Study of $B_s^0 \to \phi\phi\phi$ via charmonium resonances

IJCLAB internship

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The $B_s^0 \to \phi\phi\phi$ decay

The transition $B_s^0 \to \phi\phi\phi$, receive contributions from the three body decay and from the two body decay with a charmonium intermediate states.

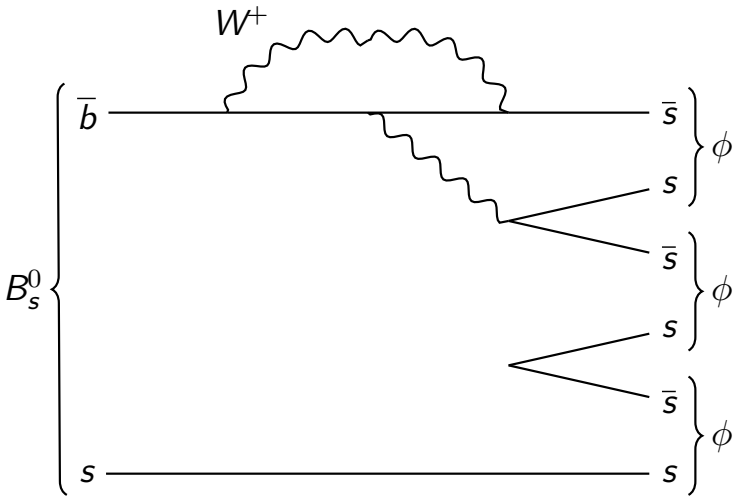

Diagram for the $B_s^0 \to \phi\phi\phi$ decay.

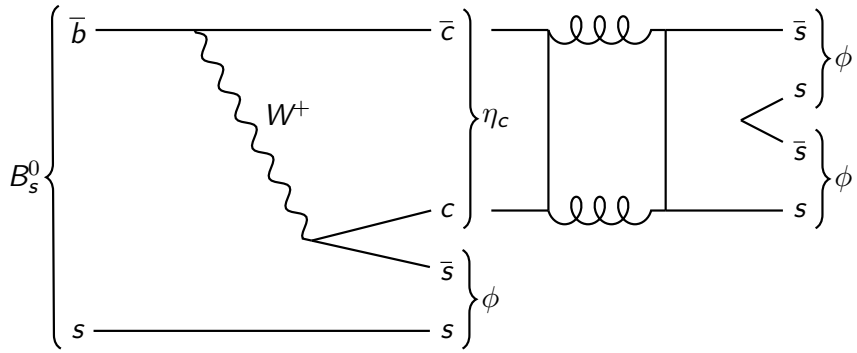

Diagram for the $B_s^0 \to \eta_c\phi(\eta_c \to \phi\phi)$ decay.

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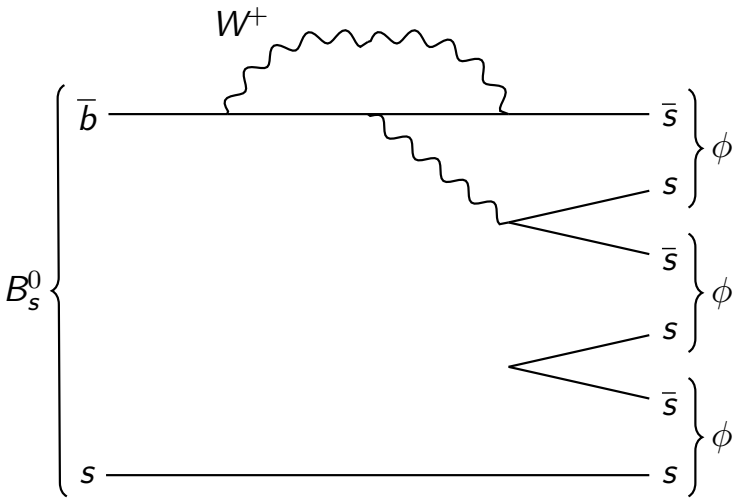

Diagram for the $B_s^0 \to \phi\phi\phi$ decay.

