Background study with collimators

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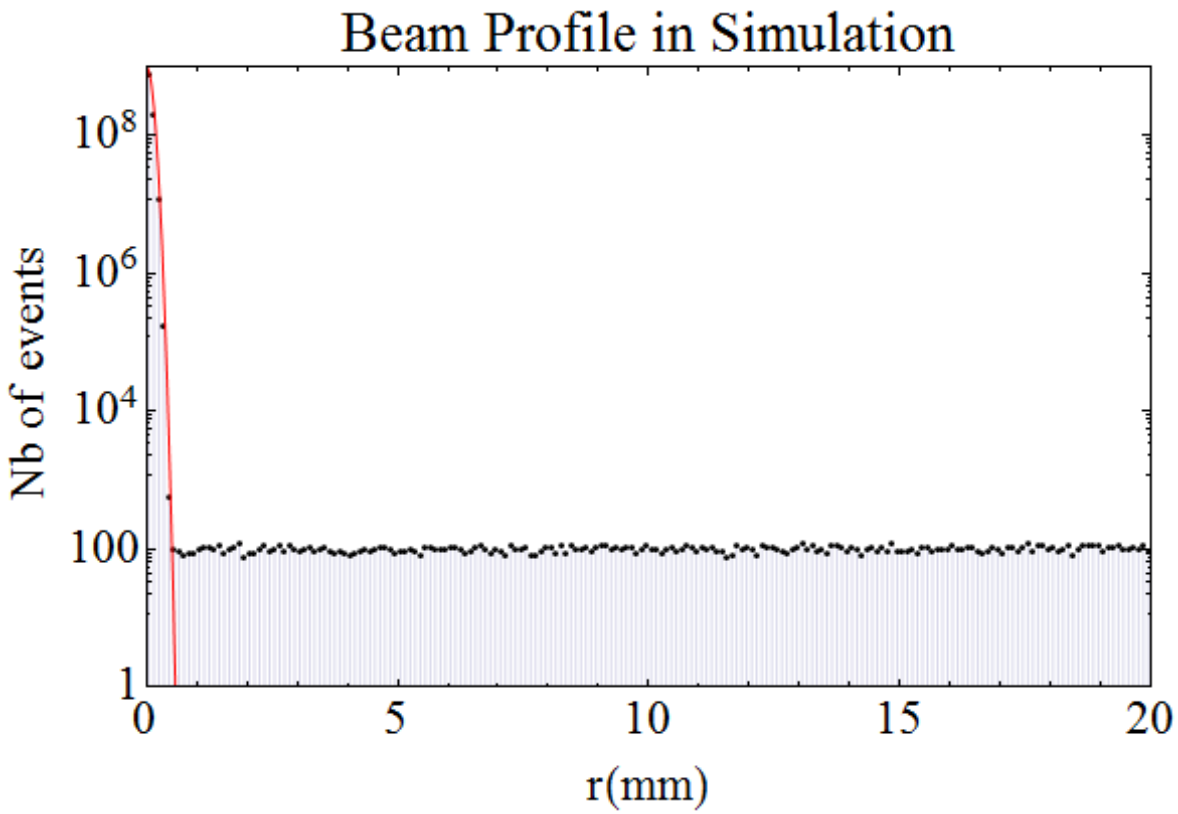
Beam profile

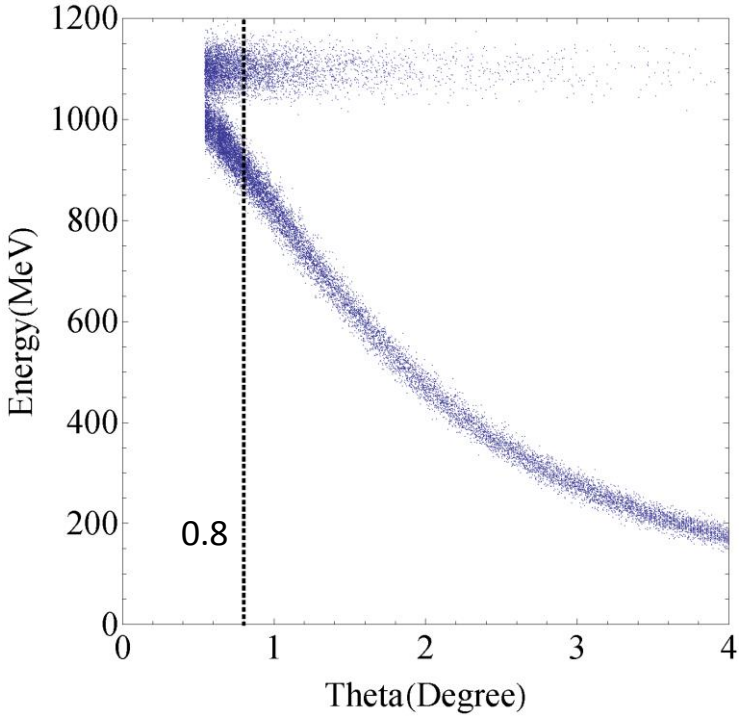
- Beam : Halo = 10^7
- Halo range: 20 mm
- Halo energy: the same as the beam energy (1.1 GeV)



