

Optimize Sequence

Belle II

Target	Selection
	Baseline selection
-	CSMVA > 0.9 & Charm Veto & Signal Region
γ	clusterE (forward) > 0.200 GeV
	clusterE (barrel) > 0.100 GeV
	clusterE (backward) > 0.175 GeV
	fakePhotonSuppressionScore > 0.46
	beamBackgroundSuppressionScore > 0.53
π^0	$\chi^2_{\pi^0} < 22$
	daughterAngle < 0.5
	cosHelicityAngleMomentum < 0.93
	0.115 < InvM < 0.150 GeV/c ²
$K^\pm$	kaonIDNN > 0.7

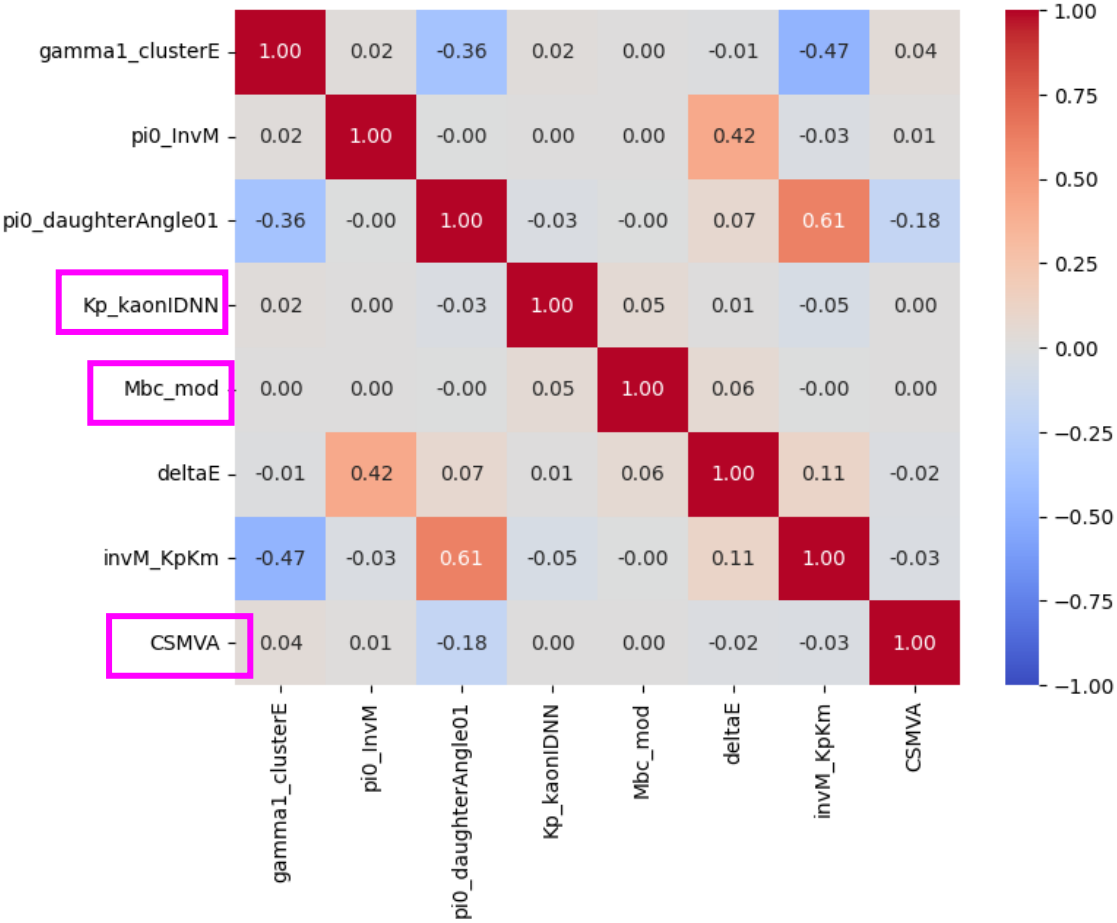
$$\varepsilon = 15.79\% , f_{SCF} = 2.37, \text{FOM} = 3.06$$

