



LPCC Fast Detector Simulation Workshop

Validation of the Fast Simulation

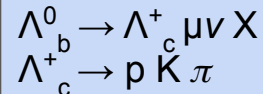
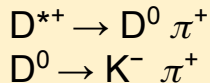
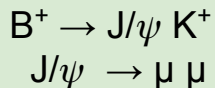
Focusing on Lamarr

Lucio Anderlini,
on behalf of the LHCb Simulation Project

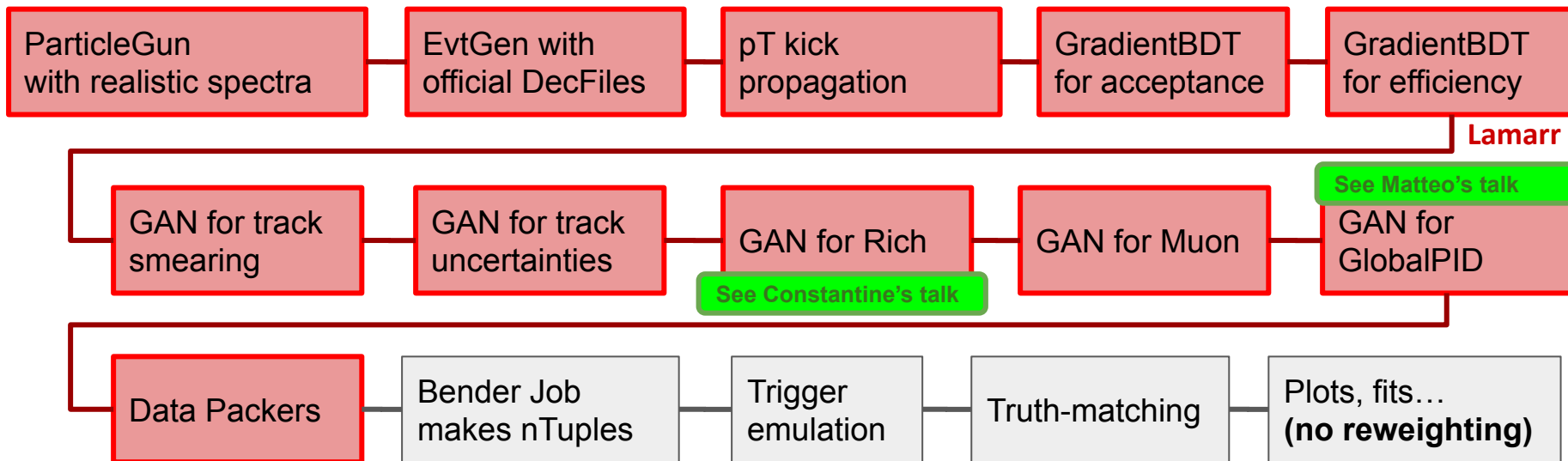
2021-11-23

Lamarr Validation

Chosen three decays with relatively wide/various kinematic coverage



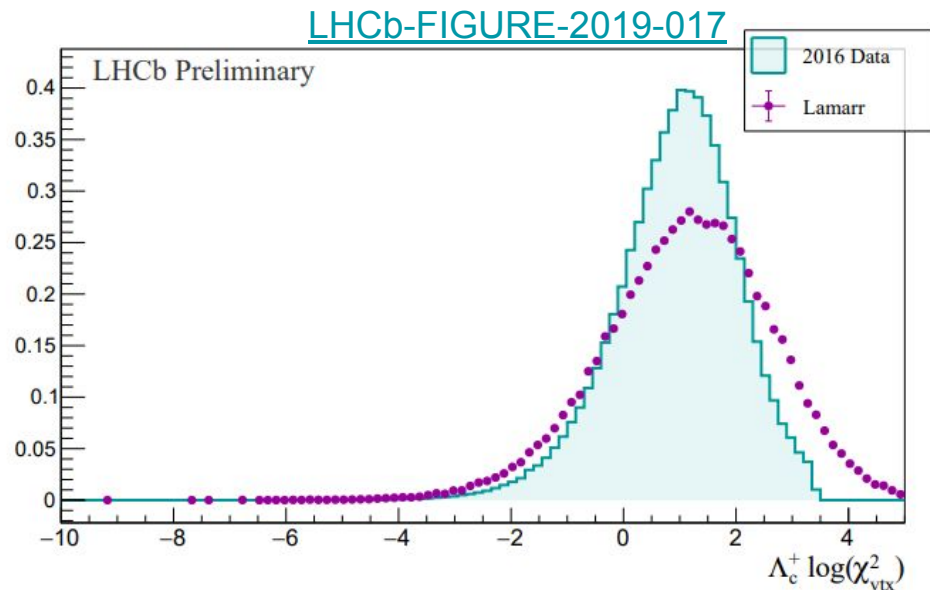
These decays are stored as part of the calibration data, providing unbiased selections on **muon**, **kaons**, **pions** and **protons**. [See Saverio's talk](#)



