DEEP UNDERGROUND NEUTRINO EXPERIMENT

LDM Status Update

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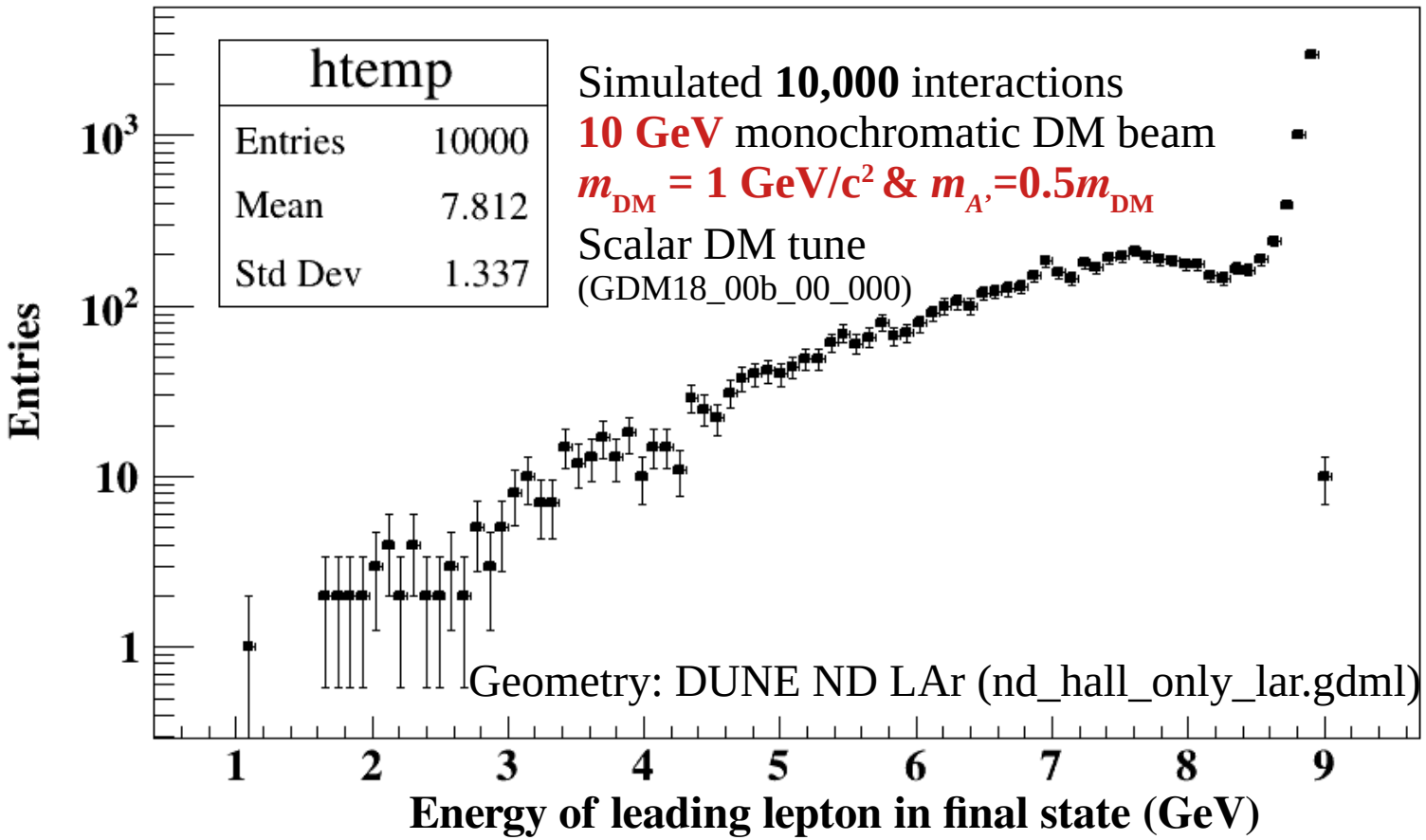
LDM – Signal Study

- I’ve done some practice runs to simulate DM and detector interaction. However, after some discussion about this, we found that this has some problem.



