Attività di analisi a Ferrara

Marco Fiore
(on behalf of the LHCb Ferrara group)

October 14th 2015

LHCb Italia Collaboration Meeting
13-14 October 2015, INFN - LNF

Outline

- B_s -> D_s K time dependent analysis

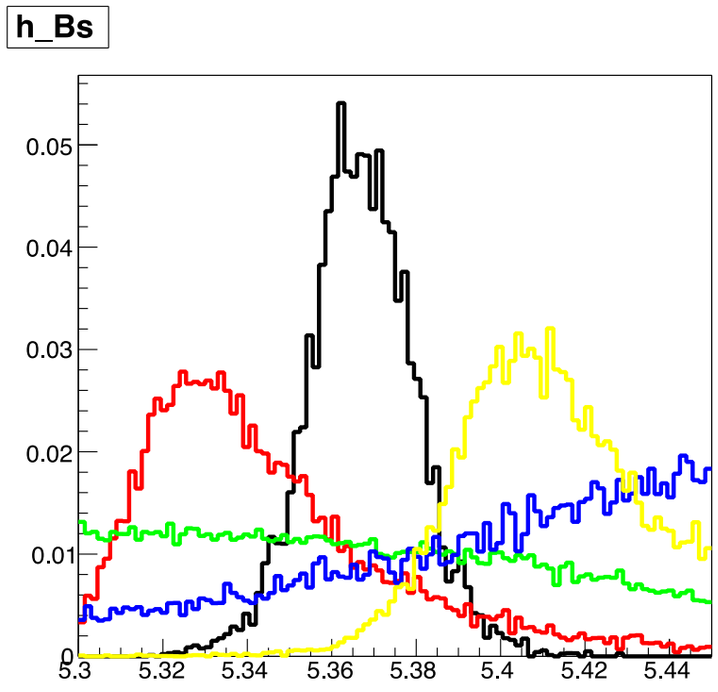
- Semileptonic B decays
  - B_d -> D* τ (—> π π π ν) ν
  - B -> D* π (π) μ ν

- Fast Monte Carlo (Delphes)

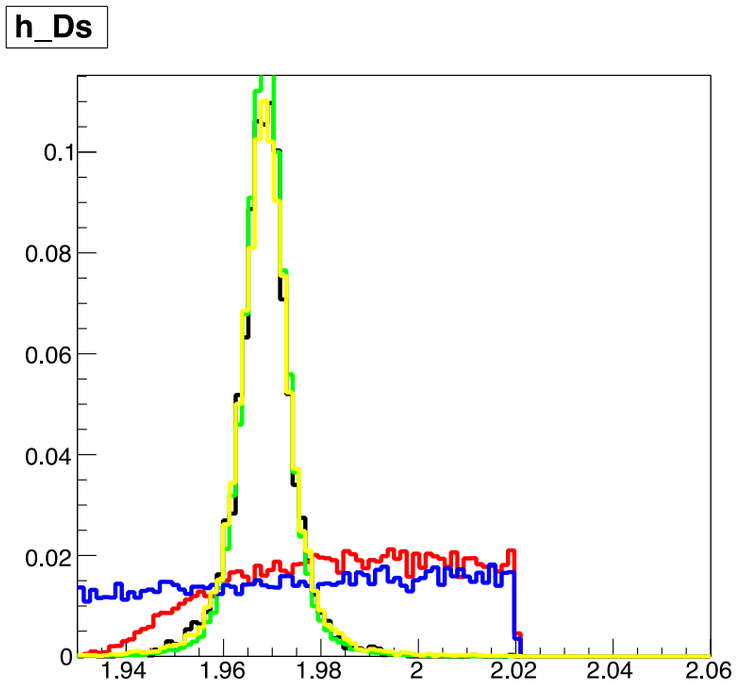
- Glances: Flavour Tagging, B->DDK, L0Muon FOI optimisation, Δm_d

$B_s \longrightarrow D_s K$
(G. Tellarini, S. Vecchi)

