Super-B: Single Bunch Lengthening and Instability.

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XII Super B Workshop

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LAPP, Annecy, France

Bunch lengthening in Super-B using half of PEP-II impedance (From the December 2009 meeting).

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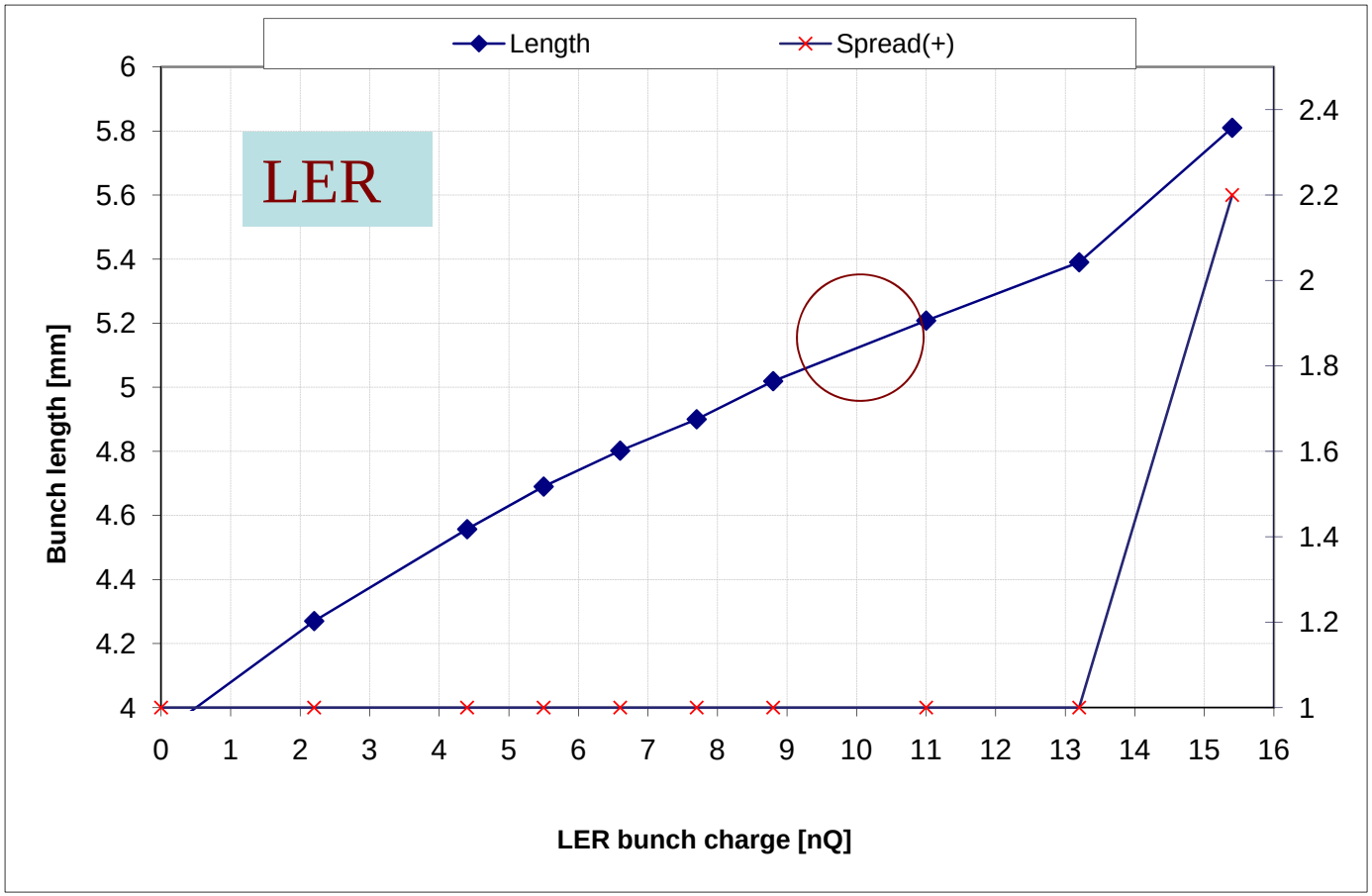

