Measuring B meson production at LHCb

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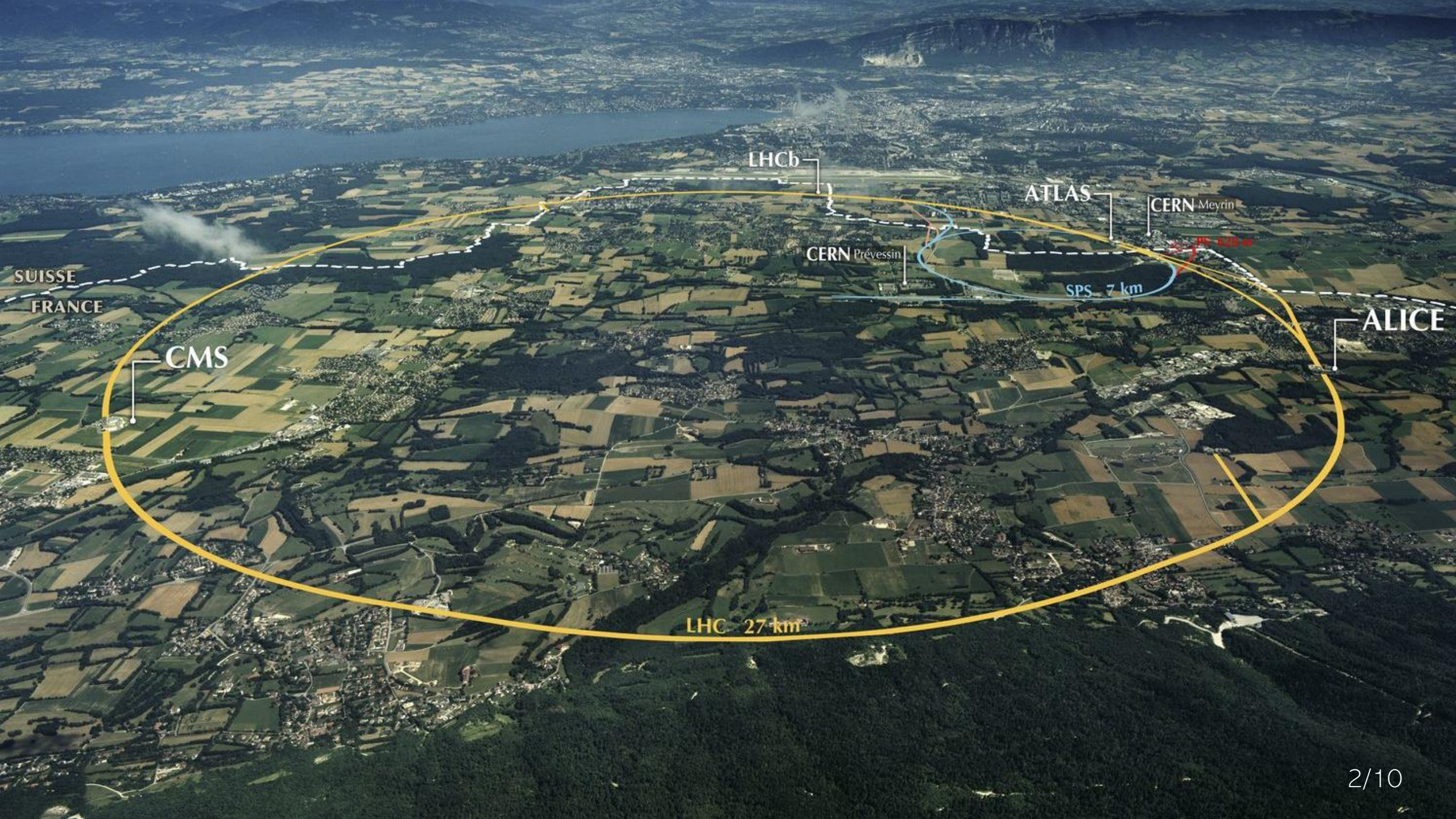
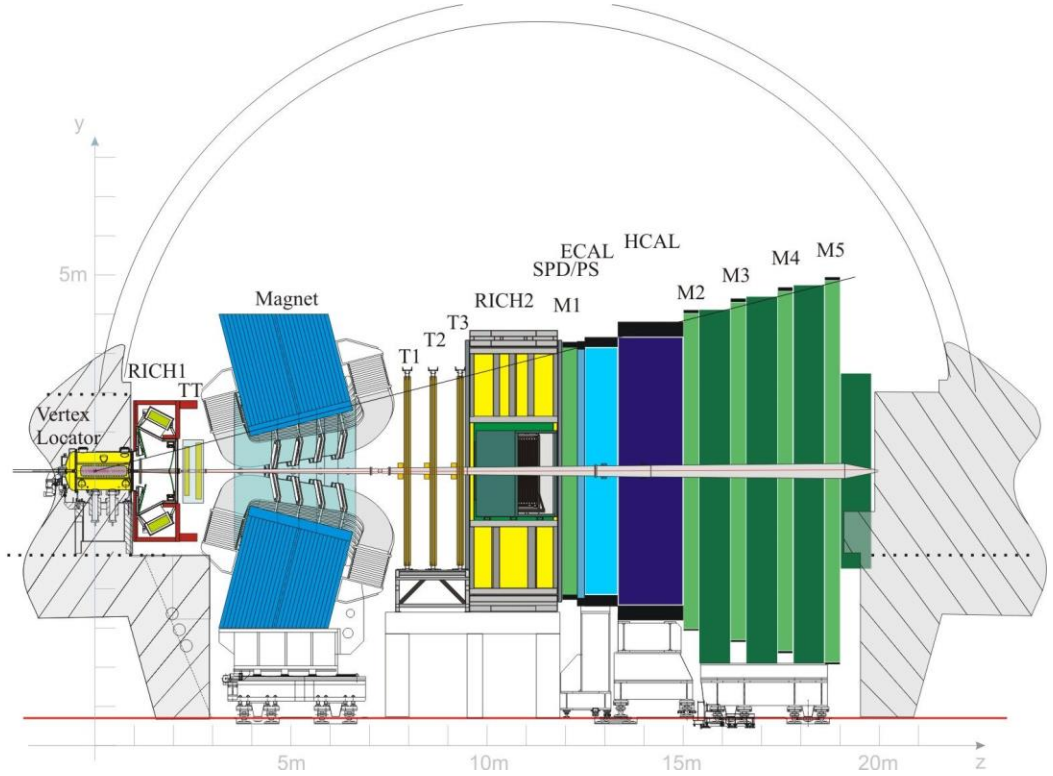
Introduction

