2018 CSC Spatial Resolution: effect of HV lowering and gas mixture change

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CSC Weekly meeting
Oct. 31, 2018

HV lowering (A.Korytov)

HV Lowering 04.10.2018

Evaldas, elog Message ID: **1066988** Entry time: **THU 04.OCT.18 16:19:11,**

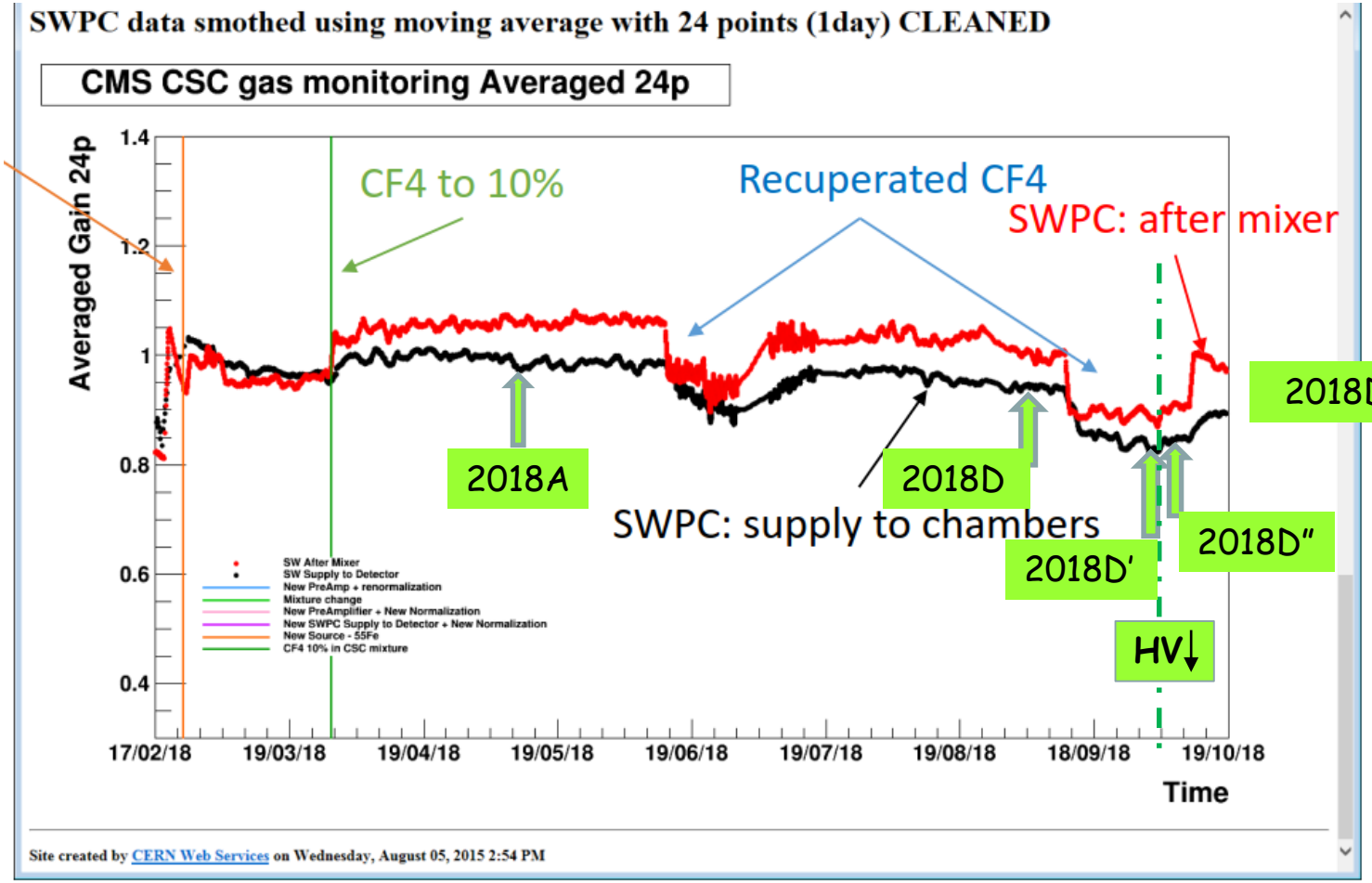
I have implemented the HV offset proposed by Andrey (more info here: https://indico.cern.ch/event/760208/contributions/3155363/attachments/1723455/2783166/2018.09.26_HV_adjustments.pdf)

- All ME1/1 chambers have been lowered by **32V**,
- All outer chambers (ME1/2, ME1/3, ME234/2) have been lowered by **35V**,
- Non-ME1/1 inner chambers have been left as is (ME234/1).

http://cmsonline.cern.ch/cms-elog/1066988

Oct.24, CSC weekly meeting Xiaofeng: Status of CSC gas system in 2018

There were 2 periods of CSC operation with recuperated CF4: [Jun.13÷Jul.05] and [Sept.12÷Oct.10] both show 10% gain drop the in SWPC.