Pantaleo and Mikhail did not like it

Super-B parameters. March 3, 2010

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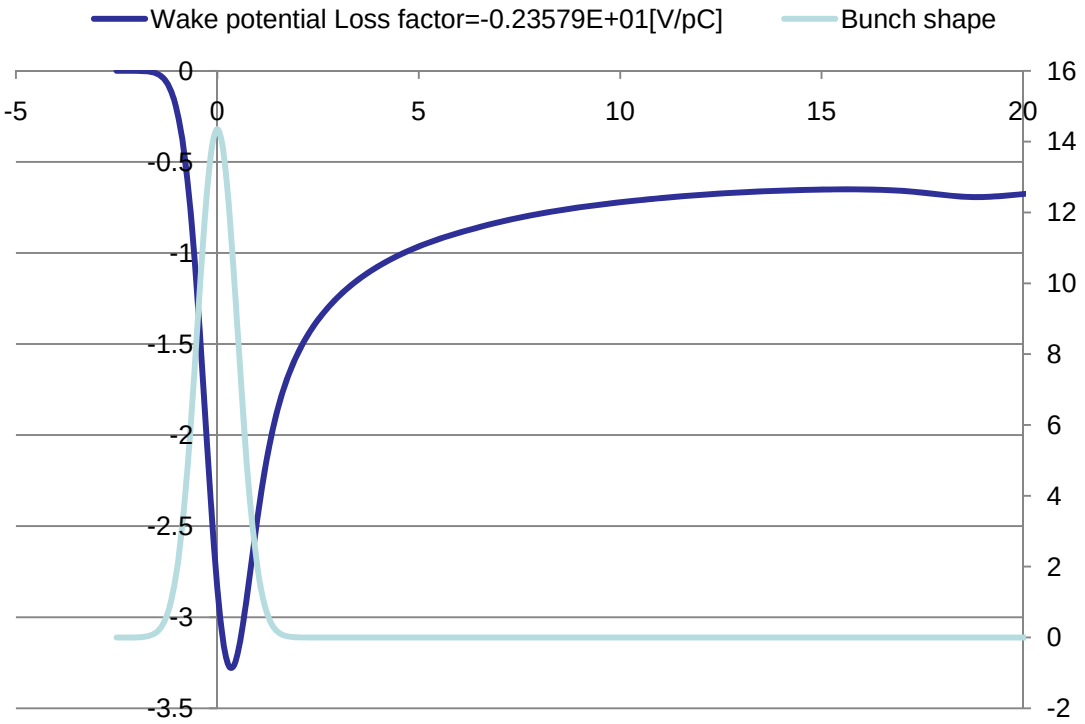
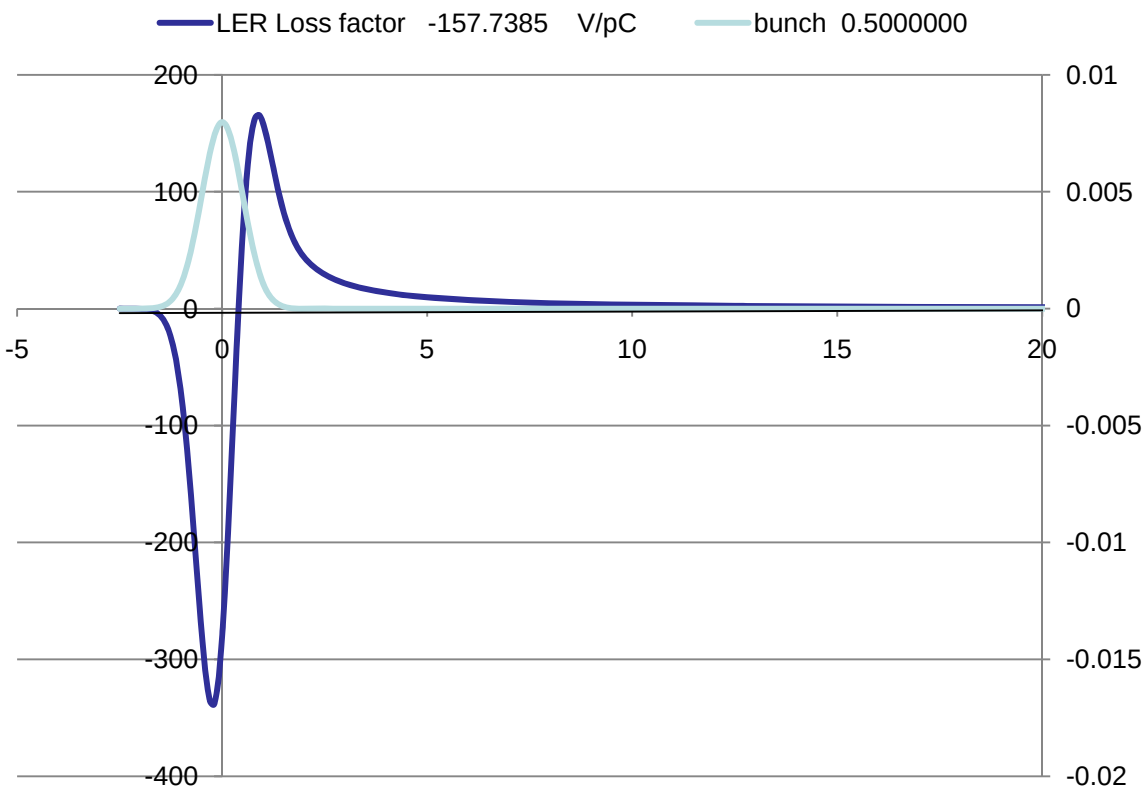
(Bold: computed values)		Base Line		Low Emittance		High Current		Tau/Charm (prelim.)	
Parameter	**Units**	**HER (e+)**	**LER (e-)**	**HER (e+)**	**LER (e-)**	**HER (e+)**	**LER (e-)**	**HER (e+)**	**LER (e-)**
Energy	**GeV**	6.7	4.18	6.7	4.18	6.7	4.18	2.58	1.61
Circumference	**m**	1258.4		1258.4		1258.4		1258.4	
Bunch length (zero current)	**mm**	4.69	4.29	4.73	4.34	4.03	3.65	4.75	4.36
Bunch length (full current)	**mm**	5	5	5	5	4.4	4.4	5	5
Beam current	**mA**	1892	2447	1460	1888	3094	4000	1365	1766
N. Buckets distance		2	2	2	2	1	1	1	1
Ion gap	**%**	2	2	2	2	2	2	2	2
RF frequency	**Hz**	4.76E+08	4.76E+08	4.76E+08	4.76E+08	4.76E+08	4.76E+08	4.76E+08	4.76E+08
Revolution frequency	**Hz**	**2.38E+05**		**2.38E+05**		**2.38E+05**		**2.38E+05**	
Harmonic number	**#**	**1998**		**1998**		**1998**		**1998**	
Number of bunches	**#**	**978**		**978**		**1956**		**1956**	
N. Particle/bunch	**#**	**5.08E+10**	**6.56E+10**	**3.92E+10**	**5.06E+10**	**4.15E+10**	**5.36E+10**	**1.83E+10**	**2.37E+10**
