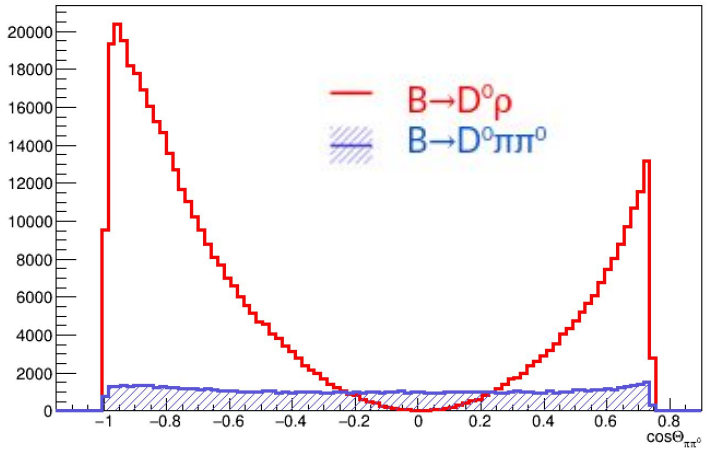
$B \to D^0 \rho$ update

Analysis meeting 25/11/2022

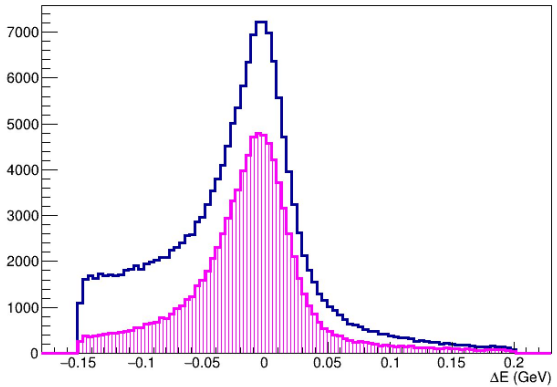
BR determination: strategy (https://indico.belle2.org/event/8059)

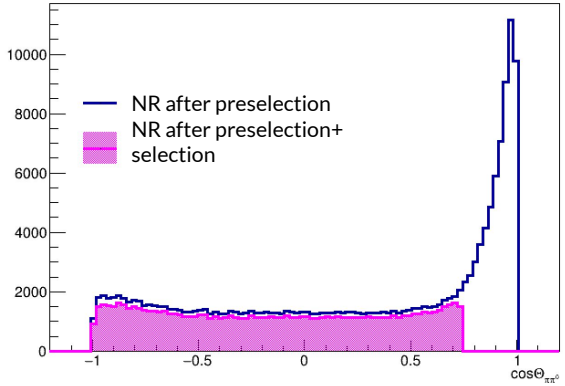
- ➔ Fit ΔE distribution to get sample composition
  - ◆ Determine $B \to D^0 (\pi\pi^0)_\rho$ candidates (in a **narrow ρ-mass window**)
- ➔ Analyse (bkg-subtracted) ρ helicity-angle distribution
  - ◆ Put a limit on $\pi\pi^0$ non-resonant and get BR($B \to D^0\rho$).
  - ◆ Need to carefully study the efficiency variation as a function of the ρ helicity angle. Check if π^0 selection introduce a sculpting.
- ➔ Could also split by charge to measure A_{CP}.

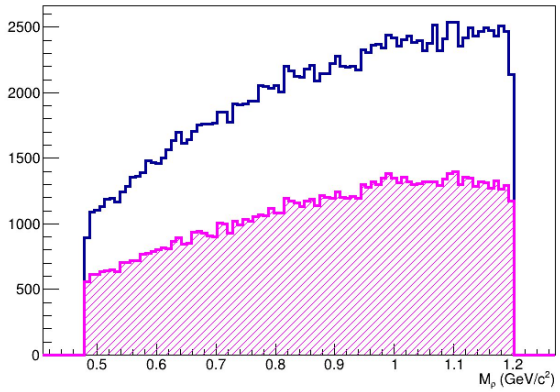


Efficiency for non-resonant decay $B \to D^0 \pi\pi^0$

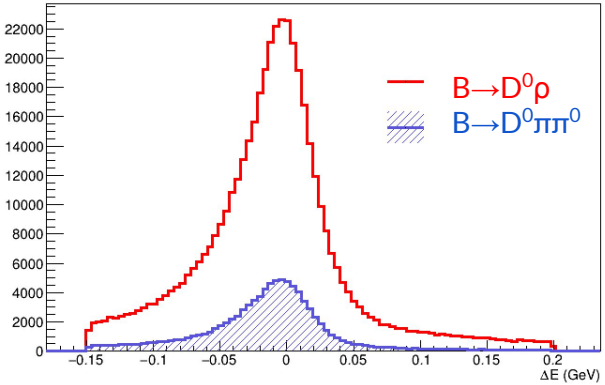
	After preselection	After preselection + selection
NR eff (ε)	~8.4%	~4.5%

