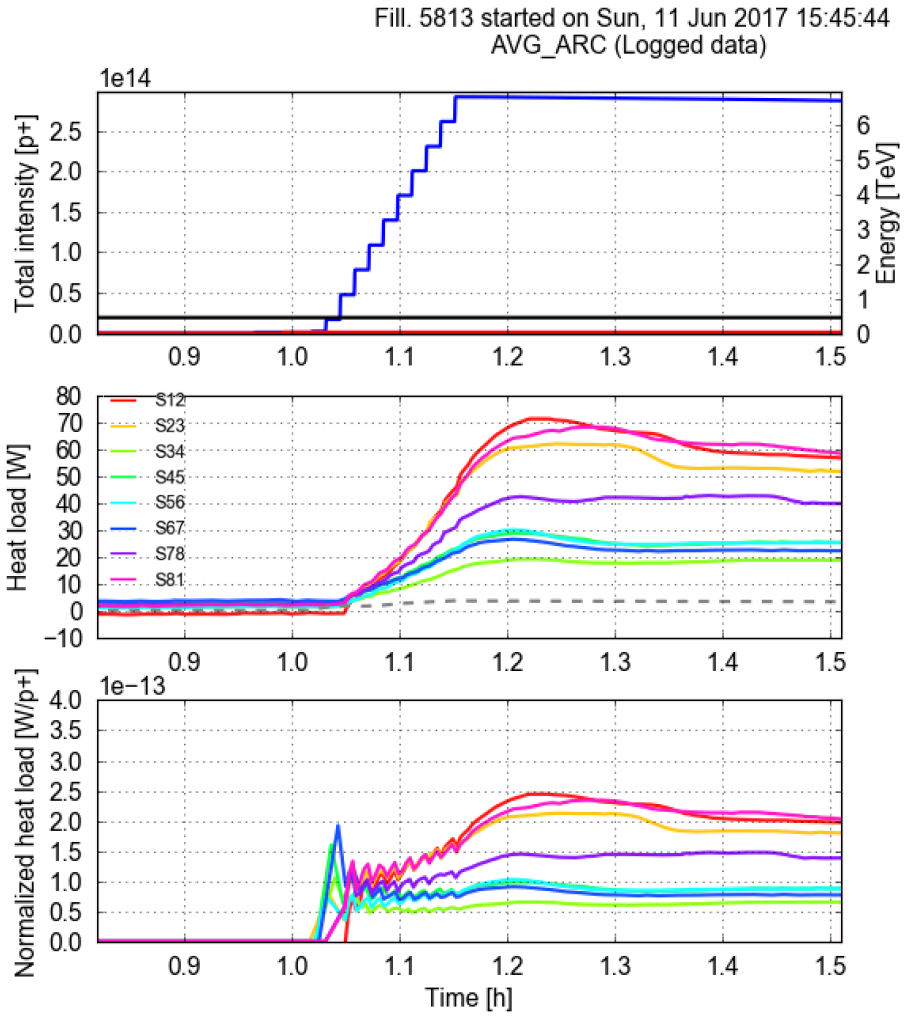
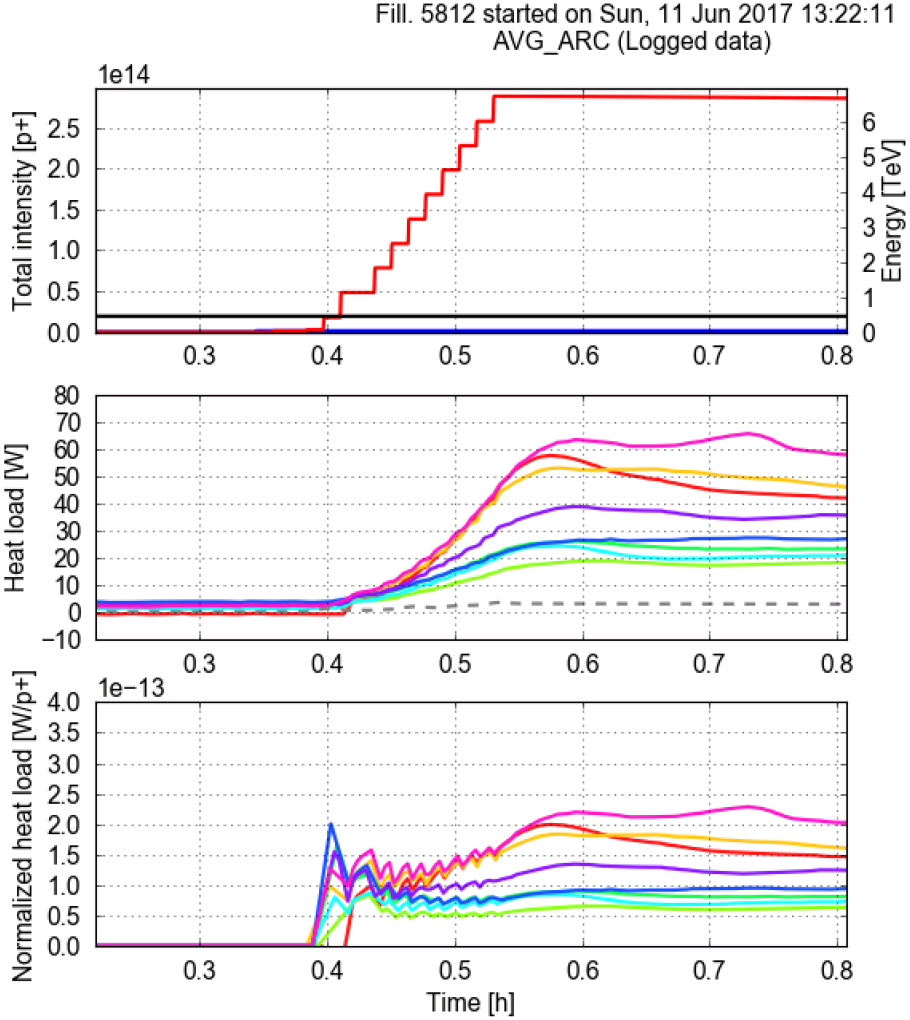
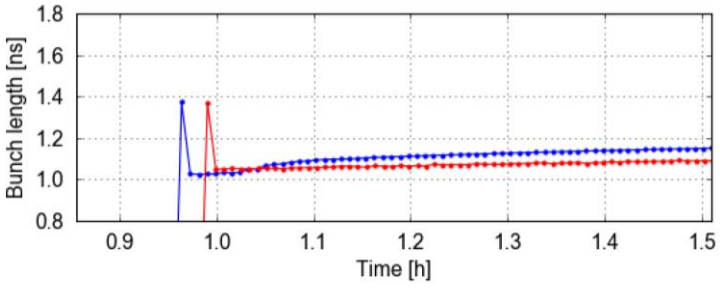
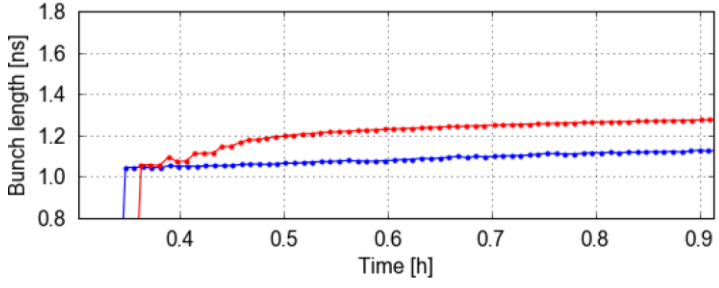
Observations from 2017 scrubbing run

In the test performed at the end of the Scrubbing Run different heat loads were measured with B1 and B2 separately especially for Sector 12. But bunch length seemed to be significantly different between the two cases.

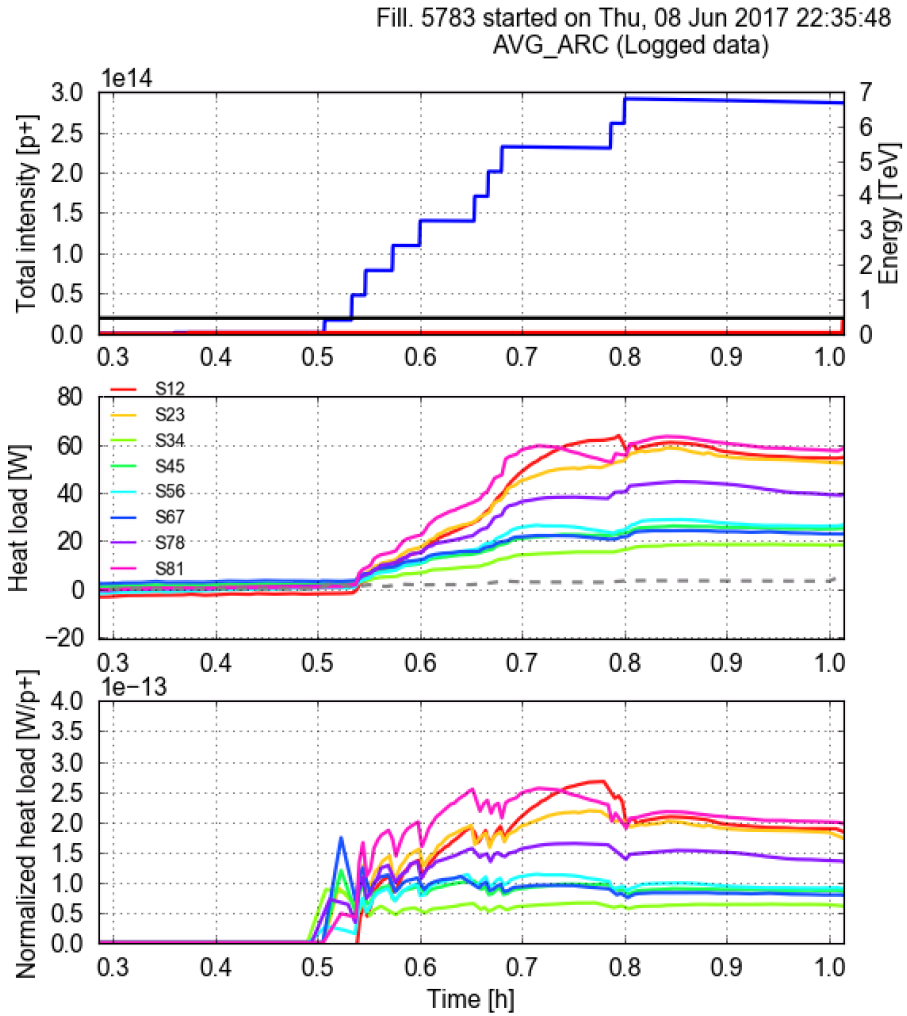


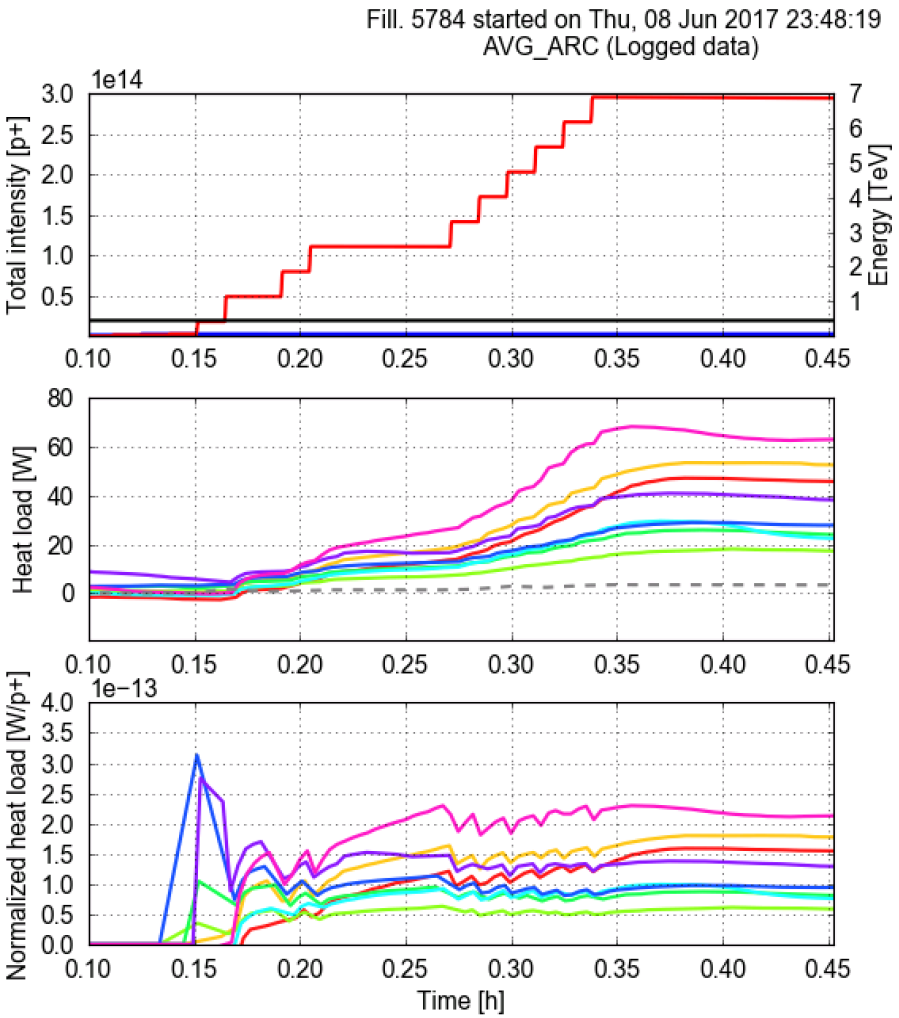


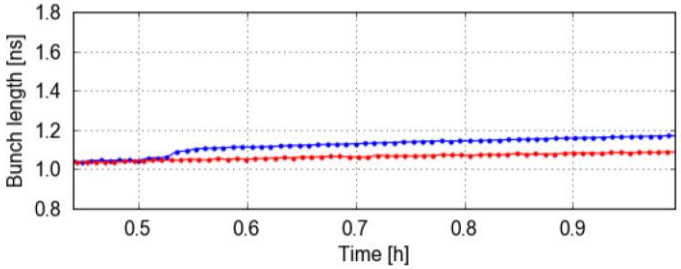


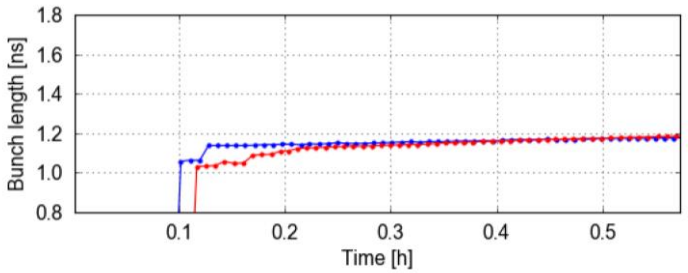


The same feature was noticed a few days before with more similar bunch length conditions → it does not seem to be related to bunch length



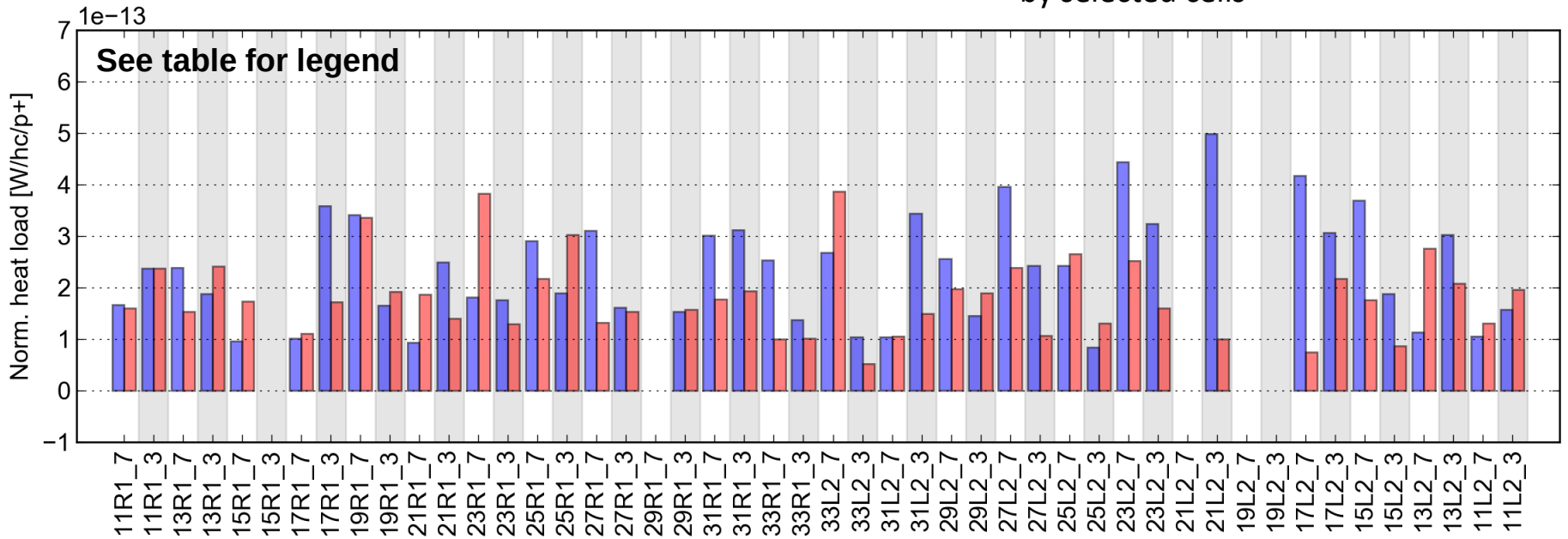


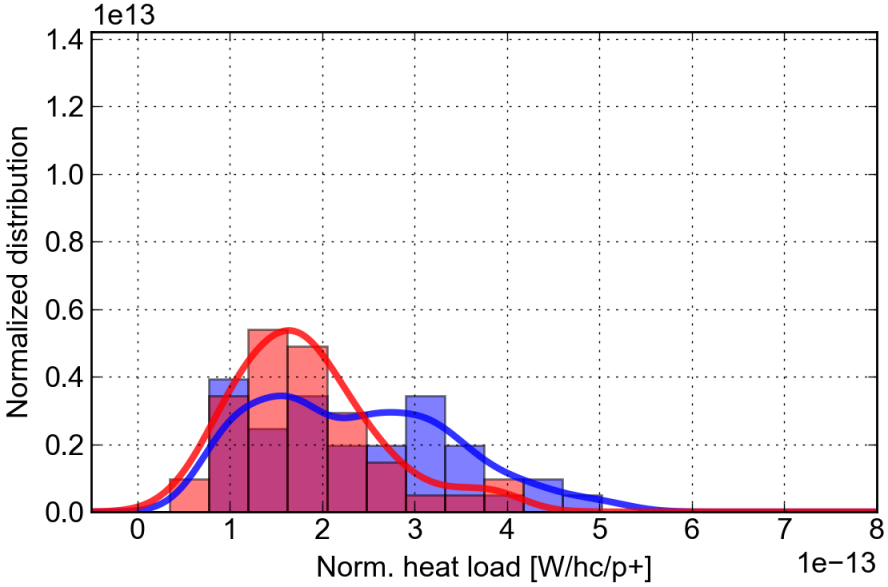




Looking at the cell by cell pattern in S12 we see that the asymmetry is generated by selected cells