Contents of talk today:

- Brief overview of the LHCb experiment
- The current problem with combinatorial backgrounds
- Aims of the project
- Conclusion


LHCb
ATLAS
CERN Meyrin
CERN Prévessin
SPS 7 km
SUISSE
FRANCE
CMS
ALICE
LHC 27 km

LHCb Experiment



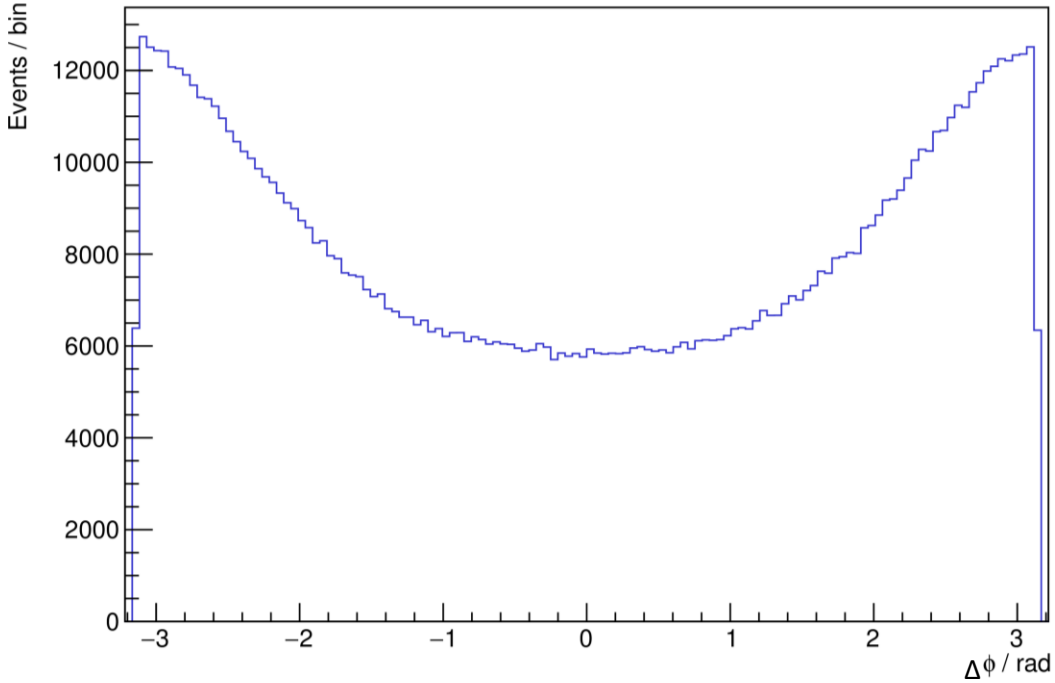
- Dedicated to the study of heavy flavour physics
- Aims to make precision measurements of CP violating processes and rare decays involving c and b quarks
- Single arm forward spectrometer
- Excellent PID and vertexing capabilities

