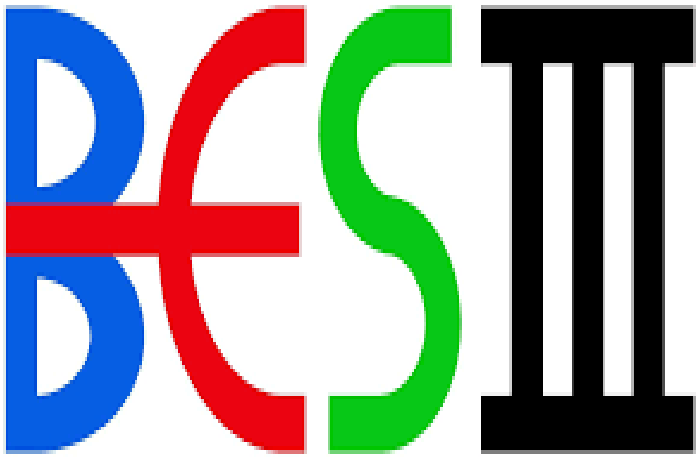
BESIII Oxford Group Meeting

Martin Tat

Oxford LHCb

25th February 2021



Introduction

- Double tagged $D \to K^+K^-\pi^+\pi^-$ events
- Previously: KK, $K\pi$, $K\pi\pi^0$, $K_S\pi^0$ tags
- Current progress: Have now implemented the following tags:
- CP tags:
  - KK, $\pi\pi$, $K_S\pi^0$, $K_S\pi^0\pi^0$, $\pi\pi\pi^0$, $K_S\eta$, $K_S\eta'(\pi\pi\eta)$, $K_S\eta'(\rho\gamma)$, $K_S(\eta,\omega)(\pi\pi\pi^0)$, $K_S\phi$
- CP conjugate tags:
  - $K_S\pi\pi$, $KK\pi\pi$
- Flavour tags:
  - $K\pi$, $K\pi\pi^0$
- Ran over full 2010 and 2011 MC $D^0\bar{D}^0$ sample ($20x$ luminosity)

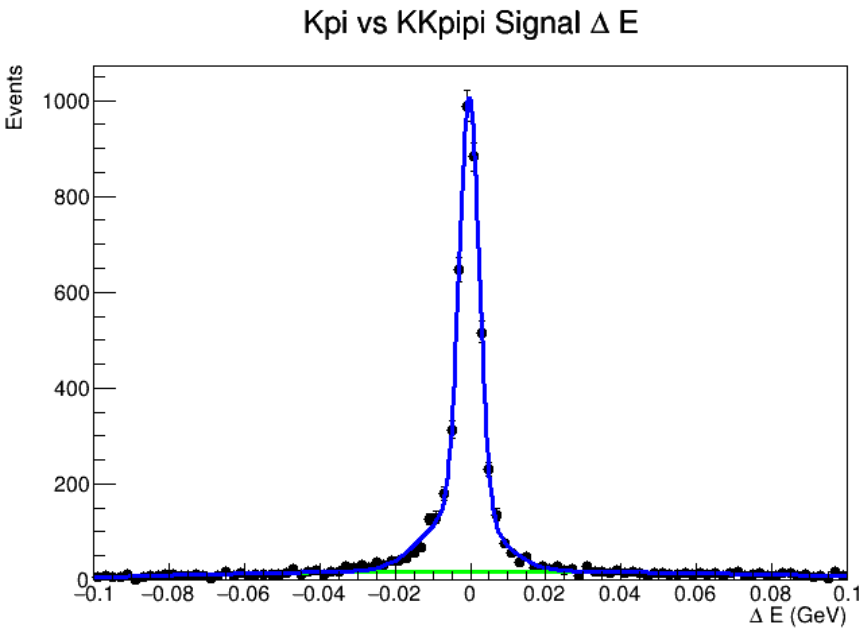
Selection procedure

- Standard cuts in the DTagTool package
- $\pi^0 \to \gamma\gamma$ with $0.110\,\text{GeV} < m(\gamma\gamma) < 0.155\,\text{GeV}$
- $\eta \to \gamma\gamma$ with $0.480\,\text{GeV} < m(\gamma\gamma) < 0.580\,\text{GeV}$
- $K_S \to \pi\pi$, flight significance cut at 2
- All $\pi\pi$ combinations have a flight significance cut at 2
- $\phi \to KK$, with $|m(KK) - m_{\text{PDG}}(\phi)| < 0.020\,\text{GeV}$
- $\eta' \to \pi\pi\eta$, with $0.940\,\text{GeV} < m(\pi\pi\eta) < 0.976\,\text{GeV}$
- $\eta' \to \pi\pi\gamma$, with $0.940\,\text{GeV} < m(\pi\pi\gamma) < 0.970\,\text{GeV}$
- $\eta \to \pi\pi\pi^0$, with $0.530\,\text{GeV} < m(\pi\pi\pi^0) < 0.565\,\text{GeV}$
- $\omega \to \pi\pi\pi^0$, with $0.750\,\text{GeV} < m(\pi\pi\pi^0) < 0.820\,\text{GeV}$

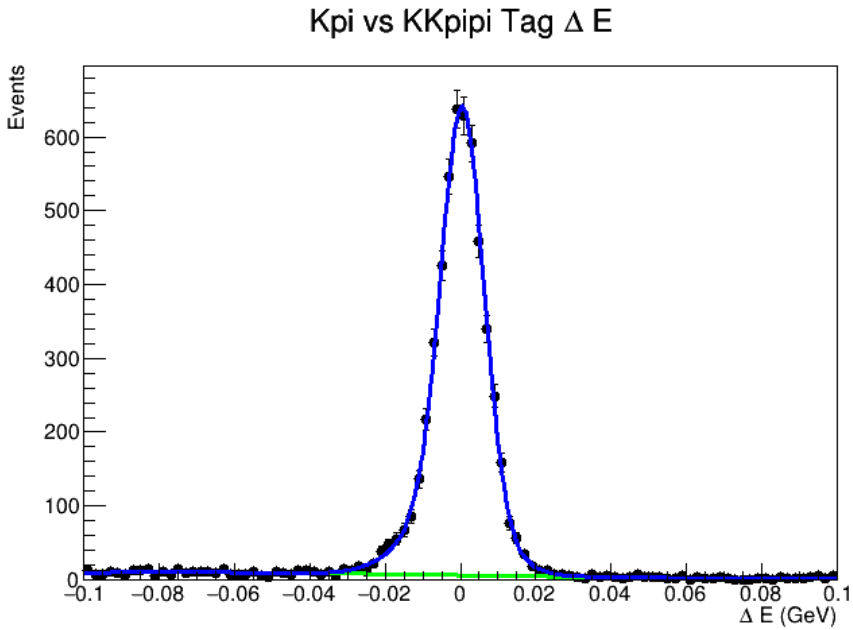
Cut on ΔE

- Fit double Gaussian and 2nd order polynomial to ΔE
- Cut at $(-3\sigma, +3\sigma)$ for modes without π^0
- Cut at $(-4\sigma, +3\sigma)$ for modes with π^0 (what about η?)
- Fit both signal and tag side

