COMPUTER VISION AND APPLICATION TO DETECTION OF TAU LEPTONS

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GOALS

• THROUGH THE USE OF NEURAL NETWORKS, DEVELOPED AN ALGORITHM WHICH EFFICIENTLY CLASSIFIES AND CALIBRATES HADRONIC DECAYS OF $\tau$ 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 $\tau$-lepton Yukawa coupling in Higgs decays at the LHC
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)
Network 1p0n scores for true 1p0n and 1p1n decay modes

A.U.

scores

0.0  0.2  0.4  0.6  0.8  1.0

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

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INVESTIGATING THE NETWORK
Peak $\eta(x)$ in $S1$
Peak $\eta(x)$ in $S2$
$\Delta \eta$ Between $S_1$ and $S_2$
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: lp0n  Event number: 447
lp0nScore: 0.7927506
lp1nScore: 0.19607303
True Mode: 1p0n Event number: 447
1p0nScore: 0.7927506
1p1nScore: 0.19607303
DIFFERENT ARCHITECTURE

Particle path through the detector

Conv2D → EMS1 → Conv2D → EMS2 → Conv2D → EMS3 → Conv2D → EMS4 → Conv2D → EMS5

Tracks → Conv2D → Dense
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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
QUESTIONS?
Dense

Particle path through the detector

Tracks

EMS1

Conv2D

EMS2

Conv2D

EMS3

Conv2D

EMS4

Conv2D

EMS5