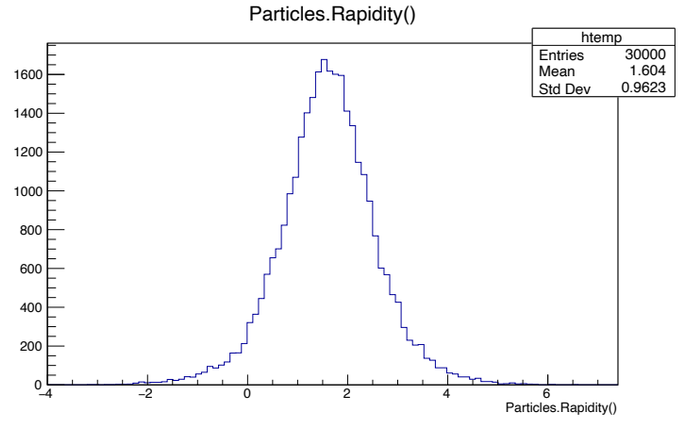

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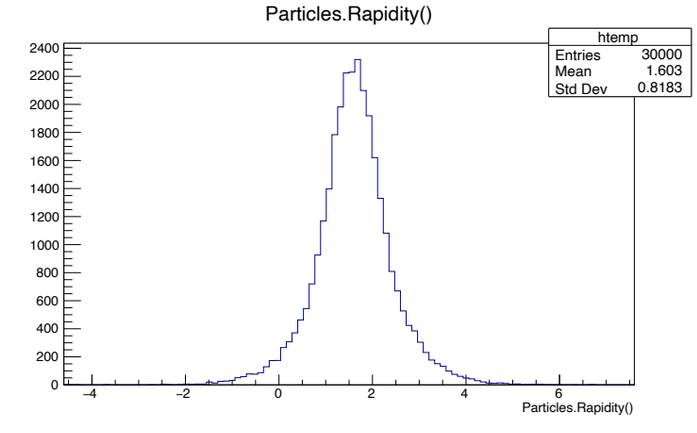
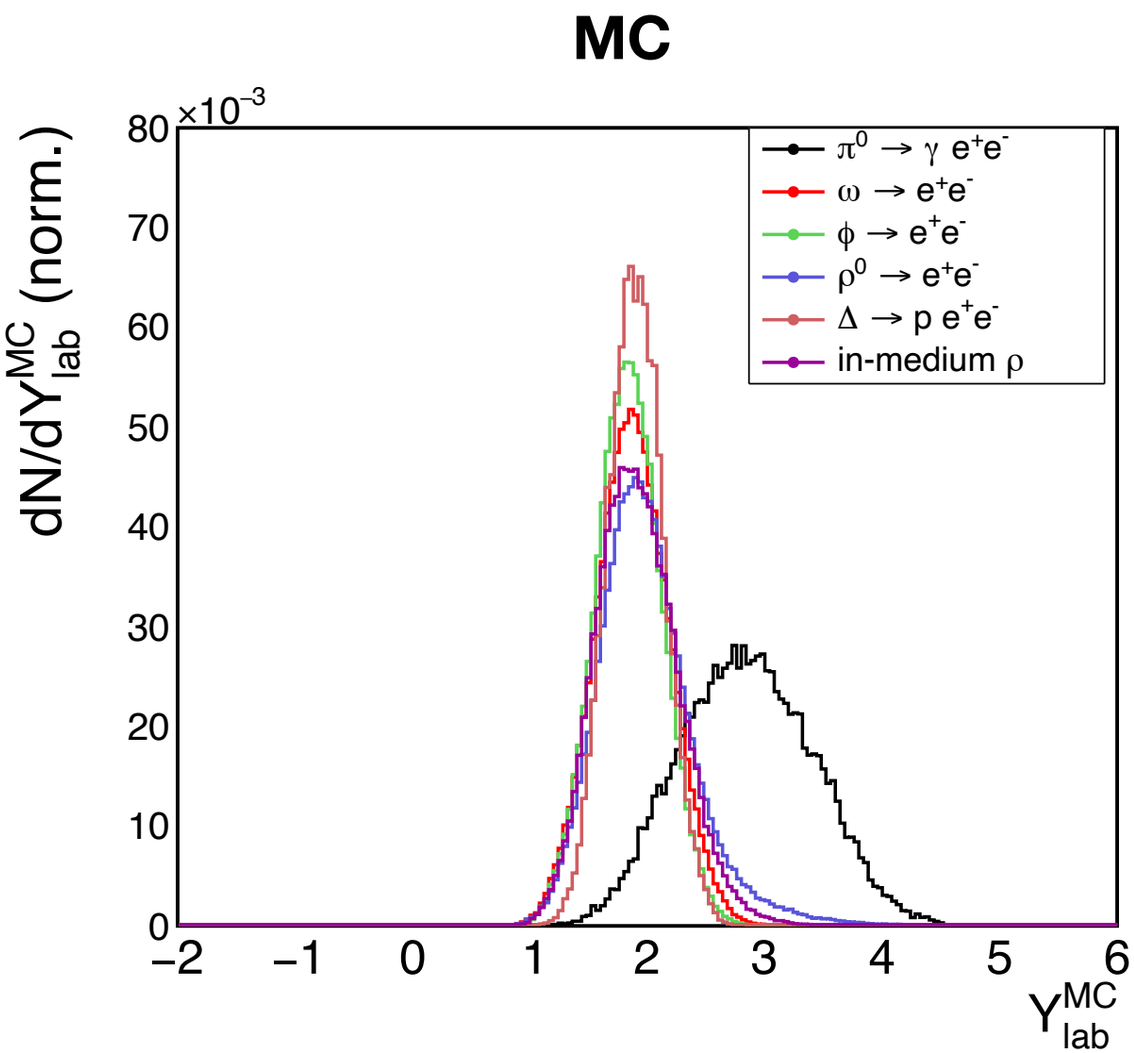
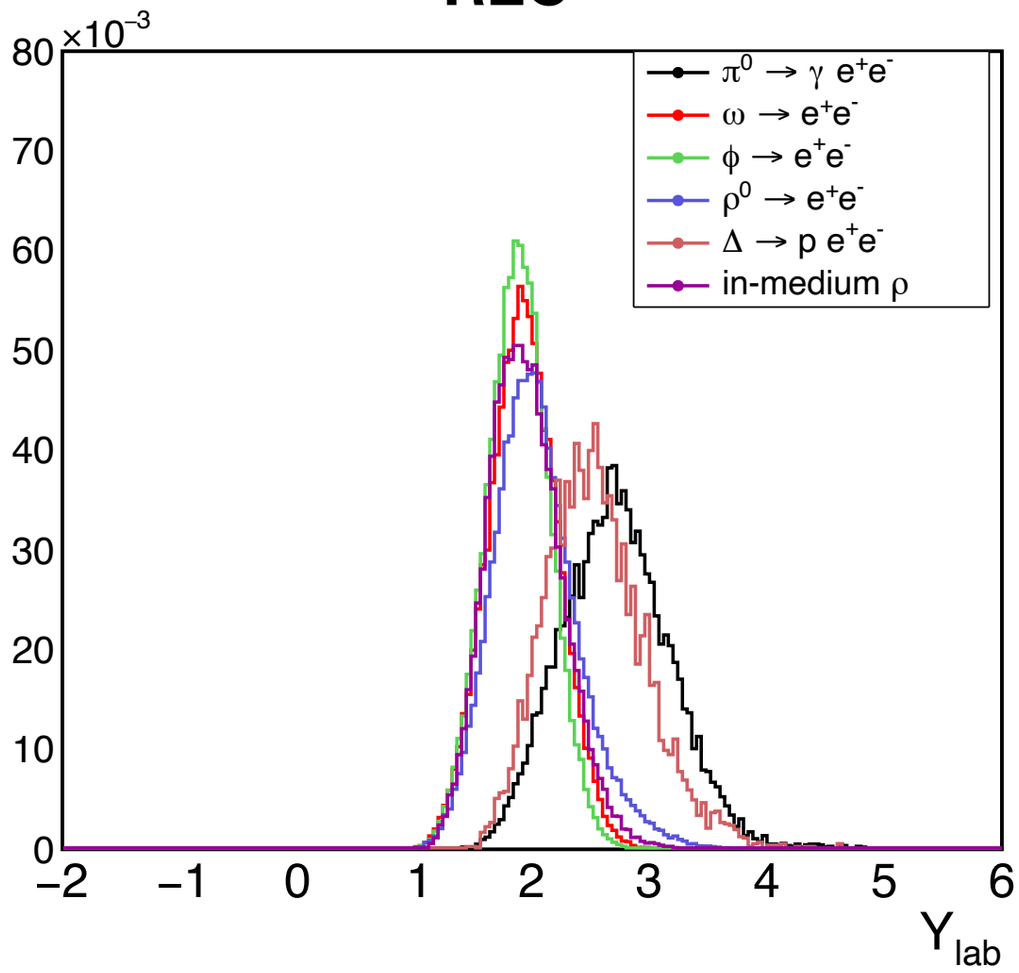