The problem: combinatorial backgrounds

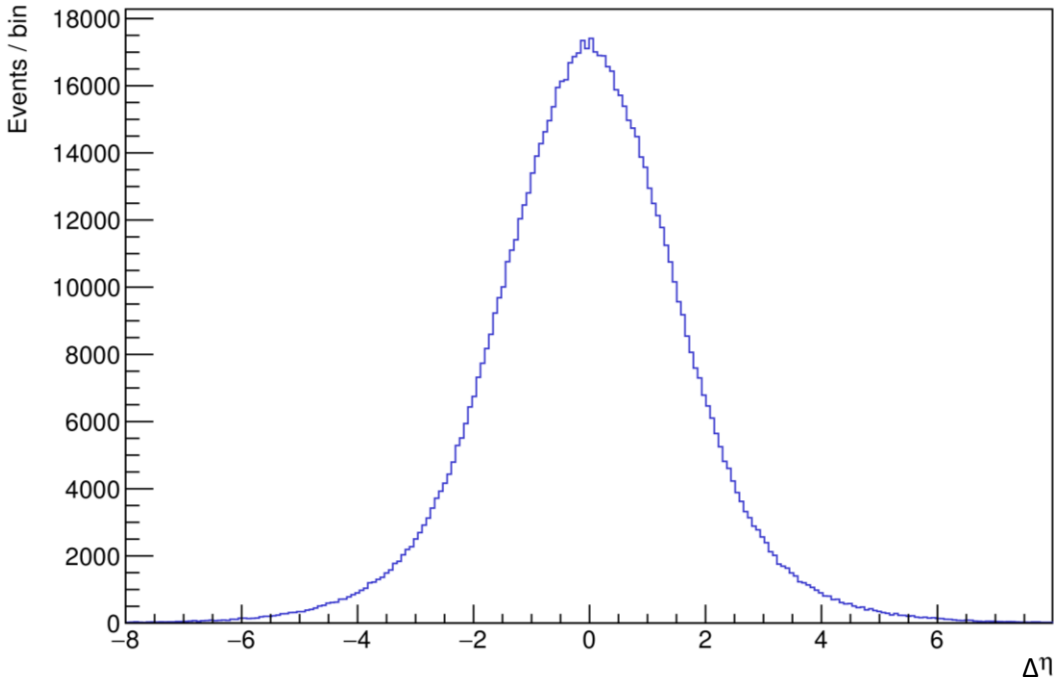
- Currently remove these by requiring little activity in a cone around the candidate event
- Definition of activity can vary (energy, number of objects considered etc.)
- Challenging combinatorial backgrounds when two B hadrons decay with their decay products overlapping in detector
- In this case would expect it difficult to isolate signal using above method, but we're not using all the available information – can we be smarter?

