



Secondary vertex studies

Open data validation

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Outline:

- ◆ decay length calculation
- ◆ $B^{+/-}$ reconstruction
- ◆ MC study: access to the *true* level

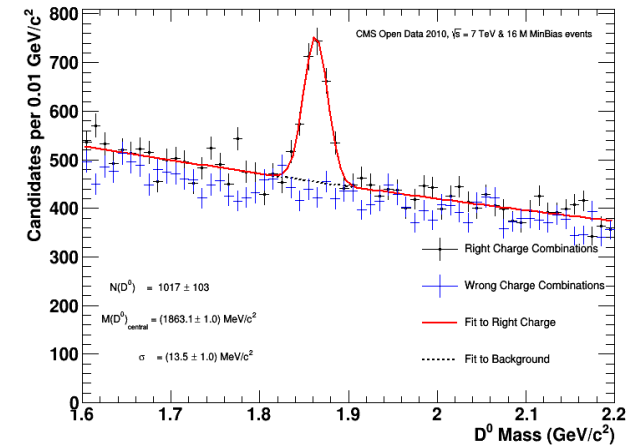
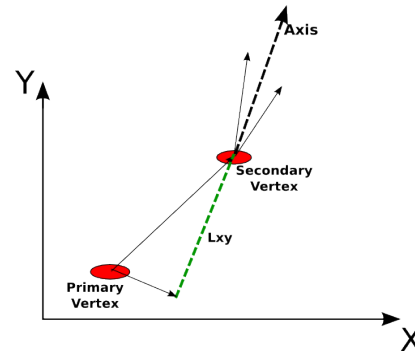
Decay length calculation/application

Decay length calculation helps to distinguish the signal and significantly suppress background

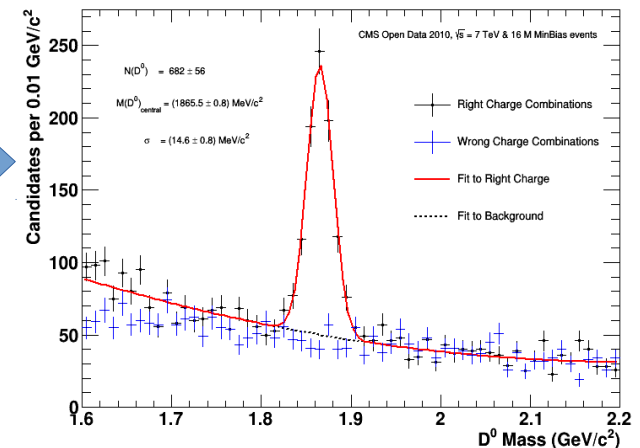
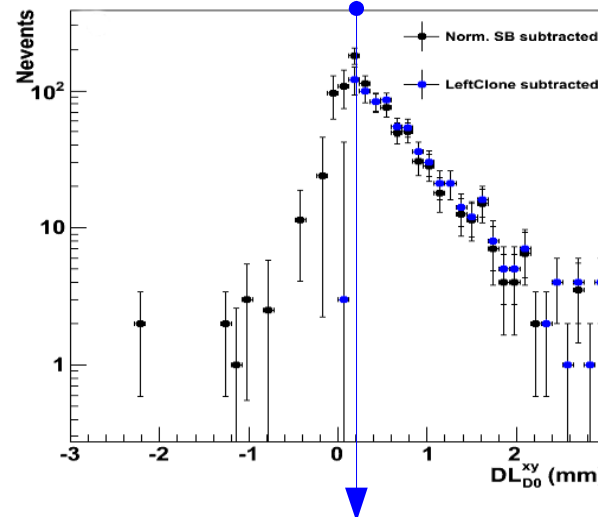
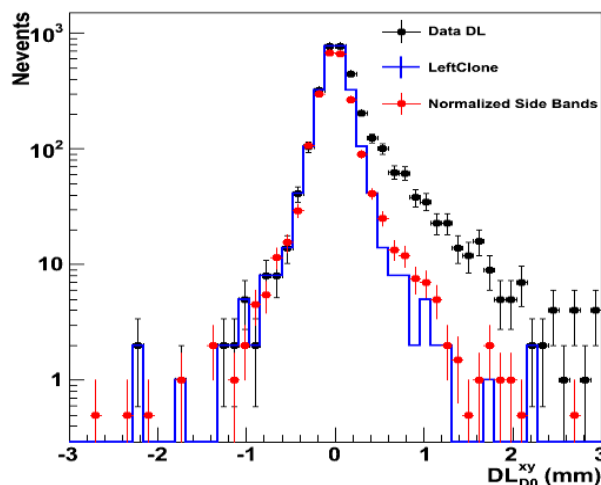
Calculation scheme:

