Two Track Trigger simulation for Bs to J/Psi Phi analysis

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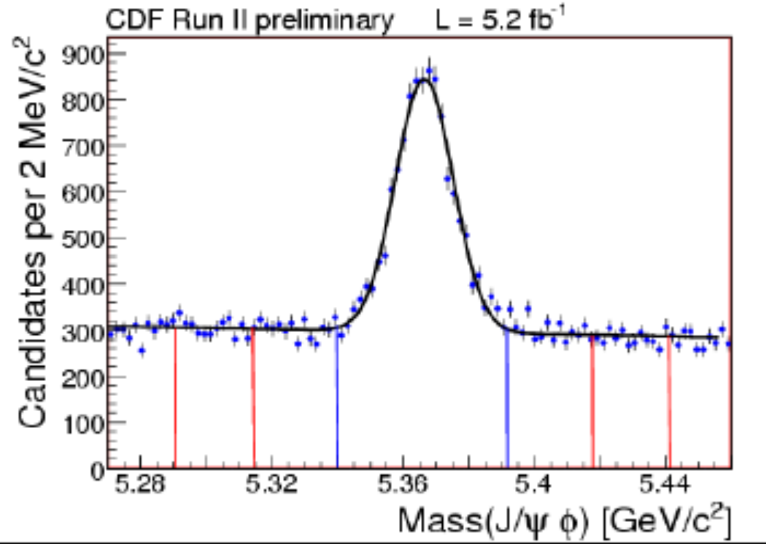
Result for B_s to J/Psi Phi at CDF

$B_s \to J/\psi\,\varphi$ (CDF)

G. Giurgiu, ICHEP-2010, CDF Public note 10206

- 5.2 fb^{-1} of data analyzed
- ~6500 signal events
- Same side flavour tagging calibrated in data
- Strong phases are free
- S wave included in the fit

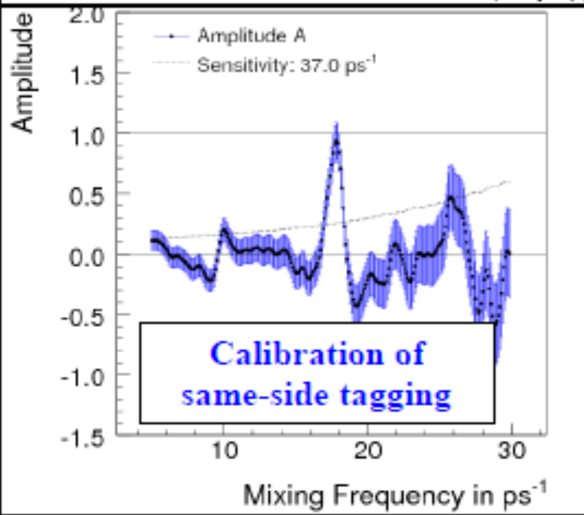
  < 6.5% at 95% CL



$$\tau_s = 1.529 \pm 0.025\ \text{(stat)}\ \pm 0.012\ \text{(syst)}\ \ \text{ps}$$

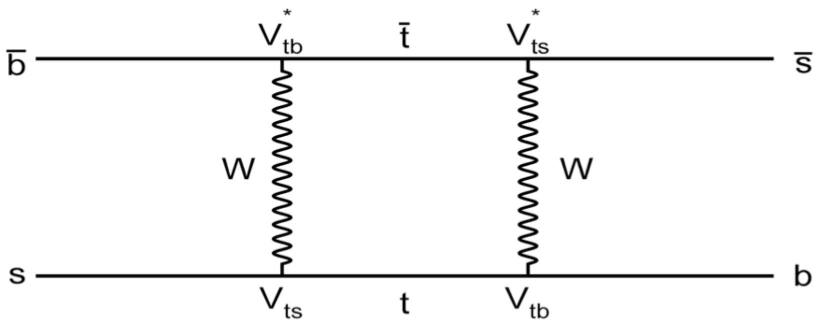
$$\Delta\Gamma_s = 0.075 \pm 0.035\ \text{(stat)}\ \pm 0.01\ \text{(syst)}\ \ \text{ps}^{-1}$$