- The goal is the measurement of the CKM γ angle (update to the 1fb^{-1} analysis, JHEP 11 (2014) 060)
- Analysis strategy: multi-dimensional fitter (m(B^0_s), m(D_s), PIDK bachelor) + time fitter
- Hints on correlations between the observables were seen in background MC —> updated analysis has to take them into account;
- Large statistics samples of all background decays are produced in the phase space with a Fast MC (using TGenPhaseSpace) developed for this analysis;
- Kinematic inputs for generation are taken from MC distributions;
- Emulate main reconstruction effects (resolution, efficiencies), analysis steps (cuts, acceptance, kinematic), PID and FT. All of the observables in the fit and the main correlations were properly reproduced;
- Main background sources have been reproduced and are shown in the plots below



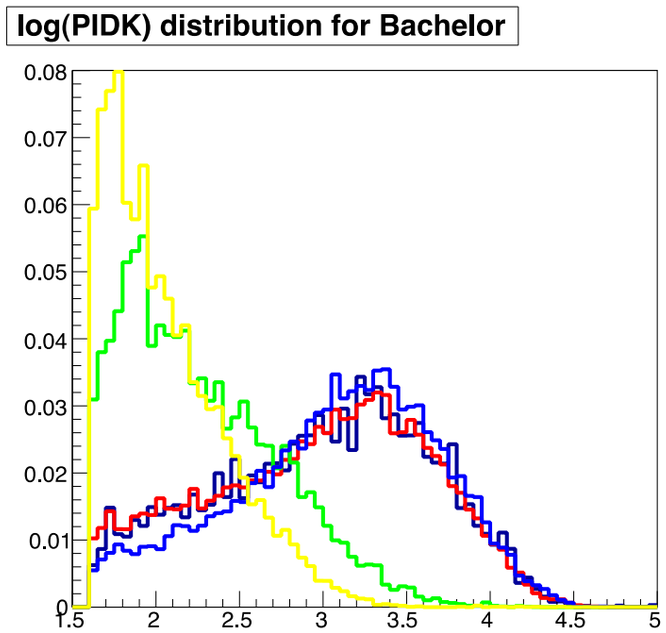
- B^0_s-> D_sK
- B^0_s-> $D_s\pi$
- B^0-> D K
- Λ_b -> Λ_cK
- Λ_b -> D^*_sp



$B_s \longrightarrow D_s K$
(G. Tellarini, S. Vecchi)

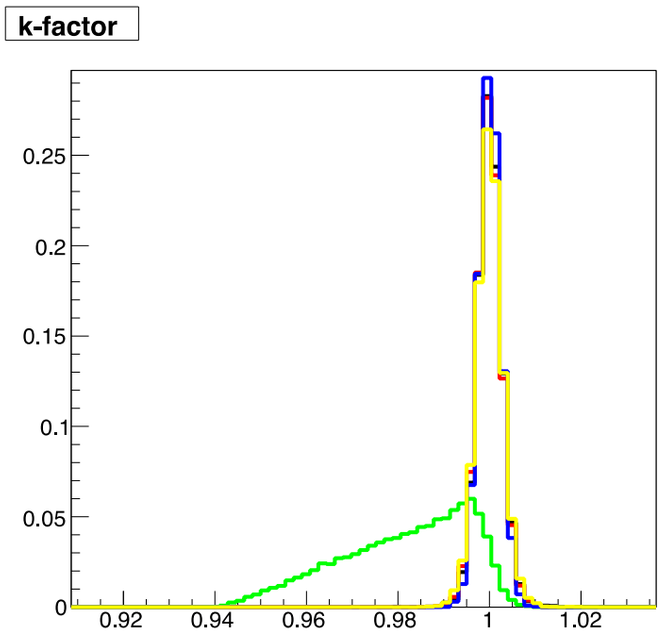
- Signal validation was done on full MC
- PID has been reproduced using the standard PIDCalib package
- Correlations studied among $m(B^0_s)$, $m(D^0_s)$, PID bachelor, t_B and δ_t :
  - Correlations were seen between MDFitter variables O(15-30%)
  - No Correlations between MDFitter and time fitter variables —> sFit technique
  - Links to last reports at the B2OC-TD meeting: 1), 2)
- Toys production using the emulator is ongoing to estimate the effect of the correlations on the determination of the CP coefficients

