Study of decay $B^0 \to K^+K^-\pi^0$ at Belle II

Group meeting

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Samples at Belle II

☐ Data samples(will be used)

- Run1: 365.29 fb^{-1} data samples collected at $\Upsilon(4S)$ peak $\sqrt{s} = 10.58\ \mathrm{GeV}$
- Run2: 133.12 fb^{-1} data samples collected at $\Upsilon(4S)$ peak $\sqrt{s} = 10.58\ \mathrm{GeV}$

☐ MC16rd simulation sample

- Generic MC samples at 4S for Run1: 1429.226 fb^{-1} Run2: 517.112 fb^{-1} (Only use Run2 temporarily)
- Signal MCrd: 2×10^6 events

☐ Skim

- HLT hardon skim(f_bhadronic_p2)

Preliminary Selection

☐ Charged track candidate:

✓ $dr < 0.5$ cm, $|dz| < 2.0$ cm and θ in CDC Acceptance

✓ nTracks ≥ 2

✓ Kaon PID: KaonIDNN > 0.6

☐ γ candidate:

✓ $0.2976 < \theta < 2.6180$ rad

✓ clusterNHits > 1.5

✓ $|\text{clusterTiming}| < 200$ ns

✓ $E_{\gamma}^{fEndcap} > 25$ MeV, $E_{\gamma}^{Barrel} > 25$ MeV, $E_{\gamma}^{bEndcap} > 40$ MeV

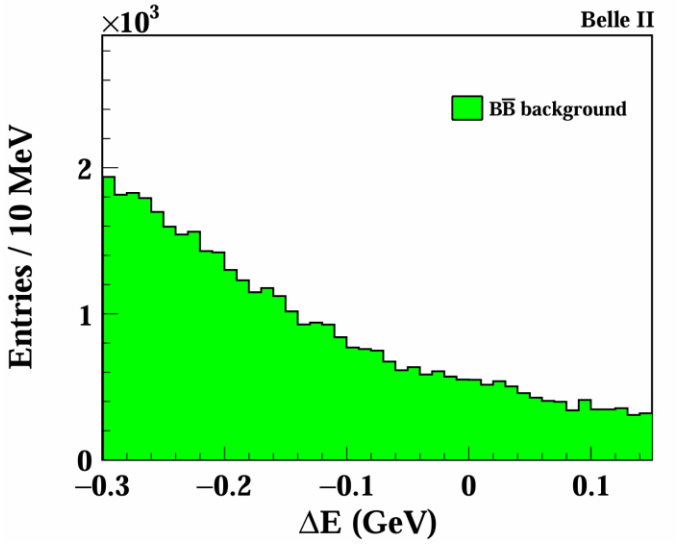
☐ π^0 candidate:

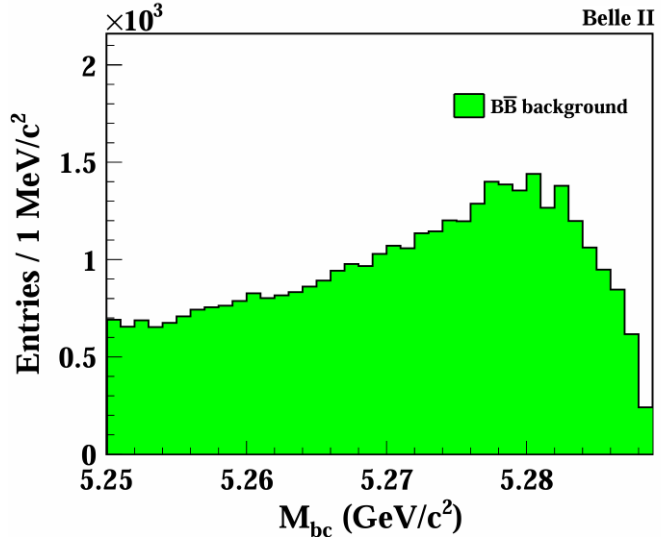
✓ $105\ \text{MeV} < M_{\gamma\gamma} < 150\ \text{MeV}$

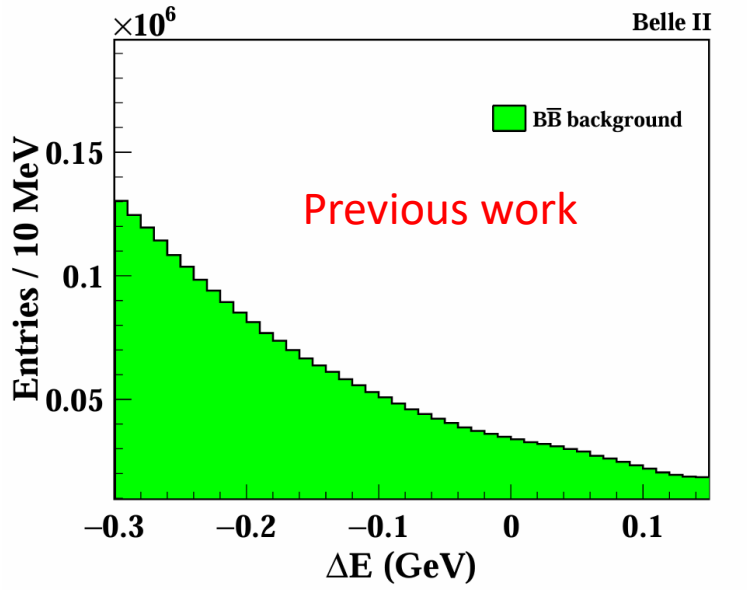
☐ B^0 candidate:

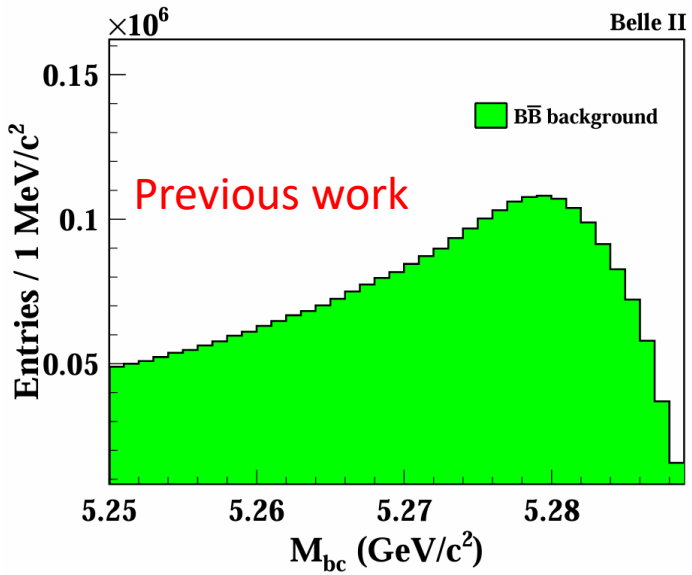
✓ $5.25\ \text{GeV} < M_{bc} < 5.289\ \text{GeV}\ \&\&\ -0.3\ \text{GeV} < \Delta E < 0.15\ \text{GeV}$

