

Interactive comment on “Possible application of a compact electronics for multilayer muon high-speed radiography to volcanic cones” by H. K. M. Tanaka and I. Yokoyama

Anonymous Referee #1

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General comments: " The article 'Development of a compact electronics for multilayer muon high-speed radiography and its possible application to parasitic cones of Usu volcano, Hokkaido' is divided into two parts, the first being more technical since it is devoted to the presentation of a readout system, the second presents a possible application programme on a given volcano. As a general comment I would say that the technical description of the readout system is not enough motivated in terms of technical limits of the present system. The added-value of the present system (MURG12) is not clear at all in the spectrum of the high energy physics (HEP) readout systems. The number of channels to be readout (196) is not so high, the splitting of the readout modules quite simple (x-y hodoscope), the number of channels per plane limited (11 to 14

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per direction), the data rate relatively low wrt the HEP standards. The figure of merit of the present system should be emphasized throughout the paper by quantitative statements rather than qualitative statements such as 'the system should be faster', 'the performance should be better' etc. In particular it seems that the present paper gives a comparison between an old muon radiography performed in 2007 and a MURG08 readout system, ie the previous version of the MURG12. This should be clarified in the paper by the authors and the performance of all systems should be quantified in terms of data transfer, charge readout resolution, power consumption, memory and cpu load, expected limits of the system etc. The proposed system uses standard elements both in the analogic and in the digital stages (SiTCP, FPGA, CPU, network). Throughout the paper the terms 'operation failure' is used without definition and/or examples. Does the system suffer from data transfer limits, cpu overload or ?

Obvious statements may be avoided in a high level scientific paper. It is evident that increasing the number of PSD will help defining straight lines and will further reduce BG contamination either by random hits or by correlated or uncorrelated cosmic showers. Also obvious that the reduction of BG level will result in a global reduction of the exposure time. All parameters involved: acceptance, angular resolution, detection surface, exposure time, foreseen density measurement accuracy etc should be discussed accurately in the paper. 'To resolve the internal structure of the edifice' is also a vague statement. What is the level of accuracy required to quote that the structure is resolved.

A discussion may be useful on the various cuts used to define a muon track (single hit, x-y coincidence, straight line within 200mrad cone). Are these criteria validated on Monte-Carlo simulations and experimental data? Since the system freezes the data taking conditions it is mandatory to evaluate the performance of the different triggering levels. Those parameters are more interesting than the number of LEMO connections available in the system.

The general features of the muon tomography (BTW radiography rather than tomography) may be avoided since they are well known (cosmic muons properties, muons

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absorption in the rock etc). In the technical parts of the paper, please focus on the technical aspects of the muon detection. Concerning the second part of the paper, observation of Usu volcano, it should be stressed what kind of improvement is expected with the use of the new system (exposure time, resolution, detection surface etc). The presentation of the physics case must be outlined in terms of potential reach. "

Specific comments on technical part: °) Abstract: - definition of operation failure? - reference of MURG08 not evident? - evident conclusion: faster=better. - comparison 600 kbps/ch (MURG12) vs (MURG08)? - detection ability improvement: resolution? acceptance? BG reduction? °) Introduction: - muon radiography features not required - p4,13: better spatial resolution than seismic tomography: to be defined - p4,112: already stated - p4,120: obvious: more PSD=more points=better line=BG reduction - p5,12: obvious: lower BG=shorter time - p5,118: definition of structure resolution, what means 'to resolve internal structure'? - p5,20: quantify 'faster' - p6,9: operation failures meaning? °) Observation system: - p6,17: critical data transfer value? - p7,11: configuration discussion: are 11 boards required? constraints on the power consumption? survey of existing ASICs for the same functions? - p8,13: 14 planes, 196 scintillators: drastic constraints? to be discussed. - p8,18: one hit events only, what about delta rays or accompanying gammas? - p9,1: zero suppression? - p9,8: DAQ PC=external memory device? - p9,17: LEMO connectors interesting? °) Test measurement with multi-PSD system - MURG08 used, not MURG12, why not wait the use of MURG12? - p12,6: comparison not clear, between 2007 and MURG08 and MURG12?

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