# Search for $B^+ \longrightarrow \rho^0 K^*(892)^+$ decay

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## Overview

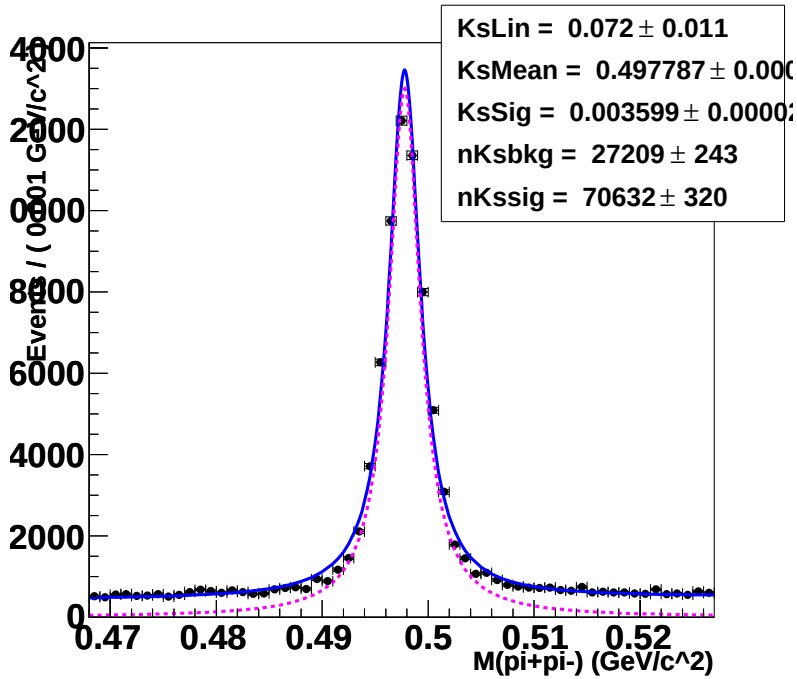
1. The analysis with signal MC
   - $B^+ \to \rho^0 K^{*+} (K^{*+} \to \pi^+ K_S^0)$
     - longitudinal vs transverse MC
   - $B^+ \to \rho^0 K^{*+} (K^{*+} \to \pi^0 K^+)$
     - longitudinal vs transverse MC
2. Skim Criteria
3. Summary and next plan

# The analysis with signal MC:

- $B^+ \rightarrow \rho^0 K^{*+}$
  - $\rho^0 \rightarrow$ free
    - $K^{*+} \rightarrow$ free
- Signal MC with considering the longitudinal and transverse for polarization fraction : each 0.3M events
- We don't use the best candidate with $\chi^2$ of vertex fit, $dr$ and $dz$.

# The analysis with signal MC: $K^{*+} \rightarrow \pi^+ K^0_S$ channel and longitudinal MC

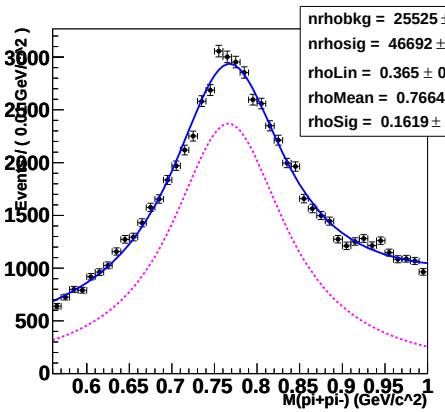
- Ks mass: to perfom the fit within $M(\pi^+\pi^-) \in (0.468, 0.527)\mathrm{GeV/c^2}$
- The signal region in $2.5\Gamma$ $M(\pi^+\pi^-) \in (0.489, 0.507)\mathrm{GeV/c^2}$ (by fitting)



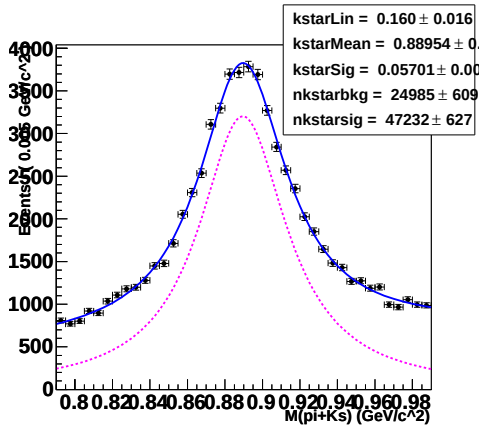
# The analysis with signal MC: $K^{*+} \to \pi^+ K^0_S$ channel and longitudinal MC