$$L_{xy}^{axis} = \cos(\vec{L}_{xy}, \vec{P}_T^{axis}) \cdot |\vec{L}_{xy}| = \frac{(\vec{L}_{xy} \cdot \vec{P}_T)}{|\vec{P}_T|}$$

$$dL_{xy}^{axis} = \vec{P}_t \cdot (M_{cov}^{PV} + M_{cov}^{SV}) \cdot P_t^T$$



DL, mass distributions for D⁰ candidates :



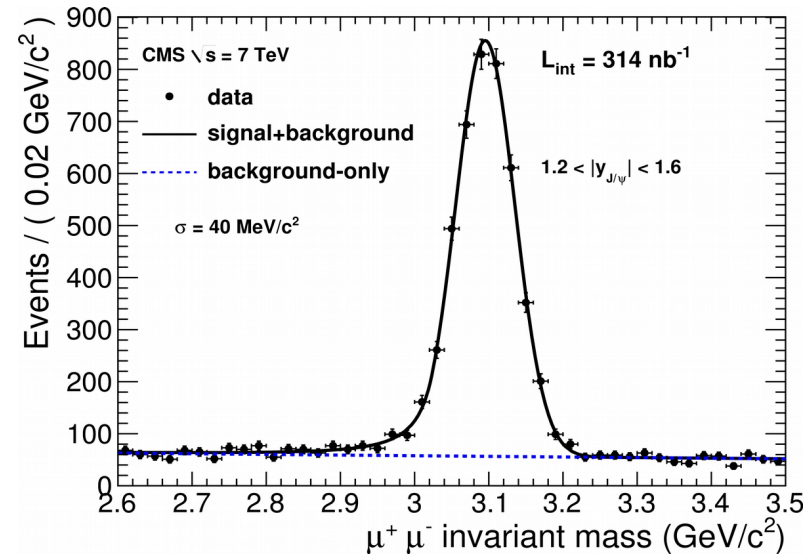
data = MinBias sample, OD 2010

J/ψ reconstruction

$J/\psi \rightarrow \mu^+ \mu^-$

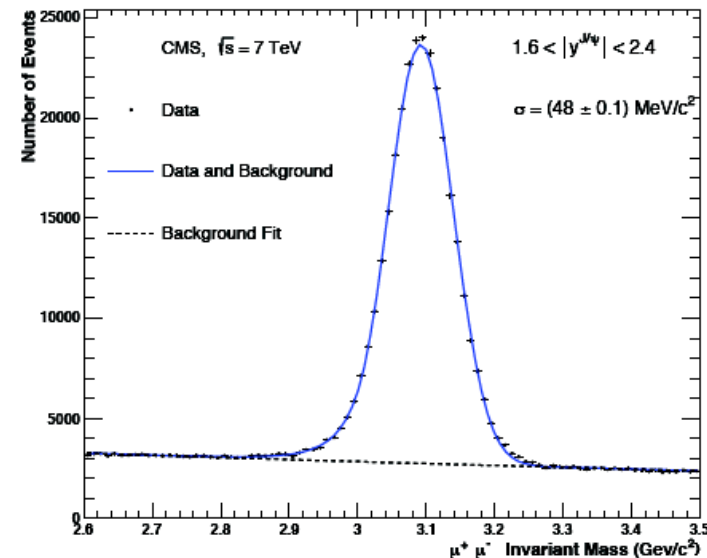
