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# Deep Learning for a Deep Detector: Neural Network Reconstruction at Hyper-Kamiokande

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The Hyper-Kamiokande detector represents the next generation of neutrino observatories, following in the lineage of the Kamiokande and Super-Kamiokande experiments. With significantly enhanced sensitivity, Hyper-Kamiokande will support a diverse and ambitious physics program, including searches for proton decay, studies of solar neutrinos under non-standard interactions, and the potential first observation of leptonic CP violation. Designed to contain 260 kilotons of water and equipped with 20,000 photomultiplier tubes of 20 inches, the scale and complexity of Hyper-Kamiokande necessitate the development of advanced event reconstruction algorithms in order to fully exploit the detector performance and achieve the measurements with higher precision.

In this presentation, we explore how next-generation approaches from the field of machine learning —specifically, Deep Neural Networks —can enhance reconstruction performances. Particular emphasis will be placed on the designs of Convolutional Neural Networks and their non-euclidian extension, Graph Neural Networks, which both already demonstrate excellent results on several benchmarks such as particle identification or momentum reconstruction. A section will be devoted to the performance gains obtained by the use of the Transformers architecture as the network backbone, surpassing the current maximum likelihood reconstruction algorithm adapted from Super-Kamiokande.

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