GAMMA-HADRON SEPARATION BASED ON ČERENKOV PHOTON ARRIVAL TIME STUDIES

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Atmospheric Čerenkov technique largely depends on the ability of the experiment to detect and discriminate the Čerenkov light produced by gamma rays from astronomical objects in the presence of an abundant background due to cosmic rays. Here we have carried out systematic Monte Carlo simulation studies of the timing information of Čerenkov photons produced by VHE gamma rays and hadronic primaries. We have investigated several measurable parameters such as radius of the shower front, pulse shape parameters (rise time, decay time and FWHM) and arrival time jitter of Čerenkov photons. The efficiency of these parameters to discriminate between gamma ray and hadronic showers has been studied in terms of quality factor. This study has been carried out for vertical as well as inclined showers and for various altitudes of observation. Among the parameters considered here, Čerenkov pulse decay time and relative arrival time jitter of Čerenkov photons are found to be particularly useful. Decay times of pulses from hadron generated showers are in general longer and hence yield a quality factor of $\sim$ 1.3 - 1.6, resulting in a rejection of $\sim$ 88% - 93% of hadronic showers, over the primary energy range of 250 GeV - 1 TeV. Similarly, hadronic showers exhibit a larger jitter yielding a quality factor of $\sim$ 2, resulting in a rejection of $\sim$ 94.4% - 98.8% of hadronic showers. Better discrimination with decay time is possible if we choose detectors only within the hump region. This result holds for inclined showers as well as different observation levels. Radius of the shower front on the other hand, has limited use in rejecting protonic showers. It however, provides good rejection efficiency for heavy primaries, *e.g.*, for iron nuclei the quality factor of $\sim$ 2 is attainable, resulting in the rejection of $\sim$ 83% of iron showers.