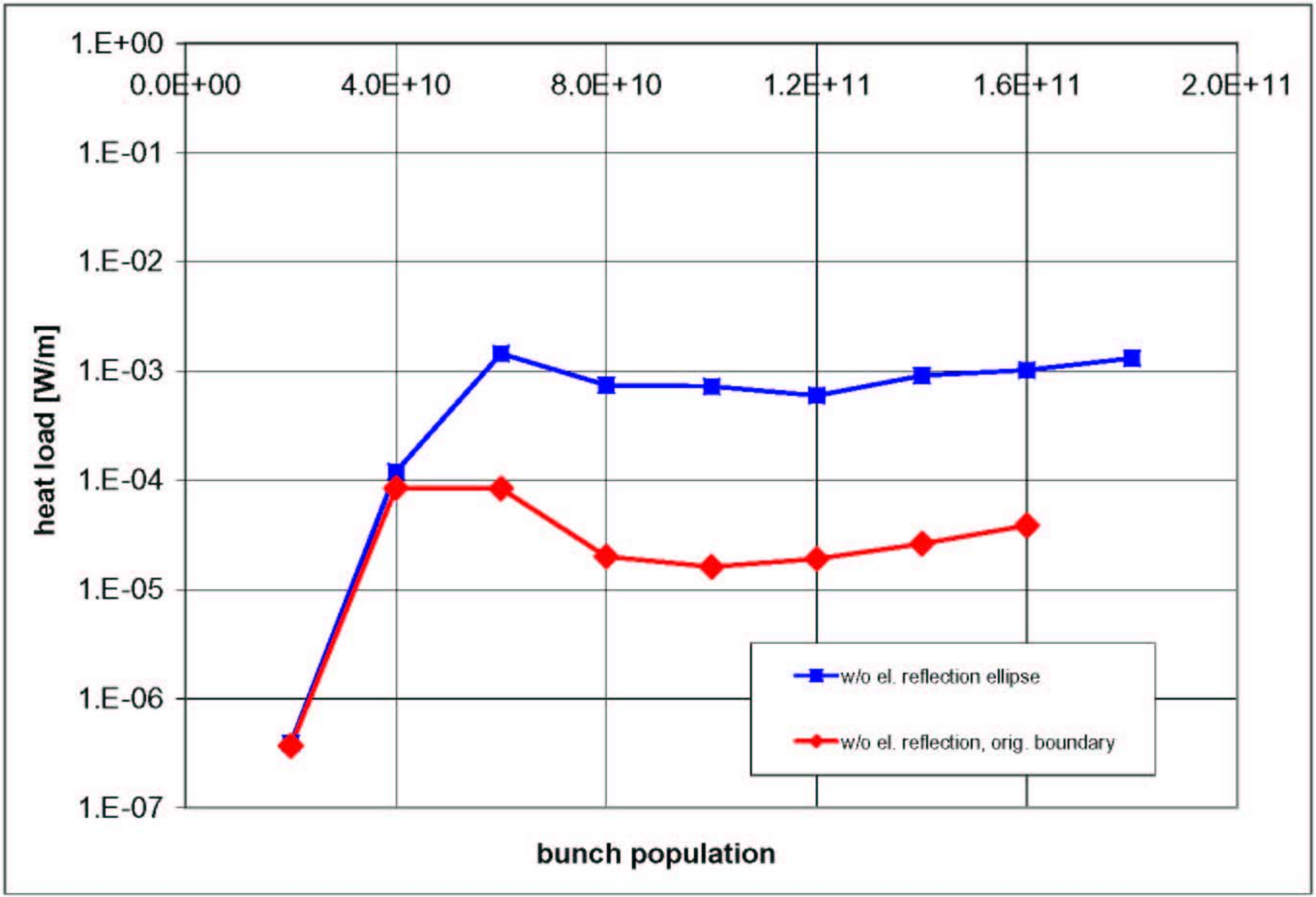
