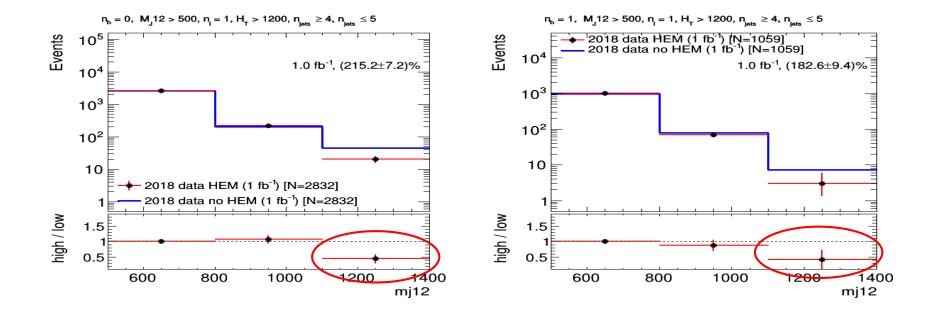
Data quality check about HEM issue

YongHo Jeong 201130

Nb		Njet	
IND.	4, 5	6, 7	8+
0	CR	CR	CR
1	CR	CR	CR
2	VR	VR	SR
3	CR	SR	SR
4+	CR	SR	SR

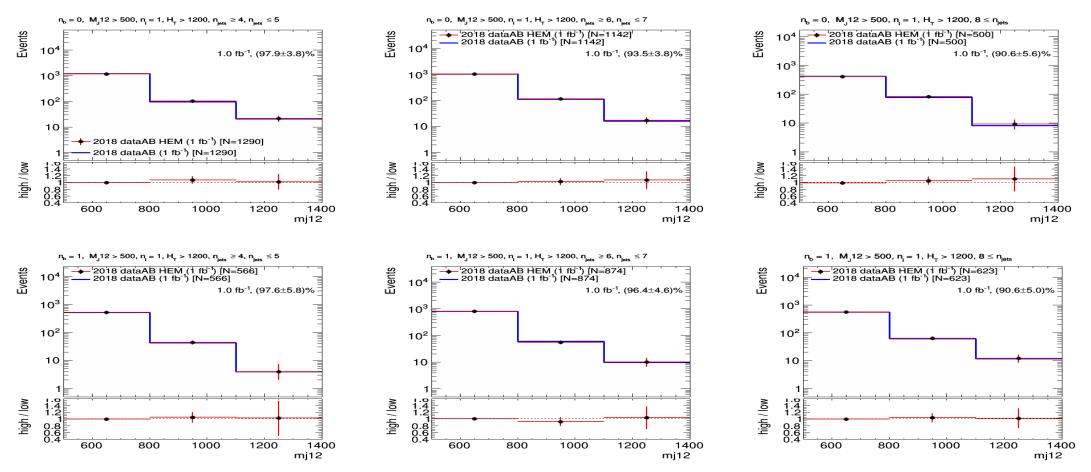
Last issue about 2018 data



Left figure is MJ distribution in $4 \le njets \le 5$ with nb=0, and right figure is nb=1 region. The difference is approximately 50%, so we need an additional study for this region.

Nb		Njet	
ND.	4, 5	6, 7	8+
0	CR	CR	CR
1	CR	CR	CR
2	VR	VR	SR
3	CR	SR	SR
4+	CR	SR	SR

HEM difference in 2018 pre HEM region



The MJ distribution 2018 data sample, blue line is no HEM issue, The red line is applied HEM issue before run 319077

Conclusion

- When applied HEM effect before the run 319077, the difference of each sample is up to 10%
- This difference is included in the statistic uncertainty

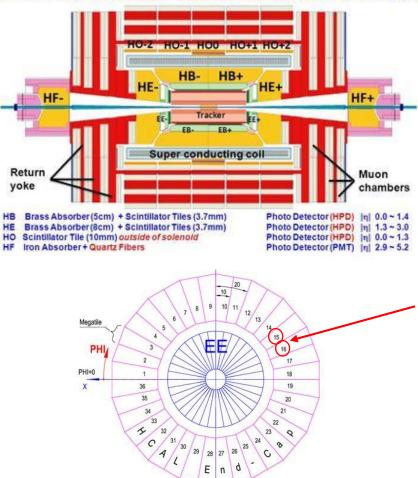
Back up

Effect of HCAL Endcap Minus side(HEM)15/16 failure

- A relevant 60% fraction of the 2018 dataset if affected by the failure of several sectors which were turned off in the HCAL.
 - After run 319077
- A loss of dataset in the HCAL performance is expected to happen around the solid angle
- Contained in the $-3.0 < \eta < -1.3$, $-1.57 < \phi < -0.87$

CMS Calorimeter

CMS Calorimeter (ECAL+HCAL) - Very hermetic (>10\lambda in all n, no projective gap)



Method of Comparison before and after HEM issue.

