



COMPUTER VISION AND APPLICATION TO DETECTION OF TAU LEPTONS

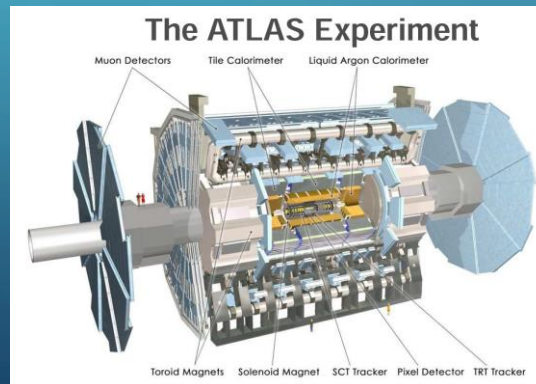
TORREY SAXTON (ILLINOIS STATE UNIVERSITY), QUENTIN BUAT (CERN), PIER-
OLIVIER DEVIVEIROS (CERN)

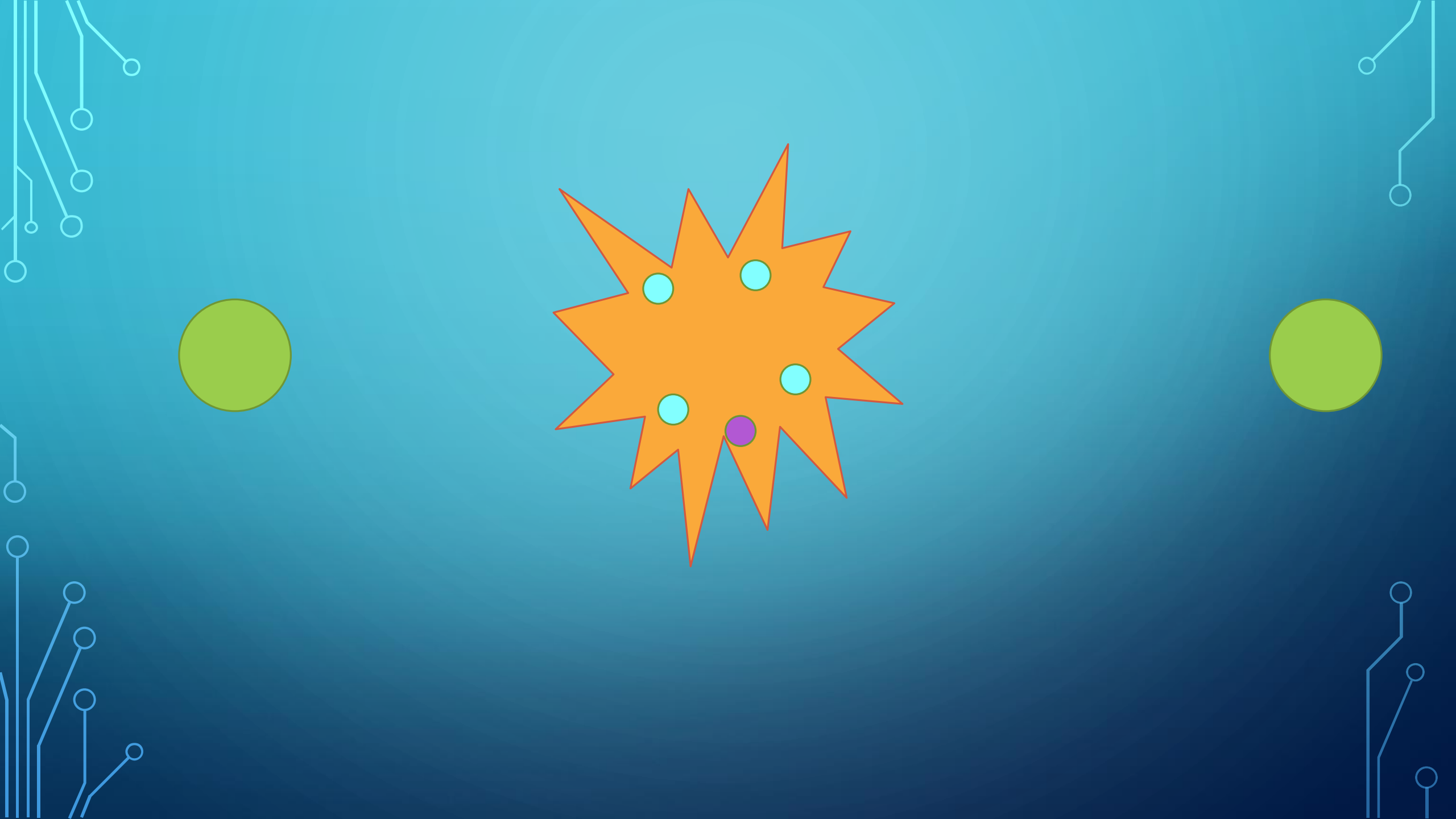
GOALS

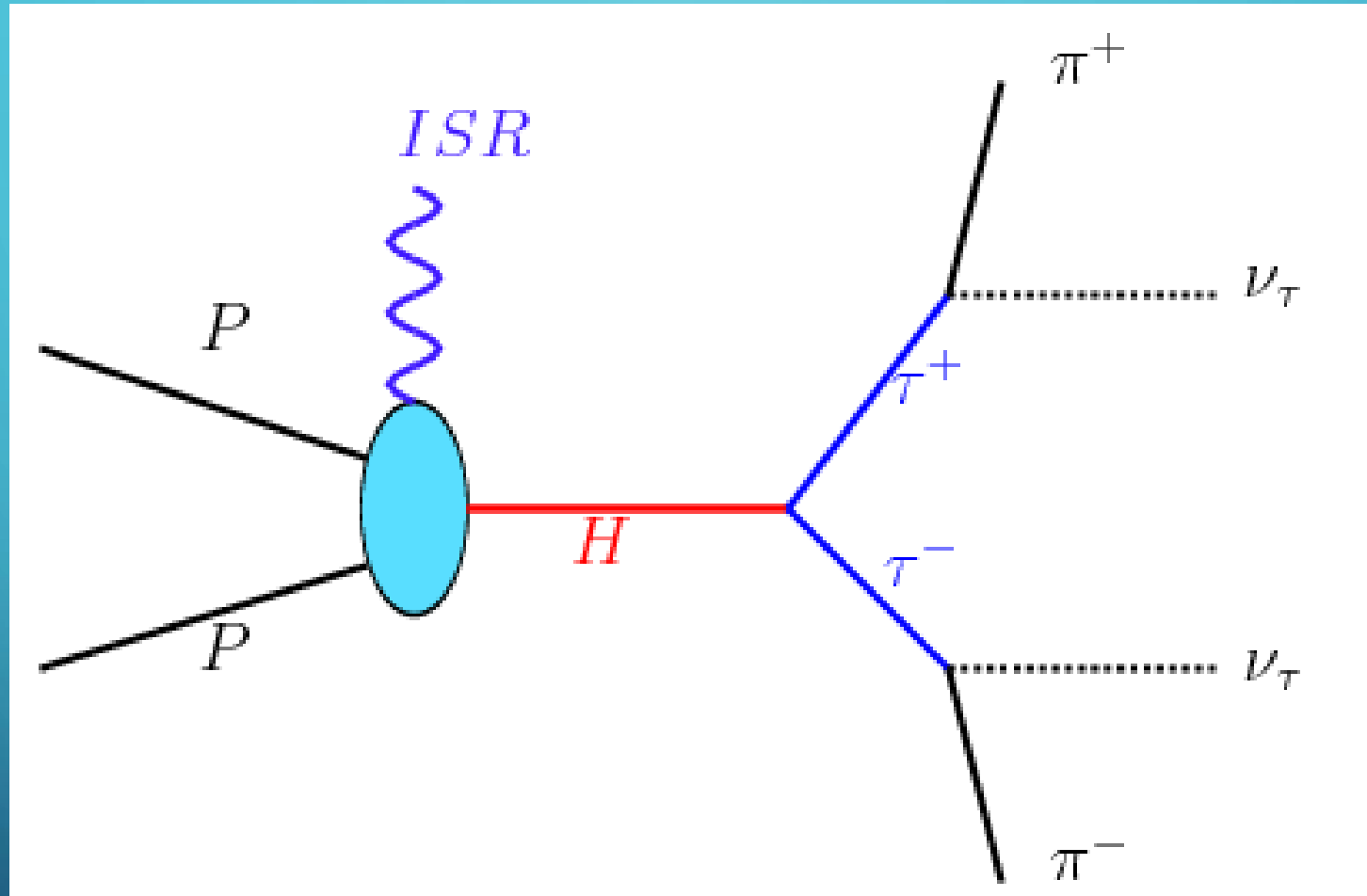
- THROUGH THE USE OF NEURAL NETWORKS, DEVELOPED AN ALGORITHM WHICH EFFICIENTLY CLASSIFIES AND CALIBRATES HADRONIC DECAYS OF τ LEPTONS
- IMPROVEMENT WILL HAVE A DIRECT IMPACT ON THE MEASUREMENTS OF THE HIGGS BOSON
- WANT TO CONSTRUCT A NETWORK WHICH PROVIDES BETTER RESULTS THAN THE ALGORITHM CURRENTLY USED

THE ATLAS COLLABORATION

- THE ATLAS DETECTOR IS A GENERAL PURPOSE DETECTOR; ITS GENERALITY IS WHAT LEADS TO THE MANY DIFFERENT EXPERIMENTS PERFORMED USING ATLAS.
- WE SPECIFICALLY FOCUS ON COLLISIONS PRODUCING VISIBLE TAU LEPTON DECAYS IN THE BARREL OF THE ATLAS DETECTOR