Target	Selection
	Baseline selection
γ	clusterE (forward) > 0.275 GeV
	clusterE (barrel) > 0.175 GeV
	clusterE (backward) > 0.200 GeV
	fakePhotonSuppressionScore > 0.68
	beamBackgroundSuppressionScore > 0.1
π^0	$\chi^2_{\pi^0} < 16$
	daughterAngle < 0.5
	cosHelicityAngleMomentum < 0.86
	0.115 < InvM < 0.150 GeV/c ²
$K^\pm$	kaonIDNN > 0.65
-	CSMVA > 0.9 & Charm Veto & Signal Region

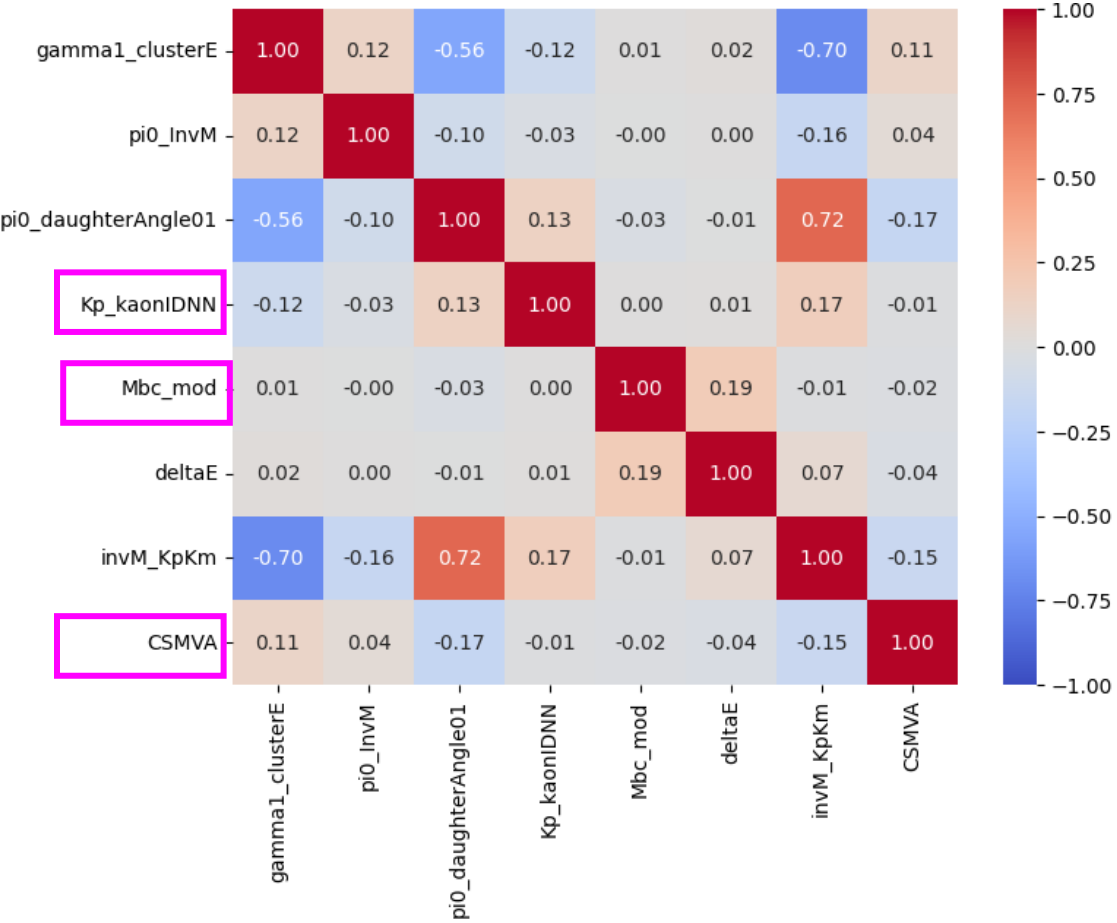
$$\varepsilon = 14.98\% , f_{SCF} = 1.56, \text{FOM} = 2.86$$