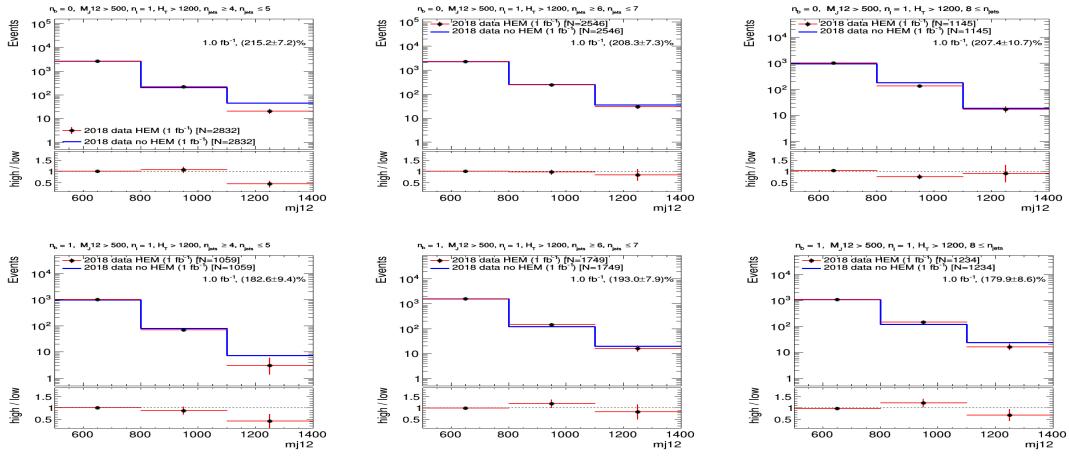
- A data to data comparison is performed by splitting 2018 data into two datasets before and after the HCAL failure.
- Two datasets(20 and $39fb^{-1}$) are renormalized to the same luminosity(1 fb^{-1}) in order to perform this comparison.
 - Run 315257~318877 : Apr/26~Jun/28, no HEM issue
 - Run 319077~325172 : Jul/1~Oct/24, HEM issue

Main effect of HEM15/16 issue

- Jet energy mismeasurements that produce different effects of the b jet veto.
- Jet energy mismeasurements that are propagated towards the missing transverse momentum.
- An increase in the lepton fake-rate in the associated region due to dependence of the lepton ID in jet related variables.
 - but this third issue does not affect our analysis

Nb		Njet	
IN D	4, 5	6, 7	8+
0	CR	CR	CR
1	CR	CR	CR
2	VR	VR	SR
3	CR	SR	SR
4+	CR	SR	SR

HEM difference CR in 2018 data nl=1



2020-11-30

The MJ distribution 2018 data sample, blue line is no HEM failure, and red line is HEM failure. up side plots are $N_b=0$, bottom side plots are $N_b=1$.

			N _{jet}			
	N _b	4, 5	6, 7	8+		
	0	CR	CR	CR		
1	1	CR	CR	CR		
=	2	VR	VR	SR		
•	3	CR	SR	SR		
	4+	CR	SR	SR		
		-				
$n_b = 0, M_J 12 > 500, n_l = 1, H_T > 1200, 8 \le n_{lets}$						
10 ⁻	4 2018 dat 2018 dat	a HEM with a HEM (1 ft	out 15/16 (1 1 5 ⁻¹) [N=854]	fb ^{-∎}) [Ń=854] 154.7±8.4)%		

