

0.1 Diffractive events

Q: What is the fraction of Single-Diffractive, Double-Diffractive component in our MinBias sample?

A: See the table below for Z2 and D6T tunes at 7 TeV. This is the fraction out of all events

	Z2		D6T	
	Before PV filter	after PV filter	Before PV filter	after PV filter
SD1	0.0954	0.0529	0.0963	0.0540
SD2	0.0967	0.0538	0.0955	0.0531
DD	0.1299	0.0771	0.1301	0.0780
total	0.3220	0.1838	0.3219	0.1851

0.1.1 Primary Vertex filter efficiency

Q: Does the ε_{PV} efficiency depend on the fraction of diffractive events?

A: Yes, it does in low multiplicity. See the numbers.

Here is the numbers for ε_{PV} and Error (from different tune variation) that we used in analysis. (for M=1-9 bins). And the last line is ε_{PV} after removing the diffractive events.

M	1	2	3	4	5	6	7	8	9
PV, used	0.0557	0.5424	0.8001	0.9166	0.9667	0.9862	0.9961	0.9993	0.9998
Err	0.0042	0.0046	0.0046	0.0038	0.0022	0.0012	0.0005	0.0001	0.0001
PV, no diff	0.0865	0.5685	0.8089	0.9213	0.9633	0.9878	0.9962	0.9990	0.9998

Q: Does $\varepsilon_{central}$ depend on the fraction of diffractive events?

A: To be done tomorrow. Finally we want to see an effect on $\varepsilon_{PV} \cdot \varepsilon_{central}$

M	1	2	3	4	5	6	7	8	9
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0.2 Shape of $\varepsilon_{central}$

Q: Why $\varepsilon_{central}$ has such a strange shape (fig. 1 left)? Particularly, the rise at bin M=2.

A: This is an effect of PV filter. The $\varepsilon_{central}$ is calculated after the PV filter is applied. If PV filter is removed, the $\varepsilon_{central}$ looks like the usual efficiency (on the right plot). If we carry on the analysis without PV filter ($\varepsilon_{PV}(M) = 1$) and $\varepsilon_{central}$ as on the right plot in fig. 1, the results of dNdEta stay the same (within the errors)

Note: If PV filter is not applied we have events in which PV algorithm fails to reconstruct the vertex. In those cases BeamSpot position is used.

Conclusion: The systematics can be applied from that study. Also, from the fact that the result doesn't change, we may conclude that there are no gas-beam background events left. (That was the main reason to apply PV filter - to remove the backgrounds)

0.3 Best PV selection, nTracks() vs chi2/ndof

Q: Is this a good choice to select the best PV based on higher number of tracks? How is it different from minimum chi2/ndof selection?

A: We think nTracks() is better than chi2/ndof. The real Primary Vertex most

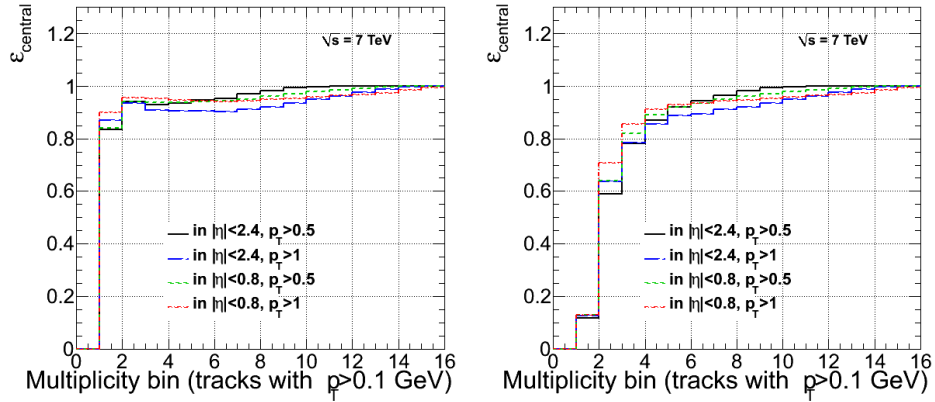


Figure 1: $\varepsilon_{central}$

Figure 2: Central track efficiency. With PV filter used (Left) and without it (right)

likely to have more tracks attached to it. While low number of tracks suggests that it is a fake Vertex or a Vertex from secondaries. On figure 3 the distributions of $nTracks()$ values plotted for two cases in MC.

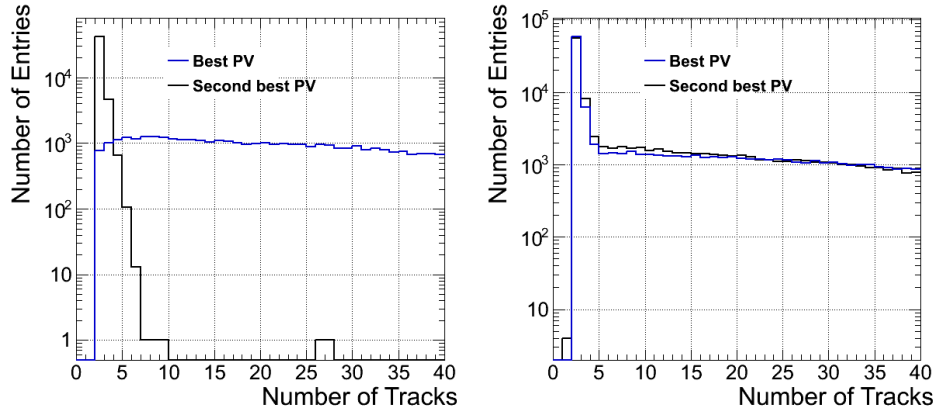


Figure 3: Plotted: $vtx \rightarrow nTracks()$ value. Selection based on higher $nTracks()$ value (left) and smallest $\chi^2/ndof$ (right). It is clear that in first case we identify real primary vertex as the best one, while in second case it is 50/50 chance to pick a fake (secondary) vertex as a primary