See Xiaofeng's report on CSC weekly meeting: https://indico.cern.ch/event/767458/

Run sets: before HV lowering, normal gas mixture

2018A

CMS p-p Runs Before MD1 May-2018

2440b-2556b, β*=0.3m, <n> = 59, Lpeak 1.8-2×e34cm-2sec-1

Fill 6642 315721 2018.05.05 04:54 - 09:04 207pb-1
Fill 6643 315741 2018.05.05 11:44 - 12:23 24pb-1
Fill 6645 315764 2018.05.05 15:33 - 17:39 112pb-1
Fill 6646 315770 2018.05.06 02:04 - 04:17 119pb-1
Fill 6648 315784 2018.05.06 10:55 - 12:13 67pb-1
315785 2018.05.06 12:22 - 14:21 103pb-1
315787 2018.05.06 14:57 - 17:57 122pb-1
315790 2018.05.06 18:11 - 00:14 168pb-1 (Linit~1e34cm-2sec-1)
Fill 6650 315800 2018.05.07 06:39 - 10:52 209pb-1
315801 2018.05.07 10:56 - 13:14 95pb-1
Fill 6654 315840 2018.05.07 21:06 - 04:39 344pb-1
Fill 6659 315973 2018.05.08 23:17 - 05:13 275pb-1
Fill 6662 316058 2018.05.09 20:30 - 23:08 133pb-1
316059 2018.05.09 23:09 - 02:50 163pb-1
316060 2018.05.10 02:52 - 08:56 188pb-1
Fill 6663 316082 2018.05.10 12:31 - 15:19 138pb-1
Fill 6666 316110 2018.05.10 21:21 - 22:43 79pb-1
316114 2018.05.10 23:42 - 10:23 351pb-1 (Linit~1.4e34cm-2sec-1)
Fill 6672 316153 2018.05.11 17:02 - 22:07 246pb-1
Fill 6674 316187 2018.05.12 03:17 - 16:45 509pb-1
Fill 6675 316199 2018.05.12 18:41 - 02:27 388pb-1
316201 2018.05.13 02:35 - 05:49 106pb-1 (Linit~1.1e34cm-2sec-1)
316202 2018.05.13 05:52 - 08:34 74pb-1 (Linit~0.8e34cm-2sec-1)
Fill 6677 316216 2018.05.13 11:47 - 14:56 172pb-1
316217 2018.05.13 15:03 - 16:47 85pb-1
316218 2018.05.13 16:51 - 23:30 237pb-1 (Linit~1.3e34cm-2sec-1)
316219 2018.05.13 23:32 - 01:27 48pb-1

Reported May 23, 2018

2018D

CMS p-p collisions, **end of Aug-2018,**

(Fill 7110 **322022** 2018.08.31 20:46 - 08:32 467pb-1 971 mbar*
Fill 7108 **321988** 2018.08.31 03:38 - 13:14 416pb-1 970 mbar*
321990 2018.08.31 13:15 - 16:22 83pb-1 970 mbar*
Fill 7105 **321973** 2018.08.30 09:29 - 17:35 365pb-1 971 mbar*
321975 2018.08.30 17:36 - 23:16 149pb-1 971 mbar*
Fill 7101 **321961** 2018.08.29 21:42 - 00:08 134pb-1 970 mbar*
Fill 7098 **321917** 2018.08.29 05:22 - 10:37 268pb-1 968 mbar*
Fill 7097 **321908** 2018.08.28 13:23 - 16:25 148pb-1 971 mbar*
321909 2018.08.28 16:30 - 03:16 347pb-1 969 mbar*
Fill 7095 **321887** 2018.08.28 00:42 - 06:54 281pb-1 971 mbar*

Run sets

2018D'

CMS p-p **Runs** **BEFORE** HV lowered – Sept-Oct.2018

Fill 7253	**323980**	2018.10.03 14:50 - 16:08	68pb-1	977 mbar*
	323983	2018.10.03 16:11 - 17:24	57pb-1	977 mbar*
	323997	2018.10.03 17:29 - 20:53	130pb-1	977 mbar*
Fill 7252	**323940**	2018.10.03 00:53 - 11:02	433pb-1	975.5 mbar*
Fill 7245	**323841**	2018.10.01 23:13 - 02:32	157pb-1	972 mbar*
	323857	2018.10.02 02:34 - 04:58	97pb-1	972 mbar*
Fill 7242	**323790**	2018.10.01 07:17 - 13:24	280pb-1	968 mbar*
Fill 7240	**323775**	2018.09.30 19:34 - 20:39	48pb-1	969 mbar*
	323778	2018.09.30 20:40 -02:52	273pb-1	969 mbar*
Fill 7239	**323755**	2018.09.30 11:06 - 17:24	302pb-1	970 mbar*
Fill 7236	323725	2018.09.29 18:31 - 20:46	120pb-1	972 mbar*
	323727	2018.09.29 21:12 - 03:44	253pb-1	972 mbar*

2018D"

CMS p-p **Runs** with CSC HV lowered - from 04.10.2018 (

Fill 7259	**324077**	2018.10.04 21:59 - 02:56	245pb-1	975 mbar*
	324078	2018.10.05 03:39 - 08:18	165pb-1	975 mbar*
Fill 7264	**324201**	2018.10.06 23:49 - 08:45	367pb-1	965 mbar*
	324202	2018.10.07 08:48 - 10:20	40pb-1	965 mbar*
Fill 7265	**324237**	2018.10.07 21:16 - 22:51	76pb-1	967 mbar*
Fill 7266	**324245**	2018.10.08 01:21 - 12:19	421pb-1	968 mbar*
Fill 7270	**324293**	2018.10.08 22:52 - 14:06	519pb-1	972 mbar*
Fill 7271	**324315**	2018.10.09 16:25 - 17:45	71pb-1	971 mbar*
	324318	2018.10.09 17:52 - 20:05	101pb-1	971 mbar*
Fill 7274	**324420**	2018.10.11 00:24 - 04:31	202pb-1	965 mbar*

2018D"'

