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Fluctuation of TeV to EeV Energy Muons and the induced muon showers in Water

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By using the integral methods in the muon propagation through water, we calculate the range fluctuation of high and ultra high energy muons. Many authors divide all radiative processes into two part, namely, the continuous part and stochastic part in their Monte Carlo simulation in order to consider the fluctuation in the both range and energies of the muons, while we treat all radiative processes as exactly as possible, without the introduction of the continuous parts in all radiative processes. The validity of our Monte Carlo method is checked by the corresponding analytical method which is methodologically independent on the Monte Carlo procedure.
Accompanied electromagnetic showers are generated by the direct electron pair production, bremsstrahlung and photo-nuclear interaction. These showers are calculated by the exact Monte Carlo Method in one dimensional way.
We report survival probabilities, their differential energy distributions, range distributions and examples of individual muon behavior.

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P

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