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Lowering the HAWC threshold to search for GRB Signals

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GRBs are gigantic extragalactic explosions, known to release 10^{51}-10^{54} ergs of isotropic energy, which outshine all radiation in the sky when they occur. GRBs are thought to arise in dissipation processes in which the energy of the relativistic jet is converted into non-thermal radiation. GRBs are unpredictable events both in time and place and one needs to search for them continuously with monitoring observatories. The Fermi satellite detector have discovered/studied several thousand GRBs with the Fermi Gamma-ray Burst Monitor in the keV-MeV range and with the Fermi-LAT detector at MeV-GeV energies. Recently, H.E.S.S., MAGIC and LHAASO have discovered hundred GeV to TeV emission during the afterglow phase of GRB180720B, GRB190829A, GRB190114C and GRB 221009A. GRBs are thus strong emitters of γ-rays also up to TeV energies, produced by the interactions of cosmic rays (CRs), ultra-relativistic particles accelerated in the extreme environments of these sources, with ambient radiation fields and gas. Radiation above several TeV is attenuated during its travel from extragalactic sources to the Earth. γ-rays with energies between several hundred GeV and several TeV are therefore the highest energy band of the electromagnetic spectrum to be detectable from these extragalactic sources and yield unique information on the mechanisms which power GRBs and accelerate particles up to the highest energies. At TeV energies the HAWC experiment, which continuously surveys 2/3 of the sky every day, is among the most sensitive γ-ray survey instruments in the world to observe their prompt phase thanks to the lack of observational delays.

A significant improvement in the HAWC sub-TeV sensitivity has been recently achieved thanks to the introduction of novel custom particle recognition (gamma/hadron discrimination) and reconstruction algorithms, included in the Pass5 release of HAWC analysis pipeline in 2023.

We will here introduce the possibility of further lowering the threshold of the PMTs in the water Cherenkov detectors by equipping the WCDs with a carpet of Resistive Plate Counters (RPCs). If testing is promising, we will perform the analysis of new and archival data in search for GRB signals including the lowered threshold energy.

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