Sector 12, 48 cells, recalc. values

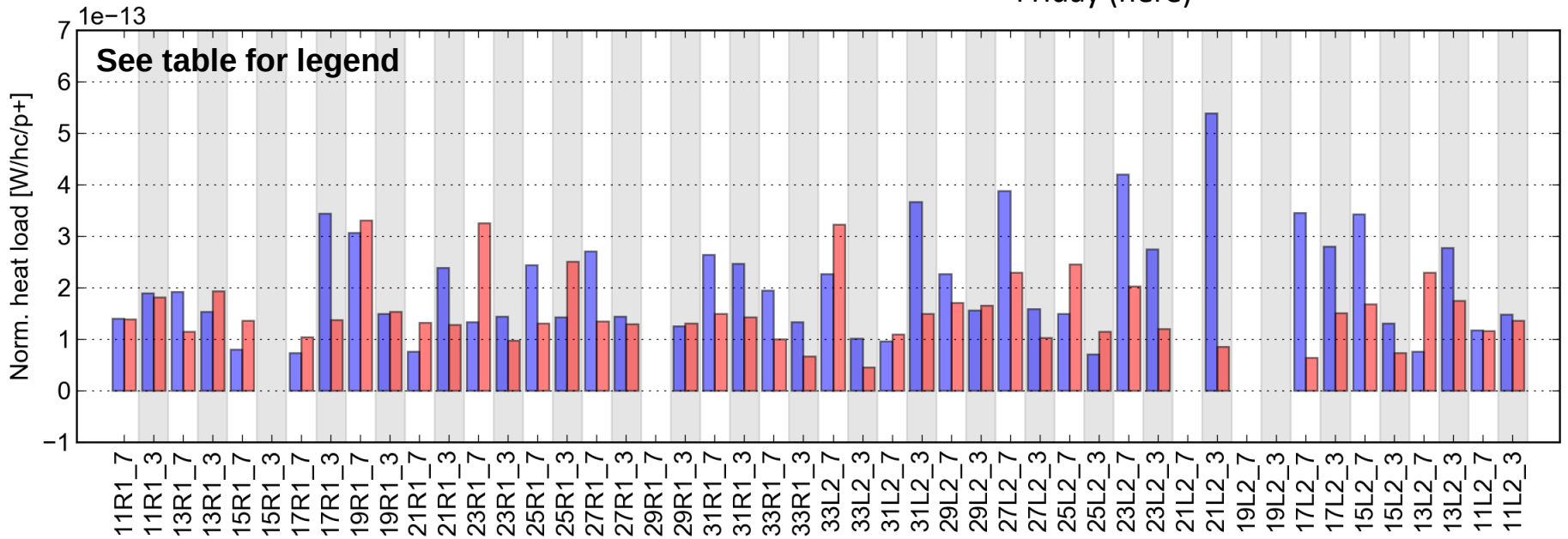


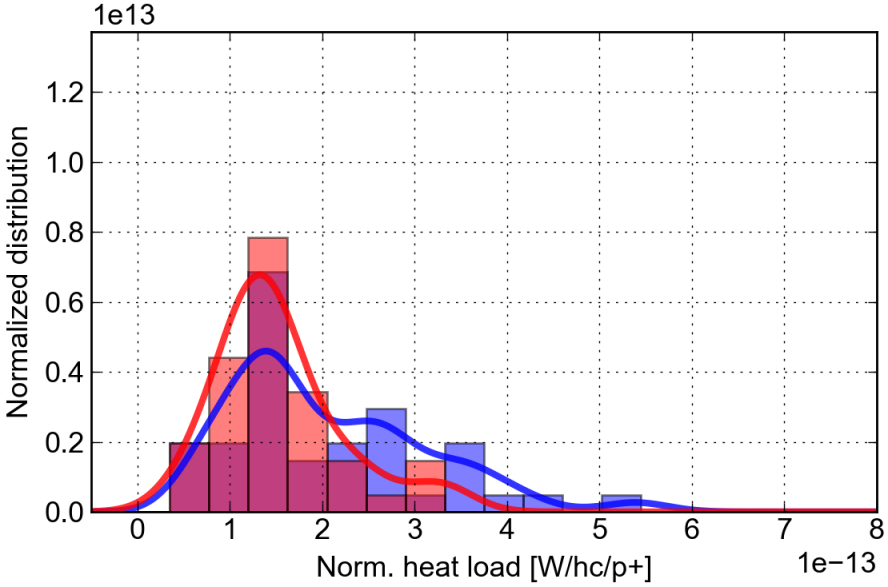


	B1 only	B2 only
Fill	5783	5784
Started on	08 Jun 2017 22:35	08 Jun 2017 23:48
T_sample [h]	0.92	0.55
Energy [GeV]	450	450
N_bunches (B1/B2)	2748/12	24/2760
Intensity (B1/B2) [p]	2.89e14/1.33e12	2.65e12/2.92e14
Bun.len. (B1/B2) [ns]	1.16/1.08	1.18/1.18
H.L. S12 (avg) [W]	68.35	53.92
H.L. S12 (std) [W]	30.36	22.27
H.L. exp. imped. [W]	3.29	3.29
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.50	0.14

Sector 12, 48 cells, recalc. values

The pattern is identical when comparing the fills from Thursday (previous slide) and Friday (here)

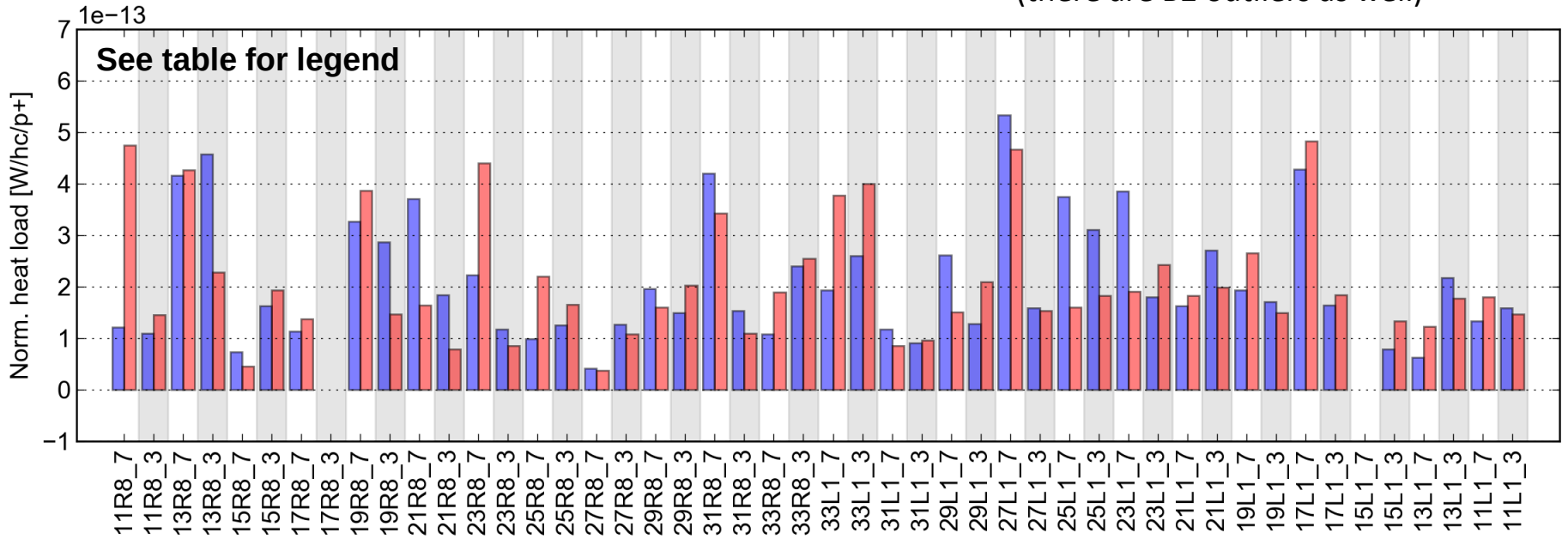


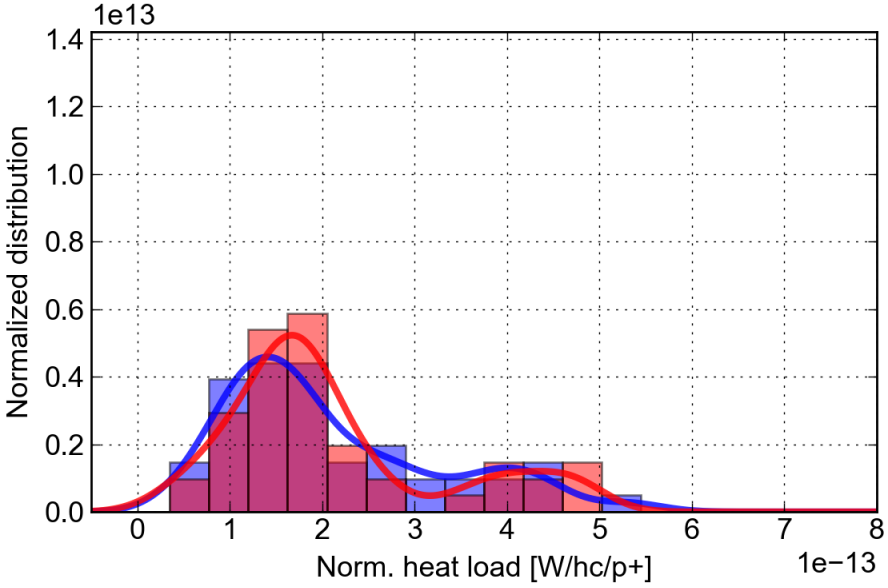


	B1 only	B2 only
Fill	5813	5812
Started on	11 Jun 2017 15:45	11 Jun 2017 13:22
T_sample [h]	1.45	0.90
Energy [GeV]	450	450
N_bunches (B1/B2)	2760/12	12/2760
Intensity (B1/B2) [p]	2.88e14/1.21e12	1.41e12/2.85e14
Bun.len. (B1/B2) [ns]	1.14/1.09	1.13/1.28
H.L. S12 (avg) [W]	59.86	43.93
H.L. S12 (std) [W]	30.68	18.79
H.L. exp. imped. [W]	3.33	2.77
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.90	0.30

Sector 81, 48 cells, recalc. values

Similar features are observed on Sector 81 even if the effect on average is smaller (there are B2 outliers as well)

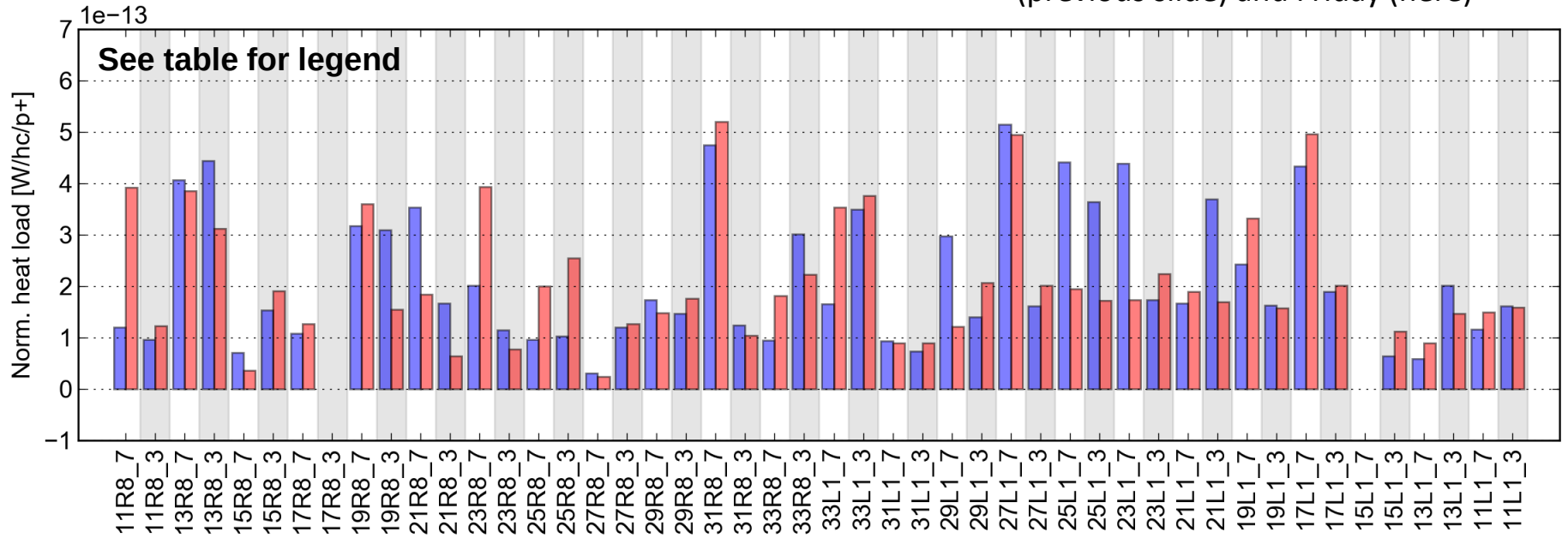


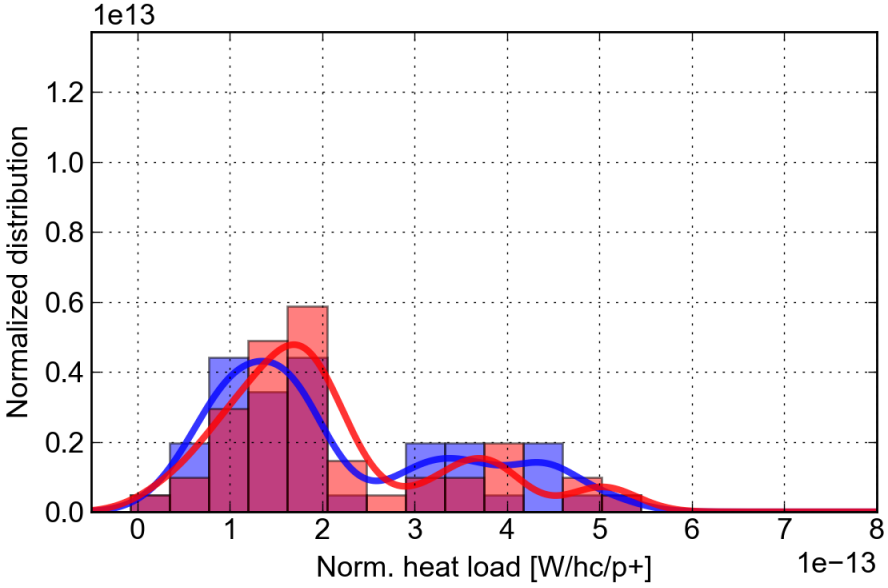


	B1 only	B2 only
Fill	5783	5784
Started on	08 Jun 2017 22:35	08 Jun 2017 23:48
T_sample [h]	0.92	0.55
Energy [GeV]	450	450
N_bunches (B1/B2)	2748/12	24/2760
Intensity (B1/B2) [p]	2.89e14/1.33e12	2.65e12/2.92e14
Bun.len. (B1/B2) [ns]	1.16/1.08	1.18/1.18
H.L. S81 (avg) [W]	60.97	62.18
H.L. S81 (std) [W]	34.18	34.34
H.L. exp. imped. [W]	3.29	3.29
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.50	0.14

Also for S81, the pattern is identical when comparing the fills from Thursday (previous slide) and Friday (here)

Sector 81, 48 cells, recalc. values

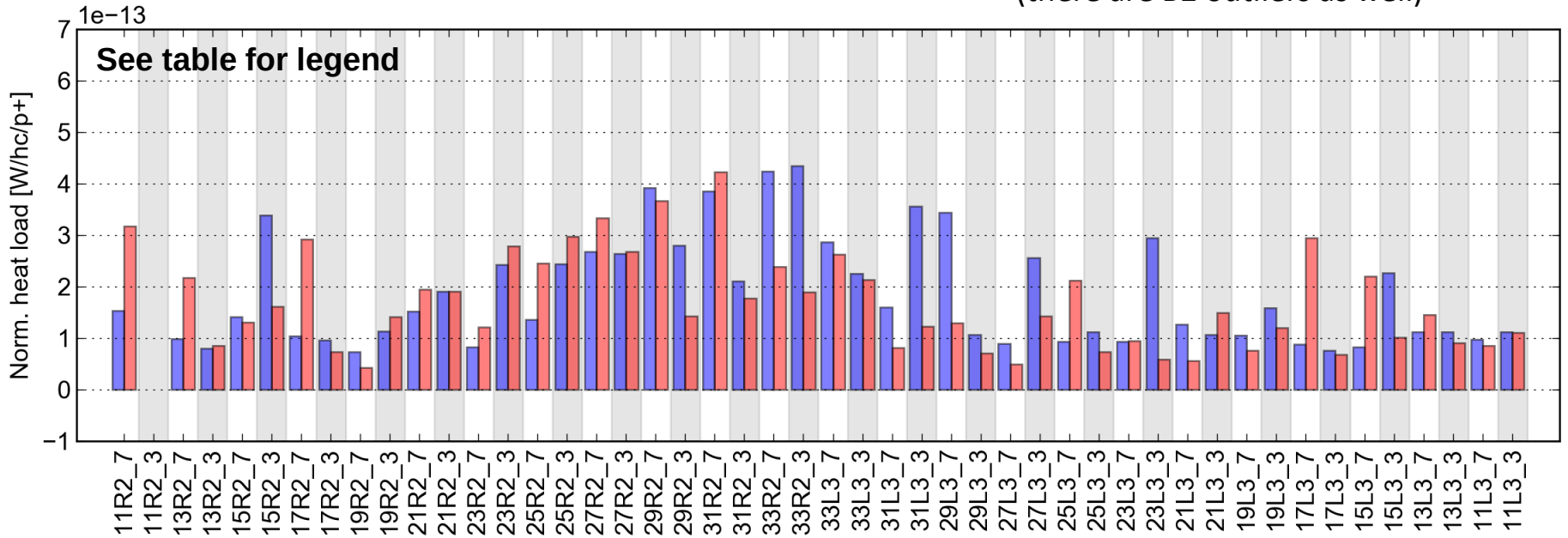


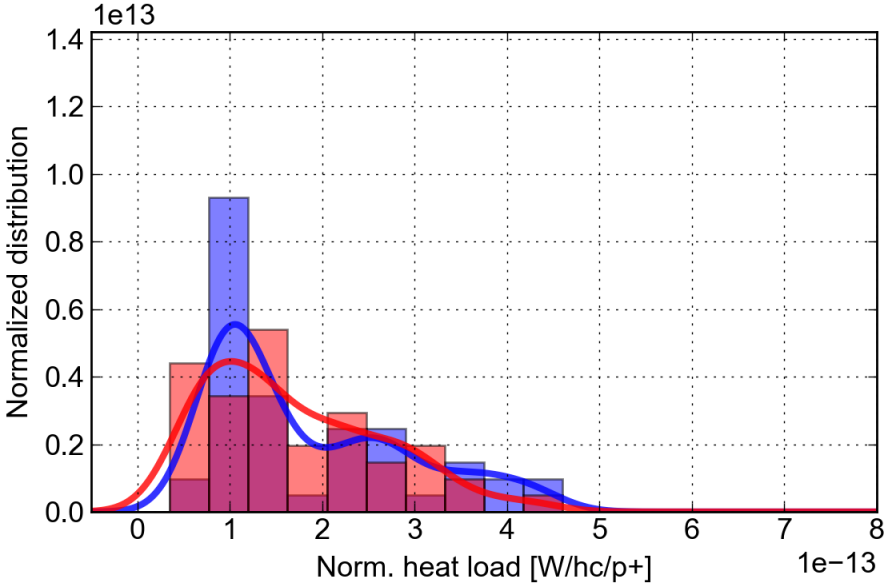


	B1 only	B2 only
Fill	5813	5812
Started on	11 Jun 2017 15:45	11 Jun 2017 13:22
T_sample [h]	1.45	0.90
Energy [GeV]	450	450
N_bunches (B1/B2)	2760/12	12/2760
Intensity (B1/B2) [p]	2.88e14/1.21e12	1.41e12/2.85e14
Bun.len. (B1/B2) [ns]	1.14/1.09	1.13/1.28
H.L. S81 (avg) [W]	62.42	60.14
H.L. S81 (std) [W]	38.09	34.81
H.L. exp. imped. [W]	3.33	2.77
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.90	0.30

Sector 23, 48 cells, recalc. values

Similar features are observed on Sector 23 even if the effect on average is smaller (there are B2 outliers as well)