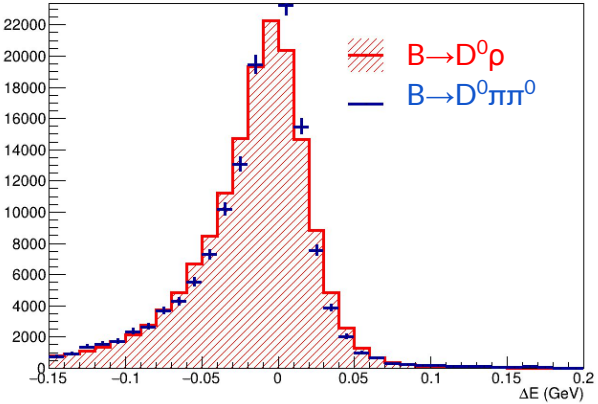


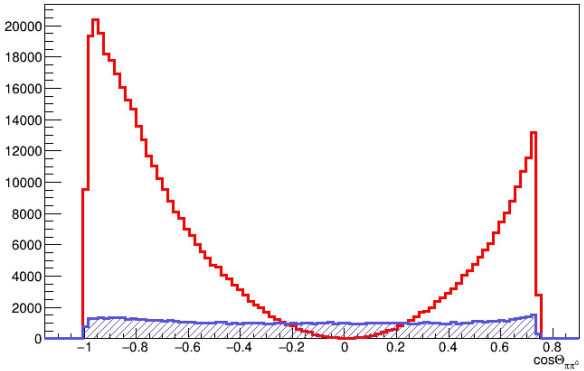


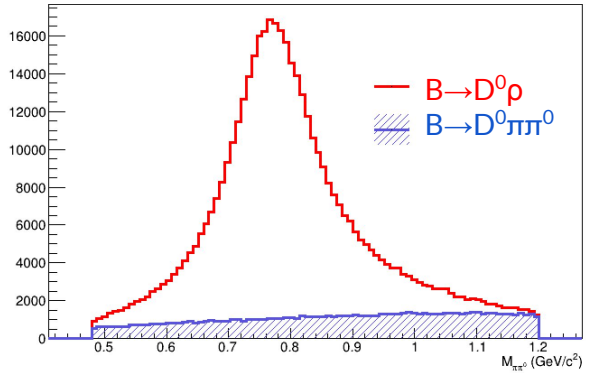


Comparison of resonant and NR signal MC15 2*10^6 events

