

Development of ML algorithms

- **Related Tasks:**

- T4.9. Development of a baseline DNN architecture based on Convolutional models [M1-12][RM1]
 - architecture developed and tested on old 4π geometry/setup, need to be tested on TB and new 4π geometries
- T4.10. Development of novel DNNs based on Graph NNs optimised for a realistic detector simulation [M13-21][RM1]
 - architecture developed and tested on old 4π geometry/setup, need to be tested on TB and new 4π geometries
- T4.11. Evolution of the Graph NNs with Bayesian structure in order to provide probabilistic assessment of the model predictions and implementation of the ability to identify single particle (photons, muons, electrons, charged pions) inside each cluster [M22-30][RM1]
 - BAYES-GNN architecture developed and tested on old 4π geometry/setup, need to be tested on TB and new 4π geometries
 - algorithm for particle-detection in cluster/jet under development, waiting for a new student to start thesis in the next months ...
- T4.12. Study of an optimised design of the DNN model developed for real-time applications (trigger, feature extractions) [M31-36][RM1]
 - implementation pipeline developed and tested for both low-latency (all in FPGA implementation) and high-throughput (FPGA accelerator boards implementation) conditions, need to be tailored and studied in the TB/ 4π HYDRA2 framework

- **Related Milestones:**

- M4.3. Baseline trained and optimised CNN model ready [M12]

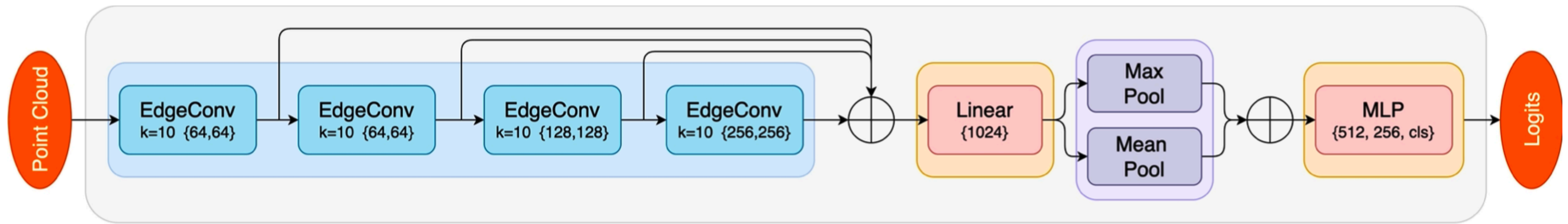
- done for old 4π geometry/setup, can be re-done quickly when new samples are available

- M4.4. Novel GNN demonstrator deployed [M21]

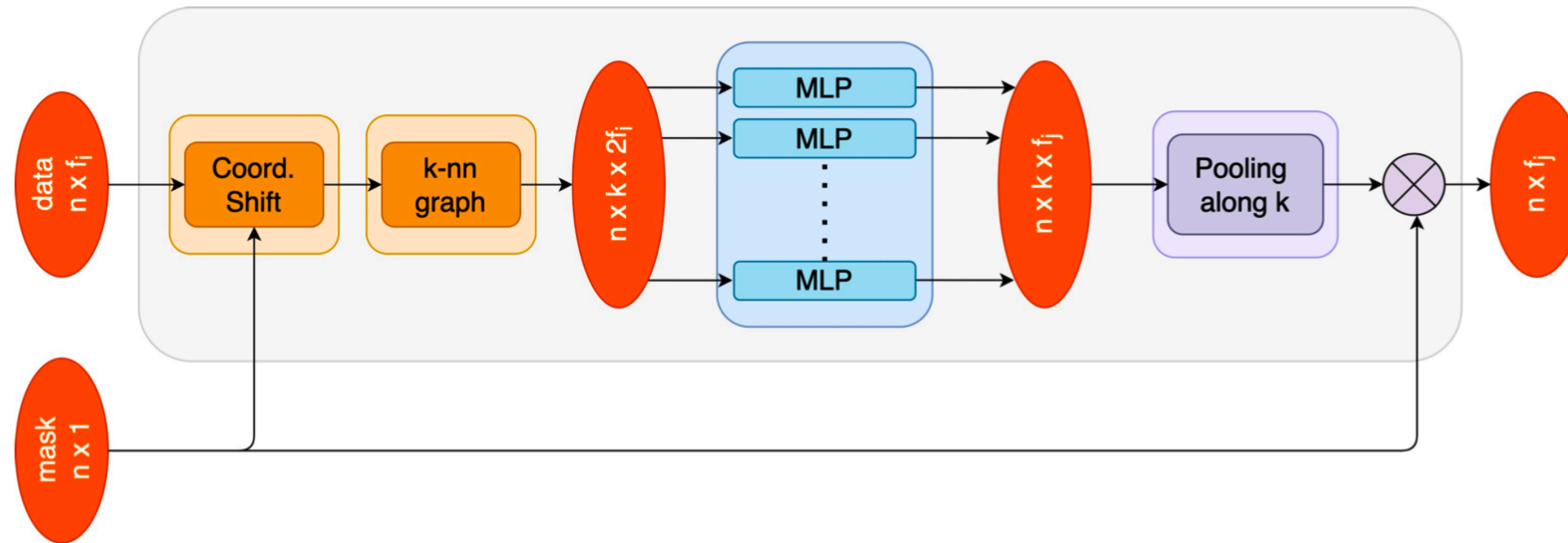