Correlation

CR Signal

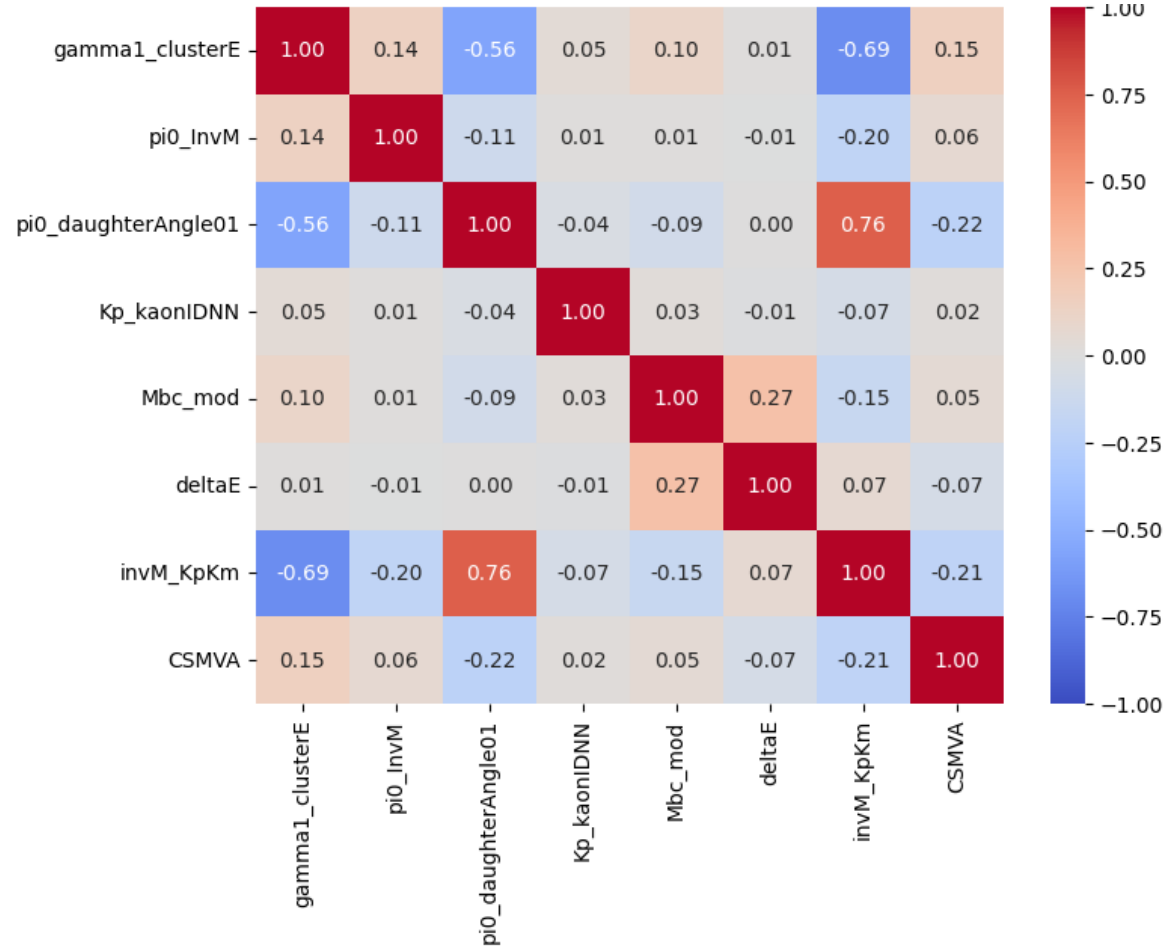


Continuum Background

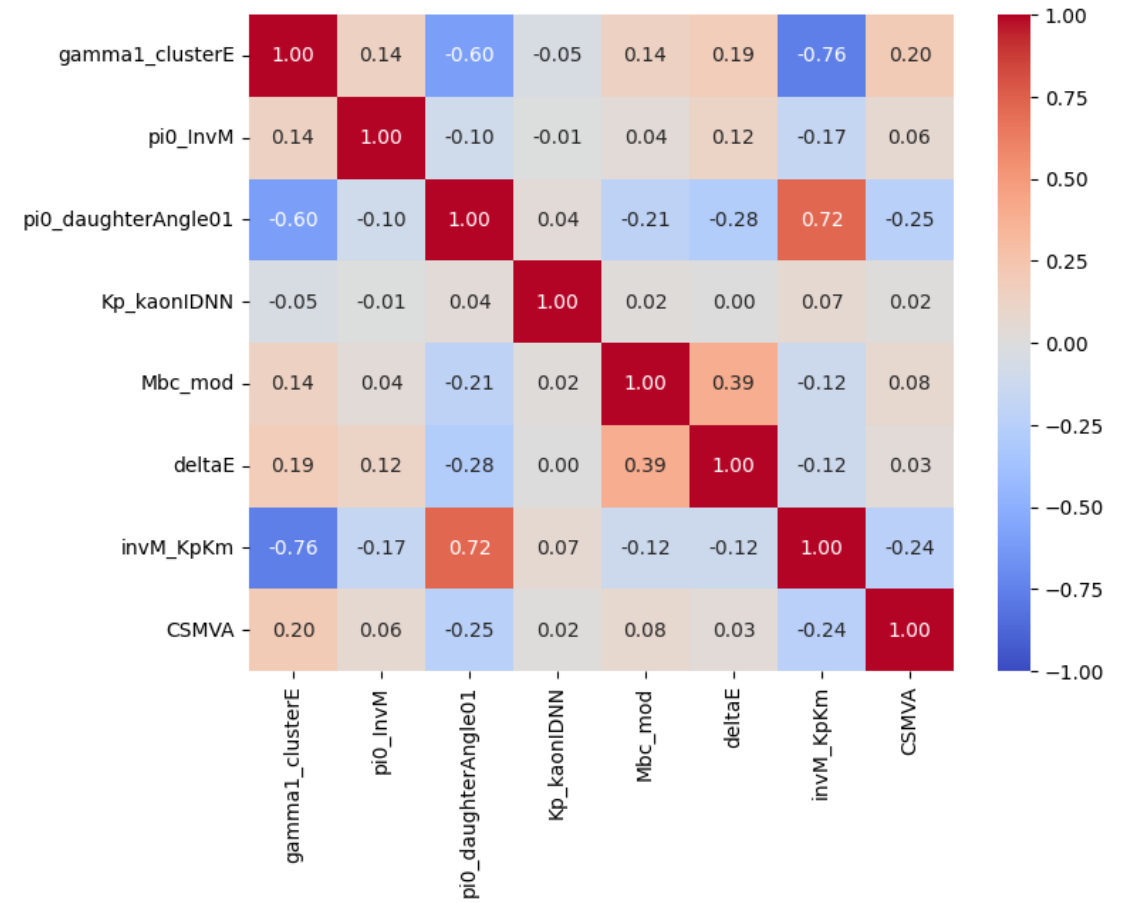


Correlation

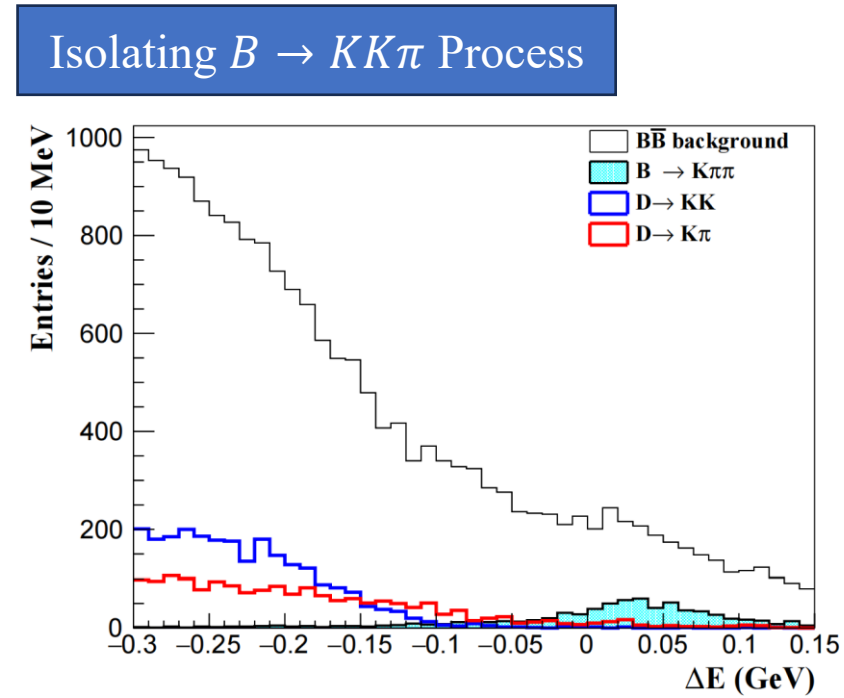
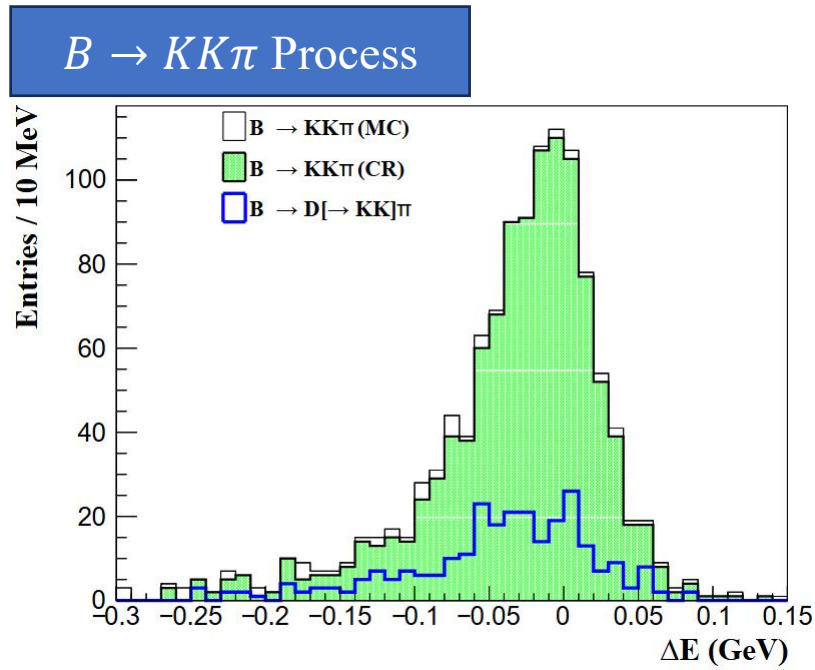
$B\bar{B}$ Background



Peaking Background



Charm Veto



- CSMVA > 0.9
- $-0.25 < \Delta E < 0.15$ GeV, $M_{bc} > 5.27$ GeV / c^2 . No charm veto window

➤ $\mathcal{B}(B^0 \rightarrow K^+ K^- \pi^0) = (2.17 \pm 0.6) \times 10^{-6}$

$N_{sig}^{exp} \approx 130$

➤ $\mathcal{B}(B^0 \rightarrow K^+ \pi^- \pi^0) = (37.8 \pm 3.2) \times 10^{-6}$

$N_{peak}^{exp} \approx 83$

➤ $\mathcal{B}(B^0 \rightarrow \bar{D}^0[\rightarrow K^+ K^-] \pi^0) = (1.09 \pm 0.04) \times 10^{-6}$