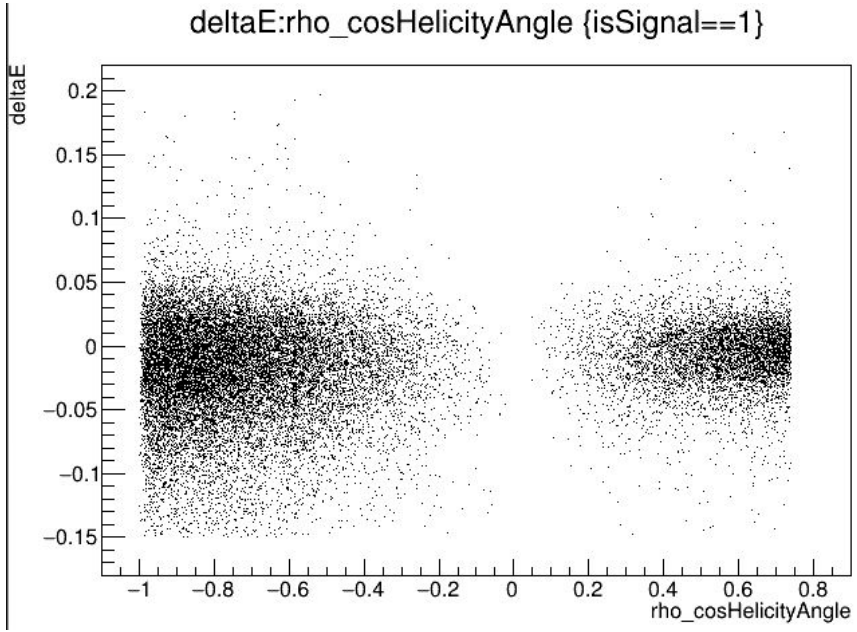


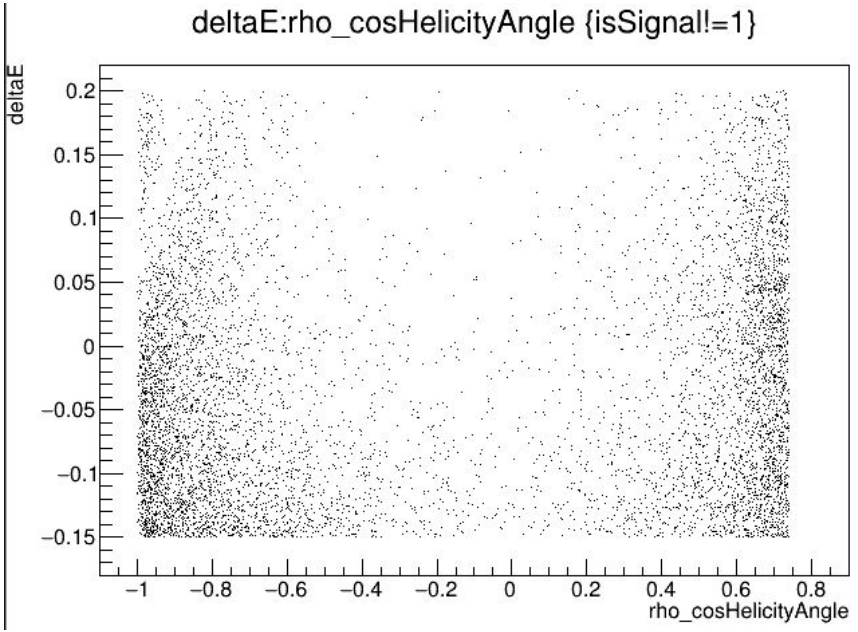




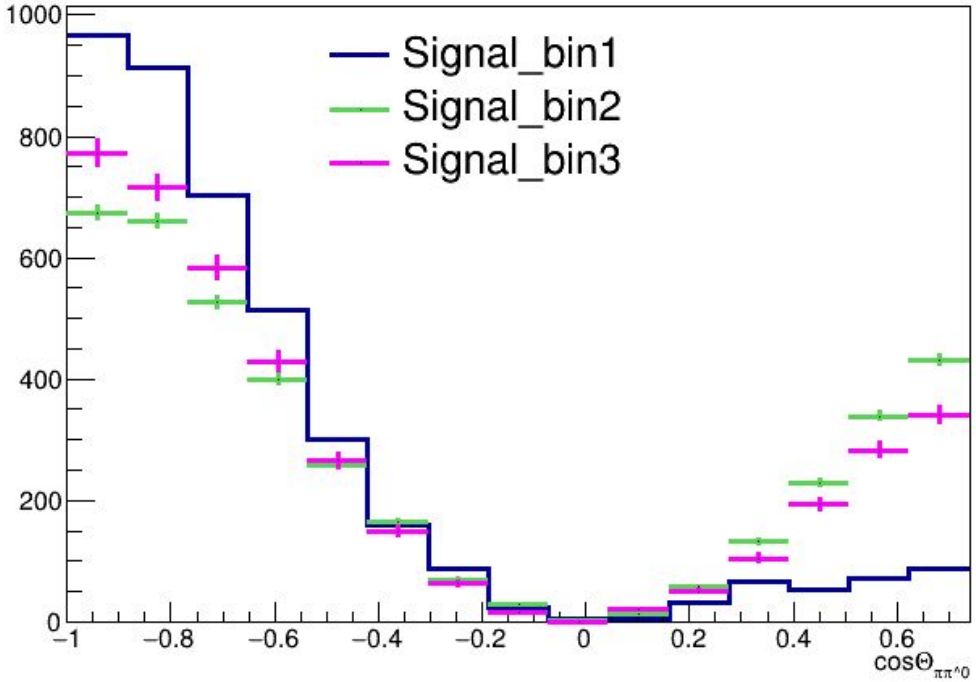


Correlations ΔE vs $\cos\Theta_{\rho}$

