My Summer with US CMS PURSUE 2024

Luis Felipe Koehler Domingues

About me!

- Luis (he/him).
- From Rio de Janeiro, Brazil.
- Junior at Grinnell College.
- Physics/Math double major.
- Just a regular guy.
- Public transport enthusiast.
- Loves music and pop culture.
- PURSUE 2024 intern!

Grinnell College

Fermilab

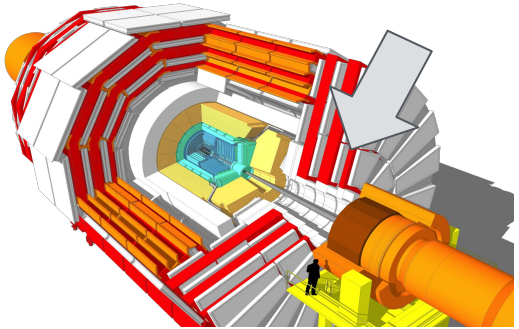
- 2 weeks of training in particle physics and programming tools.
- Lab visits and meeting researchers.
- Made friends!
- Saw bison!

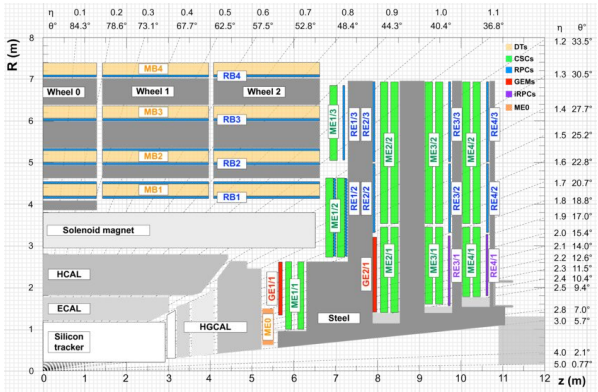
Rice University

- 8 weeks working on a CMS project.
- Amazing mentors Darin Acosta and Osvaldo Miguel Colin, who encouraged me and helped with any challenges.

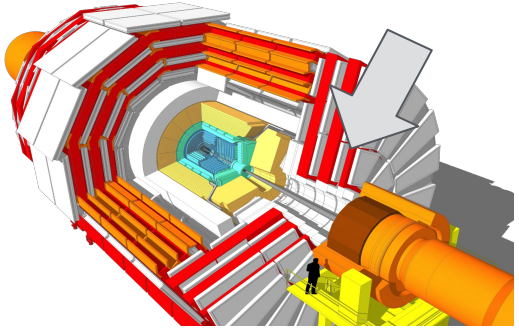
A bit of background

- 40 million LHC collisions at CMS every second → 100 Terabytes/s.
- Level 1 Trigger: electronic data filtering system: 40 MHz → 750 kHz (phase 2).
- The Endcap Muon Track Finder (EMTF) is part of the L1 Trigger and “detects” muon and possible muon-like objects at the CMS end caps.

