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Noise suppression for Baikal-GVD using spectral properties of event graphs

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Baikal-GVD neutrino telescope is located in the Southern basin of Lake Baikal with the instrumented depth ranging from 730 to 1275 m. The measured noise rates of the detector channels range from ten to hundreds of kilohertz, depending on season and the depth of the installed photomultiplier. We present an evolution of the method currently employed for muon track event reconstruction in Baikal-GVD. Like in the previous approach, it represents events as graphs, with vertices corresponding to photomultiplier hits and edges corresponding to a causality condition imposed by the Cherenkov cone. However, instead of identifying the vertices of fully connected subgraphs with Cherenkov photons, we use the graph's spectral properties to identify noise hits and provide an initial estimate of the muon direction. This increases collection efficiency for delayed photons from cascades along the track which become dominant at higher energies. The proposed approach provides a 20% increase in Cherenkov hit collection efficiency for an astrophysical neutrino sample and a reduction in processing time, while maintaining a noise rejection rate comparable to that of the previous method.

Primary author(s) : AVRORIN, Alexander (INR RAS)

Presenter(s) : AVRORIN, Alexander (INR RAS)

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