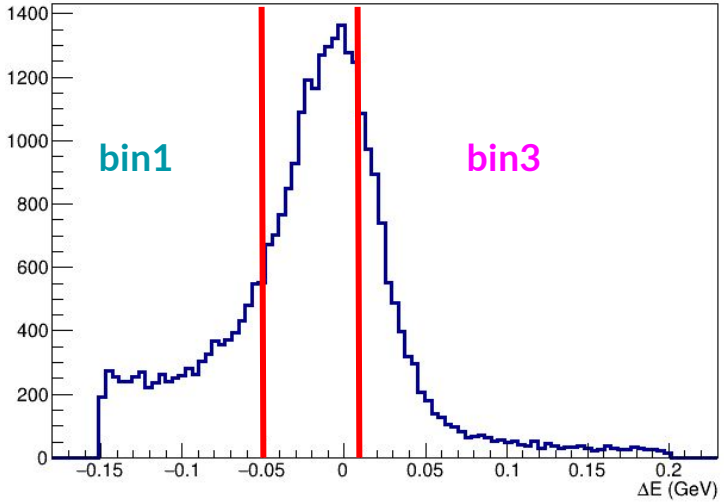




$\cos\Theta_{\rho}$ in ΔE bins for signal

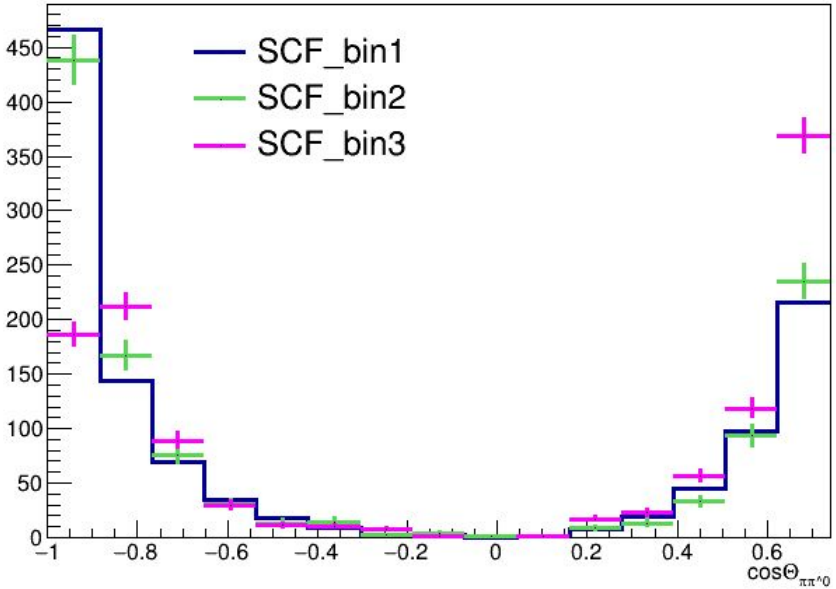


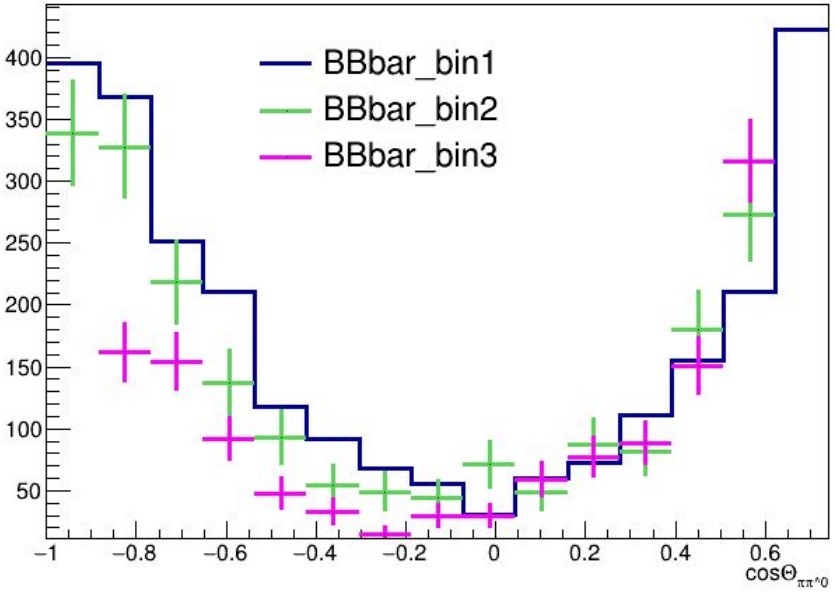
bin2



