The Kinematic Fitter of

$$B_s \to \mu\tau, \tau \to \pi\pi\pi\nu$$

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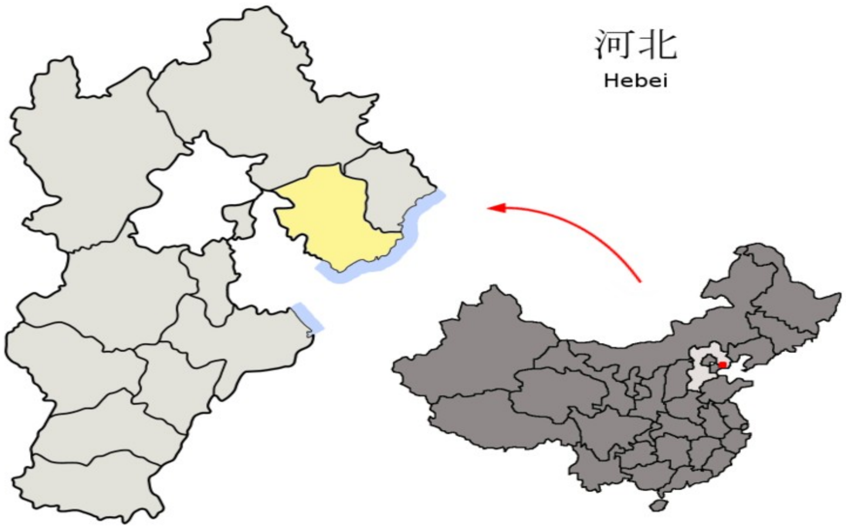
A Little bit about myself



- Music
- Badminton,table tennis
- Philosophy
- Comedy
- Sci-fi

Motivation

- LFV------Lepton Flavour Violation

  This is predicted in many extensions of SM!

- Current Upper Limit on BR:

$BR(B_d \to \mu\tau < 10^{-5})$ [BaBar Coll, Phys.Rev.D77(2008) 091104R)]

$BR(B_s \to \mu\tau)\ ?$

How to find it?   UPL can be found in LHCb

Outline of the project

- Toy generator of

$$B_s \to \mu\tau, \tau \to \pi\pi\pi\nu; B_s \to \tau\tau, \tau \to \pi\pi\pi\nu$$

- The kinematic fit studies for

$$B_s \to \mu\tau, \tau \to \pi\pi\pi\nu$$

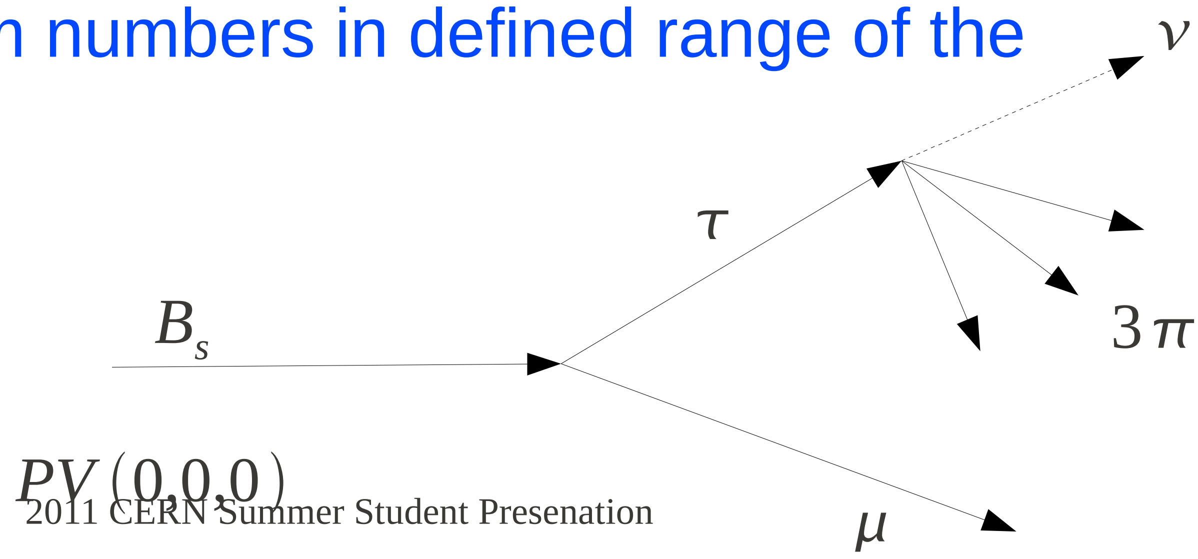
The toy genrator of $B_s \to \mu\tau, \tau \to \pi\pi\pi\nu$

- TGenPhaseSpace Class

  Utility class in ROOT to generate n-body events with constant cross section. It calculates the momentum and the energy of the particles by conservation of moemntum and energy.