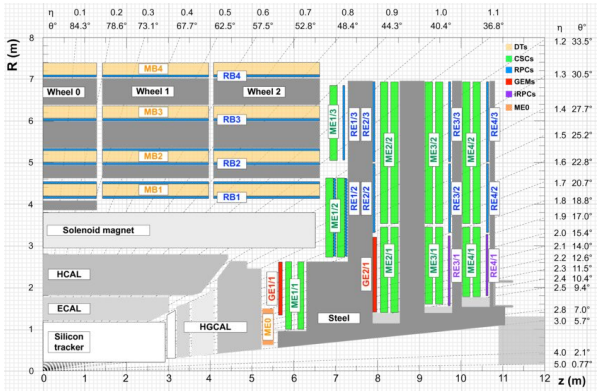




A bit of background

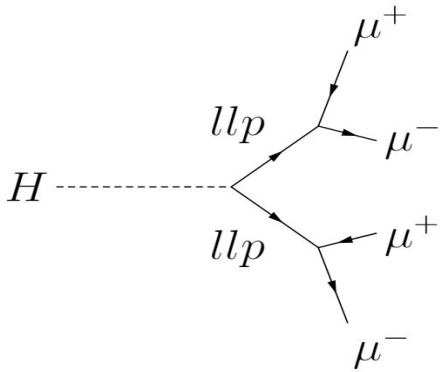


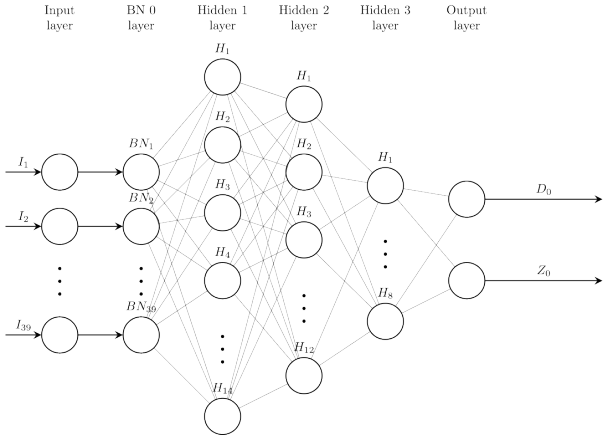
- Many models beyond the standard model predict long-lived particles (LLPs) and heavy, stable, charged particles (HSCPs).
- EMTF is not looking for those!



My Project

- Measuring properties of exotic charged particles at the EMTF using neural networks.
- Used Monte Carlo techniques to simulate events.
- Unpacked data and trained neural networks with different architectures.
- Analyzed model performance.



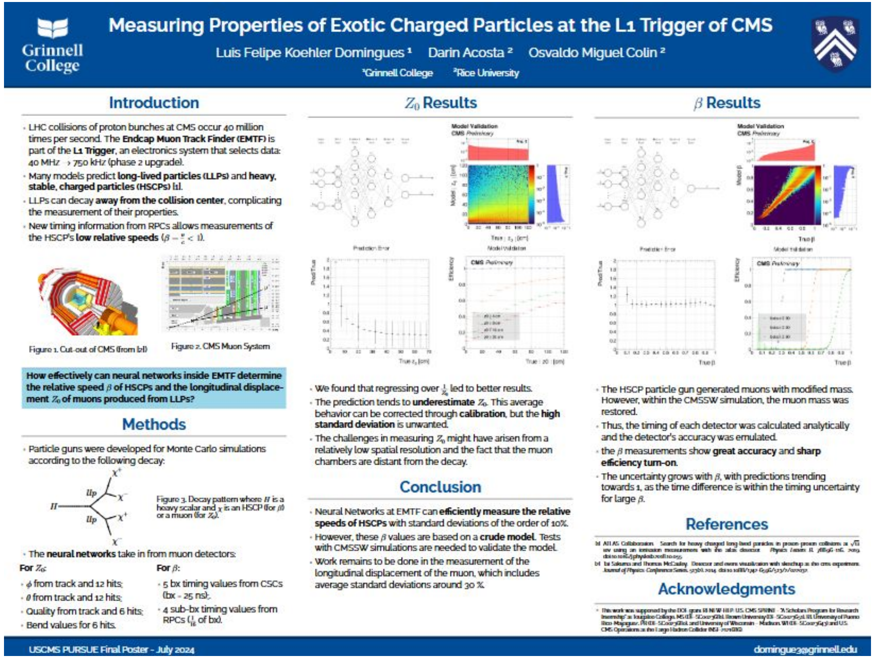


What I learned

- Improved my coding skills in Python, C++, as well as Unix commands and Git, and particle physics-specific tools such as ROOT.
- Learned widely-used machine learning packages such as Keras and TensorFlow.
- Monte Carlo simulations, CMSSW, and computing clusters.
- Particle Physics and the internal workings of CMS.
- Real-world High Energy Particle physics research.
- Networked with researchers and other mentees.
- Received grad school guidance.

What I learned (part 2!)

- Improved my communication skills with final presentation and poster.
- Had the opportunity to present my research at the Gulf Coast Undergraduate Research Symposium.
- Increased confidence in my research skills :)



Last slide :)

Thank you!

Any questions?

email: domingue3@grinnell.edu