PID distributions are in agreement with what's expected in data



- $B^0_s \to D_s K$
- $B^0_s \to D_s \pi$
- $B^0 \to D K$
- $\Lambda_b \to \Lambda_c K$
- $\Lambda_b \to D^*_s p$

Such Fast MC is suitable for producing k-factors distributions

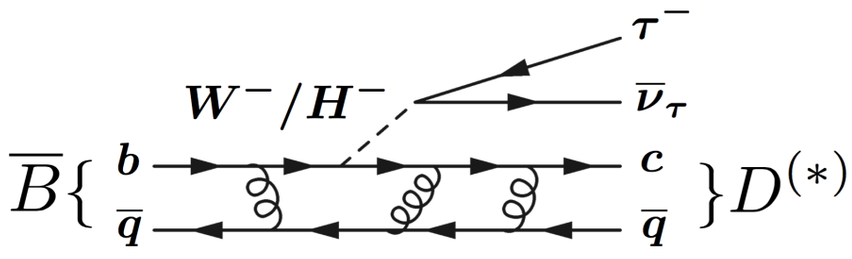


B_d —> D* τ (—> π π π ν) ν
(C. Bozzi, B. Siddi)

• New Physics contributions to semileptonic B decays would imply a stronger coupling between gauge bosons and the third lepton generation, SM extensions predict a charged Higgs boson;

• The quantity we want to measure is R(D*)

$$R(D^*) = \frac{\mathcal{B}(\bar{B}^0 \to D^{*+}\tau^-\bar{\nu}_\tau)}{\mathcal{B}(\bar{B}^0 \to D^{*+}\mu^-\bar{\nu}_\tau)}$$

