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Monte Carlo simulation of ultrahigh energy cosmic ray detection with a space telescope

The experimental technique of fluorescence light measurement is used for indirect observations of ultrahigh energy cosmic rays. The aim is to reconstruct the shower cascade curve and estimate the primary particle energy and its arrival direction. For this purpose, the development of extensive air showers, initiated by different primary particles entering the Earth's atmosphere with extreme energies up to 10ˆ20 eV, is performed with the help of a detailed Monte Carlo simulation program. Using the fluorescence light yield according to its non-linear dependence on atmospheric conditions, especially on pressure and temperature, we have converted the deposit energy in air into UV fluorescence emission between 300-430 nm. The fluorescence spectrum must be calculated accurately because atmospheric attenuation has non-linear wavelength dependence and uncertainty in the fluorescence spectrum could lead to a large error in the calculated signal detected. Finally, we propagate the produced photons to an ideal space telescope onboard the International Space Station. Our results indicate that the simulated fluorescence signal is a promising observable leading to the discrimination between photons and hadronic primary cosmic rays.

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