Preliminary Selection







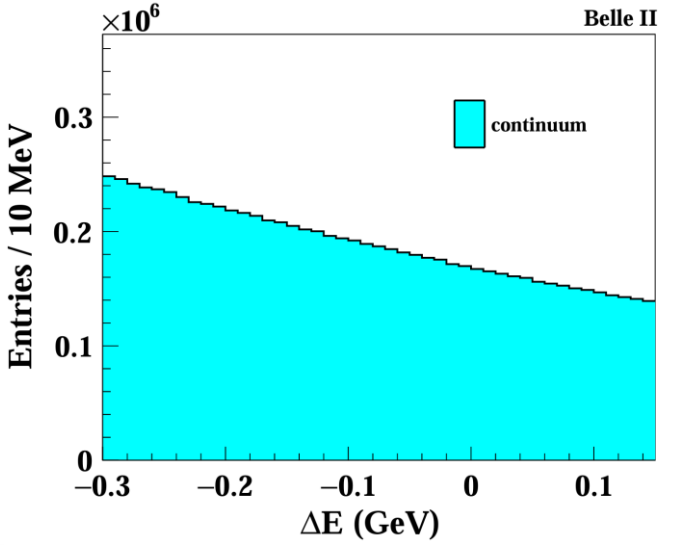


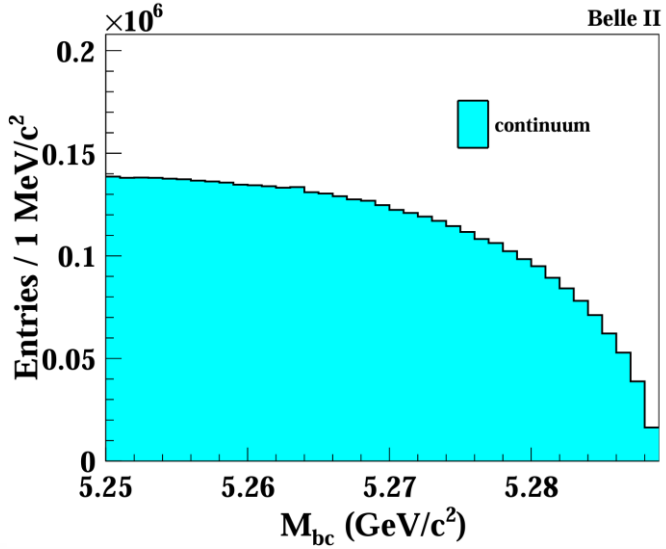
73721 events for BB bkg

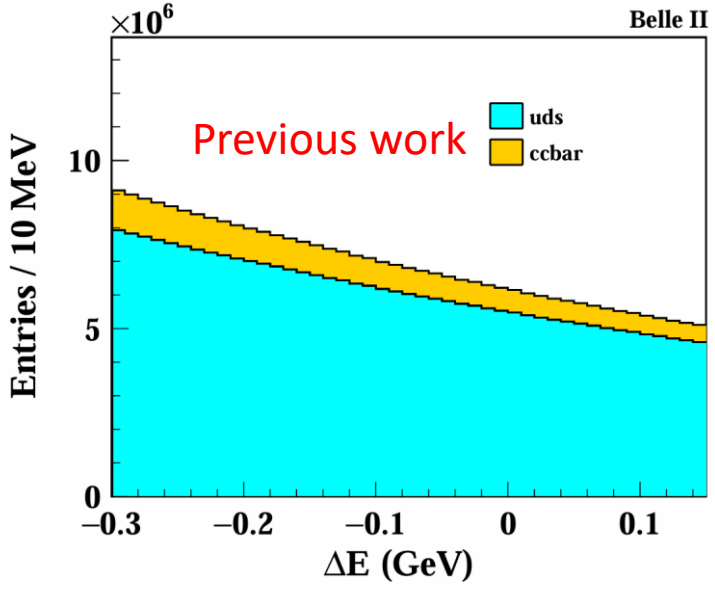
- ΔE and M_{bc}distribution from BB bkg

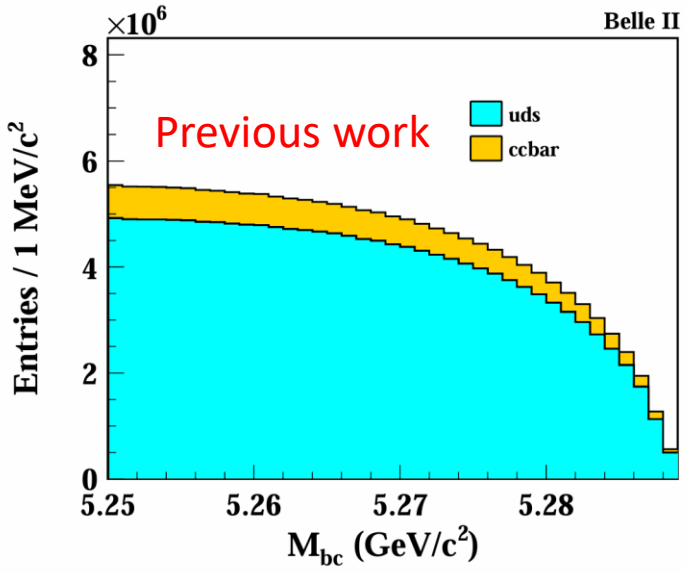
The luminosity of the samples used in the previous study is about 3 times that of the current samples (only run2)

Preliminary Selection





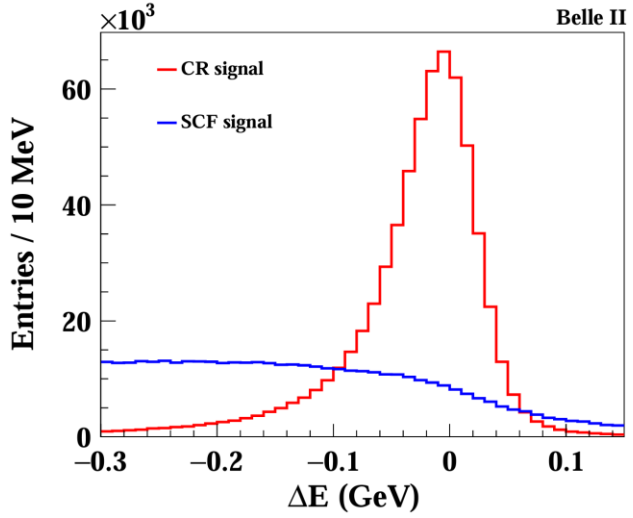


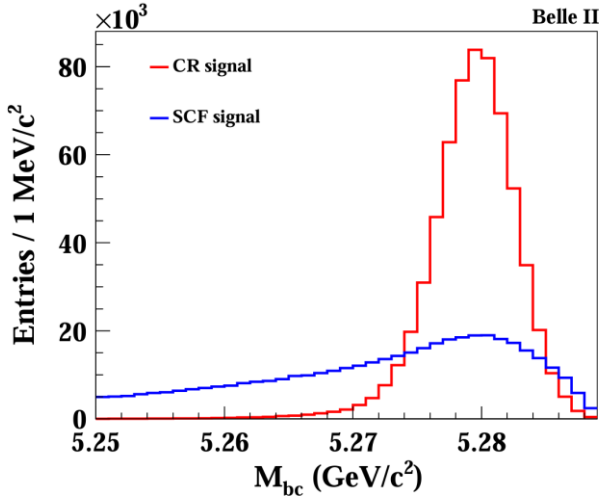


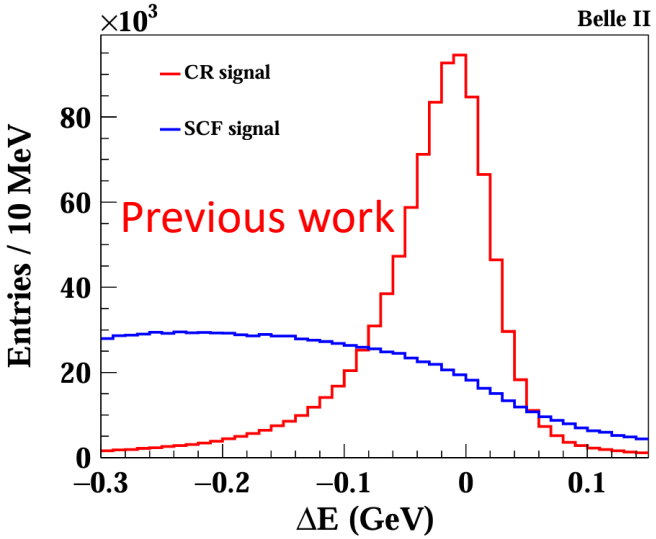
- ΔE and M_{bc} distribution from continuum bkg