- done for old 4π geometry/setup, to be done when new samples are available
- Related Deliverables:

- D4.5. Baseline performance obtained with the best CNN model documented [M12]

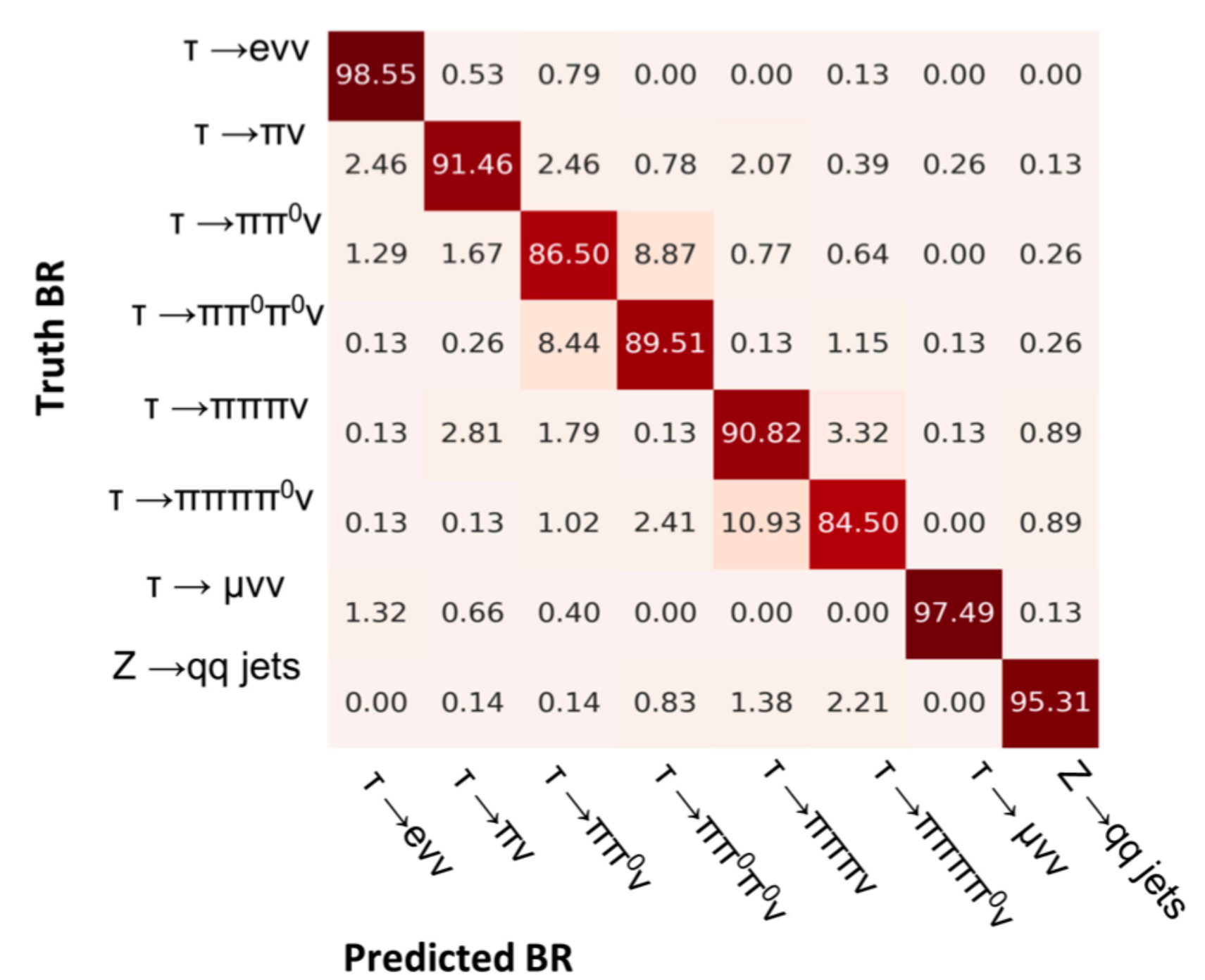
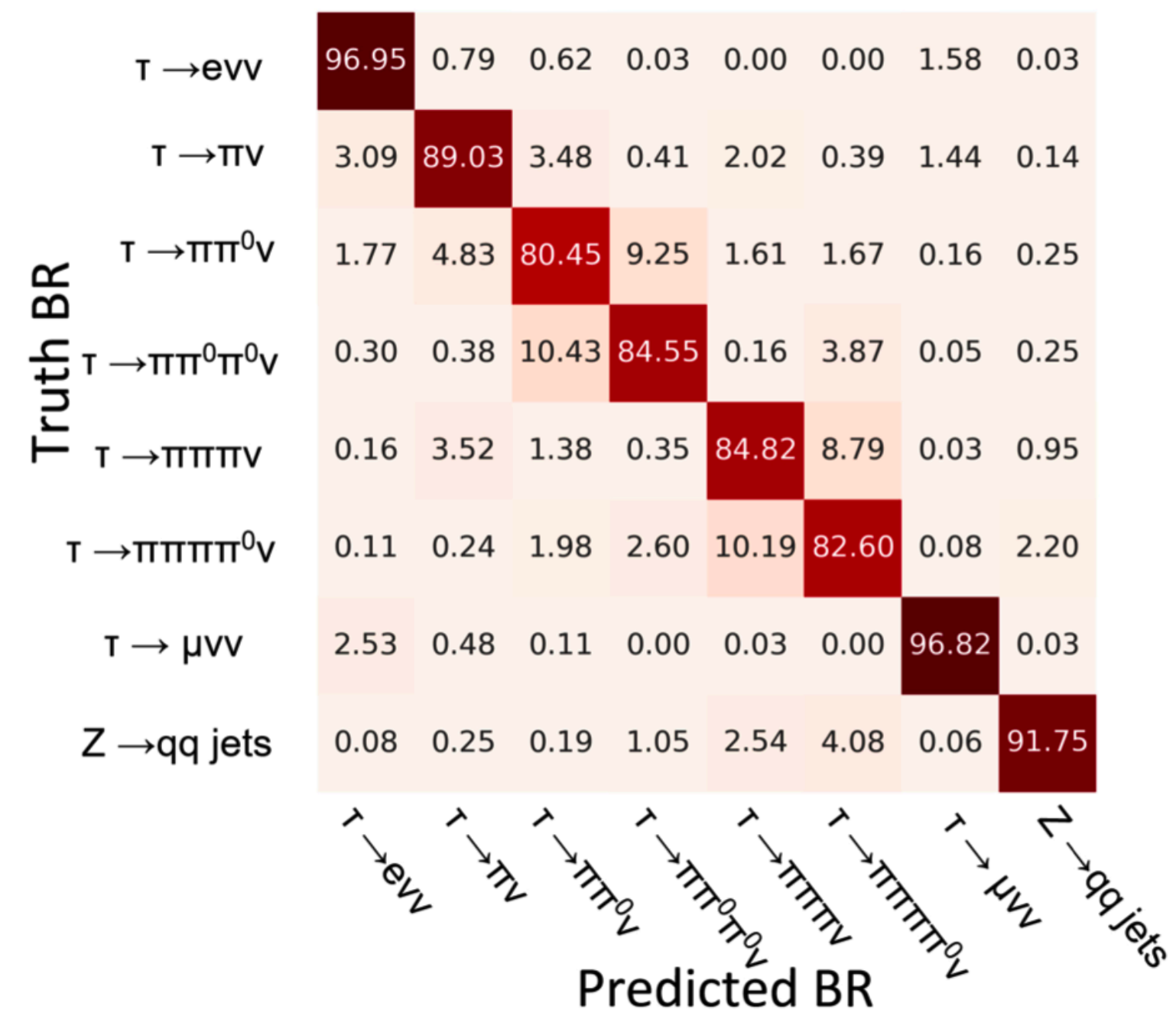
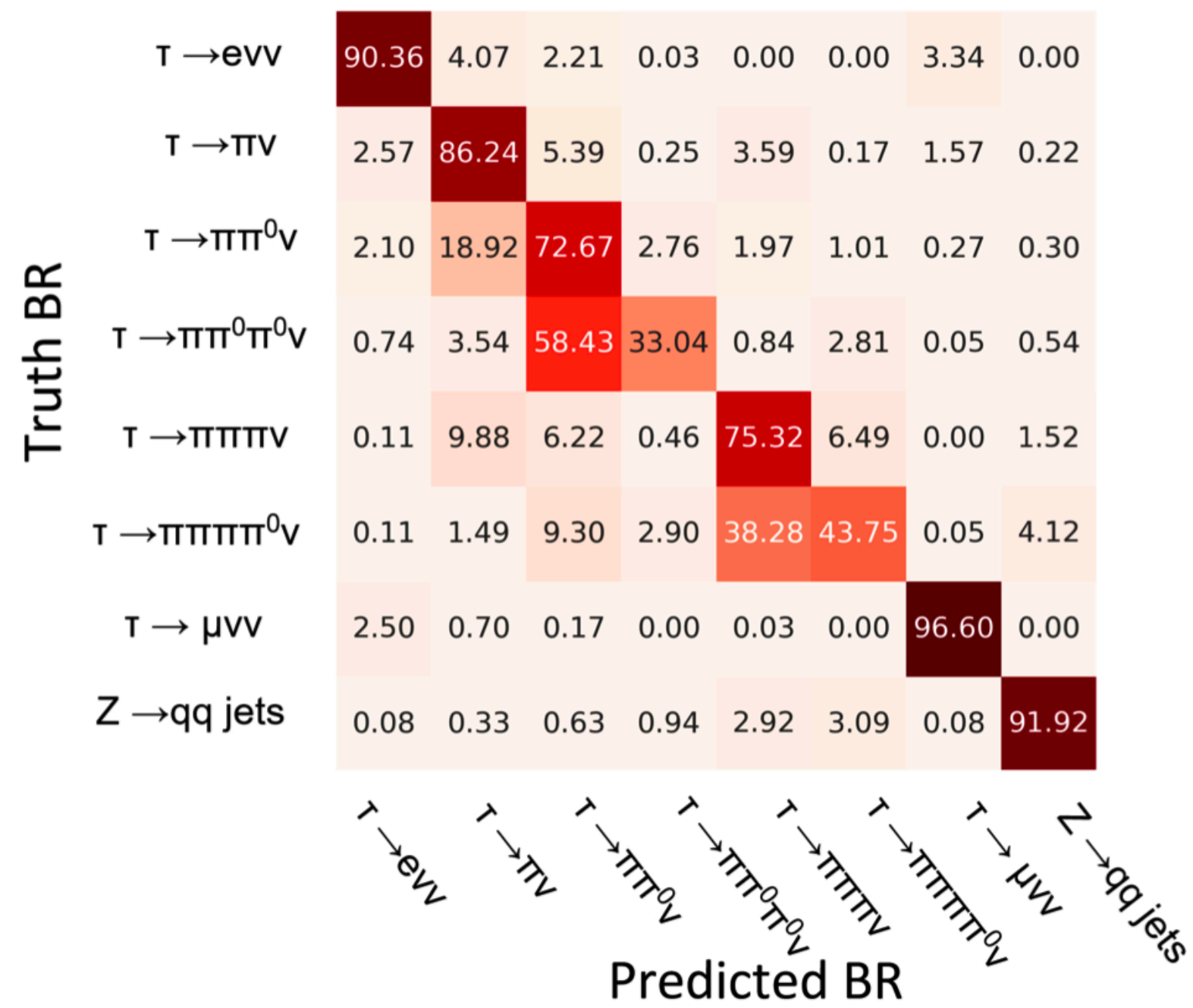