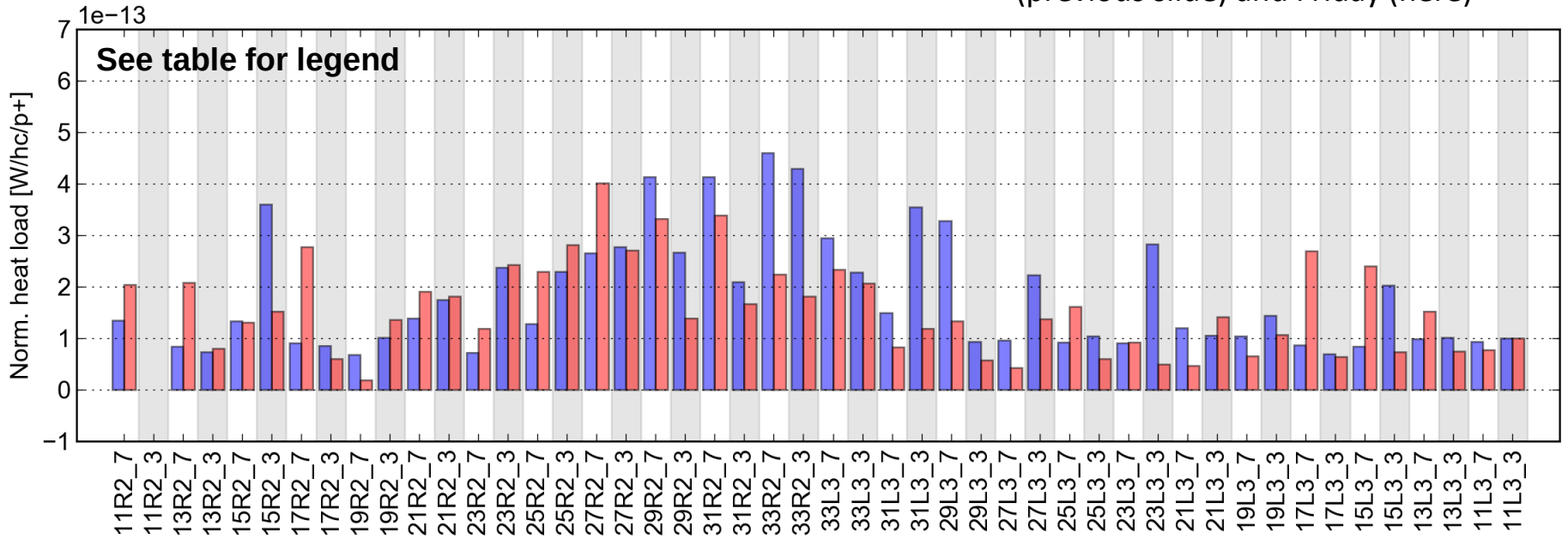


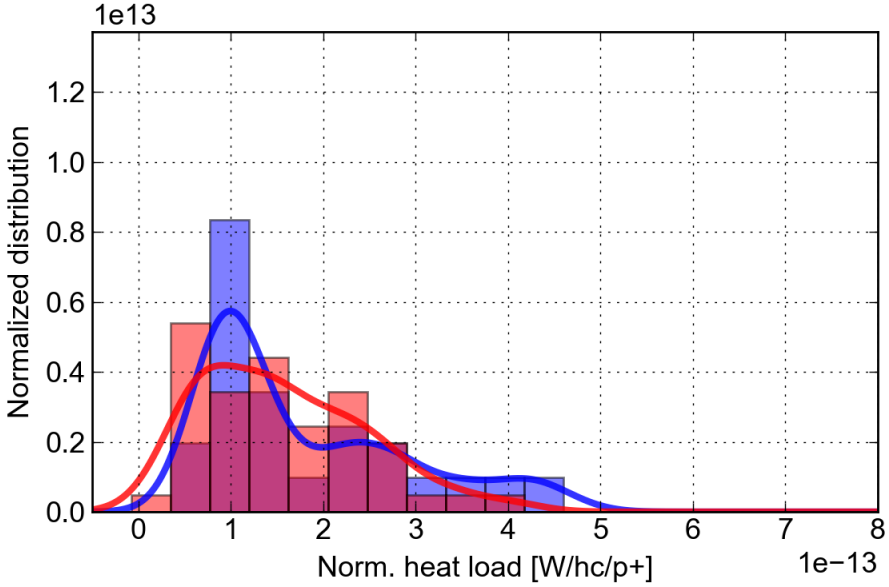


	B1 only	B2 only
Fill	5783	5784
Started on	08 Jun 2017 22:35	08 Jun 2017 23:48
T_sample [h]	0.92	0.55
Energy [GeV]	450	450
N_bunches (B1/B2)	2748/12	24/2760
Intensity (B1/B2) [p]	2.89e14/1.33e12	2.65e12/2.92e14
Bun.len. (B1/B2) [ns]	1.16/1.08	1.18/1.18
H.L. S23 (avg) [W]	53.94	50.08
H.L. S23 (std) [W]	30.43	27.47
H.L. exp. imped. [W]	3.29	3.29
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.50	0.14

Also for S23, the pattern is identical when comparing the fills from Thursday (previous slide) and Friday (here)

Sector 23, 48 cells, recalc. values

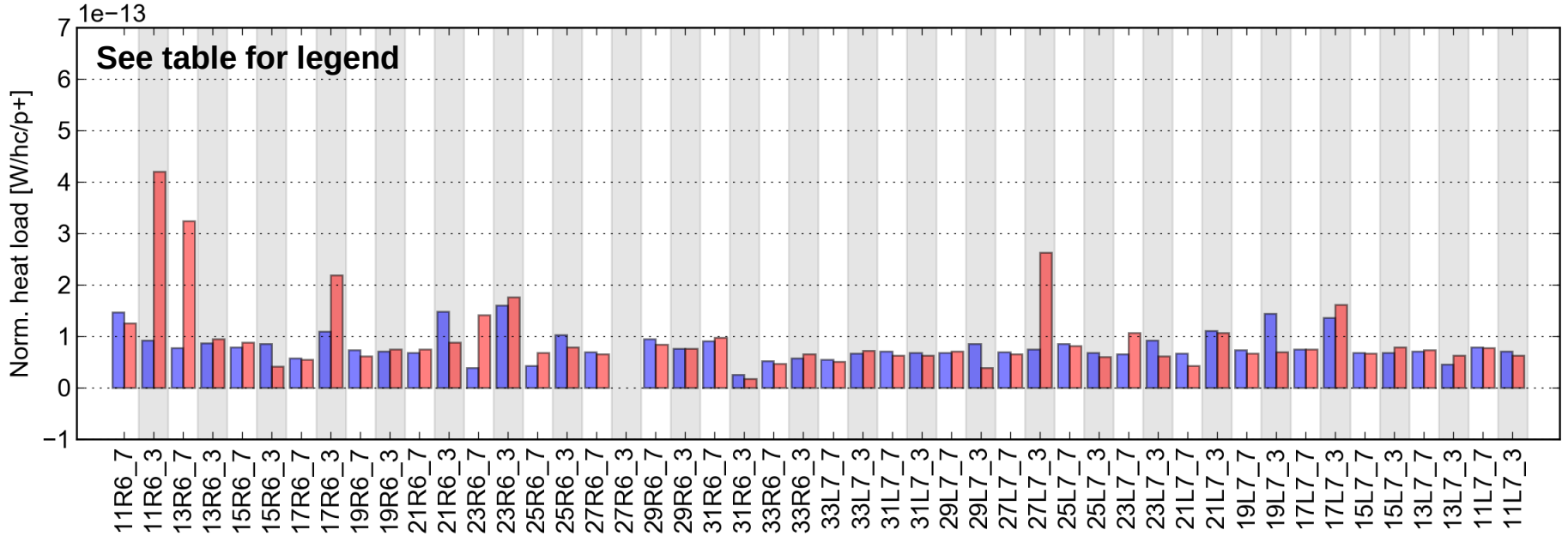


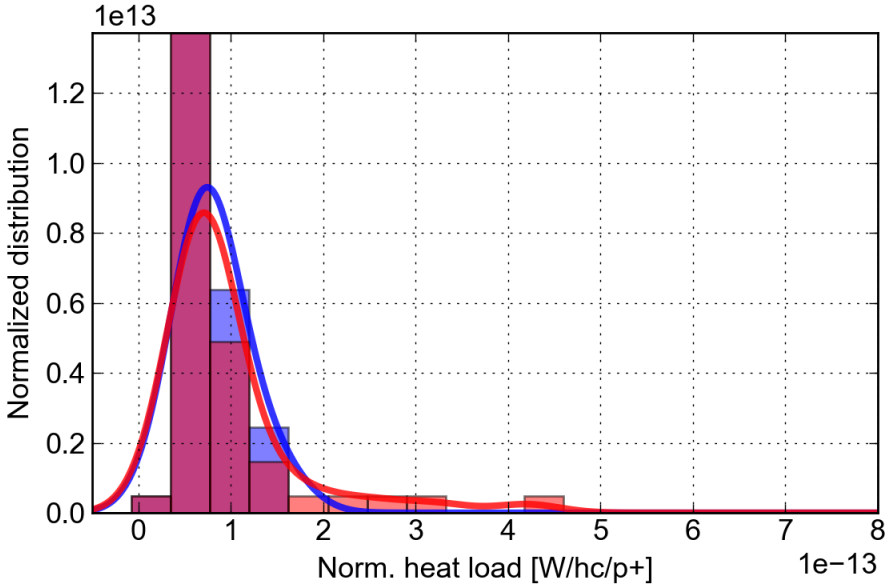


	B1 only	B2 only
Fill	5813	5812
Started on	11 Jun 2017 15:45	11 Jun 2017 13:22
T_sample [h]	1.45	0.90
Energy [GeV]	450	450
N_bunches (B1/B2)	2760/12	12/2760
Intensity (B1/B2) [p]	2.88e14/1.21e12	1.41e12/2.85e14
Bun.len. (B1/B2) [ns]	1.14/1.09	1.13/1.28
H.L. S23 (avg) [W]	52.43	44.86
H.L. S23 (std) [W]	32.17	25.27
H.L. exp. imped. [W]	3.33	2.77
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.90	0.30

A few outliers are present also in the low load sectors.

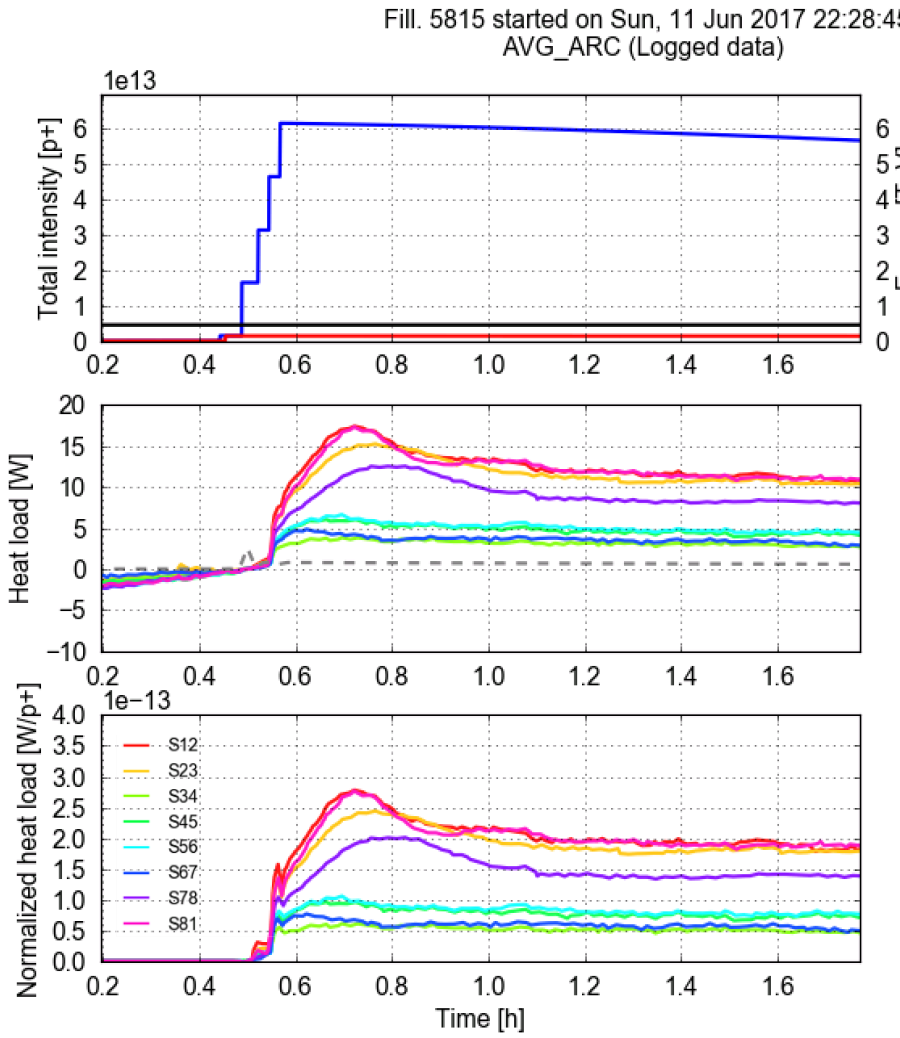
Sector 67, 48 cells, recalc. values

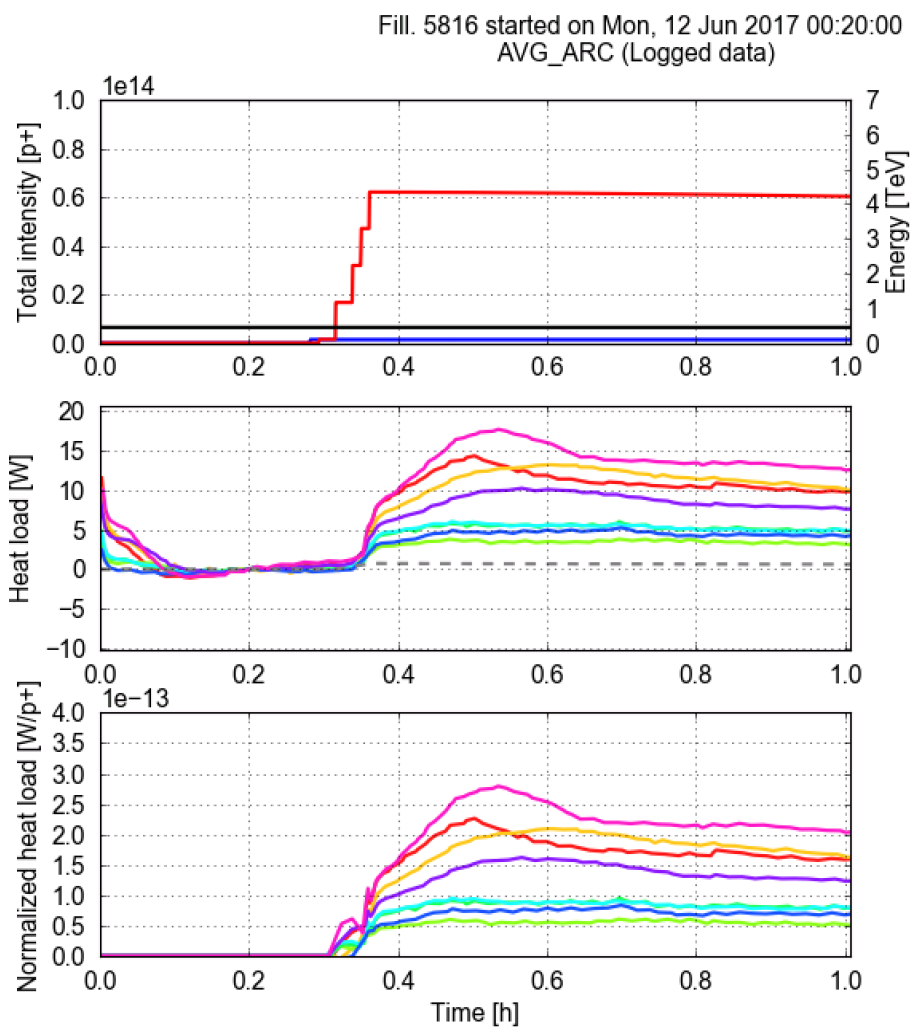




	B1 only	B2 only
Fill	5813	5812
Started on	11 Jun 2017 15:45	11 Jun 2017 13:22
T_sample [h]	1.45	0.90
Energy [GeV]	450	450
N_bunches (B1/B2)	2760/12	12/2760
Intensity (B1/B2) [p]	2.88e14/1.21e12	1.41e12/2.85e14
Bun.len. (B1/B2) [ns]	1.14/1.09	1.13/1.28
H.L. S67 (avg) [W]	23.39	27.63
H.L. S67 (std) [W]	8.20	21.05
H.L. exp. imped. [W]	3.33	2.77
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.90	0.30

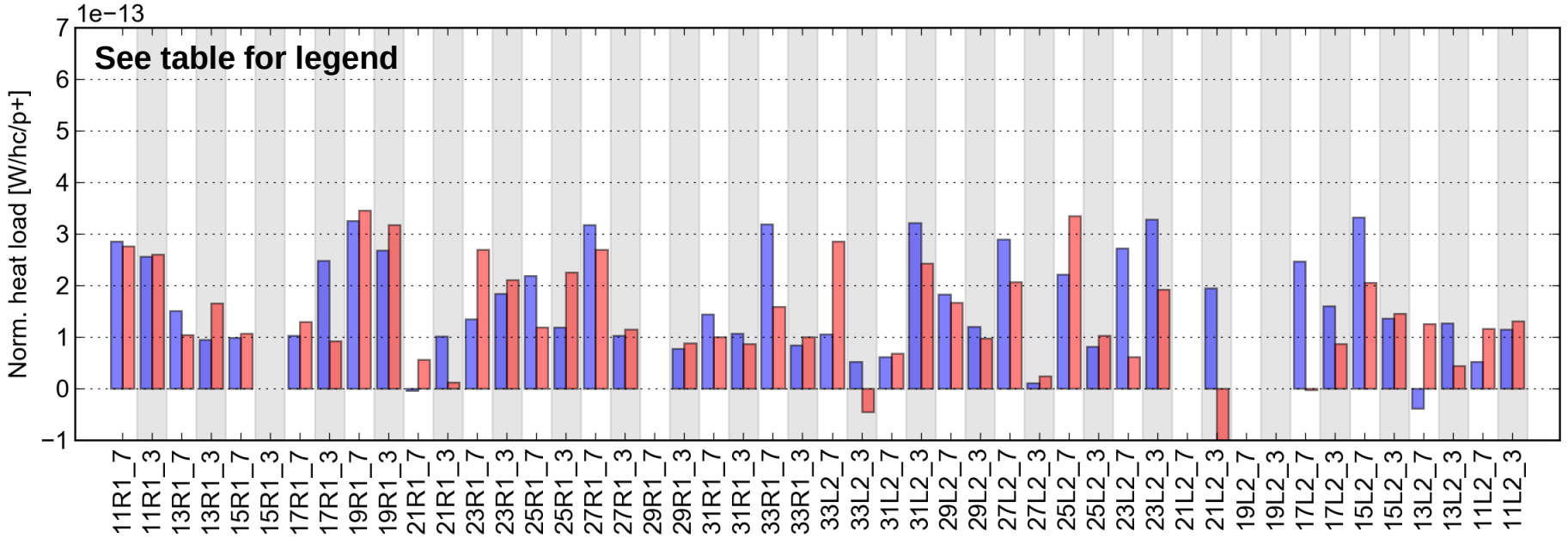
The B1vsB2 difference seems still visible a
when the test is made with 4x144b

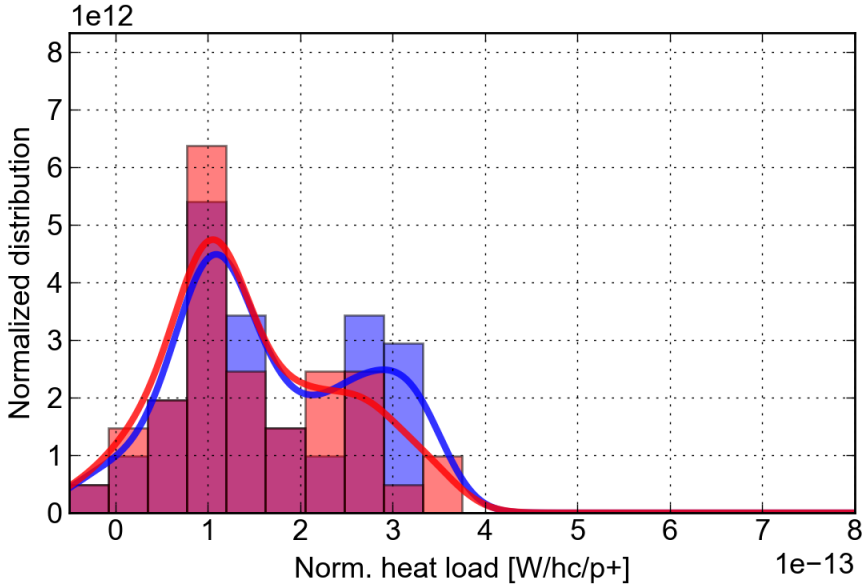




4x144b (S12)