Rapidity distributions for particles in the CBM acceptance

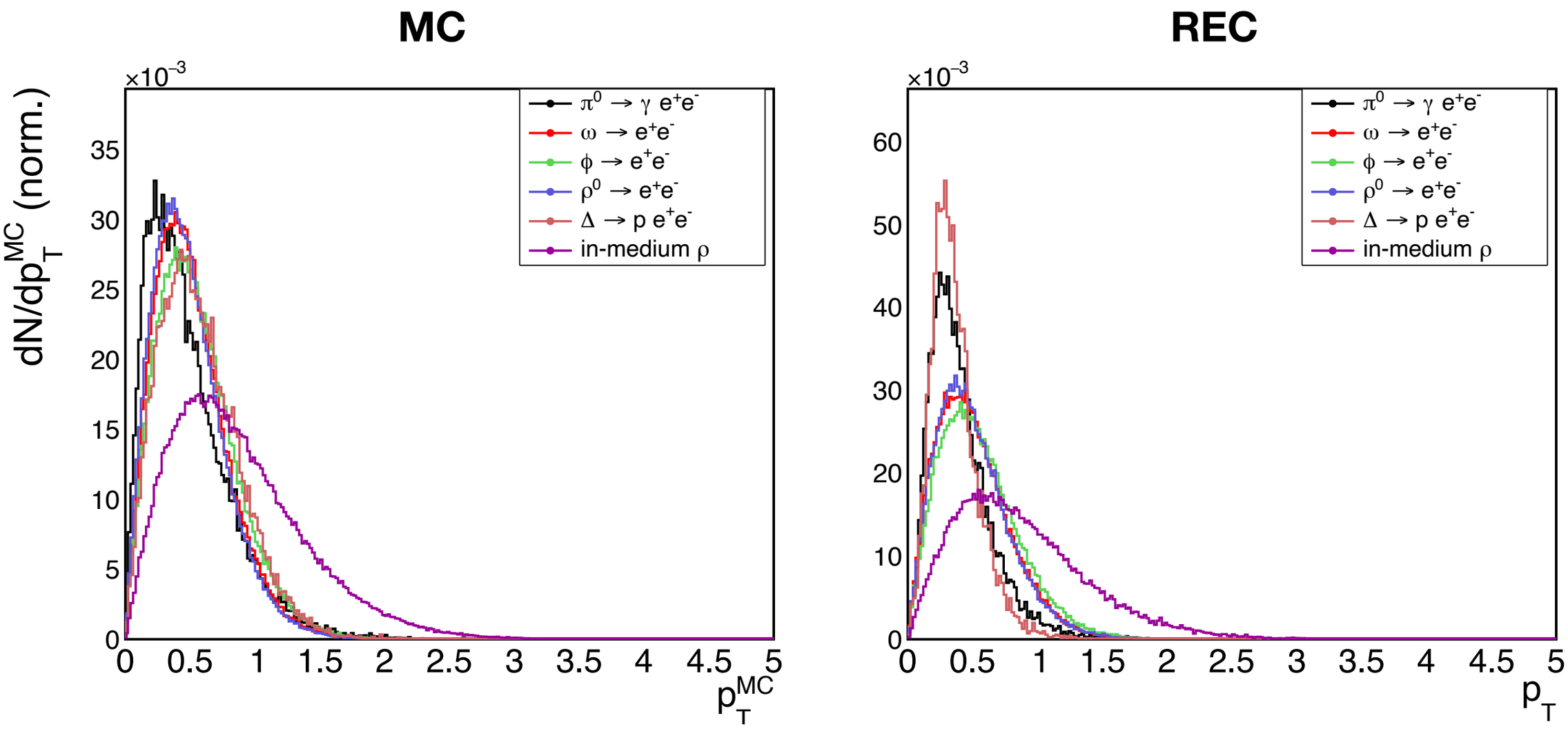




I have no idea right now what is happening to the D+

The rest of the particles seems well

