Geosci. Instrum. Method. Data Syst. Discuss., 2, C189–C191, 2012
www.geosci-instrum-method-data-syst-discuss.net/2/C189/2012/


Geoscientific Instrumentation Methods and Data Systems
Discussions

# *Interactive comment on* "Air shower simulation for background estimation in muon tomography of volcanoes" *by* S. Béné

**S. Béné**

bene@clermont.in2p3.fr

Received and published: 26 September 2012

I'll answer to the questions ans remarks of Anonymous Referee 2

Q : "Why not to perform this benchmark also considering a comparison with real data ?" A : Our setup in Geant4 is very basic for the moment : only vertical protons with 3 different values of energy are shot. Selecting events with such characteristics for comparison is easier whith the (CORSIKA) simulation data that we own than in real data.

Q : "What is the range in energy we are interested in ? What kind of background are we aiming to fight ?" A : We are aiming to fight accidental coincidences : charged particles hitting the detector coherently, faking a track. In the scope of the study of ac-



cidental coincidences, the low energy component of the muon flux at detectors altitude is not relevant to consider if the detector is to be somehow shielded (inside a box or underground for example).

Q : "Why so much attention is devoted to the muon energy loss in atmosphere ?" A : Some of the main phenomena affecting the energy spectrum of the muons are recalled, to justify the assertions made in the introduction about the interests of monte-carlo simulations when one tries to determine the atmospheric muons flux at detectors altitude, with wide energy and angular ranges.

Q : "Are we interested (in muon energy loss in atmosphere ?) at so low energies ?" A : I am sorry, the meaning of this question is not clear for me.

Remark about the different setups in Corsika and Geant4 A : I'll precise one thing, quoting my answer to Referee 1 : the events selected in the CORSIKA data are only proton-induced. It was not clear in the text, and one could be mislead and think that events initiated by Helium nuclei were also considered for the comparison.

Q : "Where do photons converting into a muon pair come from ?" A : They mainly come from neutral pion decay into two photons (B.R. 98

Q : "At which energies this channel starts to give an important contribution ?" A : With 100 TeV protons, which was the maximum primary energy we could set in Geant4, the contribution from gammas to the muon flux was still very low, of the order of what is plotted in fig.1-for 10 TeV protons.

Q : "Could the author define what if reported on vertical axes (N/Ntot) ?" A : The caption may indeed not be clear. This is in fact very simple : we simply normalised the histograms to the total number of entries, because the number of events simulated in Geant4 and CORSIKA were not the same.

Q : "Why not use a more familiar flux ? (particles $cm^{-2}$ $s^{-1}$ $sr^{-1}$ $GeV^{-1}$)" A : Because it would then have been more difficult to normalize the data from Geant4 and CORSIKA

in order to be able to compare them. Especially the "per second" part, since the initial cosmic ray flux does not have any time scale associated with it for the moment in Geant4.

Remark on figure 4 : "It hides a mistake in the analysis" A : If there is one we unfortunately could not find it. Furthermore the agreement with radial distributions and energy spectra is quite confusing. Time and position are treated in an identical way in our analysis, so if there is a mistake with time distributions, there must be one with position, which wouldn't be revealed in the plots then.

---

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 2, 563, 2012.