Validation of the tracking parametrization

Tracking is validated by comparing the distribution of high-level quantities obtained at analysis level using simulated quantities as inputs.

For example, the vertex-quality χ^2 has a distribution depending on the tracking efficiency, momentum resolution smearing, and **uncertainty predicted** for the “reconstructed” quantities.



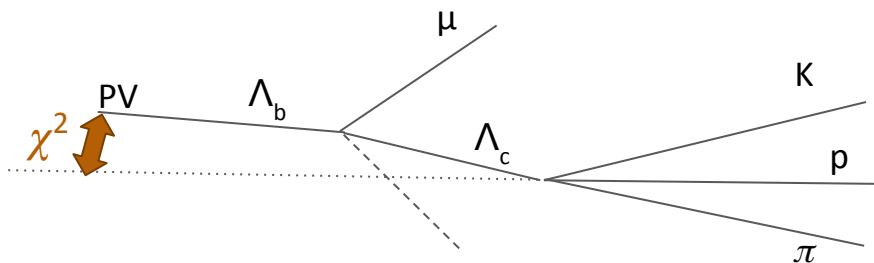
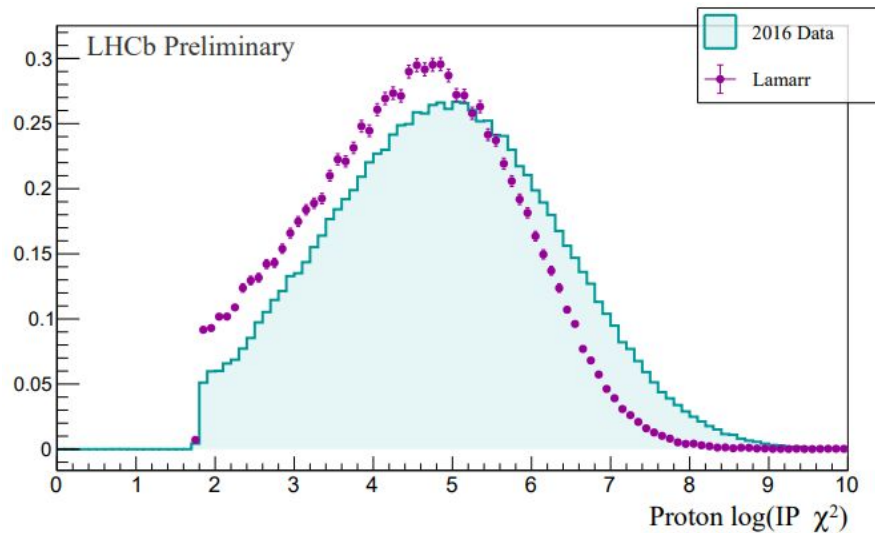
$$\chi^2 = \sum_i \frac{\Delta x_i^2}{\sigma_i^2}$$

Uncertainty from
reco algorithms,
predicted in FastSim

Validation of the tracking (and PV) parametrization

Primary Vertices are not obtained from a fit in the Fast Simulation, but their positions and the respective **uncertainties** are obtained by parametric smearing.