Pt distributions for particles in the CBM acceptance



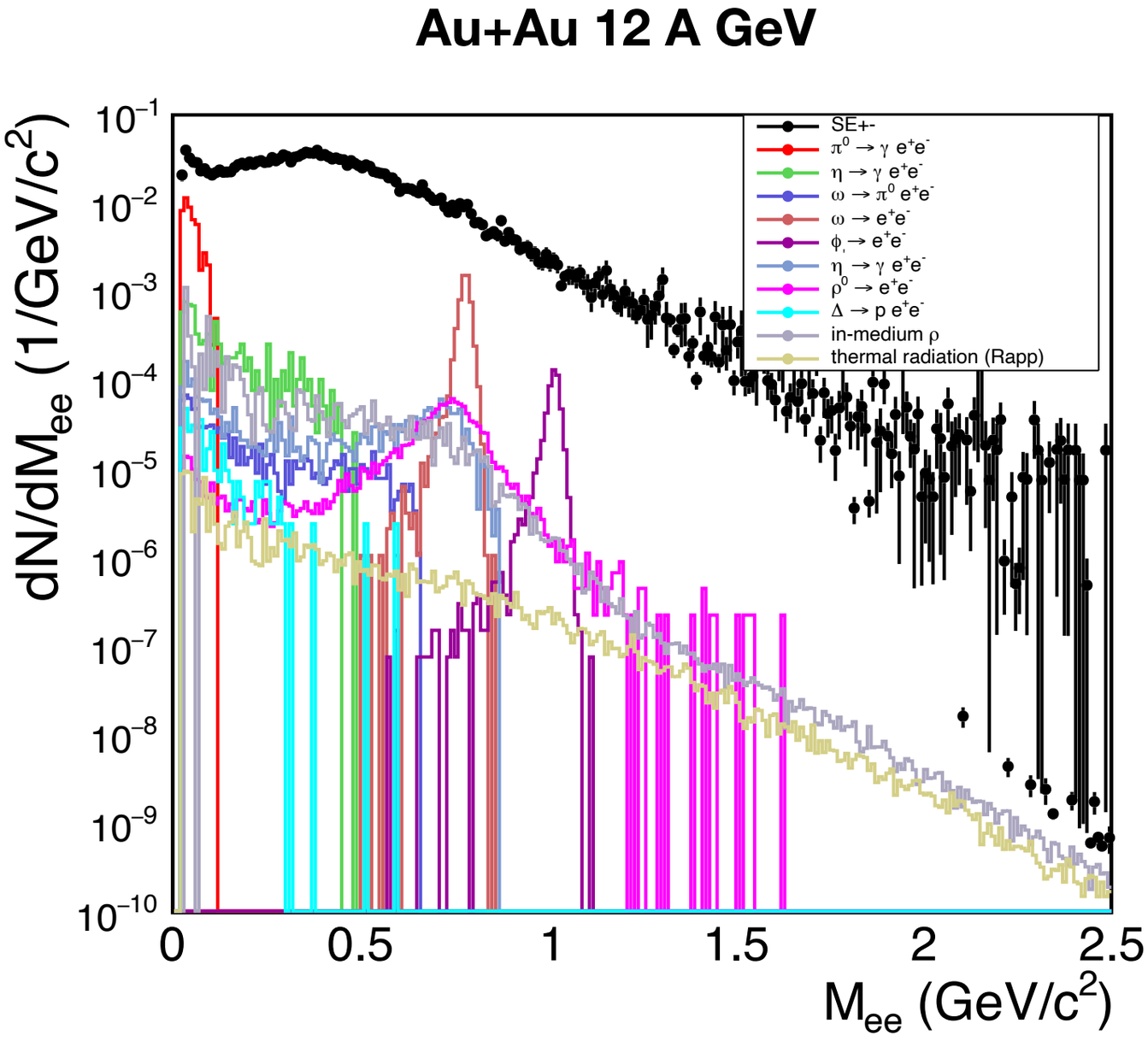
Again the D+ for transverse momentum (i will have a closer look into the calculation)

