Abstract: AMIGA (Auger Muons and Infill for Ground Array) constitutes one of the Pierre Auger Observatory final stages for the southern site; it consists of a dense array of Surface Detectors and Muon Counters with the clear objective of enlarging the detection range up to energies of $10^{17}$ eV. This increment in energy range will be accompanied with further information about the mass composition of cosmic rays. AMIGA data acquisition has started with the SD 750 m infilled area and preliminary analyzes have already been performed. On the other hand the first module of the first Muon Counter has been deployed with its electronics and is acquiring data too. Here we present preliminary results on both infilled SD region angular resolution and a first view of muons over the very first module.

1. AMIGA ON THE AUGER OBSERVATORY

![AMIGA map over the Pierre Auger Observatory site.](image1)

Figure 1: AMIGA map over the Pierre Auger Observatory site.

Fig 1 shows the AMIGA current disposition of water Cherenkov detectors (infill region) on the Pierre Auger Observatory site. Light and dark lines limit the $0^\circ - 30^\circ$ × $0^\circ - 30^\circ$, and $30^\circ - 60^\circ$ × $0^\circ - 30^\circ$ elevation and azimuthal field of view for the original 6 fluorescence telescopes and the HEAT 3 telescopes on Cerro Coihueco, respectively. The two hexagons limit the AMIGA areas of 5.9 and 23.5 km$^2$ with 433 and 760 m triangular grid detector spacings, respectively. Each dot within these hexagons represents a pair conformed of a water Cherenkov tank and a Muon Counter. The center dot is the Constanza pair placed about 6.0 km away from Cerro Coihueco. The transparent hexagon shows the current location of the unitary cell.

![Muon Counter and water Cherenkov tank disposition.](image2)

Figure 2: Muon Counter and water Cherenkov tank disposition.

Fig 2 shows the AMIGA detector pair layout. The four modules alongside the water Cherenkov tank (two 'short' 4.8 m long, and the other two 'long' of 8.8 m) conform the Muon Counter associated to it. Each counter has an area of 30 m$^2$ and is buried 2.25 m underground to avoid electromagnetic contamination from the shower.

2. MUON COUNTER DEPLOYMENT

In Fig 3 the first module buried at the Observatory site can be seen, the insert shows the electronics inside its enclosure. This is the first 5 m$^2$ module entirely built at the AMIGA laboratory located at the CAC, CNEA in Buenos Aires. The size is 4.8 m × 1.4 m × 0.01 m and is composed of 64 meters long scintillators strips, placed in two groups of 32 strips at both ends of the module. At the center there is a router plate which guides the optical fibers from each strip to an optical connector, connected vertically to the electronics system. A cylindrical electronic cover is attached vertically to the module in such a way that it is possible to access the electronics if required. Fig 4 shows the AMIGA 5 m$^2$ module, one of the four parts of the 30 m$^2$ Muon Counter in the well, just about to be buried. The module is placed over a sand bed with the service pipe that allow to access the electronics and change it if necessary.

![Crate with hanger holding the module about to placed it on the well.](image3)

Figure 3: Crate with hanger holding the module about to be placed on the well.

3. INFILL AND MUON COUNTER PRELIMINARY RESULTS

Preliminary tests were performed reconstructing events with and without the SDs from the infilled area in order to probe the main array reconstruction uncertainties. The plot showed here (Fig 5) is the space angle that comes from the comparison of the reconstruction of events from infill and using only main array detectors. This results in an upper limit for the angular resolution of 1.5 ($\theta < 10^{17}$ eV).

![Space angle calculated using the infill region.](image4)

Figure 4: AMIGA 5 m$^2$ module, part of the 30 m$^2$ Muon Counter in the well, just about to be buried. It is placed over a sand bed with the service pipe that allow to access the electronics and change it if necessary.

![Example of the digital signals acquired by the buried module.](image5)

Figure 5: Space angle calculated using the infill region.

Fig 6 shows an example of the digital signals acquired by the buried module, where each line correspond to the time (ns) of the corresponding signals from the 433 water Cherenkovs and 64 scintillators strips of the 5 m$^2$ module. The red dots indicate the trigger; for testing purposes an event is defined by a simultaneous signal in four or more scintillator strips.

![Example of the digital signals acquired by the buried module.](image6)

Figure 6: Example of the digital signals acquired by the buried module.

4. CONCLUSIONS

Half of the infilled array is deployed and acquiring data since August 2008. The reconstruction of these events can be done in the same way as for the regular Auger array with some changes due to the shorter spacing between the water Cherenkov detectors. We show the space angle of infill events that gives an upper limit for the angular resolution of the 750 m in array of 1.5° cutting at the 68% of events. Regarding the Muon Counters, the first fully equipped 5 m$^2$ module has been designed, built, tested and buried at the Observatory site. The first acquired data shows trains of pulses due, probably, to a muon that has triggered the electronics, going through the scintillator strip. Enhancements are well under way in order to study the transition region from galactic to extra galactic sources with SD, fluorescence, and muon detectors.

REFERENCES

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