Bunch current	**mA**	**1.935**	**2.502**	**1.493**	**1.930**	**1.582**	**2.045**	**0.698**	**0.903**
Energy Loss/turn	**MeV**	2.11	0.865	2.11	0.865	2.11	0.865	0.4	0.166
Momentum compaction		4.36E-04	4.05E-04	4.36E-04	4.05E-04	4.36E-04	4.05E-04	*4.36E-04*	*4.05E-04*
Energy spread (zero current)	**dE/E**	6.31E-04	6.68E-04	6.31E-04	6.68E-04	6.31E-04	6.68E-04	*6.31E-04*	*6.68E-04*
Energy spread (full current)	**dE/E**	6.43E-04	7.34E-04	6.43E-04	7.34E-04	6.43E-04	7.34E-04	*6.94E-04*	*7.34E-04*
CM energy spread	**dE/E**	**5.00E-04**		**5.00E-04**		**5.00E-04**		**5.26E-04**	
Energy acceptance		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Synchrotron frequency	**kHz**	3.01	2.8	2.97	2.77	3.54	3.26	2.96	2.77
Synchrotron tune		0.0126	0.0118	0.0125	0.0116	0.0148	0.0137	0.0124	0.0116
SR power loss	**MW**	**3.99**	**2.12**	**3.08**	**1.63**	**6.53**	**3.46**	**0.55**	**0.29**
RF Wall Plug Power (SR only)	**MW**	**12.22**		**9.43**		**19.98**		**1.68**	
Total RF Wall Plug Power	**MW**	17.08		12.72		30.48		3.11	
Number of cavities		12	8	12	8	20	12	6	4
Number of Klystrons		6	4	6	4	10	6	3	2
Total Number of klystrons		10		10		16		5	
RF Voltage	MV	7.01	5.25	6.88	5.13	9.3	7.2	2.54	1.94
R_s	MΩ								
Q_0									
β									