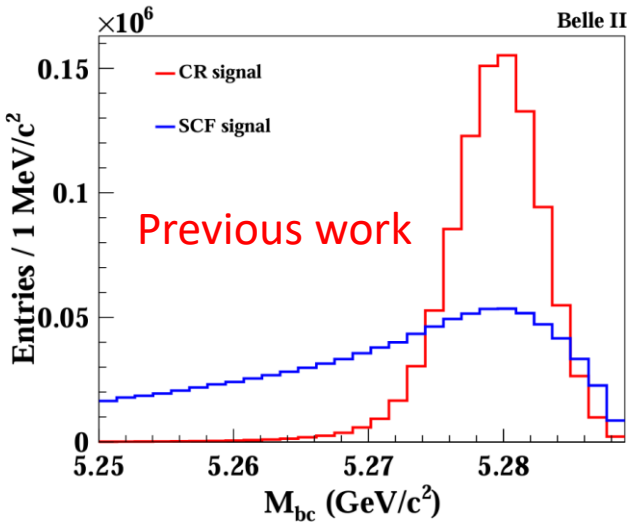
The luminosity of the samples used in the previous study is about 3 times that of the current samples (only run2)

Preliminary Selection









- ΔE and M_{bc}distribution of sig

Previous work

$$\varepsilon_{sig} = \frac{N_{CR}}{N_{gen}} = 31.69\% \qquad (48.09 \pm 0.05)\%$$

$$f_{SCF} = \frac{N_{SCF}}{N_{CR} + N_{SCF}} = 40.08\% \qquad (49.74 \pm 0.05)\%$$

$$\varepsilon_{\mathrm{Kpid}} = 65.9\%$$

FBDT Training (MC-based)

☐ Train and Test sample

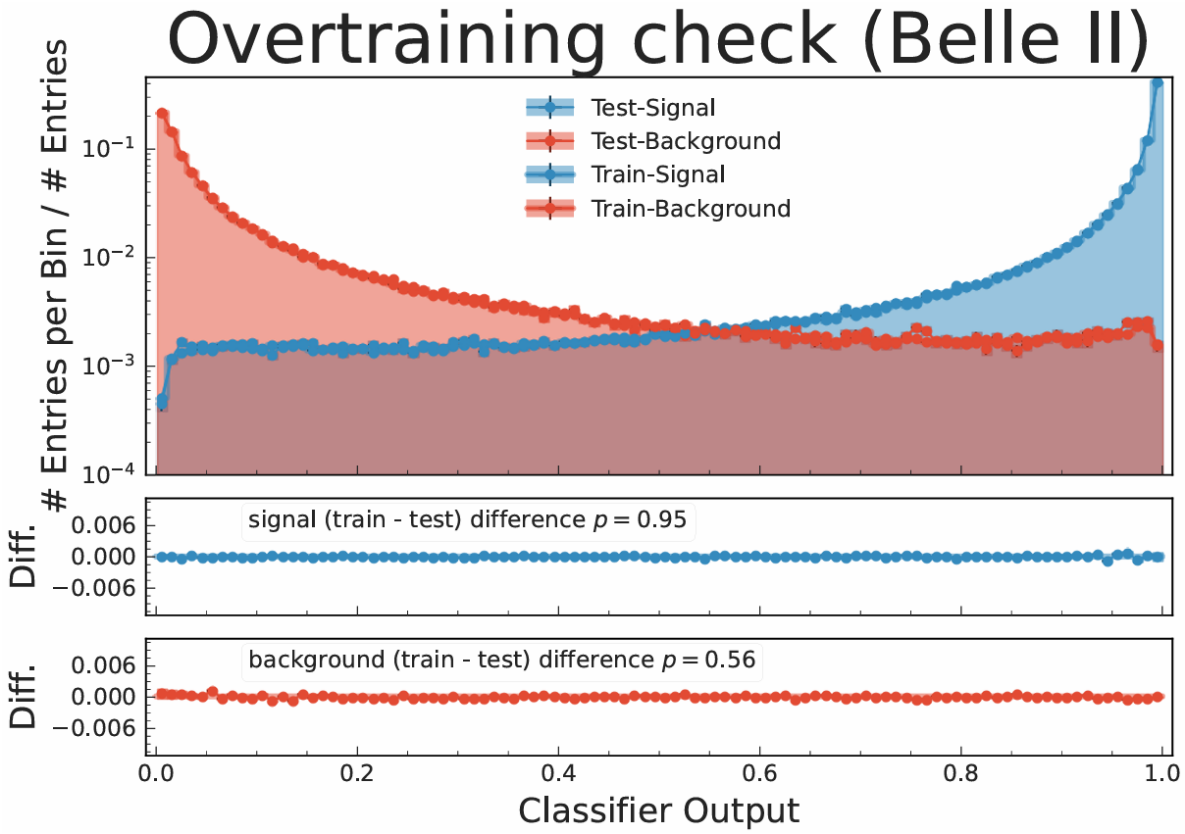
Train sample: 4×10^5 CR signal events and continuum background events