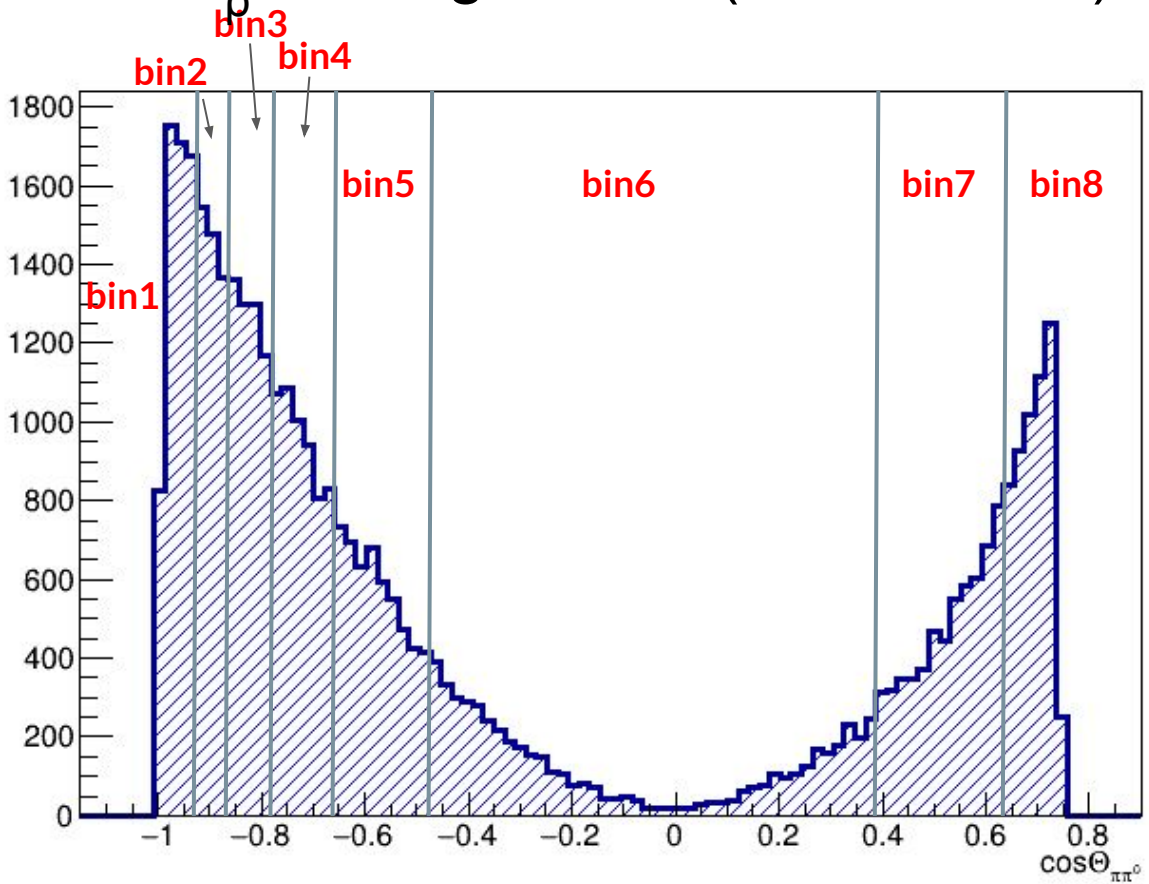
bin choice

$\cos\Theta_{\rho}$ in ΔE bins for SCF and BBbar





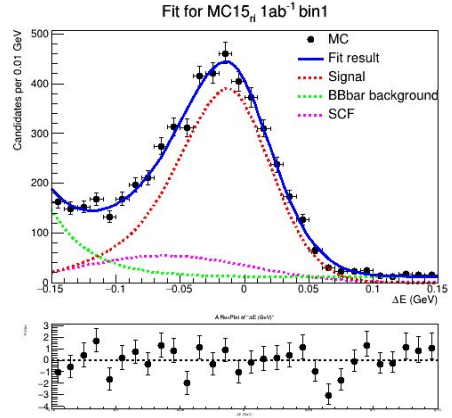
$\cos\Theta_\rho$ binning choice (not the best)