Sector 12, 48 cells, recalc. values

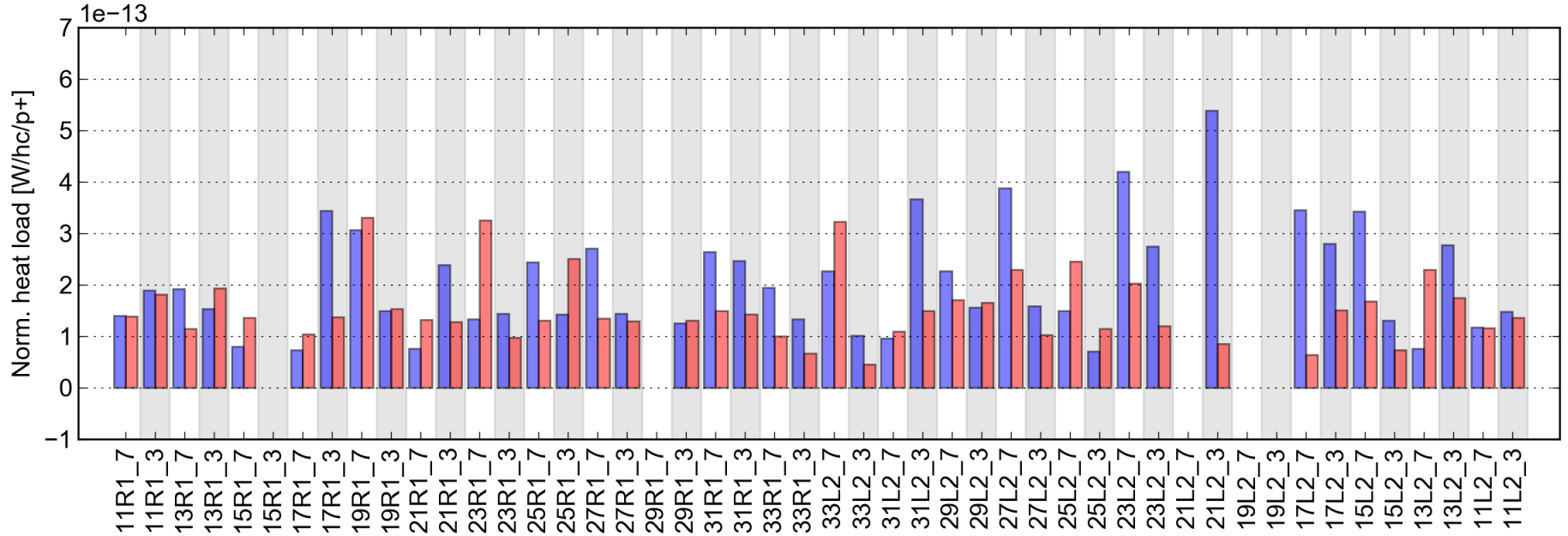


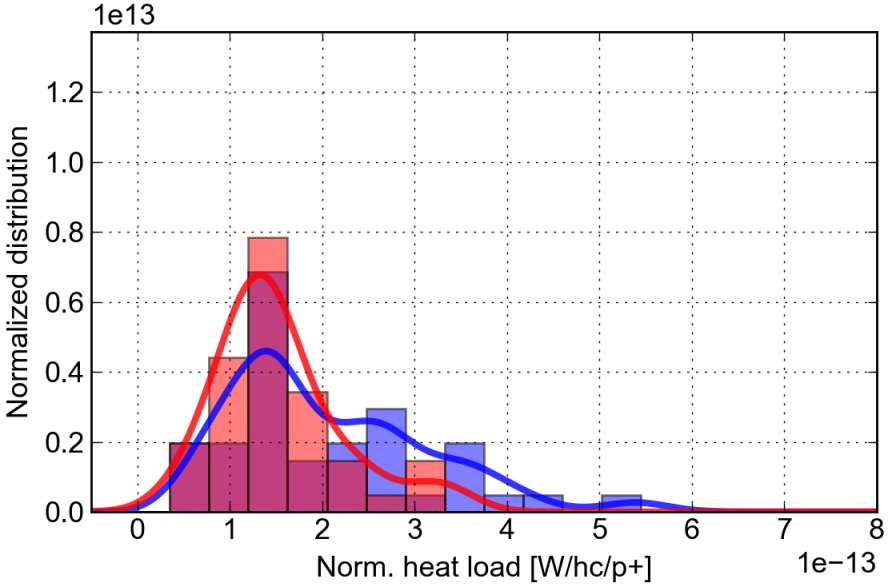


	B1 only	B2 only
Fill	5815	5816
Started on	11 Jun 2017 22:28	12 Jun 2017 00:20
T_sample [h]	1.50	0.90
Energy [GeV]	450	450
N_bunches (B1/B2)	588/12	12/588
Intensity (B1/B2) [p]	5.81e13/1.35e12	1.40e12/6.07e13
Bun.len. (B1/B2) [ns]	1.18/1.15	1.13/1.22
H.L. S12 (avg) [W]	9.84	8.73
H.L. S12 (std) [W]	5.90	6.46
H.L. exp. imped. [W]	0.62	0.64
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.40	0.20

Full beam with trains of 288b (S12)

Sector 12, 48 cells, recalc. values

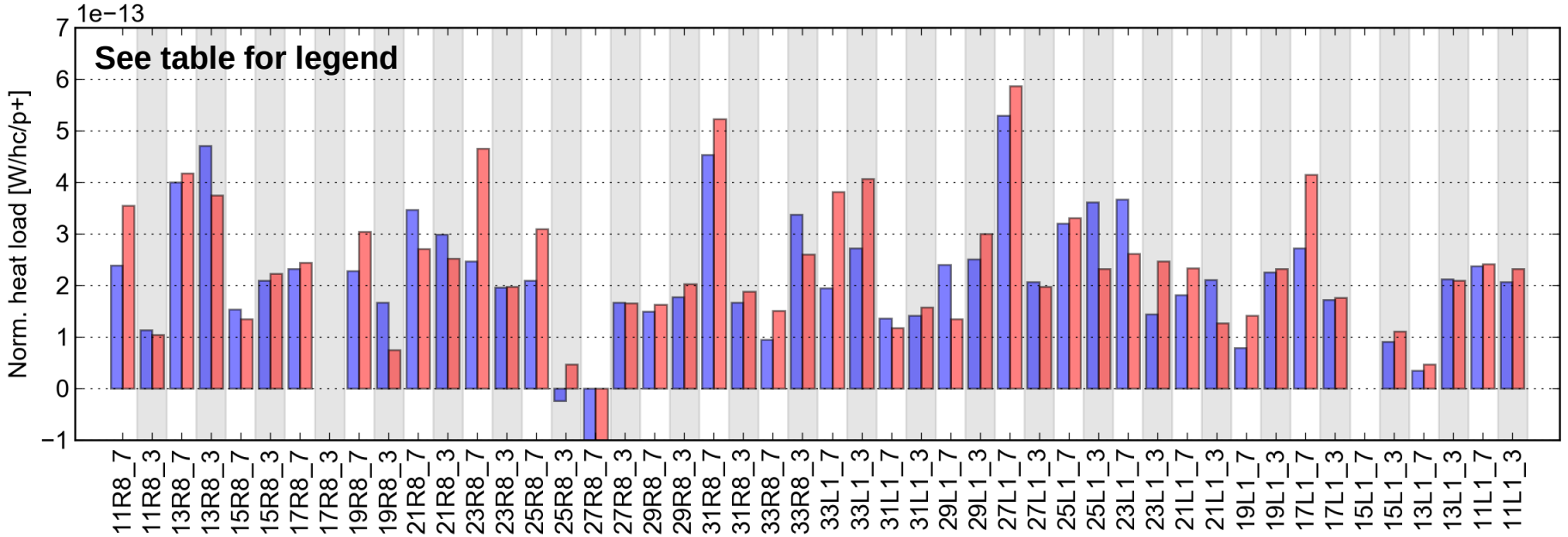


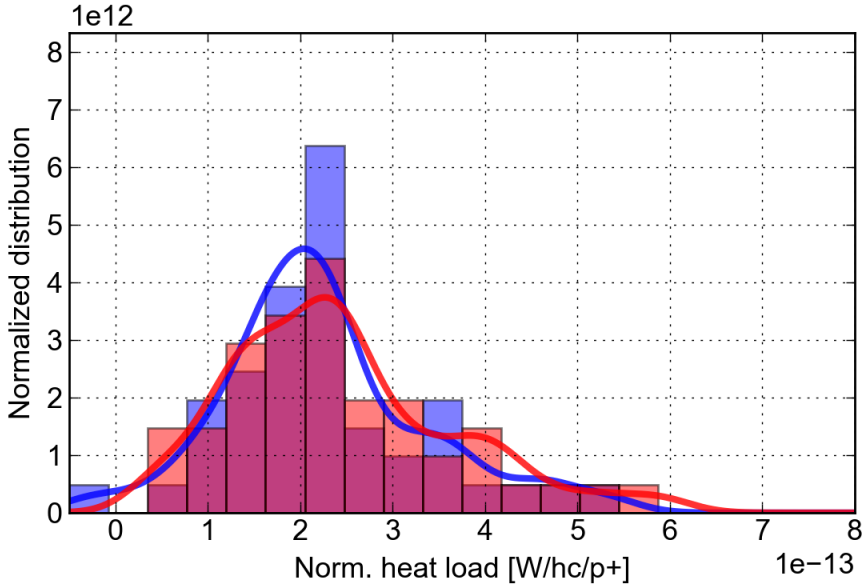


	B1 only	B2 only
Fill	5813	5812
Started on	11 Jun 2017 15:45	11 Jun 2017 13:22
T_sample [h]	1.45	0.90
Energy [GeV]	450	450
N_bunches (B1/B2)	2760/12	12/2760
Intensity (B1/B2) [p]	2.88e14/1.21e12	1.41e12/2.85e14
Bun.len. (B1/B2) [ns]	1.14/1.09	1.13/1.28
H.L. S12 (avg) [W]	59.86	43.93
H.L. S12 (std) [W]	30.68	18.79
H.L. exp. imped. [W]	3.33	2.77
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.90	0.30

4x144b (S12)

Sector 81, 48 cells, recalc. values

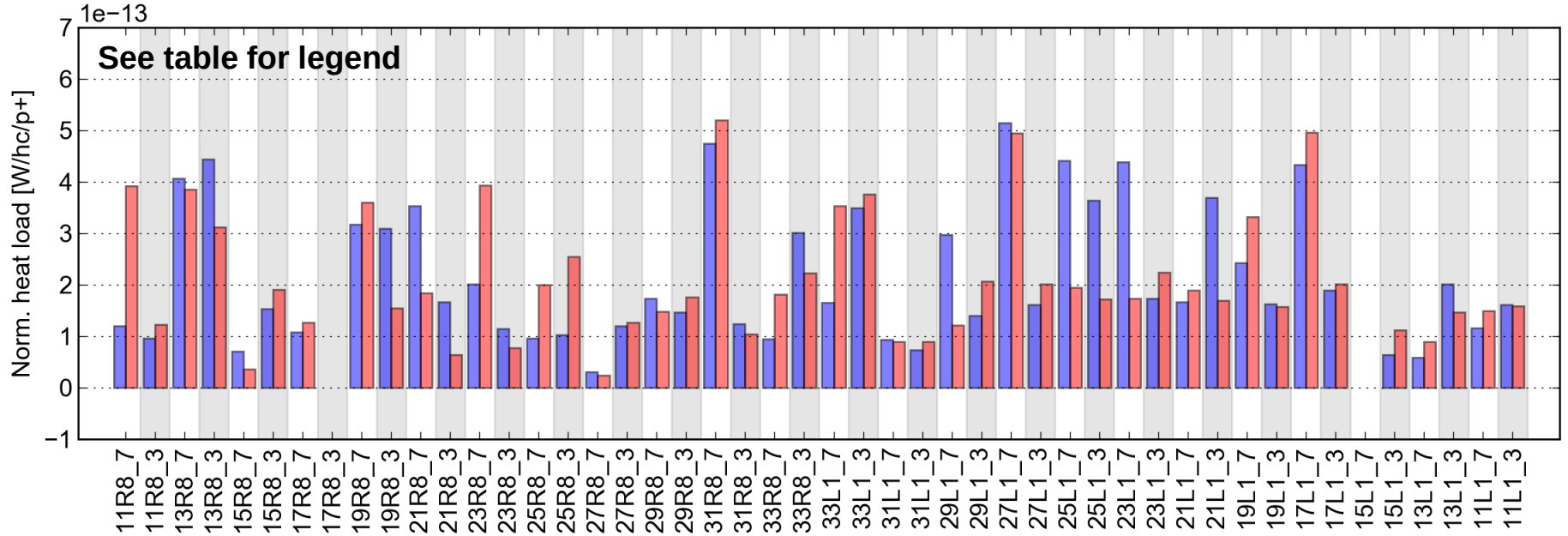


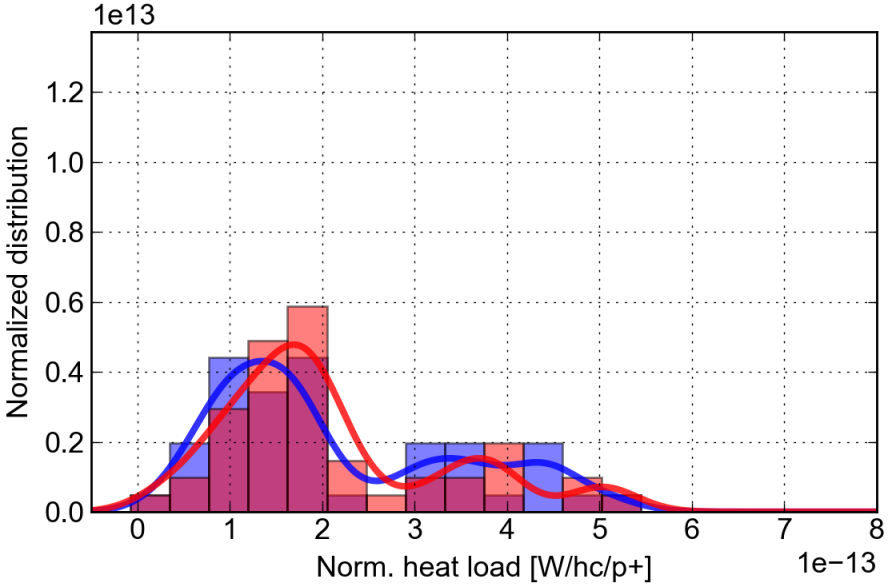


	B1 only	B2 only
Fill	5815	5816
Started on	11 Jun 2017 22:28	12 Jun 2017 00:20
T_sample [h]	1.50	0.90
Energy [GeV]	450	450
N_bunches (B1/B2)	588/12	12/588
Intensity (B1/B2) [p]	5.81e13/1.35e12	1.40e12/6.07e13
Bun.len. (B1/B2) [ns]	1.18/1.15	1.13/1.22
H.L. S81 (avg) [W]	12.87	14.59
H.L. S81 (std) [W]	7.32	8.23
H.L. exp. imped. [W]	0.62	0.64
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.40	0.20

4x144b (S81)

Sector 81, 48 cells, recalc. values

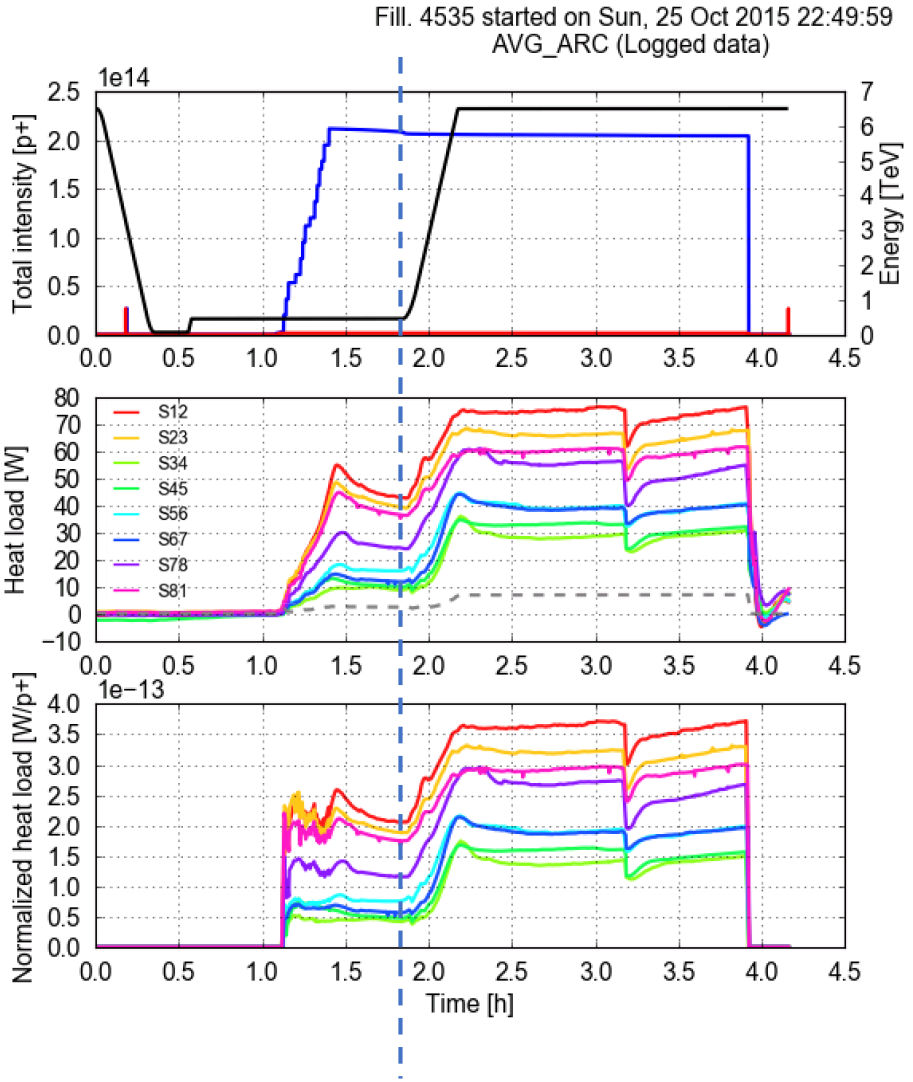


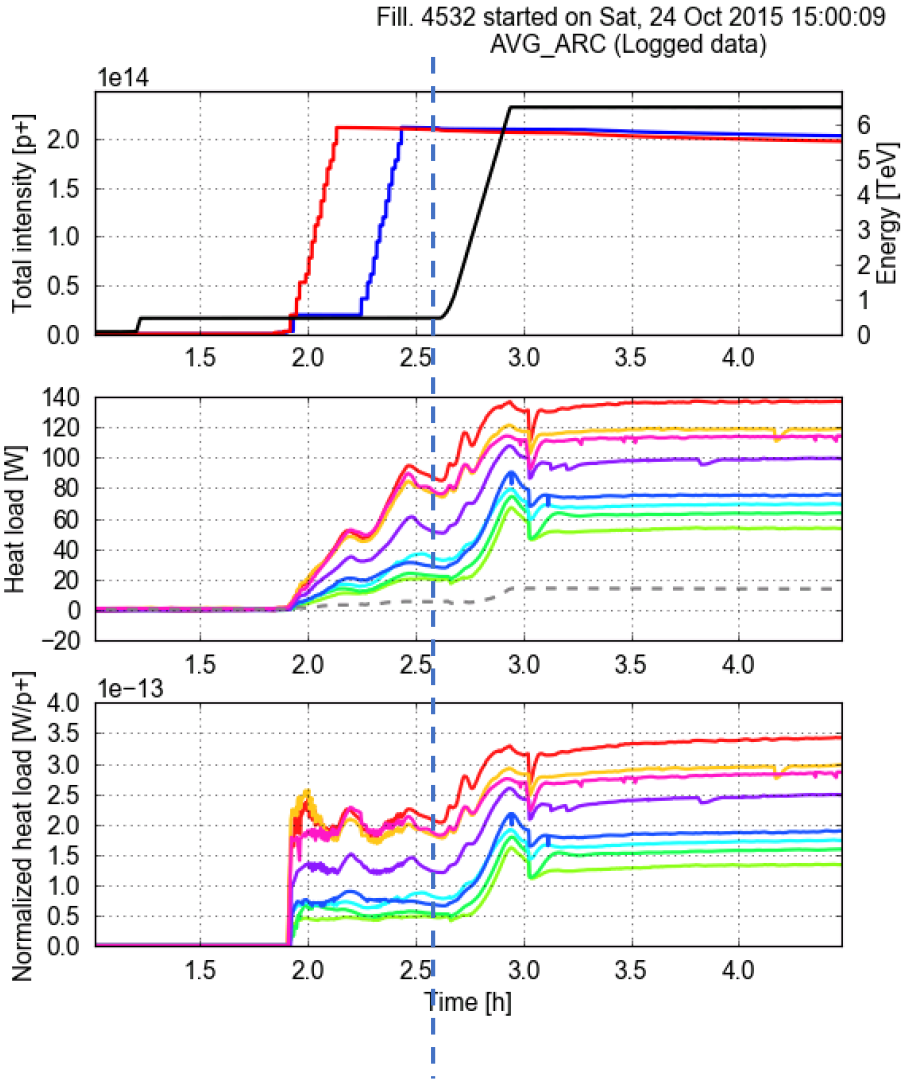


	B1 only	B2 only
Fill	5813	5812
Started on	11 Jun 2017 15:45	11 Jun 2017 13:22
T_sample [h]	1.45	0.90
Energy [GeV]	450	450
N_bunches (B1/B2)	2760/12	12/2760
Intensity (B1/B2) [p]	2.88e14/1.21e12	1.41e12/2.85e14
Bun.len. (B1/B2) [ns]	1.14/1.09	1.13/1.28
H.L. S81 (avg) [W]	62.42	60.14
H.L. S81 (std) [W]	38.09	34.81
H.L. exp. imped. [W]	3.33	2.77
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.90	0.30