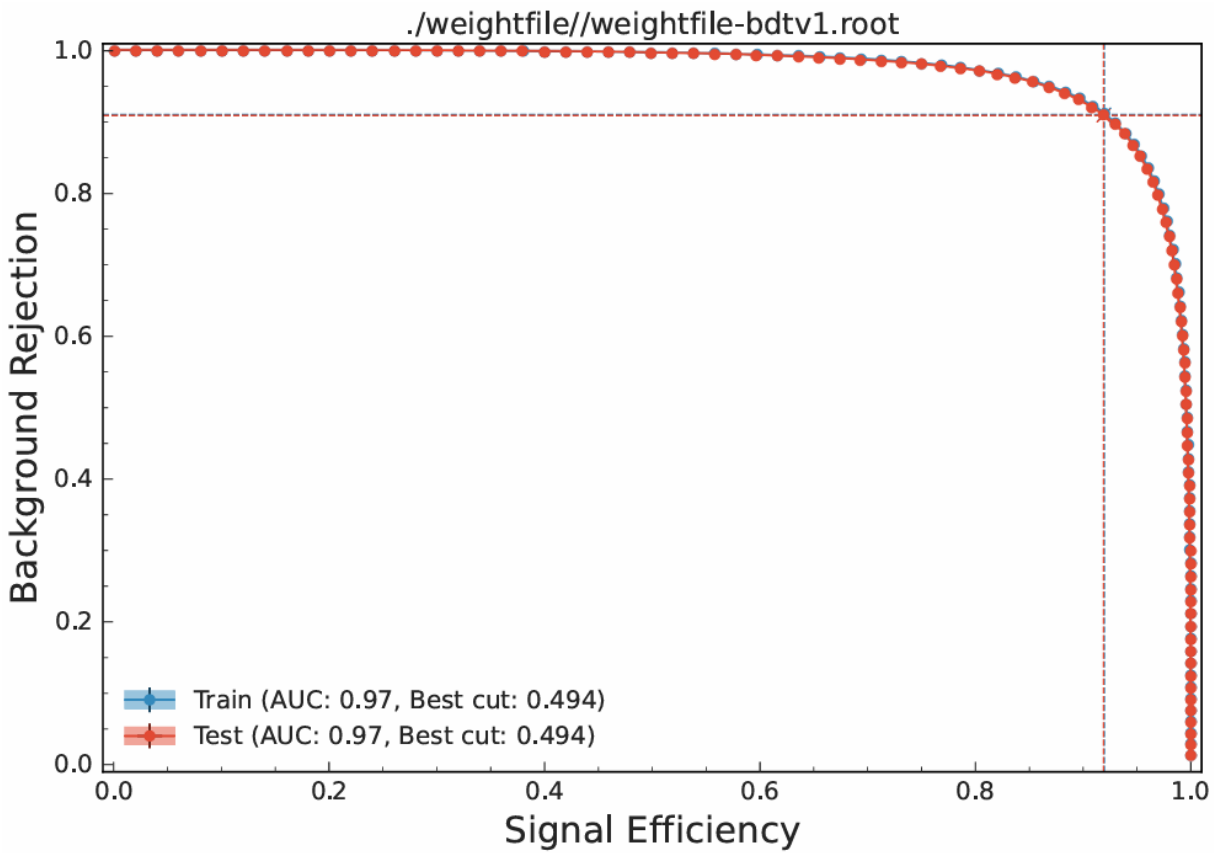
Test sample: 1×10^5 CR signal events and continuum background events

24 Variables used in FBDT training comes from previous work

Variable	Abbreviation	Variable	Abbreviation
foxWolframR2	foxWo4	DeltaZ	Delta
cosTBTO	cosTB	abs_qrGNN	abs_q
CleoConeCS2	CleoC4	qpKinLepton	qpKin
KSFWVariableshso12	KSFWV7	foxWolframR3	foxWo3
KSFWVariableshso02	KSFWV6	qpSlowPion	qpSlo
foxWolframR4	foxWo2	KSFWVariableshoo0	KSFWV5
CleoConeCS3	CleoC3	foxWolframR1	foxWo1
CleoConeCS2ROE	CleoC2	KSFWVariablesmm2	KSFWV4
thrustOm	thrus2	qpMaximumPstar	qpMax
chiProb	chiPr	KSFWVariableshso22FS1	KSFWV3
thrust	thrus1	KSFWVariableshso20FS1	KSFWV2
KSFWVariableshso10FS1	KSFWV1	CleoConeCS3ROE	CleoC1