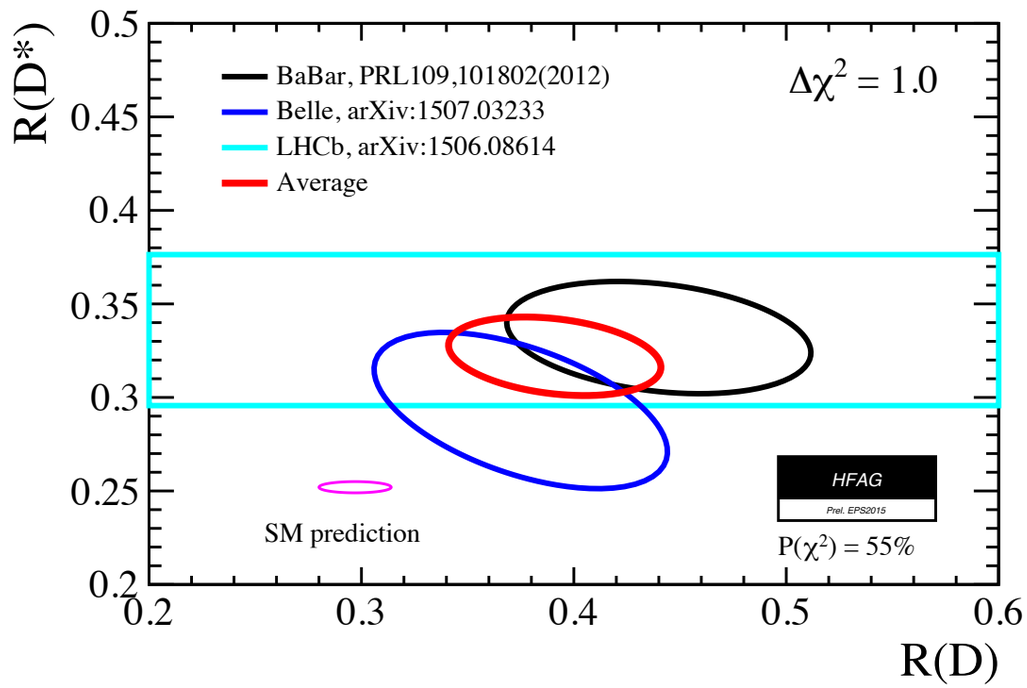


• Standard Model predicts $R(D^*) = 0.252 \pm 0.003$

• LHCb measured R(D*) using B_d —> D* τ(—> μ ν ν) ν

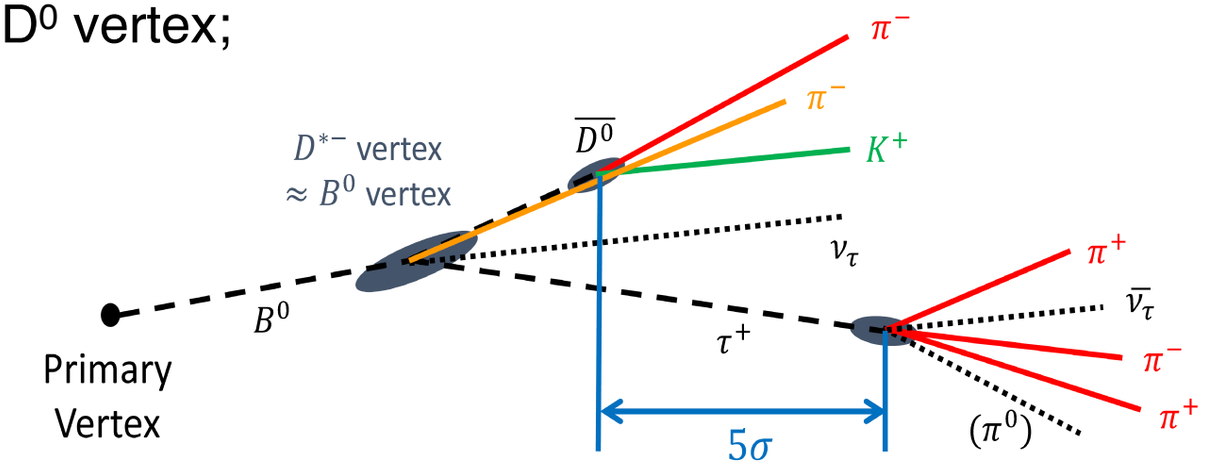
• R(D*) = 0.336 ± 0.027(stat.) ± 0.015(syst.)

~3σ tension with the Standard Model
3.9 σ including R(D(*))
from Babar and Belle

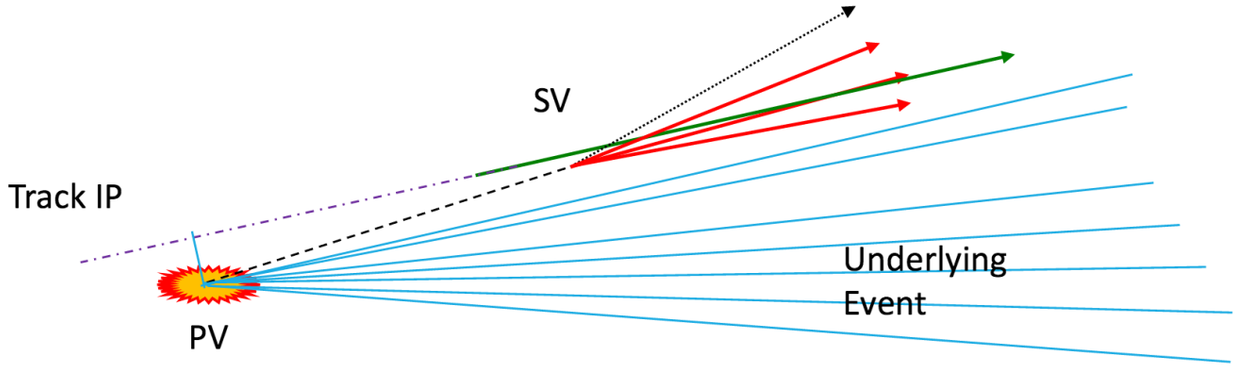


B_d —> D* τ (—> π π π ν) ν
(C. Bozzi, B. Siddi)

