Measurement of D0 – hadron azimuthal correlations in pp collisions at 13 TeV

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Outline

- Physics motivation
- Analysis details
- Analysis strategy
- D0 – charged particle correlations
- Summary and future plans

Physics Motivation

Two particle correlation :

Jets are back to back in azimuthal space

$\Delta\varphi = \varphi_{trig} - \varphi_{assoc}$

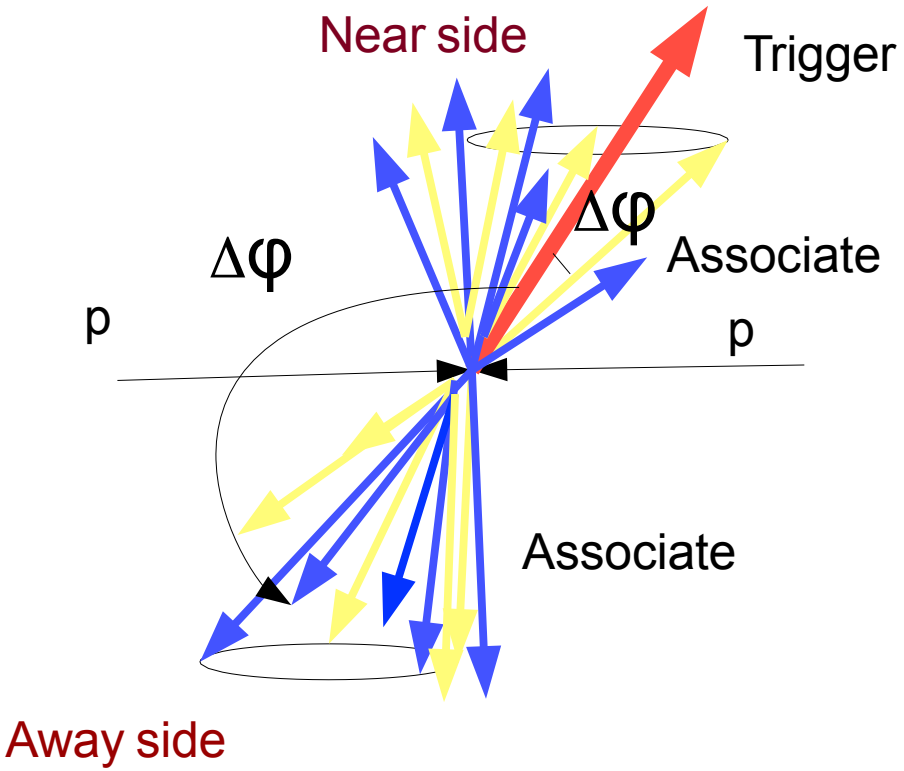
$\Delta\eta = \eta_{trig} - \eta_{assoc}$

Near side

Both particles come from same jet

Away side

Both particles come from back to back di-jet



Physics Motivation

Why Heavy flavour ?

Due to their large masses, heavy quarks (charm and beauty) are predominantly produced via hard scatterings in the initial phase of the collision, therefore they experience the full evolution of the system, losing energy while interacting with the medium.

Azimuthal correlation with heavy flavour particle :

pp :

✓Study heavy – flavour quark fragmentation and jet properties

✓Act as a reference for p-pb and pb-pb results

p-pb :

✓Asses cold nuclear matter effects

✓Search for double ridge (i.e long range ridge-like structures in near and away side regions) as observed in h-h correlations

Why 13 TeV ?

Higher luminosity & measurement in new energy

Physics Motivation

D Meson

Particle symbol	Quark content	Restmass (GeV/c^2)	Charge	Spin	Parity	Mean life time(fm)
D^0	$c\bar{u}$	1.864	0	0	-ve	$1.2*10^{11}$
D^+	$c\bar{d}$	1.869	+e	0	-ve	$3.1*10^{11}$
D^{*+}	$c\bar{d}$	2.01	+e	0	-ve	$2.07*10^{3}$

D meson hadronic decay channels :

$$D^0 \longrightarrow K^- + \pi^+ \quad (BR: 3.88 \pm 0.05\%)$$

$$D^+ \longrightarrow K^- + \pi^+ + \pi^+ \quad (BR: 9.13 \pm 0.19\%)$$

$$D^{*+} \longrightarrow D^0 + \pi^+ \longrightarrow K^- + \pi^+ + \pi^+$$

$$(BR: 2.62 \pm 0.10\%)$$

Analysis details

Dataset :