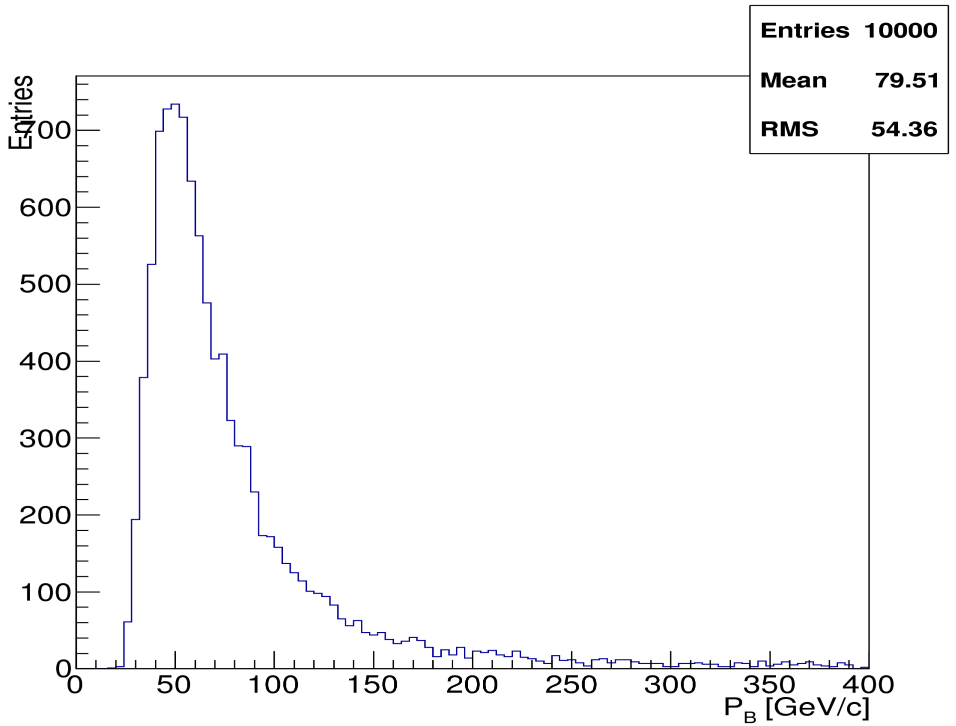
- TRandom3( )

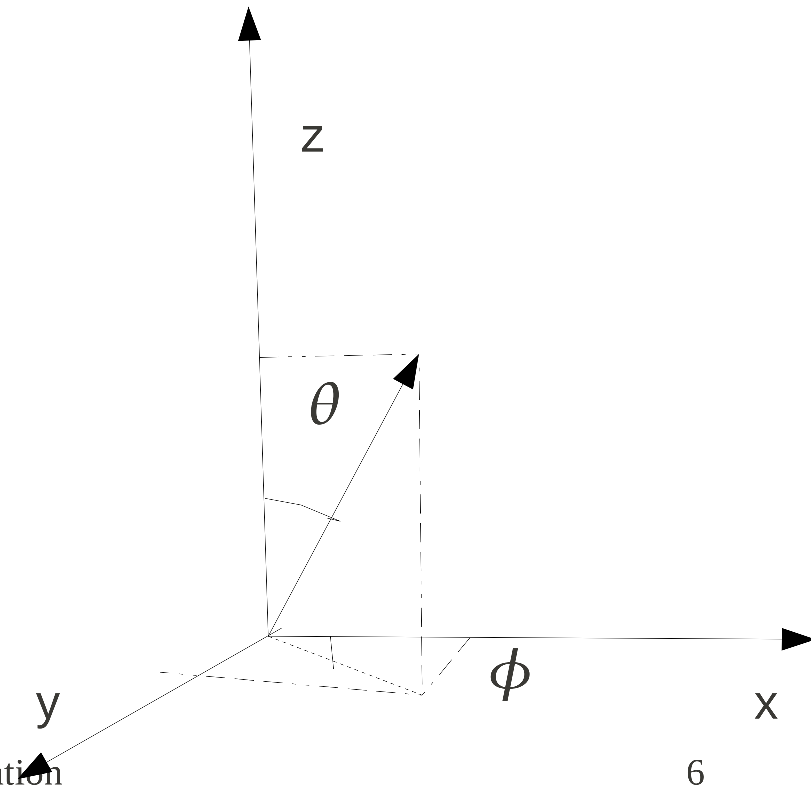
  Generate random numbers in defined range of the function.