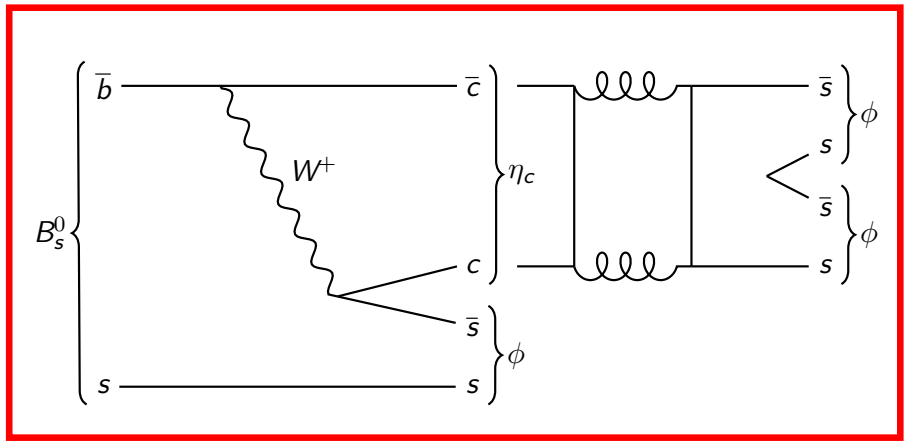

Diagram for the $B_s^0 \to \eta_c\phi(\eta_c \to \phi\phi)$ decay.

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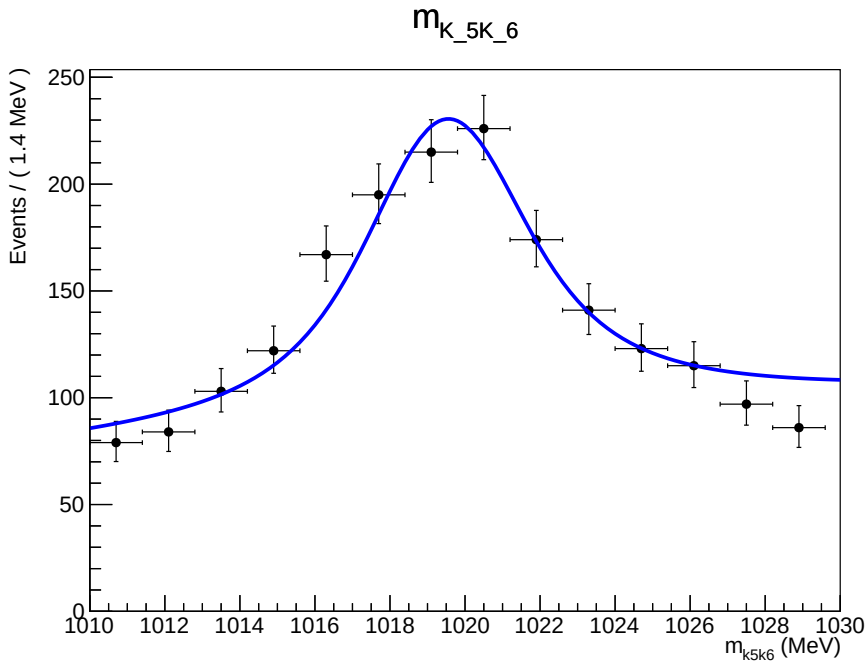
True ϕ mesons reconstruction

Separate the signal of three true ϕ mesons from permutations of K^+K^- using:

- Convolution of a Gaussian and a Briet Wigner for the ϕ signal.
- A first order polynomial for the K^+K^- background.
- A 3D fit over the permutations.

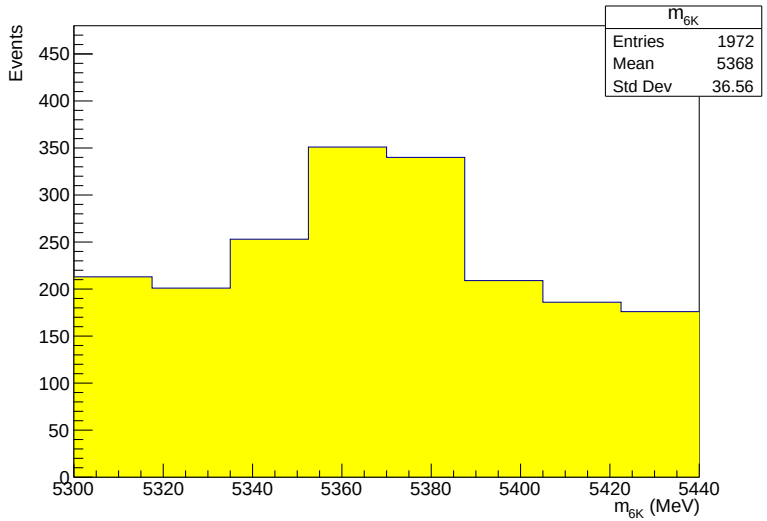


Distribution for ϕ mesons signal, with $\mu = 1019.461(16)$ MeV, $\sigma = 1$ MeV and $\Gamma = 4.249(13)$ MeV.