Most precise measurements of $\tau(B_s)$ and $\Delta\Gamma_s$

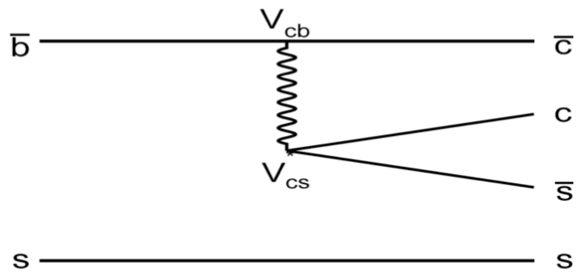


2010/07/27 BSM searches through B ph 19

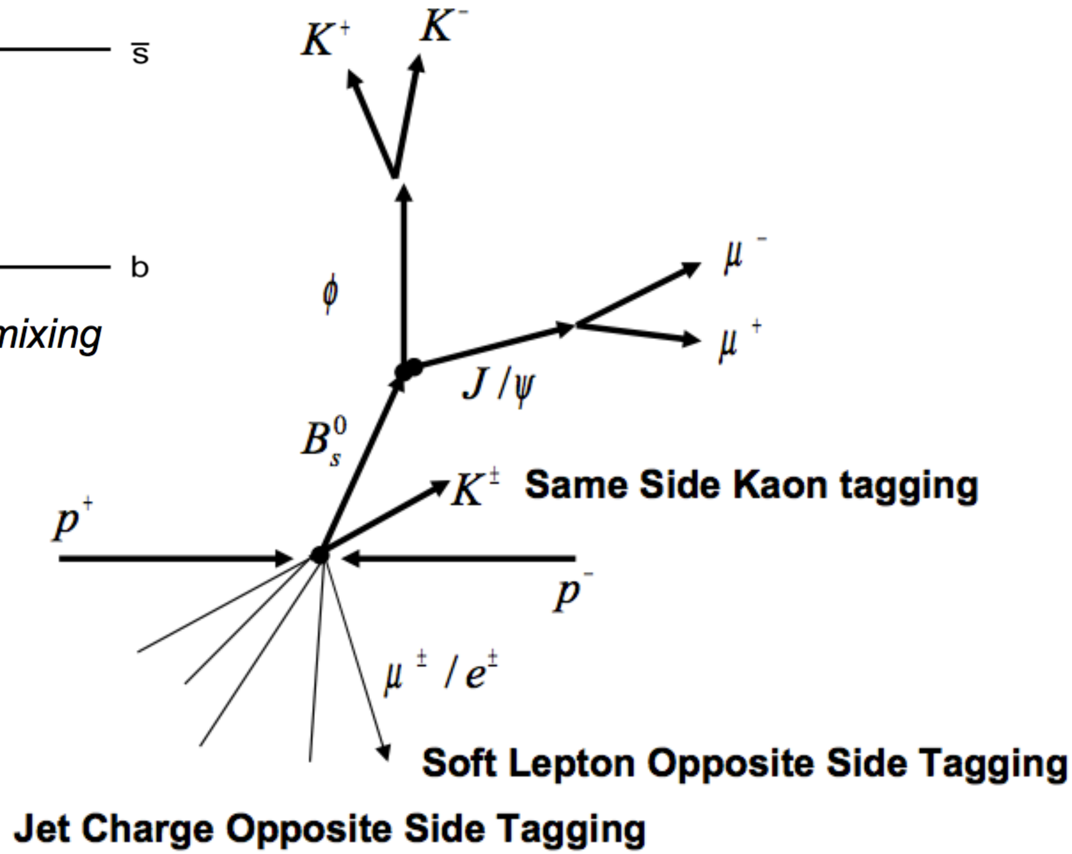
Analysis : B_s to J/Psi Phi



Feynman box diagram for the B_s mixing



Feynman diagram for the $B_s \to J/\psi\,\phi$



Kinematics of an event

Measurement of β_s and $\Delta\Gamma$

Method of Analysis

1) Reconstruction of the Bs→J/ψ φ mode
   - Kinematic recontruction of the final state
   - Identification of the Bs flavour (b-tagging)

1) Unbinned maximum likelihood fit for the determination of the βs, ΔΓ

$$L = \prod_{i=0\ldots N} \left(f_s P(S) + (1 - f_s) P(B) \right)$$

Unbinned likelihood function: generic formulation

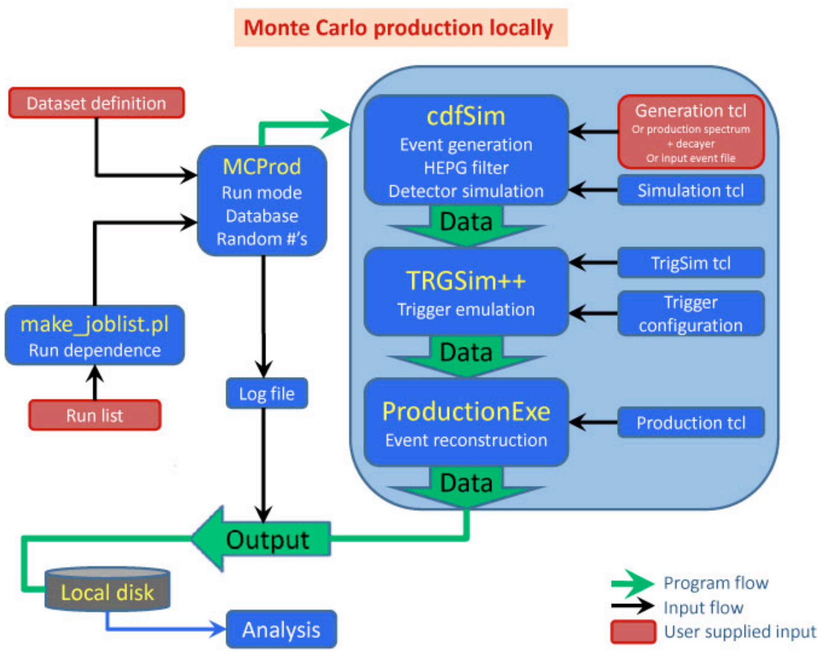
$$L = f_s \overbrace{P(m\,|\,S)}^{\text{Mass term}} \overbrace{P(ct, \vartheta, \psi, \phi\,|\,\sigma_{ct}, S)}^{\text{CP angular analysis}} \overbrace{P(\sigma_{ct})}^{\text{ct error}} +$$
$$+ (1 - f_s) \underbrace{P(m\,|\,B)}_{\text{mass term}} \underbrace{P(\vartheta, \psi, \phi\,|\,B)}_{\text{Angular distribution}} \underbrace{P(ct\,|\,\sigma_{ct}) P(\sigma_{ct})}_{\text{Decay}}$$