The toy genrator of $B_s \rightarrow \mu\tau, \tau \rightarrow \pi\pi\pi\nu$

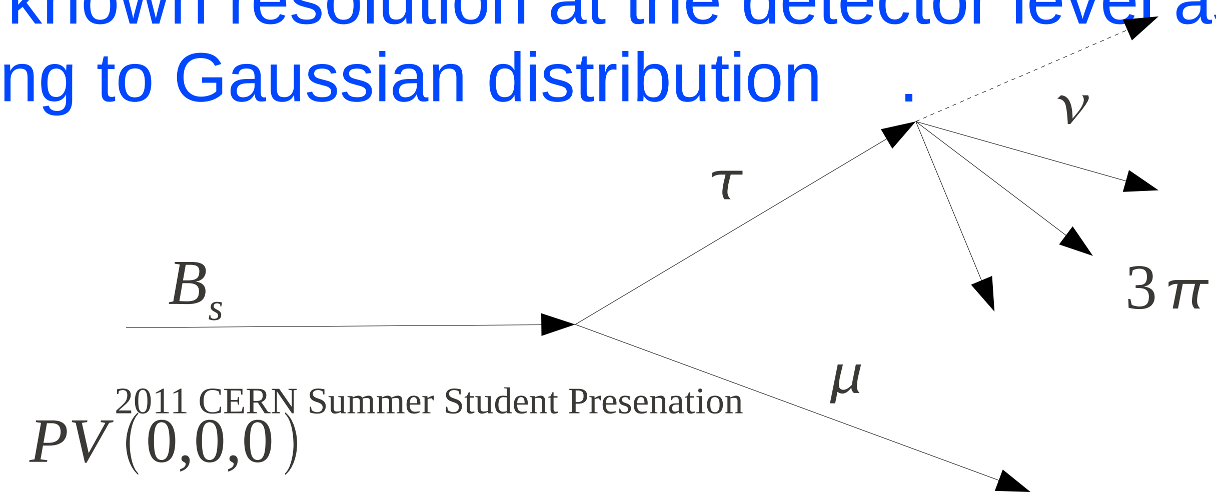
- The boost of B was generated with |p| according to Landau distribution, θ and ϕ generated according to uniform distribution.