True B_s^0 mesons reconstruction

B_s^0 reconstruction with:

- A Gaussian distribution centered at the mass of B_s^0 for the signal.
- A constant background.

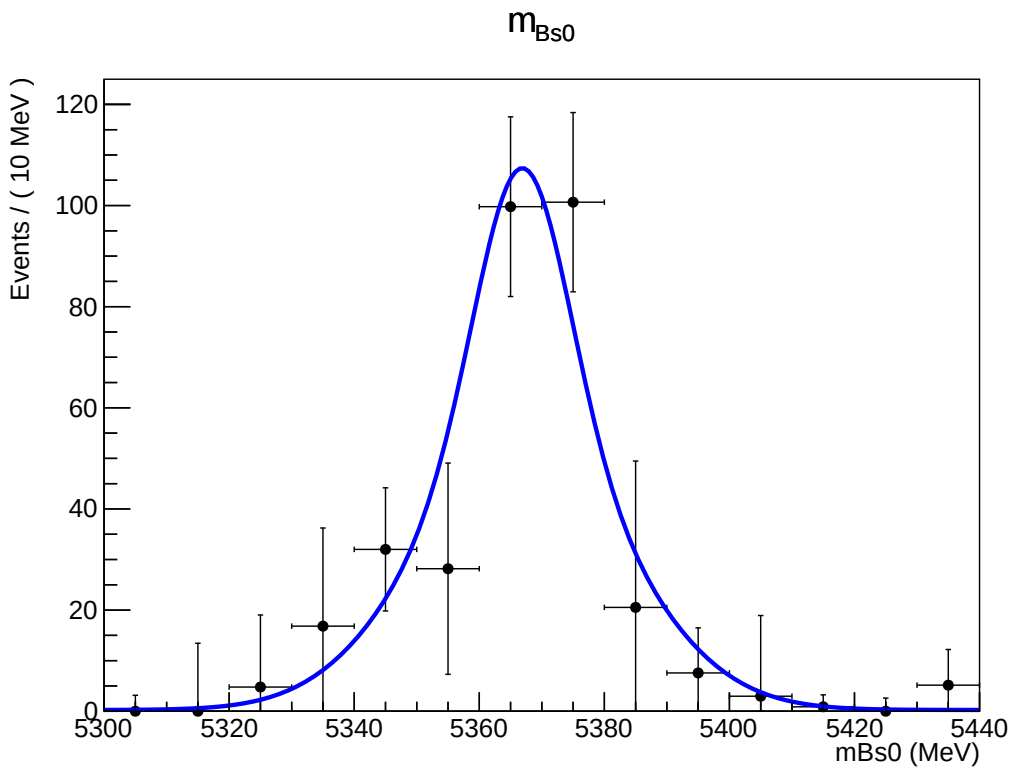


B_s^0 mass histogram.

A 3D fit in each bin.

Fit result

- $N_S = 321.3 \pm 49.3$ Events
- Background consistent to zero.