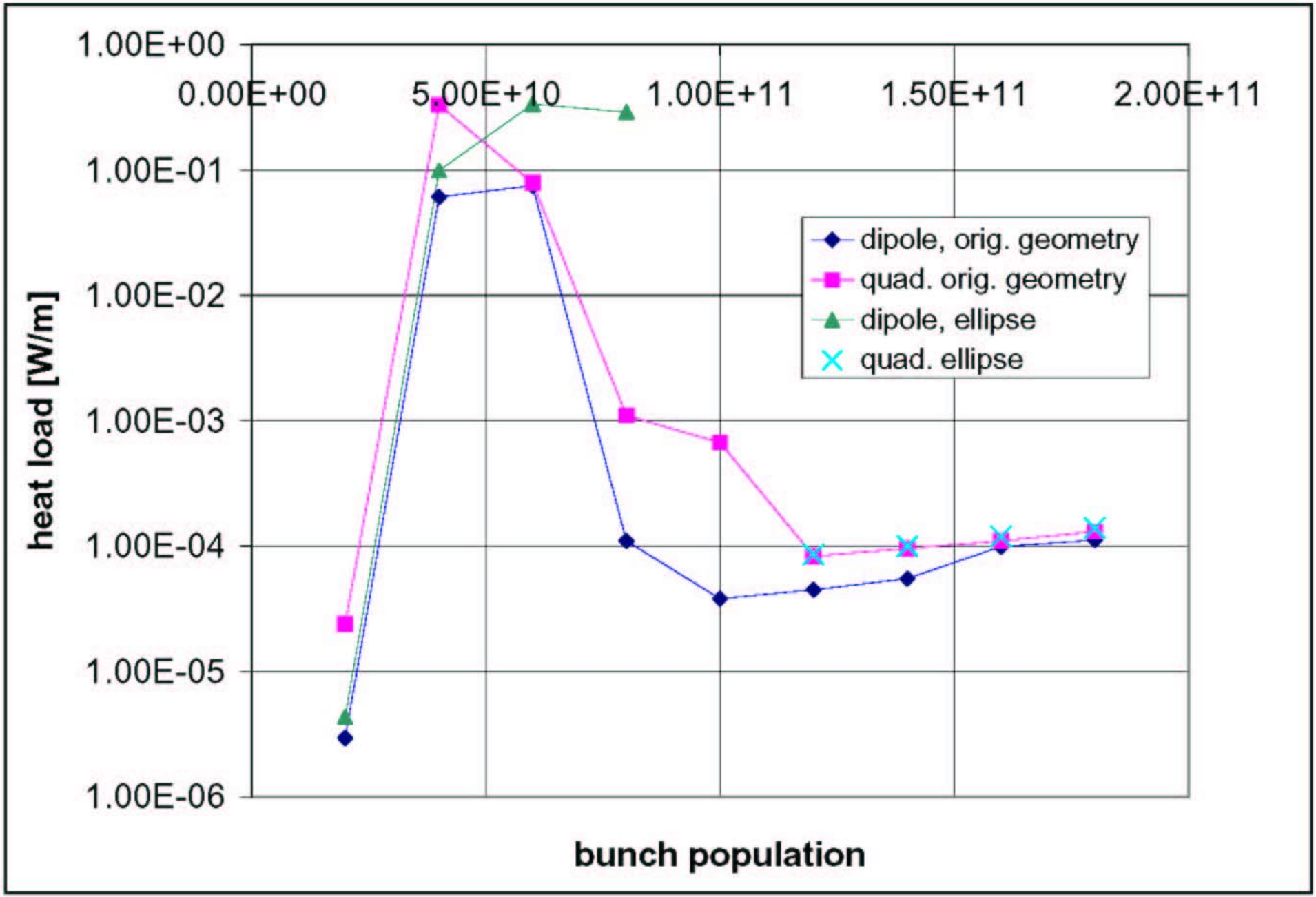
Electron Cloud in LHC at Injection

