The beginning of cosmic ray astronomy

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The Pierre Auger Observatory showed for first time that the highest energy cosmic rays are not isotropic. This sets the beginning of cosmic rays astronomy.



Traditional thinking is the charged cosmic rays are scattered by magnetic fields and do not point at their sources. The fact that the anisotropy exists shows us that cosmic ray astronomy is possible – and it will reveal lots of astrophysical information that is difficult to obtain in any other way. A good example is the GZK horizon of UHECR, which is shown below for *isotropical* source distribution. If the distribution is not isotropic, if sources are close to the supergalactic plane, the horizon definition changes.



A possible existence of extragalactic magnetic field will also decrease the GZK horizon We decided to study the correlation of the Auger events with the supergalactic plane – AGN have closer correlation with SGP than most galaxies. An early set of UHECRs (1995) showed some correlation at the 3σ level. The SGP is plotted below within 10° of supergalactic latitude. 9 (13) Auger events are within 10 (15) degrees of SGP.



Lahav et al (2000) made corrected definitions of SGP depending on the distance to us using ORS and IRAS data. We show below the new definition for distances upto 70 Mpc i.e. Z<0.017. The correlations strongly increased – 13 (15) events in the two bands. Other points show HiRes events and a small number of old events, weighted by the experimental exposure.





Chance coincidence probability for isotropic arrival directions for the two definitions of the supergalactic plane.

We have not contributed to the identification of the UHECR sources, nor to the definition of anisotropy. We have only confirmed the anisotropy discovered by the Pierre Auger observatory by a study of the correlation of UHECR with nearby large scale structure of the Universe. Eventually with the increasing statistics the sources will be identified but the current moment is the beginning of cosmic ray astronomy.

Questions ? Sergio ?