Decay Tree Fitter at Super C-Tau Factory

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Contents

Super C-Tau Factory

Super C-Tau Factory is a project of the electron-positron collider.

- Energy: 2-5 GeV
- Luminosity: $10^{35} cm^{-2} s^{-1}$

Purposes

- Search for effects of CP-violation in the decays of charmed particles

Figure 1: Super C-Tau Factory on the map of BINP

Formulation of the problem

A detector can detect only **final state particles**. But most particles are unstable, have a life time of 10^{-12} seconds.

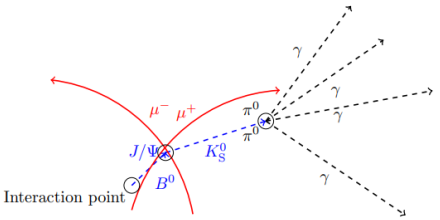

Figure 2: $B_0 \to J/\Psi(\mu^+\mu^-)K_s^0(\pi^0\pi^0)$

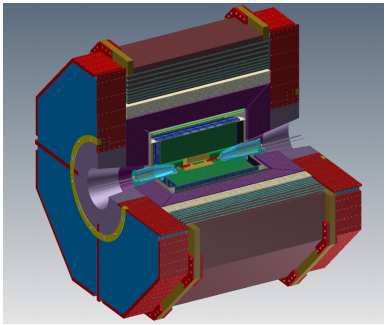

Figure 3: Detector model

Existing solutions

Features of our own experiment:

- A small number of particles of the final state.
- A lot of events with neutrals.

The most general parametrization:

$$x = \{x_1, y_1, z_1, \theta_1, p_{x1}, p_{y1}, p_{z1}, E_1, ..., x_n, y_n, z_n, \theta_n, p_{xn}, p_{yn}, p_{zn}, E_n\} \tag{1}$$

$$\begin{aligned}\chi^2_\alpha =& (m_1 - h_1(x_0^\alpha))^T V_1^{-1} (m_1 - h_1(x_0^\alpha)) + \ldots + \\ & (m_k - h_k(x_{k-1}^\alpha))^T V_k^{-1} (m_k - h_k(x_{k-1}^\alpha))\end{aligned} \tag{2}$$

The minimizing χ^2 yields

$$x_k^\alpha = x_{k-1}^\alpha - K_k^\alpha (m_k - h_k(x^\alpha)) \tag{3}$$

Experiment

Mass fit for $B_0 \to J/\Psi(\mu^+\mu^-)K_s^0(\pi^0\pi^0)$

We will perform π_0 mass constraint.

- The mass distribution is centred around the true value K_S^0 mass.
- The resolution has slightly improved as well.

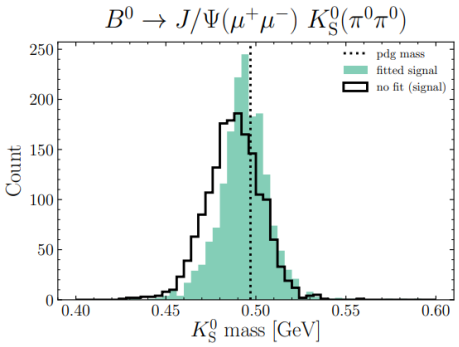

Figure 4: Fitting example: Fitted mass K_S^0 (green) and the mass before the fit (black)

Conclusion

We made sure that the iterative approach works and is suitable for restoring the decay tree.

Future plans

- Add previously unaccounted for particle classes
- Support for more kinematic constraints
- Implement algorithm in the Aurora framework

Thanks for your attention!