$N_{charm}^{exp} \approx 46$

Charm Veto

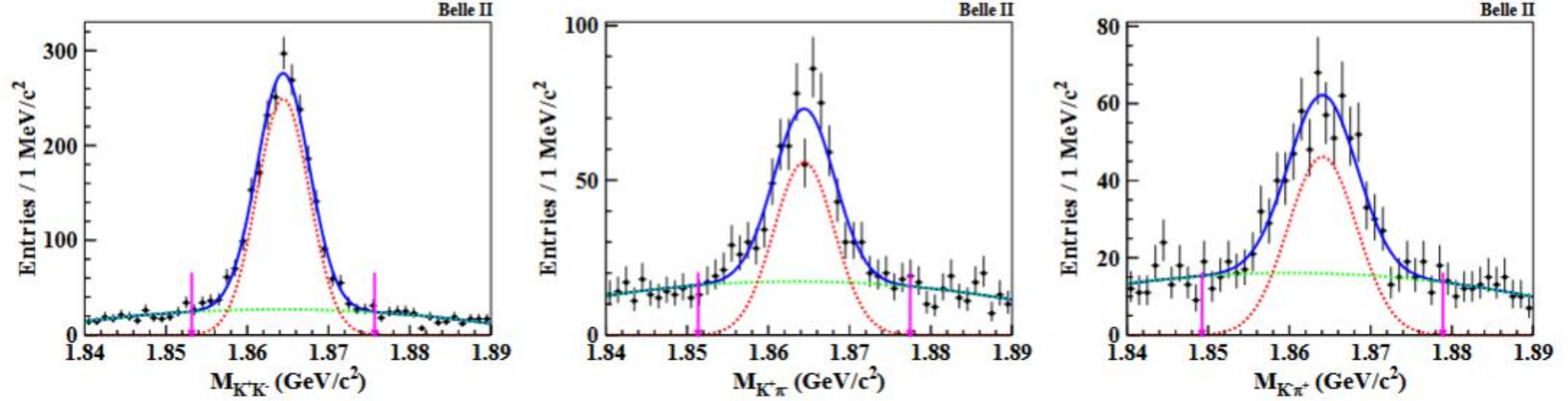


FIG. 15. Results of fitting to the invariant mass distributions of K^+K^- , $K^+\pi^-$ and $K^-\pi^+$ in Belle II. The arrows show the charm veto region.

