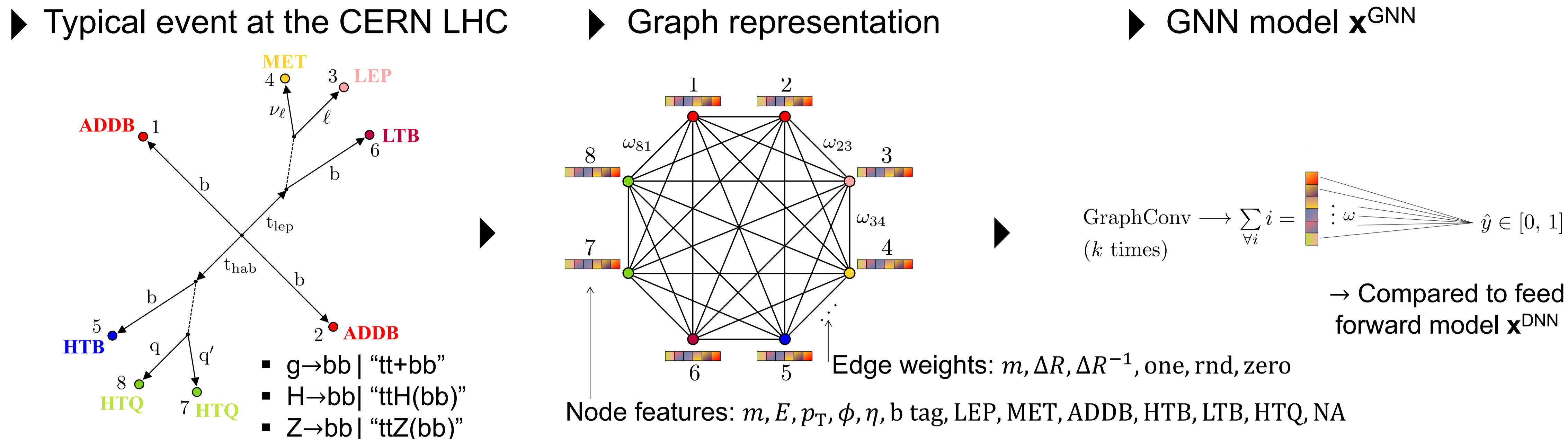


Graph neural networks on the test bench in HEP

PHYSTAT - Statistics & Machine Learning 2024 | Imperial College, London (UK)