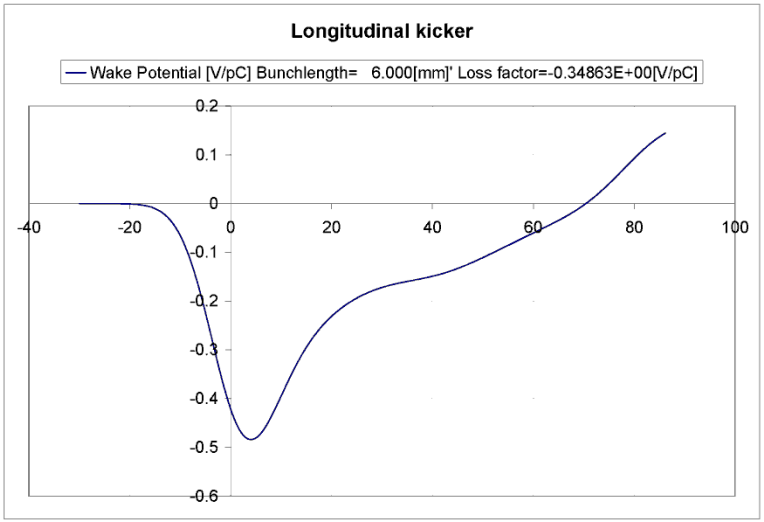
Cavity wake

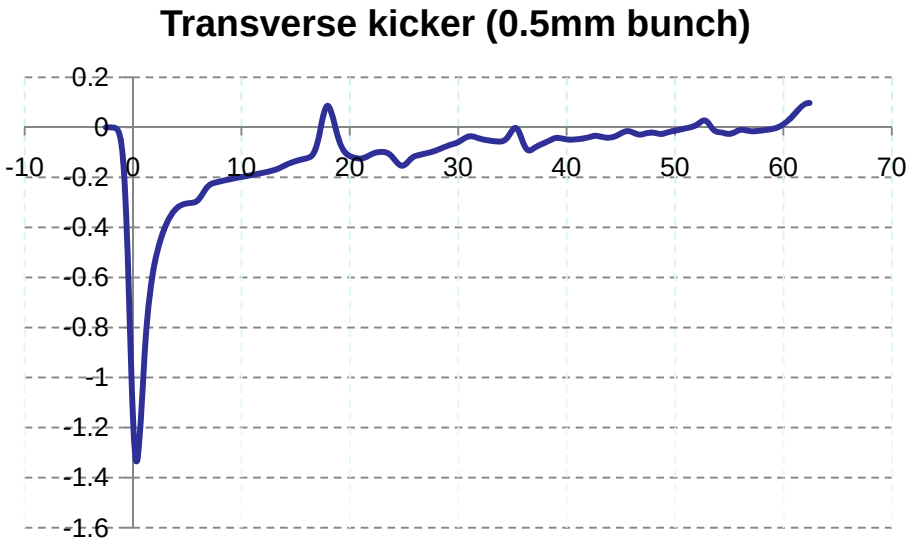


Resistive wake

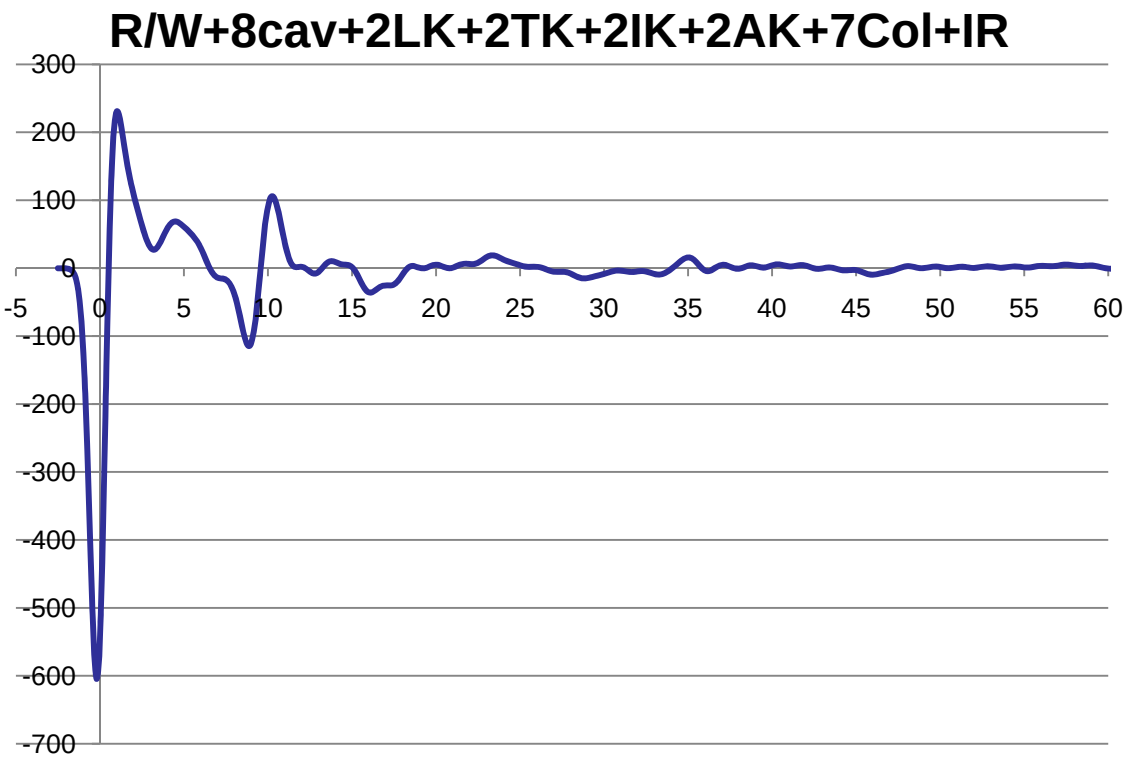


Kickers


Longitudinal kicker
Wake Potential [V/pC] Bunchlength= 6.000[mm]' Loss factor=-0.34863E+00[V/pC]
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-40
-20
0
20
40
60
80
100