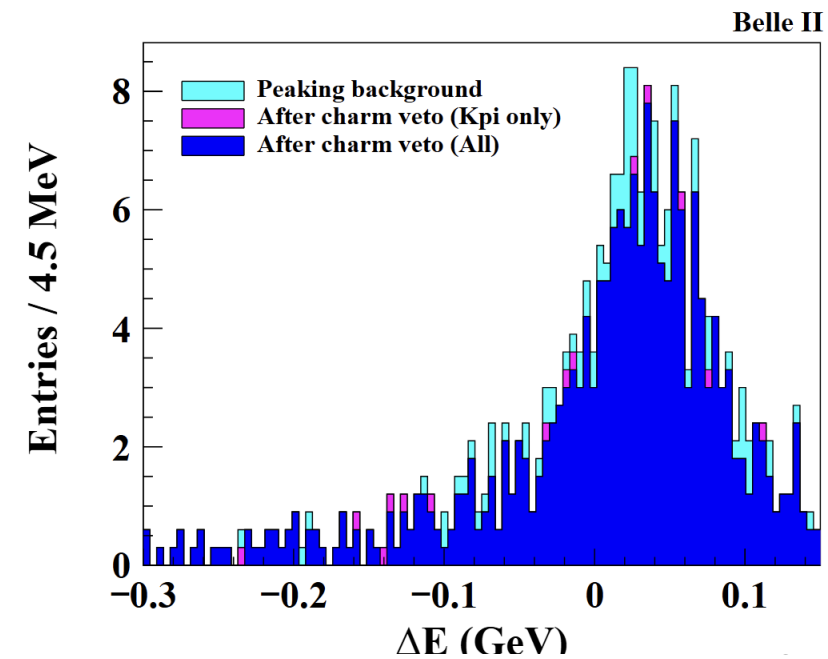
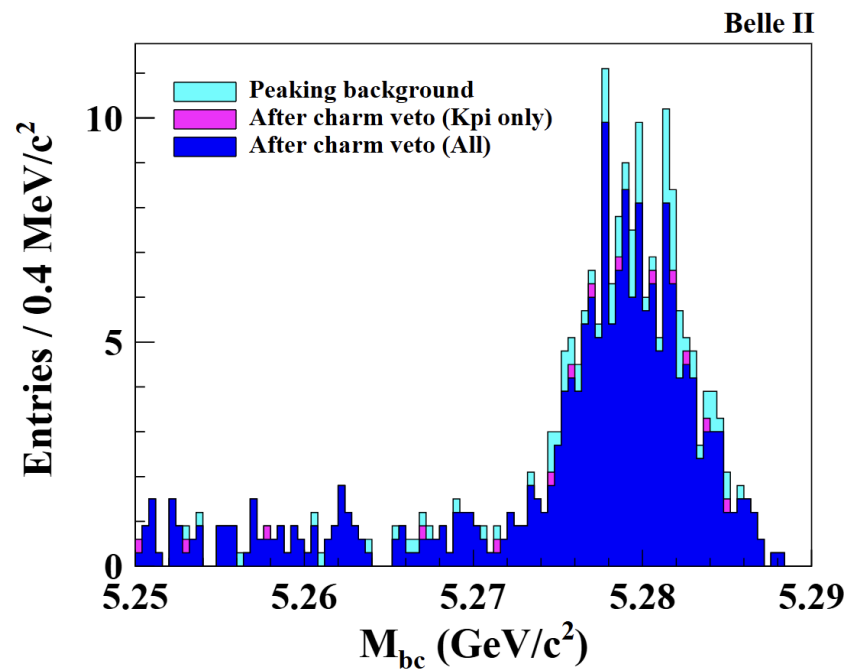
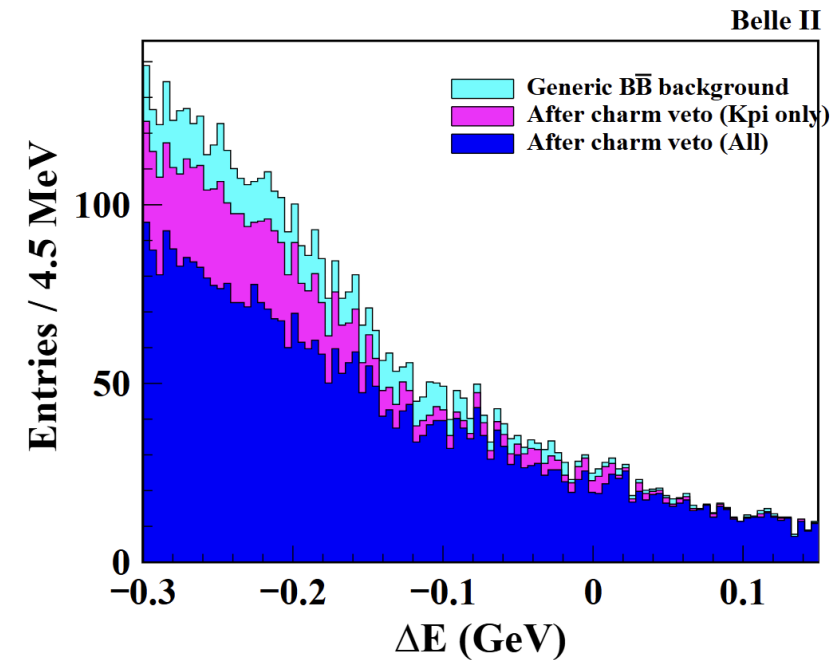