parameter	initial	final
max. secondary yield	1.9	1.1
energy at maximum	249 eV	230 eV
primary ionization e- / meter	2×10^{-8}	2×10^{-8}
parameter for elastic reflection	150 eV	150 eV
Bunch population	1.15×10^{11}	1.15×10^{11}
Bunch spacing	25 ns and 75 ns	25 ns
Rms bunch length	17.5 cm	17.5 cm
Rms transverse beam size	1 mm	1 mm
Chamber vertical half height	18 mm	18 mm
Chamber horizontal half height	22 mm	22 mm
Field	Dipole, drift, quadrupole	Dipole, drift, quadrupole

comparing two boundaries without elastic e- reflection



comparing the two boundaries with elastic e- reflection



Simulations for 2003 SPS Electron Cloud Detectors

- more than 14 types of detectors
- parameters for 25 ns and 75 ns spacing (emittance not the same)
- I am taking care of WAMPACs
- Daniel is looking at all the others (more difficult)

Name	Horizontal half size	Vertical half size	Chamber geometry	β_x	β_y	D_x
WAMPAC1 Cu	70 mm	70 mm	Round	22.4	98.2	-0.35
COLDEX 2003 Cu	33.5 mm	33.5 mm	Round	28.8	80.3	-0.43
2003 SEY setup (MBB) St.St.	64.5 mm	24.65 mm	Rect-angular	31.7	73.2	-0.45
WAMPAC3	33.5 mm	33.5 mm	Round	35.2	68.2	-0.49
WAMPAC2 (MBA) Cu	76 mm	17.65 mm	Rect-angular	98.5	22.1	-0.83
Old strip detector St.St. (MBA)	76 mm	17.65 mm	Recta-angular	90.9	24.4	-0.80
2002 new strip detector (MBA) St.St.?	76 mm	17.65 mm	Rect-angular	92.4	23.9	-0.80
Pick up for energy distr. St. St. (MBB)	64.5 mm	24.65 mm	Rect-angular	67.5	35.1	-0.68
Pick up calorimeter (MBA) St.St.	76 mm	17.65 mm	Rect-angular	78.5	29.3	-0.736
Pick up calorimeter (MBB) St.St.	64.5 mm	24.65 mm	Rect-angular	67.5	35.1	-0.68
NEG (MBB)	64.5 mm	24.65 mm	Rect-angular	27.2	75.8	-0.17
NEG ID156	78 mm	78 mm	Round	24.1	92.1	-0.2
Variable aperture stripe detector	76 mm	17.65 mm	Rect-angular	89.3	25.0	-0.79
Cold strip detector	76 mm	17.65 mm	Rect-angular	83.5	27.1	-0.76

Name	σ_x[mm] 25 ns, 26 GeV	σ_y [mm] 25 ns, 26 GeV	σ_x [mm] 75 ns, 26 GeV	σ_y [mm] 75 ns, 26 GeV
WAMPAC1 Cu	1.68	3.26	1.27	2.23
COLDEX 2003 Cu	1.93	2.95	1.46	2.01
2003 SEY setup (MBB) St.St.	2.03	2.81	1.54	1.92
WAMPAC3	2.14	2.72	1.63	1.86
WAMPAC2 (MBA) Cu	3.59	1.55	2.75	1.06
Old strip detector (MBA) St. St.	3.45	1.62	2.65	1.11
2002 new strip detector (MBA) St.St.?	3.48	1.61	2.66	1.10
Pick up for energy distr. St. St. (MBB)	2.97	1.95	2.27	1.33
Pick up calorimeter (MBA) St.St.	3.20	1.78	2.45	1.22
Pick up calorimeter (MBB) St.St.	2.97	1.95	2.27	1.33
NEG (MBB)	1.75	3.01	1.26	2.06
NEG ID156	1.66	3.16	1.20	2.16
Variable aperture stripe detector	3.42	1.64	2.62	1.12
Cold strip detector	3.31	1.71	2.53	1.17

Name	σ_x[mm] 25 ns, 26 GeV	σ_y [mm] 25 ns, 26 GeV	σ_x [mm] 75 ns, 26 GeV	σ_y [mm] 75 ns, 26 GeV
WAMPAC1 Cu	1.68	3.26	1.27	2.23
COLDEX 2003 Cu	1.93	2.95	1.46	2.01
2003 SEY setup (MBB) St.St.	2.03	2.81	1.54	1.92
WAMPAC3	2.14	2.72	1.63	1.86
WAMPAC2 (MBA) Cu	3.59	1.55	2.75	1.06
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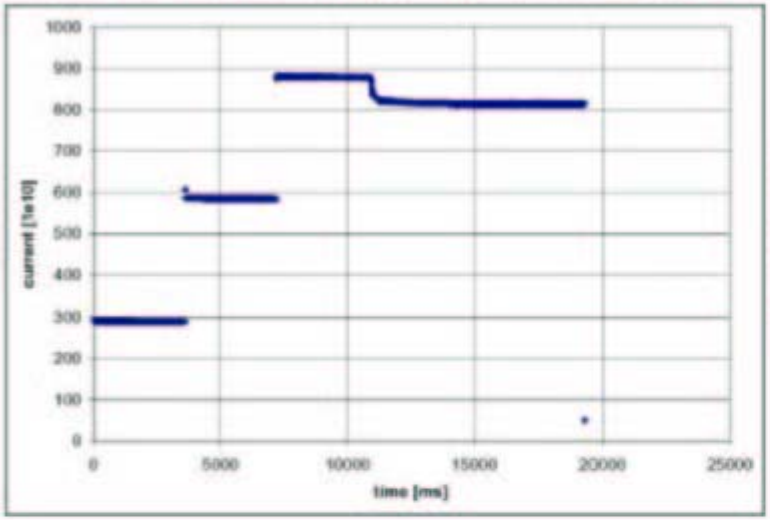
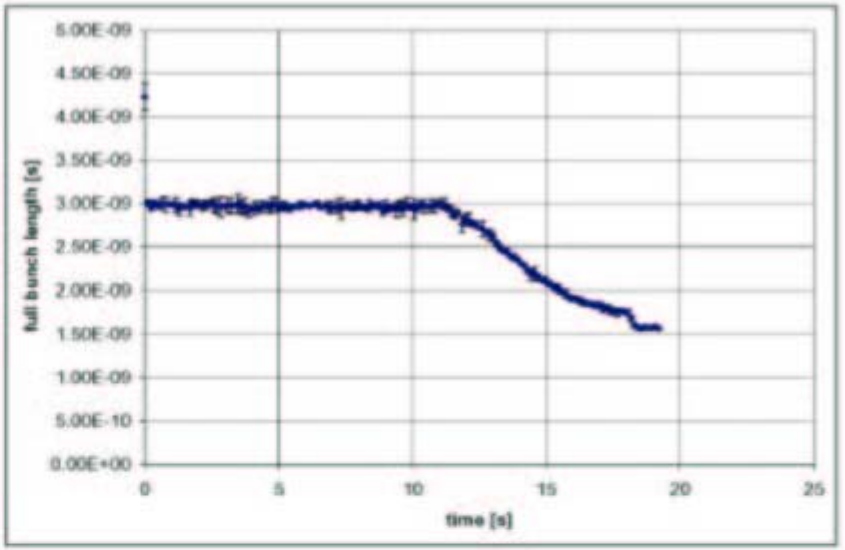
Variable aperture stripe detector	3.42	1.64	2.62	1.12
Cold strip detector	3.31	1.71	2.53	1.17

