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”Swimming” : a data driven acceptance correction algorithm

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The LHCb experiment is a spectrometer dedicated to the study of heavy flavor at the LHC. The rate of proton-proton collisions at the LHC is 15 MHz, but disk space limitations mean that only 3 kHz can be written to tape for offline processing. For this reason the LHCb data acquisition system – trigger – plays a key role in selecting signal events and rejecting background. Because the trigger efficiency, measured with respect to signal events selected by offline analysis algorithms, is not 100%, the trigger introduces biases in variables of interest. In particular, heavy flavor particles have a longer lifetime than background events, and the trigger exploits this information in its selections, introducing a bias in the lifetime distribution of offline selected heavy flavor particles. This bias must then be corrected for in order to perform measurements of heavy flavor lifetimes at LHCb, measurements which are particularly sensitive to physics beyond the Standard Model. This correction is accomplished by an algorithm called “swimming”, which replays the passage of every offline selected event through the LHCb trigger, varying the lifetime of the signal at each step, and thus computes an event-by-event lifetime acceptance function for the trigger. This contribution describes the commissioning and deployment of the swimming algorithm during 2010 and 2011, and the world best lifetime and CP violation measurements accomplished using this method. In particular we focus on the key design decision in the architecture of the LHCb trigger which allows this method to work : the bulk of the triggering is implemented in software, reusing offline reconstruction and selection code to minimize systematics, and allowing the trigger selections to be re-executed offline exactly as they ran during data taking. We demonstrate the reproducibility of the LHCb trigger algorithms, show how the reuse of offline code and selections minimizes the biases introduced in the trigger, and show that the swimming method leads to an acceptance correction which contributes a negligible uncertainty to the measurements in question.

Student? Enter ’yes’. See http://goo.gl/MVv53

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