Observations from 2015

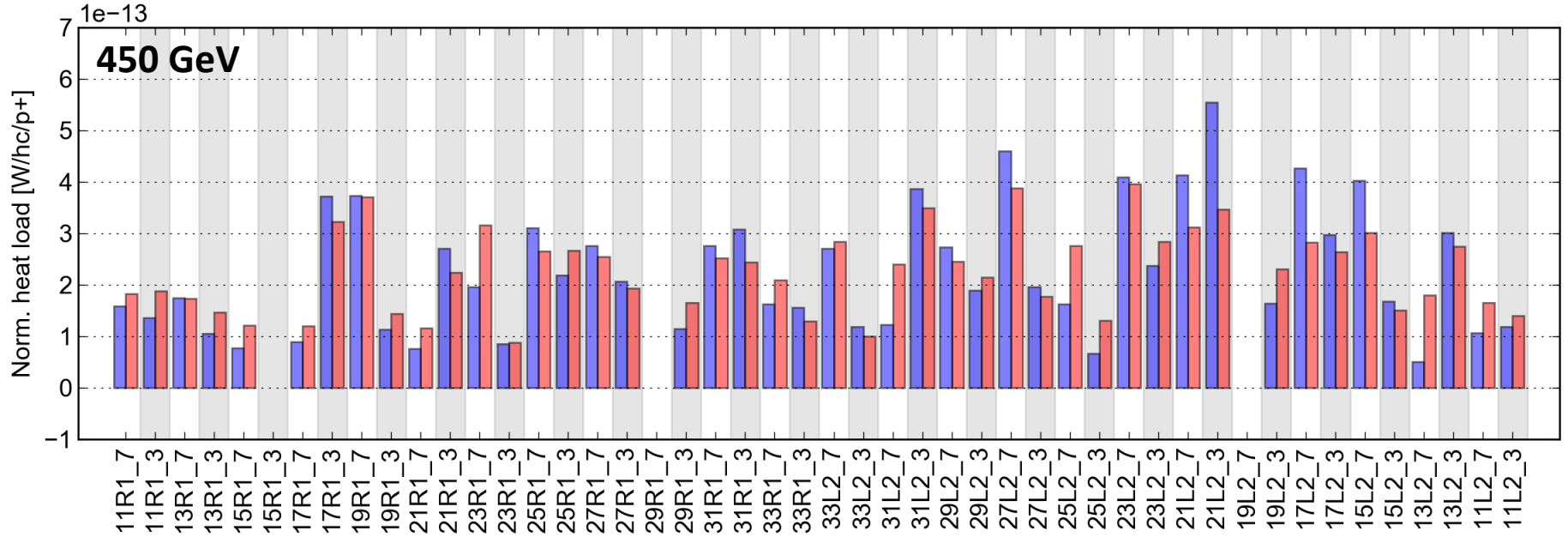
Data from 2015: we don't have a fill with B2 only. We compare B1 only with a similar physics fill.
Normalized heat loads look very similar

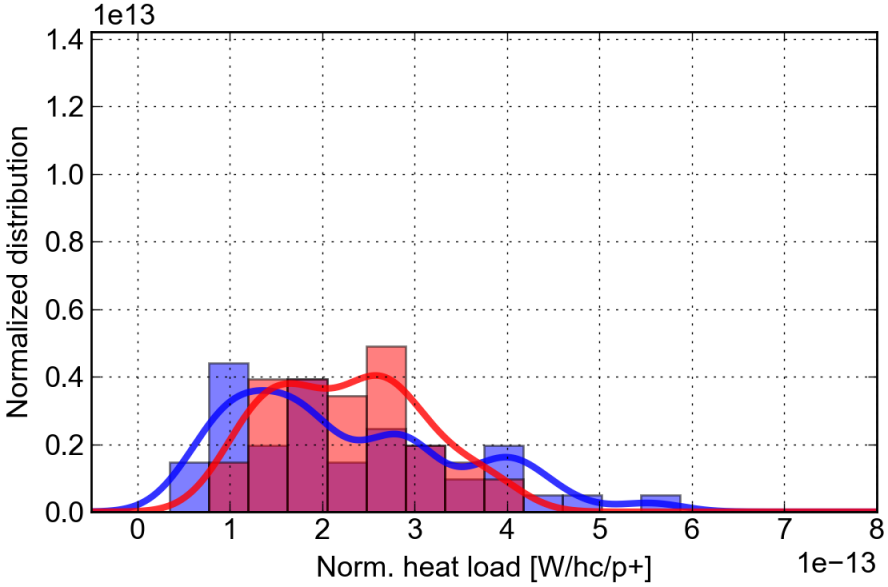




Data from 2015: few outliers in the cell-by-cell plots

Sector 12, 48 cells, recalc. values

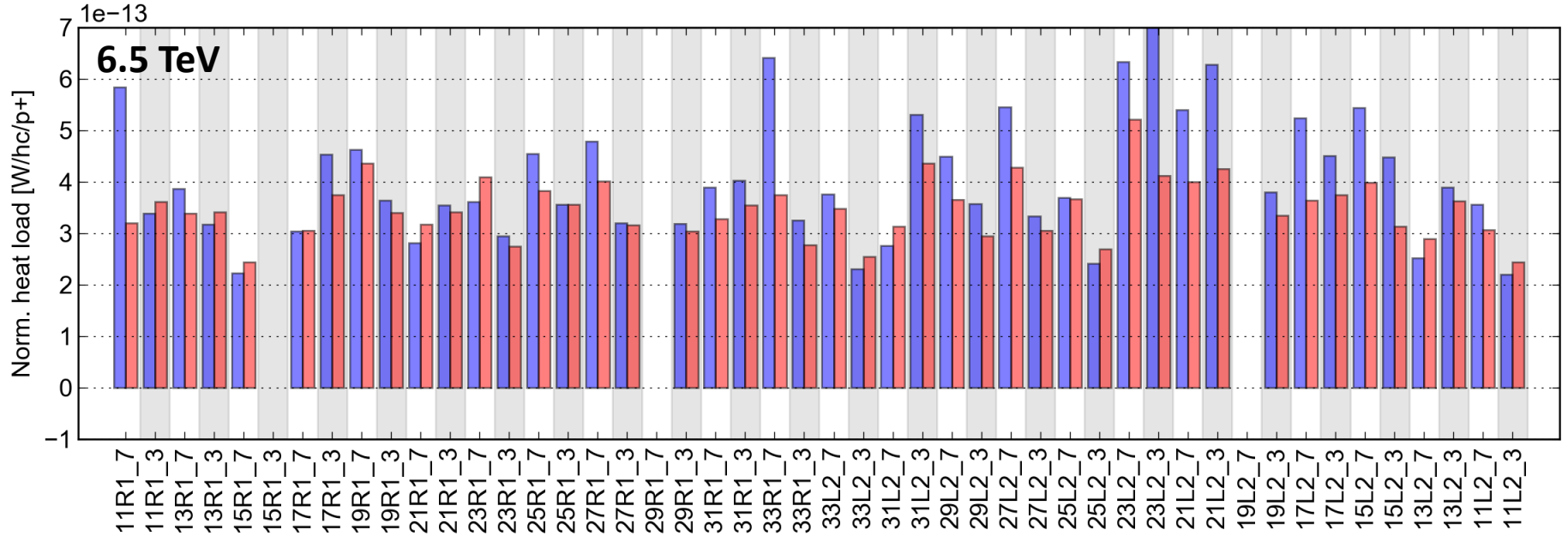


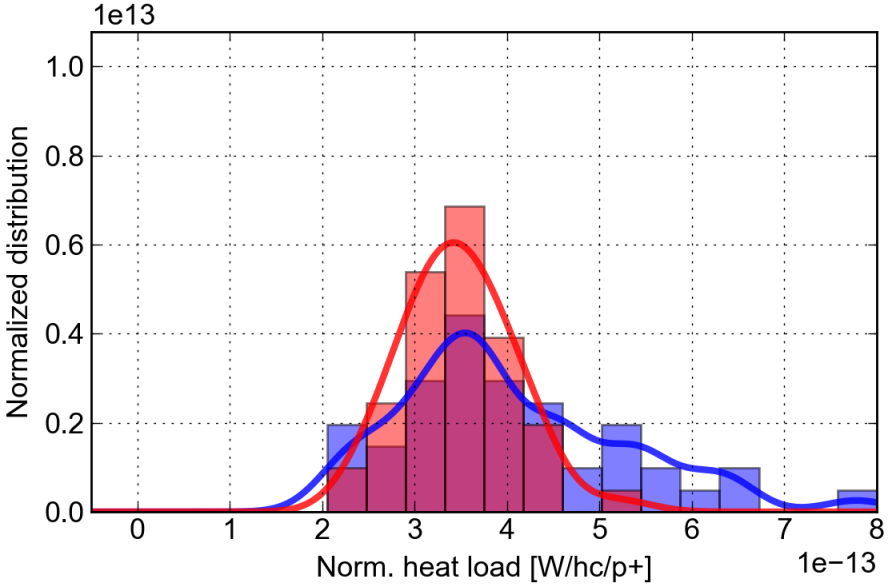


	B1 only	B1 and B2
Fill	4535	4532
Started on	25 Oct 2015 22:49	24 Oct 2015 15:00
T_sample [h]	1.75	2.60
Energy [GeV]	450	450
N_bunches (B1/B2)	1825/12	1825/1824
Intensity (B1/B2) [p]	2.09e14/1.38e12	2.11e14/2.09e14
Bun.len. (B1/B2) [ns]	1.21/1.22	1.16/1.23
H.L. S12 (avg) [W]	47.61	95.53
H.L. S12 (std) [W]	25.77	33.77
H.L. exp. imped. [W]	2.45	5.00
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.50	1.50

Data from 2015: few outliers in the cell-by-cell plots

Sector 12, 48 cells, recalc. values

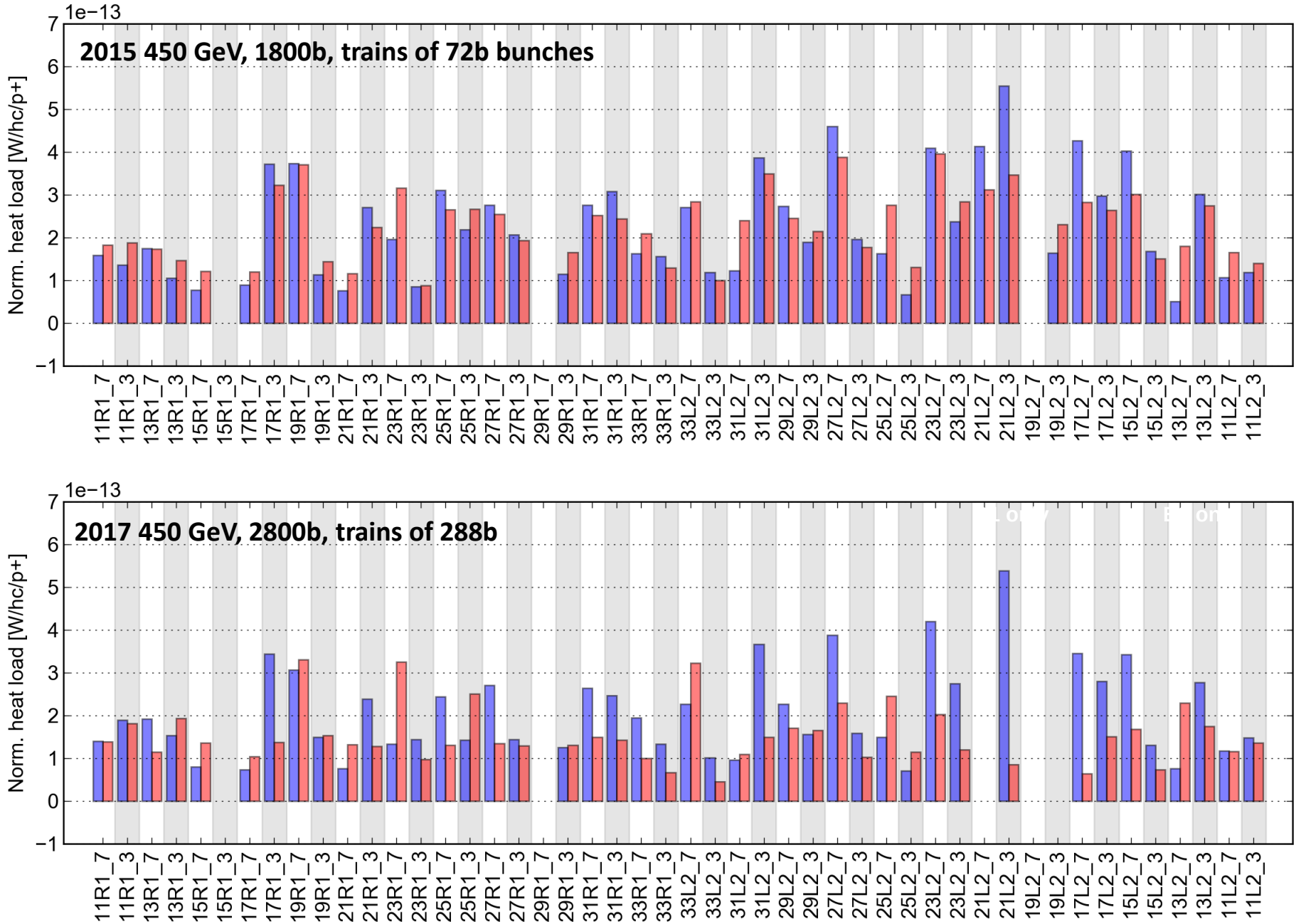




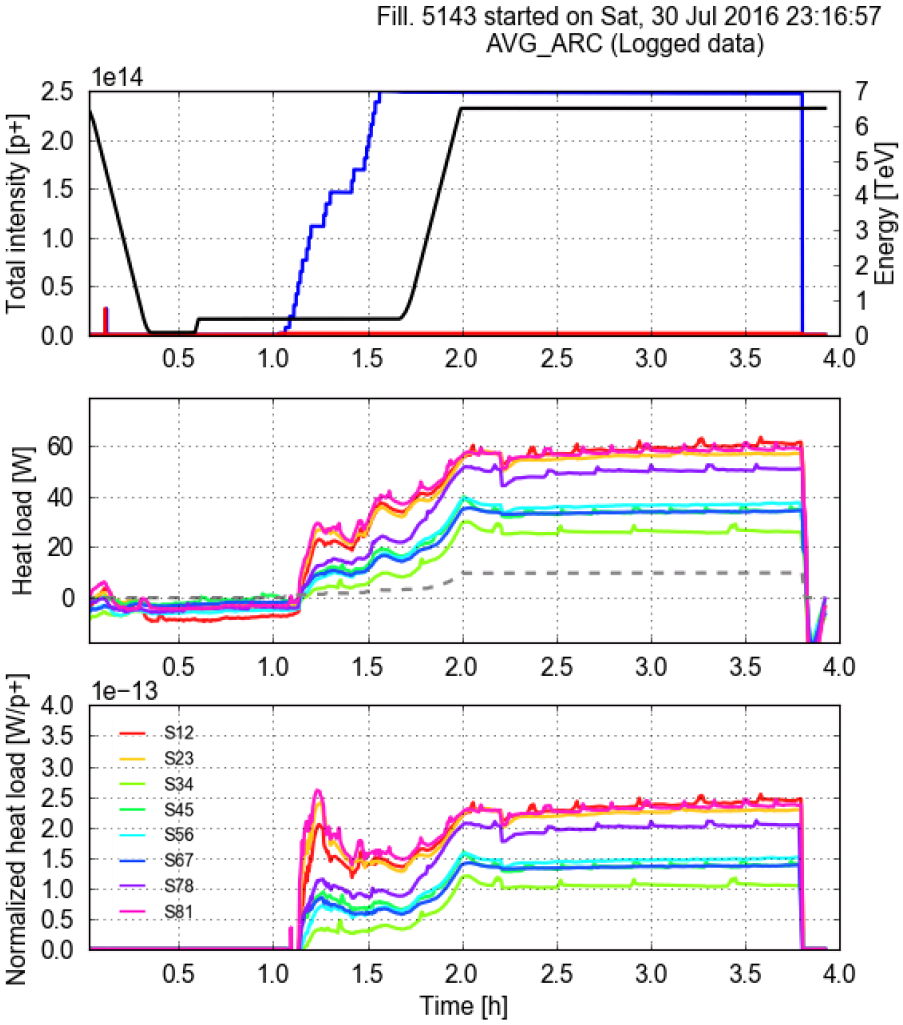
	B1 only	B1 and B2
Fill	4535	4532
Started on	25 Oct 2015 22:49	24 Oct 2015 15:00
T_sample [h]	2.70	3.20
Energy [GeV]	6500	6500
N_bunches (B1/B2)	1825/12	1825/1824
Intensity (B1/B2) [p]	2.05e14/1.37e12	2.09e14/2.06e14
Bun.len. (B1/B2) [ns]	1.31/1.31	1.30/1.35
H.L. S12 (avg) [W]	83.88	144.17
H.L. S12 (std) [W]	25.62	23.55
H.L. exp. imped. [W]	2.54	5.05
H.L. exp. synrad [W]	4.40	8.83
T_nobeam [h]	0.50	1.50