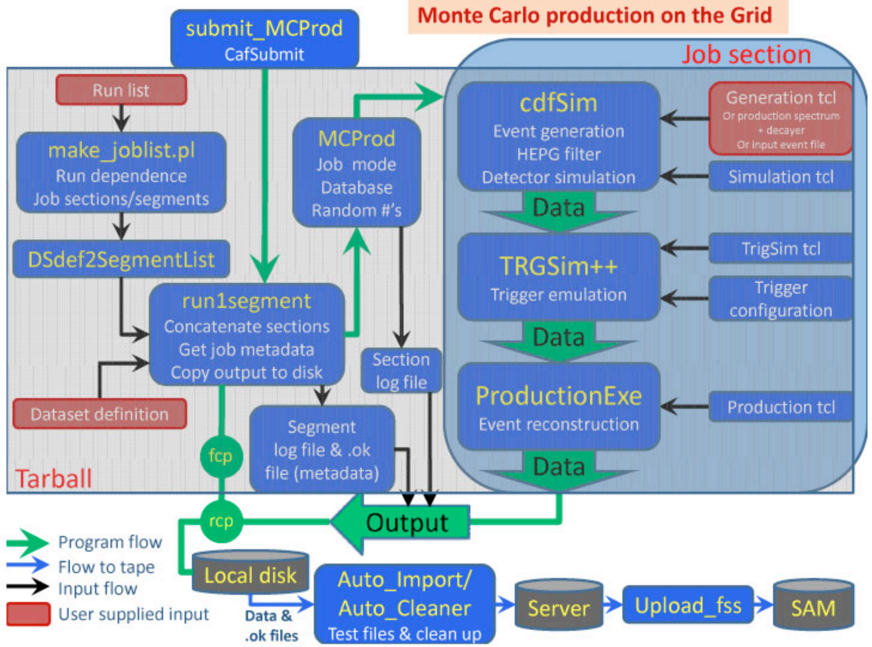
1) Mass term:
   - Signal: 1 gaussian
   - Background: 1 exponentia
2) CP angular analysis and angular distributions
3) Ct error: 2 Gamma functions
4) Background Ct distribution:
   - 1 smeared and shifted exponential (TTT)
   - 1 prompt gaussian + 2 exponential (di-muon)

To produce B-Standard Ntuple

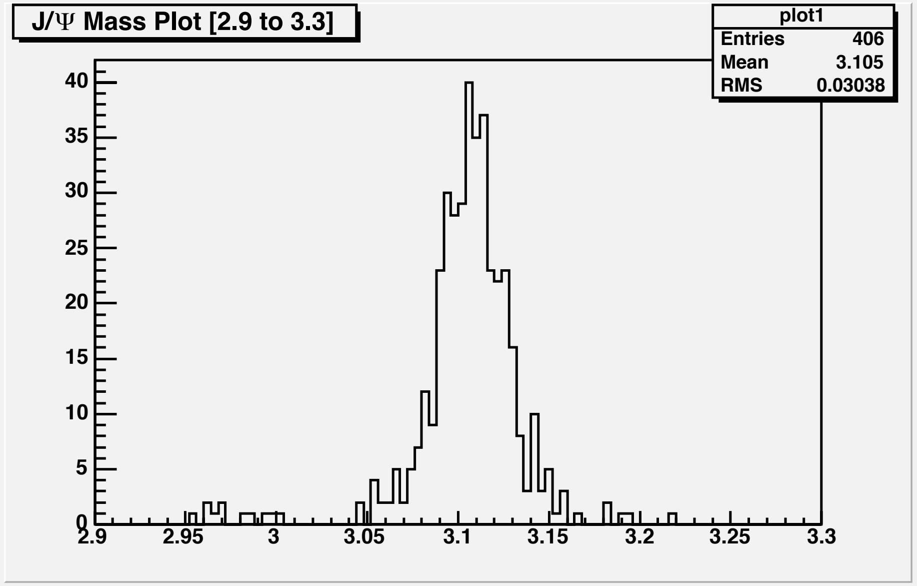
1. MC events generation with Two Track Trigger environments.

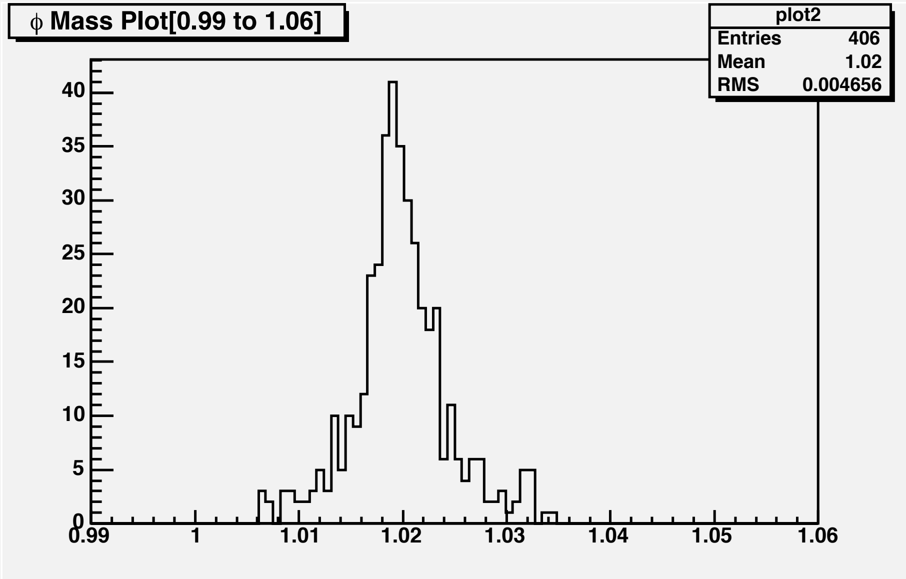
- MCProd_v6_1_4mc_t_strip_maxopt (latest patched-t version)
- Bs to J/Psi Phi decay table
- apply Two Track Trigger information to Cuts
- result : *.root and *.output files
- tested by Locally and CAF