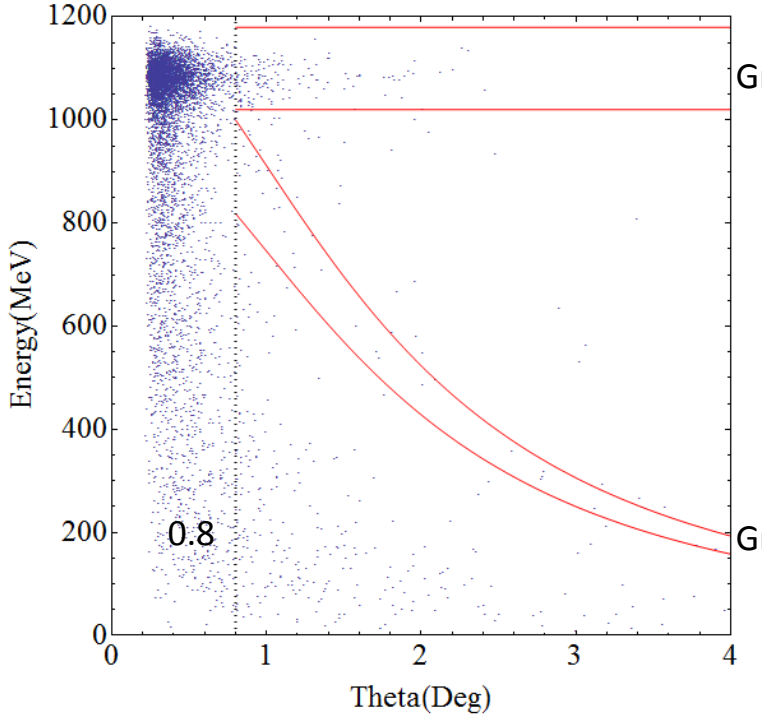
Background

- Halo has the same energy as the beam. Energy resolution 2.6 %/$\sqrt{E}$ included
- If applying the graphical cut as shown in the right plot, the background level is about 14 % for ep and about 2 % for Møller