CMS p-p collisions, **last p-p Fills Oct.-2018,**

Fill 7309	**324747**	2018.10.16 12:31 - 19:53	310pb-1	969 mbar*
	324764	2018.10.16 19:53 - 20:51	30pb-1	969 mbar*
	324765	2018.10.16 20:52 - 23:58	88pb-1	969 mbar*
Fill 7310	**324785**	2018.10.17 05:46 - 10:02	187pb-1	969 mbar*
	324791	2018.10.17 10:04 - 18:01	256pb-1	969 mbar*
Fill 7314	**324835**	2018.10.17 22:14 - 00:37	112pb-1	968 mbar*
	324841	2018.10.18 01:17 - 10:01	317pb-1	968 mbar*
Fill 7315	**324878**	2018.10.18 15:42 - 03:27	409pb-1	968.5 mbar*
Fill 7320	**324970**	2018.10.19 15:41 - 05:58	487pb-1	973 mbar*
Fill 7321	**324980**	2018.10.20 08:00 - 23:13	528pb-1	976.5 mbar*
Fill 7324	**324998**	2018.10.21 05:22 - 07:43	115pb-1	976 mbar*
	325000	2018.10.21 08:03 - 10:27	95pb-1	976 mbar*
	325001	2018.10.21 10:28 - 14:23	121pb-1	975.5 mbar*
Fill 7328	**325022**	2018.10.21 20:52 - 07:16	453pb-1	972.5 mbar*

CSC Spatial Resolution: selection

Select good quality segment/muon track for spatial resolution measurement:

- segments matched to global muons with P > 10 GeV
- 6 hits on a track segment
- Track-segment χ^2 (2D) criteria
- Cut on large angles dx/dz (local coordinates):

  | dx/dz | < 0.25 for ME11

  | dx/dz | < 0.2 for all other stations
- Track-segment χ^2 (strips) criteria
- Sum of charges for 3 strips and 3 time slices:

  $150 < Q_{3x3} < 4000$ ADCs for ME1/1 station

  $150 < Q_{3x3} < 2000$ ADCs for all other stations

Sofware: CMSSW_10_2_6
Datasets: /SingleMuon/Run2018A,-ZMu-PromptReco-v1/RAW-RECO
/SingleMuon/Run2018D,-ZMu-PromptReco-v2/RAW-RECO

CSC Spatial Resolution 2017-2018

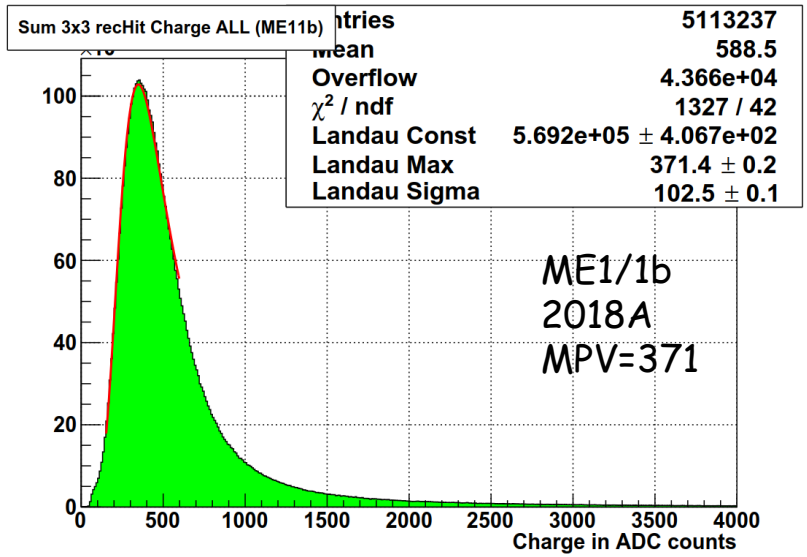
Spatial resolution per station (μm):

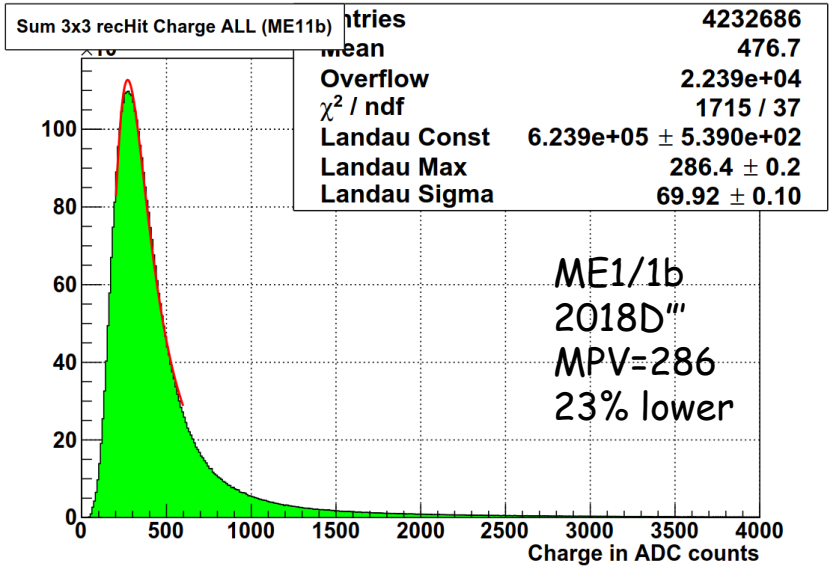
Station	Collision dataset					
			Aug.18	bef. HV lowered	HV lowered	last p-p
	2017C,F	2018A	2018D	2018D'	2018D''	2018D'''
	ZMu	ZMu	ZMu	ZMu	ZMu	ZMu
ME1/1a	46	45	46	48	52	51
ME1/1b	53	52	53	55	61	60
ME1/2	89	88	89	93	103	100
ME1/3	106	105	108	115	130	125
ME2/1	133	133	138	146	144	140
ME2/2	143	141	144	156	177	171
ME3/1	128	127	132	140	139	134
ME3/2	143	141	144	157	177	171
ME4/1	127	127	129	139	138	133
ME4/2	146	145	150	159	180	173
Statistics [fb^{-1}]		4.8	2.7	2.2	1.9	3.5

