Study of atmospheric neutrinos with the MACRO detector

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Abstract

The MACRO Collaboration performed a systematic study of atmospheric muon neutrinos, using the data collected from 1989 to 2000. Three categories of neutrino induced events were studied: upward throughgoing muons, upgoing stopping muons and upgoing semicontained muons, all of them supporting evidence for muon neutrino oscillation with $\sin^2 2\theta \simeq 1$ and $\Delta m^2 = \mathrm{O}(10^{-3} eV^2)$. Moreover the shape of the upward throughgoing muon angular distribution shows that an oscillation mechanism $\nu_\mu \to \nu_\tau$ is preferred with respect to $\nu_\mu \to \nu_x$.

A new piece of information was provided by the upgoing muon energy estimate through multiple scattering. Such analysis, calibrated with two tests performed at CERN PS/SPS beams, allowed an event by event neutrino L/E reconstruction. Results in terms of neutrino oscillations are discussed.

References

[1] The MACRO Collaboration, Phys.Lett.**B434** (1998) 451

[2] The MACRO Collaboration, Phys. Lett. **B478** (2000) 5

[3] The MACRO Collaboration, hep-physics 0203018.