It is supposed to be look like a **decreasing pattern** according to the shape of DM-e scattering cross section.

In some sense, it looks like a spectrum of **recoiled DM spectrum**, not the electron spectrum.

→ problem in my analysis script?

gevdump

```
|-------------------------------------------------------------------------------------------------------------------|
|GENIE GHEP Event Record [print level:   3]                                                                         |
|-------------------------------------------------------------------------------------------------------------------|
| Idx |          Name | Ist |        PDG |   Mother  | Daughter  |       Px |       Py |       Pz |        E |       m  |
|-------------------------------------------------------------------------------------------------------------------|
|   0 |        chi_dm |   0 | 2000010000 |  -1 |  -1 |   4 |   4 |    0.000 |    0.000 |    9.950 |   10.000 |    1.000 |
|   1 |          Ar40 |   0 | 1000180400 |  -1 |  -1 |   2 |   3 |    0.000 |    0.000 |    0.000 |   37.216 |   37.216 |
|   2 |            e- |   0 |         11 |   1 |  -1 |   5 |   5 |    0.000 |    0.000 |    0.000 |    0.001 |    0.001 |
|   3 |          Ar40 |   1 | 1000180400 |   1 |  -1 |  -1 |  -1 |    0.000 |    0.000 |    0.000 |   37.216 |   37.216 |
|   4 |        chi_dm |   1 | 2000010000 |   0 |  -1 |  -1 |  -1 |    0.003 |    0.004 |    9.893 |    9.943 |    1.000 | P = (0.000,0.000,1.000)
|   5 |            e- |   1 |         11 |   2 |  -1 |  -1 |  -1 |   -0.003 |   -0.004 |    0.057 |    0.057 |    0.001 |
|-------------------------------------------------------------------------------------------------------------------|
|       Fin-Init:                                                |    0.000 |    0.000 |    0.000 |    0.000 |          |
|-------------------------------------------------------------------------------------------------------------------|