✓Period – LHC15f/pass2(AOD)

✓Total number of events analyzed : 47 M

Track and event selections :

Event Selections :

✓Trigger mask – kMB

✓Trigger class – CINT7

Track Selections :

D0 published cuts (pp paper at 7 TeV)

Associated track cuts:

ITS Refit : No

TPC Refit : Yes

ITS SA : No

TPC SA : No

No. Min number of ITS clusters : 3

Min number of TPC clusters : 70

SPD : kOff

Filter Bit : 1

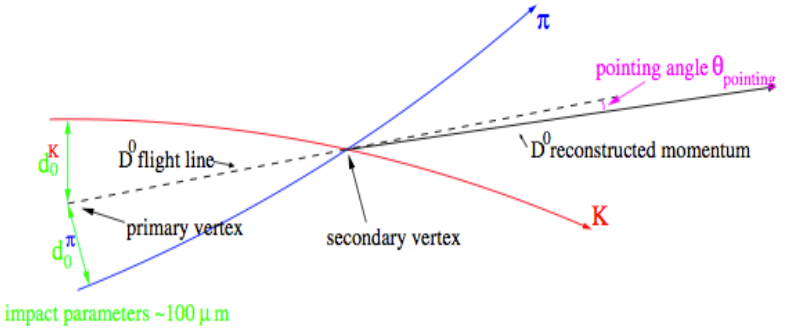
Charge : 0

Analysis strategy

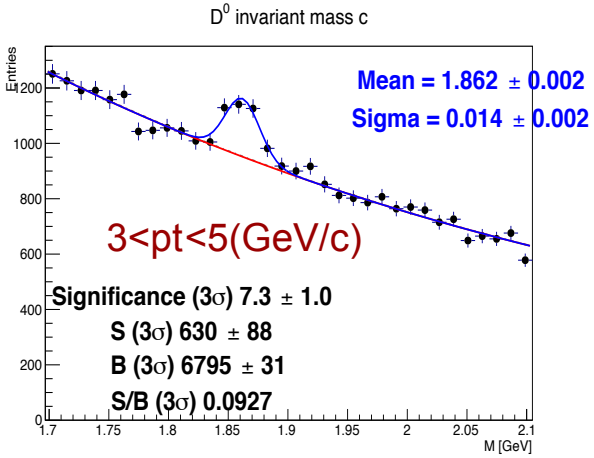
1. Signal extraction

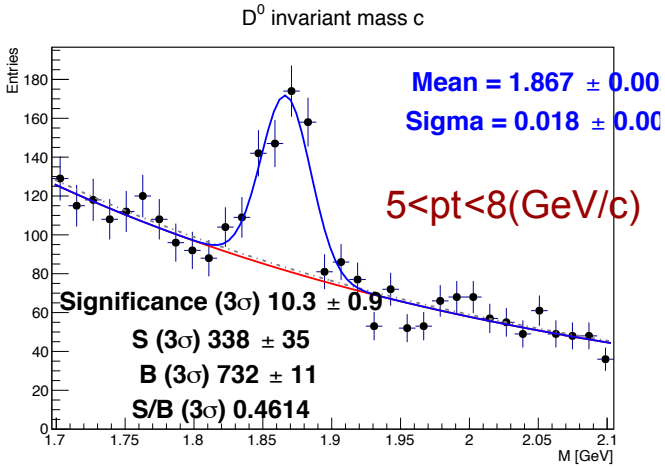
D0 meson is reconstructed from K^- and π^+ pairs of displaced tracks and selected by :

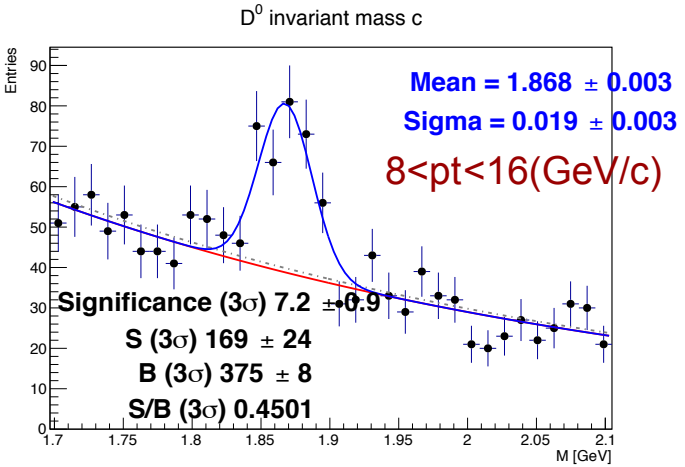
- Topology of the secondary decay vertex