ΔE cut on $K\pi$ mode

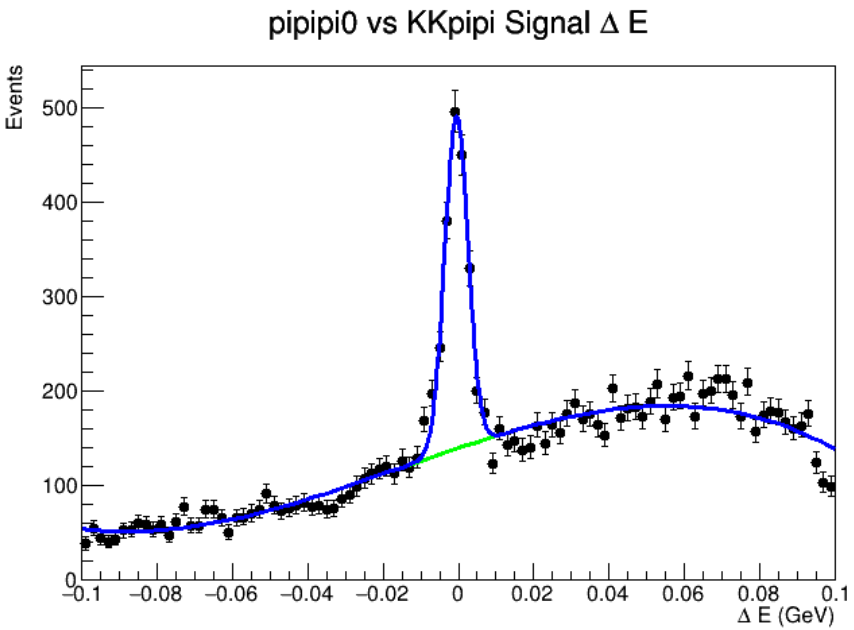


(a) ΔE, $KK\pi\pi$

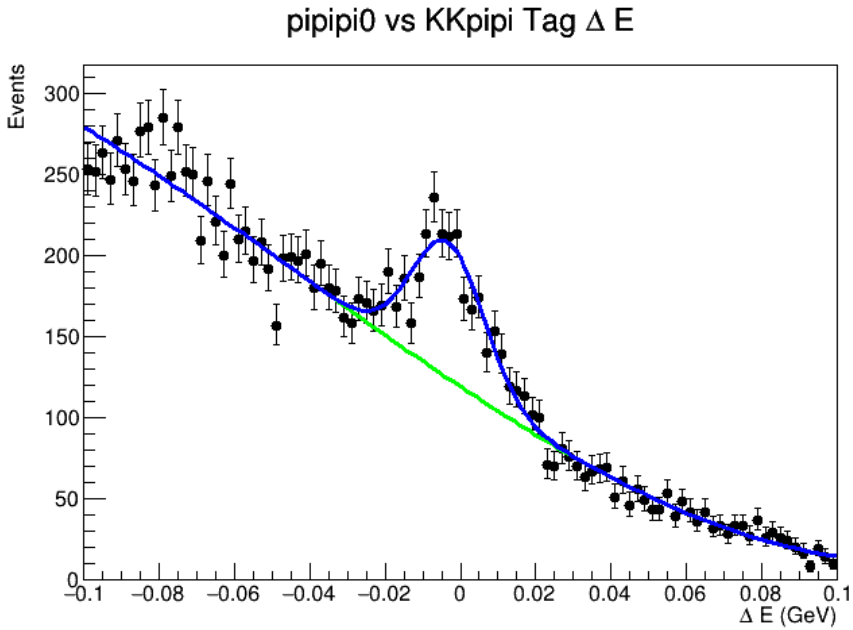


(b) ΔE, $K\pi$

ΔE cut on $\pi\pi\pi^0$ mode

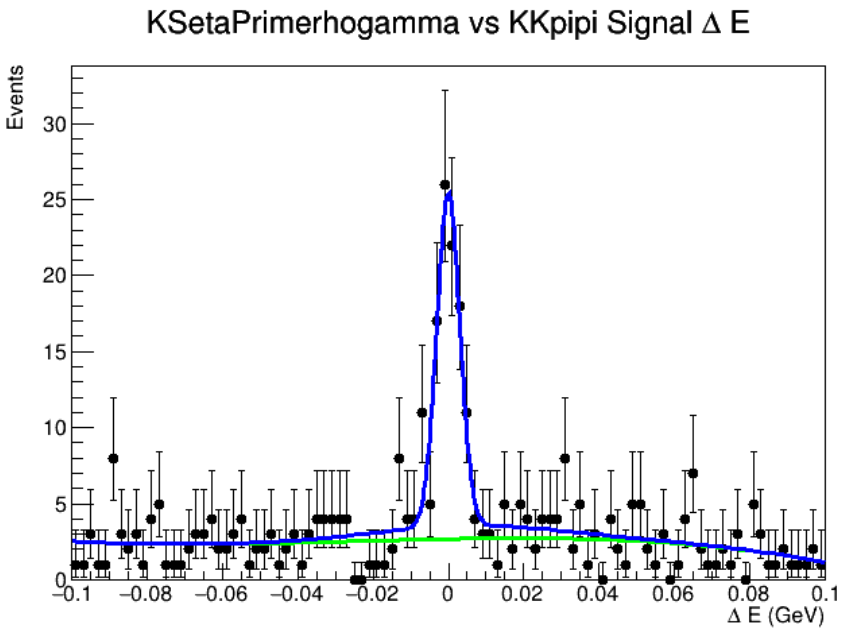


(a) ΔE, $KK\pi\pi$

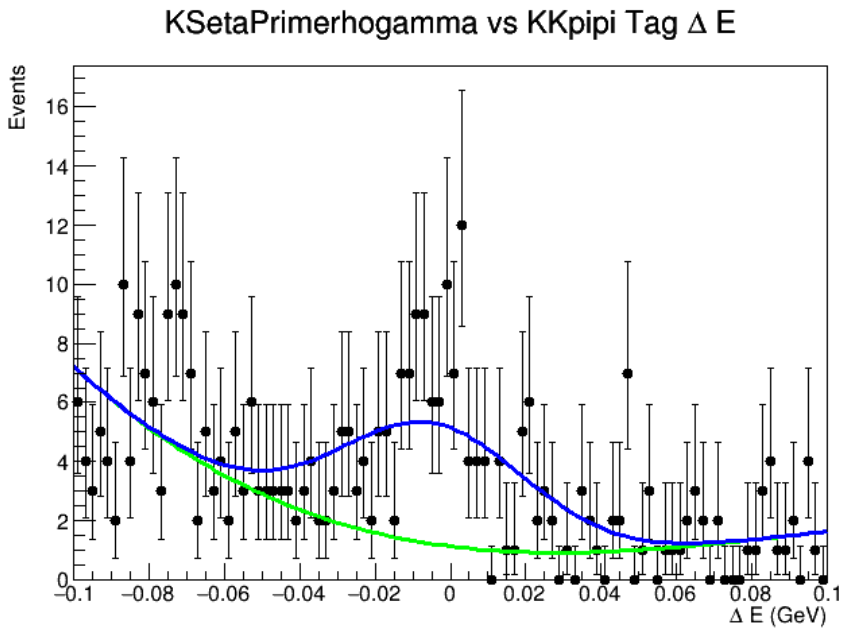


(b) ΔE, $\pi\pi\pi^0$

ΔE cut on $K_S\eta'(\pi\pi\gamma)$ mode

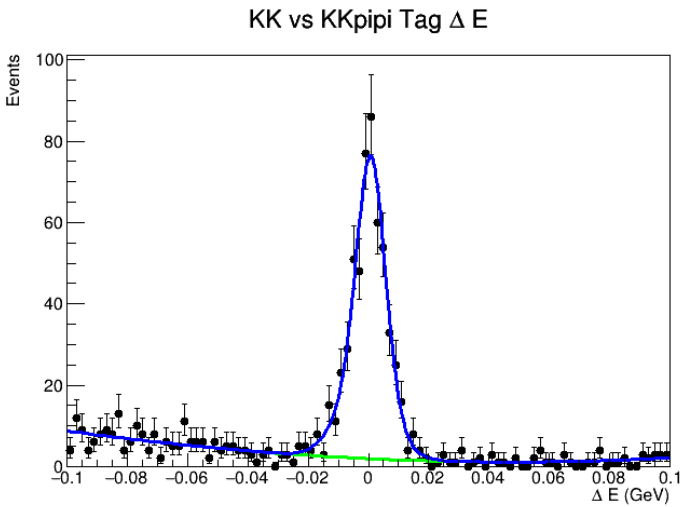


(a) ΔE, $KK\pi\pi$