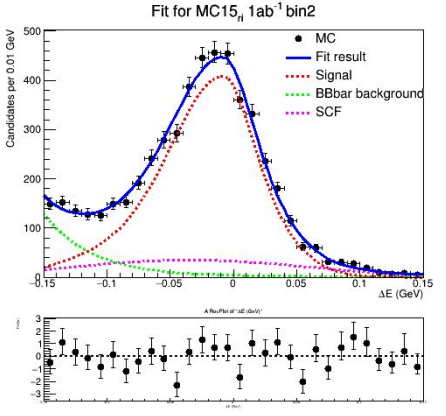


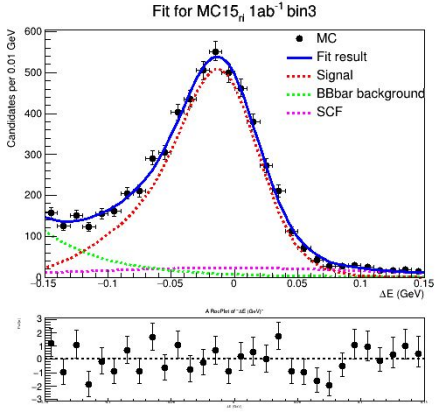
	$\cos\Theta_\rho$
Bin 1	< - 0.93
Bin 2	- 0.93 ÷ - 0.86
Bin 3	- 0.86 ÷ - 0.77
Bin 4	- 0.77 ÷ - 0.66
Bin 5	- 0.66 ÷ - 0.48
Bin 6	- 0.48 ÷ 0.38
Bin 7	0.38 ÷ 0.63
Bin 8	> 0.63

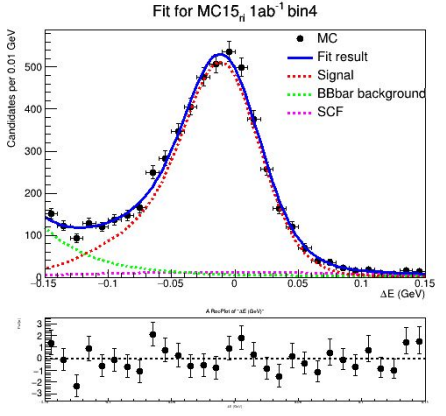
Sample composition in each bin 1 ab^{-1} $MC15_{ri}$

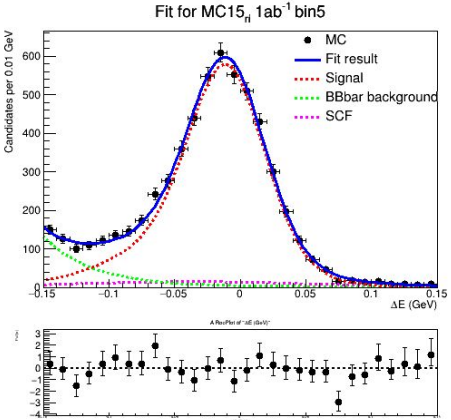
	$\cos\Theta_{\rho}$	True Sig	Self x-feed	BB-bar
Bin 1	< - 0.93	3651	1125	612
Bin 2	- 0.93 ÷ - 0.86	3968	735	517
Bin 3	- 0.86 ÷ - 0.77	4849	576	595
Bin 4	- 0.77 ÷ - 0.66	4653	318	558
Bin 5	- 0.66 ÷ - 0.48	5061	235	563
Bin 6	- 0.48 ÷ 0.38	4853	310	1116
Bin 7	0.38 ÷ 0.63	4471	910	1081
Bin 8	> 0.63	3021	1368	1190