Hydrogen gas only



Target cell only

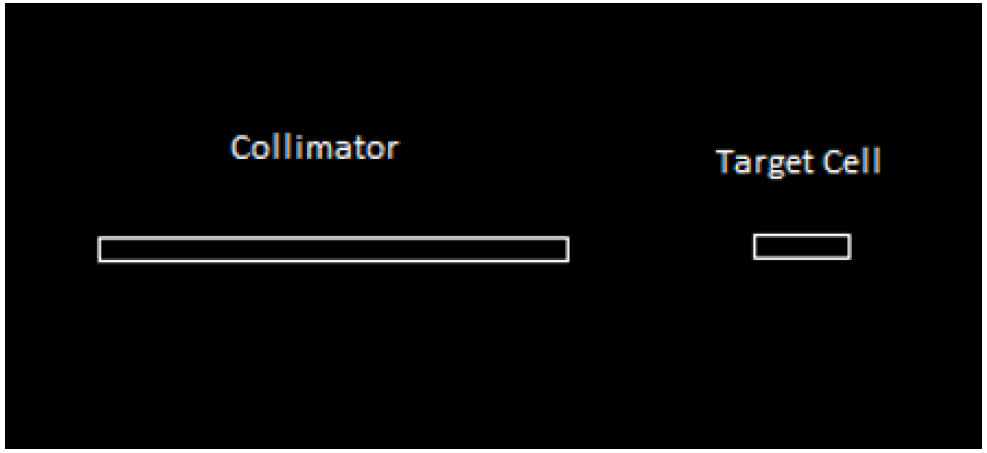


Graphical cut for ep events

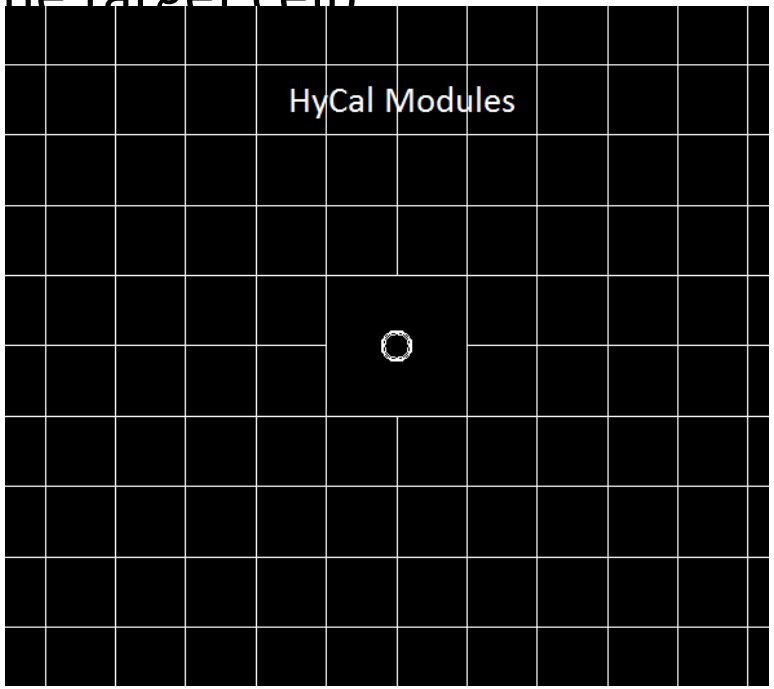
Graphical cut for Møller events

Collimator geometries

- A tube-like collimator, made of Tungsten
- Collimators is at upstream of the target, 20 cm in length, inner radius 3.5 mm, outer radius 4.5 mm (4 mm and 4.03 mm for the target cell)



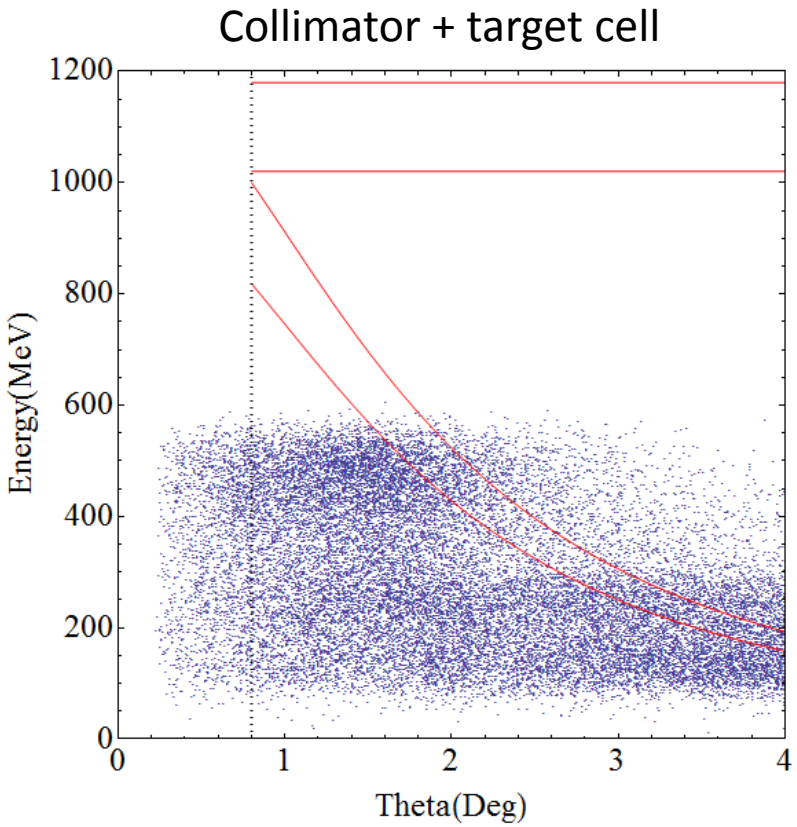
Side view



Front view

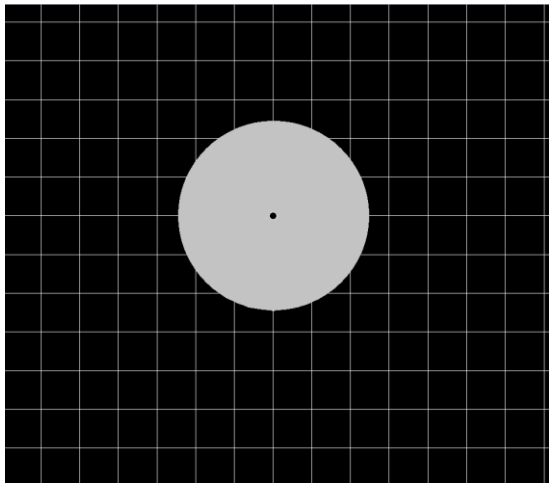
Background result

- When the collimator is placed at upstream of the target cell
- Background for ep is < 0.1 %, but Møller is destroyed when scattered angle > 1.5 degree