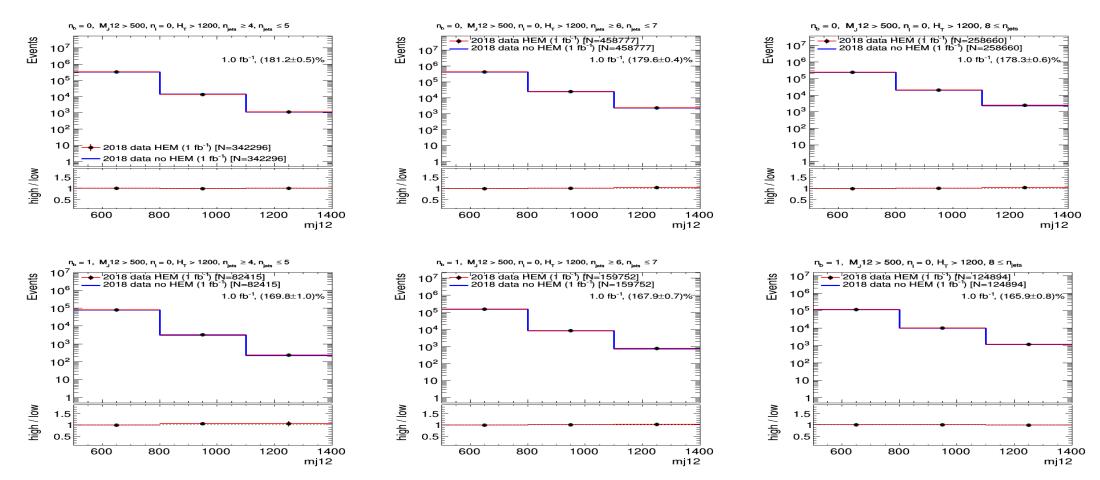
$n_b = 0, M_J 12 > 500, n_l = 1, H_T > 1200, n_{lets} \ge 4, n_{lets} \le 5$ ${n_{_{\!\!\!\! B}}}=0,\ M_{_{\!\!\!\! J}}12>500,\, n_{_{\!\!\!\! I}}=1,\, H_{_{\!\!\!\!\! T}}>1200,\, n_{_{\!\!\!\!\! jets}}\ge 6,\, n_{_{\!\!\!\! jets}}\le 7$ 10⁵ -'2018 data HEM without'15/16 (1 fb) [N=2010] - 2018 data HEM (1 fb) [N=2010] Events 10⁵ Events 1.0 fb⁻¹, (179.7±6.2)% 1.0 fb⁻¹, (164.5±6.0)% 104 104 10³ 10^{3} 10³ 10² 10² 10^{2} 10 10 10 2018 data HEM without 15/16 (1 fb⁻¹) [N=2365] 2018 data HEM (1 fb⁻¹) [N=2365] high / low high / low high / low 1.5 1.5 1.5 0.5 0.5 0.5 600 800 1000 1200 1400 600 800 1000 1200 1400 600 800 1000 1200 1400 mj12 mj12 mj12 $n_{b} = 1, \ M_{1}12 > 500, \ n_{l} = 1, \ H_{T} > 1200, \ n_{lets} \ge 6, \ n_{lets} \le 7$ $n_b = 1, M_J 12 > 500, n_l = 1, H_T > 1200, n_{lots} \ge 4, n_{lots} \le 5$ $n_b = 1, \ M_1 12 > 500, n_l = 1, \ H_T > 1200, \ 8 \le n_{lets}$ 2018 data HEM without 15/16 (1 fb) [N=915] 2018 data HEM without 15/16 (1 fb⁻¹) [N=1495] 2018 data HEM without 15/16 (1 fb) [N=1017] Events Events Events 2018 data HEM (1 fb⁻¹) [N=915] 2018 data HEM (1 fb⁻¹) [N=1495] 2018 data HEM (1 fb⁻¹) [N=1017] 10 104 1.0 fb⁻¹, (157.8±8.4)% 1.0 fb⁻¹, (165.0±6.9)% 1.0 fb⁻¹, (148.3±7.3)% 10 10 10³ 10² 10² 10^{2} 10 10 10 high / low high / low high / low 1.5 1 1.5 0.5 0.5 0.5 600 800 1000 1200 1400 600 800 1000 1200 1400 600 800 1000 1200 1400 mj12 mj12 mj12

HEM difference CR in 2018 data nl

The MJ distribution 2018 data sample, blue line is no HEM failure, and red line is HEM failure without sector 15/16. up side plots are $N_b=0$, bottom side plots are $N_b=1$.

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HEM difference CR in 2018 data nl=0

The MJ distribution 2018 data sample, blue line is no HEM failure, and red line is HEM failure. up side plots are $N_b=0$, bottom side plots are $N_b=1$.