The following two plots show the beam intensity (3 batches with 24 bunches each) and the 4-σ bunch length for a 75-ns cycle.





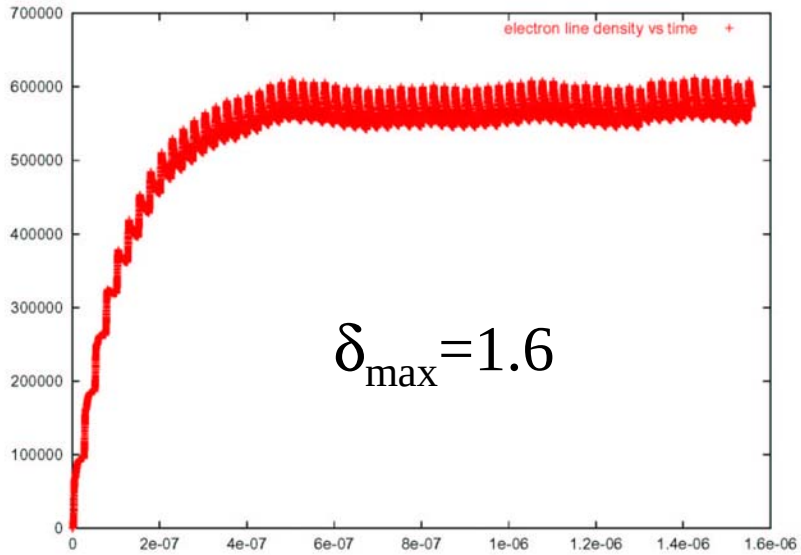
variable	25 ns, 26 GeV	25 ns, 450 GeV	75 n, 26 GeV	75 ns, 450 GeV
Horizontal emittance	2.8-3.0	3.5	1.5	1.5
Vertical emittance	3.0	4.0	1.4	1.5
Intensity	$1.2\text{x}10^{11}$	$1.2\text{x}10^{11}$	$1.2\text{x}10^{11}$	$1.2\text{x}10^{11}$
Rms bunch length	1 ns?	0.5 ns?	0.8 ns	0.4 ns
Momentum spread	$1.8\text{x}10^{-3}$?	$0.3\text{x}10^{-3}$?	$1.8\text{x}10^{-3}$	$0.3\text{x}10^{-3}$

WAMPAC1&3

I assume a pressure of 50 and 100 ntorr for 2003 (WAMPAC3) and 2002 (WAMPAC1) respectively, which translates to a primary rate of 3 or 6×10^{-8} per proton and meter. Simulations are run for 26 GeV, for three different values of the secondary emission yield and the two bunch spacings.