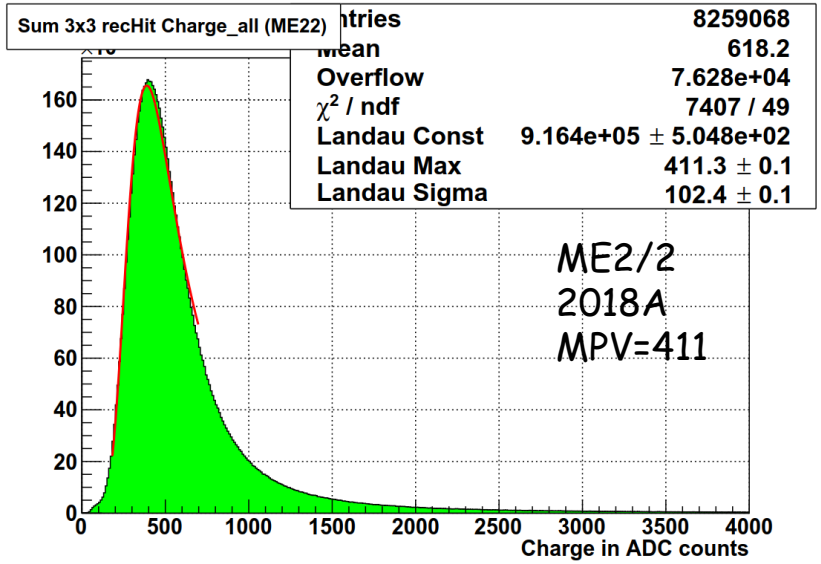
Recuperated CF4

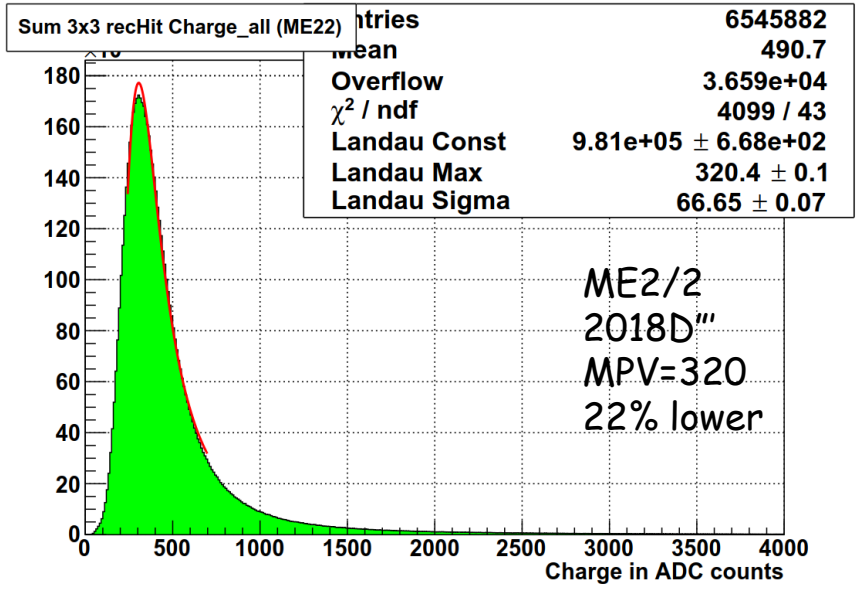
Values are normalized to atm. pressure 965 mbar

ME1/1b and G.Gain: results with 2018A and 2018D''' (HV lowered, last p-p Runs) data