- Particle identification for decay tracks

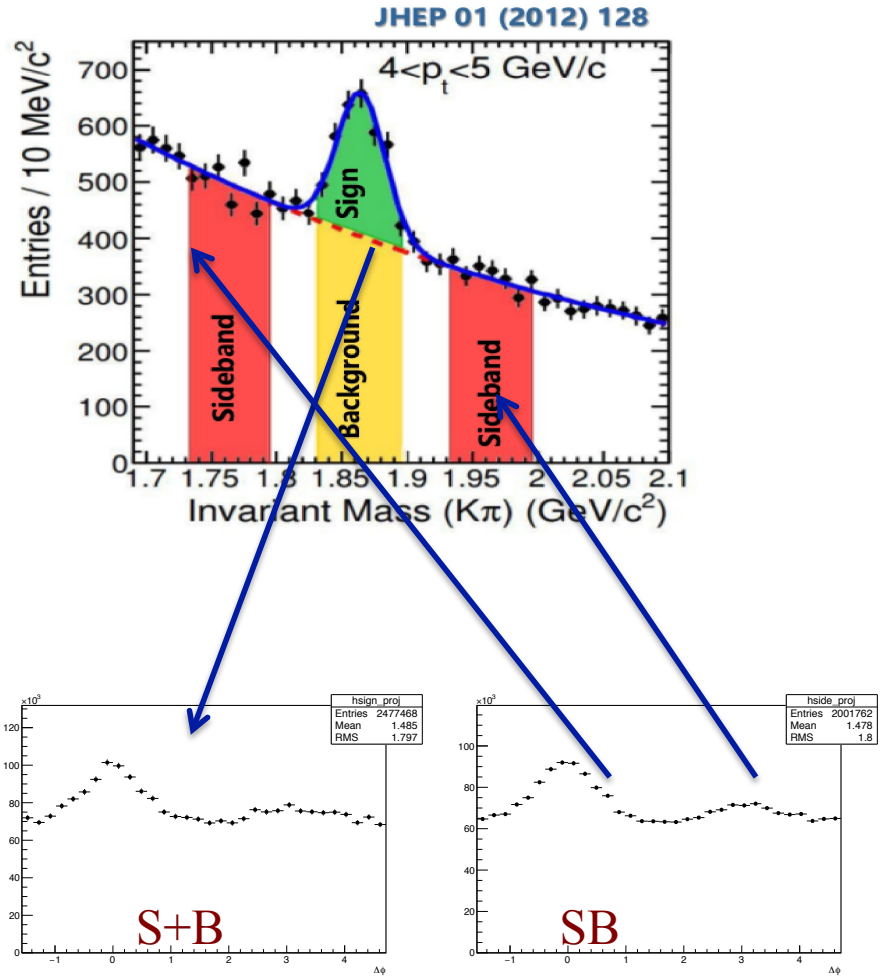






Analysis strategy

1. Azimuthal correlations



Each selected D meson is correlated with charged tracks produced in the collision (excluding the D meson daughter particles)

1) Raw correlation :

   ($\Delta\varphi,\Delta\eta$)

2) Background subtraction from sidebands:

   Obtain D-hadron correlations in

   S1. $\pm2\sigma$ region (S+B)

   S2. $-(8\sigma\text{-}4\sigma)$ Left sideband(SB)

   S3. $+(4\sigma\text{-}8\sigma)$ Right sideband(SB)

   S4. Add bkg from left and right with scaling

   S5. Subtract S4 from S1

3) Corrections:

Detector acceptance and inhomogeneities via mixed events

D meson reconstruction and selection efficiency

Associated track reconstruction efficiency

Results from pp collision at 13 TeV

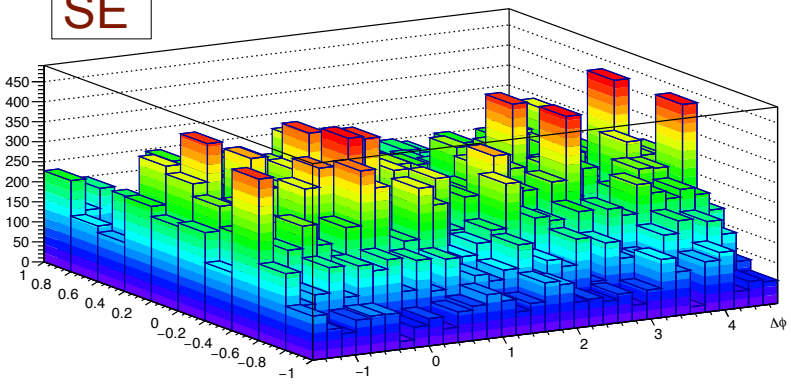
D meson *p*T range
Low(3-5), mid(5-8), high(8-16) GeV/c

Associated particle *p*T
> 0.3, 0.5, 1.0 GeV/c

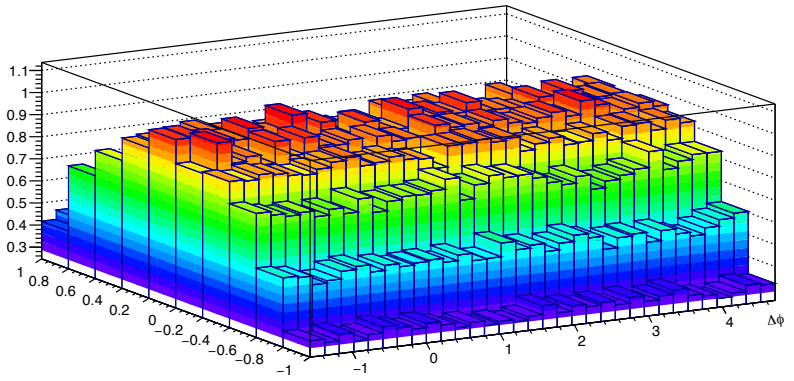
S+B correlation plots

Assoc *p*T >0.3 GeV/c

SE

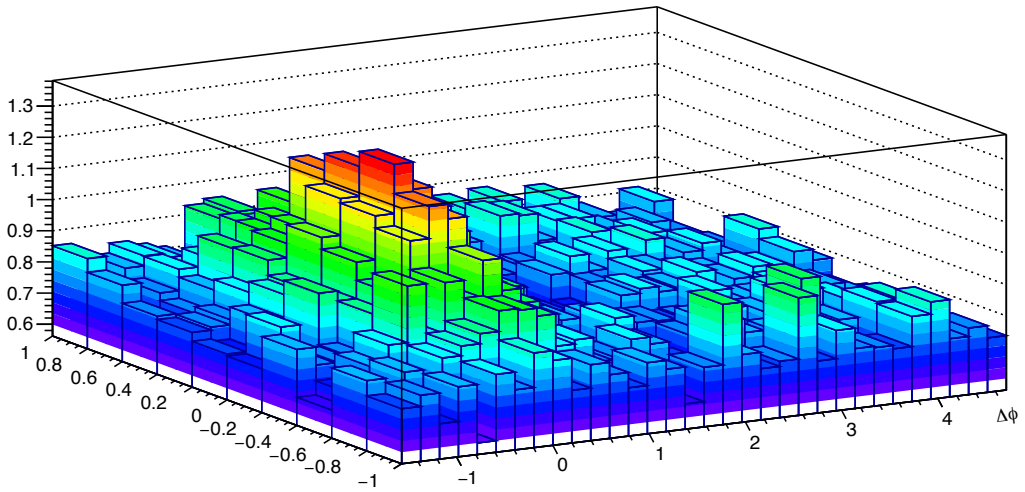


ME



SE/ME

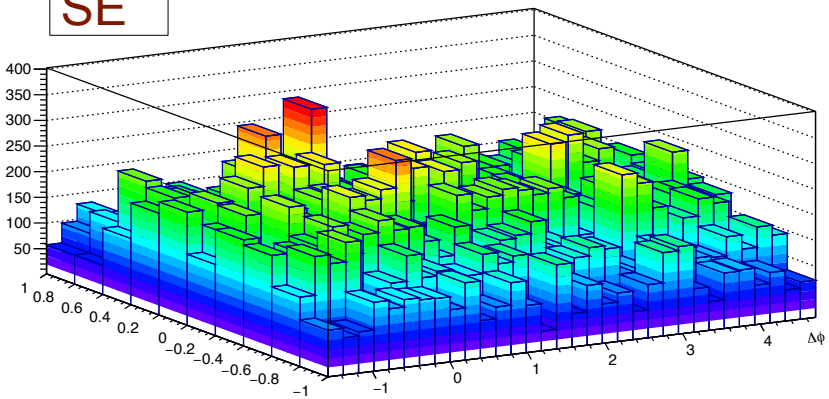
Signal region corrected by ME (SE/ME) - normalized to # of triggrers