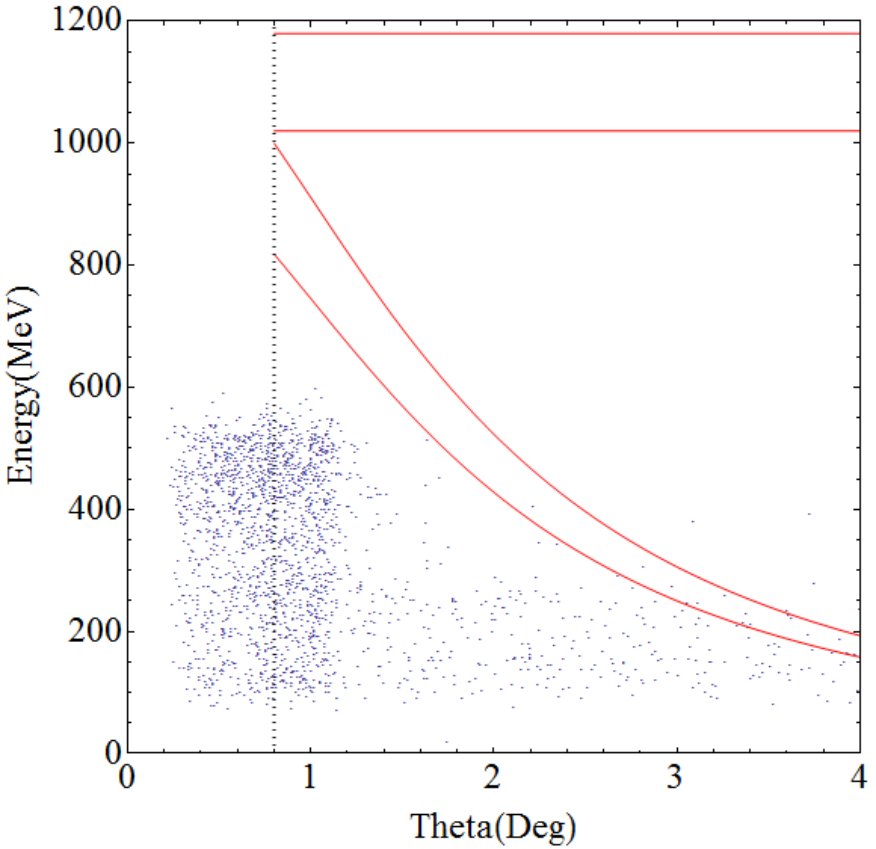
A larger collimator

- If we increase the collimator's transverse dimension
  - Inner radius from 3.5 mm to 2 mm
  - Outer radius from 4.5 mm to 50 mm
  - Length is still 20 cm
- Background is significantly reduced
  - < 0.1 % for ep, about 0.8 % for Møller