- $\rho^0$ mass: the window regin is in $1.5\Gamma$ $M(\pi^+\pi^-) \in (0.56, 1.00)\mathrm{GeV/c^2}$(by PDG)
- $K^{*+}$ mass:the window region in $2.0\Gamma$ $M(\pi^+ K^0_S) \in (0.79, 0.99)\mathrm{GeV/c^2}$(by PDG)
- $\Delta E$: the window regin is in $\Delta E \in (-0.12, 0.12)\mathrm{GeV}$
- $M_{bc}$:the window region in $2.0\Gamma$ $M_{bc} \in (5.20, 5.30)\mathrm{GeV/c^2}$

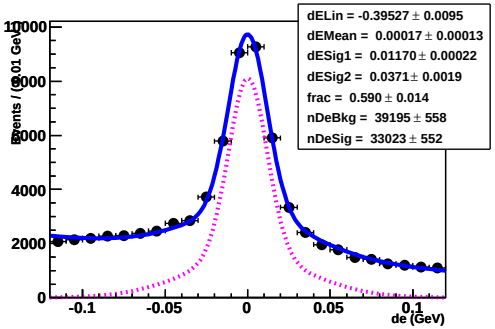
$M(\pi^+\pi^-)$;



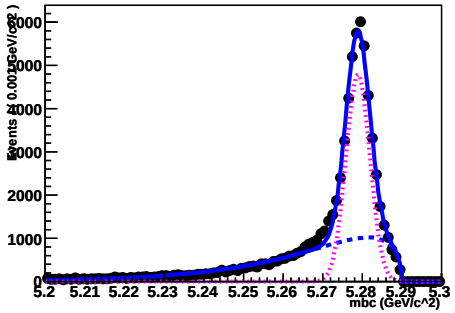

$M(\pi^+ K^0_S)$;




$\Delta E$;




$M_{bc}$;

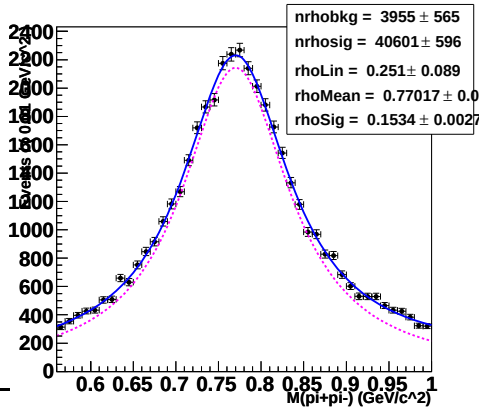


# The analysis with signal MC: $K^{*+} \rightarrow \pi^+ K^0_S$ channel and transverse MC

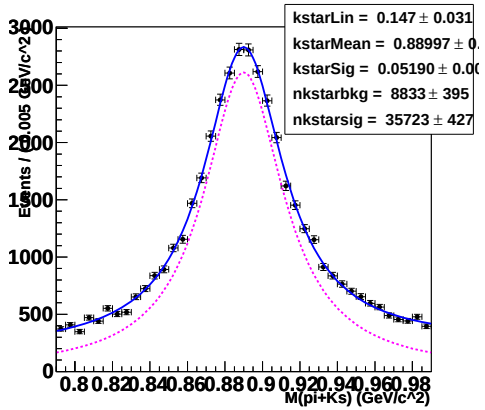
- $K^0_S$ mass: The mass range is from the longitudinal MC.
- $\rho^0$ mass, $K^{*+}$ mass, $\Delta E$ and $M_{bc}$ are same with longitudinal.
- The difference of the detection efficiency is 0.90% between longitudinal and transverse.

| | longitudinal | transverse |
|---|---|---|
| # of generated events | 0.3M | 0.3M |
| # of signal events | 33023 | 30337 |
| efficiency | 11.01% | 10.11% |

