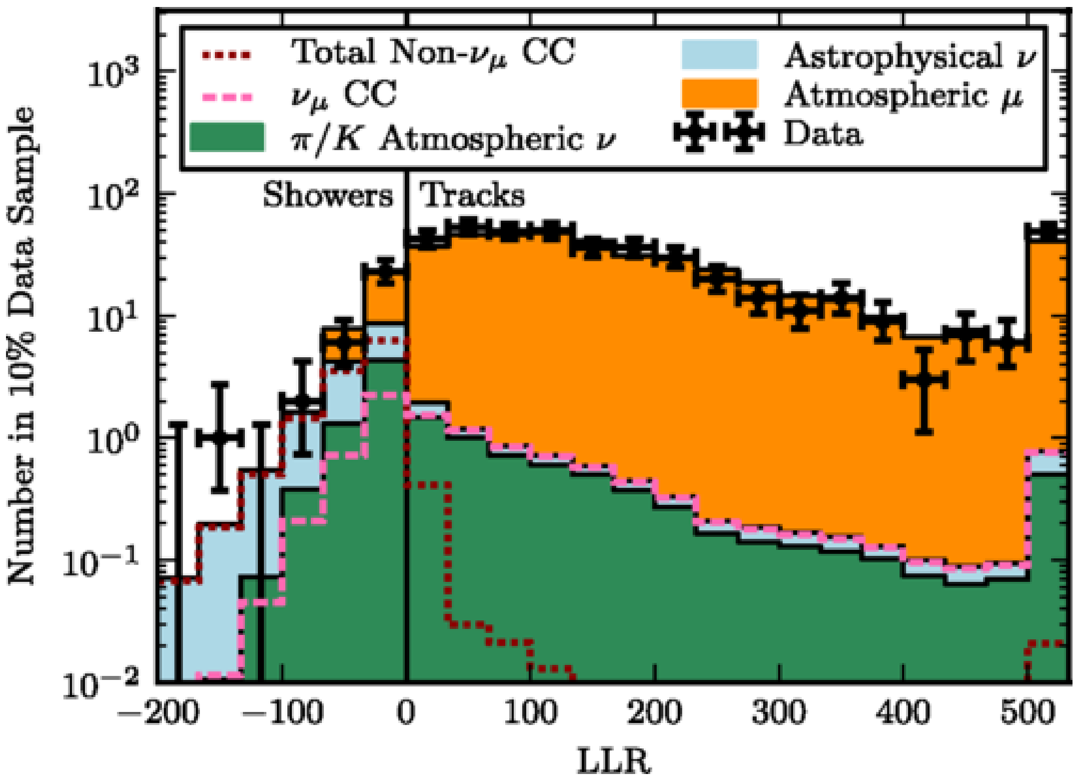
Two teams estimate the flavor of neutrinos detected by The IceCube Neutrino Observatory

April 30 2015, by Bob Yirka



The log-likelihood ratio between shower and track reconstructions for veto-passing events with more than 1500 photoelectrons. Error bars are 68% Feldman-Cousins intervals [51] and show upper limits for bins with no events. The solid-colored distributions are cumulative and result from the best-fit parameters of the distributions shown in Fig. 2. The contribution of muons is determined from a muon control sample. The dotted lines show the total contribution of $\nu\mu$ CC events (pink) and all non-$\nu\mu$ CC events (maroon) from the best-fit distributions of astrophysical and π/K neutrinos and are not cumulative with the solid-colored distributions. The last bin contains all overflow events with LLR>500. Credit:

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(Phys.org)—Two teams of researchers have now offered their findings regarding the estimates of the flavor of neutrinos that were detected by the The IceCube Neutrino Observatory (TINO) two years ago. The first group, a team at Gran Sasso Science Institute in L'Aquila found the ratio of tracks made by the neutrinos in the detector was consistent with existing models. The second group, made up of a very large team of collaborators on the IceCube project has published their findings in *Physical Review Letters.*

Scientists would really like to know more about neutrinos, and because of that have set up detectors in various locations around our planet. In this latest effort, the team working at TINO, which is located at the South Pole, identified a grand total of 137 high-energy (higher than 35 tera-electron-volts) neutrinos.

Neutrinos, scientists believe, are fundamental subatomic particles which make up everything in the universe. They are notoriously difficult to detect and study because they carry no electrical charge—they are created in a number of ways, such as via reactions in the sun and they come in three "flavors"—electron, muon and tau and each is associated with an antiparticle. To detect them, researchers set up special detection devices and then watch for "long tracks" or "showers." In this latest effort, scientists from both teams of researchers were attempting to discern which flavor the neutrinos were that were detected at the TINO, which also happened to mark the detection of the highest energy level neutrinos ever seen.

Both of the teams agree that the neutrinos are likely from a distant source, though neither can say with any certainty what that source might have been. The detector at TINO is not capable of revealing flavor but instead offers a ratio of the flavors detected. Initial study of the TINO data indicated there was no evidence of muon or tau neutrinos, which left only electron neutrinos, but that did not fit well with theories suggesting what scientists thought they should be. In this new effort both teams suggest that the ratio of tracks to showers is incompatible with 1:0:0 and 0:1:0 which suggests the initial results were not correct, though neither team is willing to guess which neutrinos were actually detected—both agree that the results do indeed fit with theory.

More information: Flavor Ratio of Astrophysical Neutrinos above 35 TeV in IceCube, *Phys. Rev. Lett.* 114, 171102 – Published 28 April 2015. dx.doi.org/10.1103/PhysRevLett.114.171102 . On *Arxiv*: arxiv.org/abs/1502.03376