Self-reflection

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The Standard Model represents what we currently know about elementary physics. I learned that the theories proposed to solve empirical and theoretical issues with the Standard Model all refer to exotic phenomena beyond the model. Therefore, it is of interest to search for new physics. By colliding two protons at high energies, collimated streams of particles called jets are produced. Their properties are then analysed in order to probe for hints of exotic physics.

In this project, the protons were collided in a synchrotron called LHC, and the cylindrical ATLAS detector was used to analyse the jets. The data analysis was entirely based on programming. My specific task was to improve some distributions from the 2015 data. These distributions displayed the fraction of collision events with central jets as a function of the collision energy. Here, central jets were indications of exotic physics, and the distributions unexpectedly diverged for low energies. I made use of the TADA framework, which only ran on a fraction of the full dataset. Thus, any potential errors in the distributions could be spotted quickly.

The theoretical knowledge was extracted from peer-reviewed scientific articles, which I considered trustworthy. This made me aware of the important physical observables concerning the jet kinematics. I also learned about the strengths and limitations of the ATLAS detector and a Monte Carlo program used in the project. Additionally, I became aware of the assumptions made in an analytical calculation in the project.

I wrote my own scripts for solving the initial tasks in project. My programming abilities were obtained hands-on by utilizing tutorials, user forums and manufacturer webpages. Also, the supervisor would assist me if some specific technique was required. Later on, when working with the TADA framework, I used codes written by others. In most cases, I single-handedly figured out how the scripts worked. I was also able to track down some bugs by myself, although the debugging meant that I overshot some minor deadlines. The absolute deadline was not jeopardized, however.

Occasionally, I would verbally explain my work to more or less experienced students. To make myself understood, I had to regulate the amount of jargon and use a pedagogical approach. I also shared written solutions to TADA script problems with other people working within my field. In order to maintain their interest, I wrote in a concise and clearly structured way. However, their experience allowed me to use a considerable amount of jargon. By sharing these solutions, other LU students would be prevented from encountering the same issues as I.

When working with the TADA framework, I made use of a computer network based at CERN. Thus, basic knowledge of how to protect computers against virus attacks and unauthorised usage was required. I was aware that a security breach could damage the work of all the people relying on the network. I also learned to not publish data which has not been reviewed by the ATLAS collaboration. Nevertheless, the thesis could still be published, provided that the data was excluded from it.

It it still up to others to find hints of physics beyond the Standard Model. Since it is important to expand our knowledge of fundamental physics, any conclusive evidence of new physics should be published. The experimental processes could potentially also reveal techniques beneficial to other fields in society. But before these techniques could be used for anything else than research, some alterations would have been required.