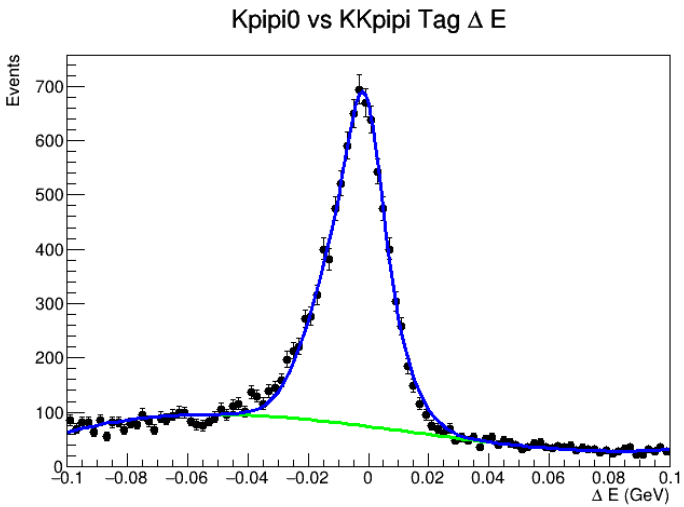


(b) ΔE, $K_S\eta'(\pi\pi\gamma)$

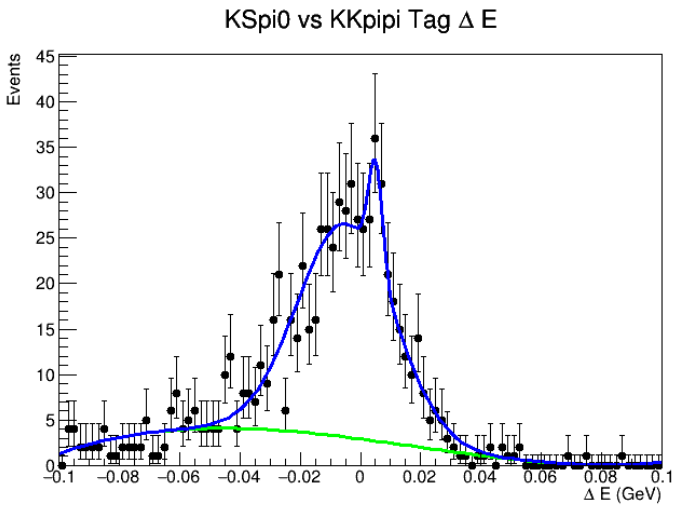
ΔE cut on other modes



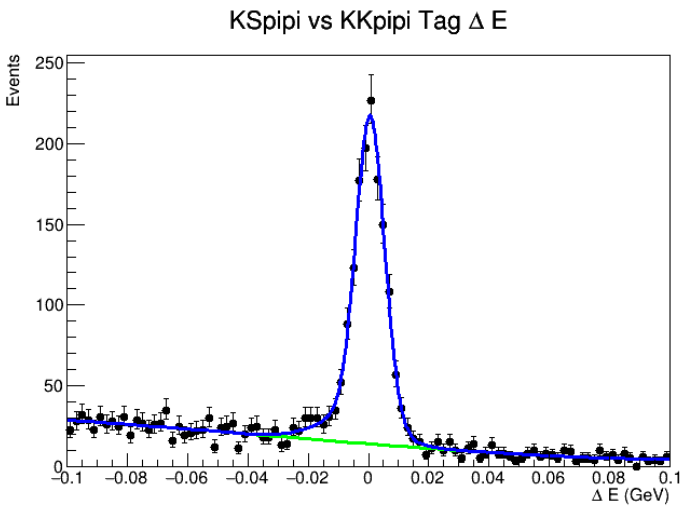
(a) ΔE, KK



(b) ΔE, $K\pi\pi^0$

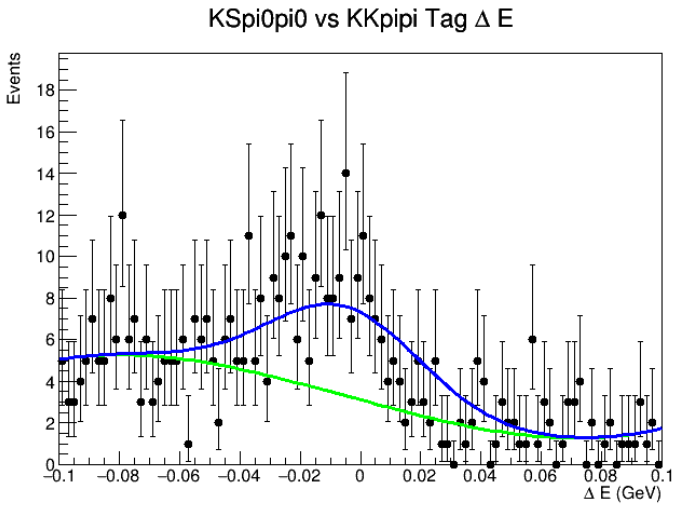


(c) ΔE, $K_S\pi^0$

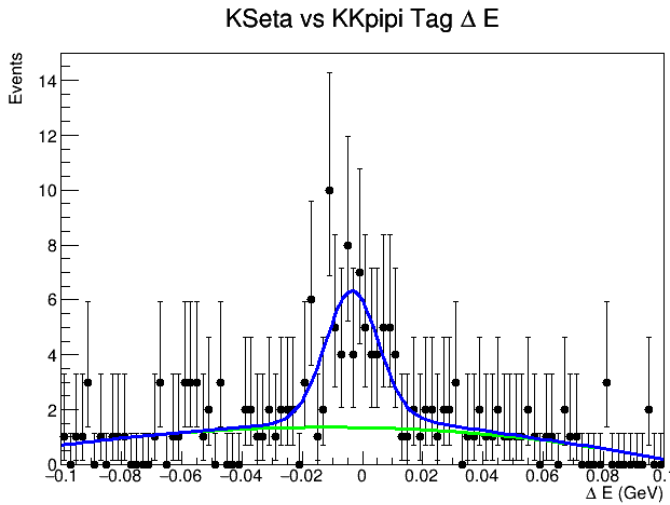


(d) ΔE, $K_S\pi\pi$

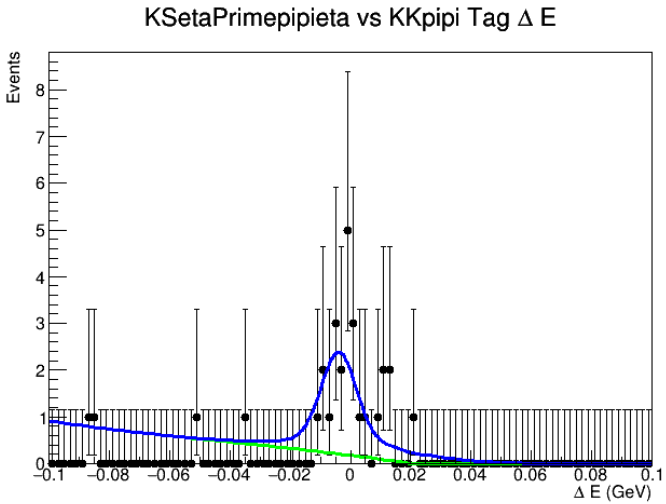
ΔE cut on other modes