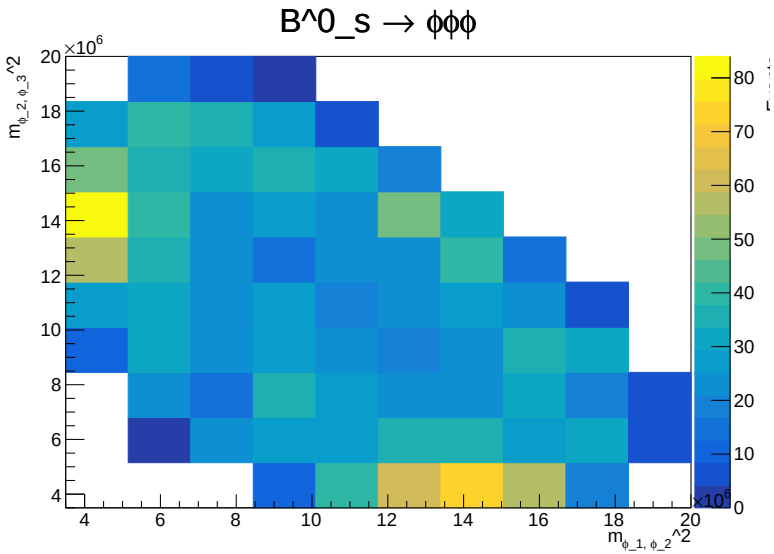


Symmetrized plots

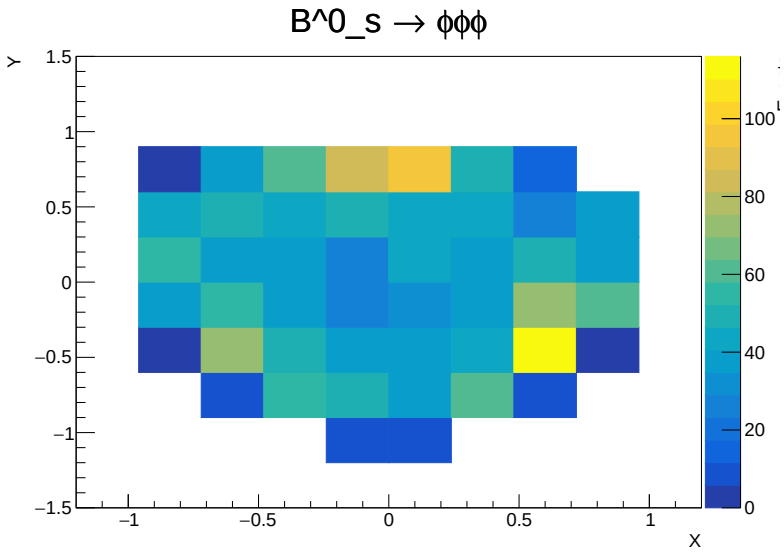
For the analysis, the symmetrized Dalitz plot was considered.

$$X = 3\frac{(T_1 - T_2)}{Q} \qquad Y = 3\frac{T_3}{Q} - 1 \tag{1}$$

$$T_{1,2,3} = \text{Kinetic energies} \qquad Q = m_{B_c} - 3m_{\phi} \tag{2}$$



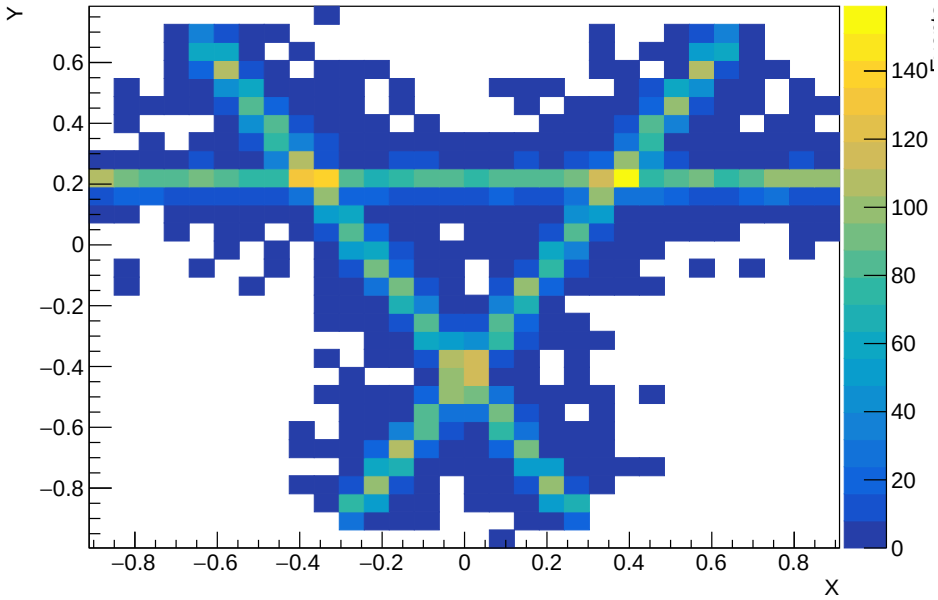
Conventional Dalitz plot.



