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Neutrino properties, mass hierarchy, and CP-violation

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All what we know about neutrinos with high confidence fits well the three-neutrino paradigm: 3 massive and mixed neutrinos with interactions described by the Standard Model. The paradigm is challenged by possible existence of new neutrino species - sterile neutrinos and new ("non-standard") interactions.

The outstanding unknowns include the type of neutrino mass ordering (hierarchy) and value of the CP-violation phase. Possibilities to determine these unknowns using the astrophysical and atmospheric neutrinos will be considered.
It appears that studies of the atmospheric neutrinos with future large underice/water detectors, like PINGU and ORCA, have a good chance to determine the hierarchy first. The hierarchy can be established from analysis of the Galactic supernova neutrino bursts.

Although it is believed that the CP phase will be measured
using accelerator neutrinos, a possibility should be explored
to determine the phase with atmospheric neutrinos and
low, (0.5 - 1) GeV, energy threshold upgrades of PINGU and ORCA.

Collaboration

– not specified –

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