FBDT Training (MC-based)





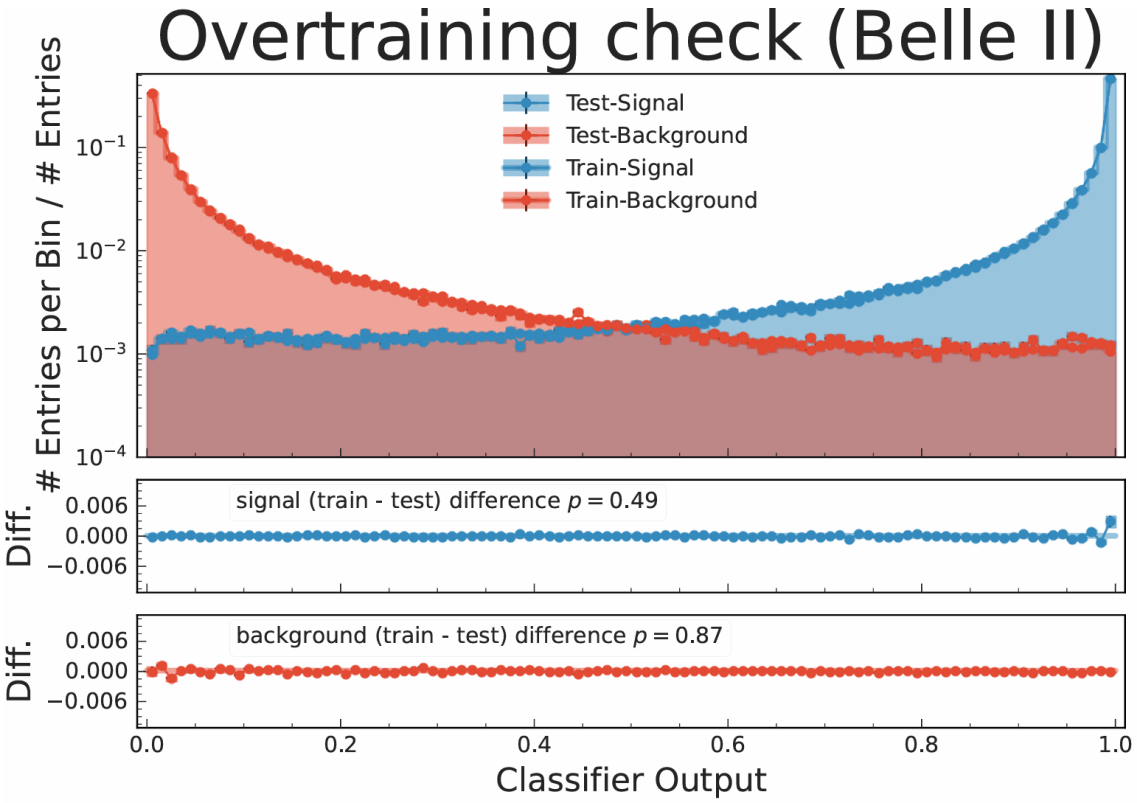
FBDT Training (offres-data-based)

