

SKYNET vertex reconstruction

I L \wedge N C E



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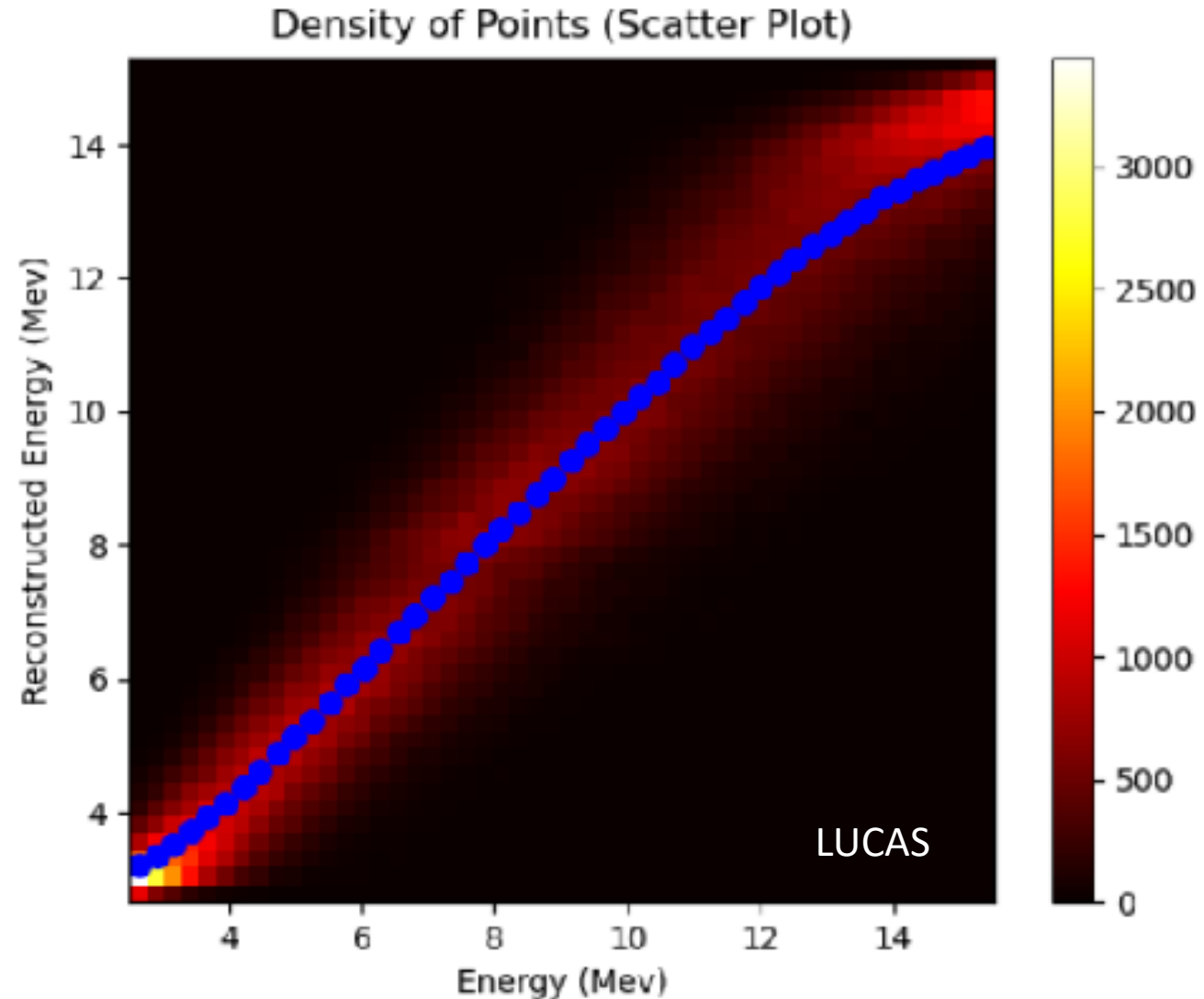
ILANCE, CNRS – University of Tokyo

