Issues with Atmospheric Event Generation in Genie

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Problems

1. Using the newer versions of Genie (2_12_0 and later), the event generation would hang when using Bartol Flux.

2. When looking at reconstructed events (for vertex resolution purposes) we noticed a strange true energy spectrum.
Hanging solution

Using the newer versions of Genie (2_12_0 and later), the event generation would hang when using Bartol Flux.

Solution: (found by Tingjun)

In GBGLRSAtmoFlux.cxx:

```cpp
123  fMaxEv = fEnergyBins[fNumEnergyBins];
124
125  fNumPhiBins = 1;
126  fNumCosThetaBins = kBGLRS3DNumCosThetaBins;
127  fNumEnergyBins = kBGLRS3DNumLogEvBinsLow + kBGLRS3DNumLogEvBinsHigh
```
Energy Problem

The original events used were originally looked at using Analysis Tree:

standard_ana_dune10kt_1x2x6.fcl

Using the reconstructed events found at:

/pnfs/dune/tape_backed/dunepro/mc/dune/full-reconstructed/01/55/07/70/prodgenie_atmnu_max_dune10kt_1x2x6__20161213T031412_merged0.root

<table>
<thead>
<tr>
<th>True Energy</th>
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</thead>
<tbody>
<tr>
<td>Entries</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>Std Dev</td>
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</tbody>
</table>
Energy Problem

Approach

Find out where in the event generation process these problems are happening and correct it.

Starting back at the beginning by generating atmospheric neutrinos.

- Using the newest version of Genie (2_12_6)
- We are looking at two different types of Flux: Bartol and Honda.
- We applied Tingjun’s fix to Genie so that the generation no longer was hanging.

BARTOL: fmax10_0401z.sou_num

HONDA: hms-ally-01-01-solmax.d.gz
BARTOL

(fmax10_0401z.sou_num)

Neutrino Energy
CosTheta

Next we looked at CosTheta of the incoming neutrinos with respect to the vertical direction.

Note: The y axis have a suppressed zero.
All events seem to be coming from directly overhead.
Conclusions

▪ Tingjun fixed the code so that the newest versions of Genie can generate neutrinos using Bartol flux.

▪ There seems to be a problem with both Honda and Bartol. Bartol has the CosTheta we’d expect, but a strange energy distribution. Honda has the expected energy distribution but a strange CosTheta.

▪ So far it seems that the problems are arising from:
  ◦ GAtmoFlux.cxx
  ◦ GBGLRSAAtmoFlux.cxx
  ◦ GHAKKMAAtmoFlux.cxx

▪ The next step is to look at these files more closely to find the exact problem.