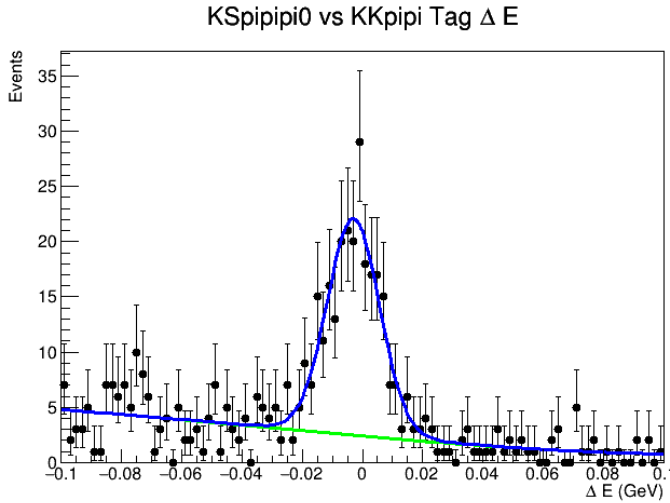
(a) ΔE, $K_S\pi^0\pi^0$



(b) ΔE, $K_S\eta$

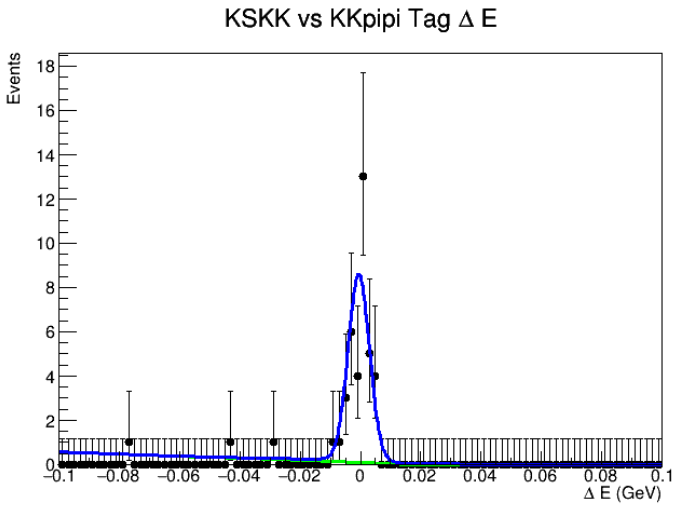


(c) ΔE, $K_S\eta'(\pi\pi\eta)$

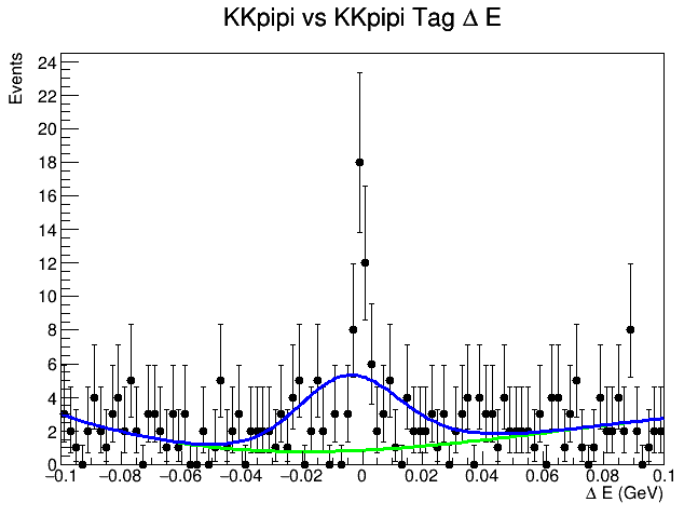


(d) ΔE, $K_S(\eta,\omega)(\pi\pi\pi^0)$

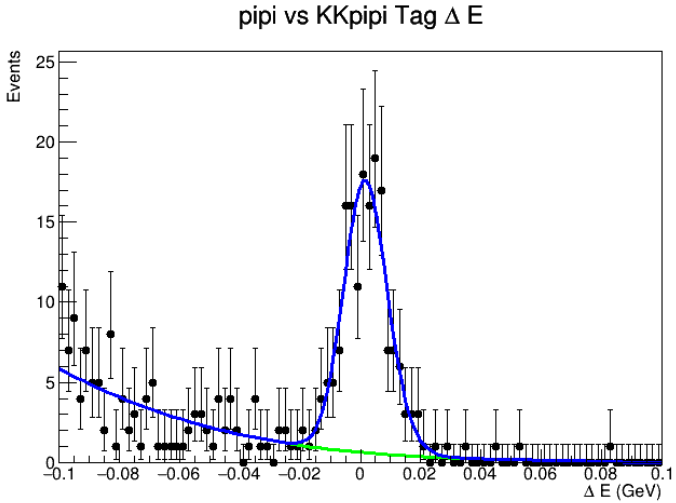
ΔE cut on other modes



(a) ΔE, $K_S KK$

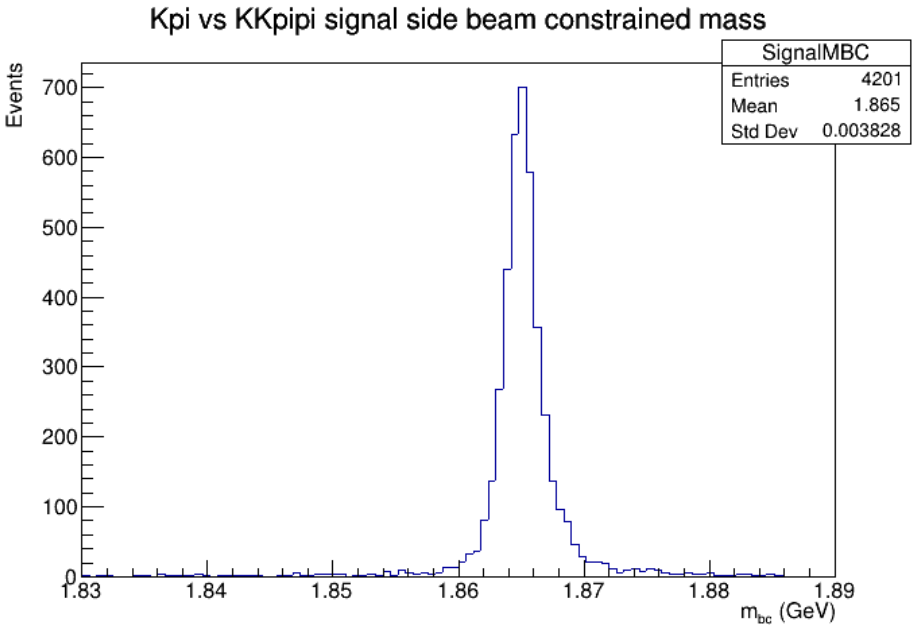


(b) ΔE, $KK\pi\pi$

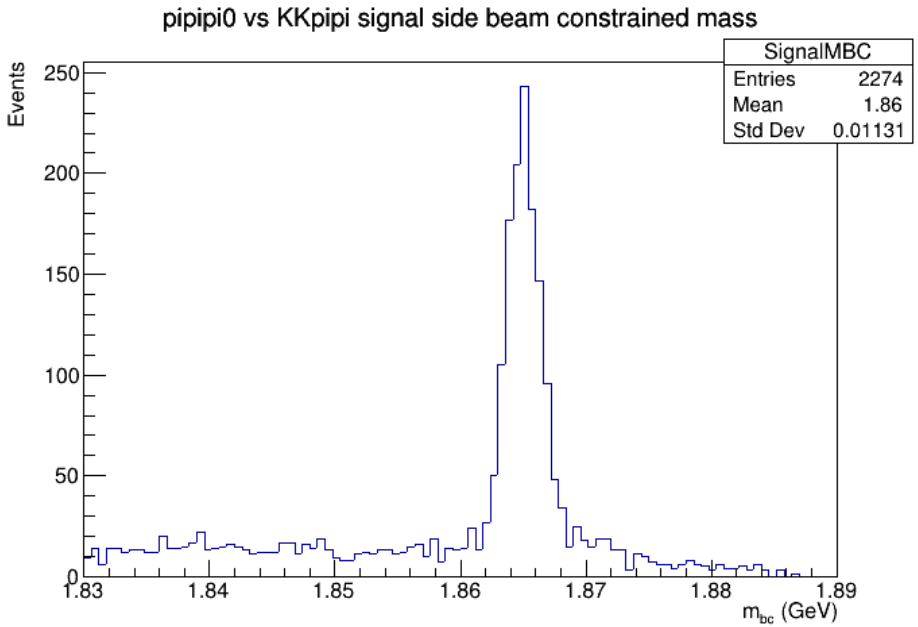