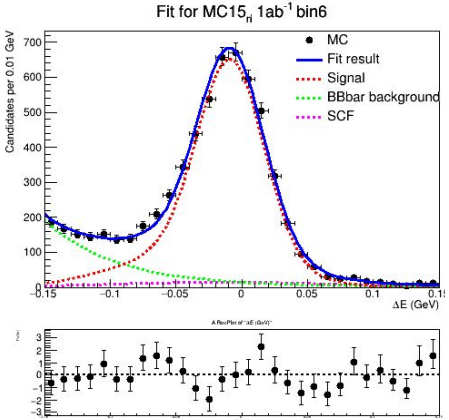

Fit for MC15$_{ri}$ 1ab^{-1} bin1
MC
Fit result
Signal
BBbar background
SCF
Candidates per 0.01 GeV
ΔE (GeV)

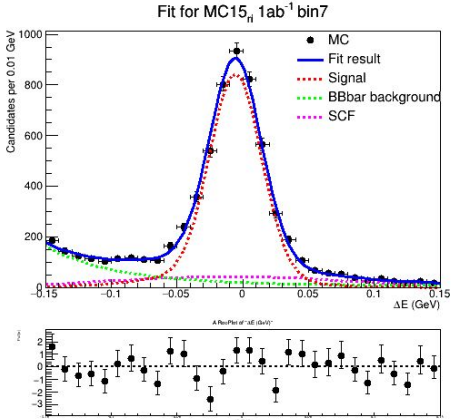

Fit for MC15$_{ri}$ 1ab^{-1} bin2
MC
Fit result
Signal
BBbar background
SCF
Candidates per 0.01 GeV
ΔE (GeV)

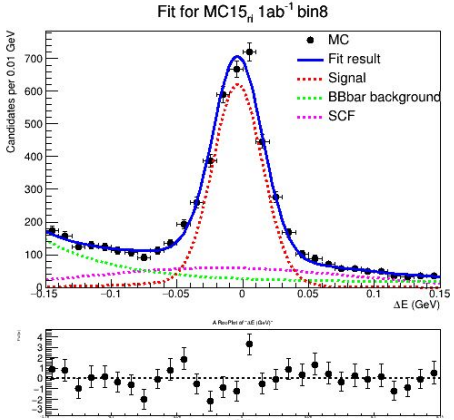

Fit for MC15$_{ri}$ 1ab^{-1} bin3
MC
Fit result
Signal
BBbar background
SCF
Candidates per 0.01 GeV
ΔE (GeV)


Fit for MC15$_{ri}$ 1ab^{-1} bin4
MC
Fit result
Signal
BBbar background
SCF
Candidates per 0.01 GeV
ΔE (GeV)

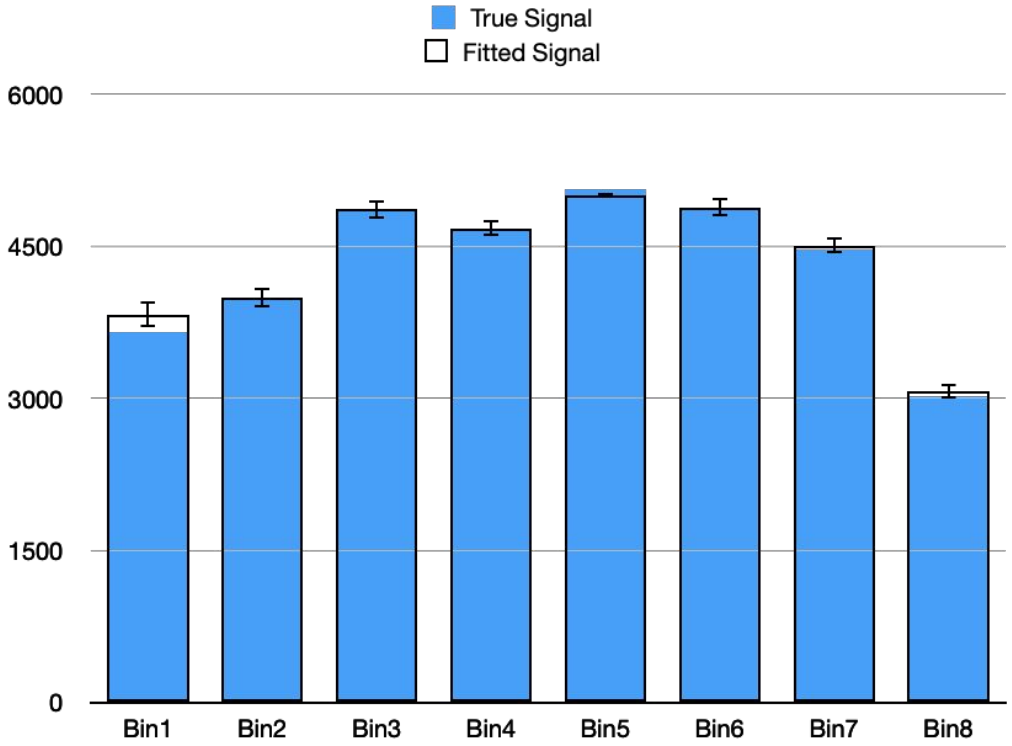

Fit for MC15$_{ri}$ 1ab^{-1} bin5
MC
Fit result
Signal
BBbar background
SCF
Candidates per 0.01 GeV
ΔE (GeV)