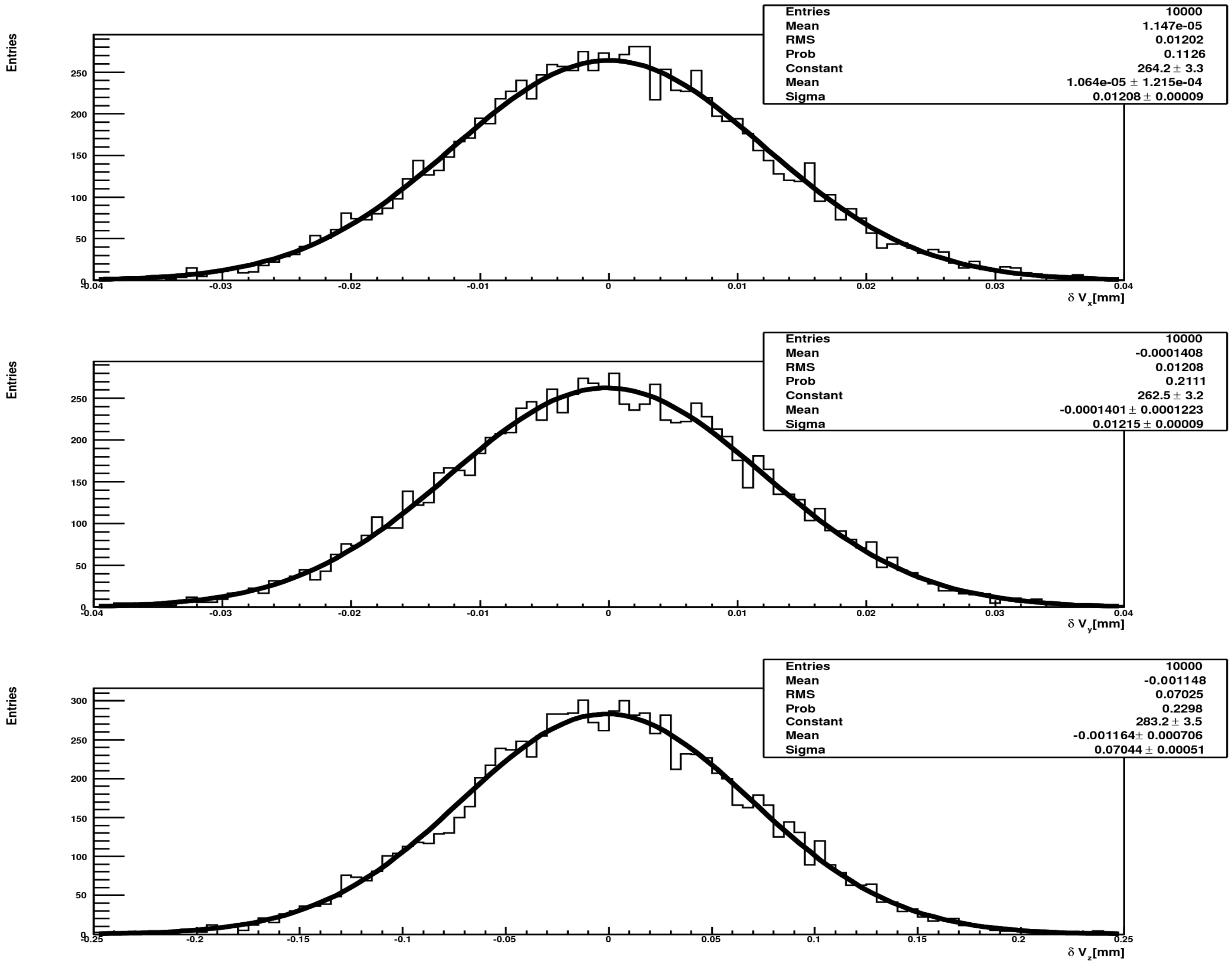


The toy genrator of $B_s \to \mu\tau, \tau \to \pi\pi\pi\nu$

- The decay time variable was generated according to the exponential decay. $\vec{p}, t, m_0 \to \vec{d} = \vec{p}\,t/m_0$
- The effect of smearing for primary vertex, the subvertex of tau and muon seed , the momentum smearing of mu and tau were also taken into account. One example shown later.
- The smearing was done by using true value as mean value and the known resolution at the detector level as sigma according to Gaussian distribution .



The toy genrator of $B_s \to \mu\tau, \tau \to \pi\pi\pi\nu$

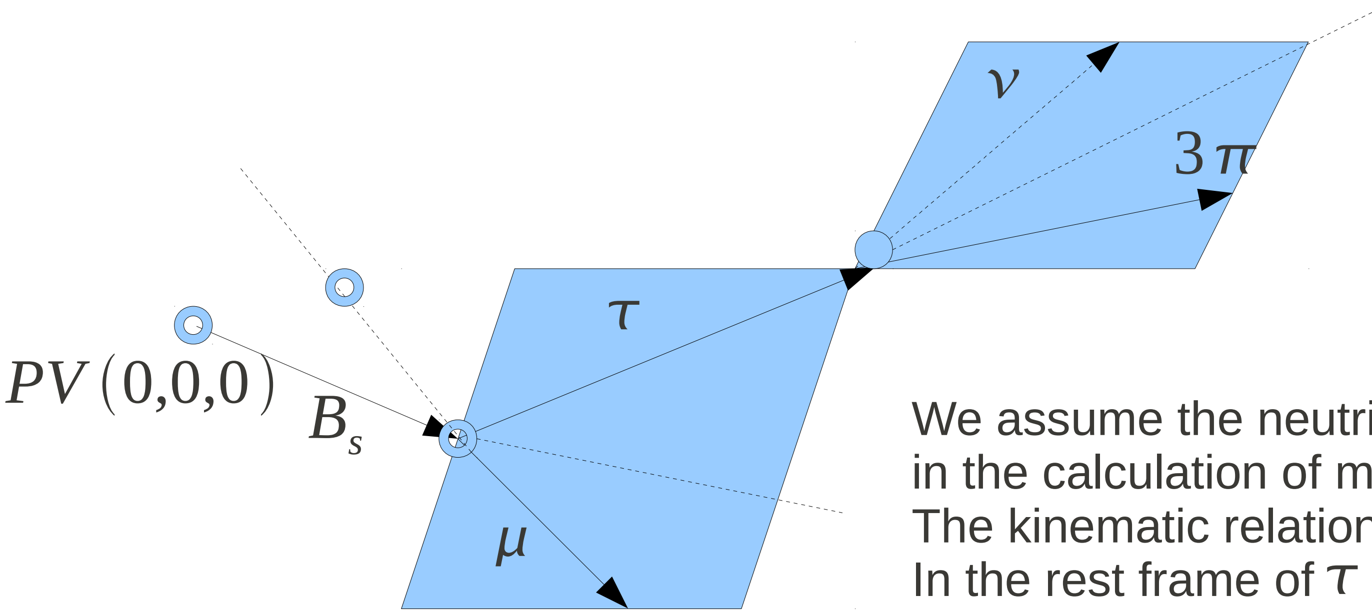


This is an example of the smearing of the primary vertex where the input sigma is 0.0012mm for x,y and 0.07mm for z