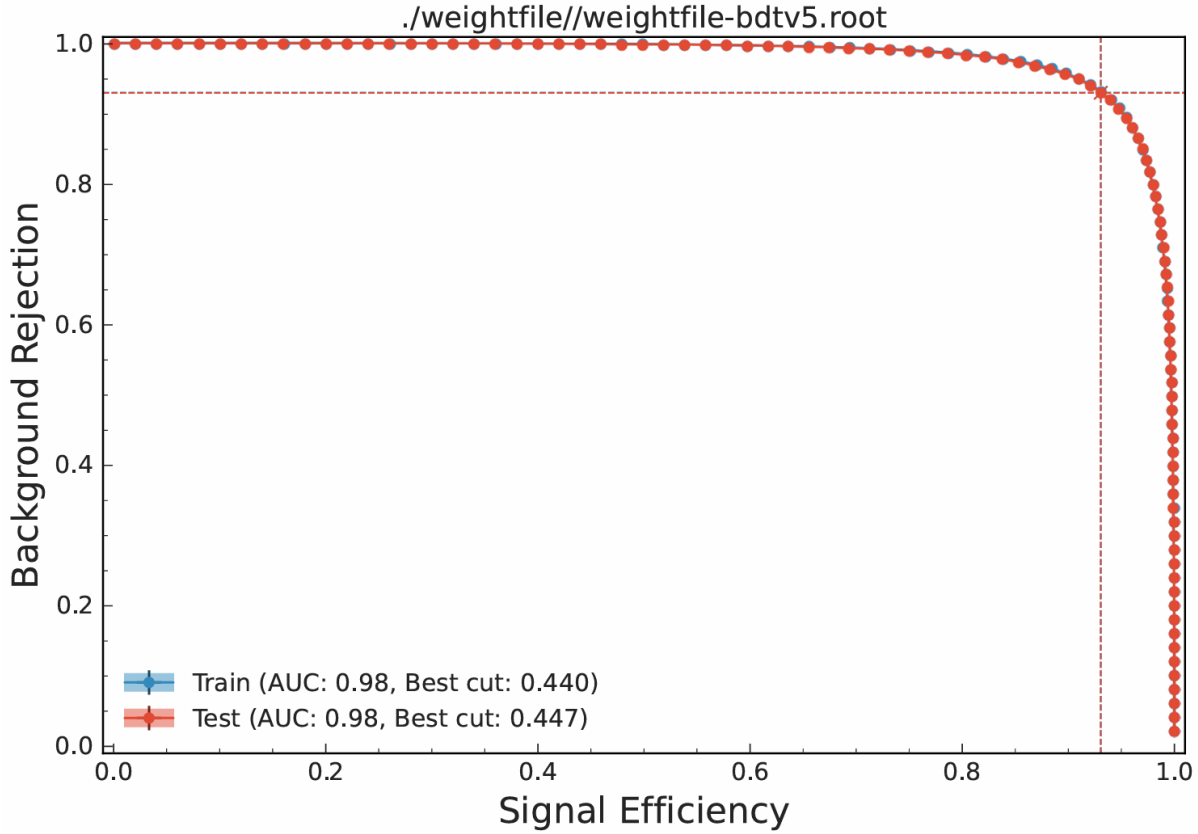
☐ Train and Test sample

Train sample: 3×10^5 CR signal events and 4S-offres data events (run1+run2)

Test sample: 0.75×10^5 CR signal events and 4S-offres data events

Loose M_{bc} and ΔE requirement for 4S-offres data $M_{bc} > 5.2$ GeV && $-0.35\text{GeV} < \Delta E < 0.30\text{GeV}$





Control samples $B^+ \to \bar{D}^0\left(\to K^+\pi^-\pi^0\right)\pi^+$

Charged track candidate:

- ✓ $dr < 0.5$ cm, $|dz| < 2.0$ cm and θ in CDC Acceptance
- ✓ Kaon PID: KaonID > 0.1, KaonIDNN > 0.6
- ✓ Pion PID: PionID > 0.1

γ candidate:

- ✓ $0.2976 < \theta < 2.6180$ rad
- ✓ clusterNHits > 1.5
- ✓ |clusterTiming| < 200 ns
- ✓ $E_\gamma^{fEndcap} > 80$ MeV, $E_\gamma^{Barrel} > 30$ MeV, $E_\gamma^{bEndcap} > 60$ MeV

B^0 candidate:

- ✓ $5.26\ \text{GeV} < M_{bc} < 5.29\ \text{GeV}$ && $-0.3\ \text{GeV} < \Delta E < 0.15\ \text{GeV}$

π^0 candidate:

- ✓ $105\ \text{MeV} < M_{\gamma\gamma} < 150\ \text{MeV}$

D^0 candidate:

- ✓ $1.826\ \text{GeV} < M_{k\pi\pi} < 1.893\ \text{GeV}$

Sig selection

$E_\gamma^{fEndcap} > 25$ MeV, $E_\gamma^{Barrel} > 25$ MeV, $E_\gamma^{bEndcap} > 40$ MeV

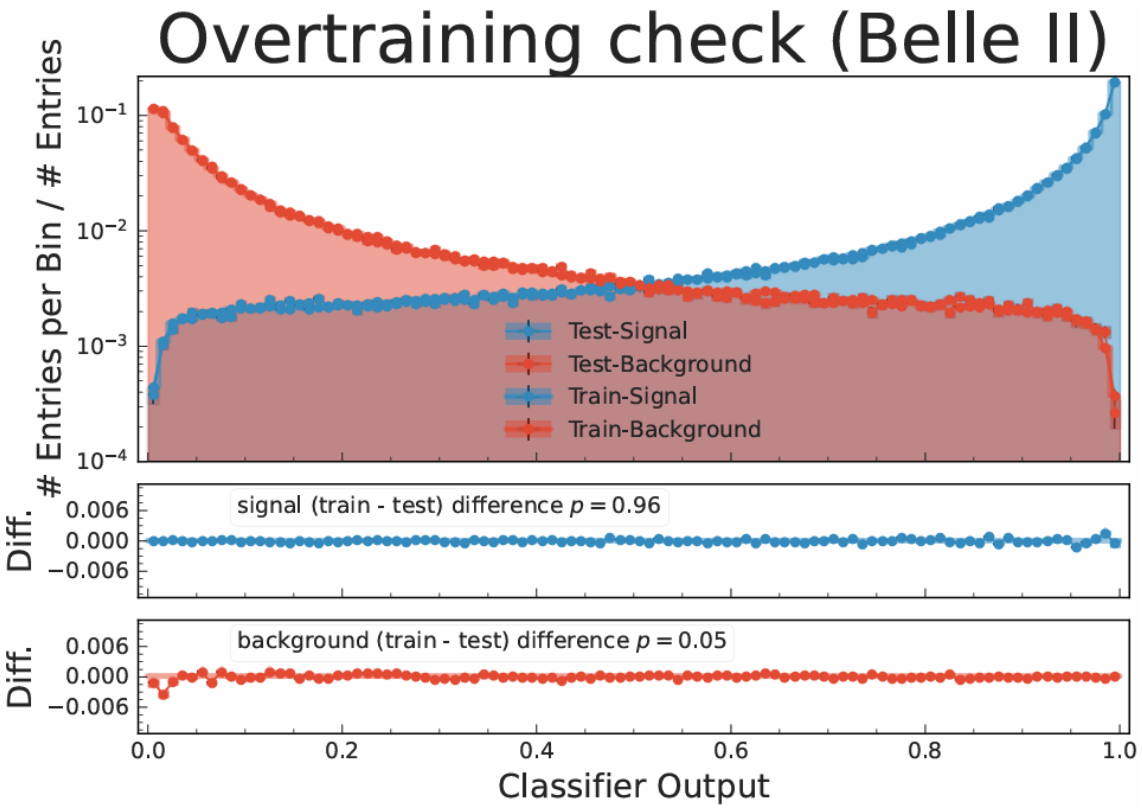
$5.25\ \text{GeV} < M_{bc} < 5.289\ \text{GeV}$ && $-0.3\ \text{GeV} < \Delta E < 0.15\ \text{GeV}$