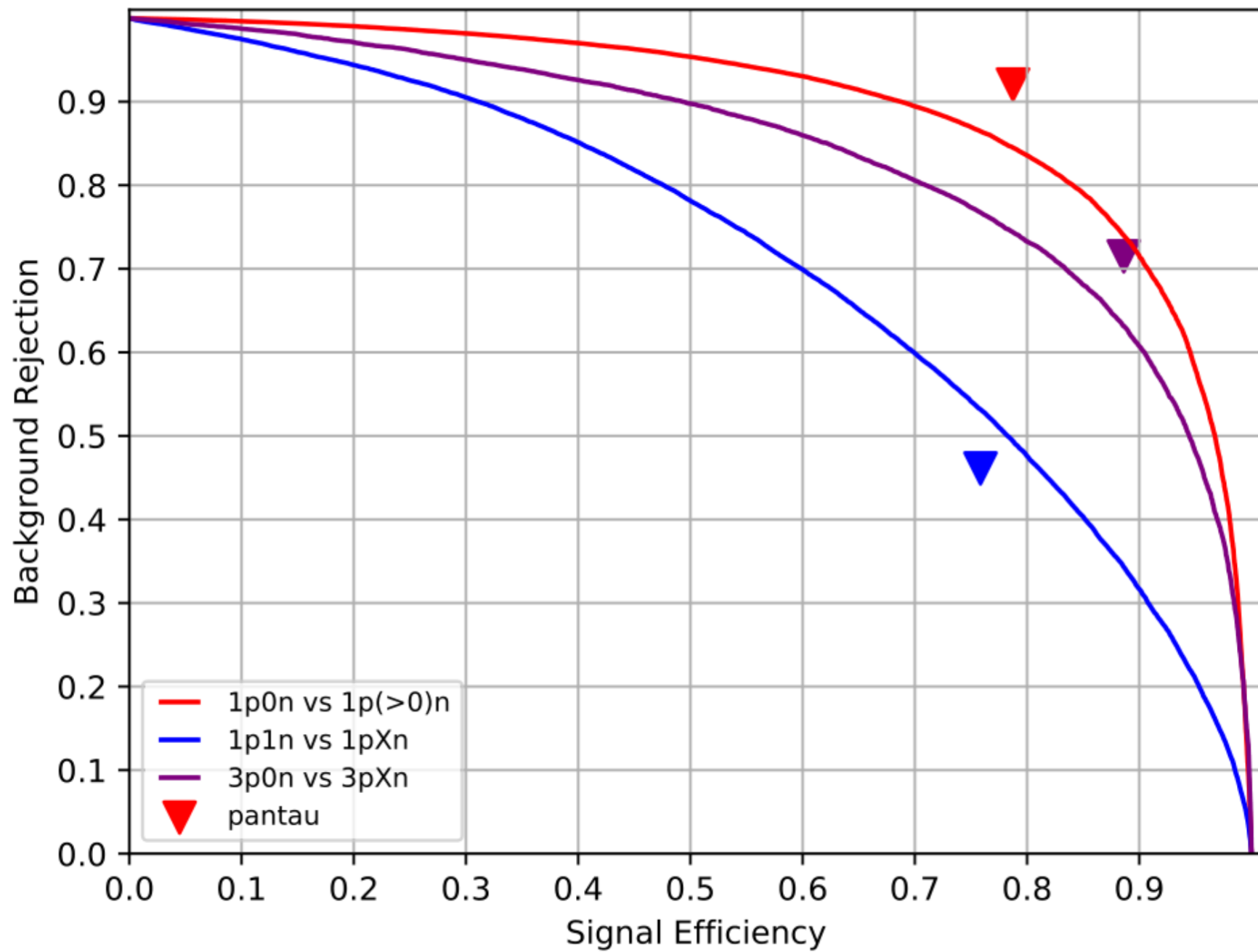




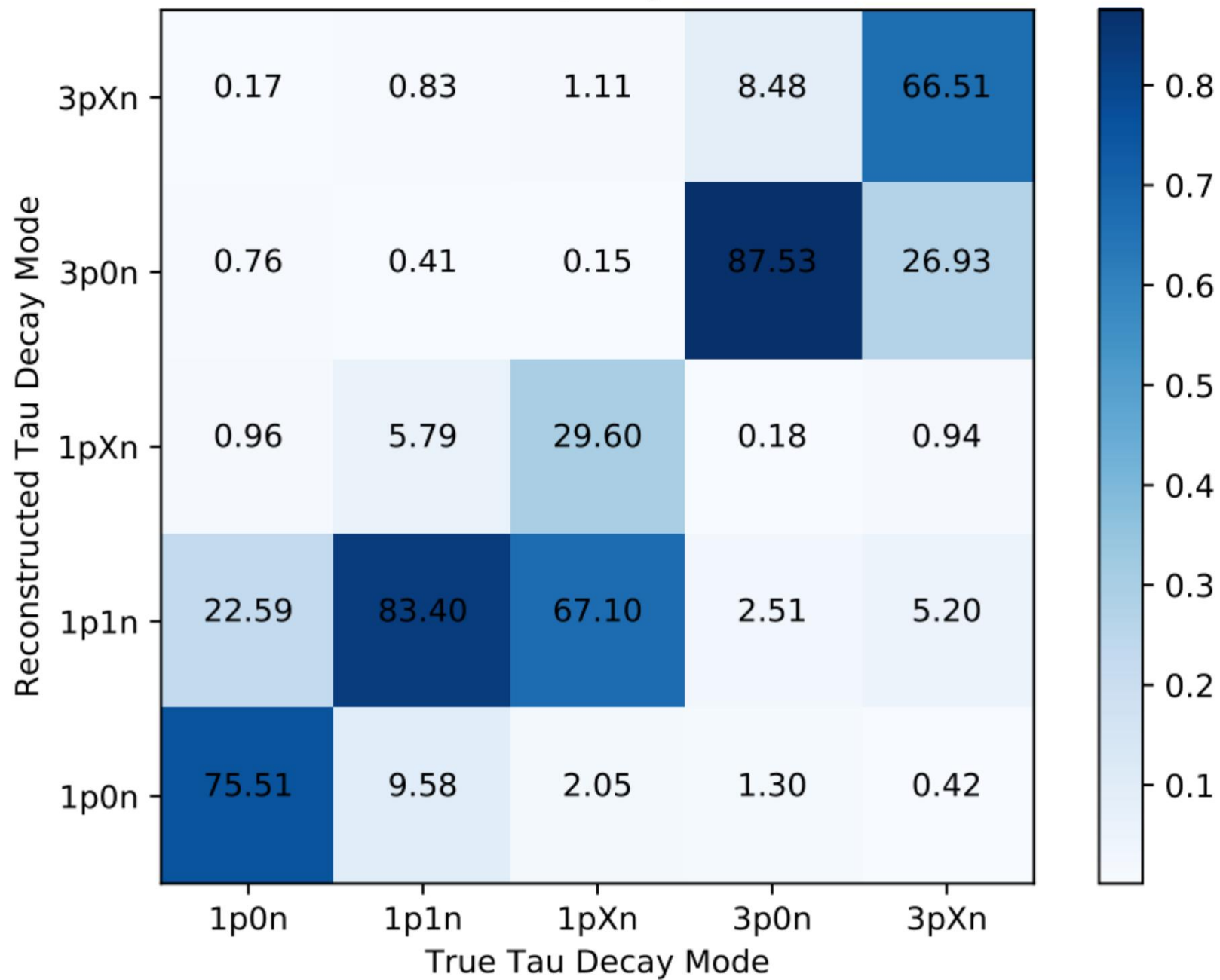
Exploring CP phase in $\tau\tau$ -lepton Yukawa coupling in Higgs decays at the LHC
Bhardwaj, Akanksha *et al.* arXiv:1612.01417 [hep-ph] ADP-16-44-T1000

WHAT DO I DO?