(c) ΔE, $\pi\pi$

m_{BC}

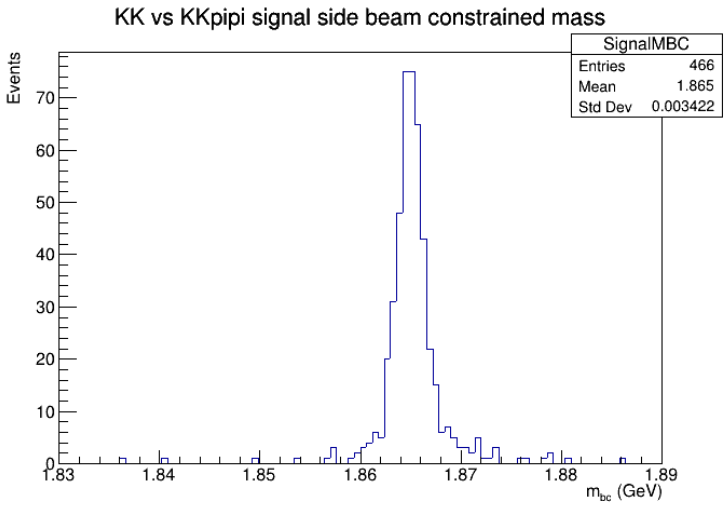


(a) m_{BC}, $K\pi$

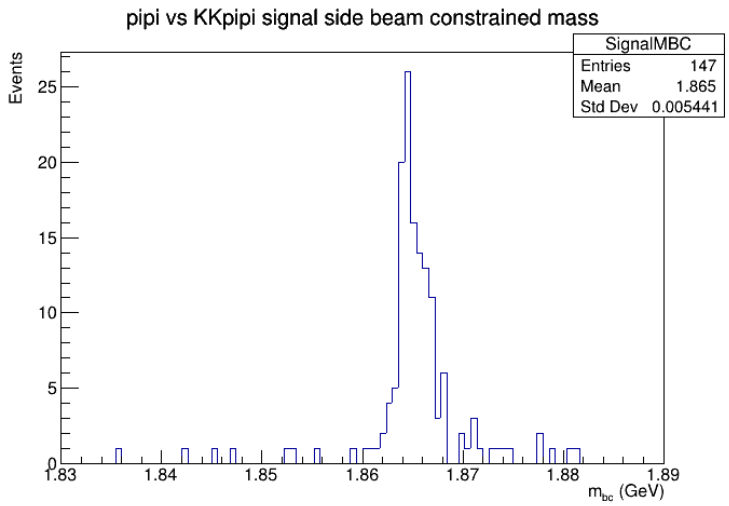


(b) m_{BC}, $\pi\pi\pi^0$

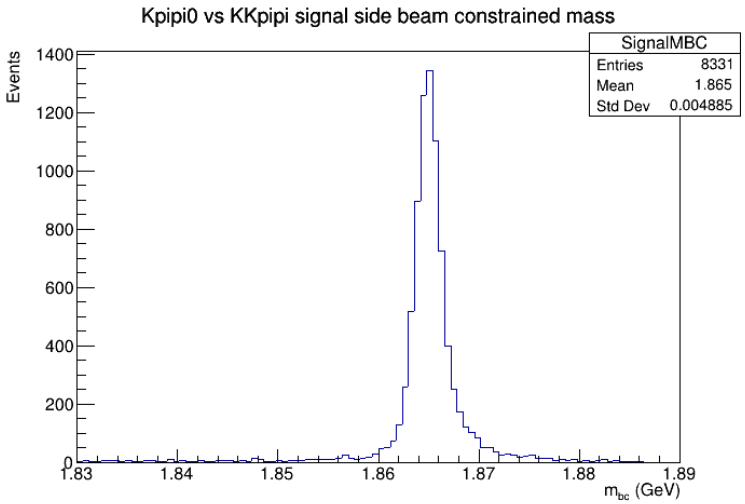
m_{BC}



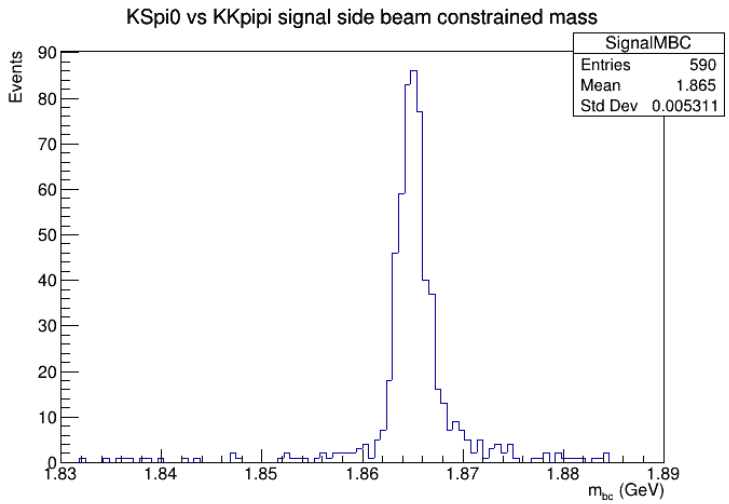
(a) m_{BC}, KK



(b) m_{BC}, $\pi\pi$

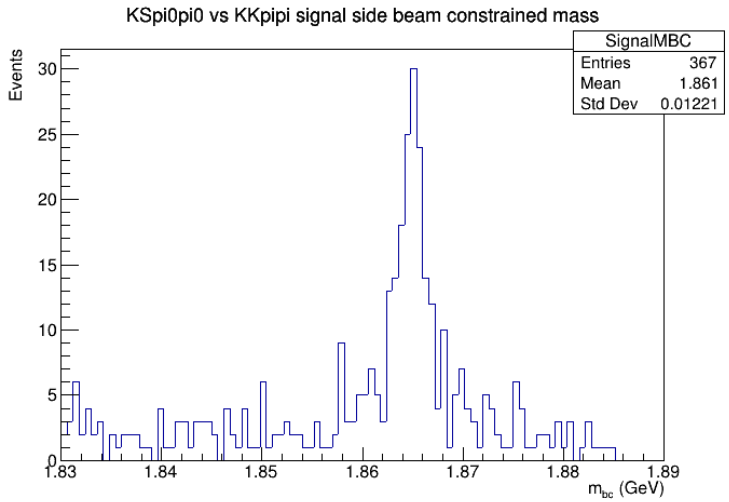


(c) m_{BC}, $K\pi\pi^0$

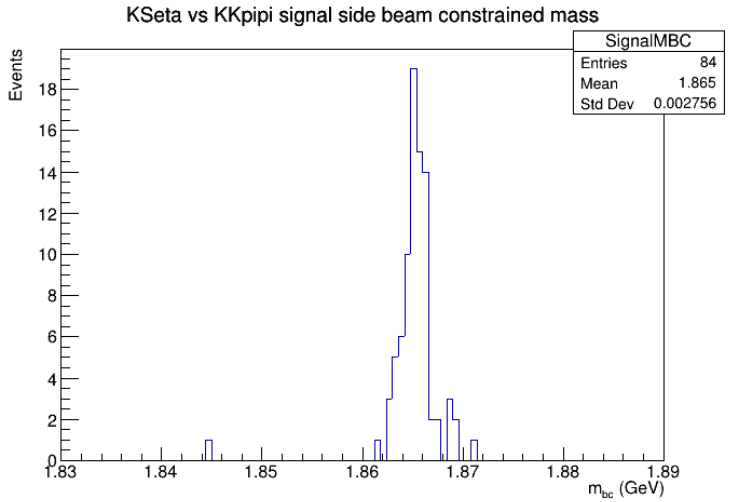