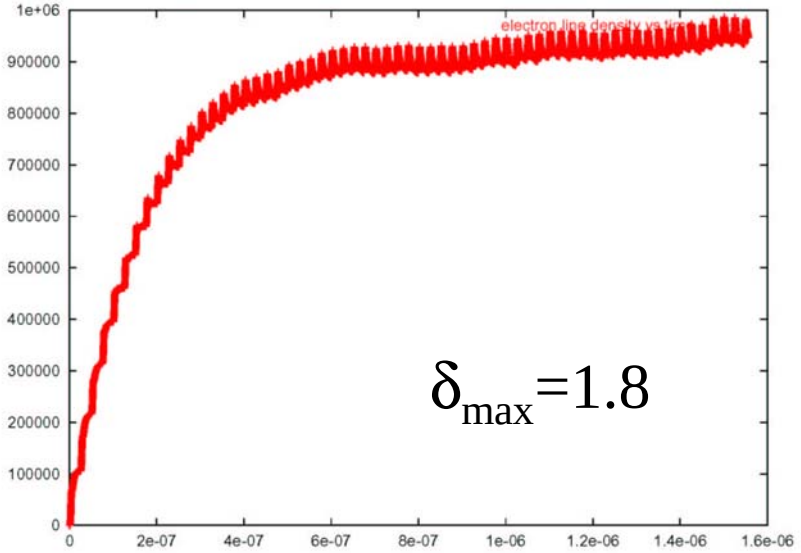
WAMPAC1, 25 ns spacing, no field, e- build up