Initial Testing: MC of B meson production

Difference in azimuthal angle

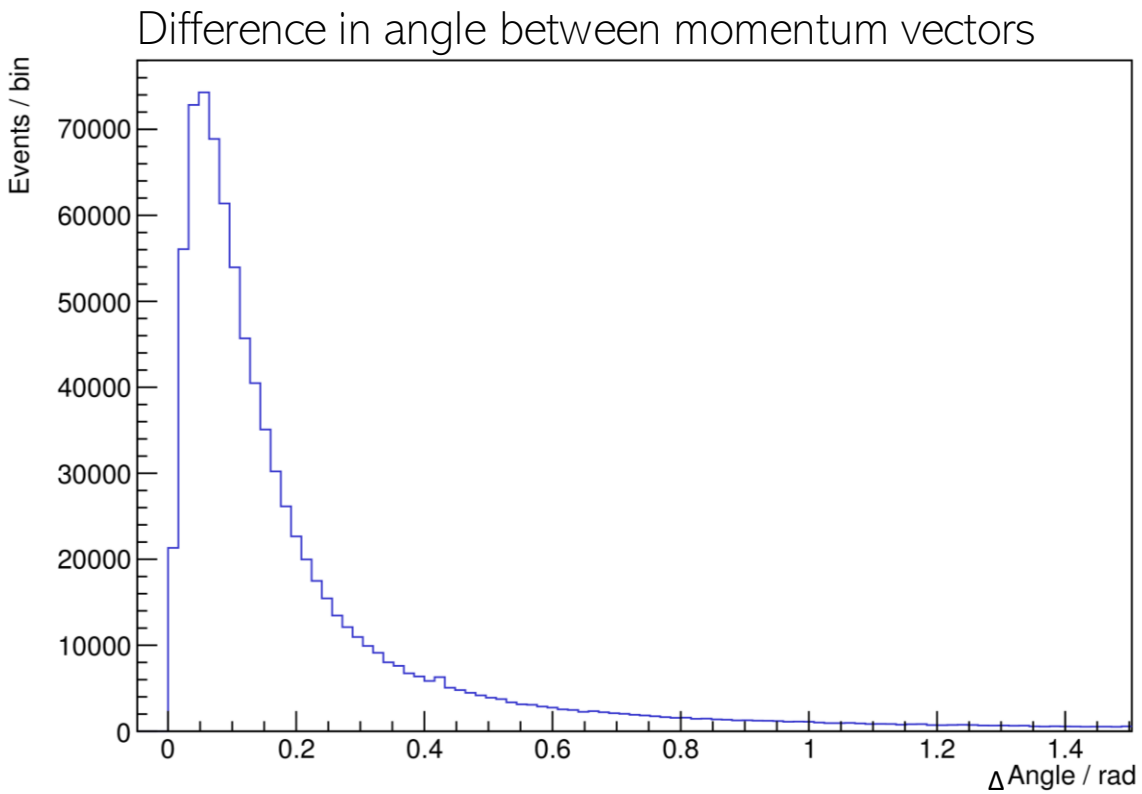


Difference in pseudorapidity



902,371 events selected

Initial Testing: MC of B meson production



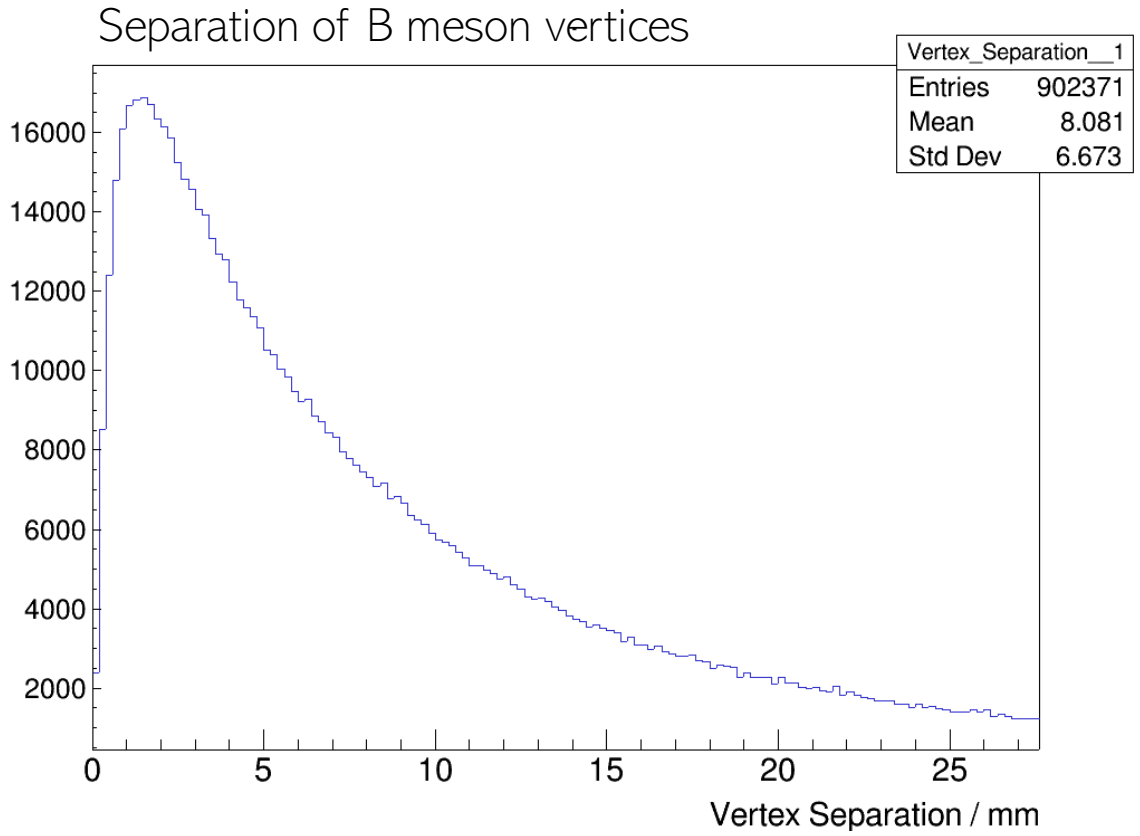
902,371 events selected

- Angle between two B mesons tends to be small
- In some cases difficult to separate tracks from one another using angular variables alone
- About 10% of the time the B mesons are in the same jet
- Using more information about tracks may help in these cases

Additional information to remove backgrounds

- Look at tracks our candidate event has and see how many good vertices each has
- The larger the number of vertices the greater the chance the candidate event is a background rather than signal
- This requires good vertexing capabilities and spatial resolution in the detector - which LHCb has!

Initial Testing: MC of B meson production



- Spatial resolution in LHCb better than 0.1mm
- This spatial resolution is crucial as can, for example, separate out well the production vertices of two B mesons