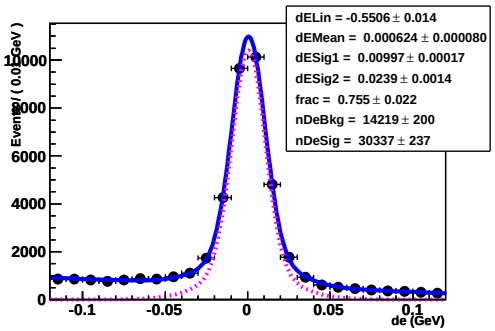
$M(\pi^+\pi^-)$;



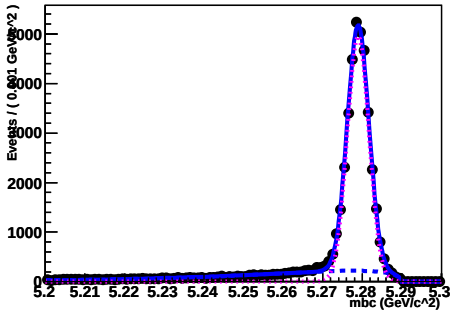

$M(\pi^+ K^0_S)$;




$\Delta E$;

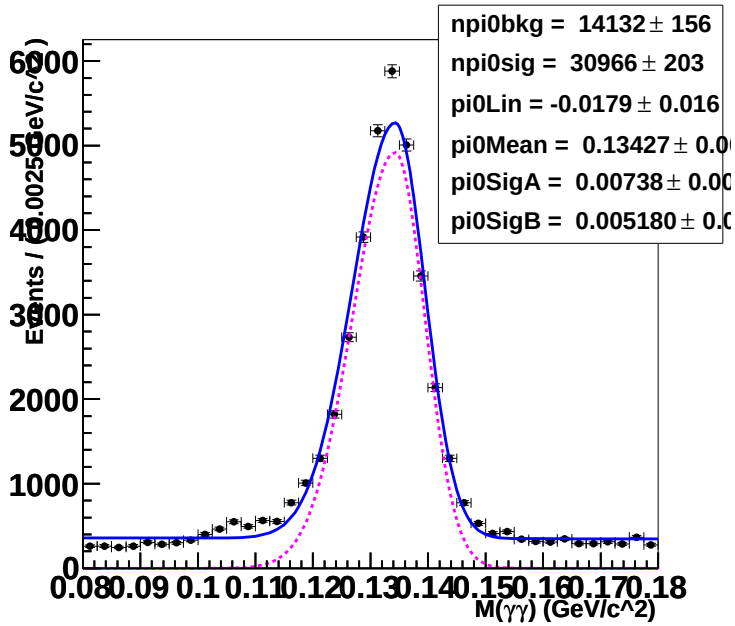


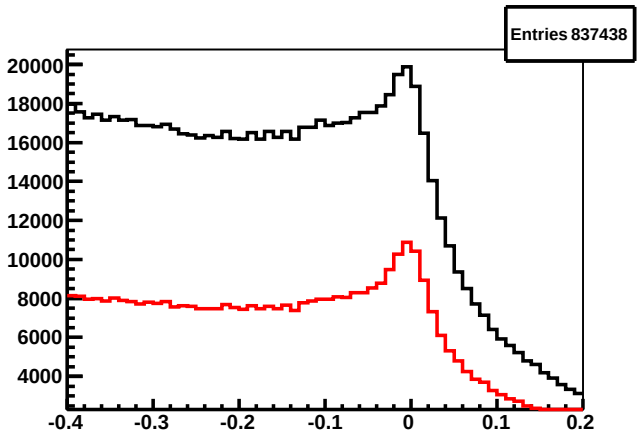

$M_{bc}$;