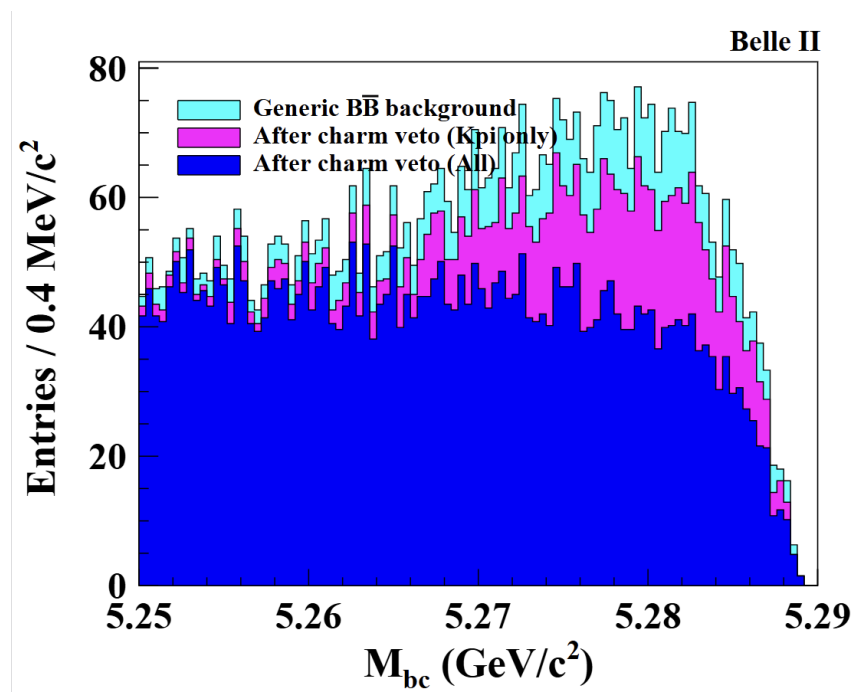
$$M_{K^\pm\pi^\mp} = \sqrt{(E_{K^\pm} + E_{\pi^\mp})^2 - (\vec{p}_{K^\pm} + \vec{p}_{\pi^\mp})^2},$$