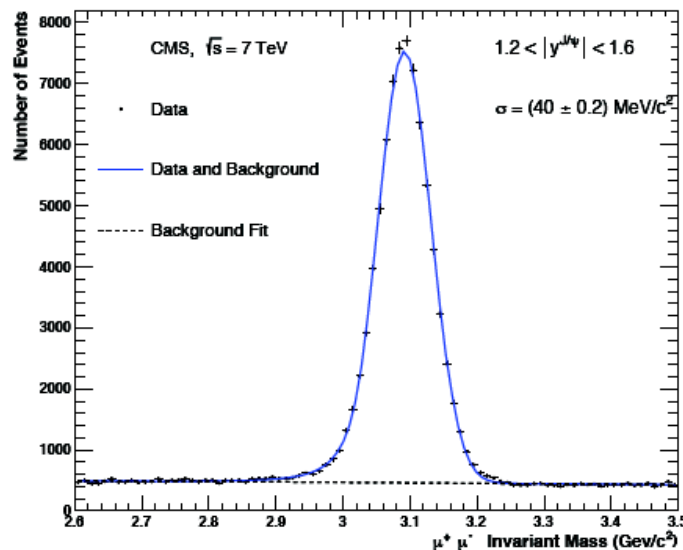
Main cuts:

- ◆ J/ψ mass (2.95, 3.35) GeV
- ◆ $P_T > 3.3$ GeV/c for $|\eta^\mu| < 1.3$
- ◆ $P > 2.9$ GeV/c for $1.3 < |\eta^\mu| < 2.2$
- ◆ $P_T > 0.8$ GeV/c for $2.2 < |\eta^\mu| < 2.4$
- ◆ $\chi^2_{\text{trackfit}} < 4$



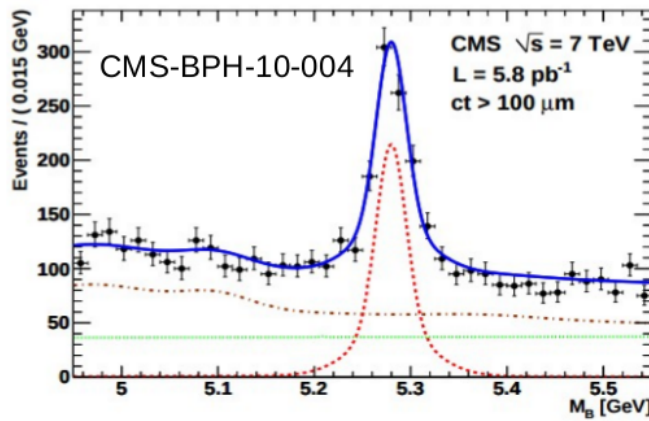
CMS-BPH-10-002

J/ψ reconstruction algorithm is based on Bridget Sheeran and Irene Dutta analysis:

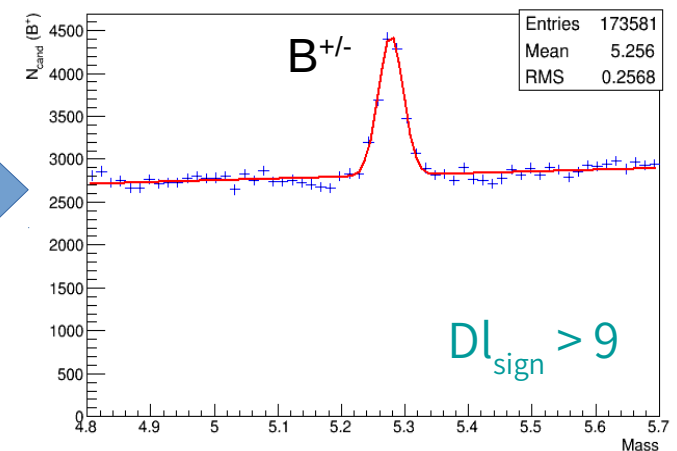
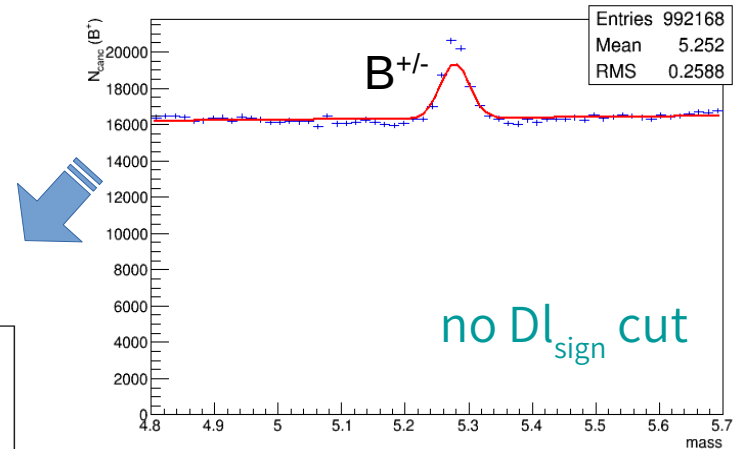
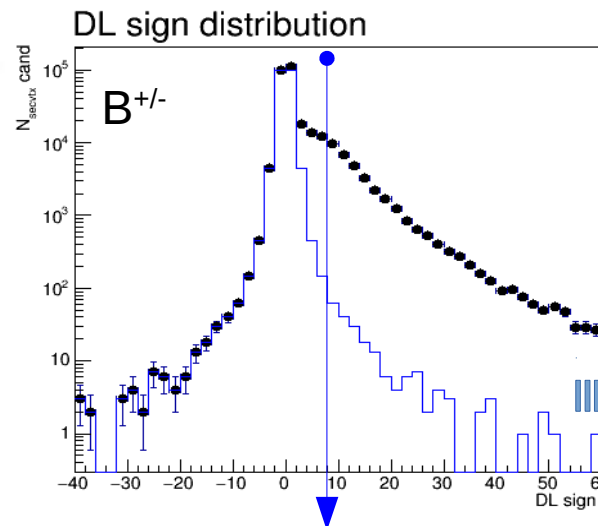


B^{\pm} reconstruction, OD 2011

Decay length calculation helps to distinguish the beauty signal and significantly suppress the background



--- signal
--- $J/\psi \pi^+$ background
--- non-prompt J/ψ bg.



$B^{\pm} \rightarrow J/\psi K^{\pm}$

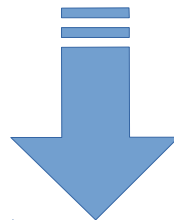
Main cuts:

- ◆ 3 tracks
- ◆ J/ψ mass (2.95, 3.35) GeV
- ◆ B candidates $P_T > 5 \text{ GeV}/c$
- ◆ $|y| < 2.4$

data = $\frac{1}{4}$ of Muonia sample, OD 2011

Technical part

MC generator level



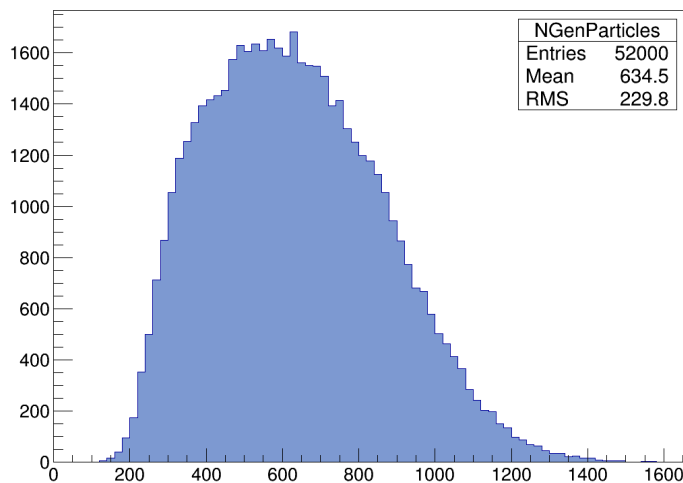
Generator level example histograms

Open Data tool allows to access the «true»/generator level (2011/10 MC)