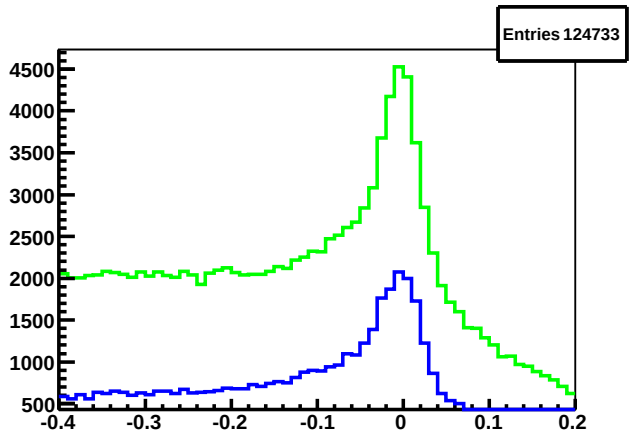


# The analysis with signal MC: $K^{*+} \rightarrow \pi^0 K^+$ channel and longitudinal MC

- $\pi^0$ mass: to perfom the fit within $M(\gamma\gamma) \in (0.08, 0.18)\mathrm{GeV/c^2}$
- The signal region in $2.5\Gamma$ $M(\gamma\gamma) \in (0.116, 0.147)\mathrm{GeV/c^2}$ (by fitting)
- The $\gamma$s energy from $\pi^0$ are applied with $> 0.2\mathrm{GeV}$



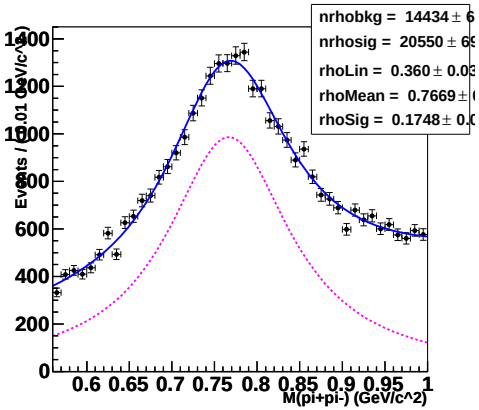




none, $> 0.05\mathrm{GeV}$, $> 0.1\mathrm{GeV}$, $> 0.2\mathrm{GeV}$

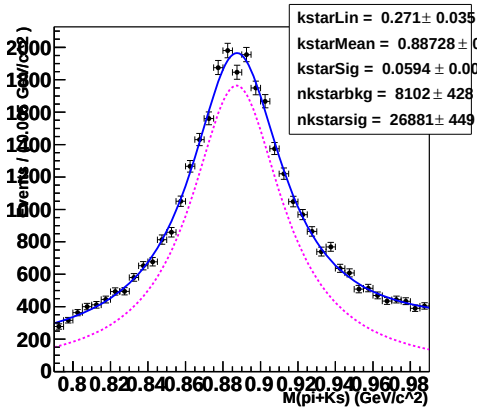
# The analysis with signal MC: $K^{*+} \to \pi^0 K^+$ channel and longitudinal MC

- $\rho^0$ mass: the window regin is in $1.5\Gamma$ $M(\pi^+\pi^-) \in (0.56, 1.00)\mathrm{GeV/c^2}$(by PDG)
- $K^{*+}$ mass:the window region in $2.0\Gamma$ $M(\pi^0 K^+) \in (0.79, 0.99)\mathrm{GeV/c^2}$(by PDG)
- $\Delta E$: the window regin is in $\Delta E \in (-0.4, 0.2)\mathrm{GeV}$
- $M_{bc}$:the window region in $2.0\Gamma$ $M_{bc} \in (5.20, 5.30)\mathrm{GeV/c^2}$

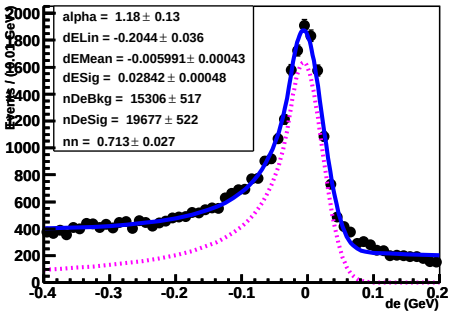
$M(\pi^+\pi^-)$;



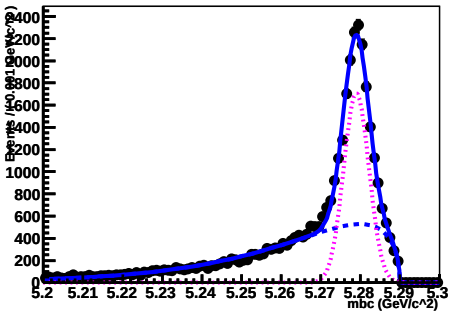

$M(\pi^0 K^+)$;




$\Delta E$;




$M_{bc}$;