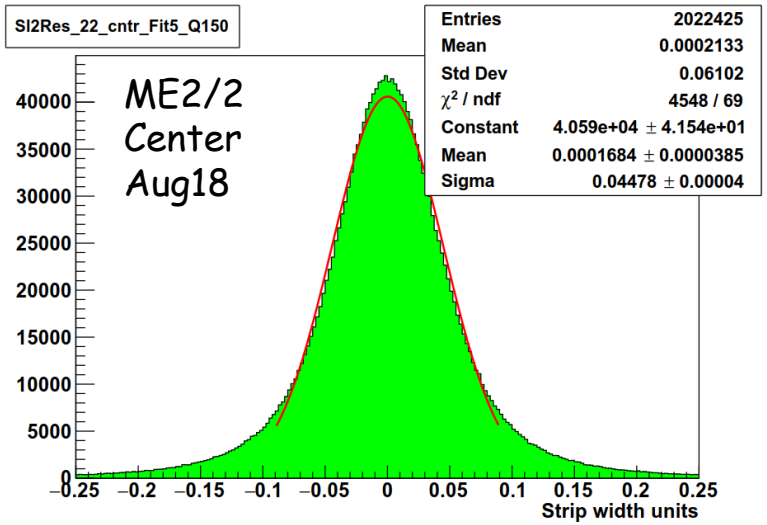


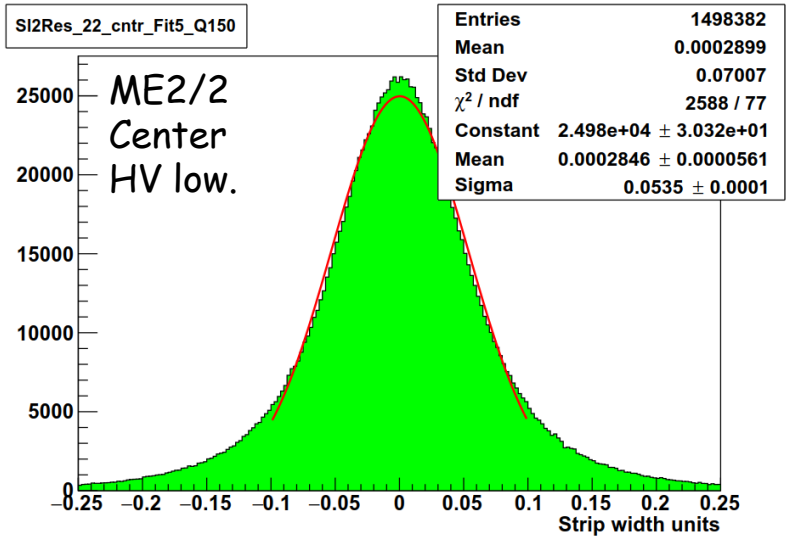




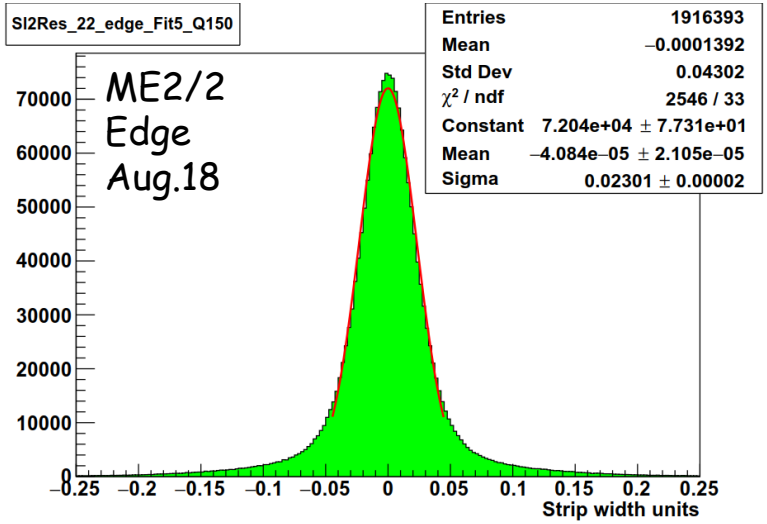
ME2/2 Spatial Resolution: results with 2018D and 2018D" (HV lowered) data

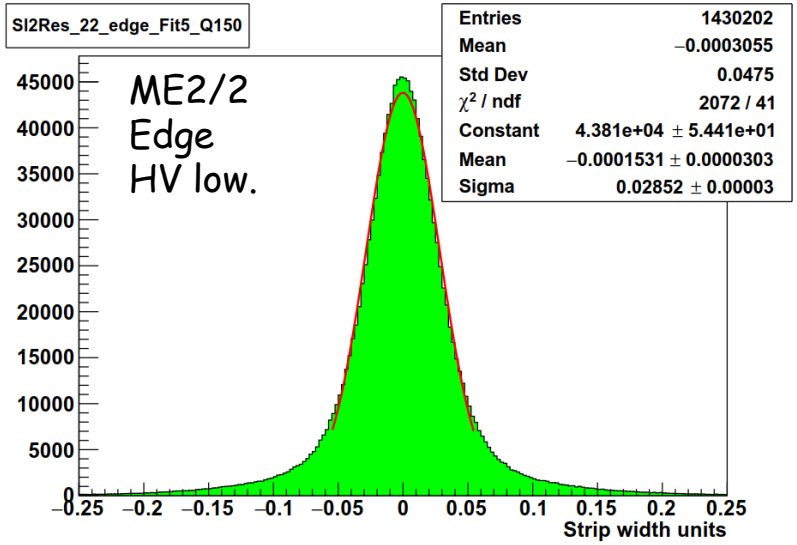
$1/\sigma^2(\text{Station}) = 3/\sigma_1^2 + 3/\sigma_2^2$