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OVERVIEW OF SKYNET

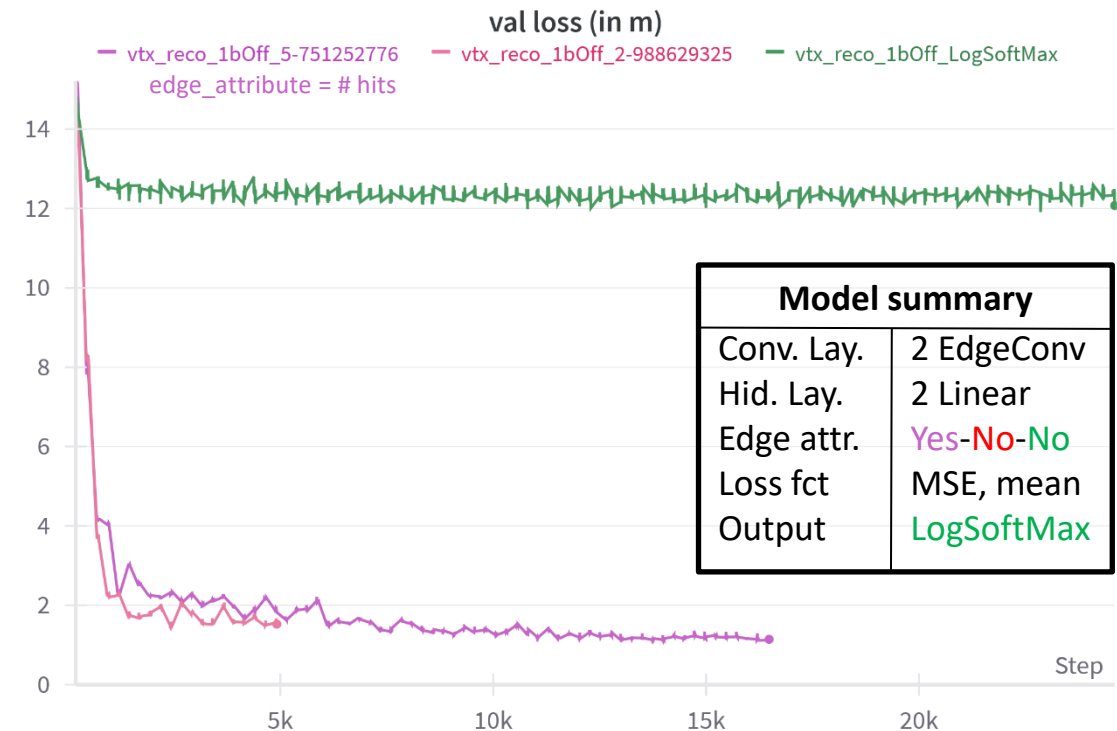
- Antoine = GNN for neutron tagging
- Lucas = GNN for electron energy reconstruction (low energy <20 MeV)
 - State of the work: left in a **apparently** working condition
 - Precision \sim 1-3 MeV
 - Not optimized yet
 - Investigated EdgeConv + Bayesian/Linear layers
- Enzo = GNN for electron interaction vertex reconstruction (low energy < MeV)
 - State of the work: left in **apparently** working condition
 - Precision \geq 10 m
 - Investigated EdgeConv + Bayesian/Linear layers