- D4.6. Final performance assessment (physics and wrt design readout strategy) for the selected DNN model and its deployment for general use [M24]



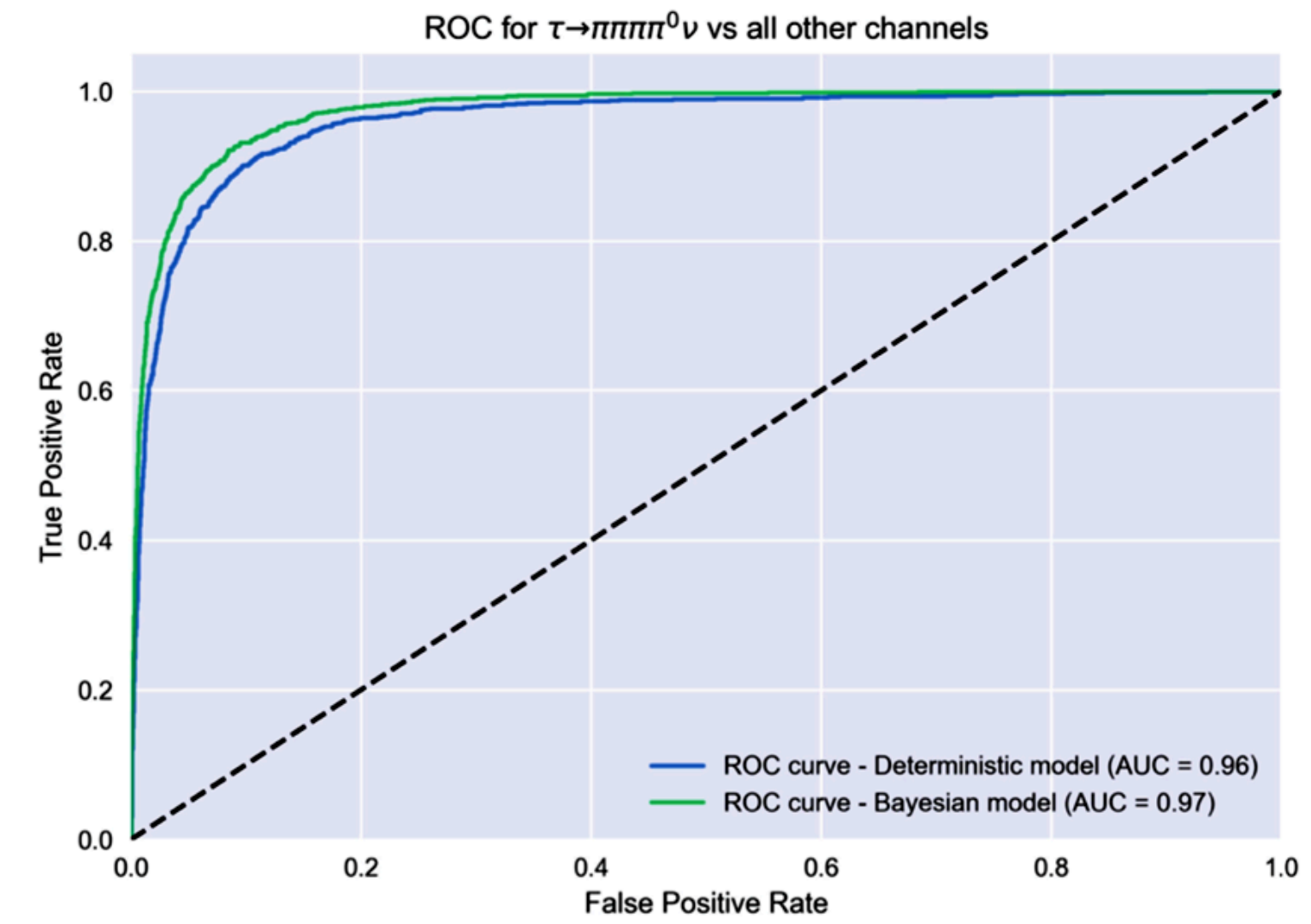
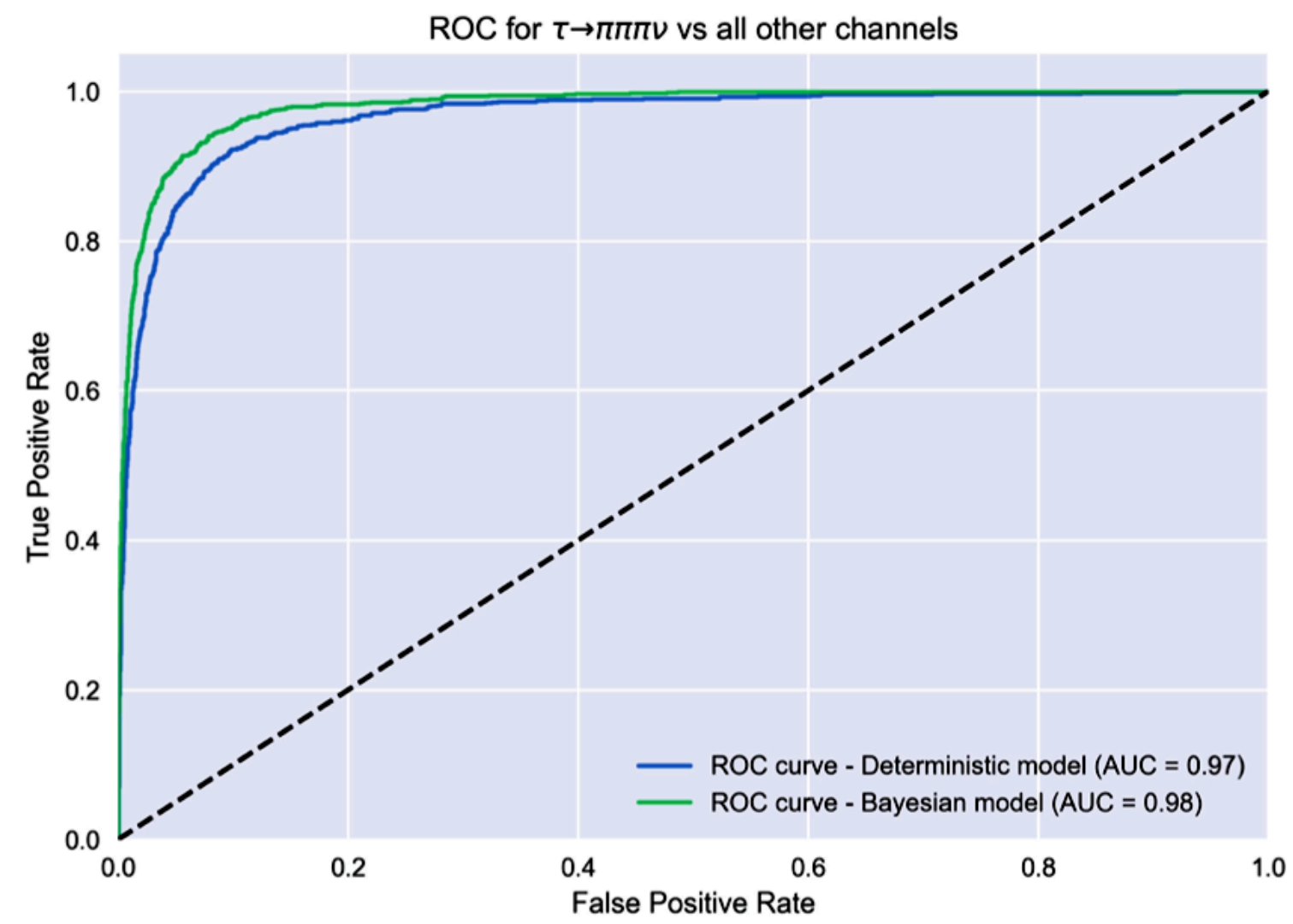
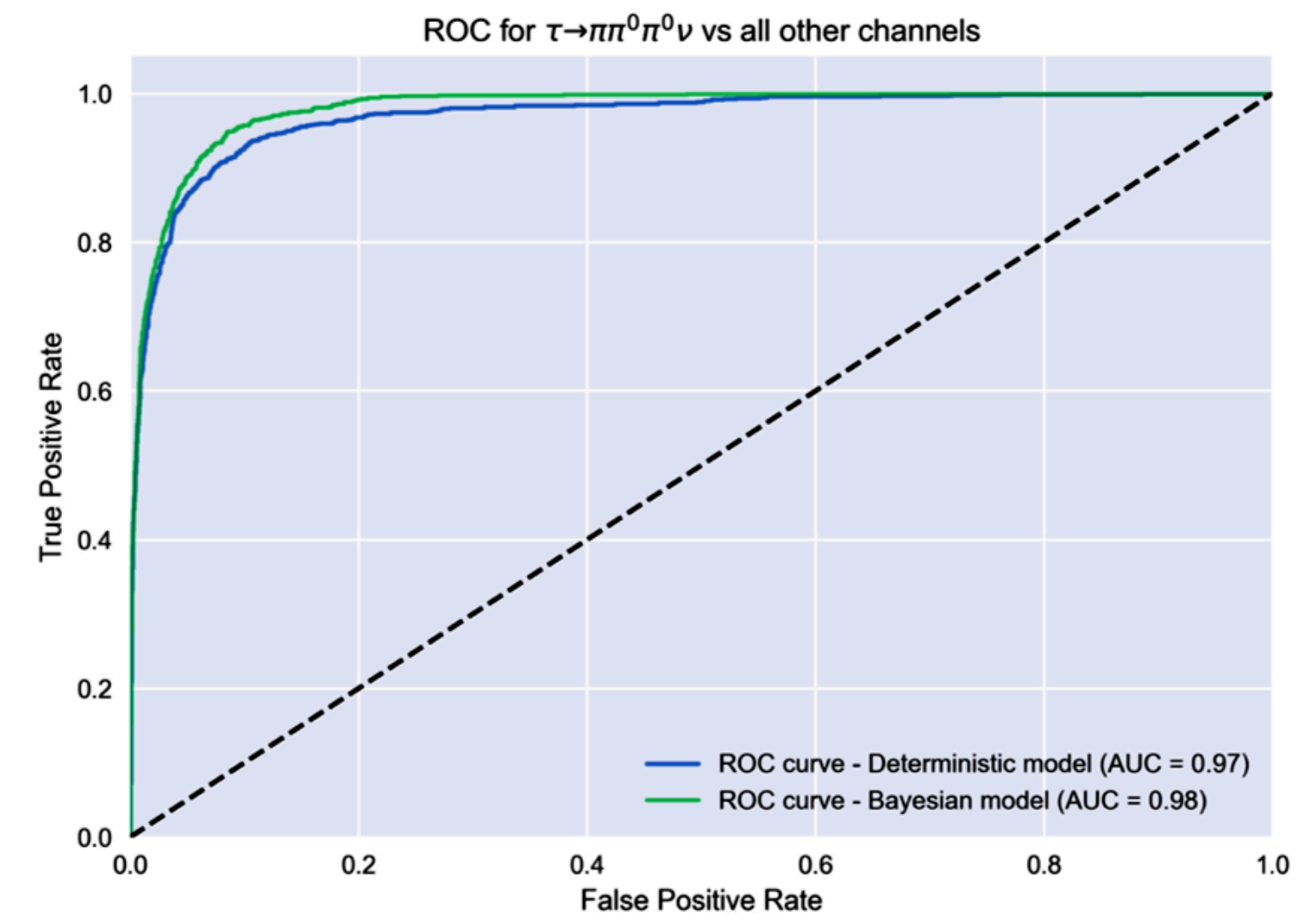
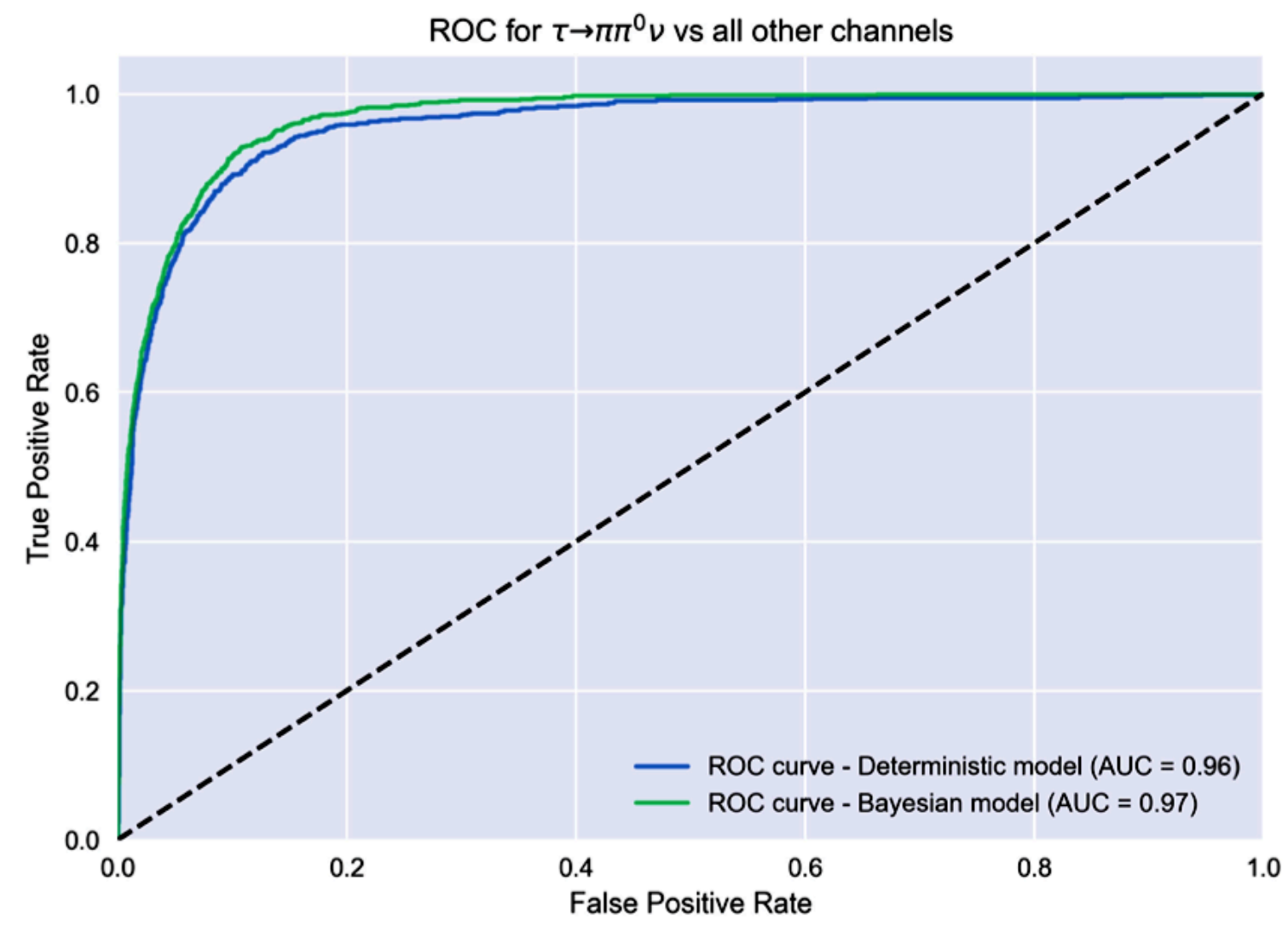
DGCNN architecture for tau decay identification



EdgeConv block augmented with masks for synthetic datapoints



Confusion matrices of DGCNN on test dataset, using geometric only, geometric+fiber type, geometric+fiber type + whole SiPM information. Matrices are normalized per row



ROC curves of Bayesian DGCNN and point-estimate DGCNN for 4 classes of decay