Emanuel Pfeffer | emanuel.pfeffer@cern.ch

Sample and model design

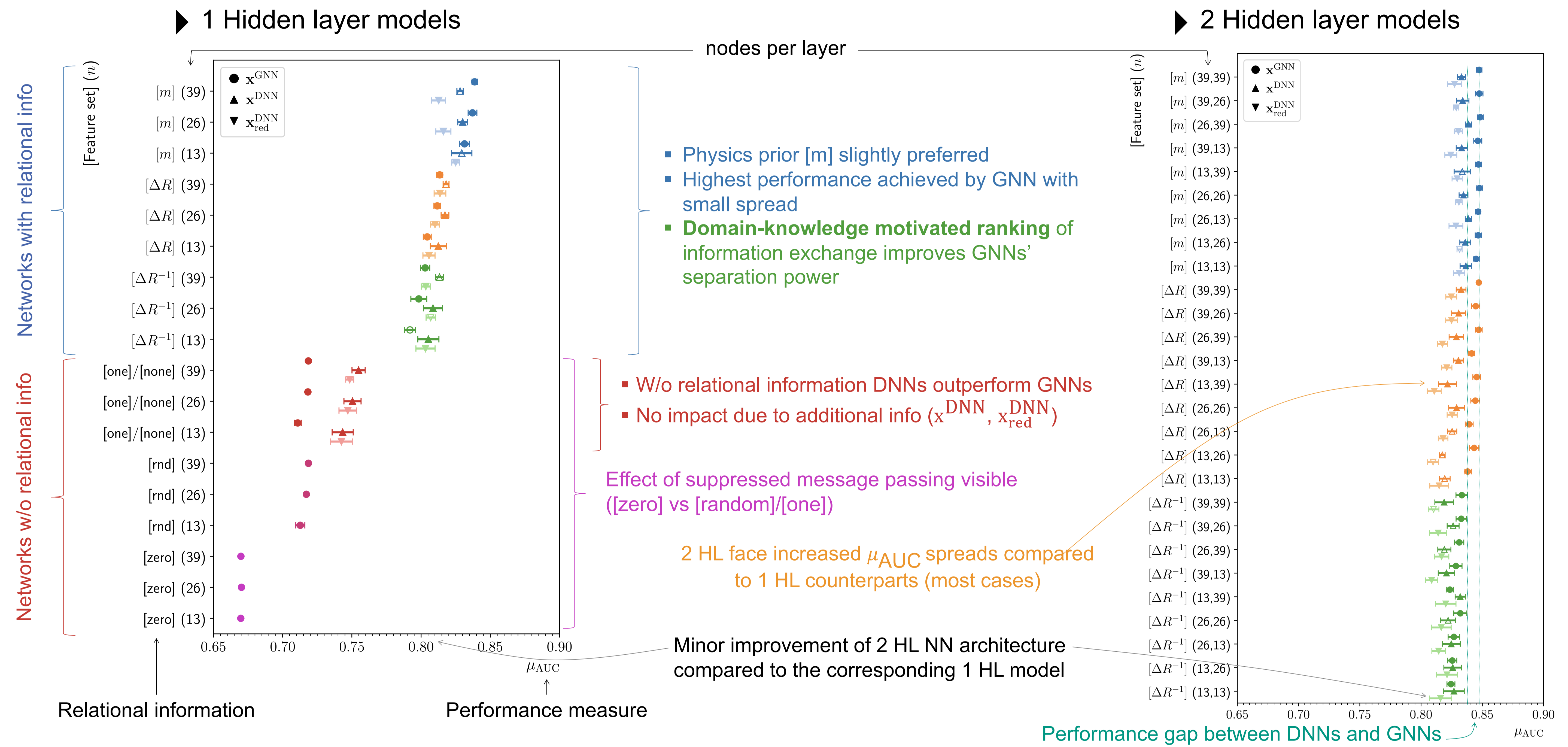


GNN vs. DNN comparison checklist

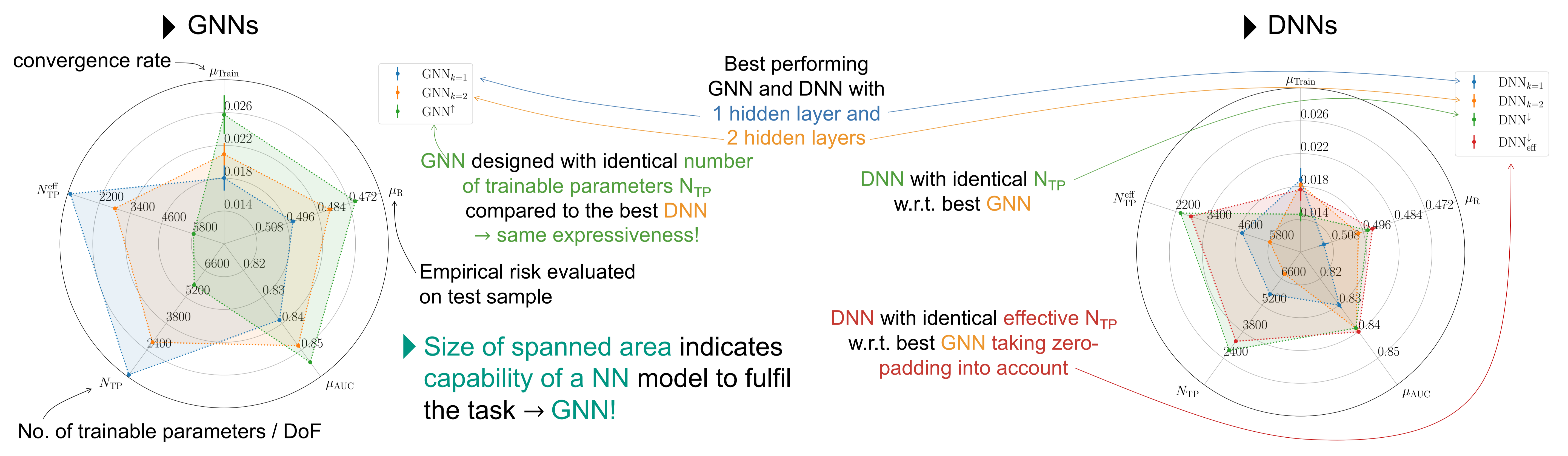
Impact of:

- no. of hidden layers
- node embeddings
- degrees of freedom
- relational information
- domain-knowledge