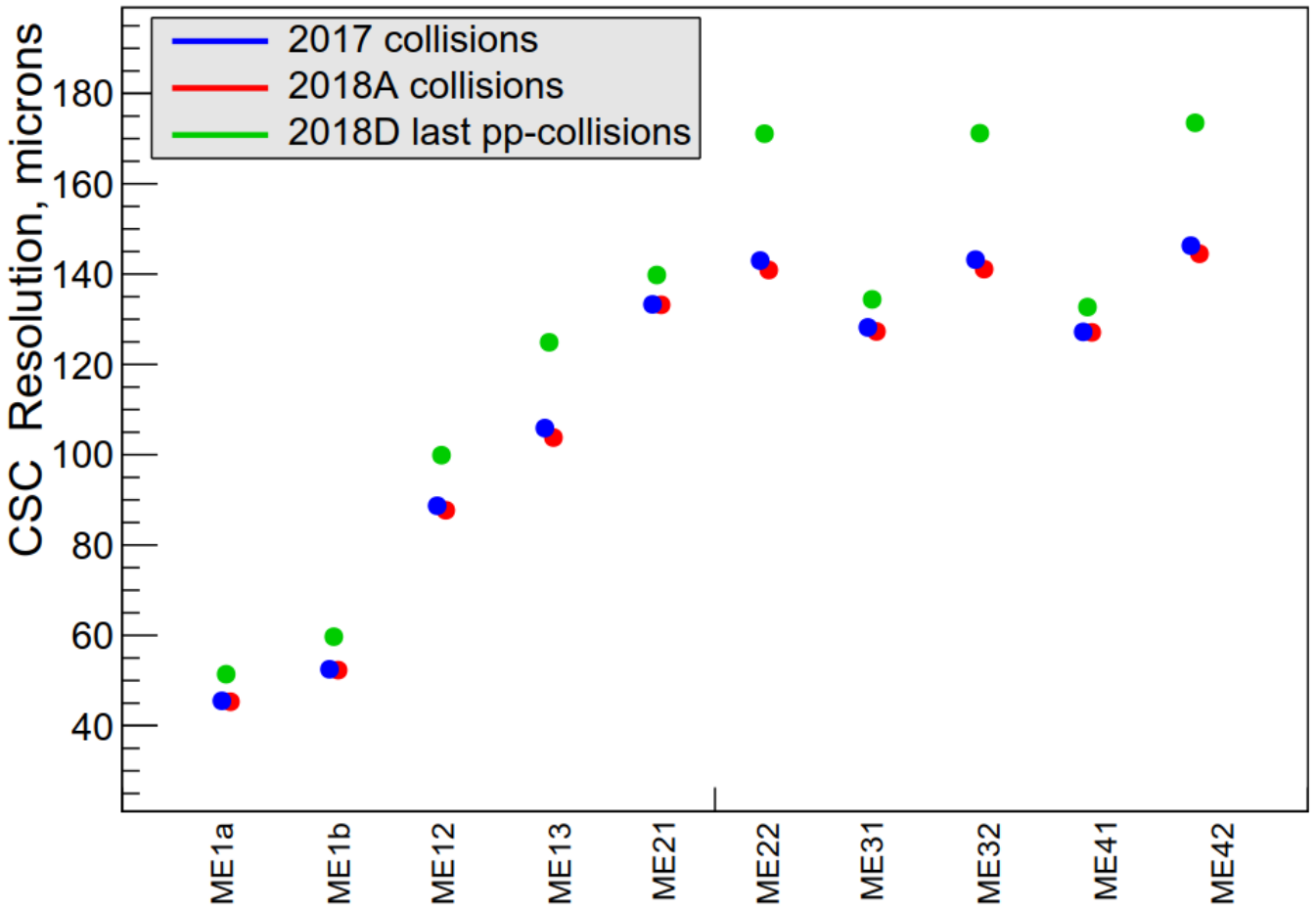


Sigma (ME2/2) = 144→177 μm





CSC Spatial Resolution 2017-2018



Conclusions

- We observe some small difference (1÷5μm) in Spatial Resolution of CSCs operating with nominal gas mixture 2018A and 2018D. The reason could the instability of the CSC gas mixer operation.

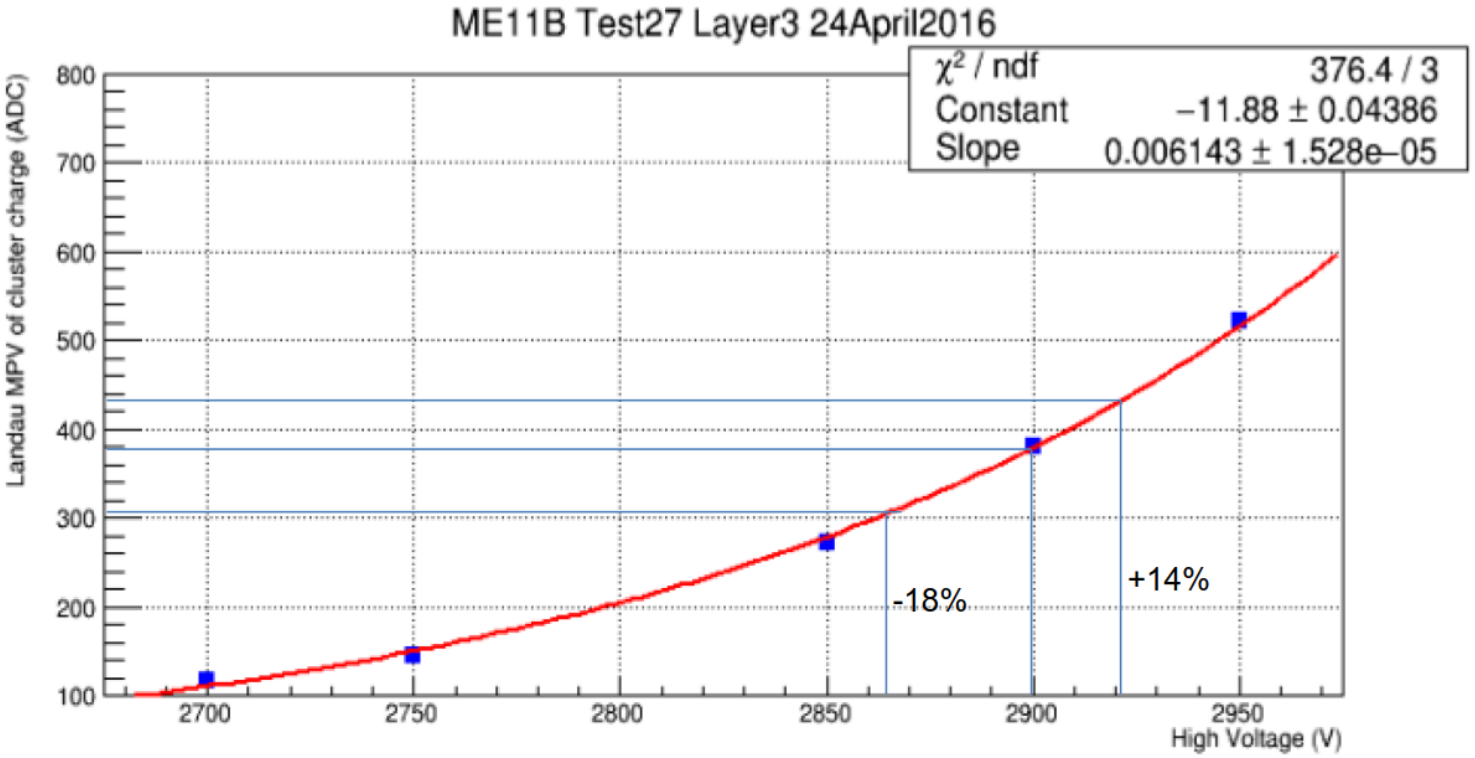
- Operation with recuperated CF4 (2018D') - the Resolution drops by 2÷10μm.