The toy genrator of $B_s \to \mu\tau, \tau \to \pi\pi\pi\nu$

- In real measurement, we don't have the neutrino momentum and the sub vertex of B is badly measured.
- We can use toy generator to compare results obatained from the kinematic fitter with the true value to check the effeciency of the kinematic fitter!!!

The kinematic fitter for $B_s \to \mu\tau, \tau \to \pi\pi\pi\nu$



We assume the neutrino mass is negligible in the calculation of mass distribution of B. The kinematic relations are listed as follows:

In the rest frame of τ :

$$E_\nu = M_\tau - E_{3\pi}$$

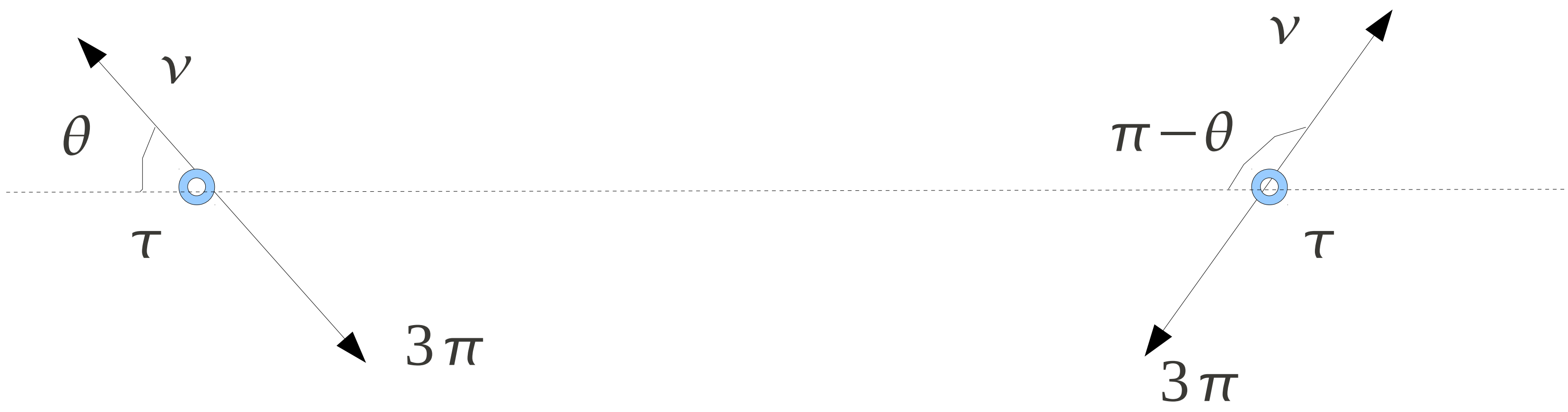
$$\begin{cases} P_L^{Lab} = \gamma_\tau P_L + \beta_\tau \gamma_\tau E_{3\pi} \\ E^{Lab} = \gamma_\tau E_{3\pi} + \beta_\tau \gamma_\tau P_L \\ P_T^{Lab} = P_T \end{cases}$$

$$\gamma_\tau = \frac{E_{3\pi} E_{3\pi}^{Lab} \pm \left| P_L P_L^{Lab} \right|}{P_T^2 + M_{3\pi}^2}$$

Quadratic ambiguity??