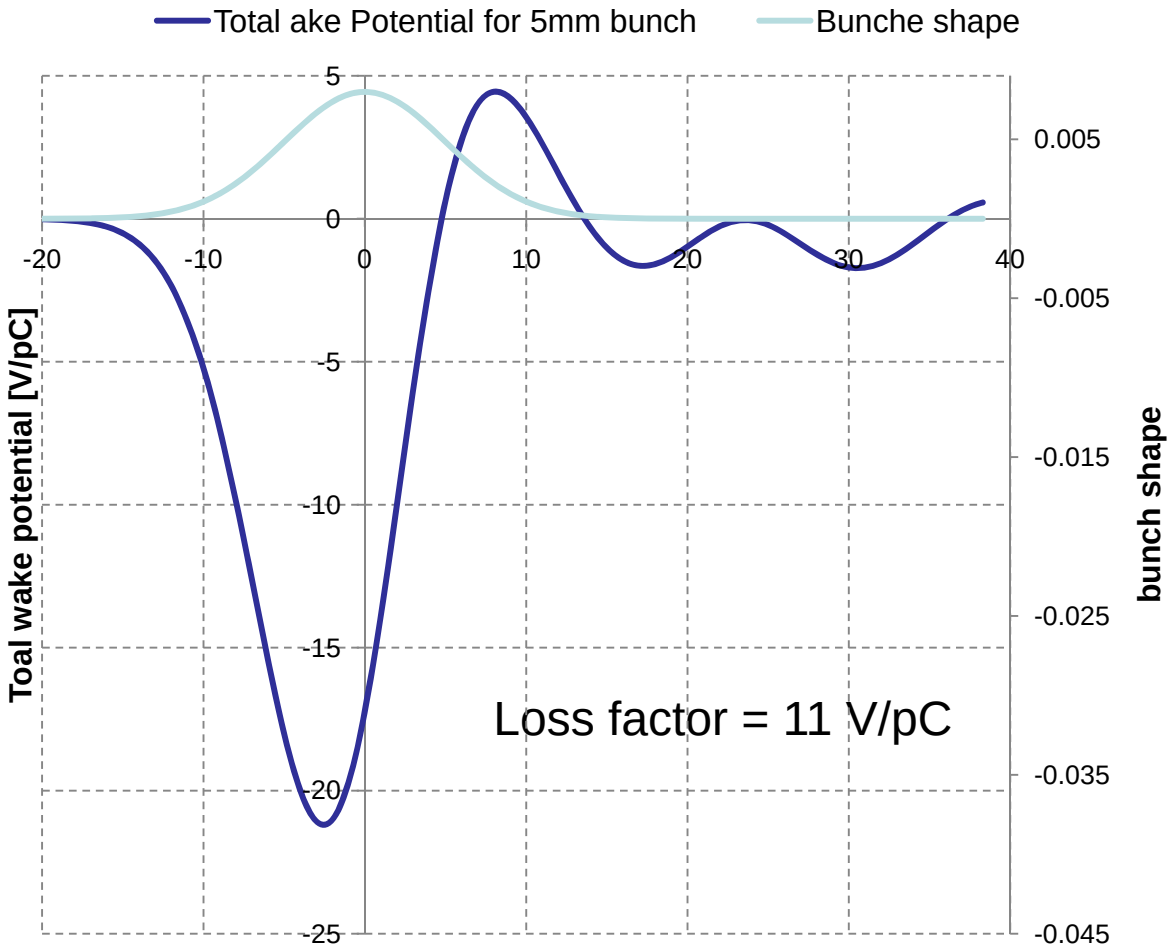

Transverse kicker (0.5mm bunch)
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-10
0
10
20
30
40
50
60
70

Wake potential of a 0.5 mm bunch.



Loss factor = 0.003 V/pC

Wake potential of a 5 mm bunch (Base line).