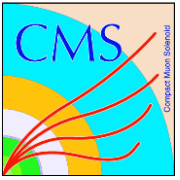
- HV lowered (2018D") – for the related stations the Resolution degradation is 4÷20μm.

- The Resolution of the outer Stations (ME2,3,4/2) is now beyond the Muon TDR requirements (150μm).

Backup Slides

ME1/1b_GIF, MPV vs HV, (Jian – 2016)

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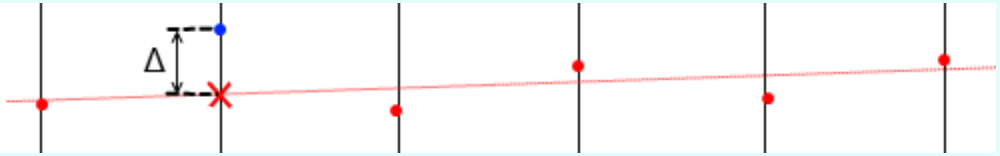
Spatial Resolution

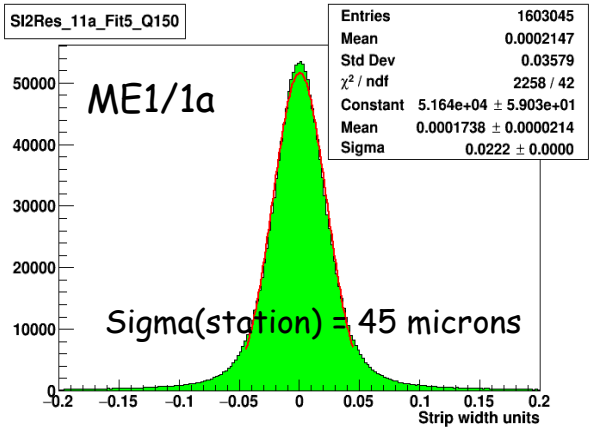
Spatial resolution calculation:

- Only 6 -point segments are considered;
- For each layer with hit a straight line fit is applied excluding the current layer and the residual (Δ) between the measured strip coordinate and the predicted track coordinate from fit is used for resolution calculation.

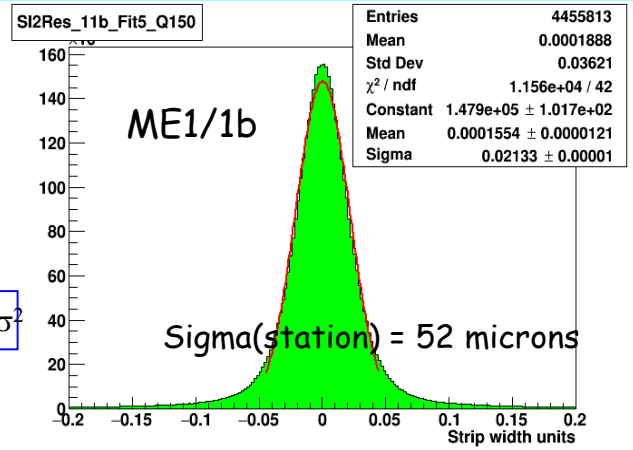


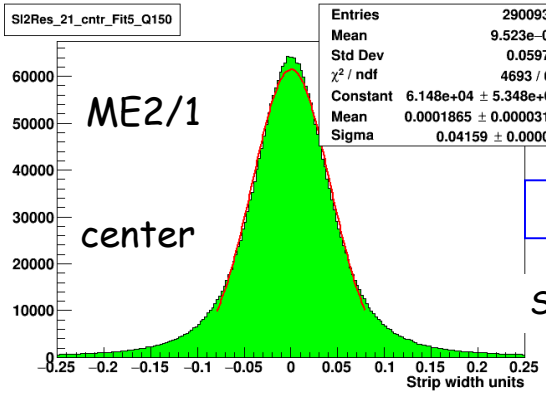
- hit used for fit
- hit excluded from fit
- predicted track coordinate

