Looking for long-range correlations among the EEE telescopes

This contribution focuses on the search of long-range correlations between Extensive Air Showers (EASs) exploiting the detection network of the Extreme Energy Events (EEE) Project.

Started in 2006 the EEE project is a network of about 60 particle tracking telescopes made by 3 wide area Multigap Resistive Plate Chambers (MRPCs), sensitive to the direction of incident charged cosmic particles. The telescopes are distributed over the whole Italian territory, thus making the EEE array an ideal tool for the detection of long-range time correlations between Extensive Air Showers.

The mechanisms which are able to explain the existence of correlations between individual cosmic ray showers at large distances are still not known, representing an interesting challenge in cosmic ray physics. Basically, they may be classified into two different classes: one implying the existence of two primary cosmics, originating from the same source and producing independent showers in the Earth's atmosphere; the other related to the possibility that a single primary interacts with the interstellar medium and/or the radiation field, thus producing two fragments which in turn produce the two showers. Numerical simulations suggest that these events are really rare and we cannot expect more than few events per year even with a large sparse array as the EEE network.

To date, no certain evidence of these mechanisms has been experimentally confirmed.

The main challenge in the search of long-range correlations between distant air showers is related to their rare occurrence, which makes them easily confused with spurious coincidences. As a consequence, different strategies have been adopted, aiming at selecting a pure sample of EAS events and thus reducing the huge amount of spurious coincidence events between telescopes. The strategy discussed in this contribution is based on the selection of multi-track events, which represent a small percentage of the total number of events collected by the telescopes. Applying several quality cuts, we observe an excess of about 20 events wrt to the background of accidental coincidences in a time window of 100 μs, resulting in a p-value of the order of 10^{-3}. The candidate events seem to be randomly distributed in terms of distance of sites involved and time of occurrence, and seem to be correlated in time but not in orientation.

In conclusion, the results discussed in this contribution suggest a promising hint of the first detection of time correlated EASs. The characteristics of the EEE array and its performance, together with the huge amount of data already available, allows to conclude that the EEE array is an ideal system to perform the search of rare long-range EAS coincidences.