Bunch lengthening in Super-B. Base line

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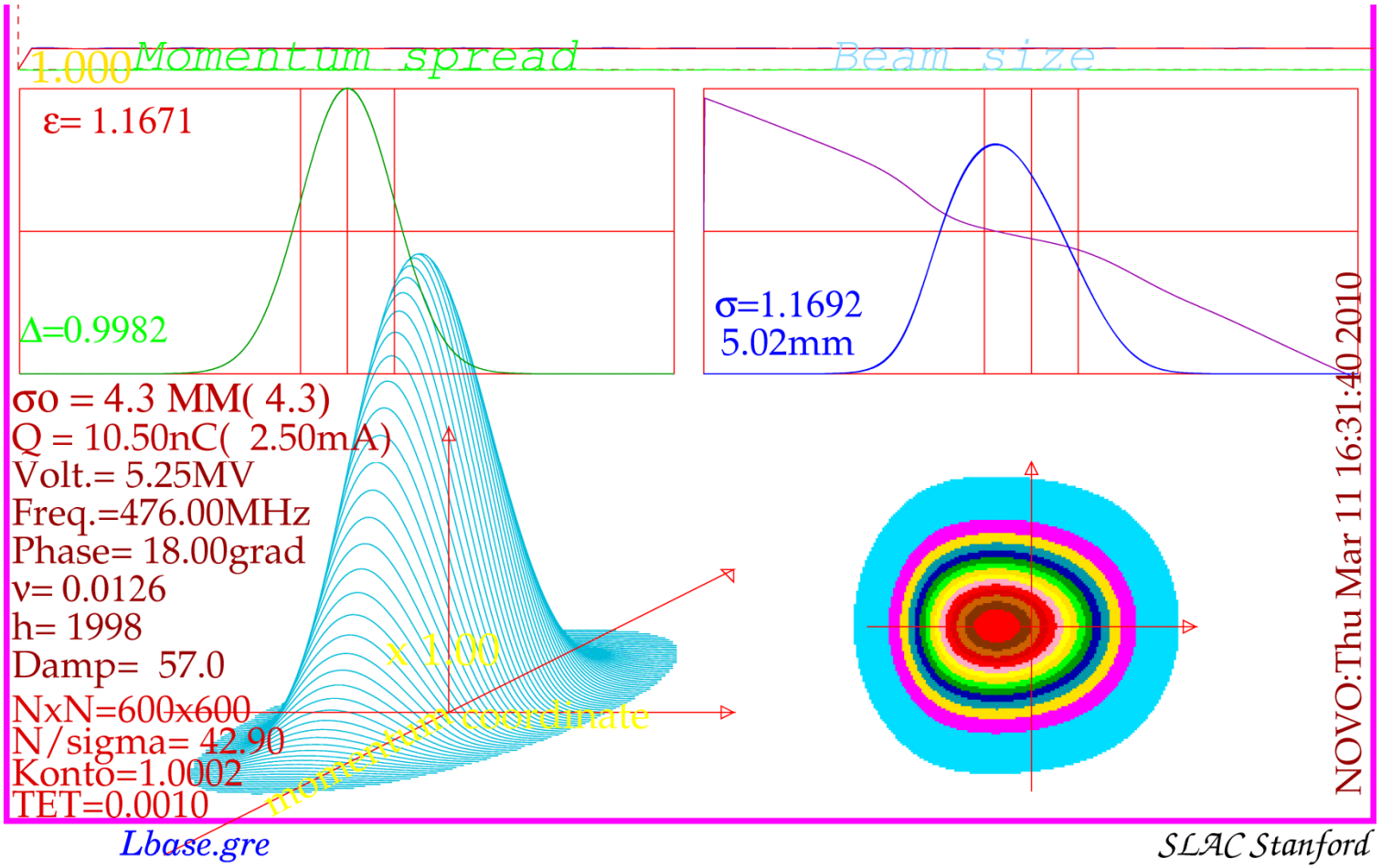

Bunch lengthening in Super-B.

