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Methods and tools for transmission muography

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We present methods and software tools developed for analyzing transmission muography images. In transmission muography one counts the number of atmospheric muons (μ) crossing a $\sim$1 m^2 detection area over a given time. Large structure(s) surrounding the detector cast a shadow in the μ count, e.g. buildings, mountains. The intensity of this shadow is informative on the shader's topology, on its density and to a lesser extent on its composition. Extracting any of this information from the μ rate is an inverse problem.

First, we present a dedicated μ transport engine, PUMAS, allowing to accurately address the forward problem by taking μ scattering into account. This was made affordable, CPU-wise, thanks to a backward Monte Carlo technique. Second, the thicker and denser the shader, the lower the statistics of μ in the shadow area, limiting the quality of the inverted images. We present a dedicated kernel based inversion algorithm, MAKI, allowing to control statistical fluctuations by varying the resolution over an image depending on the expected μ rate.

Both methods are illustrated with synthetic muography studies of some notable volcanoes, already investigated or foreseen as future targets.