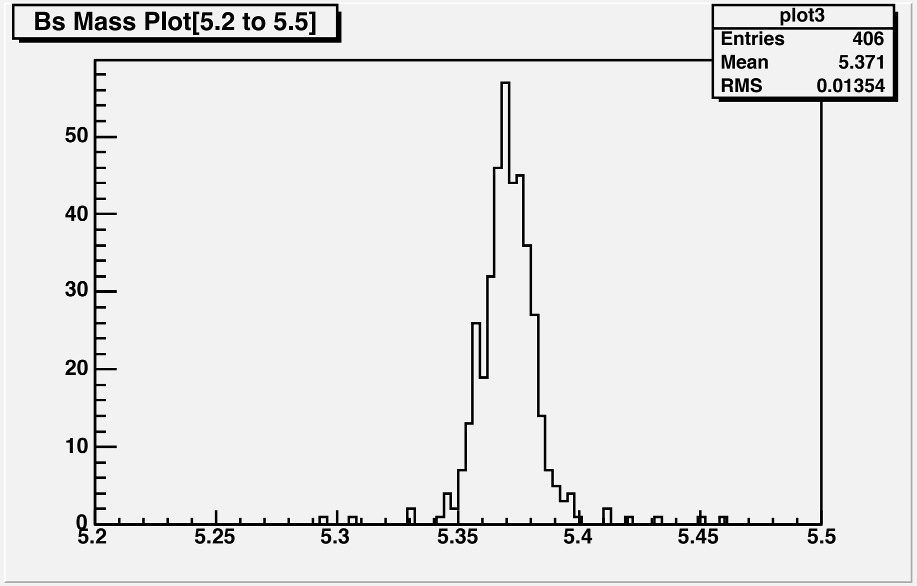


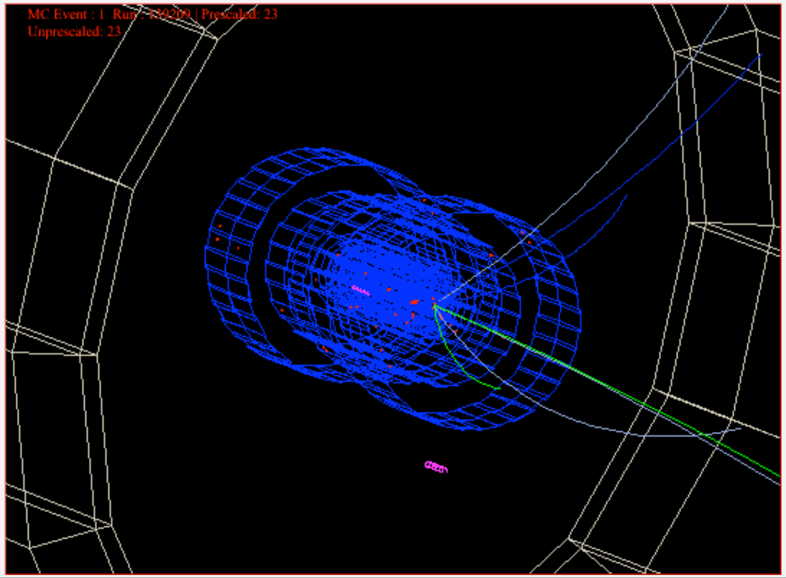


Mass Plots from B-Standard Ntuple

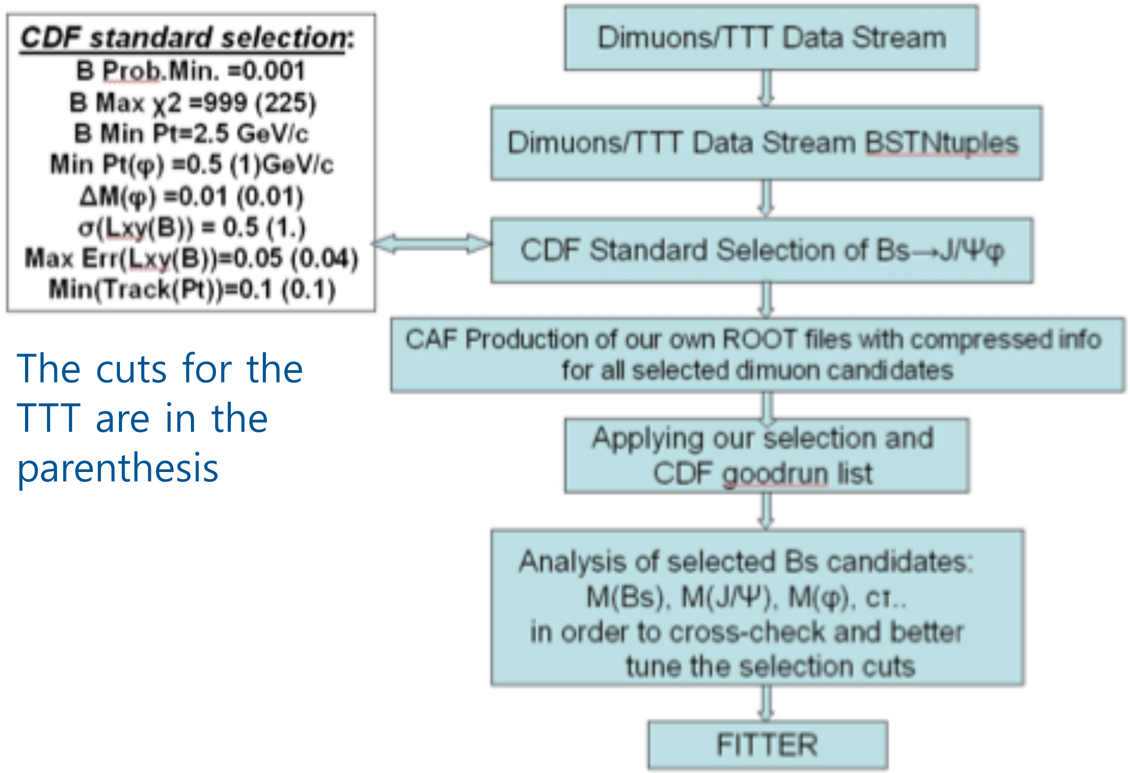








Flow DIAGRAM



The cuts for the TTT are in the parenthesis

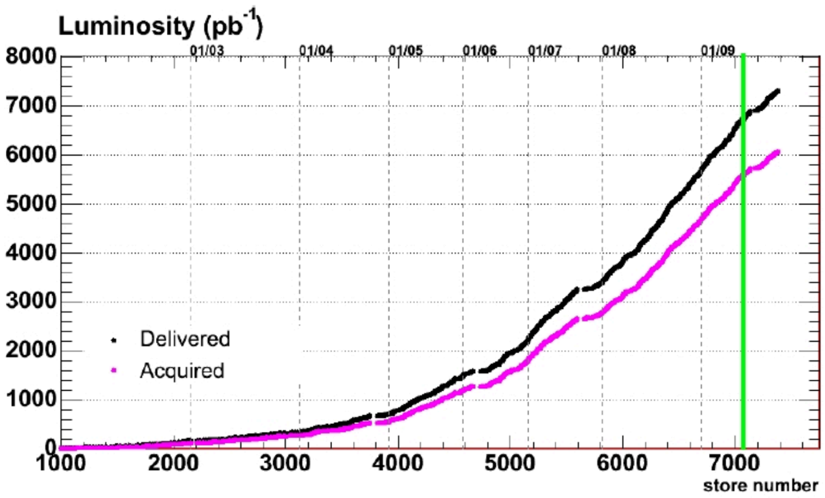
This flow diagram in summarizes the procedure used for the data selection and analysis for both the two track trigger (TTT) and the dimuon trigger streams.

The selection follows into two stages.

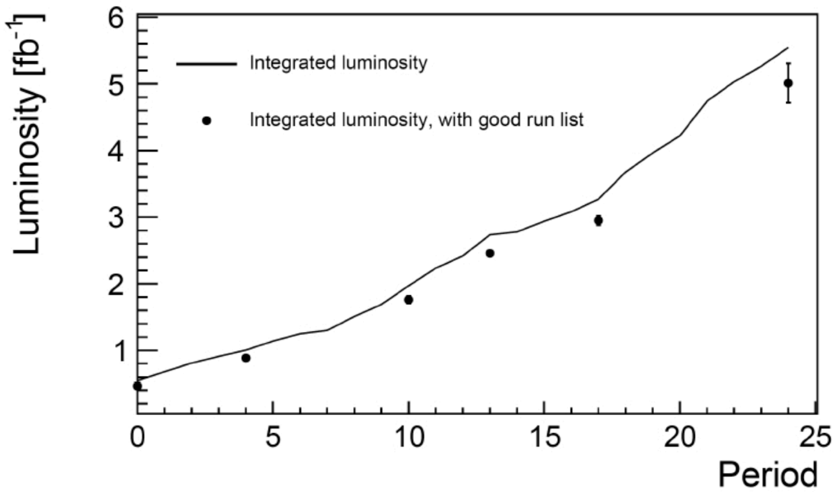
First, corresponds to applying the so called standard CDF pre-selection for both data streams.

Integrated Luminosity

The data considered correspond to the time range between the beginning of Run II and Oct. 25th 2009 (period 0 to 26). The total recorder integrated luminosity by CDF from periods 0 to 26 is 4.2 fb^{-1}.
The goodrun list version 32, as created on March 12th 2010 is applied here and the total integrated luminosity after applying the goodrun list is 5.0187 fb^{-1}.