- So far this study was performed on a MonteCarlo sample equivalent to 2 fb^{-1}
- Main background sources:
  - B -> D* 3π X suppressed requiring 3π vertex significantly downstream with respect to the D^0 vertex;



  - B -> D* D_s (-> 3π + X) avoid this background by looking for additional neutral or charged tracks in a cone around the 3π flight direction



B_d —> D* τ (—> π π π ν) ν
(C. Bozzi, B. Siddi)

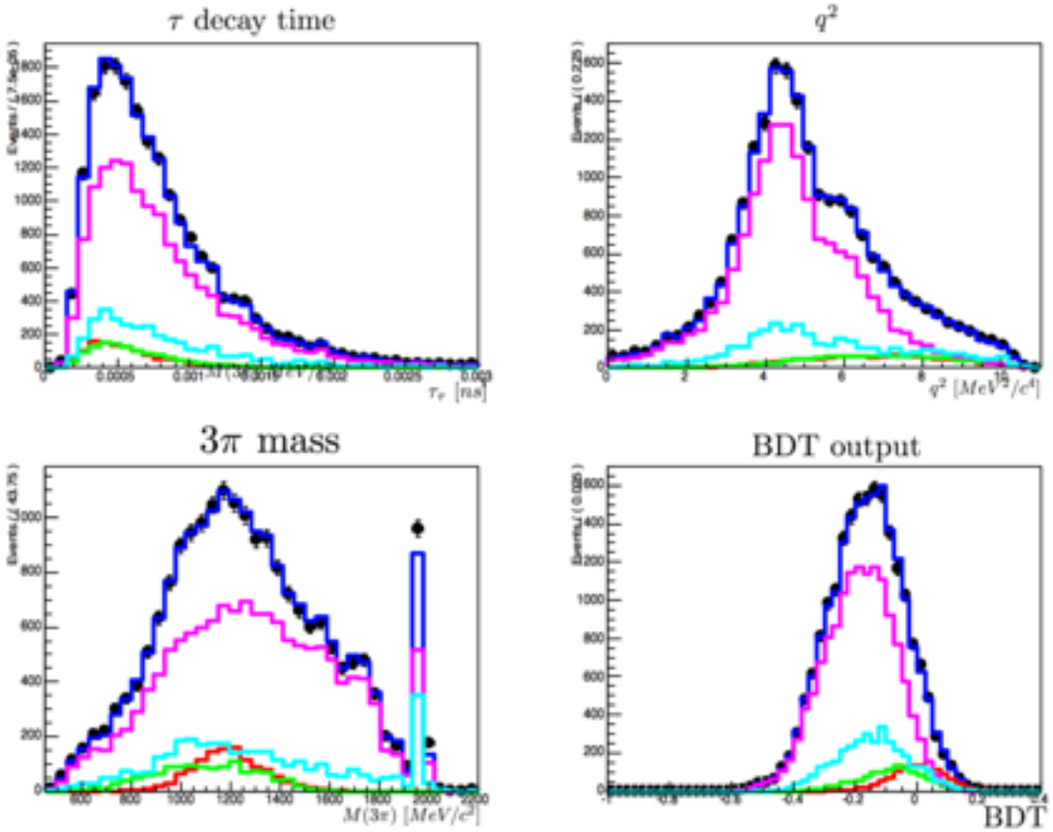
• The MC sample has four components :
τ—> 3π , τ—> 3π π^0, D^*D_s and inclusive $D^*3\pi X$;

• Simultaneous fit to τ decay time, q^2 and BDT output (trained with signal D*τν and background D^*D_s and inclusive D*3π);