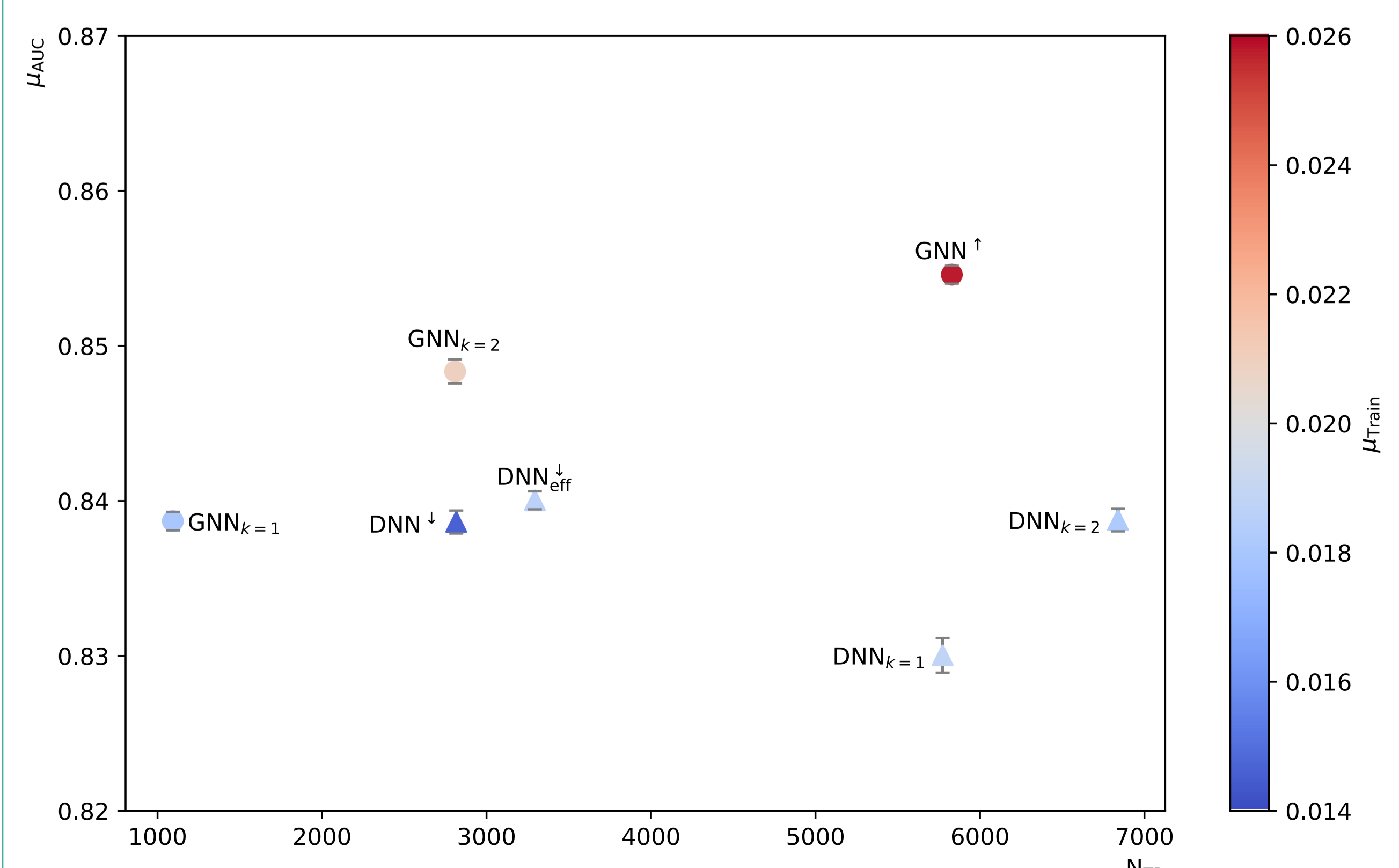
NN with similar layering of hidden nodes



NN with similar degrees of freedom



Results



Key findings | GNNs in this study:

- ✓ achieve higher performance μ_{AUC} under most conditions
- ✓ achieve better results with fewer trainable parameters N_{TP}
- ✓ converge faster
- ✓ benefit strongly from relational information and domain-knowledge

Key takeaway!

Advantage of GNN over DNN not from uncontrolled mixture in embedding space but from extra relational information between nodes based on domain-knowledge!