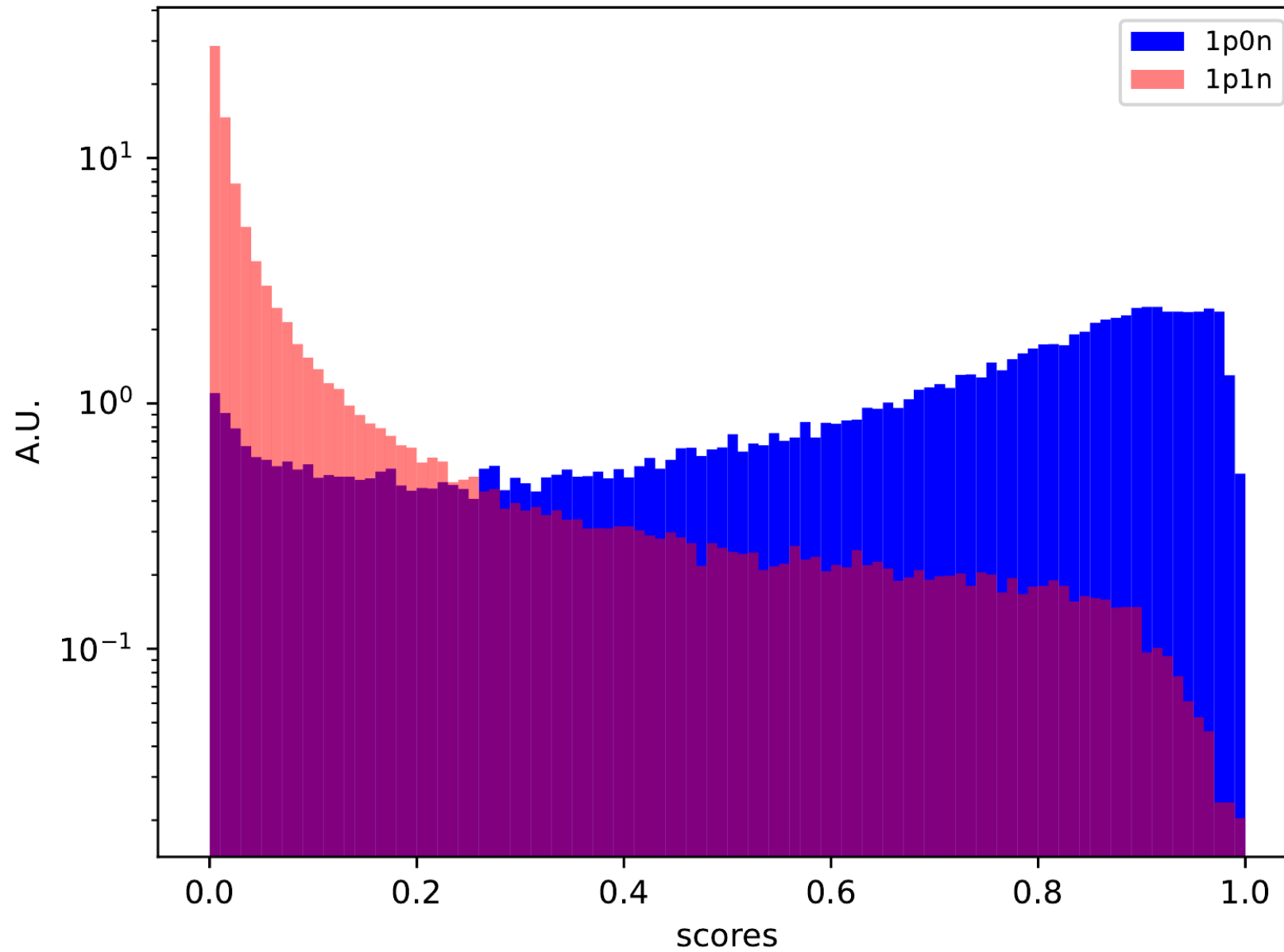
- MY ROLE IN THIS PROJECT IS TO TAKE THE ALREADY CONSTRUCTED NEURAL NETWORK, AND OPTIMIZE IT SO THAT ITS PERFORMANCE IS BETTER THAN THAT OF PANTAU (A DIFFERENT ALGORITHM)



Confusion matrix, diagonal = 71.55 %

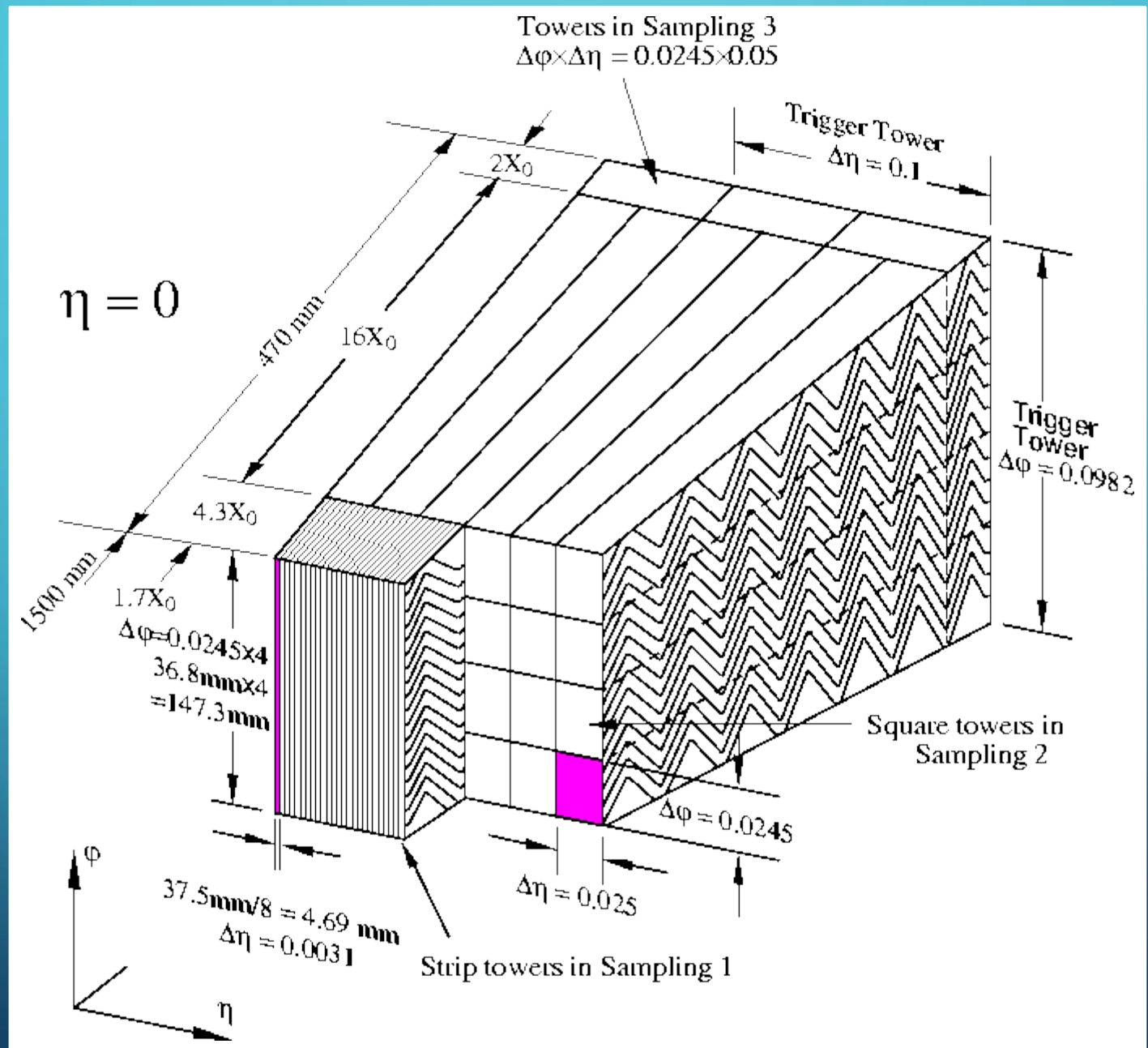


Network 1p0n scores for true 1p0n and 1p1n decay modes

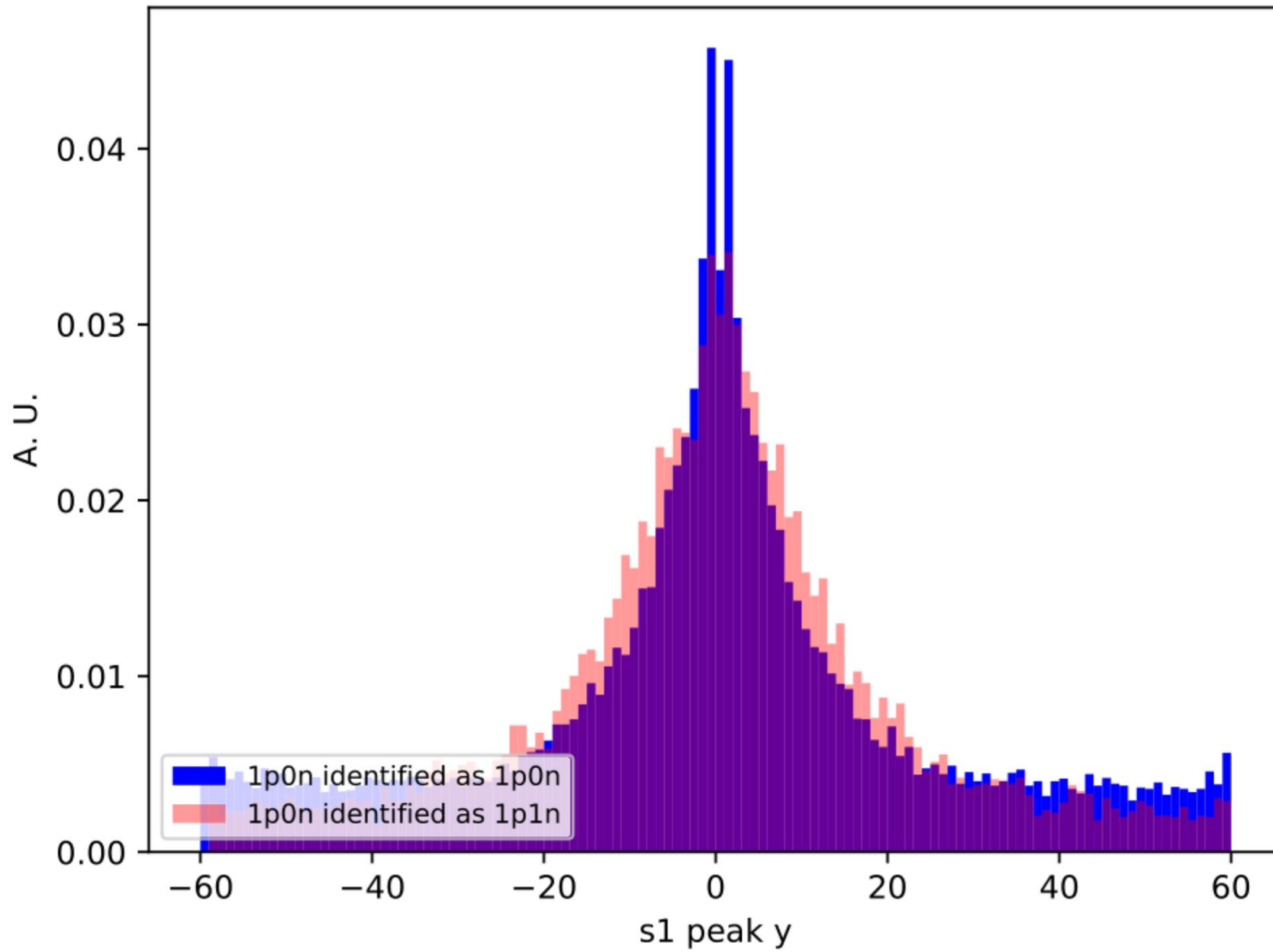


The background is a dark blue gradient. In the corners, there are white line-art illustrations of circuit boards or network diagrams, consisting of lines and small circles representing nodes or components.