Fit for MC15$_{ri}$ 1ab^{-1} bin6
MC
Fit result
Signal
BBbar background
SCF
Candidates per 0.01 GeV
ΔE (GeV)


Fit for MC15$_{ri}$ 1ab^{-1} bin7
MC
Fit result
Signal
BBbar background
SCF
Candidates per 0.01 GeV
ΔE (GeV)

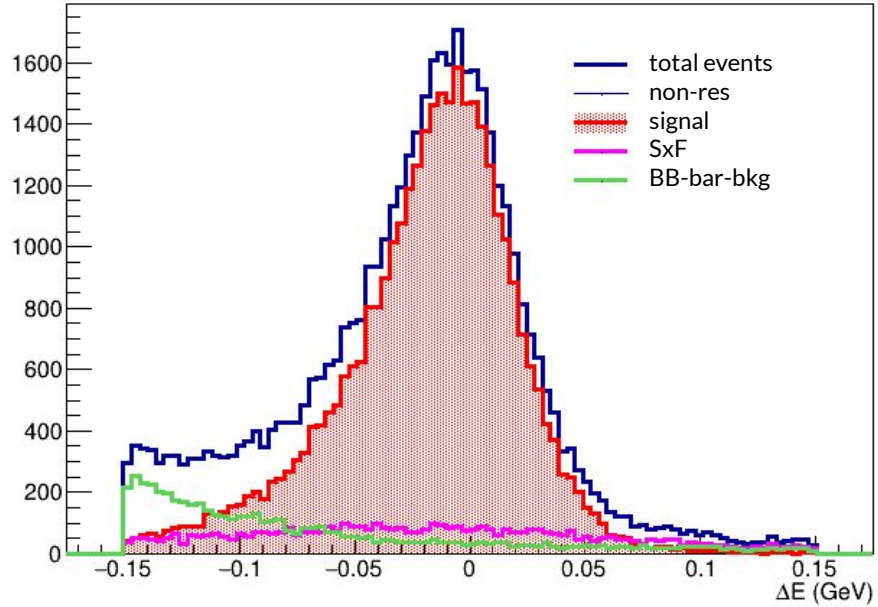

Fit for MC15$_{ri}$ 1ab^{-1} bin8
MC
Fit result
Signal
BBbar background
SCF
Candidates per 0.01 GeV
ΔE (GeV)

Comparison of True signal vs Fitted in each bin



$D^0\rho$ composition $MC15_{ri}$ 1 ab^{-1}

```
# 2-pi
0.013448300   rho+  anti-D0                    SVS;  #[BF update - PG 09/2020]
0.000500000   anti-D0  pi0  pi+                PHSP; #No PDGLive value. Keep original value in .DEC. #[Comment - PG 09/2020]
```



Composition	Nevents	Fraction
Signal	34088	0.72
Non-res	71	0.001
SCF	4982	0.11
BB-bar bkg	5361	0.11
Total events	47371	1.0

Selection and efficiency strategy

DONE

➔ Rationale: cut hard to minimise background while keeping 1% statistical uncertainty on signal yield:

➔ Calculate efficiency from simulation, considering the following corrections from control data:

- for CS, from B→Dπ control sample: expected uncertainty ~1% (https://arxiv.org/abs/2209.05154)
- for PID, from systematic framework: expected uncertainty ~<1% (https://arxiv.org/abs/2209.05154)
- for π^0, should be done in collaboration with neutral-group. Need to consider π^0 efficiency as a function of momentum. Taking current approach, current uncertainty ~4% (https://docs.belle2.org/record/2096)

ONGOING

➔ Validate everything with ~4.5% accuracy using $B \to D^0(\to K\pi\pi^0)\pi$ control channel