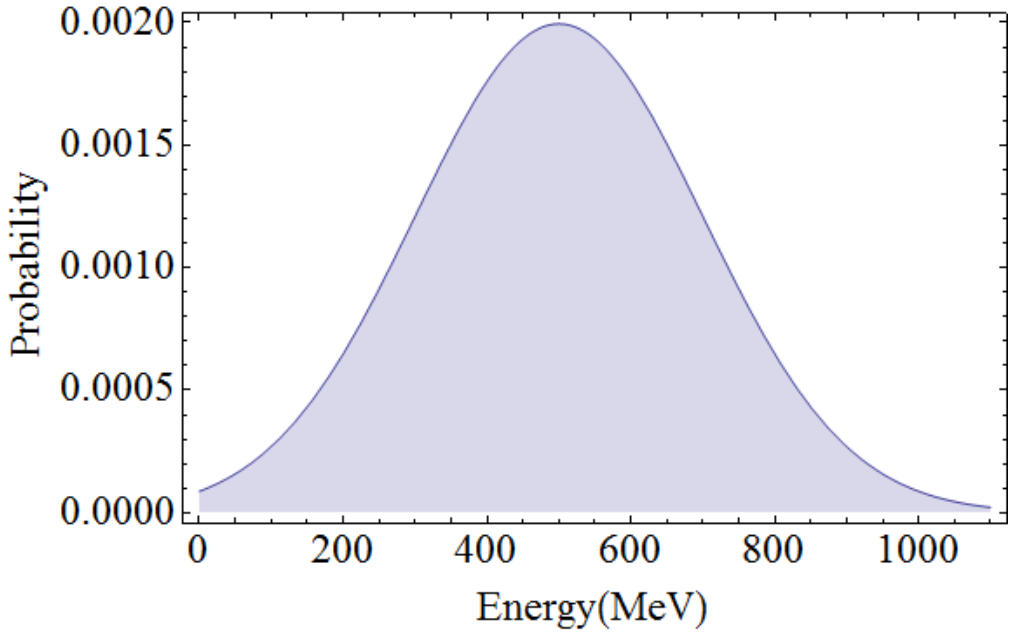
Front view

Large collimator + target cell



Different energy of beam halo

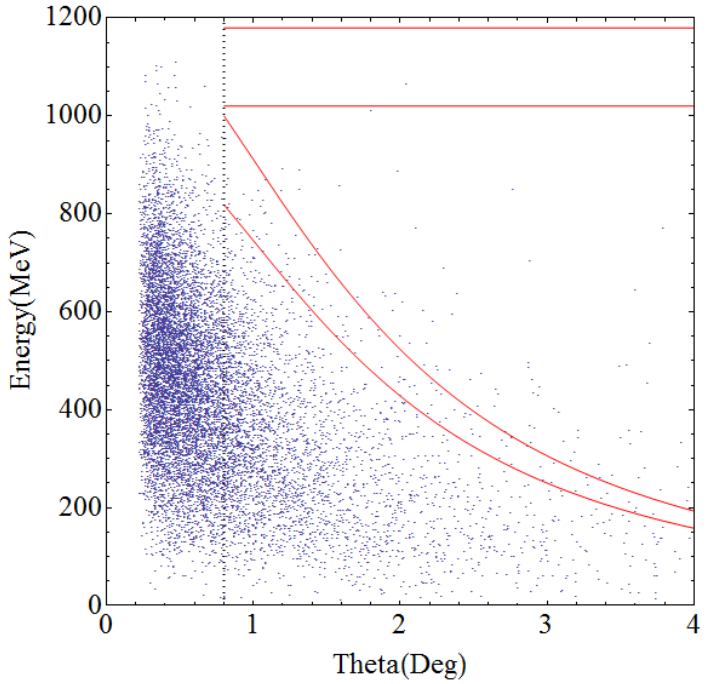
- Beam halo energy might be different with the beam energy
- Assuming a Gaussian distribution for the halo energy, mean = 500 MeV, sigma = 200 MeV



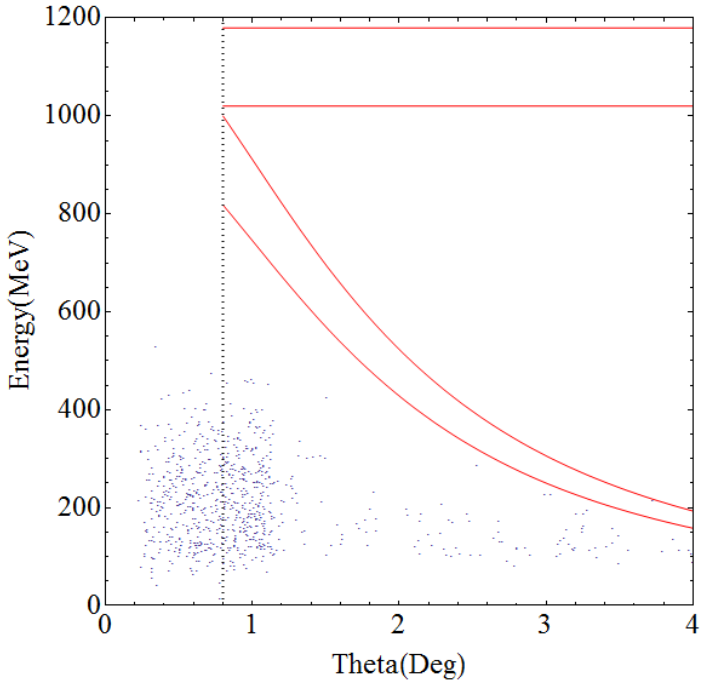
Background results

- Background is about 0.3 % for ep, but about 10 % for Møller
- Background with collimator is < 0.1 % for ep, and about 0.2 % for Møller

Target cell only



Large collimator + target cell



Summary

- A large enough collimator is helpful to reduce the background
- If the energy of beam halo is lower than beam energy, compared to the case of halo with the same energy as beam
  - It is very likely to have a lower background for ep and higher background for Møller without a collimator
  - Both background of ep and Møller events are lower with a collimator
- The shape of the collimator should be more complicated in order to cover the neck part, which is not included in this simulation