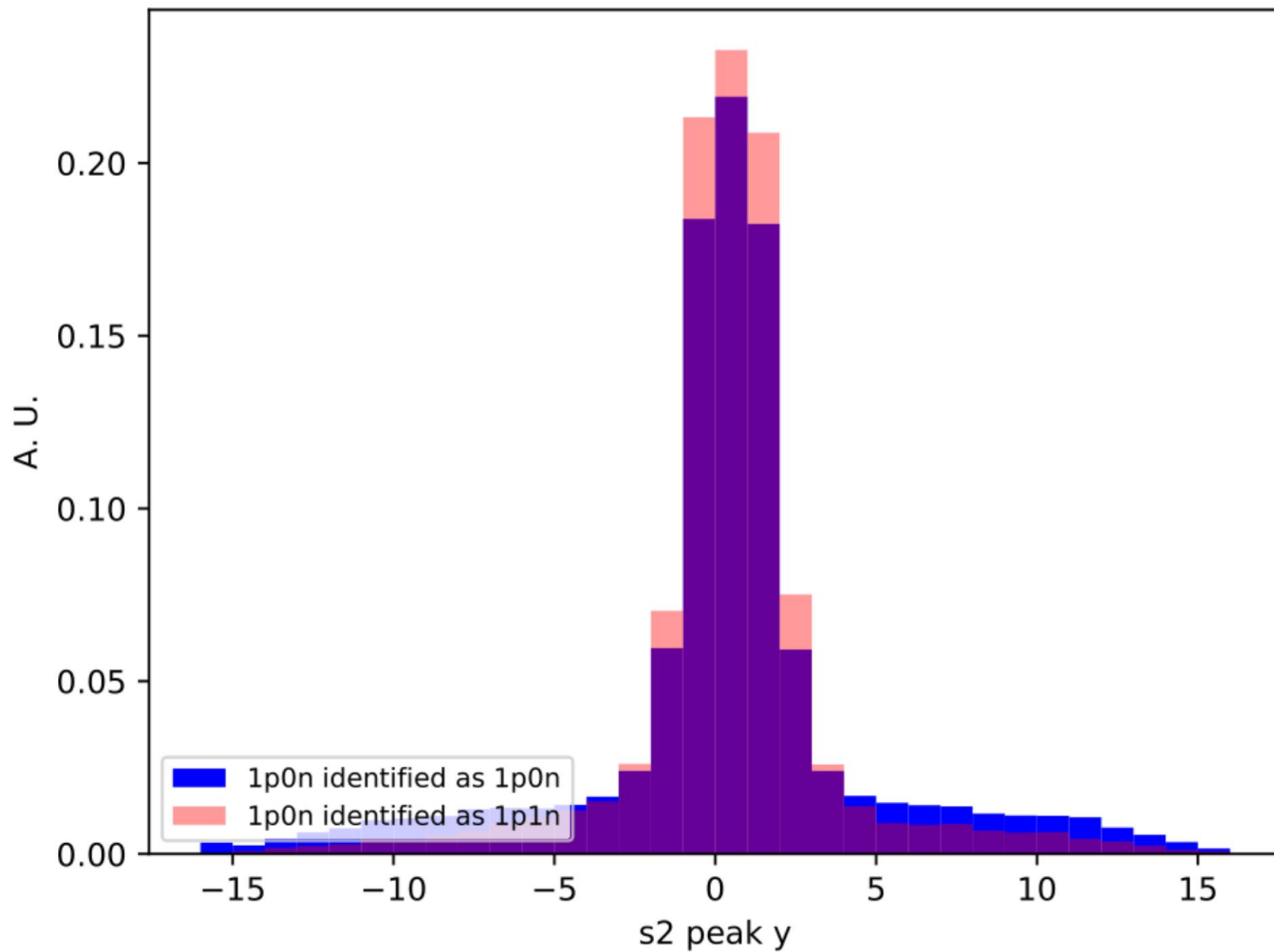
INVESTIGATING THE NETWORK



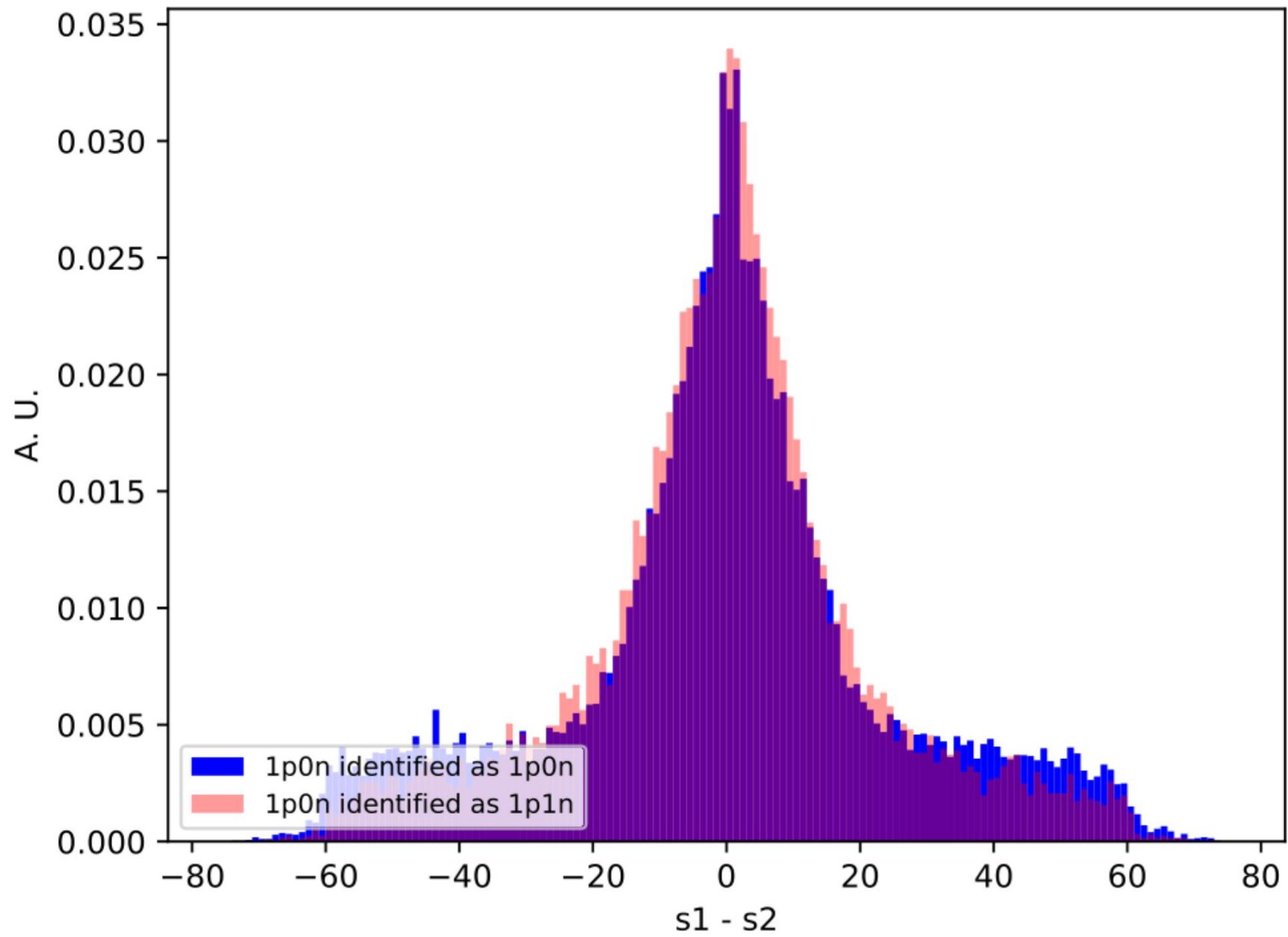
Peak $\eta(x)$ in S1



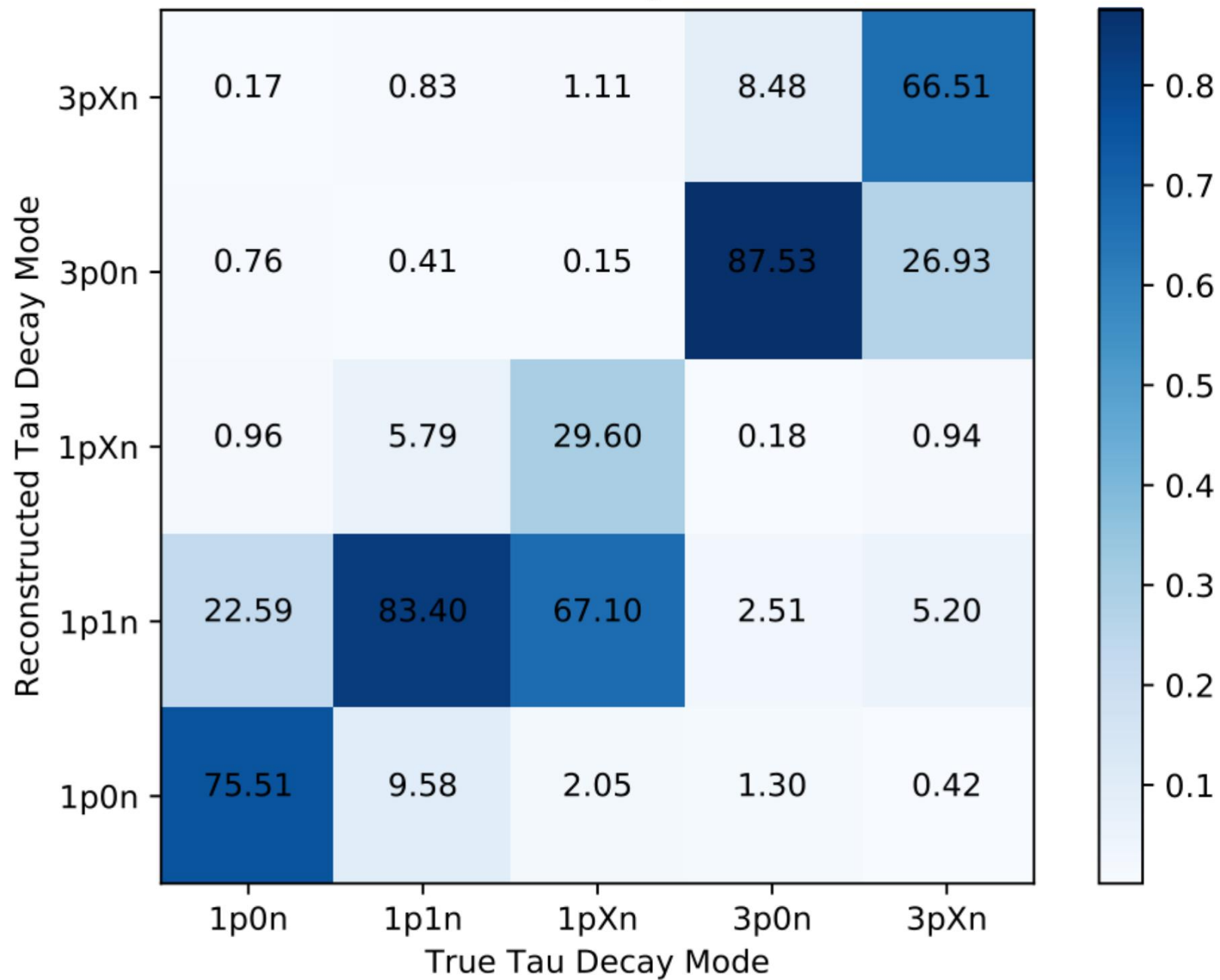
Peak $\eta(x)$ in S2



$\Delta\eta$ Between S1 and S2



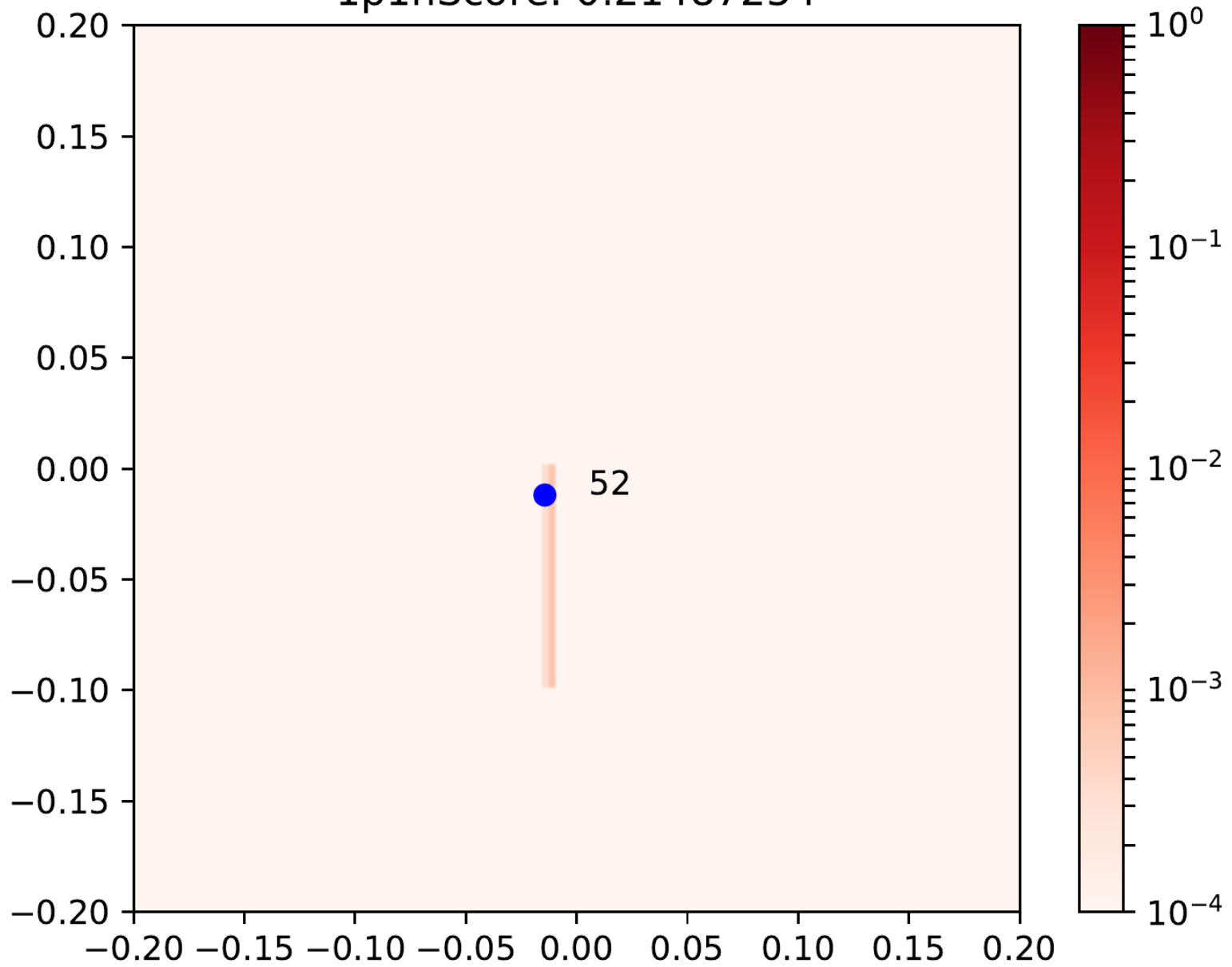
Confusion matrix, diagonal = 71.55 %



True Mode: 1p0n Event number: 970

1p0nScore: 0.7730685

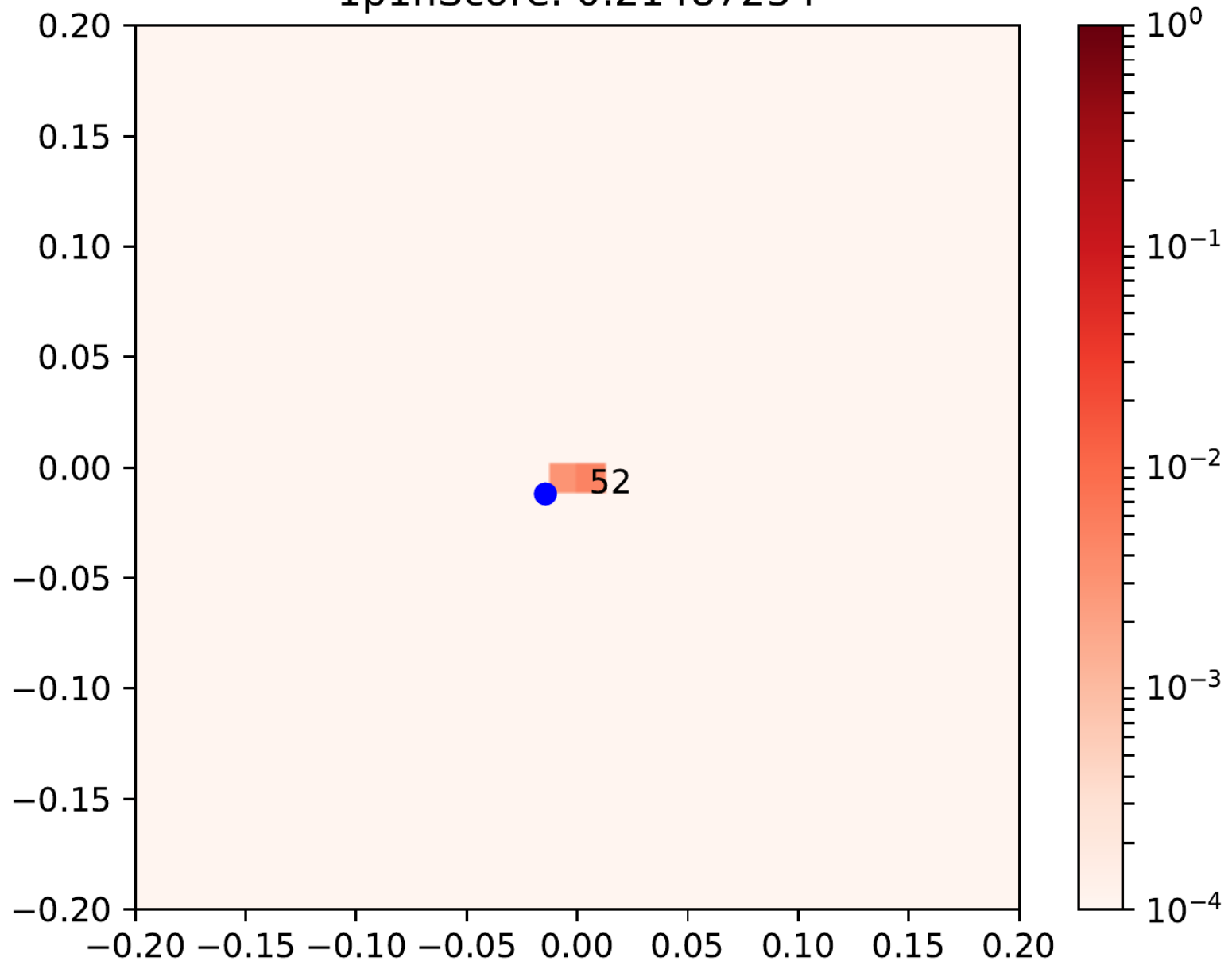
1p1nScore: 0.21487254



True Mode: 1p0n Event number: 970