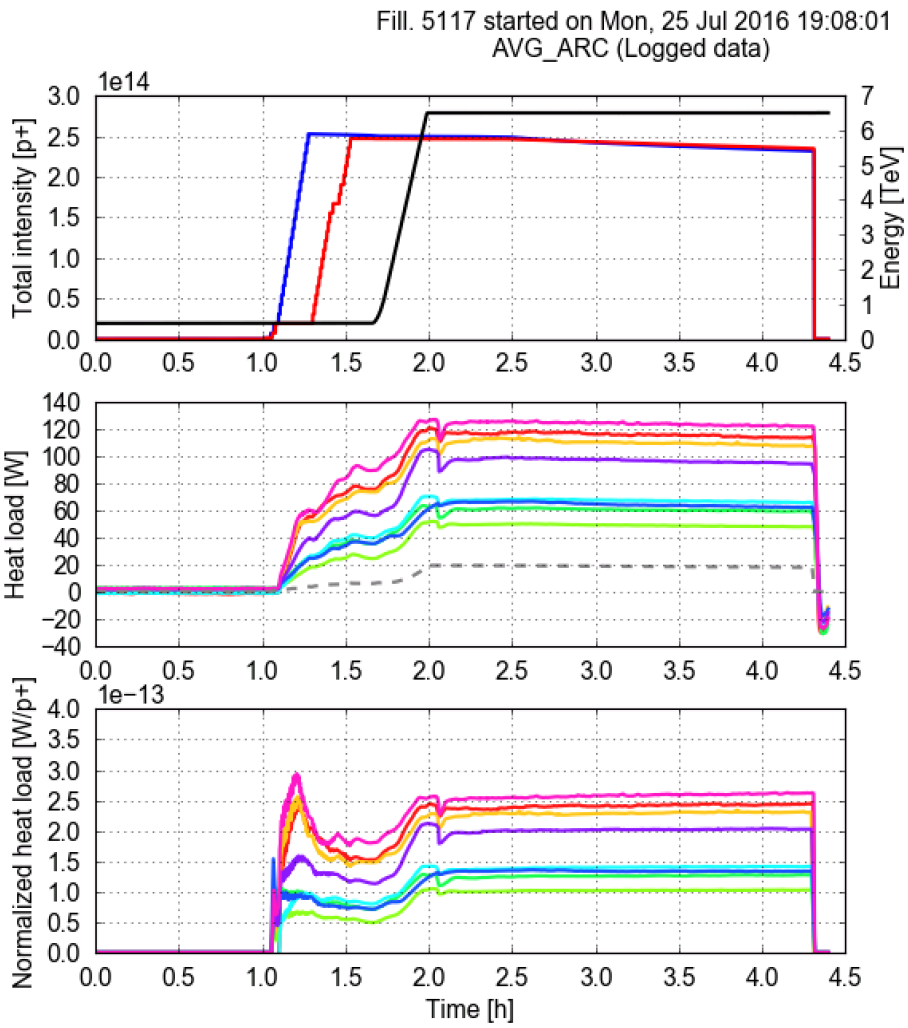
Comparison 2015 vs 2017

Sector 12, 48 cells, recalc. values



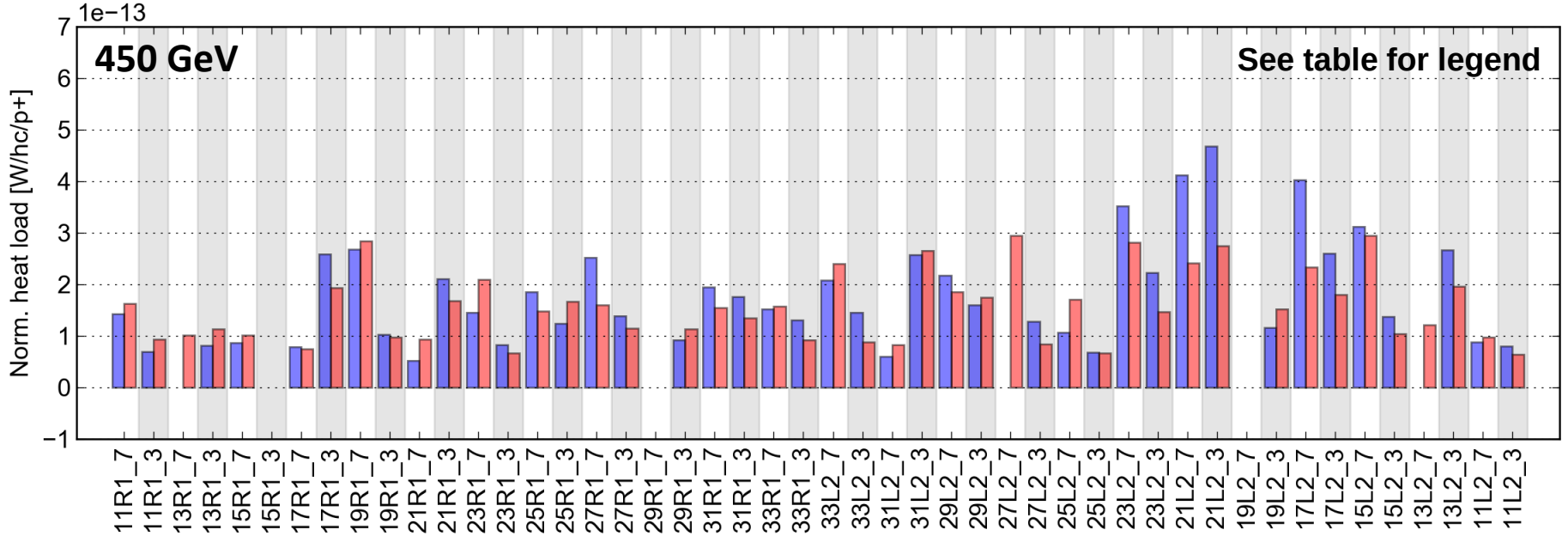
Data from 2015: we don't have a fill with B2 only. We compare B1 only with a similar physics fill.
Normalized heat loads look very similar

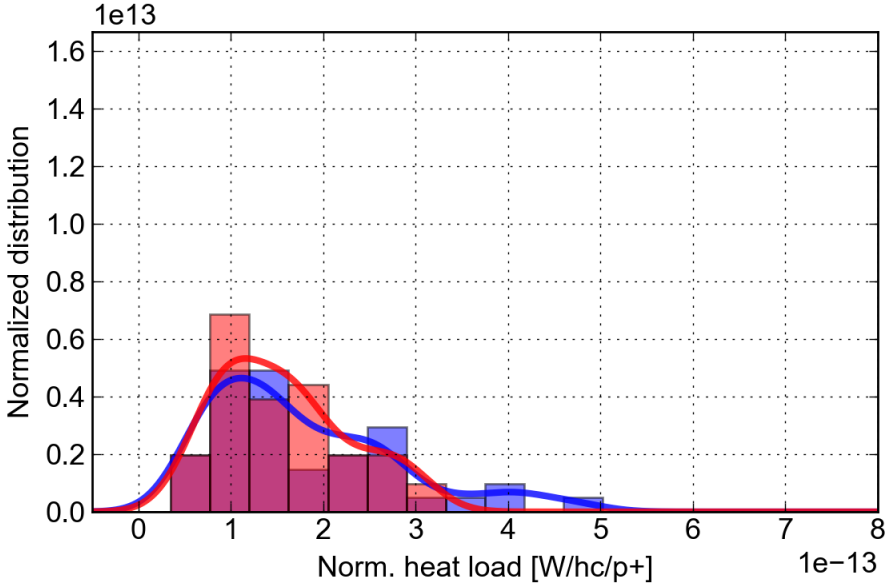




Data from 2016: apart from few outliers the data from one and two beams are strongly correlated

Sector 12, 48 cells, recalc. values

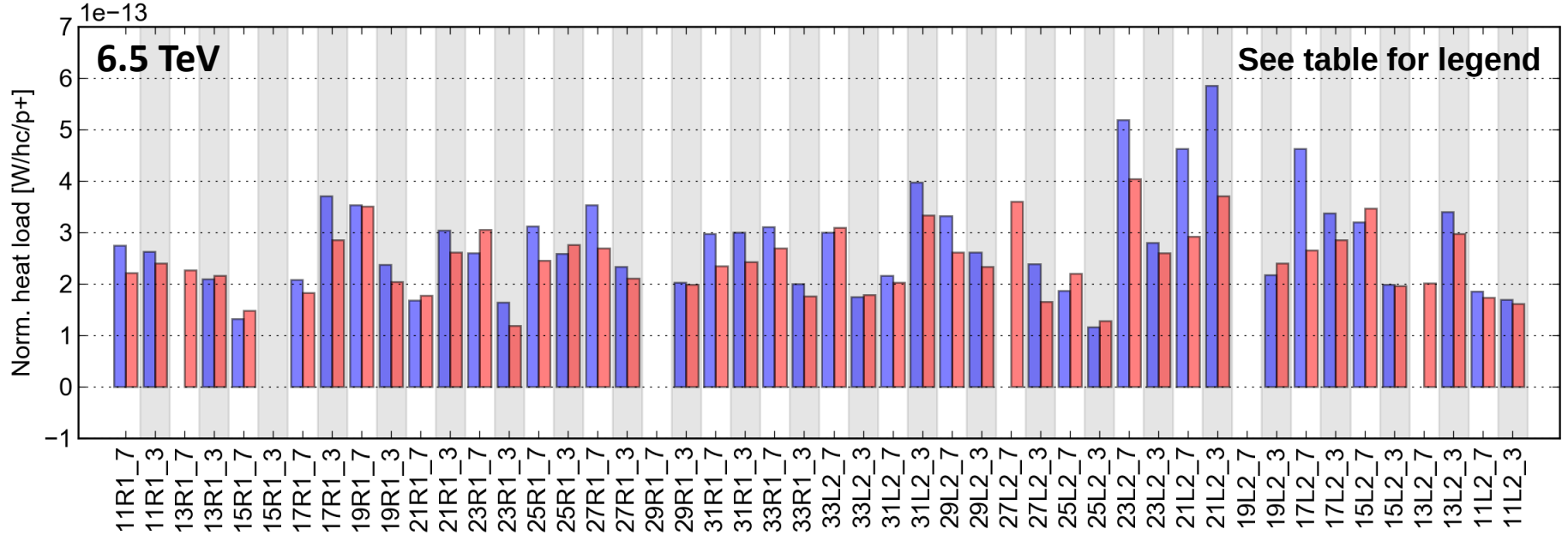


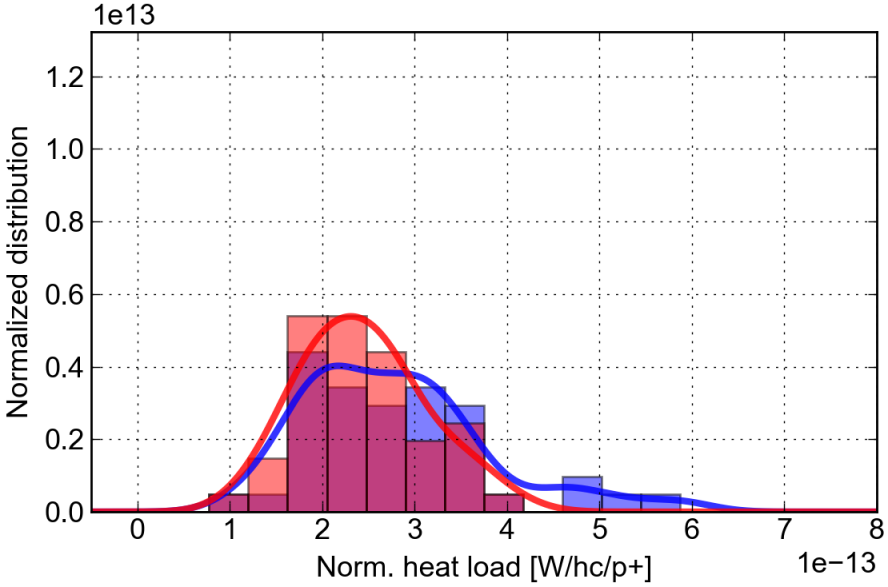


	B1 only	B1 and B2
Fill	5143	5117
Started on	30 Jul 2016 23:16	25 Jul 2016 19:08
T_sample [h]	1.65	1.65
Energy [GeV]	450	450
N_bunches (B1/B2)	2076/12	2076/2076
Intensity (B1/B2) [p]	2.50e14/1.37e12	2.51e14/2.47e14
Bun.len. (B1/B2) [ns]	1.23/1.15	1.22/1.22
H.L. S12 (avg) [W]	44.86	78.06
H.L. S12 (std) [W]	25.35	33.63
H.L. exp. imped. [W]	2.99	5.96
H.L. exp. synrad [W]	0.00	0.00
T_nobeam [h]	0.70	0.50

Data from 2016: apart from few outliers the data from one and two beams are strongly correlated

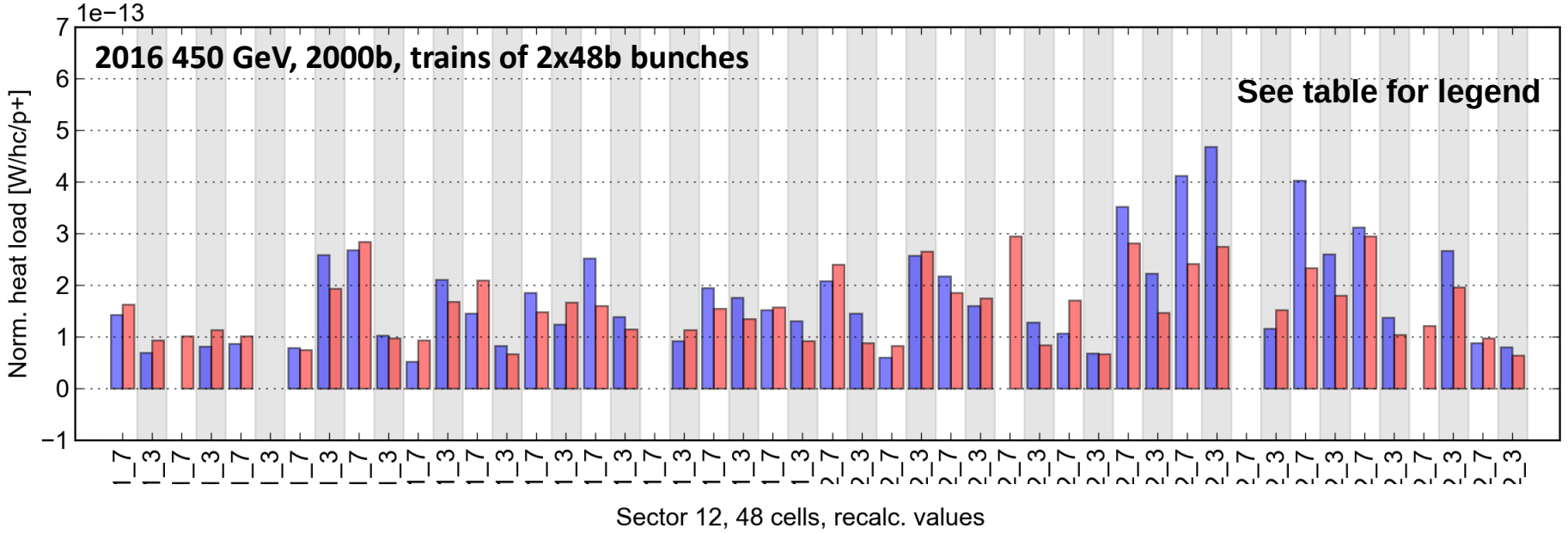
Sector 12, 48 cells, recalc. values

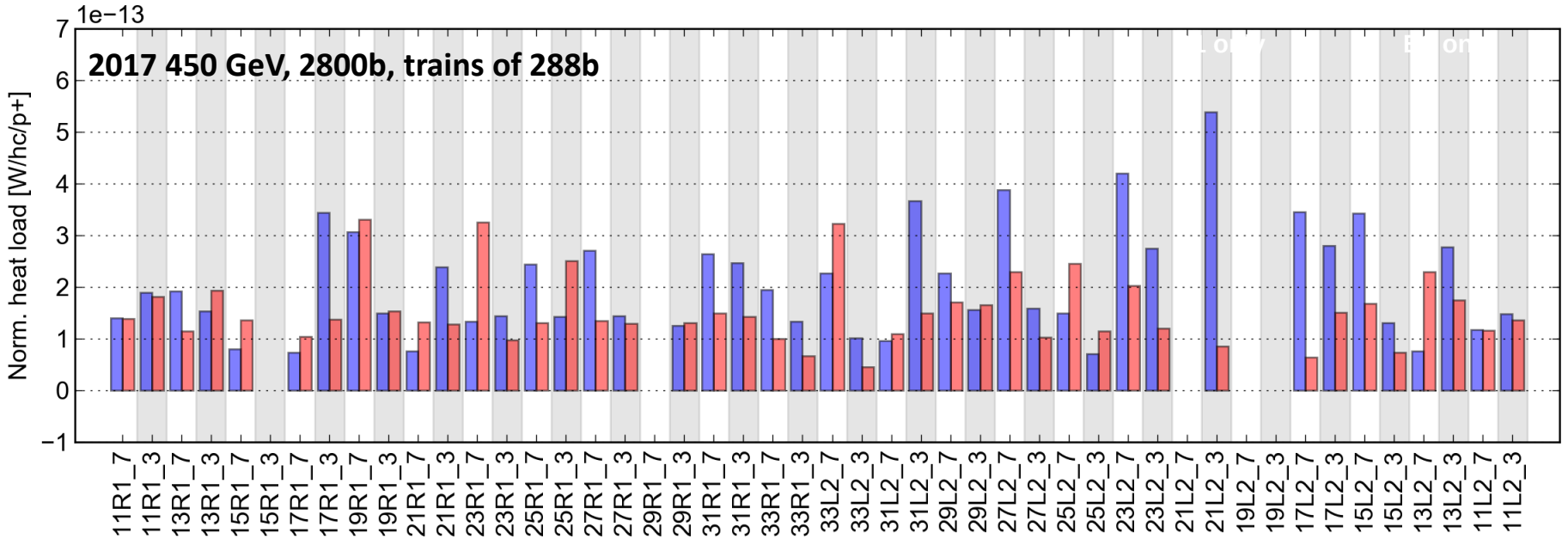




	B1 only	B1 and B2
Fill	5143	5117
Started on	30 Jul 2016 23:16	25 Jul 2016 19:08
T_sample [h]	2.50	2.45
Energy [GeV]	6500	6500
N_bunches (B1/B2)	2076/12	2076/2076
Intensity (B1/B2) [p]	2.48e14/1.37e12	2.49e14/2.46e14
Bun.len. (B1/B2) [ns]	1.07/1.06	1.06/1.07
H.L. S12 (avg) [W]	69.67	120.59
H.L. S12 (std) [W]	25.07	32.32
H.L. exp. imped. [W]	4.41	8.77
H.L. exp. synrad [W]	5.31	10.54
T_nobeam [h]	0.70	0.50