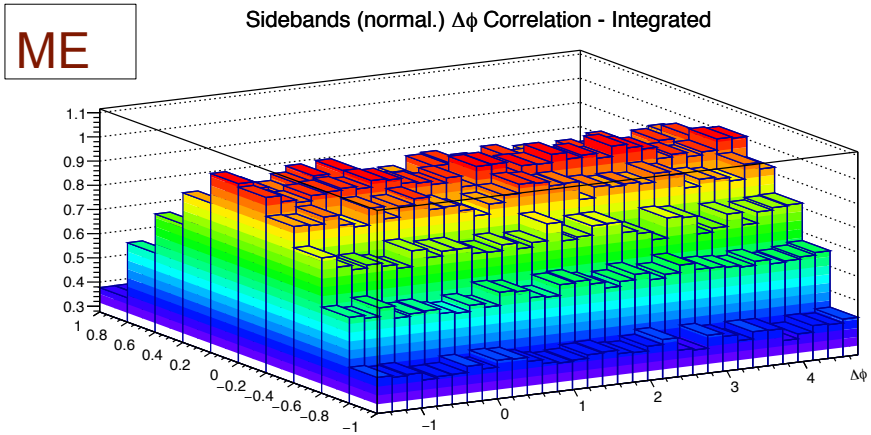
Sideband correlation plots

Assoc *p*T >0.3 GeV/c

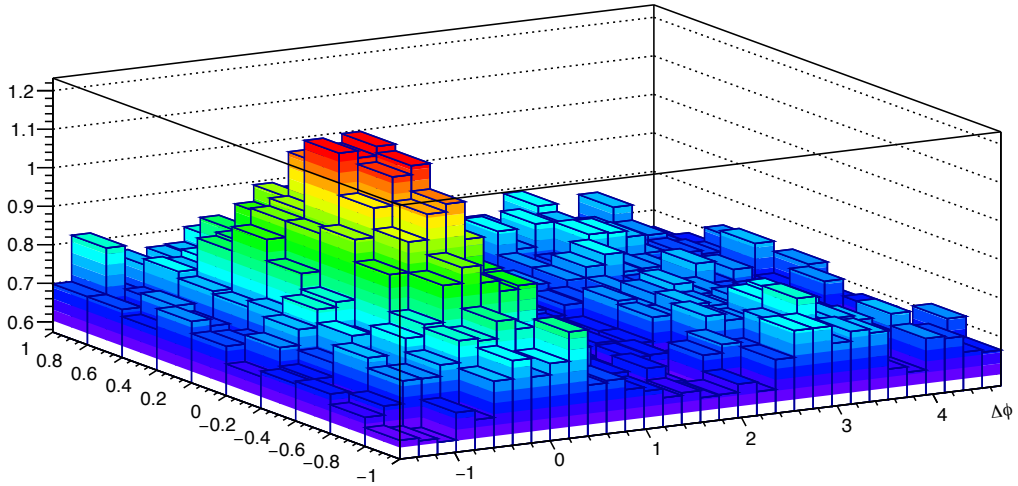
SE



ME

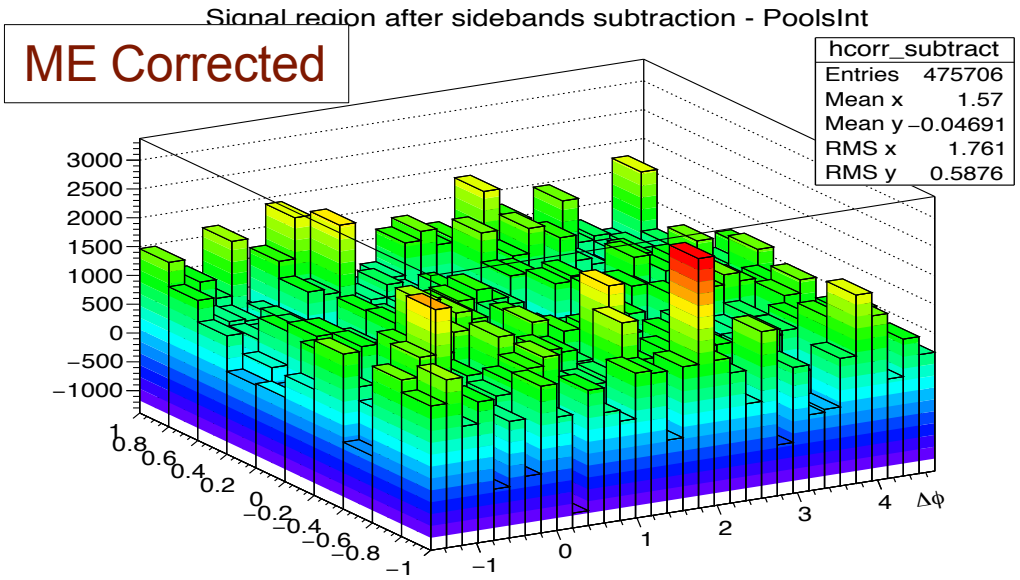


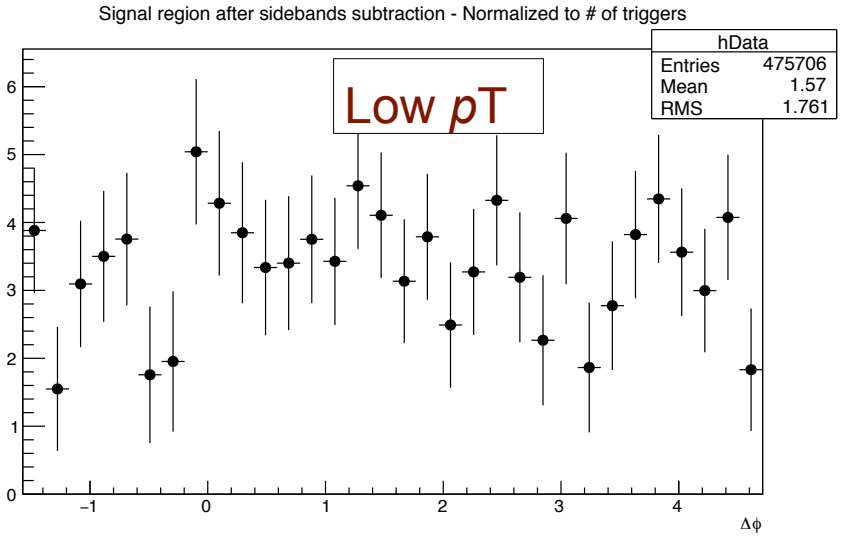
SE/ME

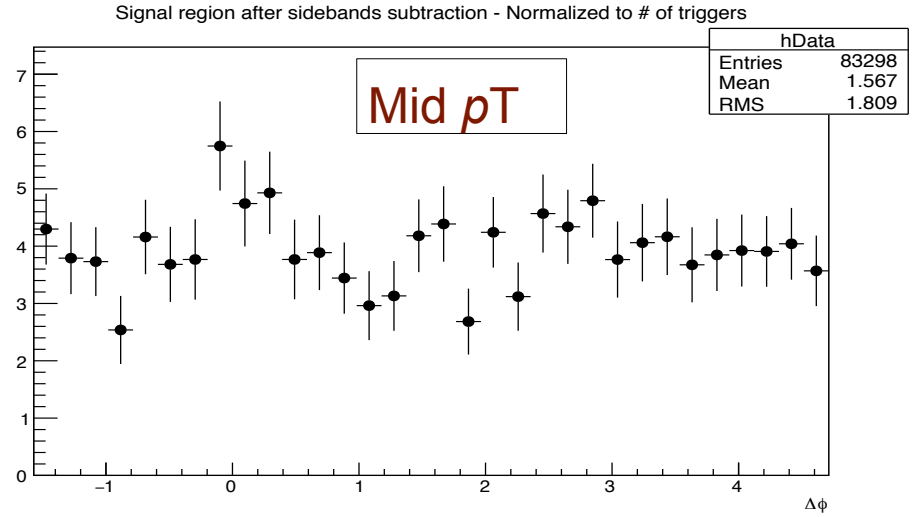


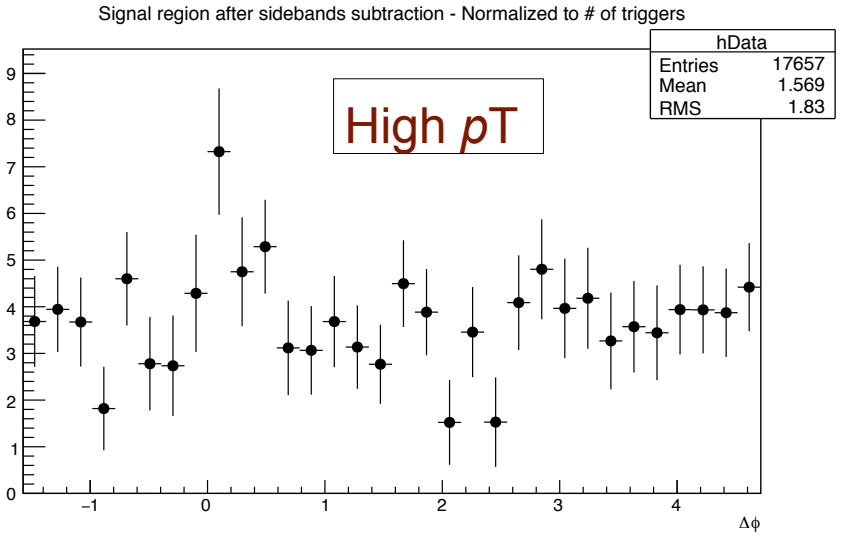