Conclusion: there is an effect on $dNd\eta$ (drop by 0-1.5% in central η and by 1-3% in high η) Should we include this in systematics? If we want to be conservative - yes. However, it is clear to me now that $\chi^2/ndof$ selection is biased and $nTracks()$ is appropriate one to use.

0.4 Efficiency dependence on multiplicity

Q: Why does ε_{bin} depend on the event multiplicity M ? (fig 0.4)

A: There are two reasons:

- It is conditional, i.e. calculated only from events with a central track above 500 MeV reconstructed.
- I still think it is not a per-track efficiency. See an example of 'simple physics' below.

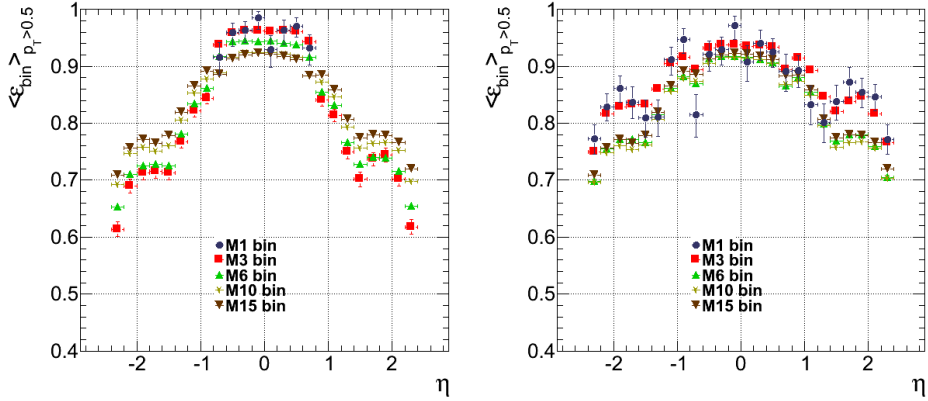


Figure 4: ε_{bin} for two conditions: a reconstructed track with $p_T > 0.5$ GeV in $|\eta| < 0.8$ (left) and $|\eta| < 2.4$ (right) regions

0.4.1 Simple Physics

Suppose that in pp collisions only four type of events could happen in equal probabilities: no charged particles produced, 1, 2 or 3 charged particles produced. Say we have a sample of 4000 events such that:

N_{ch} particles	Events
0	1000
1	1000
2	1000
3	1000

Assume that all the particles are above pt-threshold we are interested in. And also let's only have a single eta-bin (say all the particles are produced within $|\eta| < 0.8$ region). Therefore consider a single bin in pt. In this case our M-binning is done with the same particles as for $dN/d\eta$

0.4.2 Reco tracks

Now assume that the track reconstruction efficiency is **80%** (the probability to reconstruct a track) and does not depend on pt or multiplicity. Also there are

no 'fakes' or 'secondaries'. Then the following table represents the outcome of the "measurement":

N_{ch} particles	Events	N_{tracks} reco	Events
0	1000	0	1000
1	1000	0	200
		1	800
2	1000	0	40
		1	320
		2	640
3	1000	0	8
		1	96
		2	384
		3	512

Now let's see how those reconstructed events are distributed in M-bins:

M (reco track multiplicity)	Events	Sum of different N_{ch} contributions
1	1216	= 800+320+96
2	1024	= 640+384
3	512	= 512

Now, corrections. Suppose that:

$$\epsilon_{trig} = \epsilon_{PV} = \epsilon_{central} = 1, \text{ therefore } \omega_{event} = 1.$$

Since, T=D=0, we only have ϵ_{bin} .

$$\epsilon_{bin}(M) = \frac{N_{tracks}^{reco,matched}(M)}{N_{particles}^{true}(M)} \quad (1)$$

M (track multiplicity)	$\epsilon_{bin}(M)$
1	$\frac{1216}{800+2\cdot320+3\cdot96} = 0.704$
2	$\frac{2\cdot1024}{2\cdot640+3\cdot384} = 0.842$
3	$\frac{3\cdot512}{3\cdot512} = 1.000$

As you can see, the efficiency changes with M, using this definition of ϵ_{bin} . It grows with M. On the figure 0.4 you can see two different behavior. Efficiency grows with M in high eta but it decreases in central-eta region.

Explanation: In our actual analysis, the M-binning is done with respect to the different tracks than those plotted in ϵ_{bin} . So, for M=1 the percentage of tracks above 500 MeV is $\sim 100\%$ for M=2 it is $\sim 50\%$, M=3, $\sim 30\%$ etc.

Therefore $\epsilon_{bin}(M) = \frac{N_{tracks}^{reco,matched}(M)}{N_{particles}^{true}(M)}$ that calculated decreases with M.

And for higher M-bins, the percentage of tracks ($p_T > 0.5$) is about the same, so efficiency doesn't change.