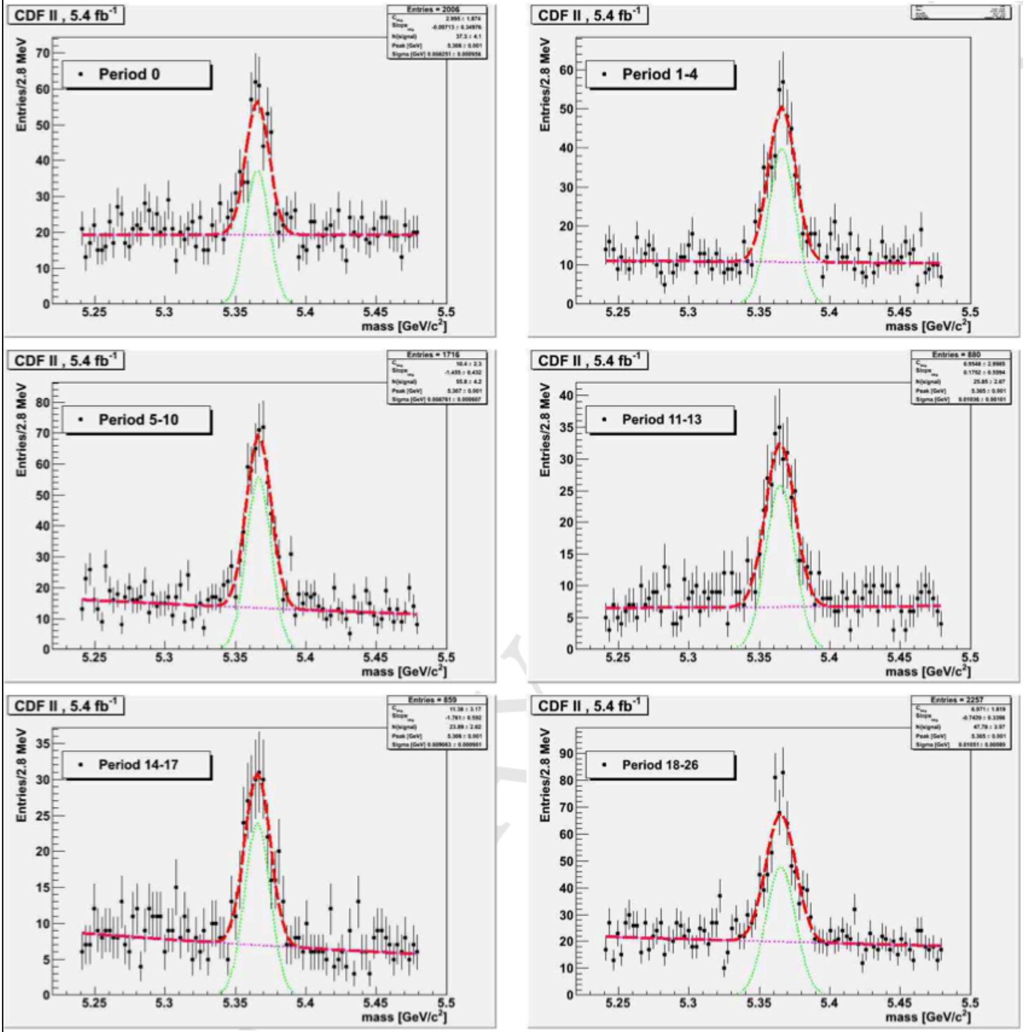


Delivered and acquired luminosity at the CDF experiment (period 0-24)