Invariant mass distribution

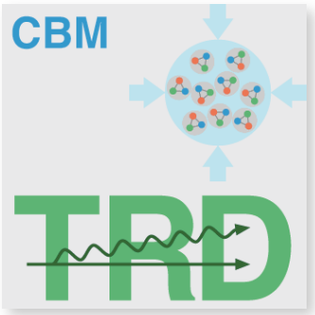
Input and weighting is working correctly

Thermal signal spectrum is incredibly improved

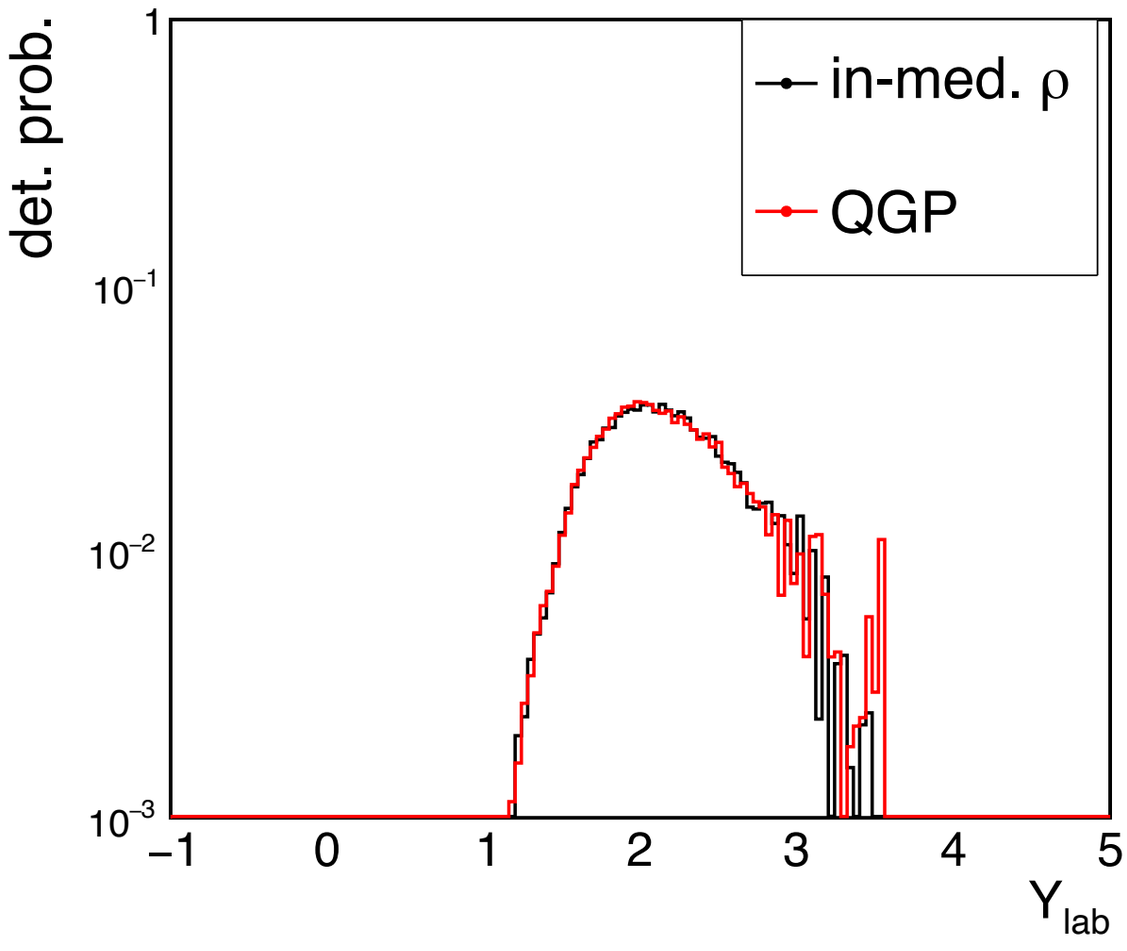
IMPORTANT: thermal signals have to be weighted wrt the mass distribution in the calculations!!

