



Interactive comment on “Experimental study of source of background noise in muon radiography using emulsion film detectors” by R. Nishiyama et al.

Anonymous Referee #1

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General Comments

The paper addresses a novel concept for a detector to be used in muon radiography. The paper has some flaws (see further comments below) but the science seems sound and the measurement results agree very well with simulations performed by the authors themselves. References are made to other works which help clarify some of the points raised. While recommending its publication I think that a revision of the paper is needed. Below are my comments and issues I think should be addressed.

The authors state that they want to study background noise which presumably derives

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from physical sources (i.e. low energy electrons). Yet the apparatus described is not really suited to this purpose since it lacks any kind of meaningful particle identification capability. This fact is recognised by the authors themselves when in the last paragraph they mention the fact that they lack a calorimeter for electromagnetic showers. Thus one is left with a paper which in reality describes an improvement (significant) to a standard apparatus used for muon radiography. Within this scope the paper manages to give a relevant contribution to this budding field of applied physics, and the agreement between data and simulations found by the authors is impressive, showing that the authors hypothesis on particle backgrounds has some foundation. I would thus change the title of the paper to reflect the focus on detector improvement and suggest that the authors further develop this aspect in their conclusions, covering feasibility of large area detectors and deployability in the field.

Another issue concerns the English used in the paper. While in general the text is readable and understandable it would certainly benefit from a revision by a native english speaker. Expressions used throughout the text are often incorrect and sentence construction belies very little confidence with the language used.

Paragraph Comments

Introduction (1) As stated earlier, it would benefit from a brief overview of what type of detectors have been used so far in this application. Also it's not clear why the authors suppose straight away that backgrounds to muon radiography are due only to low momenta particles. Could they also be due to high momentum muons coming from behind (scattered on the ground surface) ?

Section 2.2 The comment "Unfortunately there are no sufficient experimental data for the angular dependence of the energy spectrum" referring to the electron component, belies the fact that these are electromagnetic residues from calorimetric showers (the atmosphere being the calorimeter) with an energy of 100 MeV. So what do the authors imply ? Do they expect significant variations with energy ? Do they expect significant

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deviations from the angular distribution of atmospheric muons ? How would this impact their study ?

Section 2.3 The fact that muons can deviate substantially while travelling through rock is certainly true. The problem with this section though is that this type of behaviour is not “noise” in the sense the authors intend. These are “corrupt muon signals” which can only be estimated from simulations which are then used during data analysis to correct for this effect. The authors seem a little optimistic about the removal of this kind of events, in fact even high energy muons (above 2 GeV) have a significant scattering probability even for angles as high as 100 mrad. A clarification concerning this matter would make this paragraph more understandable in the context of the paper itself. In fact, are they making a claim that the ECC detector can remove this kind of events in a significant and efficient manner ?

Section 3.2 It is true that one can measure on an event by event basis the momentum of the particle from the measured deflection angles in the detector. This is really applicable though only for very low energy muons and not low energy electrons which suffer Bremsstrahlung. Thus a clarifying statement should be made to how the authors intend to use this information and whether this affects also the electrons traversing the detector.

Section 5.2.1 The first sentence is incomprehensible. I surmise that the authors cut away events with tracks having grain densities higher than a certain threshold. If this interpretation is correct, the text should be modified accordingly.

Section 5.2.3 It would be interesting to know whether any requirement is made for the ECC detector on possible hits in the first and last layers (i.e. whether a track must be seen “going out” of the detector or not.

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 3, 649, 2013.

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