• From the fit we can reproduce the components and determine the signal and background fractions;

• The signal fraction has an uncertainty of 5.0%, 2 times better than the current precision

• Next steps: compute the systematic uncertainties and apply this method to the data



B_d —> D* π (π) μ ν
(C. Bozzi, M. Fiore)

• Charm meson spectroscopy (e.g. D**);

• Gap between inclusive semileptonic BR and the sum of all exclusive decays BRs;

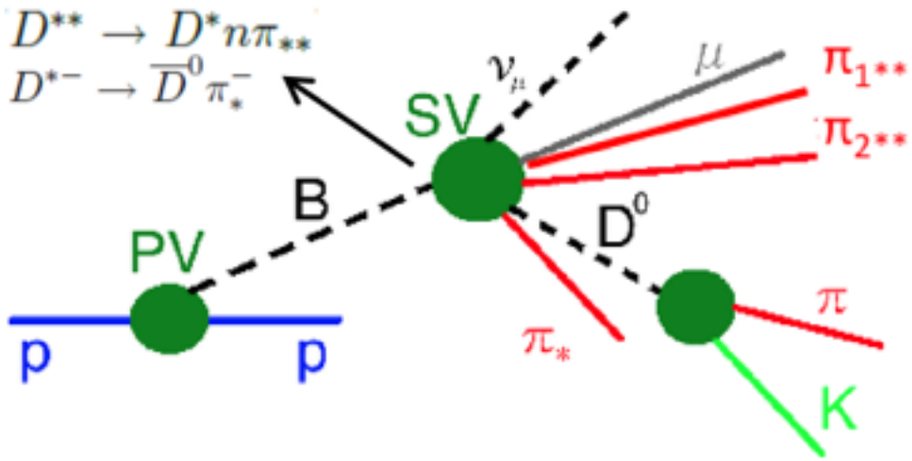
• Reconstruction based on kinematical and topological requirements;

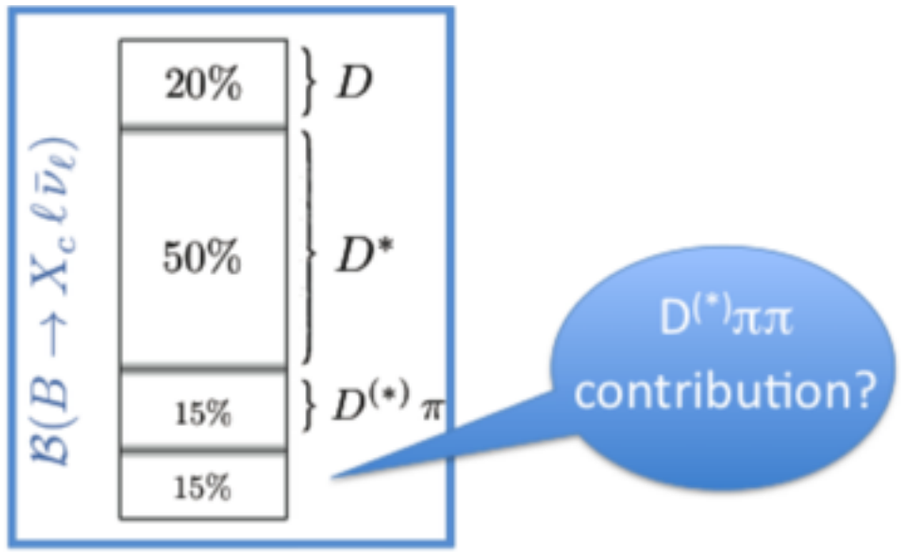
• Isolation tool was developed to pre-select pions from the signal B, moreover an MVA selects the best pion(s);

• The analysis strategy is to perform a 1D fit to the log(IP_π) distribution (2D for π π channel)

• Backgrounds: combinatorial, Prompt D*, B -> D^0 decays, mis-ID pions, μ from τ decays;

• Previous studies showed a potential reduction of the gap from 15% to 6-8% using 2π mode (to be refined)