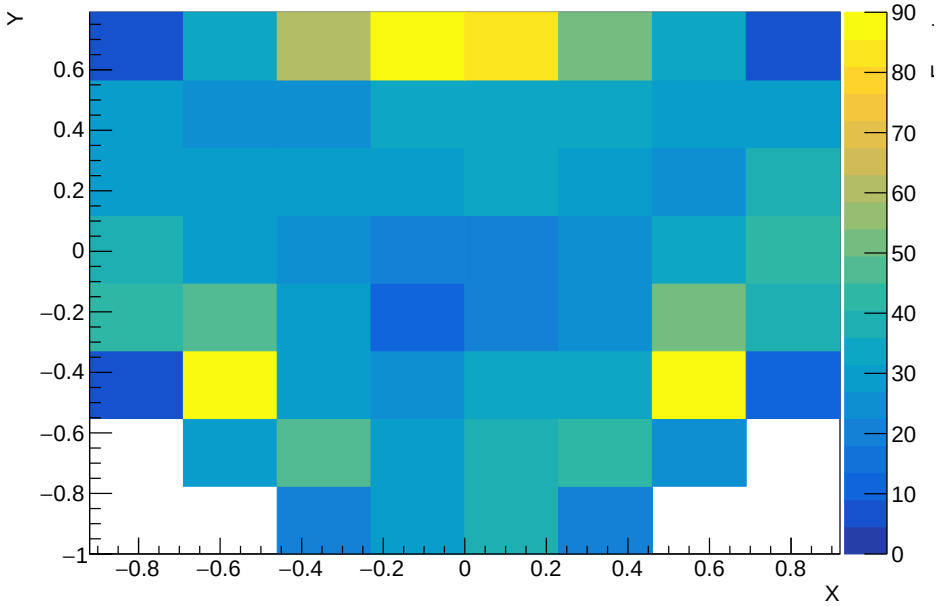
Symmetrized Dalitz plot.

Resonance signal

Extract the signal from decays with resonances.



MonteCarlo simulation for Charmonia resonances resonances in a Dalitz plot.

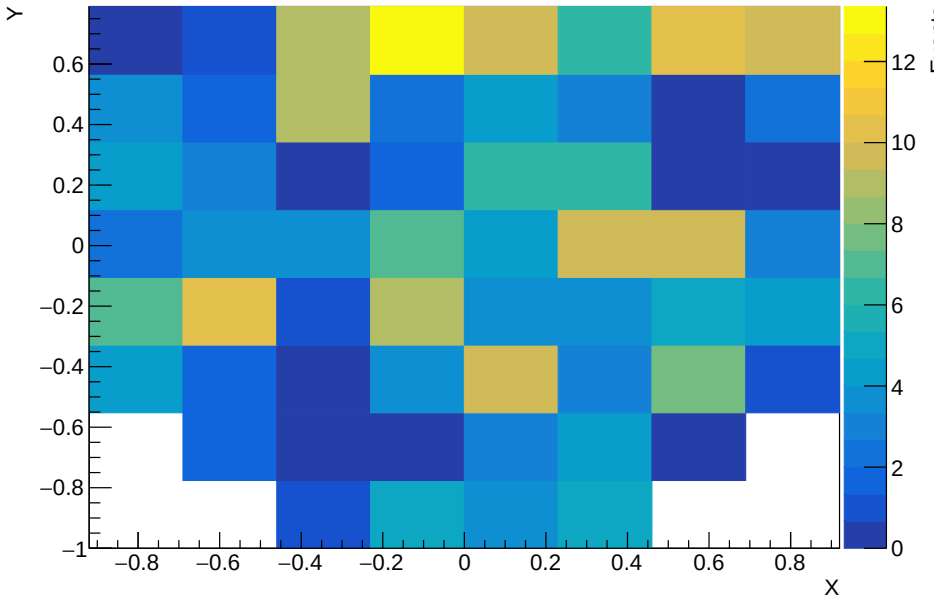


Dalitz plot of the data.

1

[1] At first sight there is no contribution of the resonances in the data.

Dalitz plot after bin fits



Dalitz plot after bin fits.

Just as in the B_s^0 histogram, a fit of the three ϕ mesons and also a fit on the B_s^0 signal were applied to each bin in the symmetrized Dalitz plot.

Summary

1. We reconstructed the $B_s^0 \to \phi\phi\phi$ decay with the LHCb data.
2. We reduced the combinatorial background with bin fits reconstructing true ϕ mesons.
3. Next step is to fit the Dalitz plot to reconstruct the the resonances.