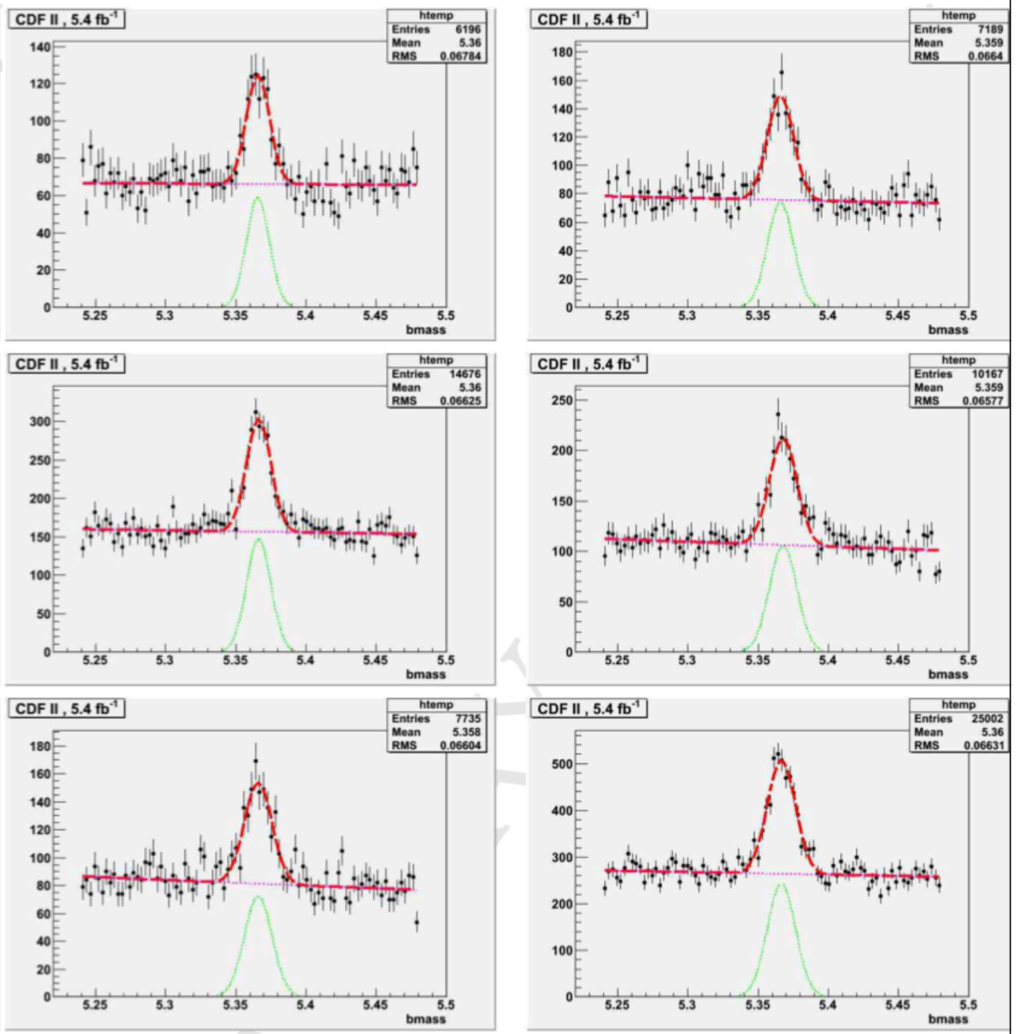


CDF integrated luminosity before (full line) and after (points) the application of the goodrun list (period 0-24)

Bs Mass Spectrum Plots for TTT and Dimuon



Bs mass spectrum after selection and exclusion of the overlapping events for each run period in the **TTT data sample** (period 0-26)



Bs mass spectrum after selection for each run period in the **Dimuon data sample** (period 0-26)

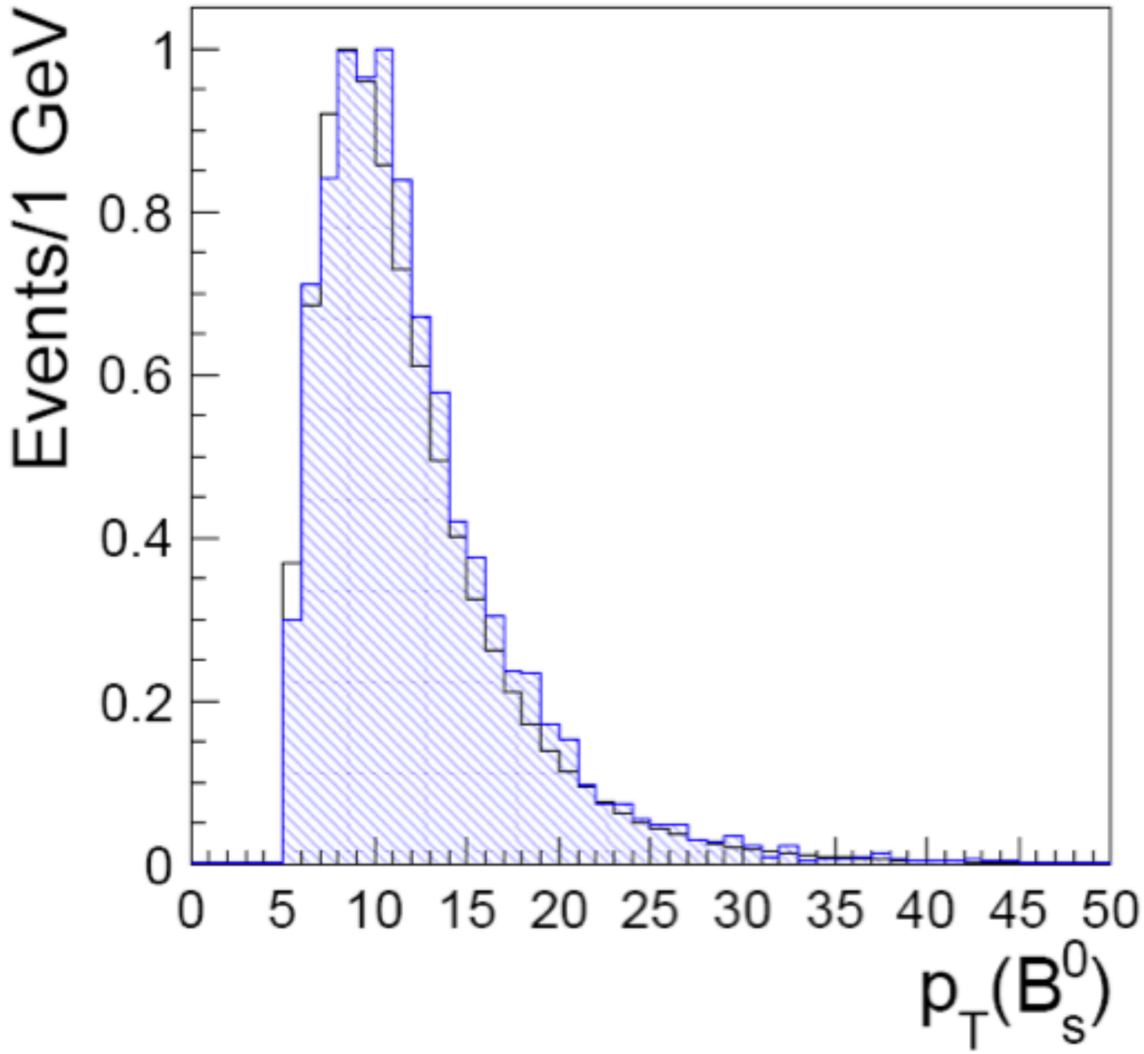
Selection cuts defining a Bs → J/Ψϕ candidates

Second, refines the selection of Bs candidates on both data and MC with same cuts.

