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Search for Signatures of Extra-Terrestrial Neutrinos with a Multipole Analysis of the AMANDA-II Sky Map

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Abstract content

In this analysis 3329 neutrino events detected by AMANDA-II during the years 2000-2003 are analysed for anisotropies or unexpected structures in their arrival direction. The structures could arise due to the presence of a signal from many weak and therefore unresolved cosmic neutrino sources, extended sources or a few brighter sources.
For the first time a technique, well known from the analysis of the cosmic micro-wave background, is applied to AMANDA-II data. The sky-distribution of arrival directions (sky-map) is expanded in a series of spherical harmonics and the power in each multipole moment is calculated. The application of this technique is challenging because of small event statistics and a non-uniform acceptance of the detector. However, the analysis is a model-independent probe of unexpected deviations of the sky-map from the expectation for atmospheric neutrinos. Compared to previous AMANDA-II analyses, it provides a new complementary approach, in particular in the search for very weak individual astro-physical sources.
The experimentally measured angular power spectrum agrees well with the expectation for a sky-map of purely atmospheric neutrinos and no excess from extra-terrestrial sources is found. Statistical errors as well as systematic errors related to the uncertainty of the angular distribution of the atmospheric neutrinos are quantified using the Feldman-Cousins unified approach.
Limits for contributions from extra-terrestrial sources to the sky-map are derived as function of the average source strength and the spectral index of the energy spectrum for different sky-distributions: weak sources isotropically distributed in the northern sky, sources located in the galactic and super-galactic plane.
The tested average flux per source varies between phi = 5*10ˆ-13 cmˆ-2sˆ-1 and phi=5*10ˆ-11 cmˆ-2sˆ-1 at the earth, assuming an Eˆ-2 power spectrum in the sensitive energy range between 1.6 TeV and 1.6 PeV. The number of such sources in the sky can be limited at 90% C.L. to be less than 3000 for the weakest and less than 30 for the strongest case.

If this papers is presented for a collaboration, please specify the collaboration

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Summary

Reference

Proceedings of the 30th International Cosmic Ray Conference; Rogelio Caballero, Juan Carlos D'Olivo, Gustavo Medina-Tanco, Lukas Nellen, Federico A. Sánchez, José F. Valdés-Galicia (eds.);

Universidad Nacional Autónoma de México, Mexico City, Mexico, 2008; Vol. 5 (HE part 2), pages 1405-1408

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