Bkg subtracted correlation plots

Assoc *p*T >0.3 GeV/c



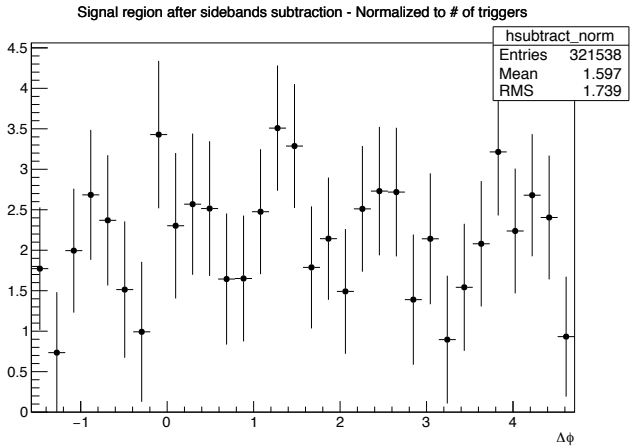




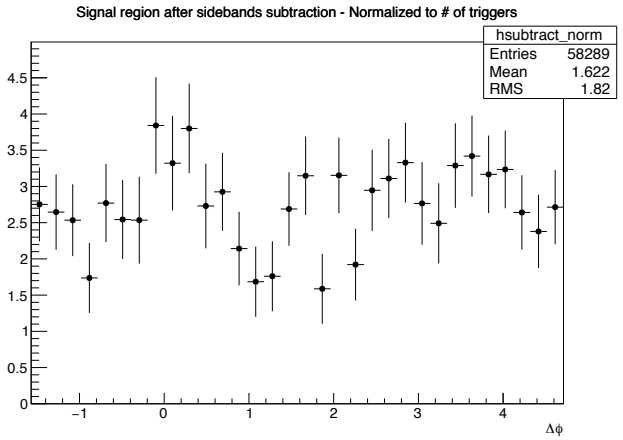


Bkg subtracted correlation plots

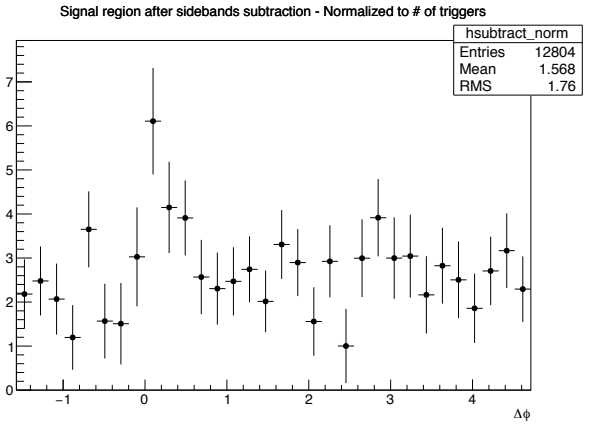
Low *p*T(3-5 GeV/c)



Mid *p*T(5-8 GeV/c)



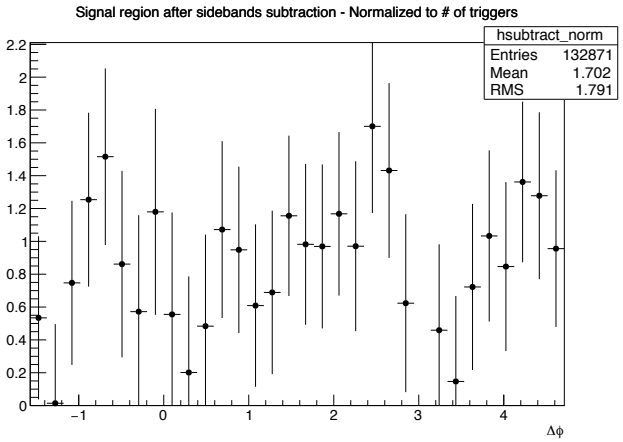
High *p*T(8-16 GeV/c)



