Studies on HAWC Dark Matter and Outriggers

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ABSTRACT: The High Altitude Water Cherenkov Observatory (HAWC) is a high energy (500 GeV to 100 TeV) gamma ray detector located in southern Mexico. The detector consists of a 200x200 meter array of water tanks that detect cosmic-ray induced air showers via the Cherenkov light they produce in the water. The shower profile is then used to reconstruct the original gamma ray energy and direction. HAWC has been taking data almost continuously for two years and produced a catalog of sources (2HWC). No significant sources with dark matter annihilation were found, so we set all-sky limits on the dark matter annihilation cross section. In addition, the project involved work on the expansion of HAWC known as the outriggers. This will include a secondary array of water tanks surrounding the main detector with the goal of improving our sensitivity and event reconstruction at the highest energies. To demonstrate the effect of the outriggers, we produced an updated plot of HAWC's effective area vs energy based on simulations including the new tanks. We also wrote updated software to monitor the expanded experiment, in particular a series of scripts to remotely control and monitor the high voltage supplies connected to the tanks. The final goal of the project is to combine the data obtained with the outriggers with our dark matter analysis techniques to better constrain dark matter signals within the Milky Way galaxy.