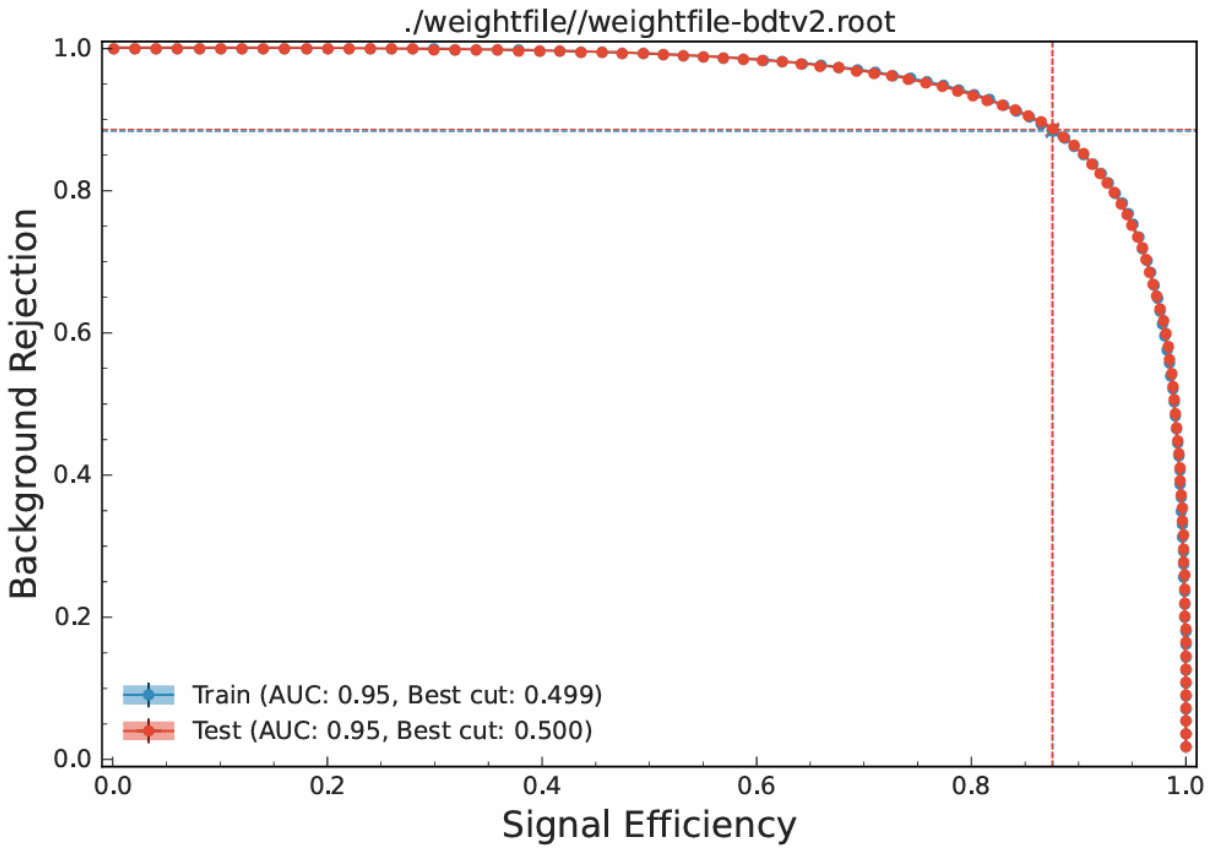
FBDT Training (MC-based)

☐ Train and Test sample

Train sample: 3×10^5 CR signal events and continuum background events (run1)

Test sample: 0.9×10^5 CR signal events and continuum background events





Summary

Next:

- ☐ Use run1 samples
- ☐ Add CSMVA to root as a variable
- ☐ Data-simulation comparison
- ☐ Veto M_{KK}

Thanks for listening!