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The Detector Design of the Southern Wide-Field Gamma-Ray Observatory

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The Southern Wide-Field Gamma-Ray Observatory (SWGO) observatory will use water Cherenkov detector (WCD) technology to construct a large-area, high-altitude observatory to measure the energy and arrival direction of gamma and cosmic rays. The proposed observatory will have a sensitive area of approximately 0.3 km2 with possible extensions to 1 km2 and be located at a high altitude (>4400m) between 10-degrees and 30-degrees south latitude. The high altitude of the observatory facilitates the detection and measurement of gamma and cosmic rays by placing the detector well into their extensive air shower (EAS) for energies down to several hundred GeV. The large detector area provides significant sensitivity to energies into the PeV range. The location in the southern hemisphere offers a view of sources in the southern sky, including the Galactic Center. WCDs can be operated during daylight, continuously monitoring the overhead sky, enabling coverage of a large fraction of the sky. The detector design also seeks to optimize gamma-hadron discrimination to distinguish the gamma-ray-induced EAS from those induced by the far more numerous cosmic rays. The reference design utilizes double-chamber WCD detector units. The larger volume of the WCD's upper compartment provides calorimetry and timing information for the electromagnetic component of the EAS. The lower compartment will be used for muon tagging to aid in the rejection of muon-rich hadronic showers. The array layout of the individual WCDs is optimized to provide the best performance at the lowest cost. Excellent sensitivity and gamma-hadron separation over a wide range of energies with good angular resolution will be achieved by varying detector unit spacing, with a dense inner core and an outer region populated at a lower density. This presentation will describe the research and development program for mechanical design, photosensors, readout electronics, and data-acquisition systems to produce the optimal detector for SWGO.

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