BIG DATA: LHCb



Project flow map

Welcome to Big Data: LHCb! As part of one the Oxford Summer School projects, Big Data: LHCb offers training and an opportunity for students to apply to a research project of their choice. It gives students multiple routes, depending upon their interests and experience. This workshop will teach you about particle physics analysis, how we can use the collected data from the LHCb experiment and perform some measurements that are very interesting for us as particle physicists!

If you have zero experience with programming and particle physics, there is no need to be worried! By following these codes you will gain the initial experience required and learn some of the fundamentals tools that you will need to use as an experimental particle physicist such as python, histograms and root files. We will build together the necessary knowledge by going through introductory notebooks some particle physics examples and, at the end, you will be able to develop yourself a code to analyse real LHCb data!

Look at the flowchart on the next page!

The **green boxes** show the training notebooks (Books 1 to 7) – these books must be completed in the order shown, but students do not have to finish them all. The books become more challenging as Python skills are progressively developed and applied to analysing and interpreting data.

The **blue boxes** show opportunities to (a) complete the optional exercises to help consolidate student learning before moving on to the next book, or (b) to leave the training books and use the exercise/s as a student research project.

All students start at Book 1, which provides some background to Big Data: LHCb. However, from Book 2 onwards it is up to the student how far they go before switching to their research project. For example, it would be acceptable to gain some Python training in Book 2 before switching to the optional Book 2.5 and use one or more of the exercises as their research project. Alternatively, the student could dip into to Book 2.5 to gain some consolidation, before proceeding to Book 3 and beyond.

Note that other than Book 2.5, all optional exercises/research opportunities are at the end of each book (for Books 3 to 7). You can choose to ignore these optional exercises, use them for consolidation or select an exercise for your research project.

At the end, we will be running a small conference. We hope that you will be able to attend and show what you have achieved in Big DATA: LHCb! To take part, you'll need to create a PowerPoint talk or an academic poster. Don't worry, we will leave enough time for you to prepare your poster!

Happy coding!

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Project flow map

Book 1

Before we begin

An introduction to particle physics and accelerators

Book 2

Intro to Python 1

An introduction to coding in Python

Book 3

Intro to Histogramming

An introduction to computing techniques used in High Energy Physics (HEP) analysis

Book 4

Intro to Four-vectors

An introduction to four-vector structures

Book 5

Invariant mass in D decays

Obtaining invariant mass distribution in $D \to \pi\pi\pi$ decays

Book 6

Unknown 3body decays

Find the decay given the final state particles

Book 7

Asymmetries in B decays

Measuring global asymmetries in $B \to KKK$ decays

Book 8

Lifetime measurements in D decays

Measuring the D^0 lifetime

CONSOLIDATION/ PROJECT IDEAS

Book 2.5 Using Python for Physics

Optional exercises for consolidation or as ideas for your own research

Book₃

Optional Histogramming exercises or project ideas

Optional exercises for consolidation or as ideas for your own research

Book 4

Optional Four-vectors
exercises or project ideas
Optional exercises for
consolidation or as ideas for

Book 5

your own research

Optional invariant mass exercises or project ideas Optional exercises for consolidation or as ideas for your own research

Book 6

Optional 3body exercises or project ideas
Optional exercises for consolidation or acideas for

consolidation or as ideas for your own research

Book 7

Optional asymmetry exercises or project ideas

Optional exercises for consolidation or as ideas for your own research

Book 8

Optional lifetime exercises or project ideas Optional exercises for consolidation or as ideas for your own research