|       Vertex:         chi_dm @ (x =     0.00000 m, y =     0.00000 m, z =     0.00000 m, t =    0.000000e+00 s)  |
|-------------------------------------------------------------------------------------------------------------------|
| Err flag [bits:15->0] : 0000000000000000    |  1st set:                                                     none |
| Err mask [bits:15->0] : 1111111111111111    |  Is unphysical:    NO |   Accepted:   YES                          |
|-------------------------------------------------------------------------------------------------------------------|
| sig(Ev) =       4.65303e-35 cm^2  | dsig(y;E)/dy =            4.02590e-33 cm^2       | Weight =          1.00000 |
|-------------------------------------------------------------------------------------------------------------------|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GENIE Interaction Summary
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[-] [Init-State]
 |--> probe        : PDG-code = 2000010000 (chi_dm)
 |--> nucl. target : Z = 18, A = 40, PDG-Code = 1000180400 (Ar40)
 |--> hit nucleon  : no set
 |--> hit quark    : no set
 |--> probe 4P     : (E =    10.000000, Px =     0.000000, Py =     0.000000, Pz =     9.949874)
 |--> target 4P    : (E =    37.215526, Px =     0.000000, Py =     0.000000, Pz =     0.000000)

[-] [Process-Info]
 |--> Interaction : DarkMatter
 |--> Scattering  : DME
[-] [Kinematics]
 |--> *Selected* Inelasticity y = 0.994310
[-] [Exclusive Process Info]
 |--> charm prod.  : false |--> strange prod.  : false
 |--> f/s nucleons : N(p) = 0 N(n) = 0
 |--> f/s pions    : N(pi^0) = 0 N(pi^+) = 0 N(pi^-) = 0
 |--> f/s Other    : N(gamma) = 0 N(Rho^0) = 0 N(Rho^+) = 0 N(Rho^-) = 0
 |--> resonance    : [not set]
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```
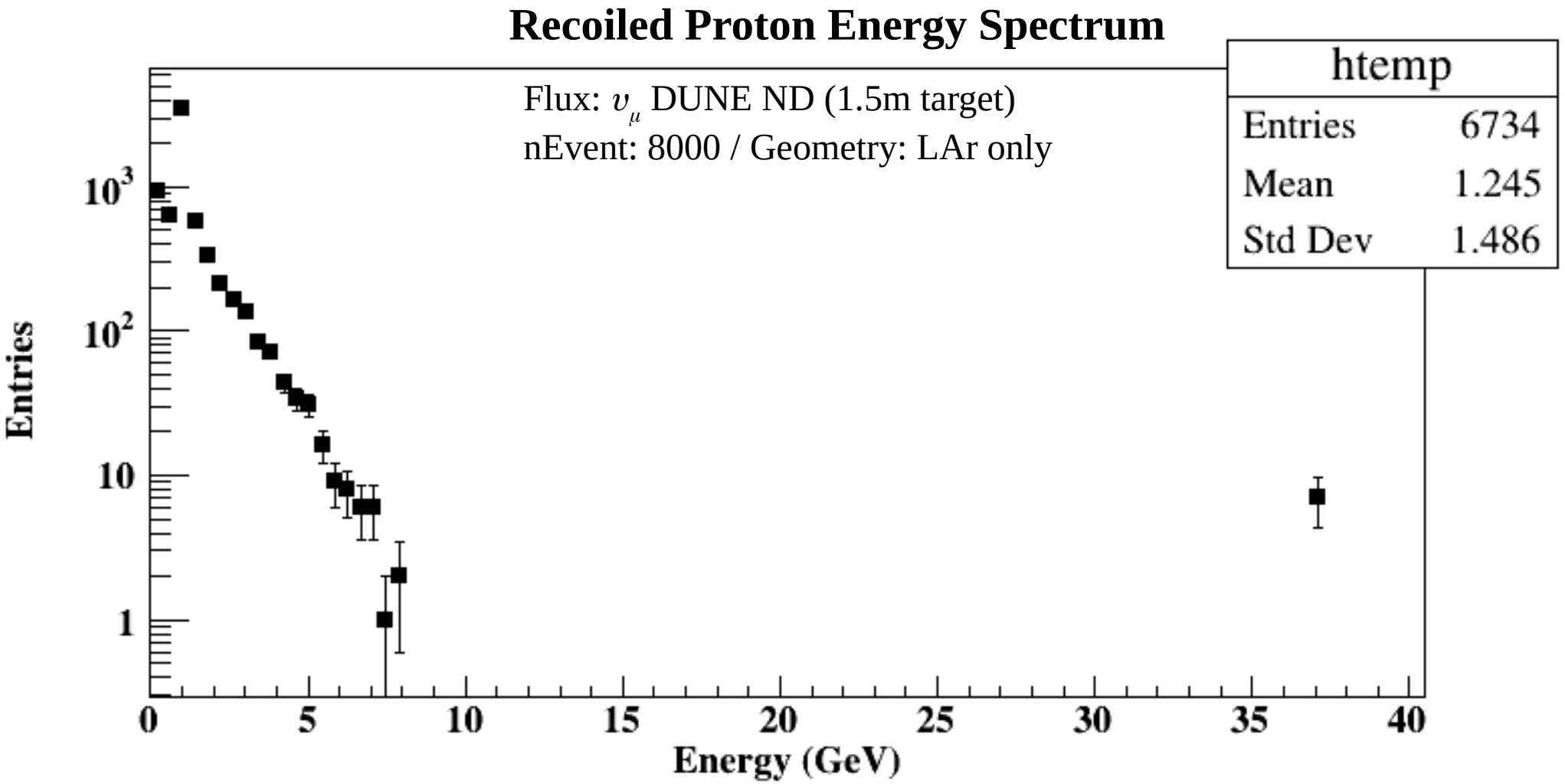

LDM – Background Study

- I think I can start a validation study for background simulation.
- To me, the results from practice runs seem natural.
