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Neural Reconstruction of Muon Tracks in Baikal-GVD Using NTSim Simulations

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Muon reconstruction in the Baikal-GVD neutrino telescope requires inferring particle parameters from sparse, irregularly distributed optical signals. We investigate graph neural networks and transformer architectures for reconstructing muon direction and track position, using classical track fitting as a reference. Muon energy estimation is considered as an additional task.

Using Baikal-GVD events simulated with NTSim, we will compare reconstruction accuracy and computational efficiency under common evaluation conditions. The neural models will use detector geometry and the spatial and temporal structure of optical signals. We will also explore whether joint estimation of energy and track parameters improves reconstruction.

The comparison will examine how reconstruction errors depend on event characteristics and identify conditions in which the methods offer complementary strengths. This will help assess the trade-off between accuracy and computational cost when selecting reconstruction methods for Baikal-GVD.

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