4) Reply to Referee 4

General comments
The topic is of great interest, the idea is clever and should be pursued, and this paper will stimulate valuable discussion. However, while the concept is described well, the paper does not seriously address several significant problems with the proposed experiment. This paper is an excellent starting point, and no doubt these issues will be worked out with continuing peer-community discussion, and growing pressure to address explicit, practical plans in more detail as possible mars mission planning proceeds. The paper should certainly be published and authors may want to address specific comments below before finalizing

We would like to thank the referee for his detailed reading and for support of publication.

Specific comments

The earth-based experiment doing muon tomography in a volcano, used as a model (several references by Tanaka et al, in particular GEOPHYSICAL RESEARCH LET-TERS, VOL. 36, L01304), employed 48 scintillator bars and photomultiplier tubes. The latter paper certainly demonstrate the kind of results that can be obtained, but it does not mention exposure time or statistics, and no statistical errors are shown on plots, so these facts cannot be deduced. However the statement that a practical muon detector could have power consumption as low as 2 3 watts is quite impossible, unless the authors are referring to just one of the scintillator-PMT bars used in the volcano experiment. Even the FPGA processor chip required as part of the data acquisition system would consume this much or more power. The detector sketched in the mars rover figure could be about the same size as the volcano experiment (about 1.5m square) but would have mass 160 kg which would be impractical as part of a planetary payload. Any Mars detector would have to be MUCH smaller and would thus require (given the reduced muon flux due to the thin Martian atmosphere, and the various hadronic back-grounds mentioned in the paper), much longer data collection time. So I would suggest the authors consider a scheme whereby the rover would drop off small autonomous detectors, with their own solar panels, which could be left in place long-term to collect adequate statistics. These could perhaps communicate data with the rover via cellphone-type radio links.

The referee's surprise is justified with regards to the claimed power requirements. Even a simple NIM bin in any tabletop test will use more than 1 watt. But as our co-author has pointed out if careful attention is given to the setup, readout and triggering very low power levels can be obtained. In 2009 Tanaka constructed a complete muon telescope system for remote applications which consumed only ~ 55 watts [Uchida (2009)] then confirmed that using a new low-power Cockcroft-Walton circuit the power could be reduced to ~8 watts [Taira (2010)] finally in 2012 a complete and portable muon telescope, ~ 1m^2, was developed that was battery powered consuming less than 3 watts [Tanaka (2012)].

References below have been have been added in the section concerning low power consumption.

T. Uchida, H. K. M. Tanaka, and M. Tanaka, Space Saving and Power Efficient Readout System for Cosmic-Ray Muon Radiography, IEEE Transactions on Nuclear Science, Vol. 56, No.2, pp. 448-452, Apr., 2009.

H. Taira and H.K.M. Tanaka , A potential space- and power –effective muon sensor module for imaging a volcano, Earth Planets Space, 62, 179-186 (2010)

H.K.M. Tanaka, Volume slicing with mulit-directional muon radiography, International Workshop on "Muon and Neutrino Radiography, April 17-20, 2012