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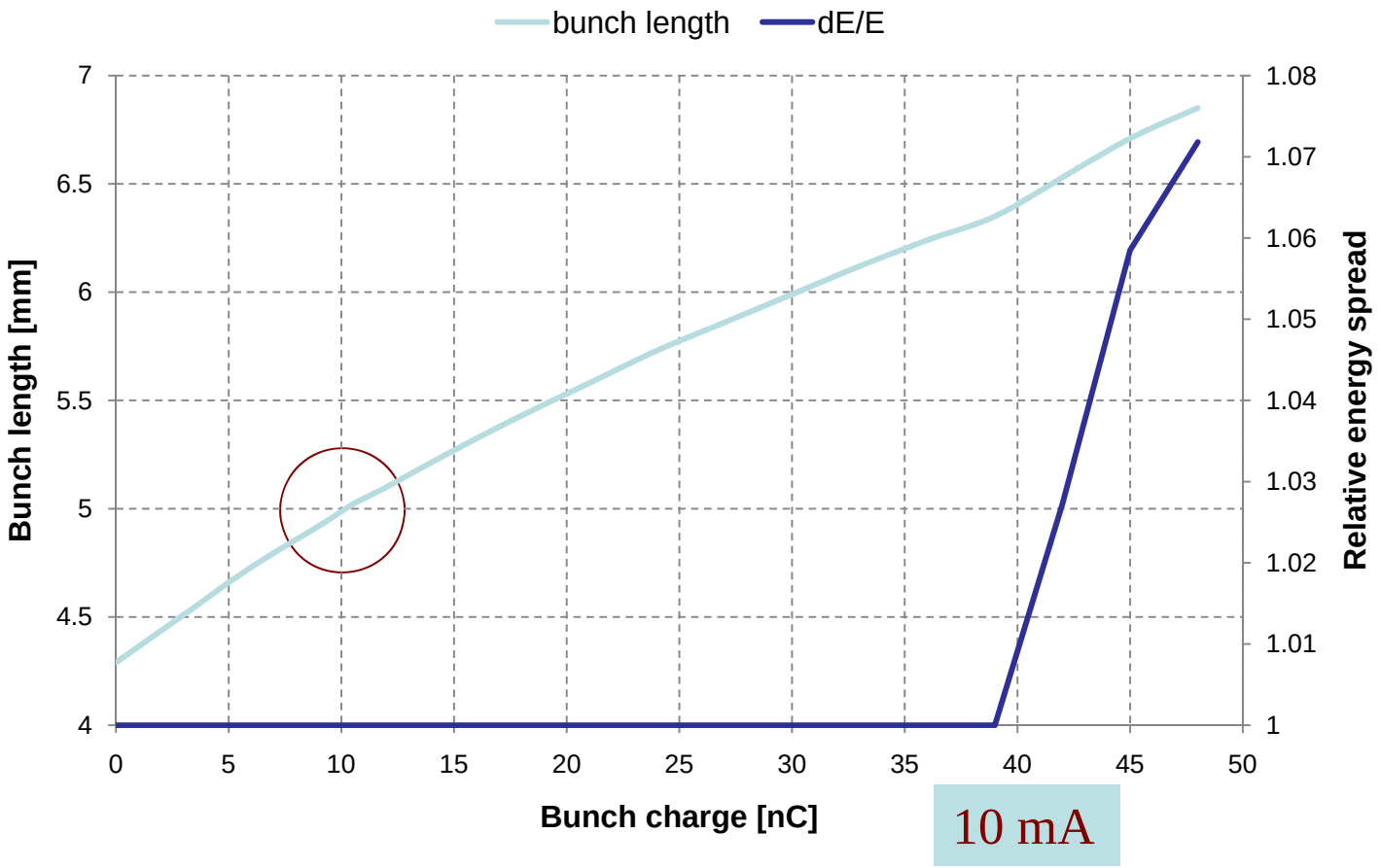
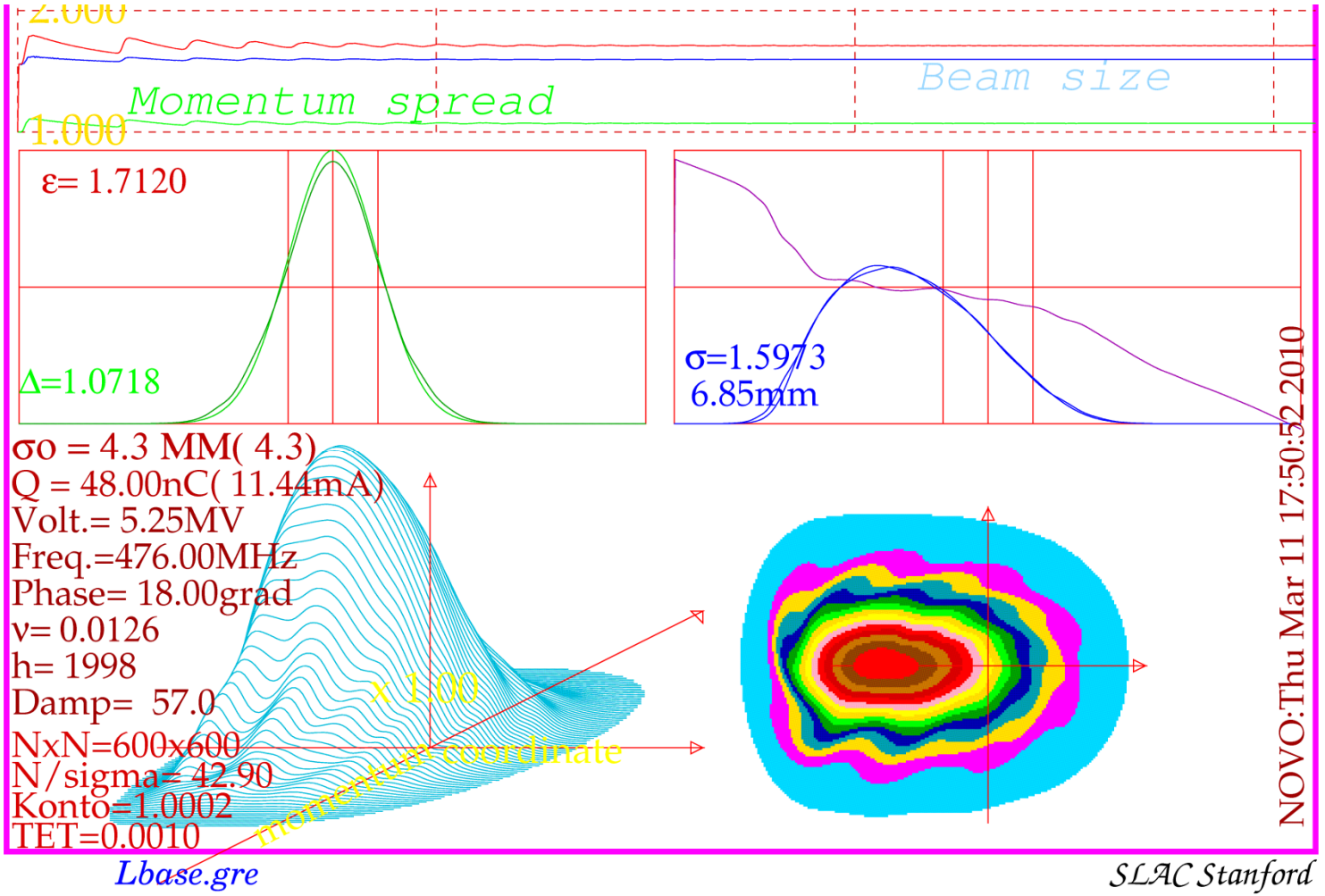
LER



