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Enhancing sensitivity in Hyper Kamiokande

Design of the geomagnetic field compensation system and machine learning techniques to improve sensitivity in Hyper Kamiokande

Abstract

Enhancing sensitivity in Hyper Kamiokande

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The Hyper-Kamiokande (HK) neutrino detector being built in Japan is expected to start operations at the beginning of 2026. To enhance sensitivity our group is working in two directions: the design of the Geomagnetic Field Compensation System (GFCS). The GFCS is based on two sets of coils, horizontal circular, and rectangular, wound around the cylindrical detector. The ML techniques have been successfully employed in simulations for the detection of tau-neutrinos [3]. There are still large challenges to be met before HK starts measuring:

The design of the GFCS must be checked with real measurements in the building site. The value of magnetic field is affected by the amount of steel used in the building and the exact position of the cables. The effect of rebar and sagging has already been simulated and shows no large changes. This task will provide the real value of the magnetic field and the further calibration and careful measurements in all PMTs will determine the exact values of currents needed in the cables.

The enormous amount of data produced in PMTs will have to be treated to detect particles, especially low energy particles. The first steps toward developing an algorithm to improve the low-energy trigger, below 10 MeV, particularly at energies below 5 MeV, are being taken, and further development is planned as the experiments begin to run

[1] S.R.Cabo et al, Eur. Phys. J.Plus 138 (2023) 903

[2] S.R.Cabo et al, Eur. Phys.J.Plus 140 (2025) 649

[3] S.L.Suárez and P.Fernández, Nu fact Proc. (2021)

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