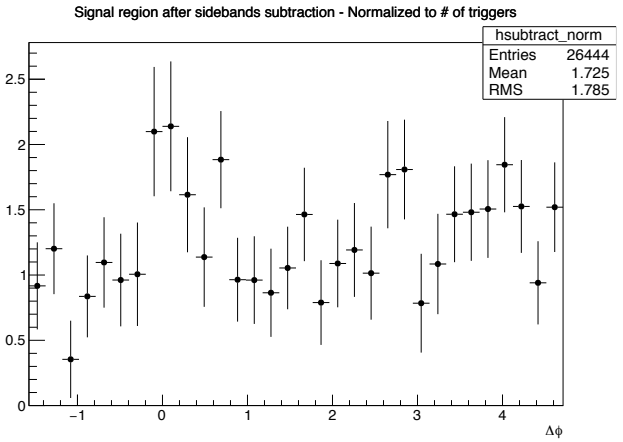
Assoc *p*T >0.5 GeV/c

Bkg subtracted correlation plots

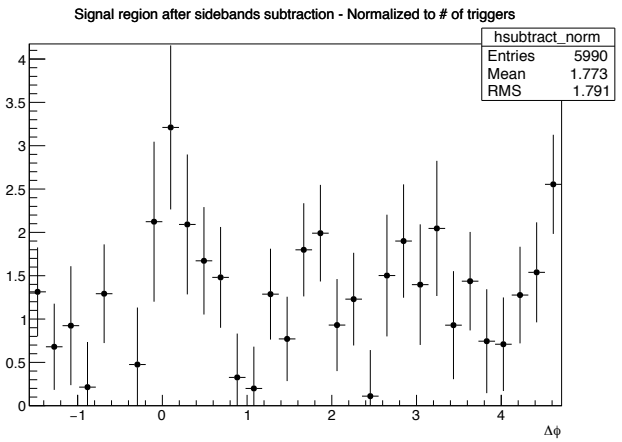
Low *p*T(3-5 GeV/c)



Mid *p*T(5-8 GeV/c)



High *p*T(8-16 GeV/c)



Assoc *p*T >1.0 GeV/c

Summary and Future plans

- Correlations obtained in standard D0 pT range and associated pT threshold using standard cuts and committed class.

- Correlations pattern are visible but high statistical fluctuations.

- Repetition of analysis with more upcoming 13 TeV data to get better D0 signal or correlations.

- Future corrections and checks like (beauty feed down, purity corrections, MC studies etc.).