(d) m_{BC}, $K_S\pi^0$

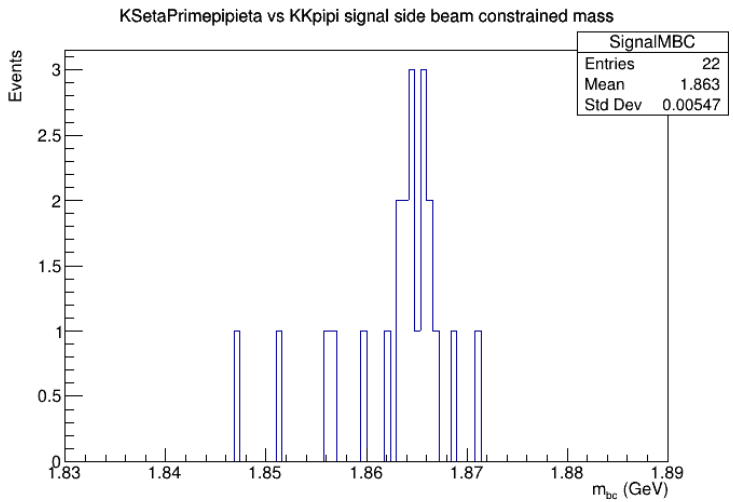
m_{BC}



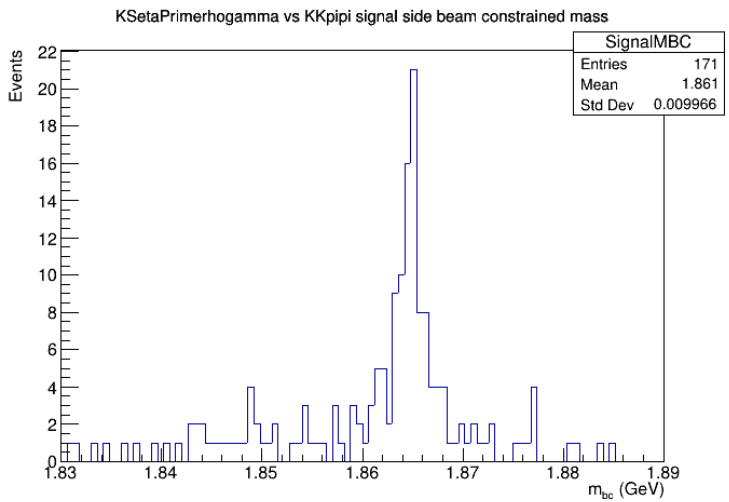
(a) m_{BC}, $KS\pi^0\pi^0$



(b) m_{BC}, $K_S\eta$

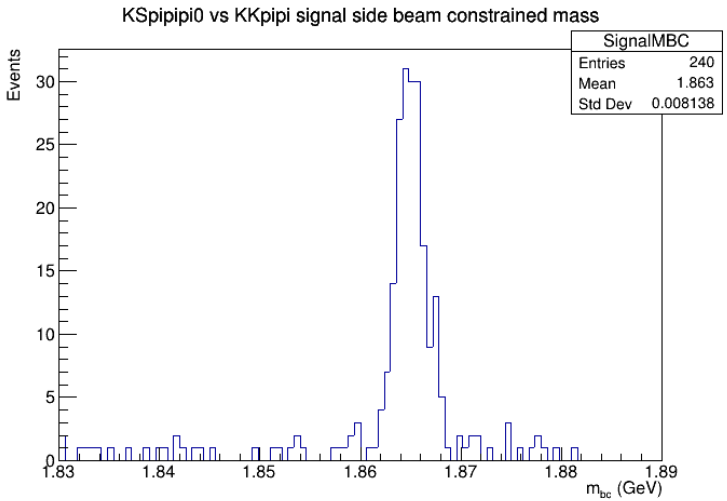


(c) m_{BC}, $K_S\eta'(\pi\pi\eta)$

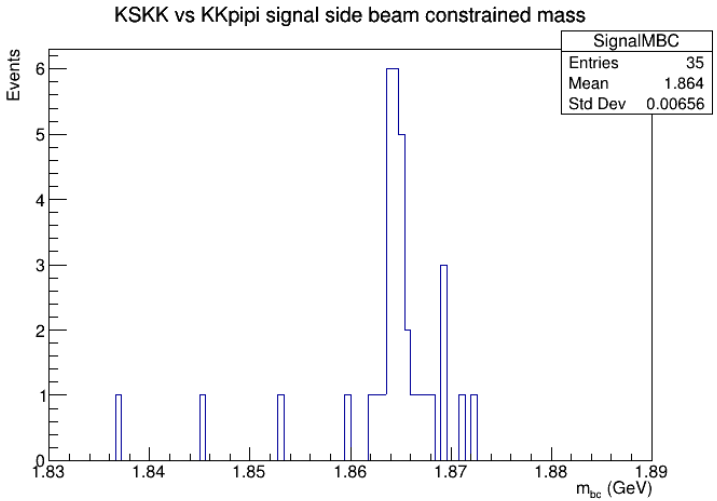


(d) m_{BC}, $K_S\eta'(\pi\pi\gamma)$

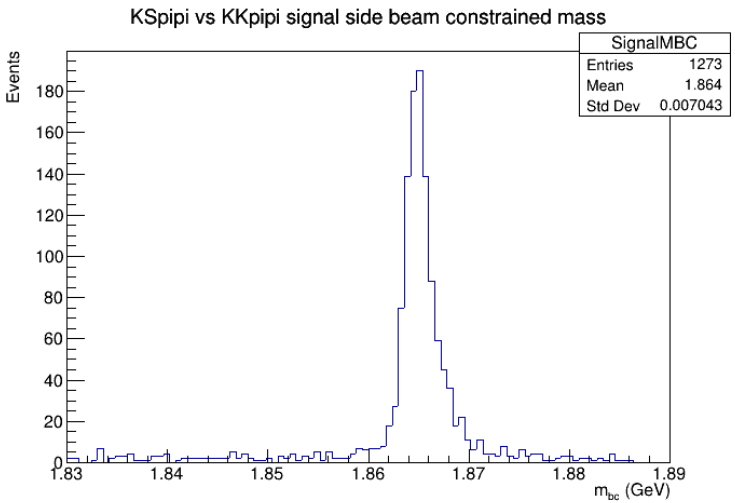
m_{BC}