0.7E6/m



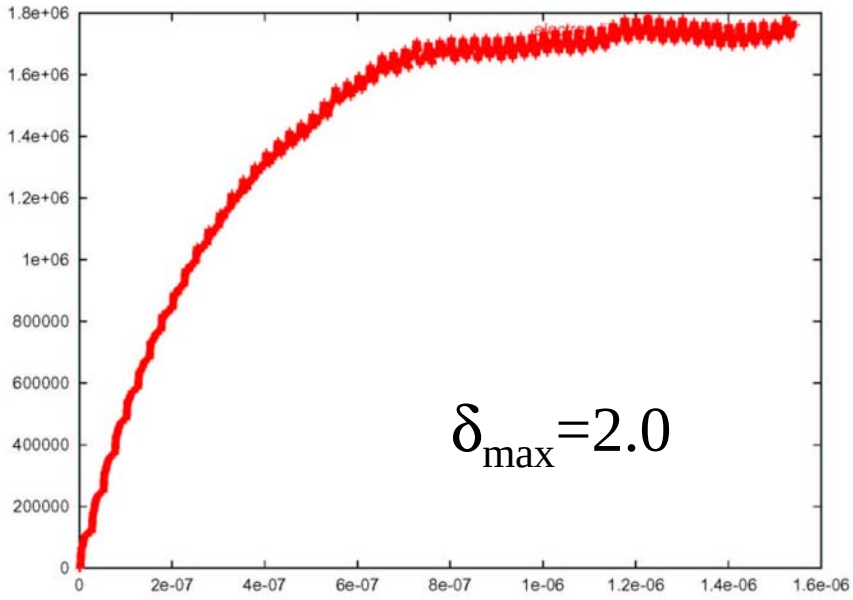
δ_{max}=1.6

1.0E6/m



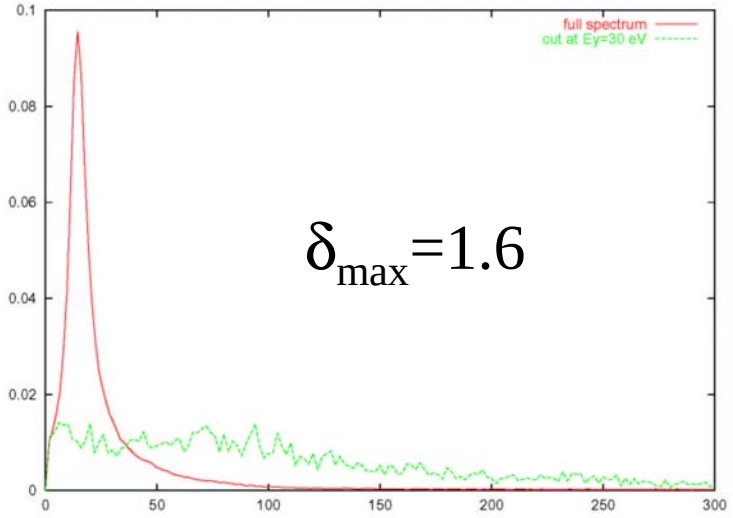
δ_{max}=1.8

1.8E6/m

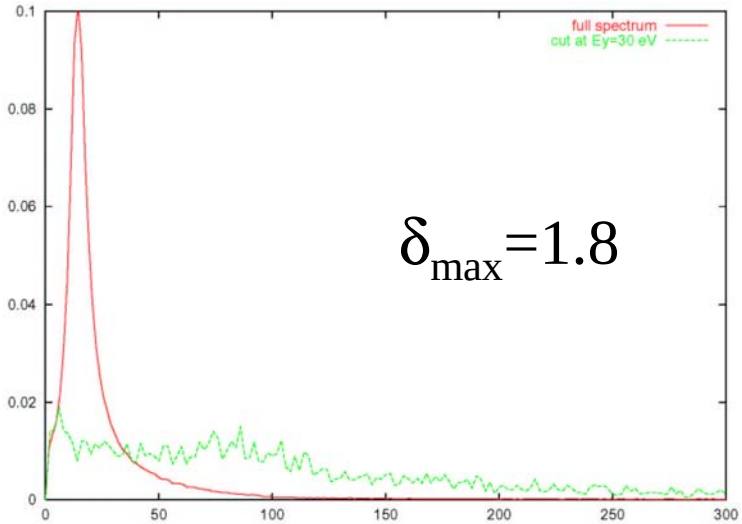


δ_{max}=2.0

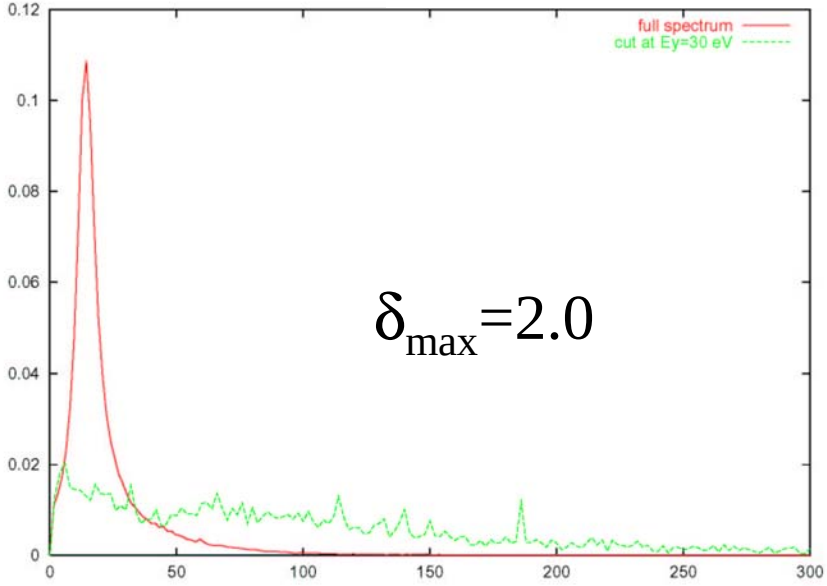
WAMPAC1, 25 ns spacing, no field, e- energy spectra