The kinematic fitter for $B_s \to \mu\tau, \tau \to \pi\pi\pi\nu$

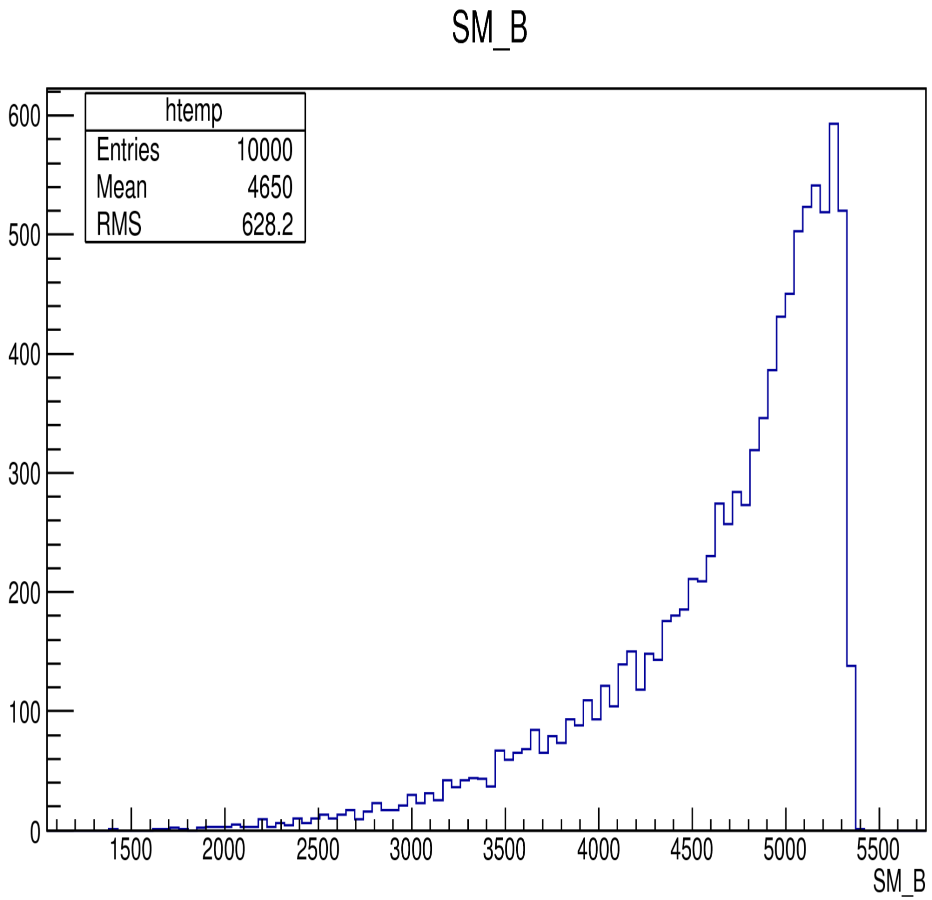
- Where does it come from?

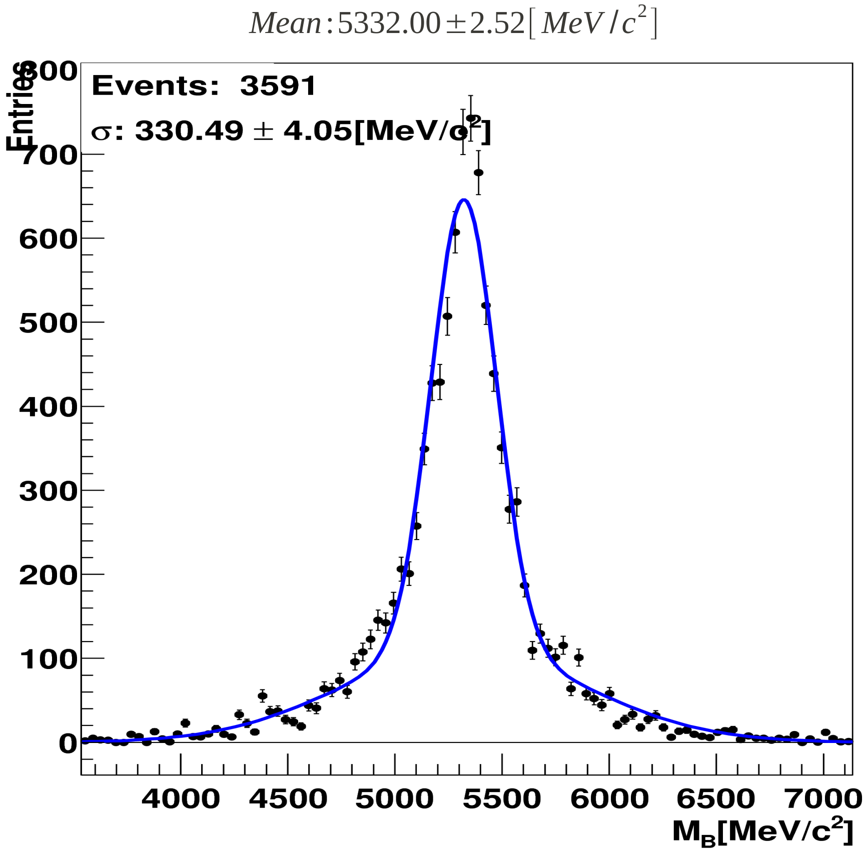


- The quardratic ambiguity was solved by choosing the solution which gives the invariant mass closest to the true B mass