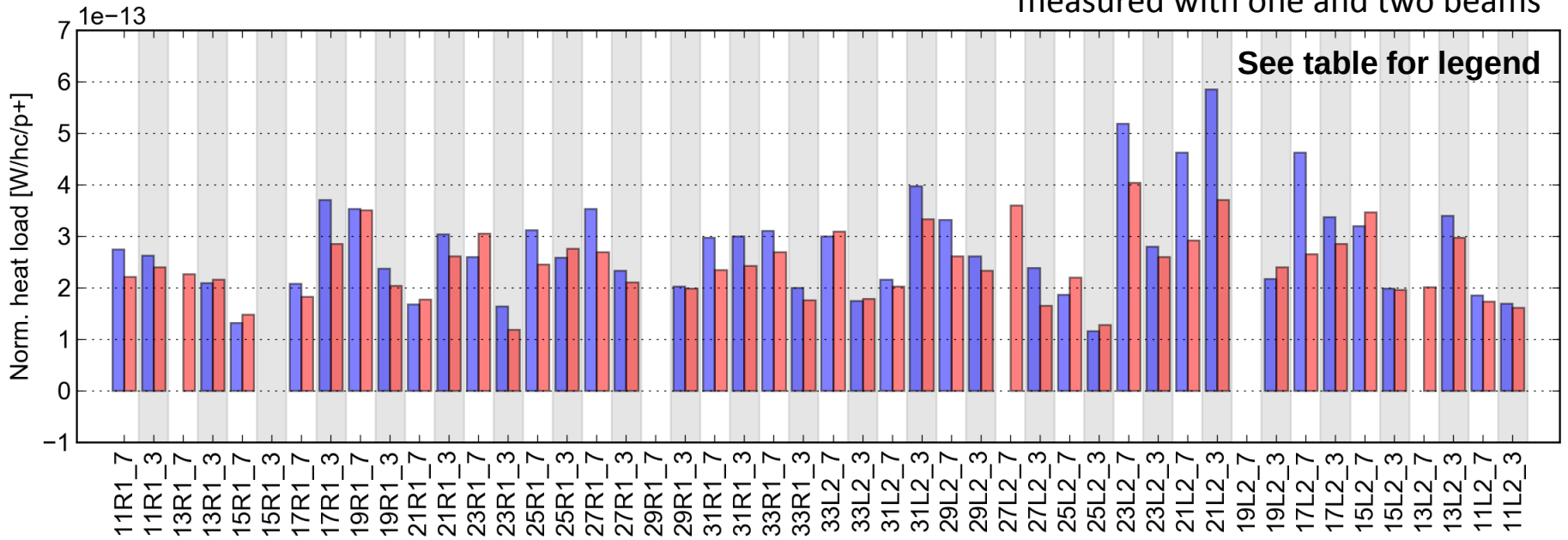
Comparison 2016 vs 2017

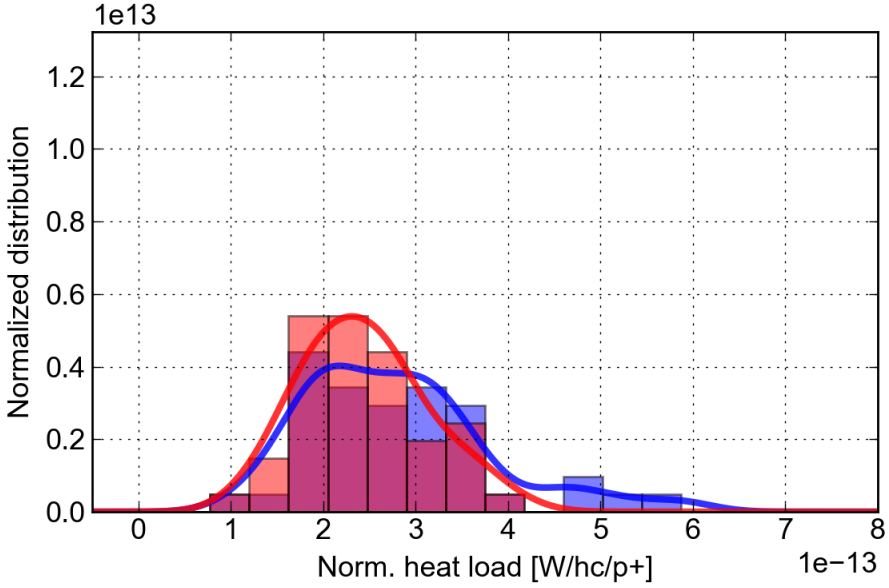




Sector 12, 48 cells, recalc. values

Apart from few outliers there is strong correlations between heat loads measured with one and two beams

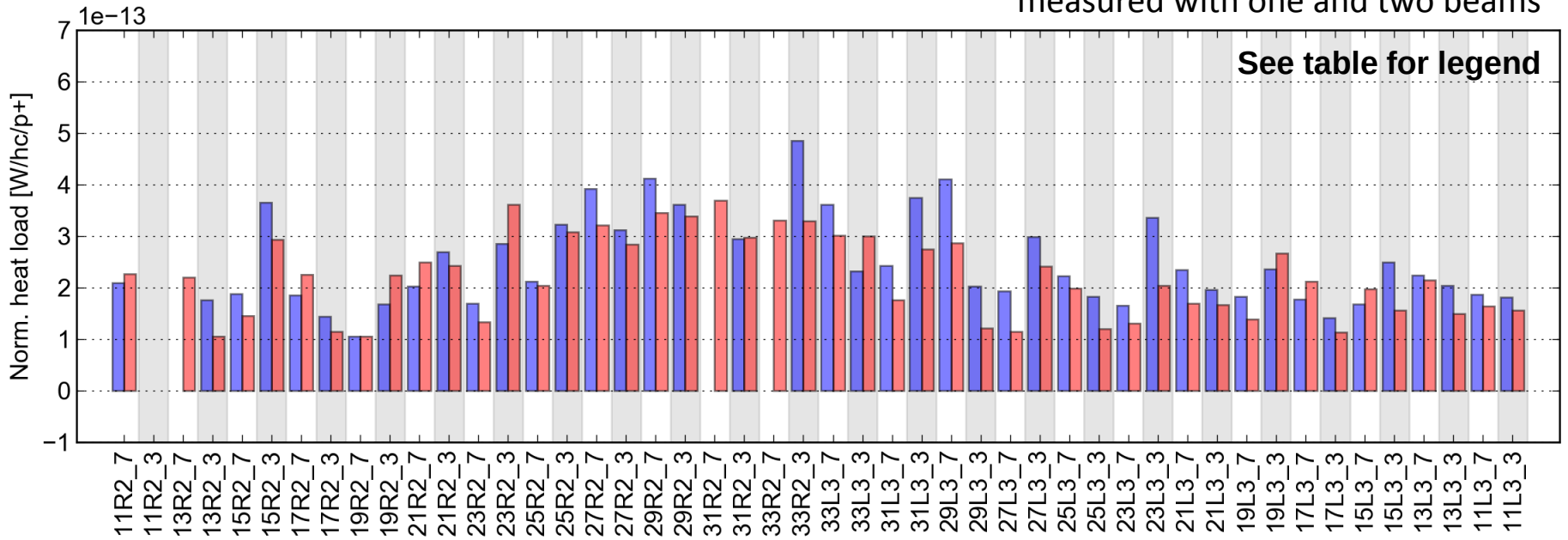


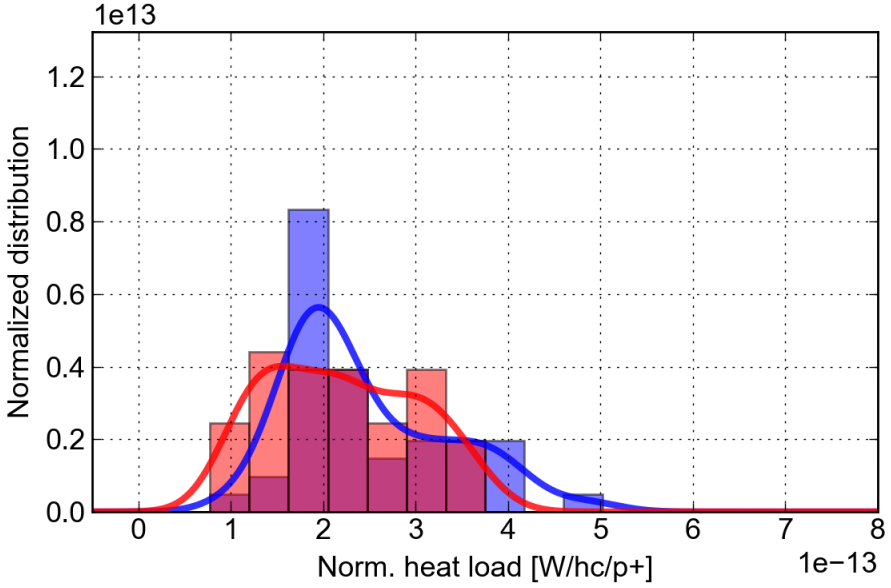


	B1 only	B1 and B2
Fill	5143	5117
Started on	30 Jul 2016 23:16	25 Jul 2016 19:08
T_sample [h]	2.50	2.45
Energy [GeV]	6500	6500
N_bunches (B1/B2)	2076/12	2076/2076
Intensity (B1/B2) [p]	2.48e14/1.37e12	2.49e14/2.46e14
Bun.len. (B1/B2) [ns]	1.07/1.06	1.06/1.07
H.L. S12 (avg) [W]	69.67	120.59
H.L. S12 (std) [W]	25.07	32.32
H.L. exp. imped. [W]	4.41	8.77
H.L. exp. synrad [W]	5.31	10.54
T_nobeam [h]	0.70	0.50

Sector 23, 48 cells, recalc. values

Apart from few outliers there is strong correlations between heat loads measured with one and two beams

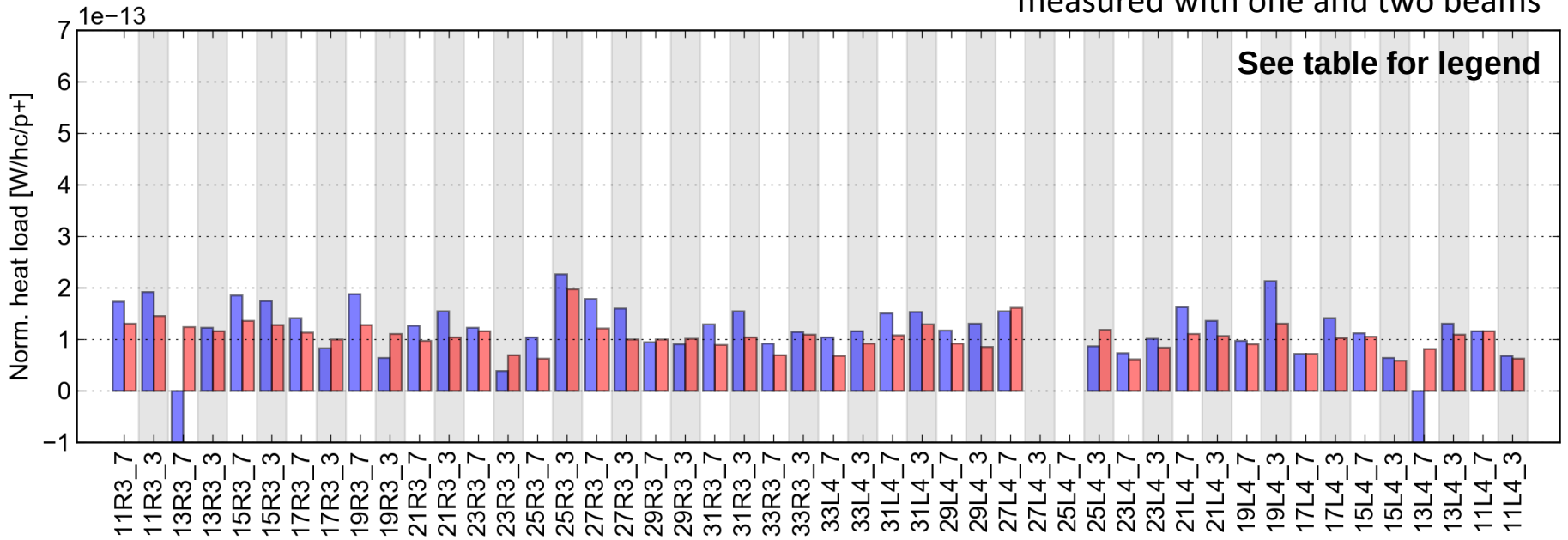


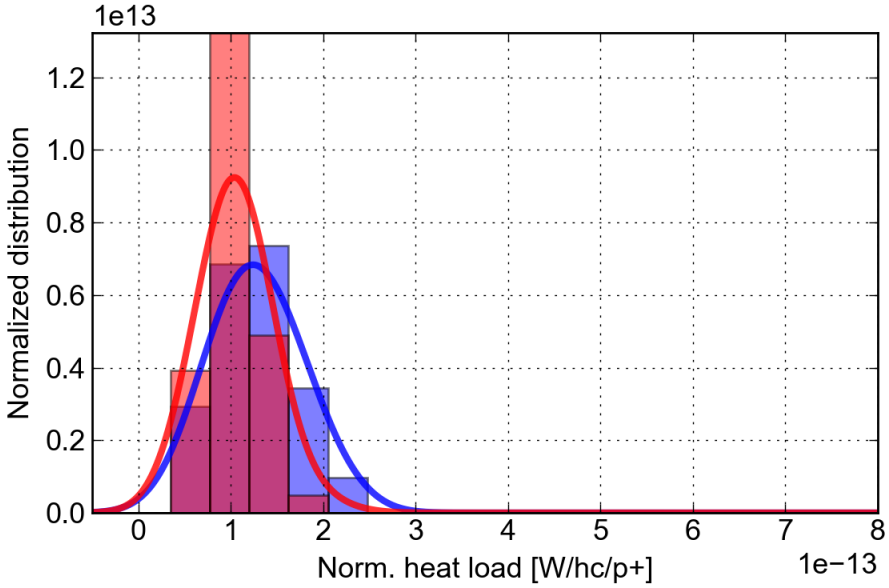


	B1 only	B1 and B2
Fill	5143	5117
Started on	30 Jul 2016 23:16	25 Jul 2016 19:08
T_sample [h]	2.50	2.45
Energy [GeV]	6500	6500
N_bunches (B1/B2)	2076/12	2076/2076
Intensity (B1/B2) [p]	2.48e14/1.37e12	2.49e14/2.46e14
Bun.len. (B1/B2) [ns]	1.07/1.06	1.06/1.07
H.L. S23 (avg) [W]	61.68	109.23
H.L. S23 (std) [W]	21.55	38.66
H.L. exp. imped. [W]	4.41	8.77
H.L. exp. synrad [W]	5.31	10.54
T_nobeam [h]	0.70	0.50

Sector 34, 48 cells, recalc. values

Apart from few outliers there is strong correlations between heat loads measured with one and two beams

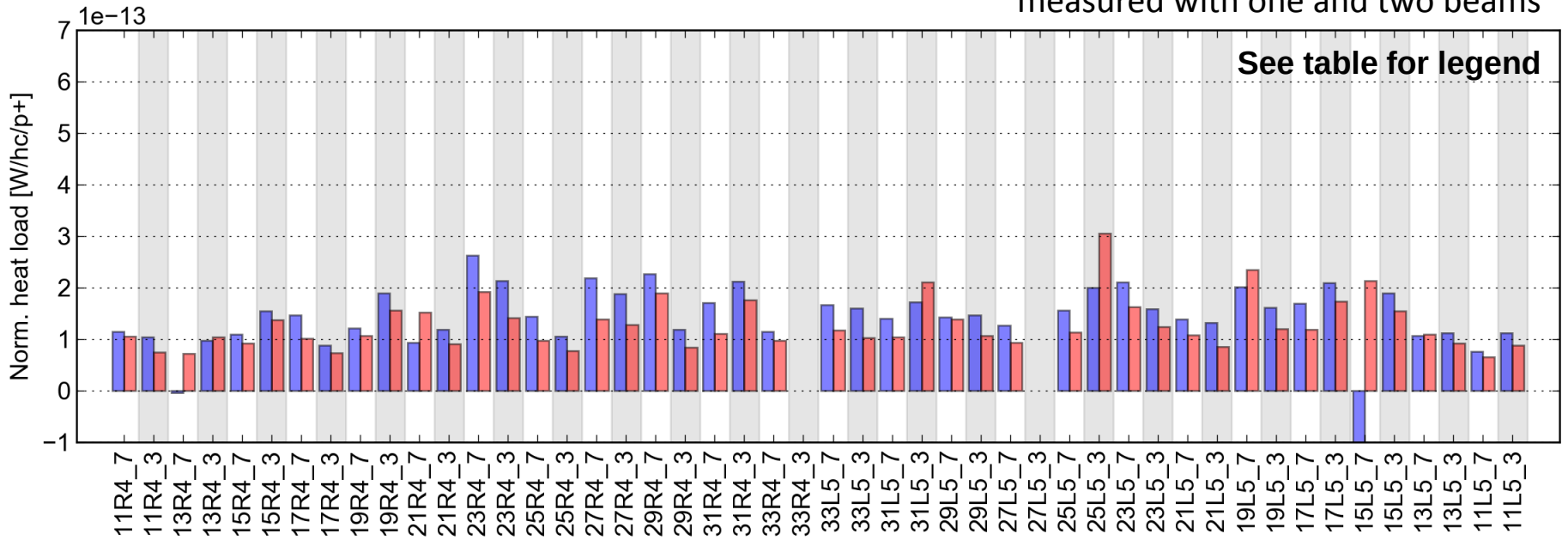


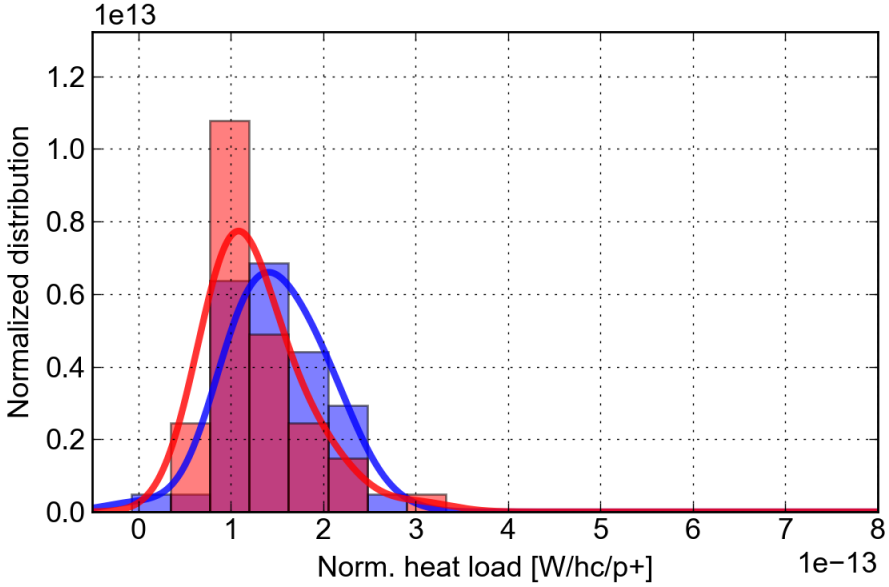


	B1 only	B1 and B2
Fill	5143	5117
Started on	30 Jul 2016 23:16	25 Jul 2016 19:08
T_sample [h]	2.50	2.45
Energy [GeV]	6500	6500
N_bunches (B1/B2)	2076/12	2076/2076
Intensity (B1/B2) [p]	2.48e14/1.37e12	2.49e14/2.46e14
Bun.len. (B1/B2) [ns]	1.07/1.06	1.06/1.07
H.L. S34 (avg) [W]	26.64	52.12
H.L. S34 (std) [W]	27.10	13.37
H.L. exp. imped. [W]	4.41	8.77
H.L. exp. synrad [W]	5.31	10.54
T_nobeam [h]	0.70	0.50

Sector 45, 48 cells, recalc. values

Apart from few outliers there is strong correlations between heat loads measured with one and two beams