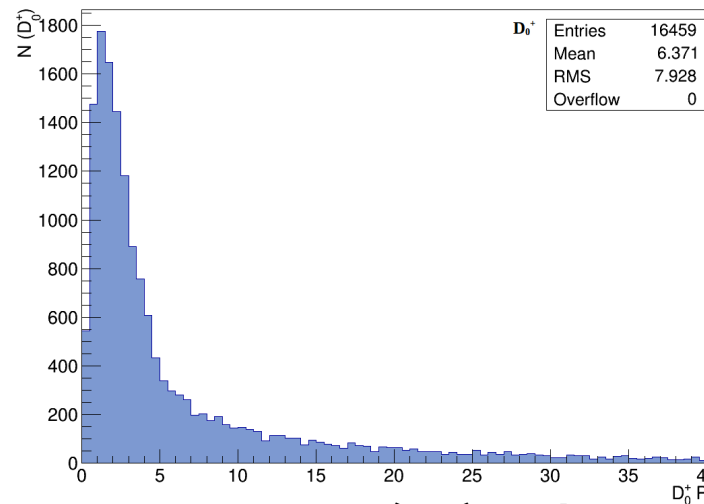
Main part of the information how to access generator level variables is described here:

<https://twiki.cern.ch/twiki/bin/view/CMSPublic/WorkBookGenParticleCandidate>

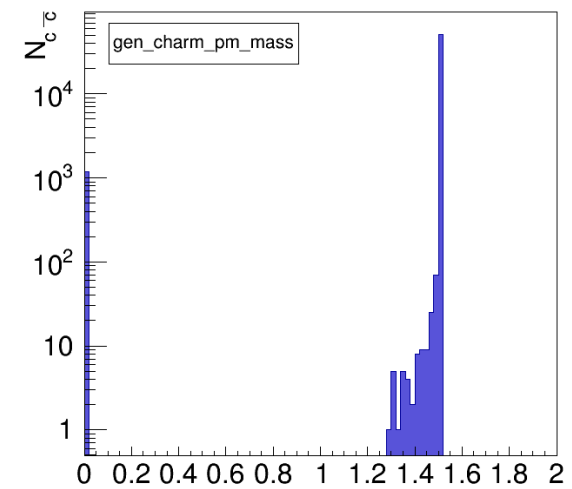
On this stage it was checked with the 2011 data* and with chosen parameters:



gen. particle number at the generator level



P_T spectrum (D_0^+) at the generator level



c-quark mass log scale (gen. level)

data* = MC_data2011_QCD_Pt50_80 sample

Displaying of the generator level decay chain

Open Data tool allows to display 2011 MC decay chain of the event

Main part of the information was taken from the official CMS documentation.

<https://twiki.cern.ch/twiki/bin/view/CMSPublic/SWGuideCandidateModules>

Official CMS tool to display decay chain of the event works well with the Open Data software. It has **two possibilities** to display:

1)

```
p+
+--> g
|   +--> g
|   |   +--> g cbar
-- decay tree: --
p+
+--> g
|   +--> cbar
|   |   +--> g cbar
```

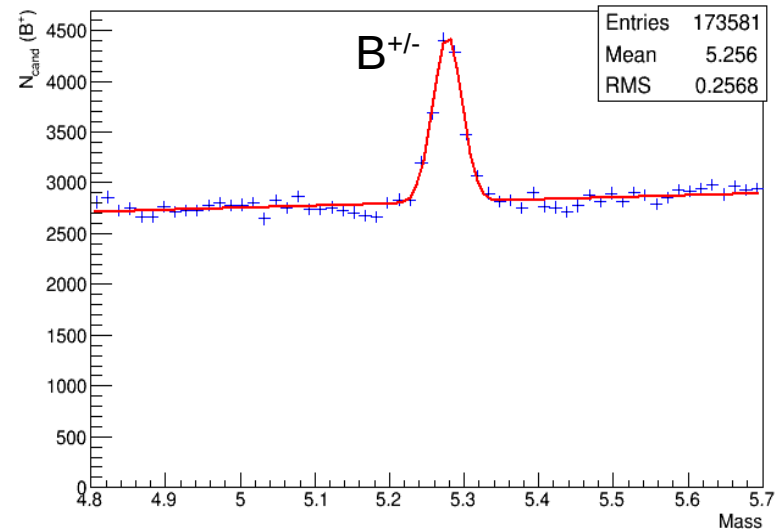
2) One even example of the decay chain with all possible information:

[ParticleListDrawer] analysing particle collection genParticles																
idx	ID	Name	Stat	Mo1	Mo2	Da1	Da2	nMo	nDa	pt	eta	phi	px	py	pz	m
0	2212 -	p+	3	-1	-1	2	60	0	19	0.000	26256.000	0.000	0.000	0.000	3500.000	0.938
1	2212 -	p+	3	-1	-1	3	79	0	14	0.000	-26256.000	0.000	0.000	0.000	-3500.000	0.938
2	21 -	g	3	0	0	4	89	1	48	2.473	6.364	-3.088	-2.469	-0.133	717.625	0.000
3	21 -	g	3	1	1	5	8	1	2	2.861	-6.540	0.523	-2.479	1.428	-990.251	-0.000
4	21 -	g	3	2	2	6	7	1	2	35.613	0.019	-2.838	-33.979	-10.663	0.670	0.000
5	-4 -	cbar	3	3	3	6	7	1	2	3.050	-6.021	0.416	2.791	1.232	-628.631	0.000
6	21 -	g	3	4	5	40	40	2	1	53.727	-0.483	1.905	-17.598	50.763	-26.991	0.000
7	-4 -	cbar	3	4	5	67	68	2	2	61.710	-2.972	-1.793	-13.590	-60.195	-600.970	1.500
8	4 -	c	2	3	3	90	90	1	1	0.745	-6.565	3.134	-0.744	0.006	-264.193	1.500
9	21 -	g	2	1	1	90	90	1	1	0.323	-3.173	-2.894	-0.313	-0.079	-3.843	0.000
10	21 -	g	2	0	0	90	90	1	1	0.462	-2.547	-2.945	-0.453	-0.090	-2.929	0.000
11	21 -	g	2	0	0	90	90	1	1	2.053	-1.299	2.930	-2.007	0.431	-3.481	-0.000
12	21 -	g	2	0	0	90	90	1	1	0.273	0.466	1.106	0.122	0.244	0.132	0.000
13	21 -	g	2	2	2	90	90	1	1	1.337	2.059	0.965	0.761	1.099	5.152	0.000
14	21 -	g	2	2	2	90	90	1	1	0.844	0.020	2.493	-0.672	0.510	0.017	-0.000
15	21 -	g	2	2	2	90	90	1	1	7.841	-0.875	0.830	5.289	5.788	-7.766	-0.000
16	21 -	g	2	2	2	90	90	1	1	3.335	-1.089	0.737	2.469	2.242	-4.391	0.000
17	-2 -	ubar	2	2	2	90	90	1	1	7.229	-1.121	0.321	6.860	2.278	-9.911	0.330

Summary

Secondary vertices study :

- ◆ Improved J/Ψ reconstruction algorithm
- ◆ $B^{+/-}$ hadrons reconstructed with 2011 data
- ◆ Calculated decay length for $B^{+/-}$, D^0 (D^*) candidates
- ◆ DL_{sign} cut significantly reduce background



```
p+
+--> g
|   +--> g
|   |   +--> g cbar
-- decay tree: --
p+
+--> g
|   +--> cbar
|   |   +--> g cbar
```

MC generator level :

- ◆ Standard CMS packages work with VM and OD 2011/10
- ◆ Access to the generator level is present
- ◆ «true» distributions, and two decay chain options were shown

Thank you for your attention!

Particle ids distribution at the «true» level

Backup

