THE UNIVERSITY OF CHICAGO
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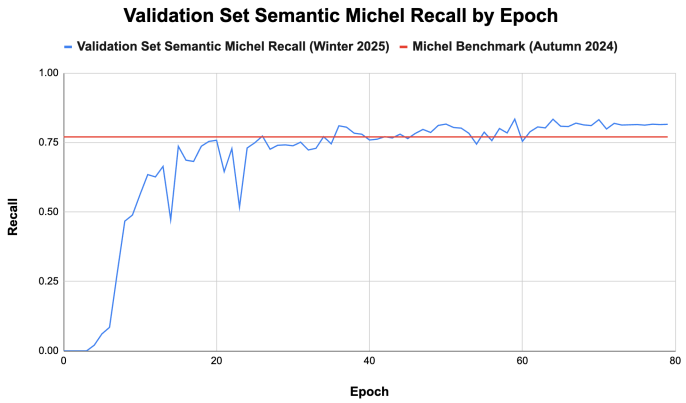
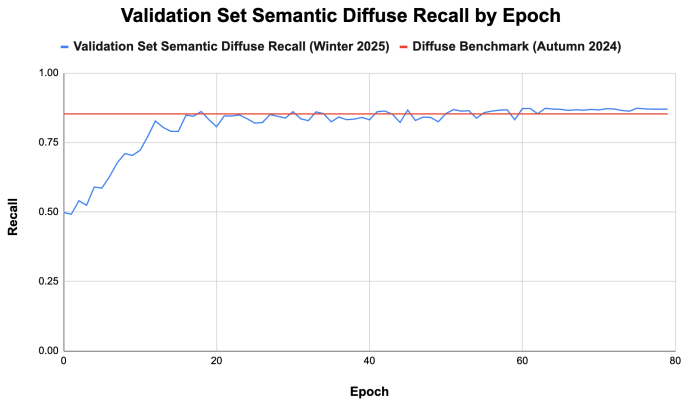
NuGraph3, a Fermilab Graph Neural Network, aims to identify signals from neutrino interactions with signal wires and classify hits by particle type. The team focused on exploring graph architectures to connect optical data with particle hit data and optimizing decoders for two challenging particle types: Michel and diffuse.

To address the latter, the team implemented specialized attention modules. The Michel module analyzed track endpoints through connectivity analysis, propagating this information to neighboring nodes with a residual architecture and trainable feature weighting. This improved Michel electron recall by 6% compared to the benchmark model. The diffuse module quantified local feature coherence through neighborhood statistics, reducing the misclassification of diffuse hits as showers by 12% in recall. As shown in the recall graphs, both particle types perform at or above benchmark levels with rapid convergence, confirming the effectiveness of these targeted improvements.





Additionally, the team began implementing connections between PMT (optical) and nexus (wire plane) data hierarchical levels, shown in the graph below. This required mapping PMT coordinates to enable message-passing between intermediate levels, not just at the event node. The development of these connections is ongoing and aims to better correlate spatial and temporal information across detector components.