The result of kinematic fitter for $B_s \to \mu\tau, \tau \to \pi\pi\pi\nu$

- For the toy generator

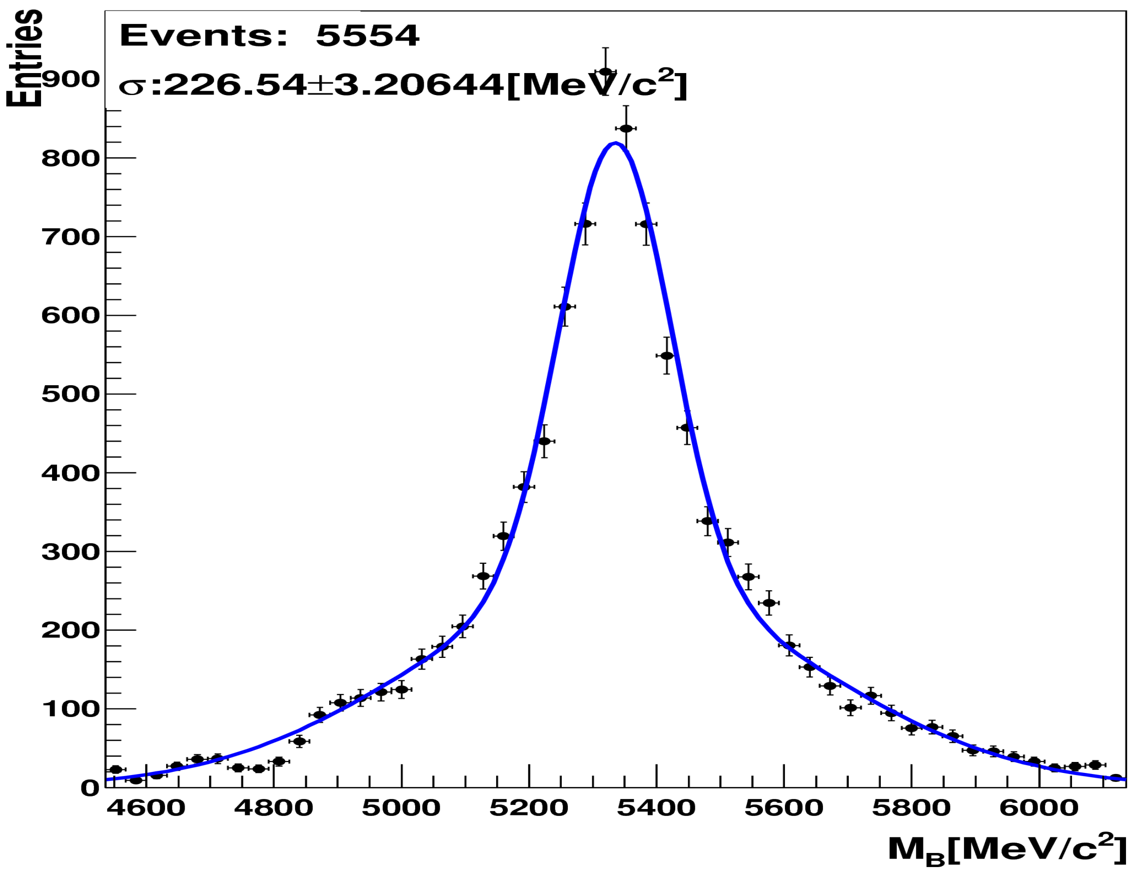




The kinematic fitter for $B_s \to \mu\tau, \tau \to \pi\pi\pi\nu$

- After a simple procedure on the kinematic fitter, the mass resolution improves significantly:

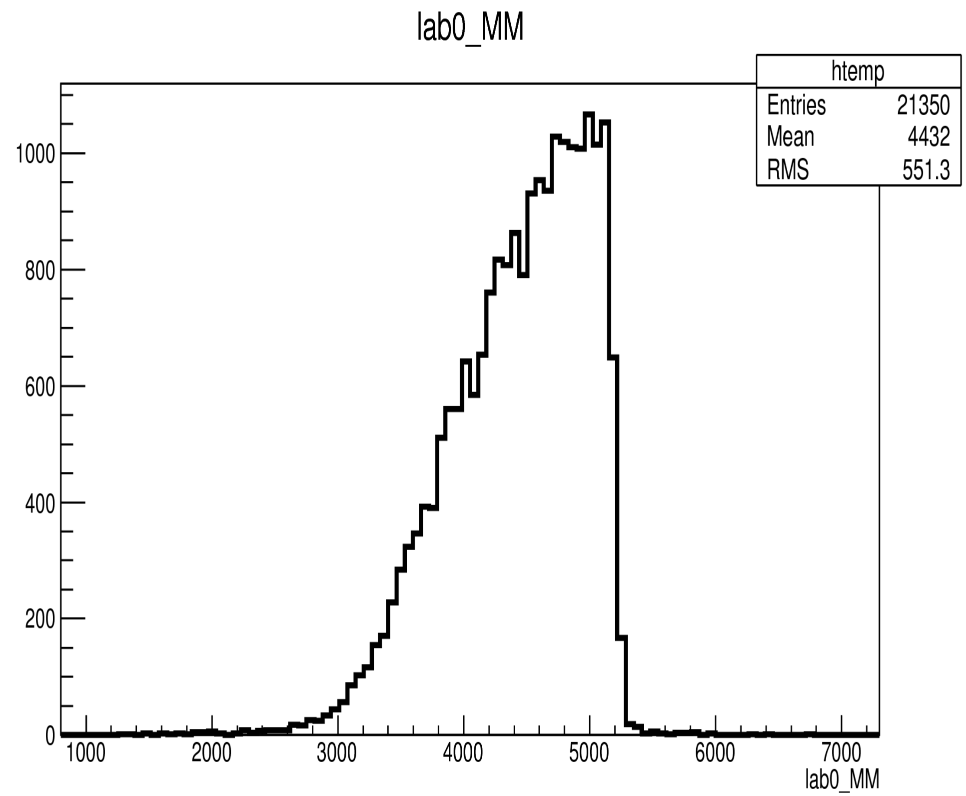
$Mean: 5348.39 \pm 1.59 [MeV/c^2]$

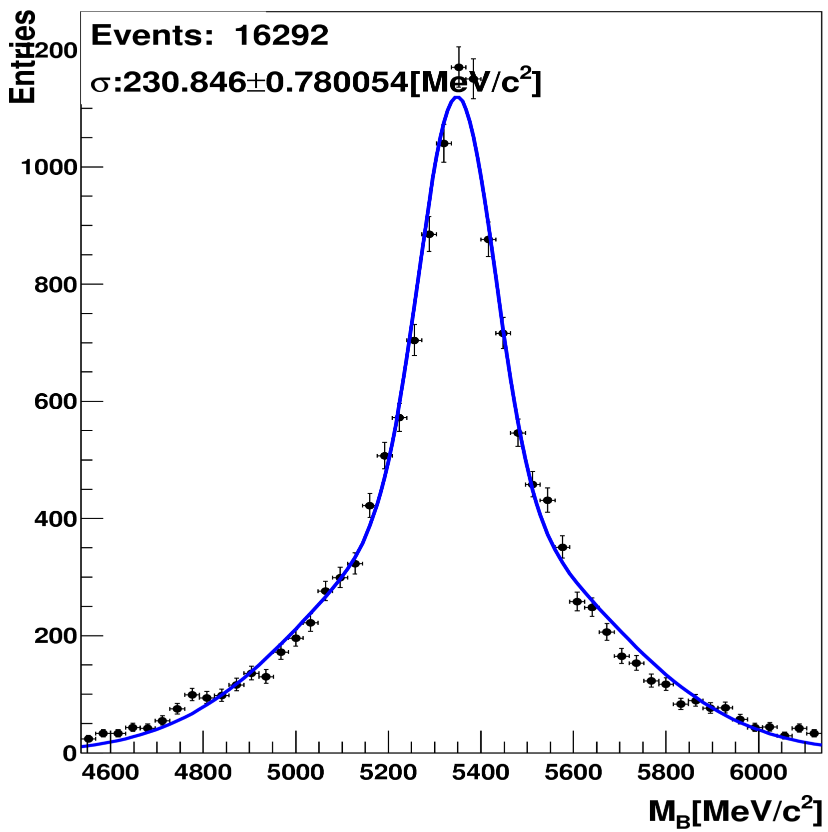


The result of kinematic fitter for $B \to \mu\tau, \tau \to \pi\pi\pi\nu$

$Mean: 5335.15 \pm 1.82 [MeV/c^2]$

- For MC :





Summary

- Two toy generators
- The kinematic fit works but there are still improvements to increase the mass resolution
- Data ?
- Next step is to reconstruct the mass distribution in the decay process of $B \rightarrow D\pi, D \rightarrow K\pi\pi$ assumming one of the pions is missing to prove it in principle.

Aknowledgement

- Special thanks to Eduardo and Nico
- Thanks Christian for providing the corecode of the fitter
- Special thanks to my supervisor Prof. Terry Wyatt in University of Manchester
- Thank you all for your attention! You are all brilliant!!!!