δ_{max}=1.6

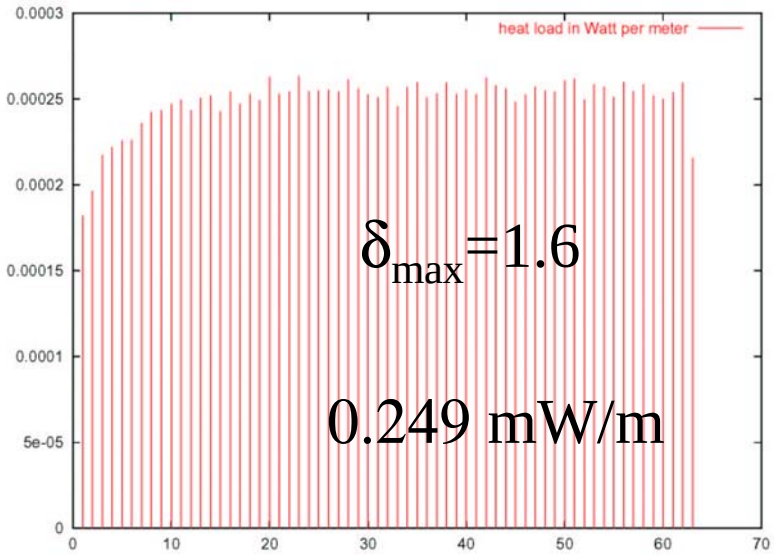


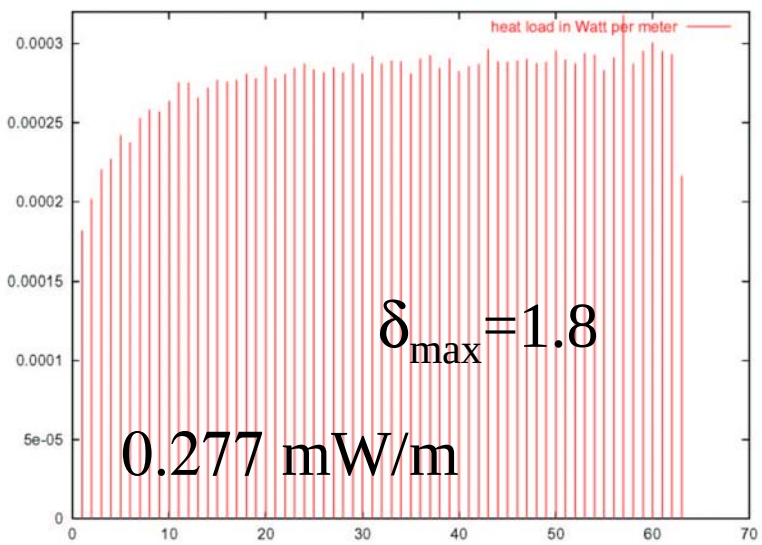
δ_{max}=1.8

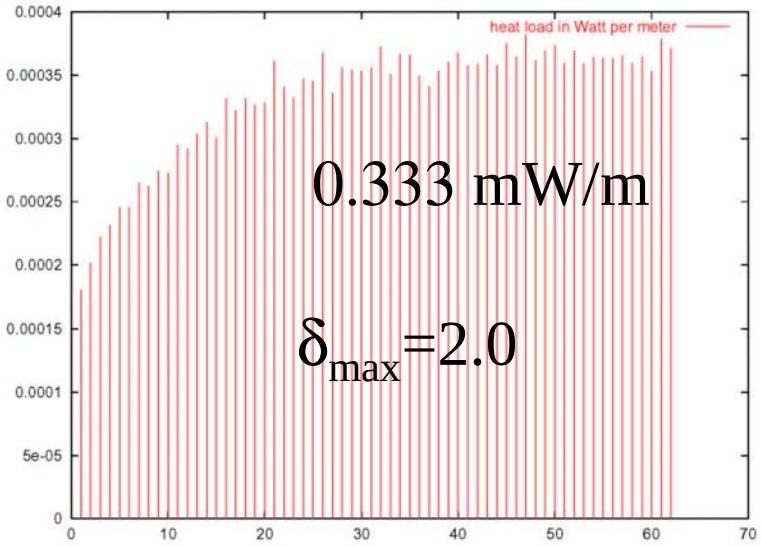


δ_{max}=2.0

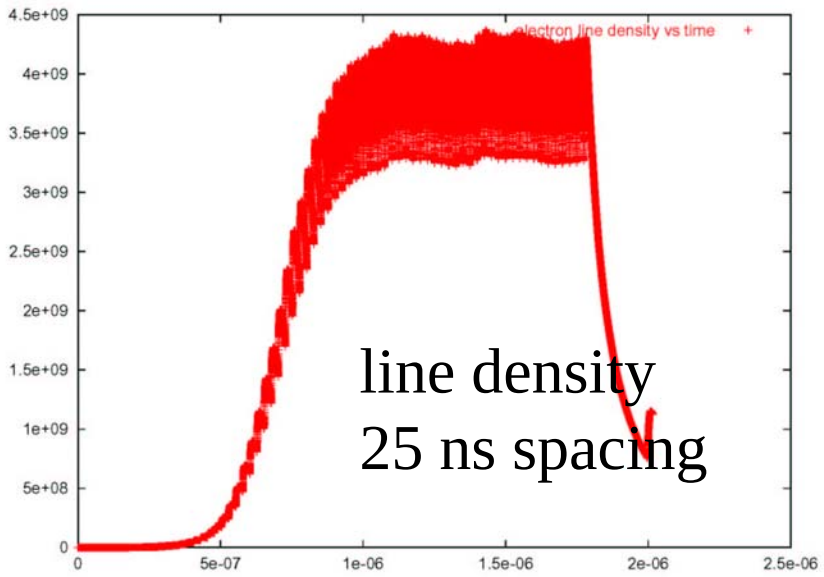
WAMPAC1, 25 ns spacing, no field, heat load