- Will require that we can spatially isolate potentially good vertices of tracks from backgrounds

Plans for the project

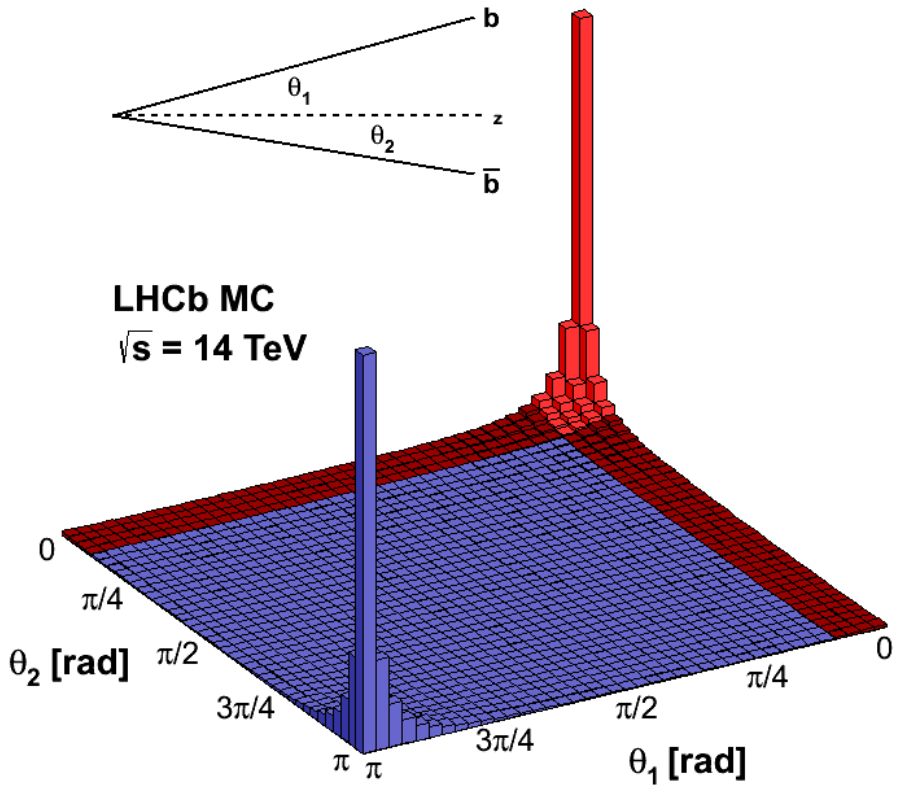
- Need to investigate whether we can identify backgrounds based on spatial isolation and number of potential vertices for each track
- Could use several different track variables to help us do this
- May use machine learning to identify most important features / check how useful our approach is
- Hope that this will allow for a better yield in analyses at LHCb

Conclusions

- Current strategy for removing combinatorial backgrounds based on angular variables alone may not be the most effective
- Can be difficult to remove large amounts of backgrounds whilst keeping yield high
- Aim to introduce a new strategy based on spatial isolation and vertices of tracks to identify potential backgrounds
- Will develop and test this idea over the coming months

Thank you for listening!

b quarks produced in same direction



Good PID, example from RICH