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# Statistical significance estimation of a signal within the GooFit framework on GPUs

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Graphical Processing Units (GPUs) represent one of the most sophisticated and versatile parallel computing architectures available that are nowadays entering the High Energy Physics field. GooFit is an open source tool interfacing ROOT/RooFit to the CUDA platform on nVidia GPUs. Specifically it acts as an interface between the MINUIT minimisation algorithm and a parallel processor which allows a Probability Density Function (PDF) to be evaluated in parallel.

In order to test the computing capabilities of GPUs with respect to traditional CPU cores, a high-statistics pseudo-experiment technique has been implemented both in ROOT/RooFit and GooFit frameworks with the purpose of estimating the local statistical significance of the structure observed by CMS close to the kinematical boundary of the  $J/\psi$  invariant mass in the  $B^+ \rightarrow J/\psi K^+$  decay. The optimized GooFit application running on GPUs provides striking speed-up performances with respect to the RooFit application parallelised on multiple CPU workers through the PROOF-Lite tool.

By means of GooFit it has also been possible to explore the behaviour of a likelihood ratio test statistic in different situations in which the Wilks Theorem may apply or does not apply because its regularity conditions are not satisfied.

The described technique has been extended to situations when, dealing with an unexpected signal, a global significance must be estimated.

The LEE is taken into account by means of a scanning technique in order to consider - within the same background-only fluctuation and everywhere in the relevant mass spectrum - any fluctuating peaking behavior with respect to the background model. The execution time of the fitting procedure for each MC toy considerably increases and GooFit is a reliable tool to carry out this p-value estimation method.

## Summary

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