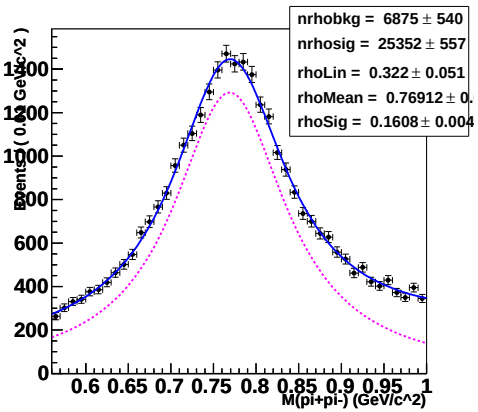


# The analysis with signal MC: $K^{*+} \rightarrow \pi^0 K^+$ channel and transverse MC

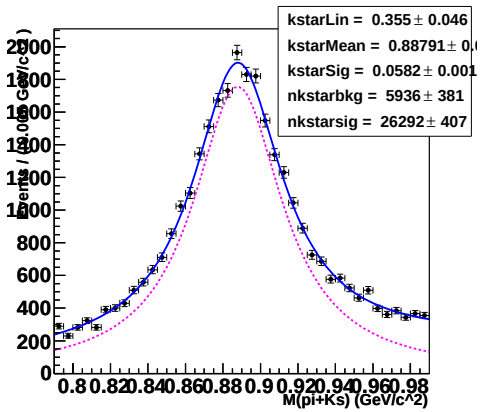
- $\pi^0$: The mass range is from the longitudinal MC and $\gamma$ energy is $> 0.2\mathrm{GeV}$
- $\rho^0$ mass, $K^{*+}$ mass, $\Delta E$ and $M_{bc}$ are same with longitudinal.
- The difference of the detection efficiency is 0.54% between longitudinal and transverse.

| | longitudinal | transverse |
|---|---|---|
| # of generated events | 0.3M | 0.3M |
| # of signal events | 19677 | 18058 |
| efficiency | 6.56% | 6.02% |

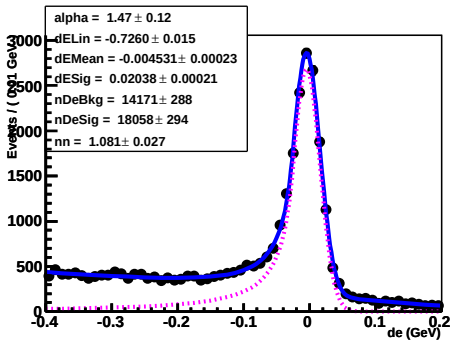
$M(\pi^+\pi^-)$;



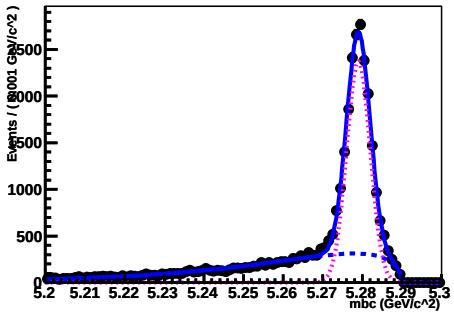

$M(\pi^0 K^+)$;




$\Delta E$;




$M_{bc}$;



# Skim Criteria

- We define the the criteria based on the signal MC
- We consider $K^{*+} \to \pi^+ K^0_S$ and $K^* \to \pi^0 K^+$

  - $\rho$ mass; $M(\pi^+\pi^-) < 1.9\mathrm{GeV/c^2}$
  - $K^{*+}$ mass; $M(\pi^+ K^0_S) < 1.9\mathrm{GeV/c^2}$
  - $\Delta E \in (-0.42, 0.42)\mathrm{GeV}$
  - $M_{bc} > 5.19\mathrm{GeV/c^2}$
  - $\gamma$ energy;$> 0.05\mathrm{GeV}$ for $K^* \to \pi^0 K^+$ channel

- generic $B$ MC;
  - uds and charm MC of data $\times 3$ was skimmed.
  - mixed and charged MC of data $\times 6$; will do
- rare $B$ MC and data; will do

# Summary and Next step

- Added the $K^* \rightarrow \pi^0 K^+$
- Study the longitudinal and transverse MC for both channel
- Determined to the skim criteria : done
- Skimming for $q\bar{q}$ background MC : done
- Skimming for $b \rightarrow c$ background MC : doing
- Applying for particle identification: will do