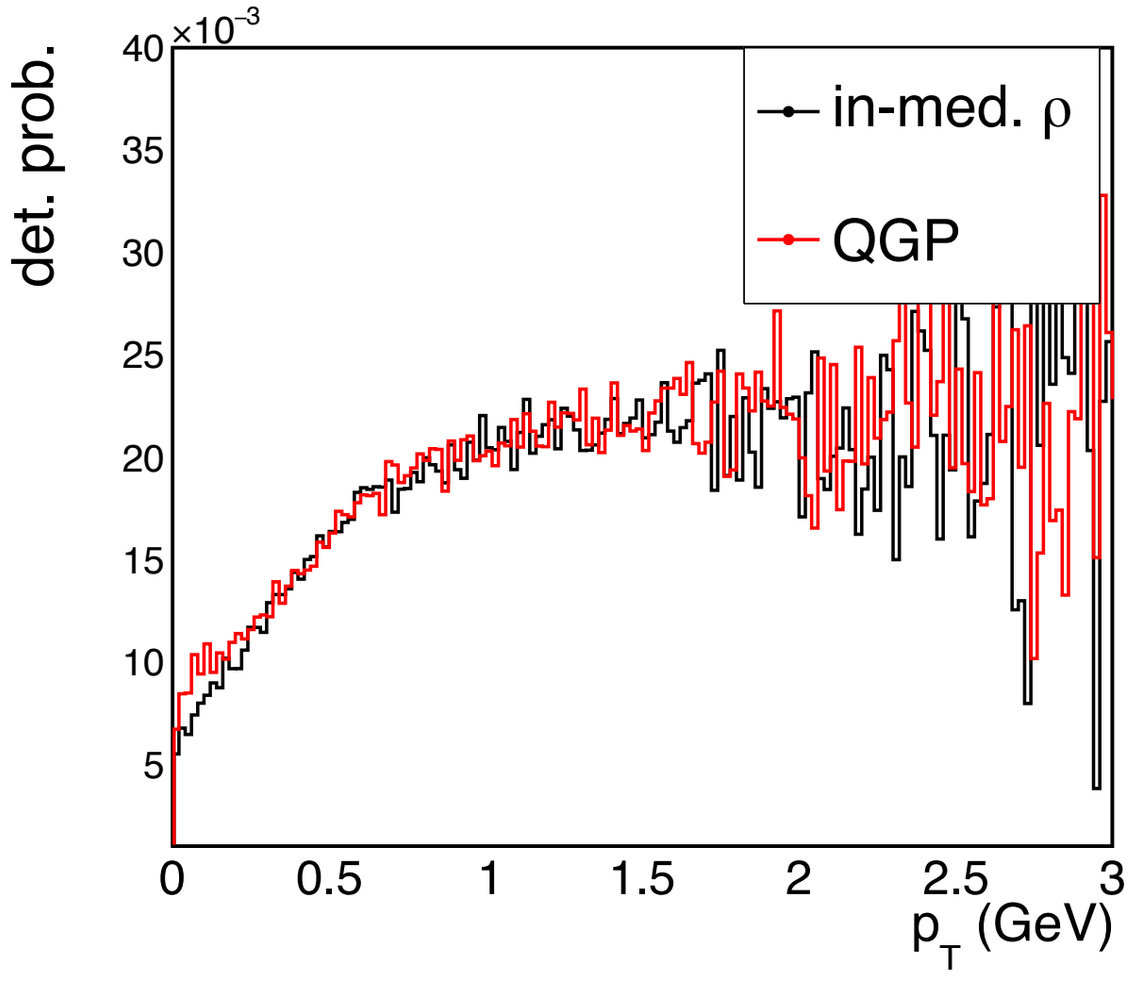


Detection probability of the thermal signals



Fully identified / 4 pi MC





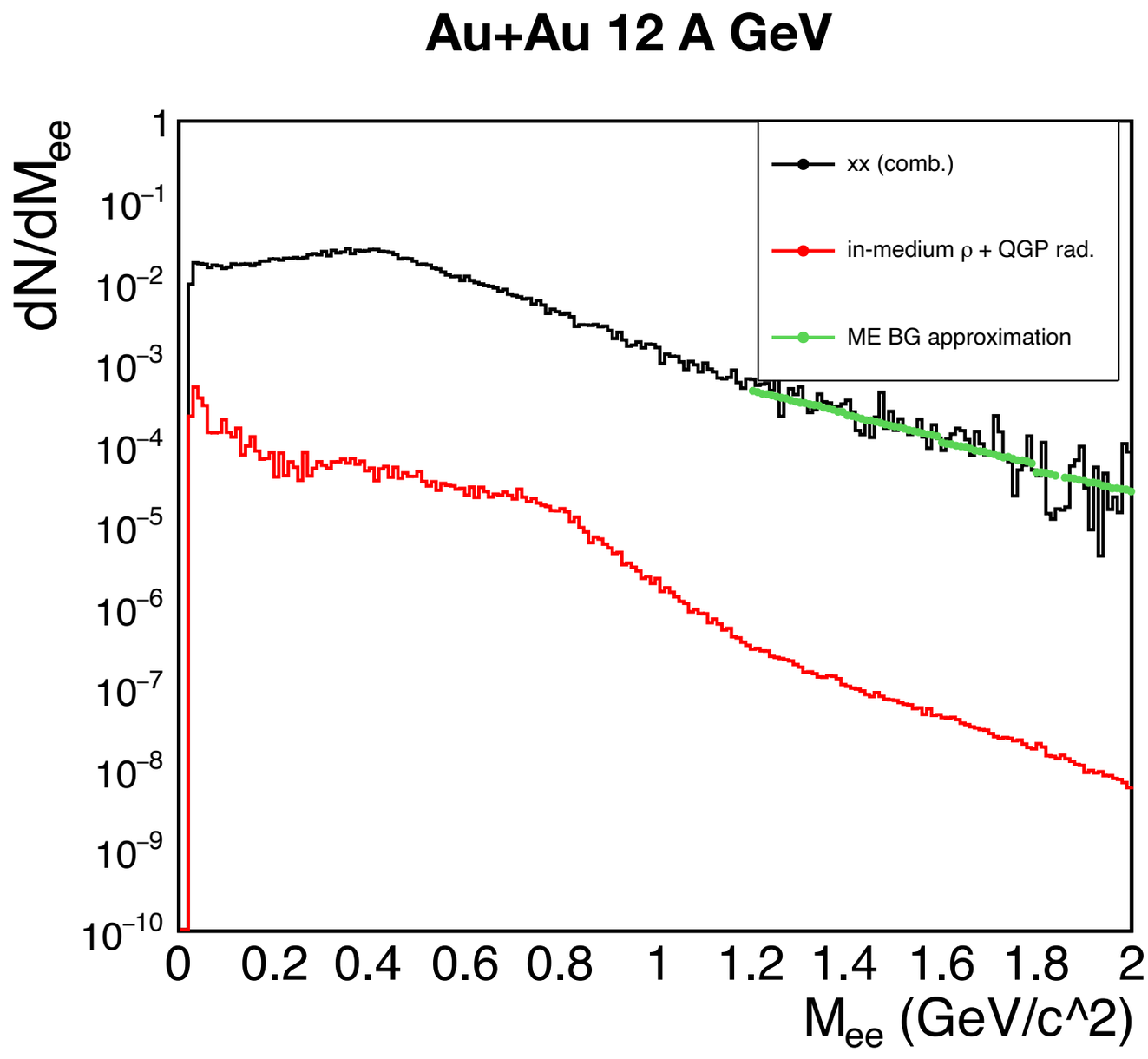
We have a detection efficiency of about 1-2%

Event mixing in the IMR

Event mixing seems to work fine

ME BG was scaled with the mean of the like sign pairs

Background combinatorics show a lot of fluctuations



Outlook and conslucion

Outlook
Look into PID performance and pion suppression with the next production

LMVM
Caused problems with their MC tracks, which was easy to fix

Thermal signals
Were working correctly, but show the typical statistics problems for larger masses
-> Can be improved with a mass independent pluto generation?! Let me know if I am missing something!

Locations
At the moment they are at:

- /lustre/hebe/cbm/users/galatyuk/pluto/
- /lustre/nyx/cbm/users/ebechtel/pluto/thermal_rapp

But they are foreseen to be moved, see:

- https://redmine.cbm.gsi.de/issues/1682