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HAWC upgrade with a sparse outrigger array

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The High Altitude Water Cherenkov (HAWC) high-energy gamma-ray observatory has recently been completed near the Sierra Negra in central Mexico. HAWC consists of 300 Water Cherenkov Detectors, each containing 200 tons of purified water and 4 PMT's (three 8"and one 10"), that cover a total surface area of 20,000 m^2. HAWC observes gamma rays in the 0.1–100 TeV range and has a sensitivity to TeV-scale gamma-ray sources an order of magnitude better than previous air-shower arrays. Its two steradians field-of-view and >90% duty cycle make HAWC an ideal instrument for surveying the high-energy sky.

HAWC collects multi-TeV gamma rays with an effective area of 10^5 m^2, but the performance of the reconstruction is not efficient for showers falling outside the array. An upgrade that increases the present fraction of well reconstructed multi-TeV showers by a factor of 3-4 can be done with a sparse outrigger array of small water Cherenkov detectors. It will help to pinpoint the core position and by that improve the angular resolution of the reconstructed showers. Such an outrigger array is of the order of ~300 small water Cherenkov detectors of 2.5 m^3 equipped with one 8"PMT, placed over an area four times larger than HAWC. In this contribution, we will give an overview of the outrigger array and present the results for the layout optimization using different tank and PMT options. We will also present the performance of the FADC electronics used on the outrigger readout.

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