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Njet

6, 7

CR

CR

VR

SR

SR

8+

CR

CR

SR

SR

SR

Nb

0

1

2

3

4+

4, 5

CR

CR

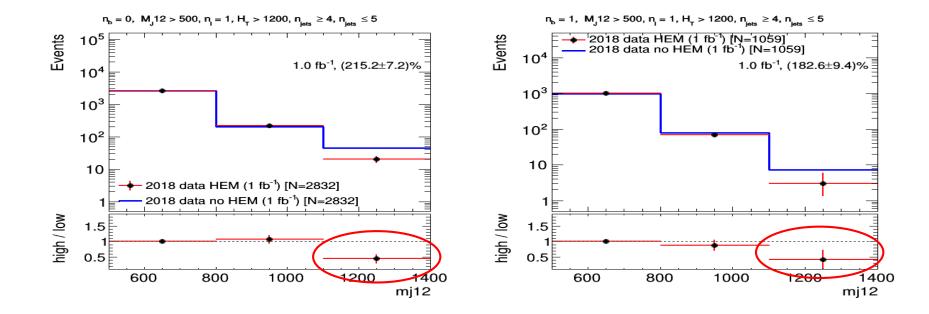
VR

CR

CR

Nb		Njet	
IN D	4, 5	6, 7	8+
0	CR	CR	CR
1	CR	CR	CR
2	VR	VR	SR
3	CR	SR	SR
4+	CR	SR	SR

HEM difference CR in 2018 data nl=1



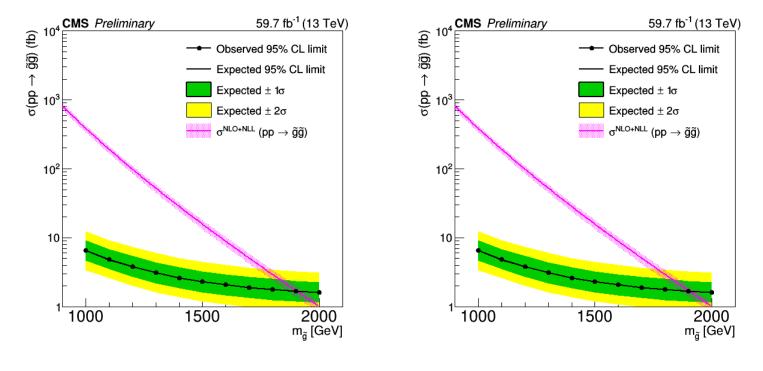
Left figure is MJ distribution in $4 \le njets \le 5$, nb=0, and right figure is nb=1 region. The difference is approximately 50%.

Extremely decreased the events affected by HEM issue

Mj	QCD	$t \bar{t}$	W+jets	Other	All bkg.	Data	$m_{\tilde{g}} = 1900 \text{GeV}$
	$N_{leps} = 1, H_T > 1200 \text{ GeV}, 4 \le N_{jets} \le 5, N_b = 0$						
500 800	978.1 ± 39.2	310.5 ± 1.6	2445.5 ± 6.0	282.2 ± 6.6	4016.3 ± 40.3	4016	0.4
800 1100	91.8 ± 9.5	36.4 ± 0.5	243.1 ± 1.6	31.4 ± 2.7	402.8 ± 10.0	403	0.2
1100	8.4 ± 1.8	5.5 ± 0.2	32.4 ± 0.4	7.5 ± 2.4	53.8 ± 3.0	54	0.1
- 60%	QCD	$t\bar{t}$	W+jets	Other	All bkg.	Data	
MJ	QCD)	Data	$m_{\tilde{g}} = 1900 \text{GeV}$
	$N_{leps} = 1, H_T > 1200 \text{ GeV}, 4 \le N_{jets} \le 5, N_b = 0$						
500 800	978.1 ± 39.2	310.5 ± 1.6	2445.5 ± 6.0	282.2 ± 6.6	4016.3 ± 40.3	4016	0.4
800 1,00	91.8 ± 9.5	36.4 ± 0.5	243.1 ± 1.6	31.4 ± 2.7	402.8 ± 10.0	403	0.2
1100	3.3 ± 0.7	2.2 ± 0.1	13.0 ± 0.2	3.0 ± 1.0	21.5 ± 1.2	22	0.1

In the third bin, 60% of MCs affected by the HEM problem were removed

Comparison pre & post HEM issue of the limit



Observed Limit of 1900 GeV: r < 0.9715

Observed Limit of 1900 GeV: r < 0.9722

The expected upper limits, left figure is not included HEM effect, right one is included HEM effect.