Spatial Resolution: results with 2018A collision data



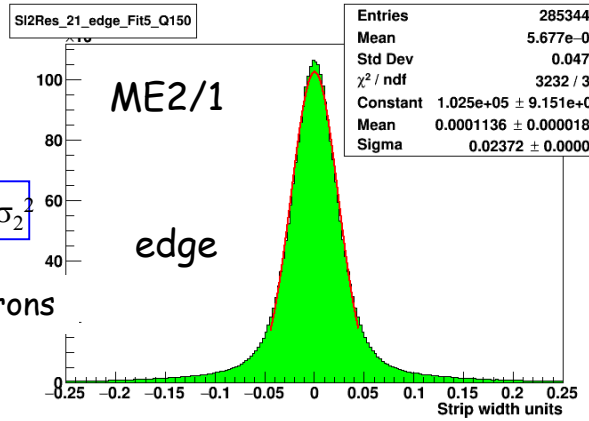
$1/\sigma^2\,(\text{Station}) = 6/\sigma^2$

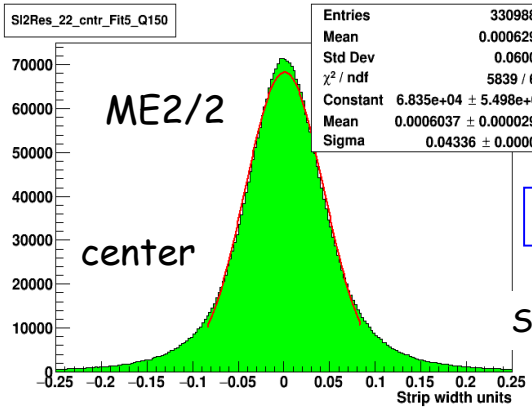




$1/\sigma^2\,(\text{Station}) = 3/\sigma_1^2 + 3/\sigma_2^2$

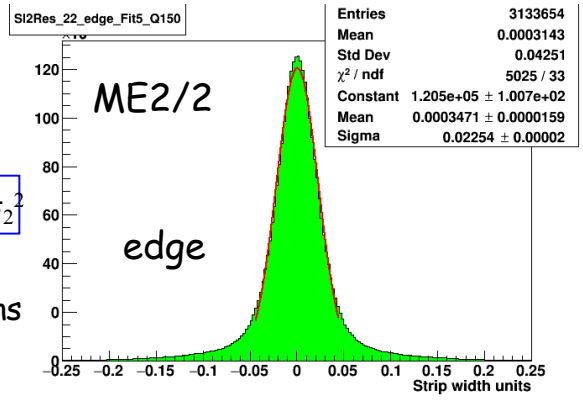
Sigma(station) = 133 microns





$1/\sigma^2\,(\text{Station}) = 3/\sigma_1^2 + 3/\sigma_2^2$

Sigma(station) = 141 microns

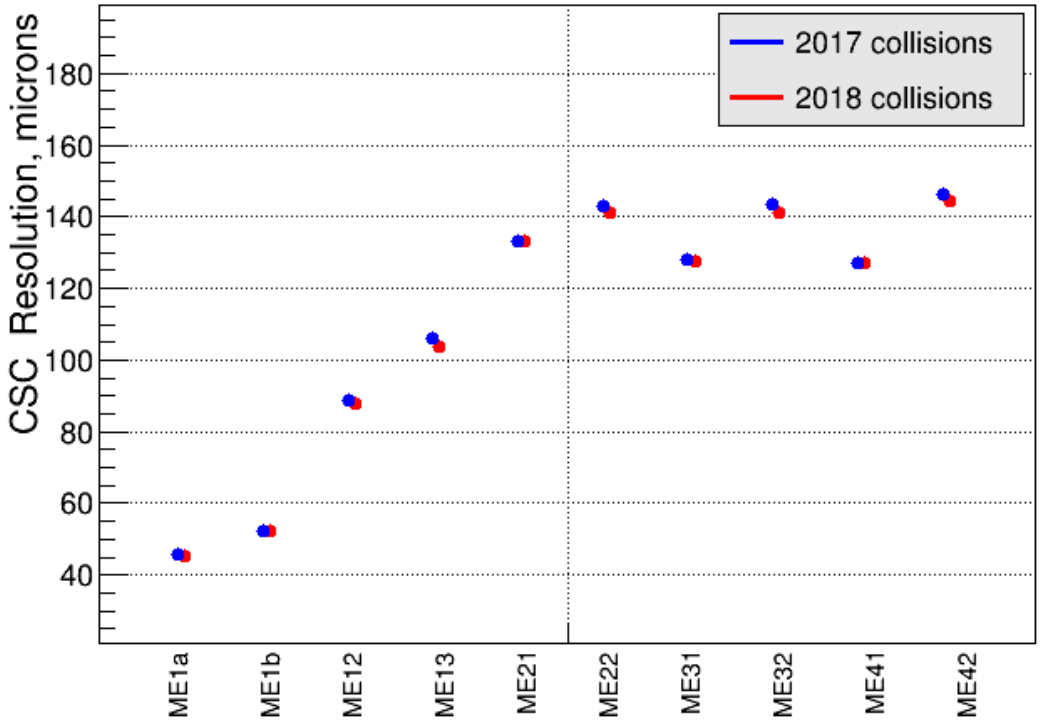


CSC Spatial Resolution 2017-2018

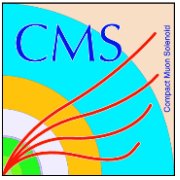
Spatial resolution per station (μm):

Values are normalized to atm.pressure 965 mbar

Station	Collision dataset	
	Run2	
	2017C,F	2018A
	ZMu	ZMu
ME1/1a	46	45
ME1/1b	53	52
ME1/2	89	88
ME1/3	106	105
ME2/1	133	133
ME2/2	143	141
ME3/1	128	127
ME3/2	143	141
ME4/1	127	127
ME4/2	146	145



Results 2017/2018 are in good agreement


CMS
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