1p0nScore: 0.7730685

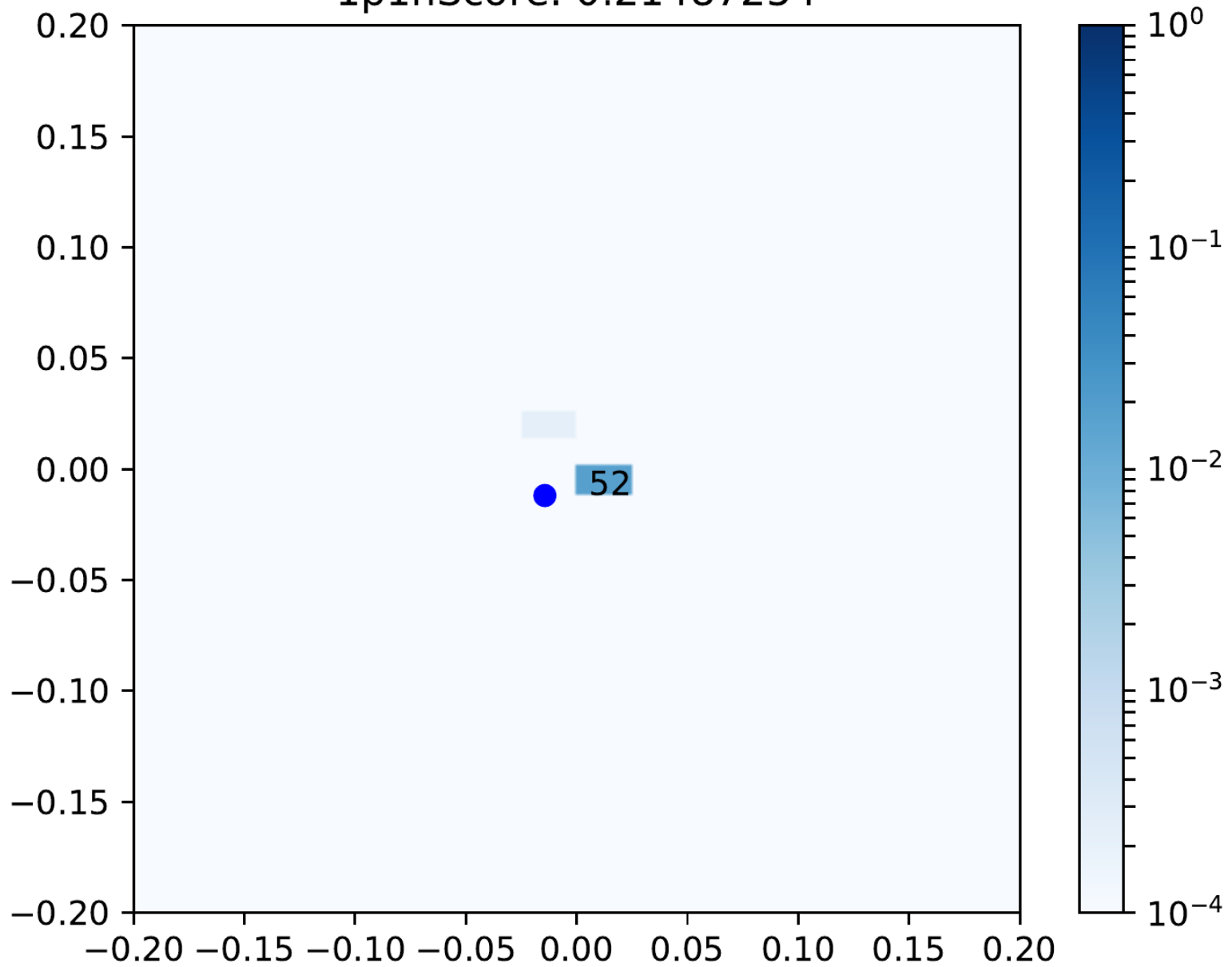
1p1nScore: 0.21487254



True Mode: 1p0n Event number: 970

1p0nScore: 0.7730685

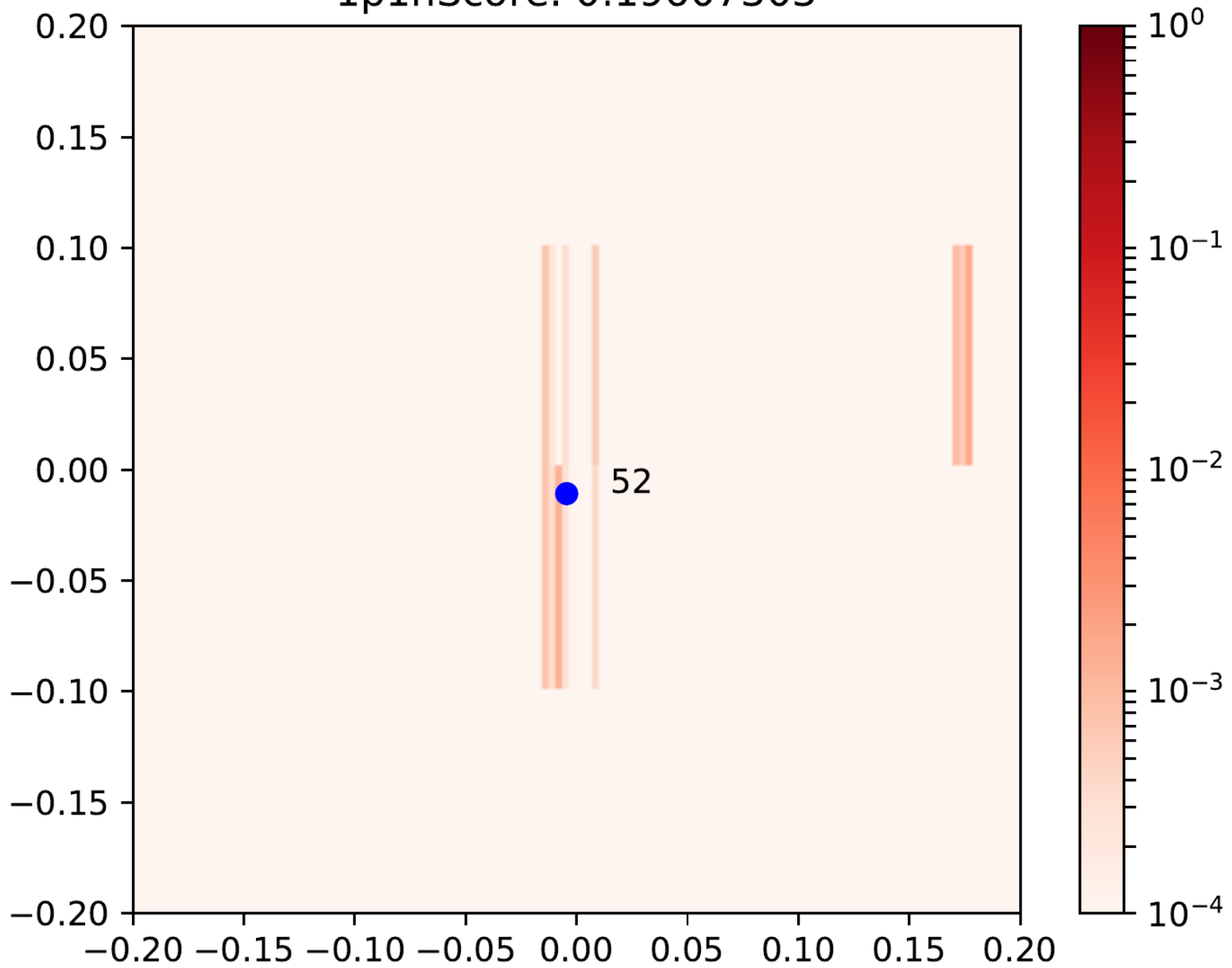
1p1nScore: 0.21487254



True Mode: 1p0n Event number: 447

1p0nScore: 0.7927506

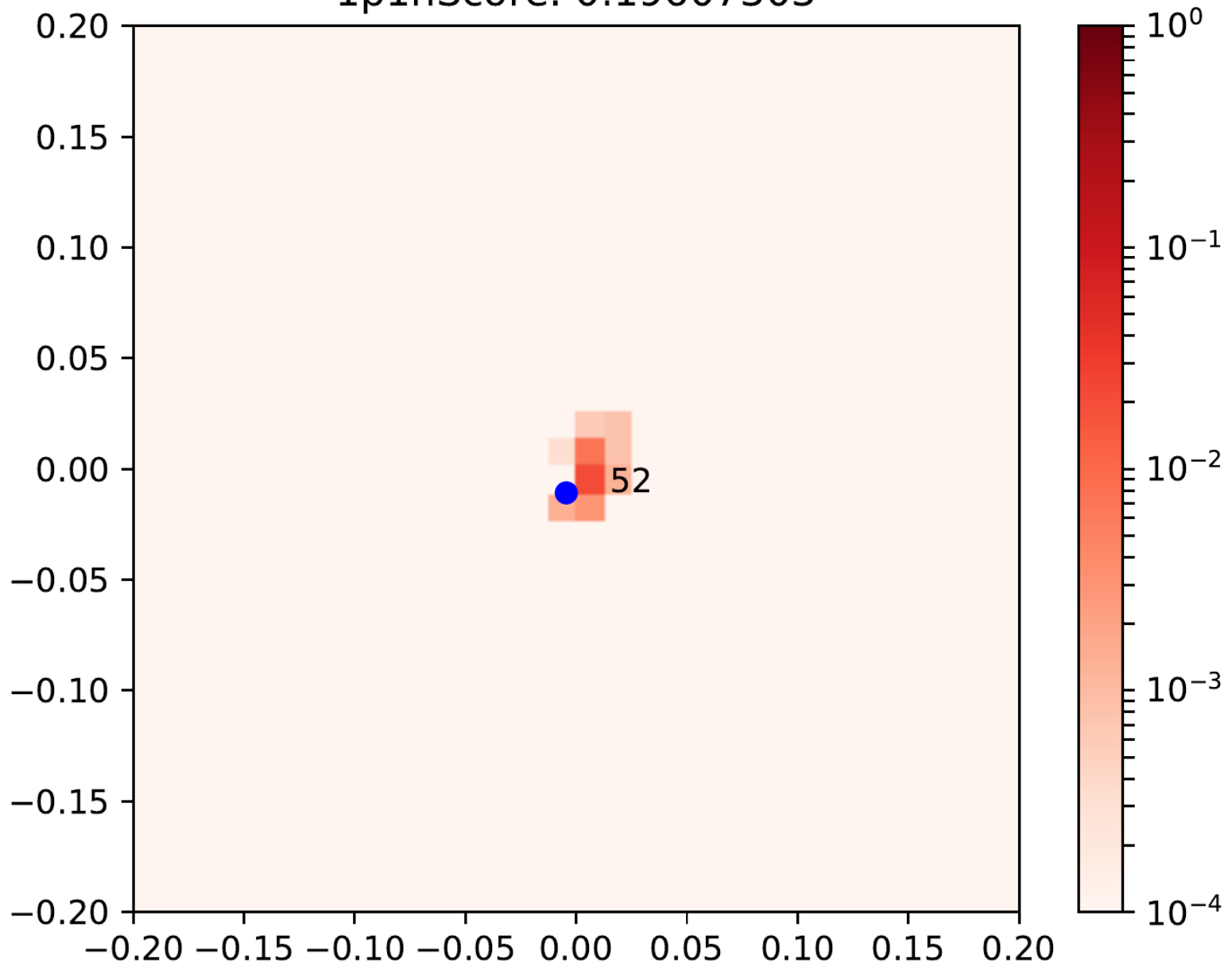
1p1nScore: 0.19607303



True Mode: 1p0n Event number: 447

1p0nScore: 0.7927506

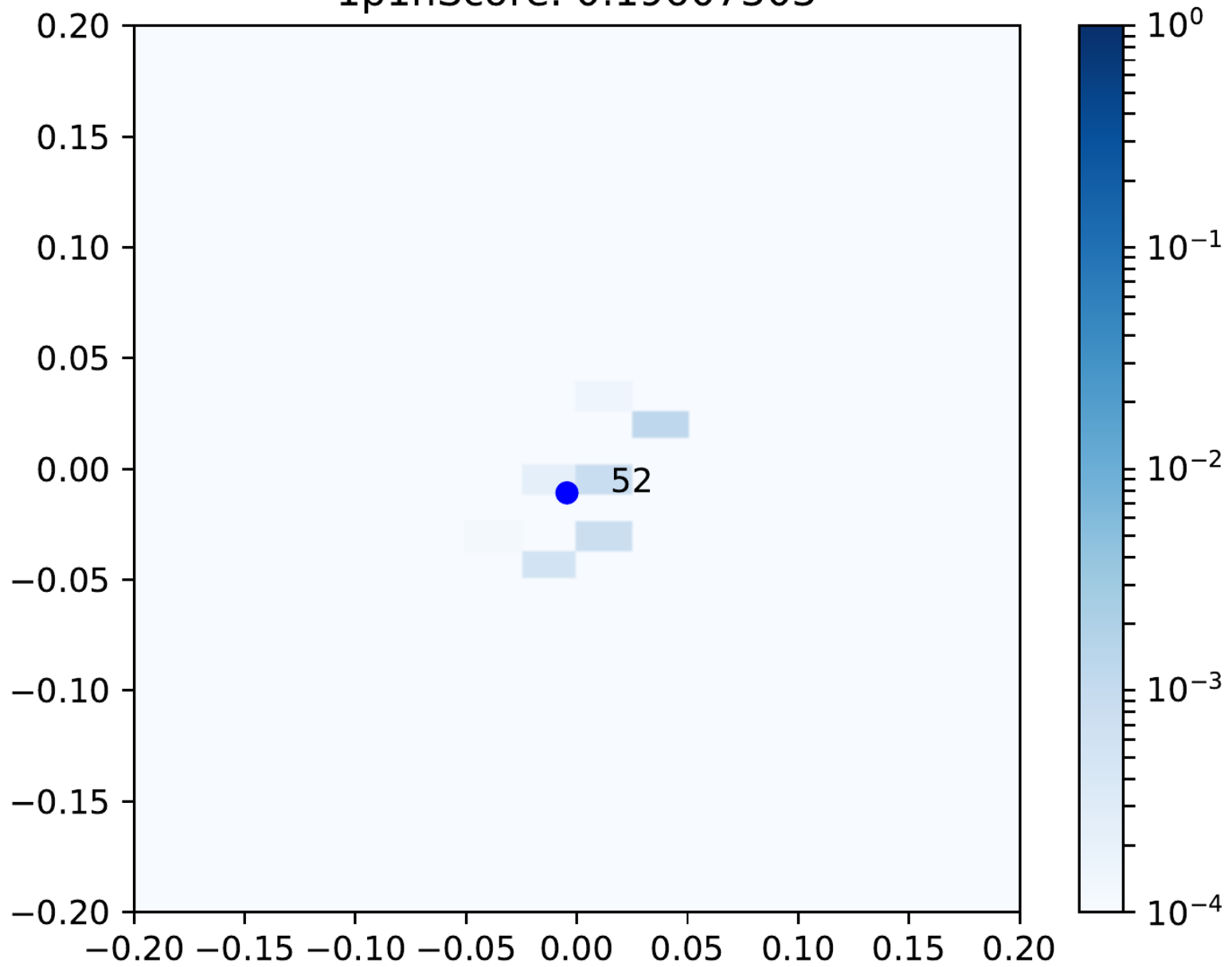
1p1nScore: 0.19607303



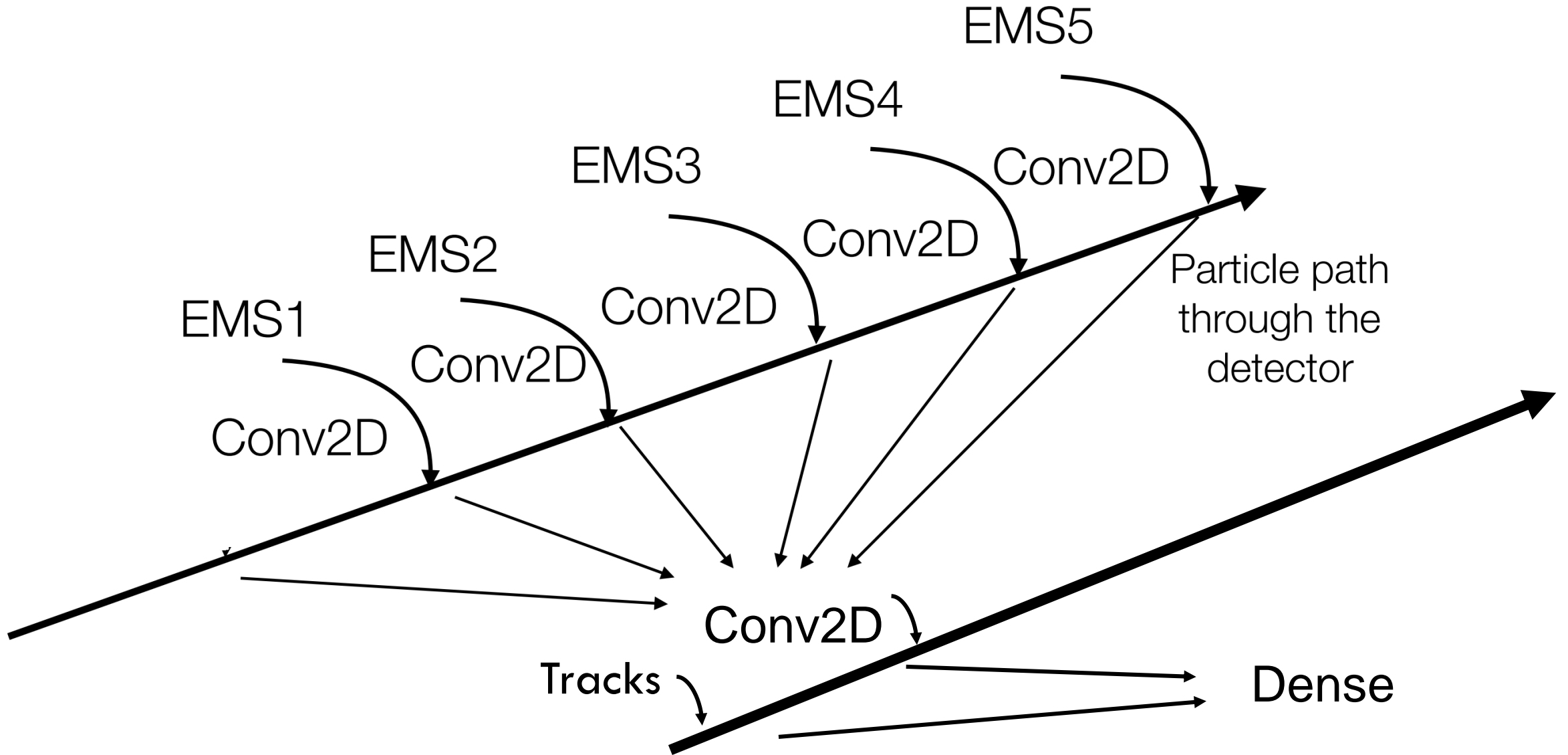