$$E_{K^\pm} = \sqrt{\vec{p}_{K^\pm}^2 + m_{K^\pm}^2},$$

$$E_{\pi^\mp} = \sqrt{\vec{p}_{\pi^\mp}^2 + m_{\pi^\mp}^2}.$$

Charm Veto

- Veto $M_{K\pi}$ only?



Charm Veto

- Signal mode: $B^0 \rightarrow K^+ K^- \pi^0$
- Possible charm decay mode:
 - $B^0 \rightarrow \bar{D}^0 [\rightarrow K^+ K^-] \pi^0$

$B^0 \rightarrow \bar{D}^0 \pi^0$ Decay Mode Summary			PDGID:S042.128	JSON (beta)	INSPIRE Q
Mode (*)	Fraction (Γ_i / Γ)	Scale Factor/ Conf. Level	P(MeV/c)		
$\Gamma_{162} \quad B^0 \rightarrow \bar{D}^0 \pi^0$	$(2.67 \pm 0.09) \times 10^{-4}$		2308		

$D^0 \rightarrow K^+ K^-$ Decay Mode Summary			PDGID:S032.7	JSON (beta)	INSPIRE Q
Mode (*)	Fraction (Γ_i / Γ)	Scale Factor/ Conf. Level	P(MeV/c)		
$\Gamma_{222} \quad D^0 \rightarrow K^+ K^-$	$(4.08 \pm 0.06) \times 10^{-3}$	S=1.6	791		

- $B^0 \rightarrow \bar{D}^0 [\rightarrow K^+ \pi^-] \pi^0$ (Due to kaon misidentification)

$D^0 \rightarrow K^- \pi^+$ Decay Mode Summary			PDGID:S032.1	JSON (beta)	INSPIRE Q
Mode (*)	Fraction (Γ_i / Γ)	Scale Factor/ Conf. Level	P(MeV/c)		
$\Gamma_{43} \quad D^0 \rightarrow K^- \pi^+$	$(3.945 \pm 0.030) \times 10^{-2}$	S=1.2	861		

- $B^0 \rightarrow D^- [\rightarrow K^- \pi^0] K^+$

$B^0 \rightarrow D^- K^+$ Decay Mode Summary				PDGID:S042.201	JSON (beta)	$D^+ \rightarrow K^+ \pi^0$ Decay Mode Summary				PDGID:S031.234	JSON (beta)	INSPIRE Q
Mode (*)		Fraction (Γ_i / Γ)	Scale Factor/ Conf. Level	P(MeV/c)	Mode (*)		Fraction (Γ_i / Γ)	Scale Factor/ Conf. Level	P(MeV/c)			
Γ_{43}	$B^0 \rightarrow D^- K^+$	$(2.05 \pm 0.08) \times 10^{-4}$		2279	Γ_{181}	$D^+ \rightarrow K^+ \pi^0$	$(2.08 \pm 0.21) \times 10^{-4}$	S=1.4	864			