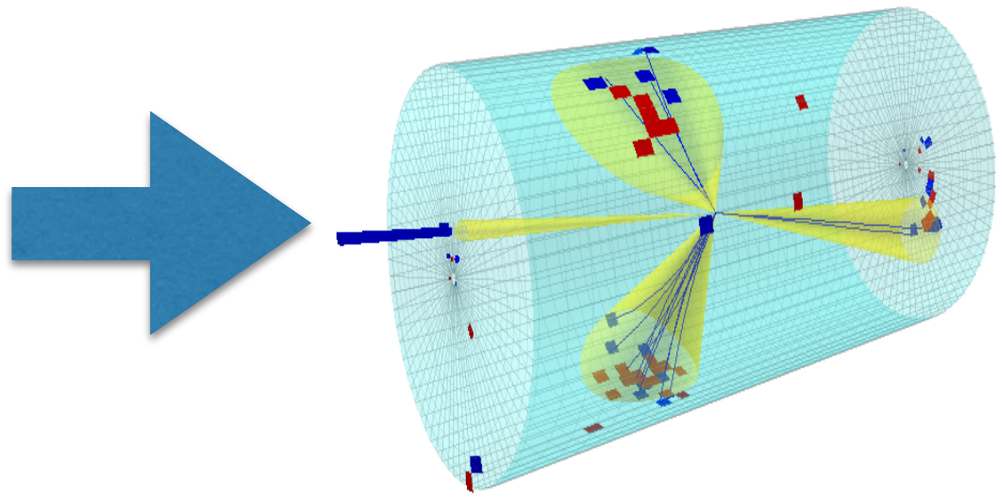




Fast Monte Carlo
(C. Bozzi, B. Siddi)

- A general Fast MC simulation is still missing in LHCb;
- Delphes is a modular framework that parametrises the response of a multipurpose detector and the reconstruction algorithm (already implemented in ATLAS and CMS);
- Advantages with respect to full simulation:
  - Mitigation of CPU resources needed;
  - Possibility to generate larger and more inclusive data sample
- Disadvantages:
  - Detailed understanding of interactions with detector material is needed;
  - Detector response “averaged out”
- Integration of Delphes in LHCb simulation just started

A typical Vector Boson Fusion $H \rightarrow b\bar{b}$ event in a central detector, shown with the Delphes event display (courtesy of Delphes developers)



Glances

B —> DDK
(L. L. Pappalardo)

• The goal is to measure the relative BF of B->$D^0\bar{D}^0$ K, B->D^+D^- K, B->D_sD_s K (first observation);
• Analysis crew changed : S. Neubert left, D. Johnson joined —> unavoidable delay;
• Data and MC are being reprocessed;
• Optimisation strategy revised: an additional BDT will substitute previous multi-dimensional cut based selection;
• The 3D fitter is ready;
• Codes for efficiency corrections are under development;

Δm_d with B->D(*) μ ν
(C. Bozzi, M. Fiore, S. Vecchi, MIB)

• LHCB-CONF-2015-003 : preliminary results were shown at EPS;
• The analysis is being finalised: reviewers and PC requested us to reduce the systematic uncertainty due to momentum scale calibration;
• Also re-evaluating all of the systematic uncertainties;
• A paper draft is ready;
• More details will be given by Paul in the next talk

L0Muon FOI optimisation
(M. Fiore)

• New L0Muon FOI configuration ({4,3,0,4,8} instead of {6,5,0,4,8}) is already implemented in the trigger since the beginning of July. Most recent talk @ LHCb week

Flavour Tagging
(G. Tellarini, S. Vecchi, MIB)

• Finalising the analysis of NNetKaon tagging for publication
  - The analysis is now under review
  - The RC requested to validate the analysis of the $B_s \to D_s \pi$ channel for SSK calibration by means of :
    A. Dedicated toy studies : almost done
    B. Further studies on data (bootstrap) : done
• A paper draft is ready