⇒ Enzo's version not good, reason advanced not convincing



DETAIL OF ENZO' SKYNET

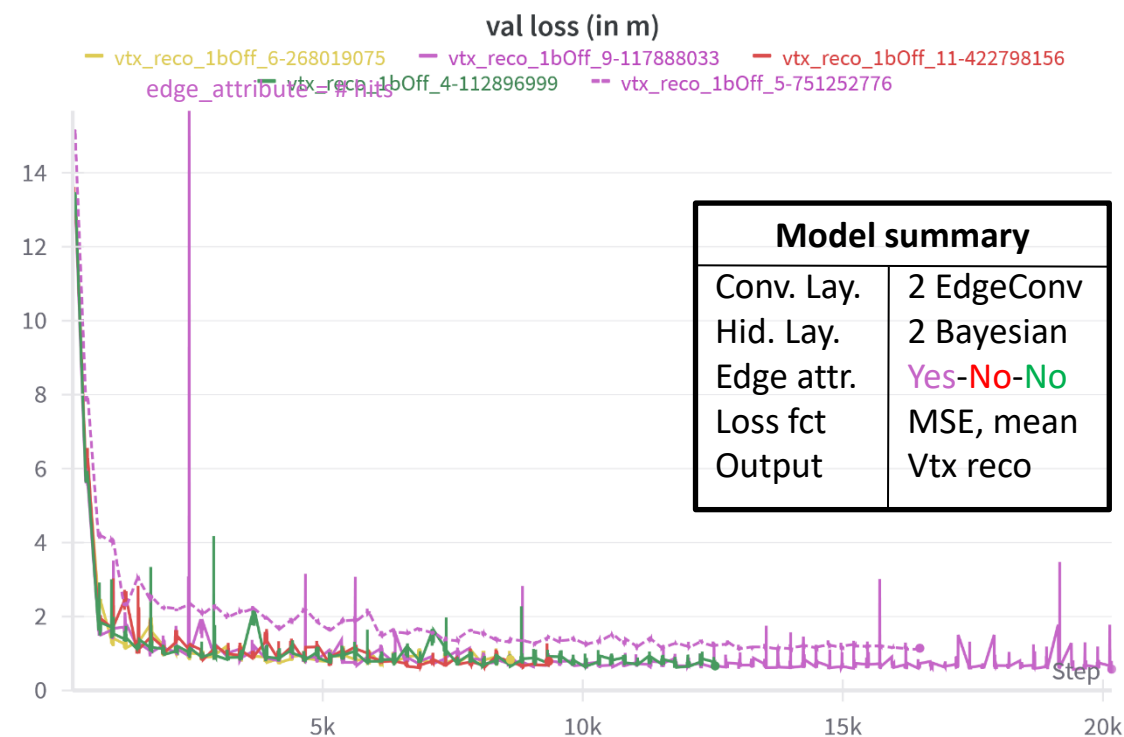
- Labels: true vertex, r_{true}
- Node features: PMT hits, time and/or ID
- Convolution layers: DynamicEdgeConv
- Hidden and final layers: Linear or Linar+2 Bayesian
- **Output: LogSoftMax(vtx_reco) if no Bayesian**
 - Poor reconstruction is **partly** due to the choice of LogSoftMax instead of regular vtx_reco
 - Not clear why this has been used, probably because this was done for the classification in Antoine's SKYNET
 - **Removing the LogSoftMax function improves results**
- Loss function: $(\text{mse_loss, reduction}=\text{«mean»})^{1/2}$
 - $\neq |r_{\text{true}} - r_{\text{reco}}|$



Note: to understand the behavior we use simulation of 10 MeV positron interaction in HK **without dark noise**

SKYNET-VERTEX EDITION

- Labels: true vertex, r_{true}
- Node features: PMT hits, time, coordinate
- Convolution layers: DynamicEdgeConv
- Hidden and final layers: Linear or Bayesian
- Output: vtx_reco
- Loss function: test different functions based on MSE, RMSE, MAE, LogSoftMax, 68% CL resolution
 - **Currently investigating** which one of them results in the best **68% CL resolution** as a metric ?



Note: to understand the behavior we use simulation of 10 MeV positron interaction in HK **without dark noise**

Note2: this is not the resolution ! Resolution is at least 2 higher

SKYNET-VERTEX EDITION

- Due to symmetry by revolution, we can remap any event to this square
- Can the GNN do better in reconstruction event in this limited 2D area ?
- Then add a step where the best vertex candidate is searched like in LEAF over two circular pathes

\Rightarrow Ivan is investigating the impact of this remapping until next week