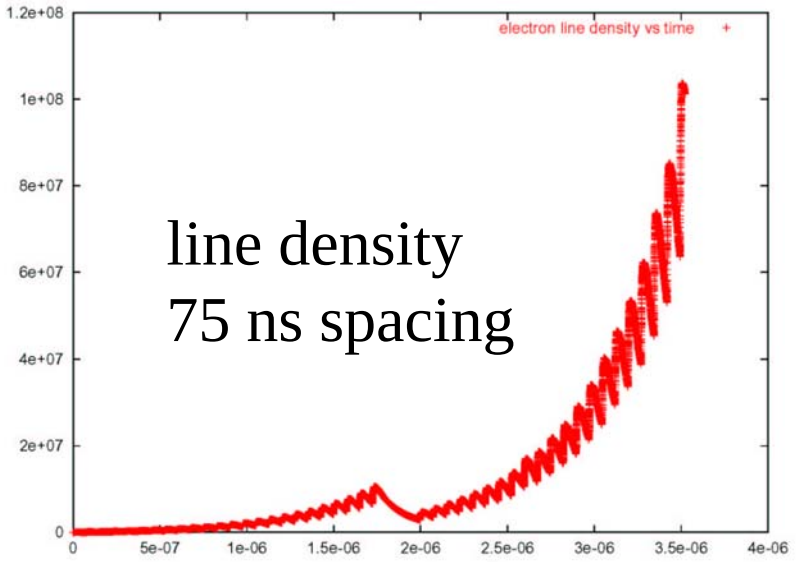




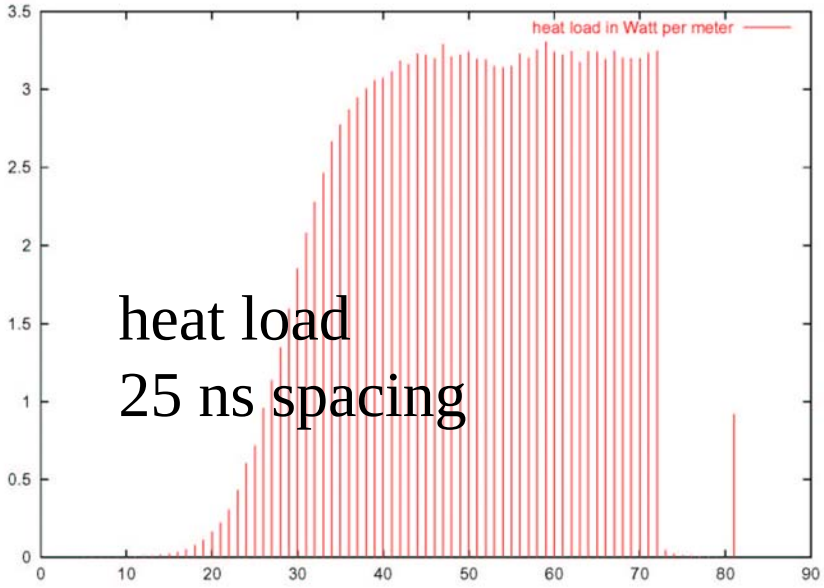
WAMPAC3, no field, δ_{max}=1.6



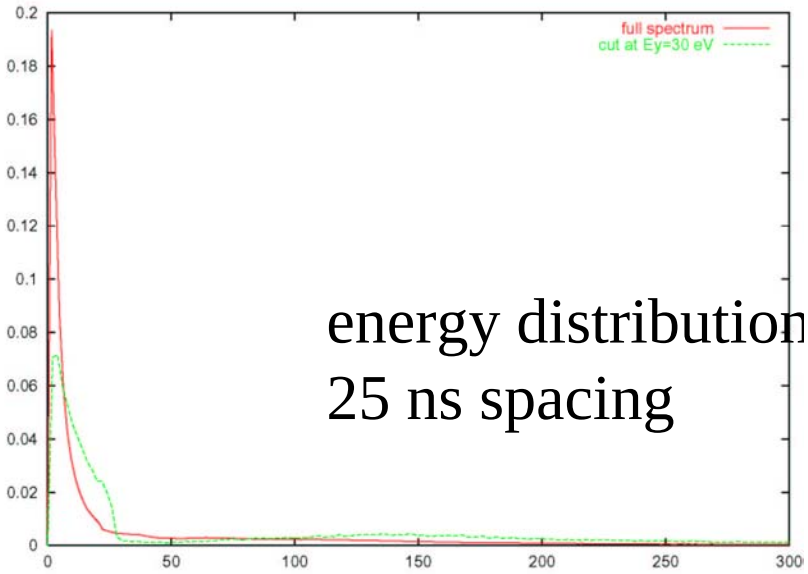
line density
25 ns spacing



line density
75 ns spacing



heat load
25 ns spacing



energy distribution
25 ns spacing