True Mode: 1p0n Event number: 447

1p0nScore: 0.7927506

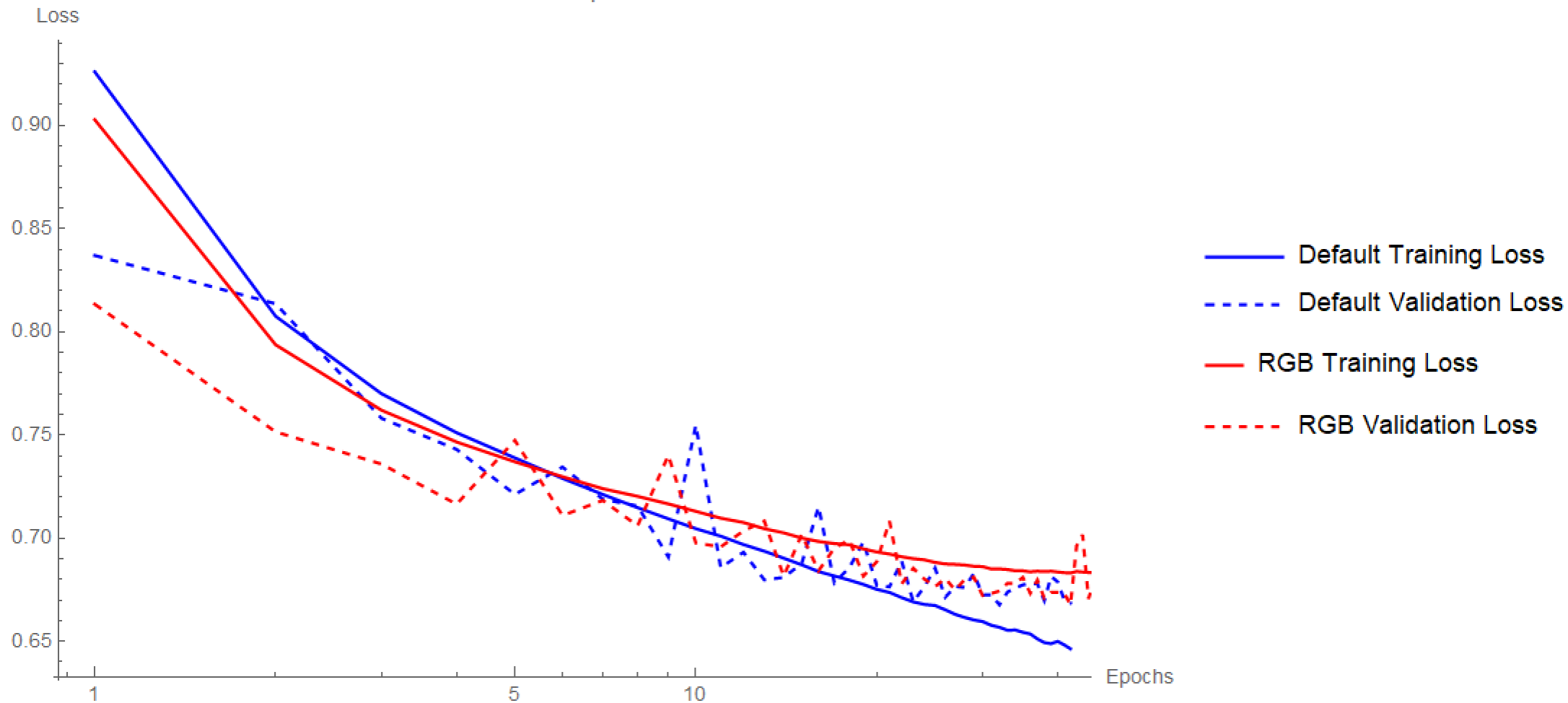
1p1nScore: 0.19607303



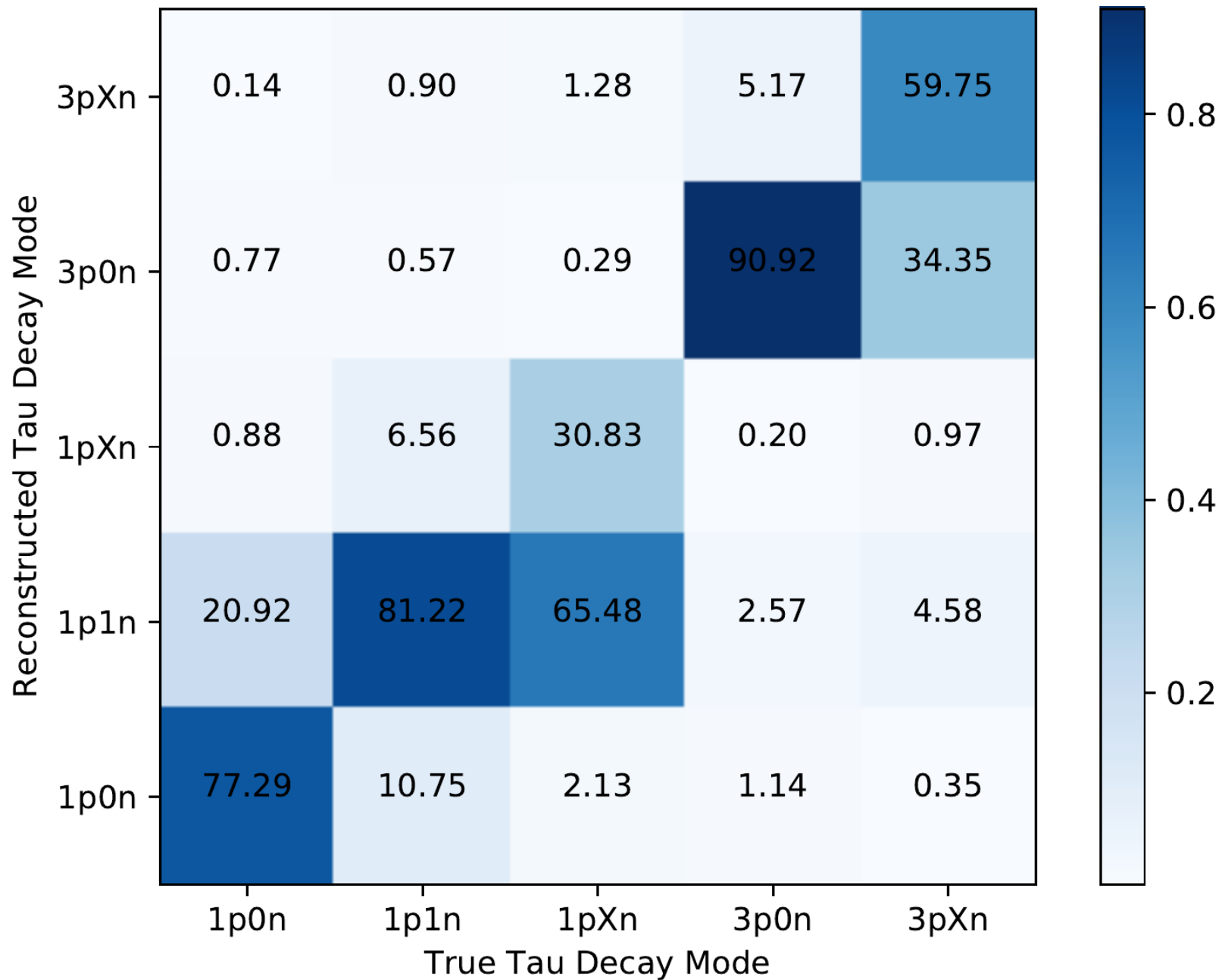
DIFFERENT ARCHITECTURE



Loss vs Epochs



Confusion matrix, diagonal = 71.14 %



ACKNOWLEDGEMENTS

- I would like to acknowledge the University of Michigan CERN Research Experiences for Undergraduates program funded by the National Science Foundation Grant Number 1659393.
- I would also like to thank my advisers Drs Pier-Olivier DeViveiros and Quentin Buat for their patience and guidance through this project over the course of the summer.
- The Summer Student Programme team at CERN for their time and dedication to the background administrative processes that go into a large program such as this.

REFERENCES

- https://www.hep.phy.cam.ac.uk/atlas/ATLAS_Det.jpg
- **Exploring CP phase in $\tau\tau$ -lepton Yukawa coupling in Higgs decays at the LHC**
Bhardwaj, Akanksha *et al.* arXiv:1612.01417 [hep-ph] ADP-16-44-T1000
- <http://www.hep.lu.se/atlas/thesis/egede/thesis-node43.html>

The image features a blue gradient background with white circuit-like lines in the corners. These lines consist of straight paths that branch out and terminate in small circles, resembling a stylized PCB or network diagram. The lines are most prominent in the top-left and bottom-left corners, with smaller segments in the top-right and bottom-right corners.

QUESTIONS?