10 mA

Turbulent instability at LER at 11 mA



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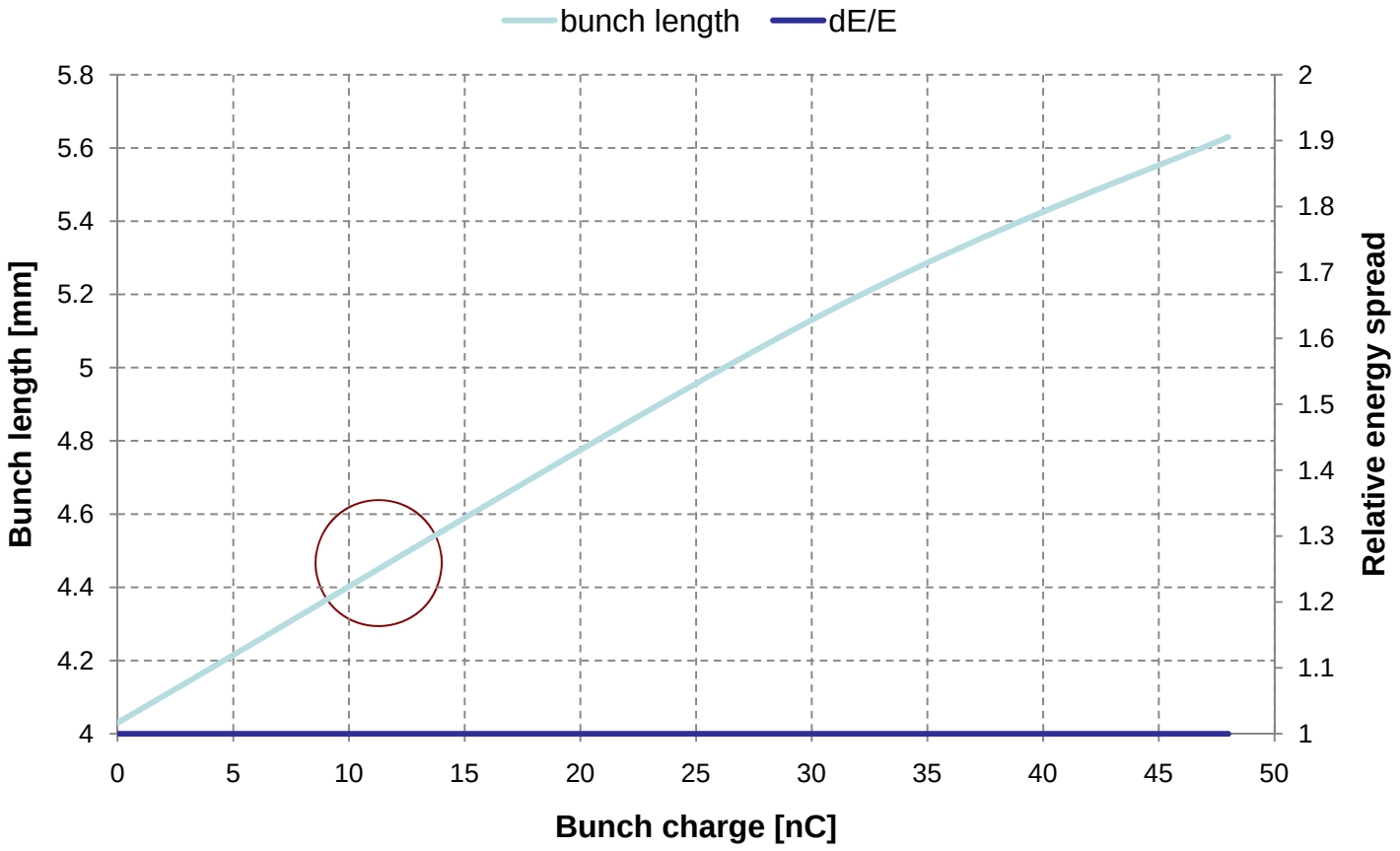
HER "high current"



Summary

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- Impedance of the main beam pipe elements (resistive-wall, cavity, kickers and collimator) keeps reasonable bunch lengthening and high instability threshold.
- However other "small' elements may increase the bunch lengthening and decrease the instability level.
- The work is continued.