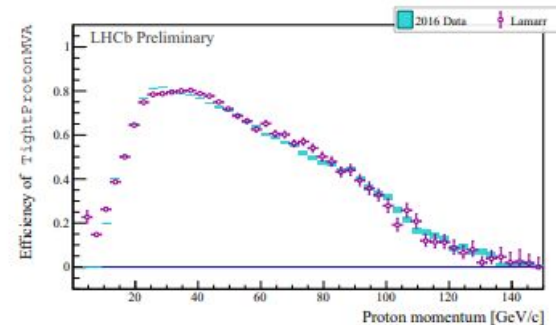
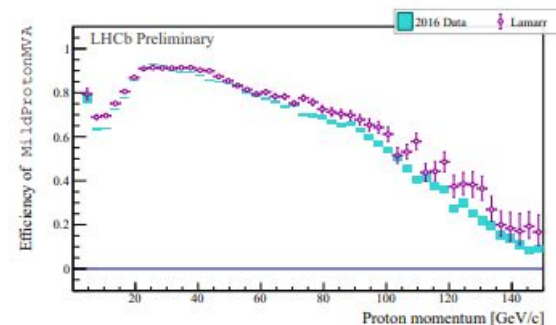
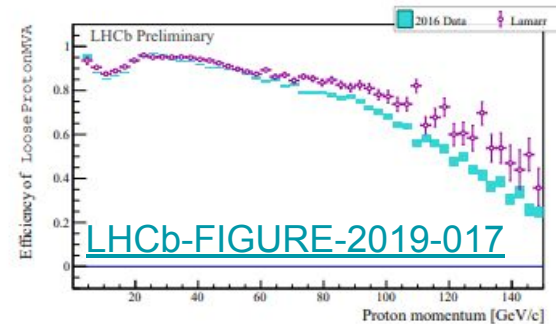
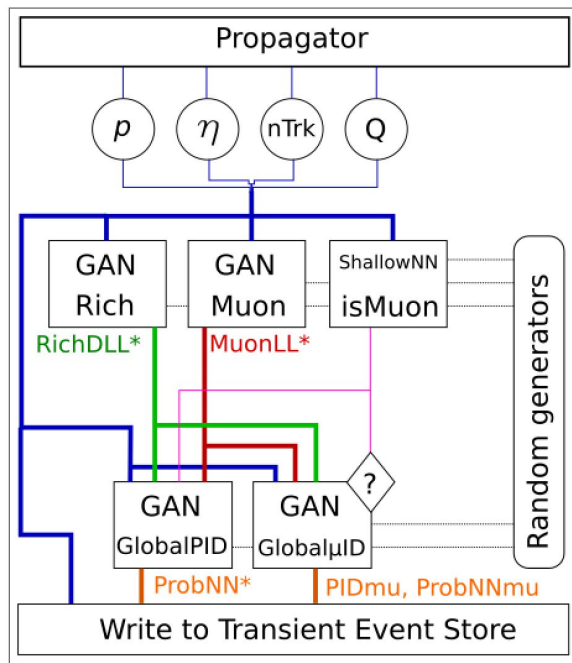
They enter validation through the test of variables like the *impact parameter* χ^2 which is a measure of the consistency of the particle trajectory and the PV.



Particle Identification validation

On particle identification, we compare to data analysis-level quantities obtained combining lower-level detector responses.

Since the detector performance drastically depends on the kinematic variables, we chose a threshold and **plot efficiency** as a function of kinematics.



Conclusion

- Validation of Fast Simulation based on the comparison with **real data collected as part of calibration samples**, but not used in the training of the ML components.
- Try to push the comparison toward highest-, **analysis-level quantities** as a kind of checksum.
- Quality of the comparison in shown today is not very exciting, but the only public plots are slightly outdated (mid 2019) and **a lot of progress** is is being done



For the validation of fast simulations not based on machine-learning techniques see for example the [ReDecay paper](#).