Monte Carlo	Real Data
$5.24 < \text{Mass}(B_s^0) < 5.48\ GeV/c^2$	$5.24 < \text{Mass}(B_s^0) < 5.48\ GeV/c^2$
$3.05 < \text{Mass}(J/\psi) < 3.15\ GeV/c^2$	$3.05 < \text{Mass}(J/\psi) < 3.15\ GeV/c^2$
$1.011 < \text{Mass}(\phi) < 1.029\ GeV/c^2$	$1.011 < \text{Mass}(\phi) < 1.029\ GeV/c^2$
$P_t(B_s^0) > 5\ GeV/c$	$P_t(B_s^0) > 5\ GeV/c$
$P_t(J/\psi) > 1.00\ GeV/c$	$P_t(K) > 1.00\ GeV/c$
$P_t(\phi) > 1.00\ GeV/c$	$P_t(\phi) > 1.00\ GeV/c$
At least one muon stub	At least one muon stub
$\chi^2_{xy}(B_s) < 22$	$\chi^2_{xy}(B_s) < 22$
$d_0(B_s) < 65\ \mu m$	$d_0(B_s) < 65\ \mu m$

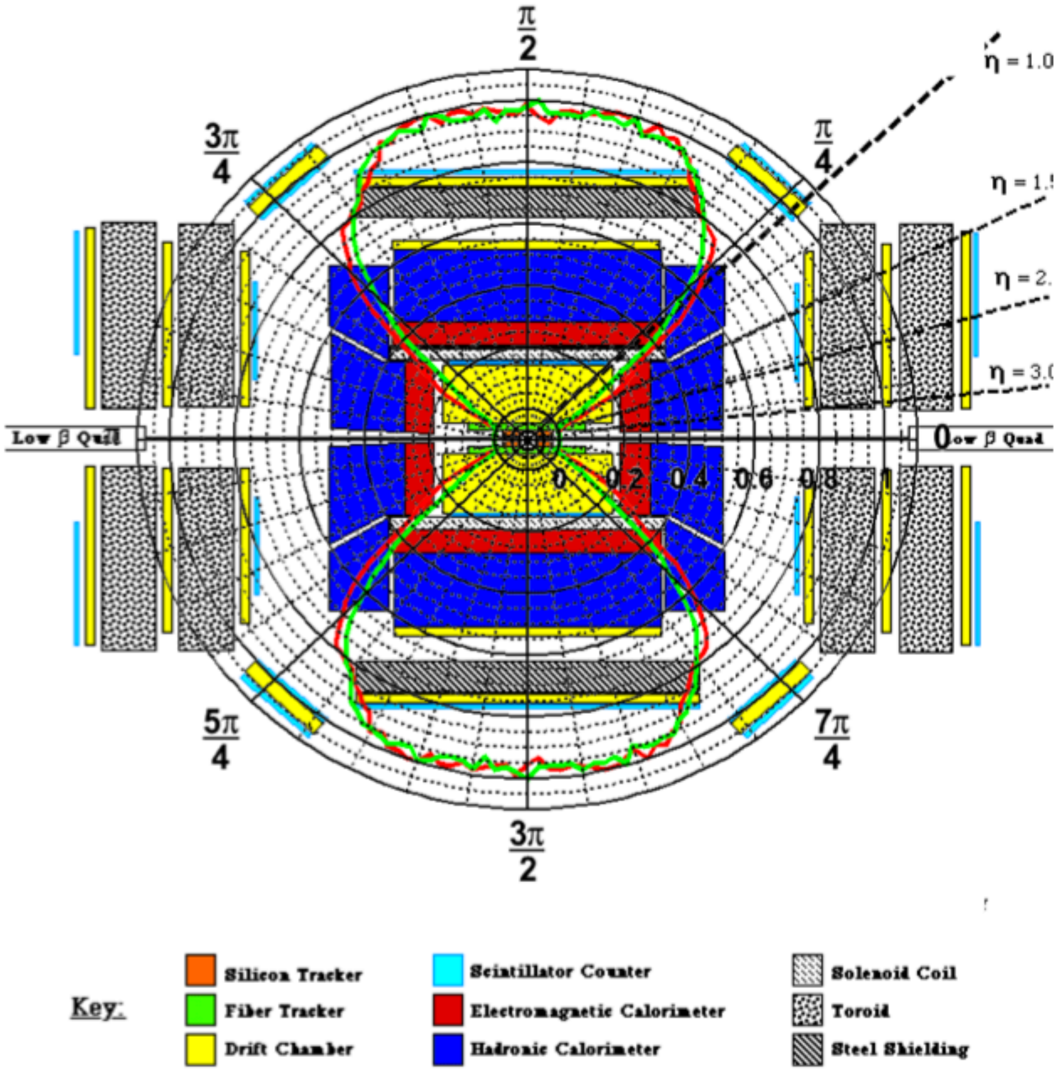
500M events simulated, 6.6M events after TTT, reconstruction and selection for MC.
Data periods is 1 to 36 using preselected in BSTNtuples.
TTT efficiency (3%) dominates the overall efficiency.

Comparison MC-DATA



Pt(Bs) distribution for data (black line) and Monte Carlo (filled histogram)

Angular Efficiency Function



Bs to J/Ψ ϕ Monte Carlo μ^+ and K^+ angular efficiency in the laboratory frame, longitudinal view of the CDF detector.

The impact of the geometry of the tracking system (kaon) and of the muon detectors (only muon) on the efficiency is well described in the Monte Carlo

Angular efficiency function - projections