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Detection of primary photons in high energy cosmic rays using Cherenkov imaging and surface detectors

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Given that two important experiments to study γ rays are, the Large High Altitude Air Shower Observatory (LHAASO) and the Cherenkov Telescope Array (CTA), are currently in the planning phase we analyzed some simulations made by the Cosmic Ray Simulations for KASCADE (CORSIKA) to compare Extensive Air Showers (EAS) induced by protons to EAS by photons having simulated power law dN/dE=cE-2 and energy in the range [1GeV; 1TeV]. Our concentration was focused on EAS to study differences between photons and protons showers. For this reason, first of all, arbitrarily choosing two primary particles energies, E=150GeV and E=1TeV, it was plotted secondary particles distribution at observation level (setted on 4300m asl); by plots we can observe that secondary particles of gamma rays showers are arranged on surfaces centered in EAS core smaller than particles of proton showers. To confirm what showed by these distributions, it was calculated particles density in circular crowns centered in EAS core up to 10Km from it, showing that increasing the distance from the core, the density decreasing of secondary particles produced by gamma rays showers is faster than for secondary particles produced by proton showers. Moreover, arbitrarily choosing 3 distances from the core, 10m, 100m, 600m, secondary particles density was calculated, showing that for fixed distances, increasing primary particles energy, secondary particles density increases too and also showing that, at higher distances from the core, secondary particles density is higher in proton showers than in photon showers. Lastly, we observed the difference between a number of secondaries e± and μ± produced by photon and proton showers; by plots, it's clear that e± / μ± is higher in photon showers than in proton ones because in proton showers we have higher μ± production than in photon showers. Obtained results are important because they allow us to test theories at the basis of LHAASO and CTA realization, that is thanks to algorithms based on differences between lateral developments of showers in atmosphere, lateral distribution at observation level about charged and neutral particles around the shower core, number about e± and μ±, it will be possible to discern gamma rays from proton showers, to acquire the signal and to reject hadronic background. Finally, comparing experimental data to obtained values of studied physical quantities as a function of primary particles energies, it will be possible to estimate the latter.

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