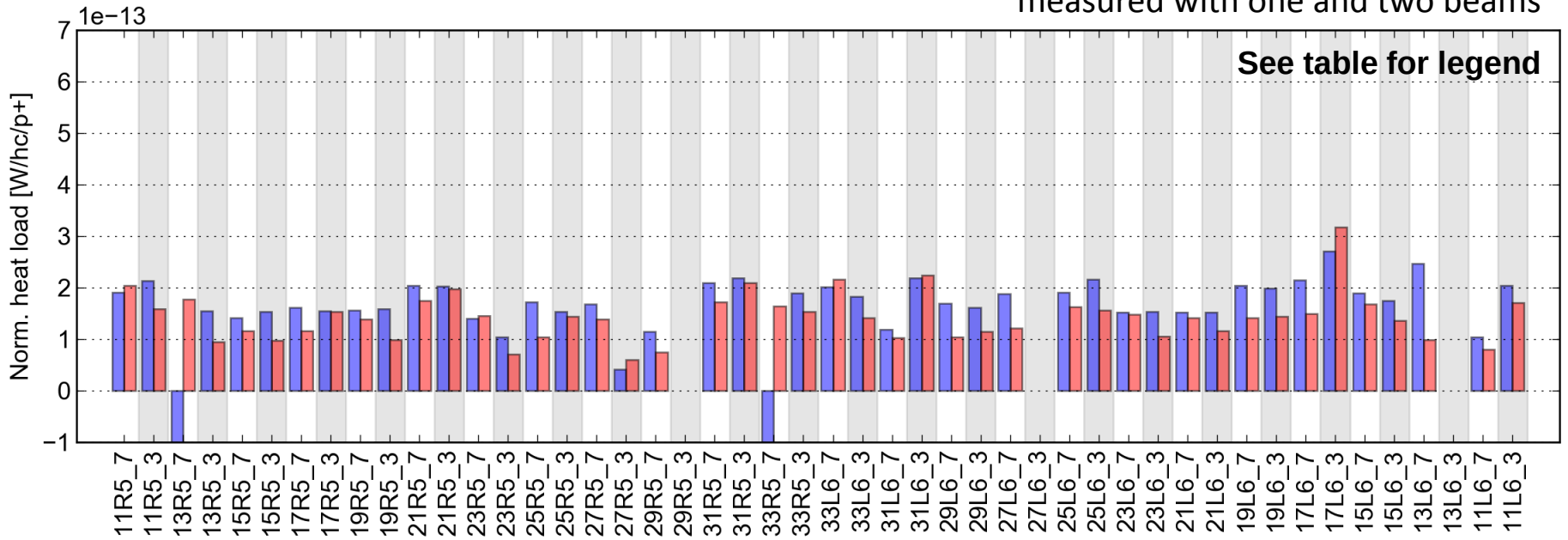


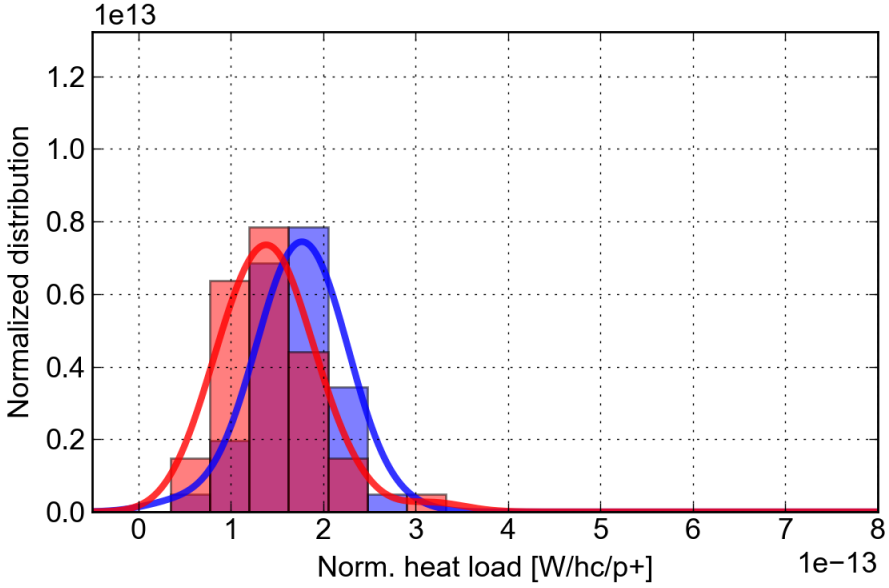


	B1 only	B1 and B2
Fill	5143	5117
Started on	30 Jul 2016 23:16	25 Jul 2016 19:08
T_sample [h]	2.50	2.45
Energy [GeV]	6500	6500
N_bunches (B1/B2)	2076/12	2076/2076
Intensity (B1/B2) [p]	2.48e14/1.37e12	2.49e14/2.46e14
Bun.len. (B1/B2) [ns]	1.07/1.06	1.06/1.07
H.L. S45 (avg) [W]	34.11	63.06
H.L. S45 (std) [W]	24.10	23.77
H.L. exp. imped. [W]	4.41	8.77
H.L. exp. synrad [W]	5.31	10.54
T_nobeam [h]	0.70	0.50

Sector 56, 48 cells, recalc. values

Apart from few outliers there is strong correlations between heat loads measured with one and two beams

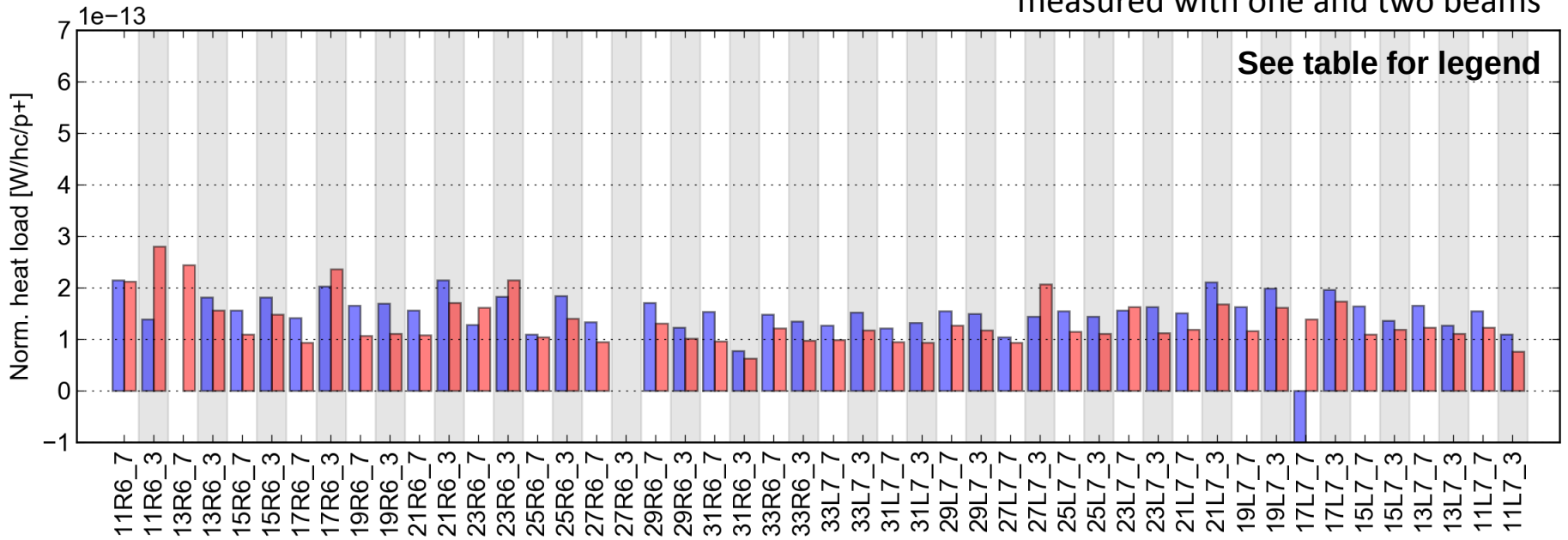


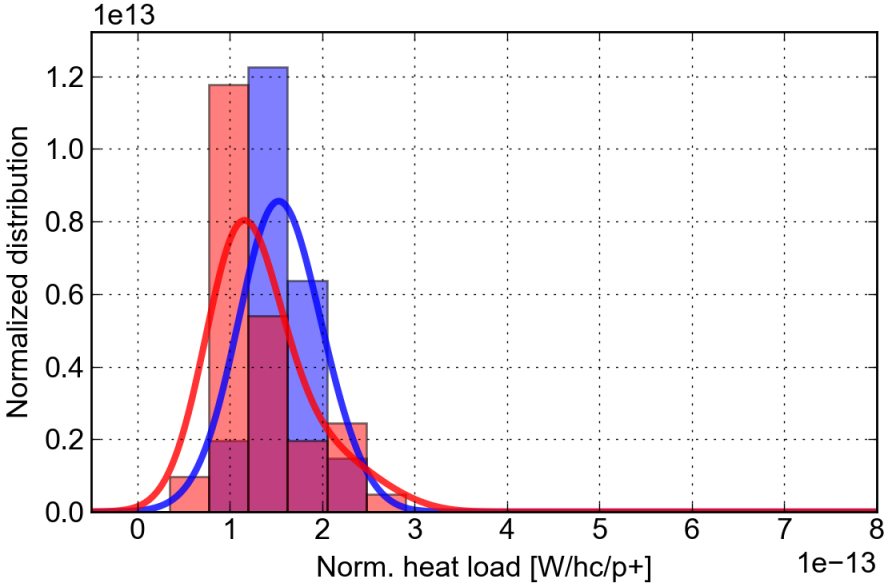


	B1 only	B1 and B2
Fill	5143	5117
Started on	30 Jul 2016 23:16	25 Jul 2016 19:08
T_sample [h]	2.50	2.45
Energy [GeV]	6500	6500
N_bunches (B1/B2)	2076/12	2076/2076
Intensity (B1/B2) [p]	2.48e14/1.37e12	2.49e14/2.46e14
Bun.len. (B1/B2) [ns]	1.07/1.06	1.06/1.07
H.L. S56 (avg) [W]	37.31	70.87
H.L. S56 (std) [W]	30.01	23.11
H.L. exp. imped. [W]	4.41	8.77
H.L. exp. synrad [W]	5.31	10.54
T_nobeam [h]	0.70	0.50

Sector 67, 48 cells, recalc. values

Apart from few outliers there is strong correlations between heat loads measured with one and two beams

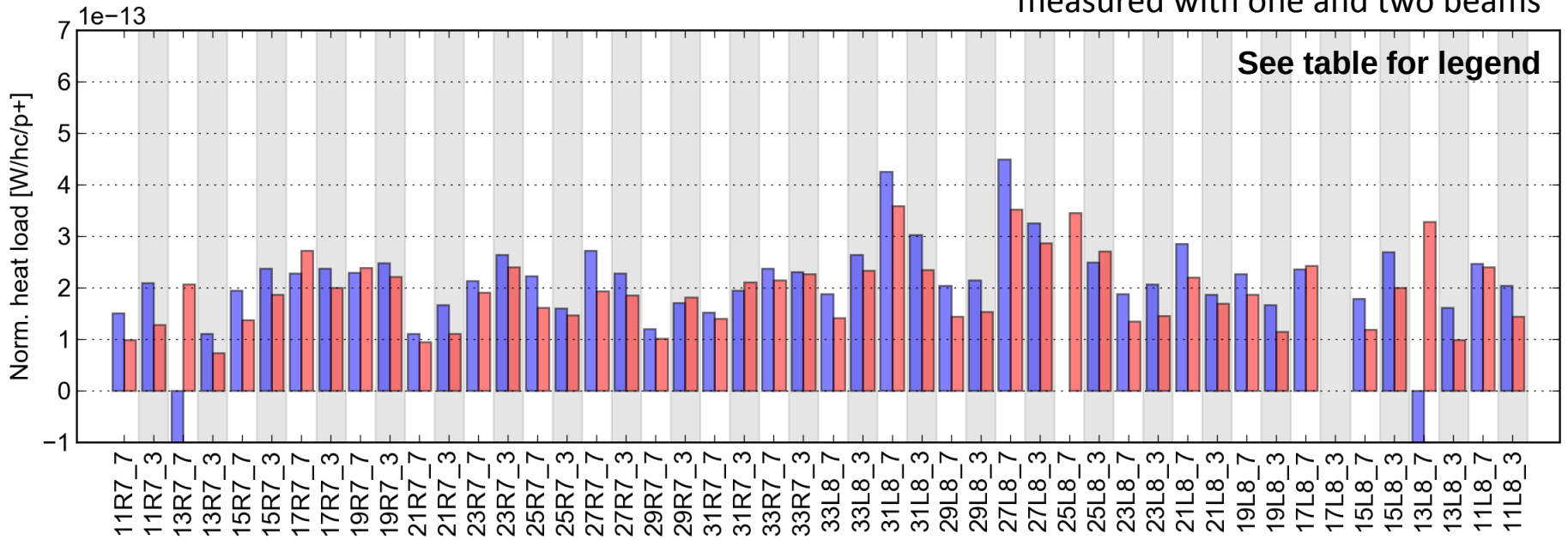


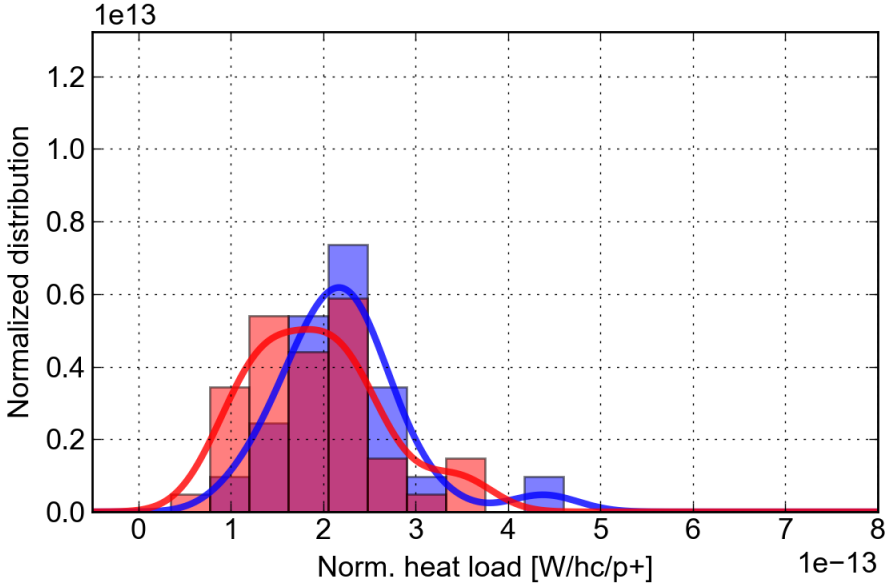


	B1 only	B1 and B2
Fill	5143	5117
Started on	30 Jul 2016 23:16	25 Jul 2016 19:08
T_sample [h]	2.50	2.45
Energy [GeV]	6500	6500
N_bunches (B1/B2)	2076/12	2076/2076
Intensity (B1/B2) [p]	2.48e14/1.37e12	2.49e14/2.46e14
Bun.len. (B1/B2) [ns]	1.07/1.06	1.06/1.07
H.L. S67 (avg) [W]	36.02	66.35
H.L. S67 (std) [W]	18.79	22.60
H.L. exp. imped. [W]	4.41	8.77
H.L. exp. synrad [W]	5.31	10.54
T_nobeam [h]	0.70	0.50

Sector 78, 48 cells, recalc. values

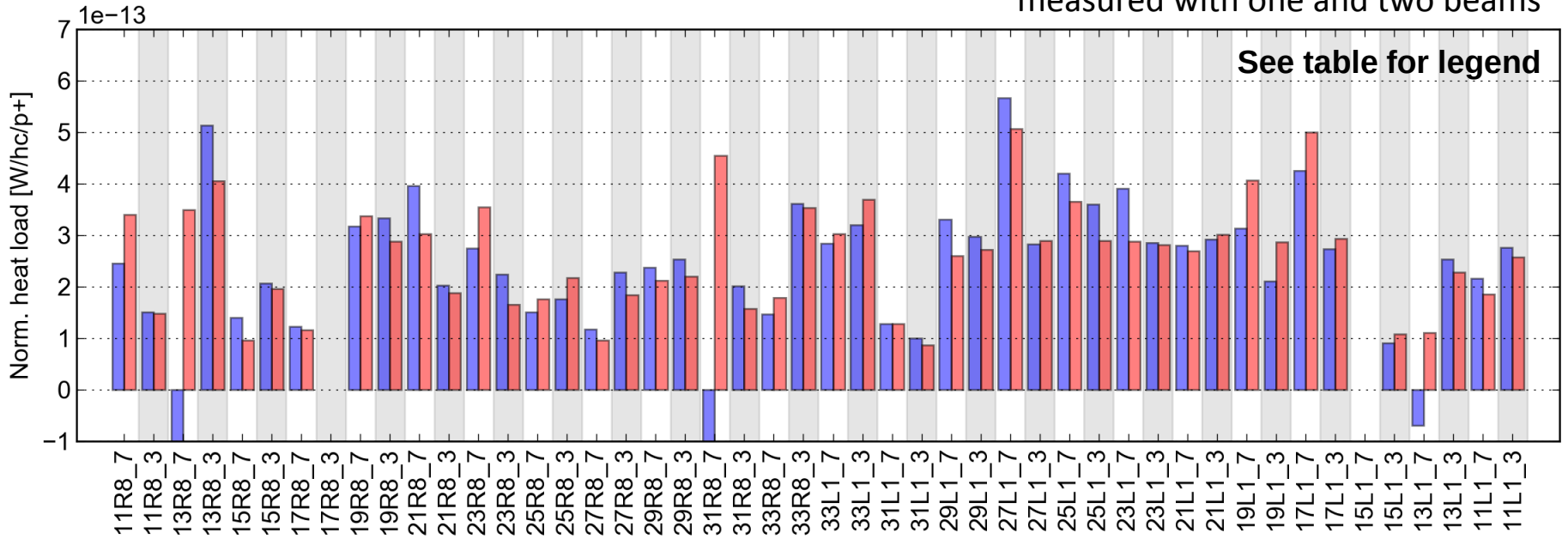
Apart from few outliers there is strong correlations between heat loads measured with one and two beams

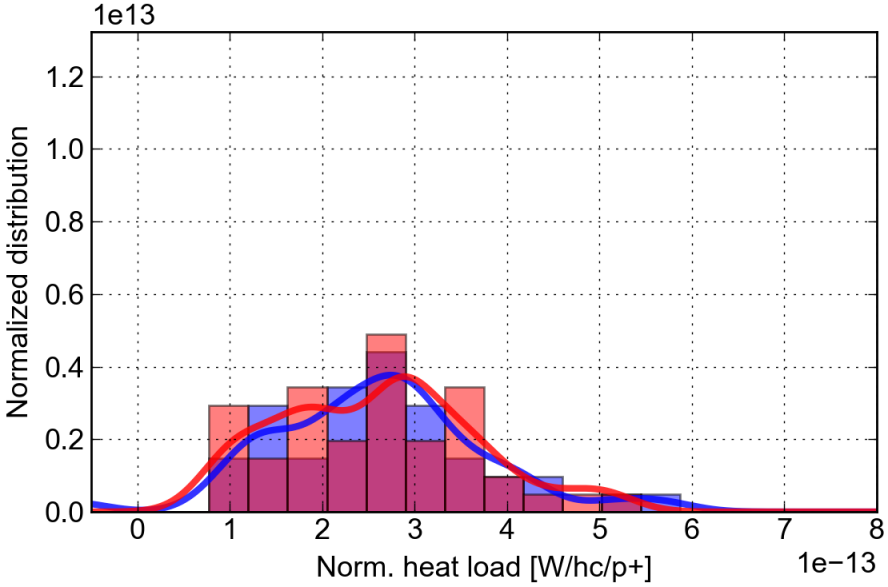




	B1 only	B1 and B2
Fill	5143	5117
Started on	30 Jul 2016 23:16	25 Jul 2016 19:08
T_sample [h]	2.50	2.45
Energy [GeV]	6500	6500
N_bunches (B1/B2)	2076/12	2076/2076
Intensity (B1/B2) [p]	2.48e14/1.37e12	2.49e14/2.46e14
Bun.len. (B1/B2) [ns]	1.07/1.06	1.06/1.07
H.L. S78 (avg) [W]	49.09	95.25
H.L. S78 (std) [W]	34.06	34.52
H.L. exp. imped. [W]	4.41	8.77
H.L. exp. synrad [W]	5.31	10.54
T_nobeam [h]	0.70	0.50

Apart from few outliers there is strong correlations between heat loads measured with one and two beams





	B1 only	B1 and B2
Fill	5143	5117
Started on	30 Jul 2016 23:16	25 Jul 2016 19:08
T_sample [h]	2.50	2.45
Energy [GeV]	6500	6500
N_bunches (B1/B2)	2076/12	2076/2076
Intensity (B1/B2) [p]	2.48e14/1.37e12	2.49e14/2.46e14
Bun.len. (B1/B2) [ns]	1.07/1.06	1.06/1.07
H.L. S81 (avg) [W]	57.74	128.49
H.L. S81 (std) [W]	41.88	52.18
H.L. exp. imped. [W]	4.41	8.77
H.L. exp. synrad [W]	5.31	10.54
T_nobeam [h]	0.70	0.50