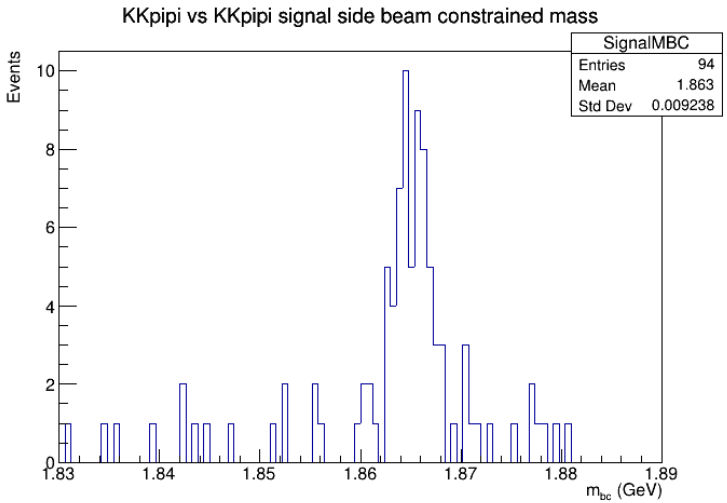
(a) m_{BC}, $K_S(\eta,\omega)(\pi\pi\pi^0)$



(b) m_{BC}, $K_S KK$



(c) m_{BC}, $K_S\pi\pi$



(d) m_{BC}, $KK\pi\pi$

Flat background estimate

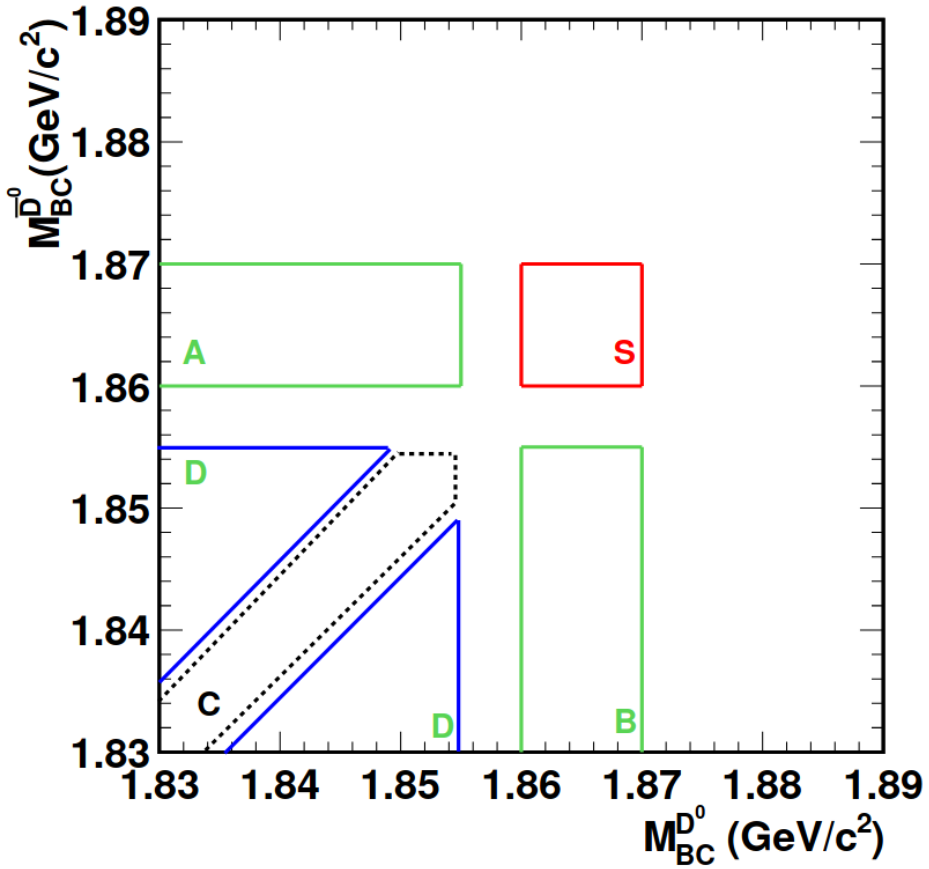


Figure 11: m_{BC} plane, BESIII $K^0_S K^+ K^-$ MEMO

$$F = \frac{a_S}{a_D} D + \sum_{i=A,B,C} \frac{a_S}{a_i} \left(i - \frac{a_S}{a_i} D \right)$$

Flat background estimate

Tag mode	Yield	Background
$K\pi\pi^0$	6898	178.5
$K\pi\phi$	3855	32.8
$\pi\pi\pi^0$	1295	14.4
$K_S\pi\pi$	1043	7.3
K^0_π	481	4.8
KK	413	8.0
$K_S(\eta,\omega)(\pi\pi\pi^0)$	183	1.3
$K_S\pi^0\pi^0$	149	10.6
$\pi\pi$	122	2.6
$K_S\eta'(\pi\pi\gamma)$	79	5.0
$K_S\eta$	68	5.6
$KK\pi\pi$	52	6.1
$K_S\phi$	28	1.2
$K_S\eta'(\pi\pi\eta)$	15	0.8

Next steps

- Implement K_L tag modes
  - $K_L\pi^0$, $K_L\omega$, $K_L\pi^0\pi^0$
- Run over data