  - nEvent : 8,000 / Flux: υ_{μ} DUNE ND (1.5m target) / Geometry: nd_hall_only_lar.gdml

LDM – Background Study



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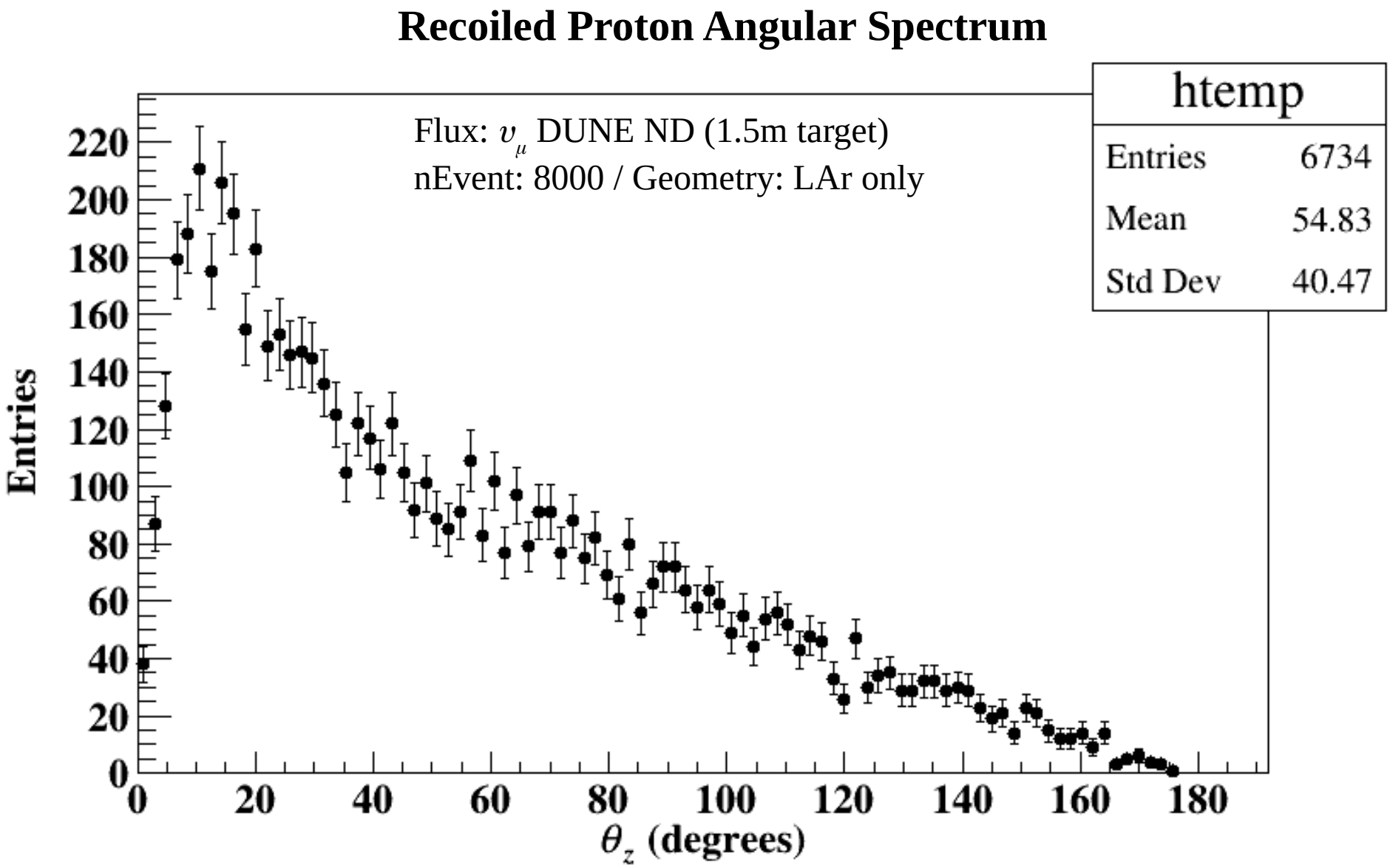
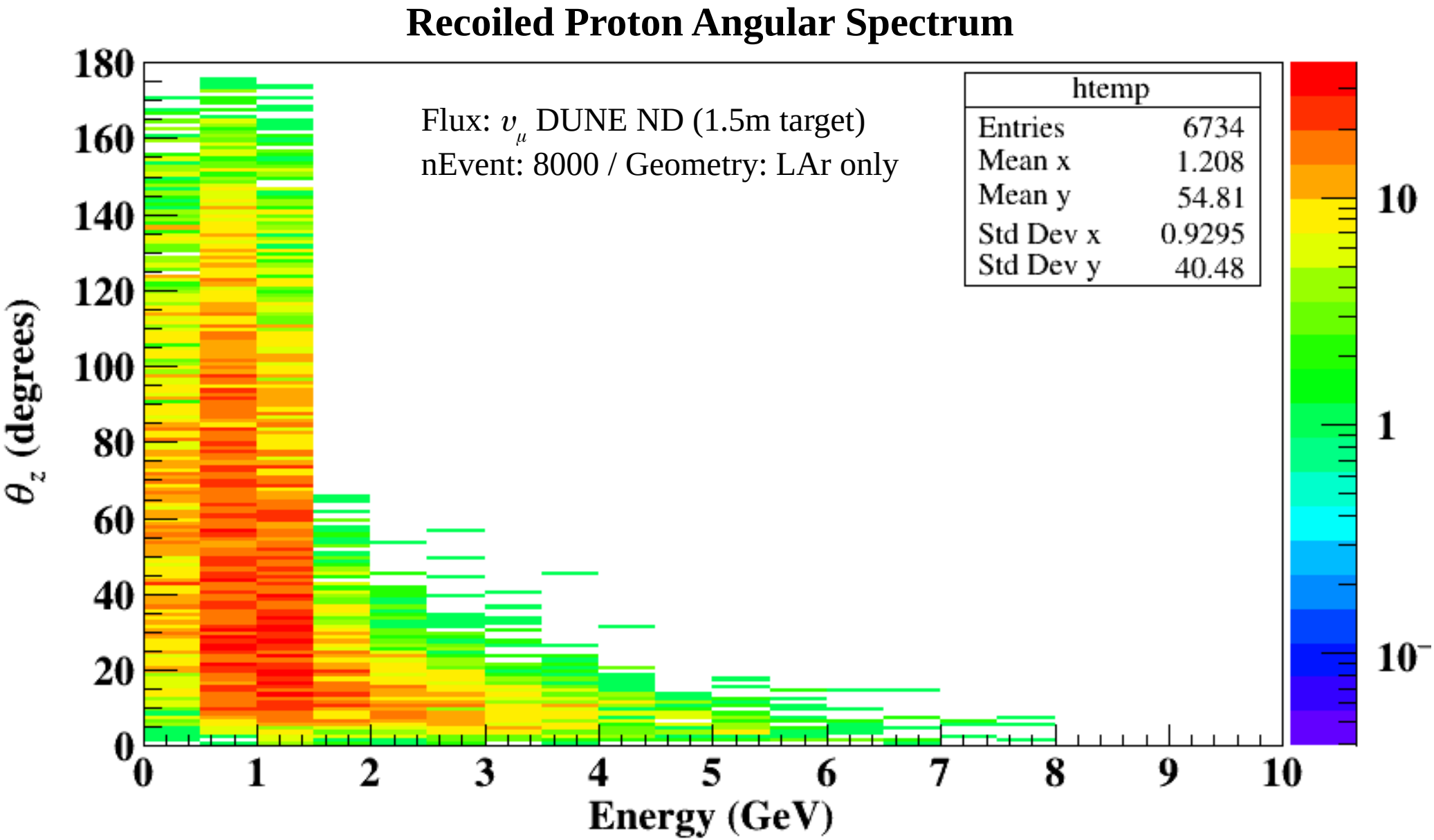


LDM – Background Study



Summary

- Signal study
  - I think the GENIE software setup with the **dark matter module** is almost done.
  - But there are some problems related to my analysis skill and this is needed to be improved. I'd like to investigate this further by discussing it with other colleagues.
- Background study
  - The practice run result seems reasonable.
  - However, before we move on to G4 edep-sim study for detector simulation, I would like to check the current result to make sure that the reliability of the simulation.
  - I'm thinking about the strategy for this validation study, but I also would like to listen to your comment or guide for this validation study.