Pbar IBS Studies

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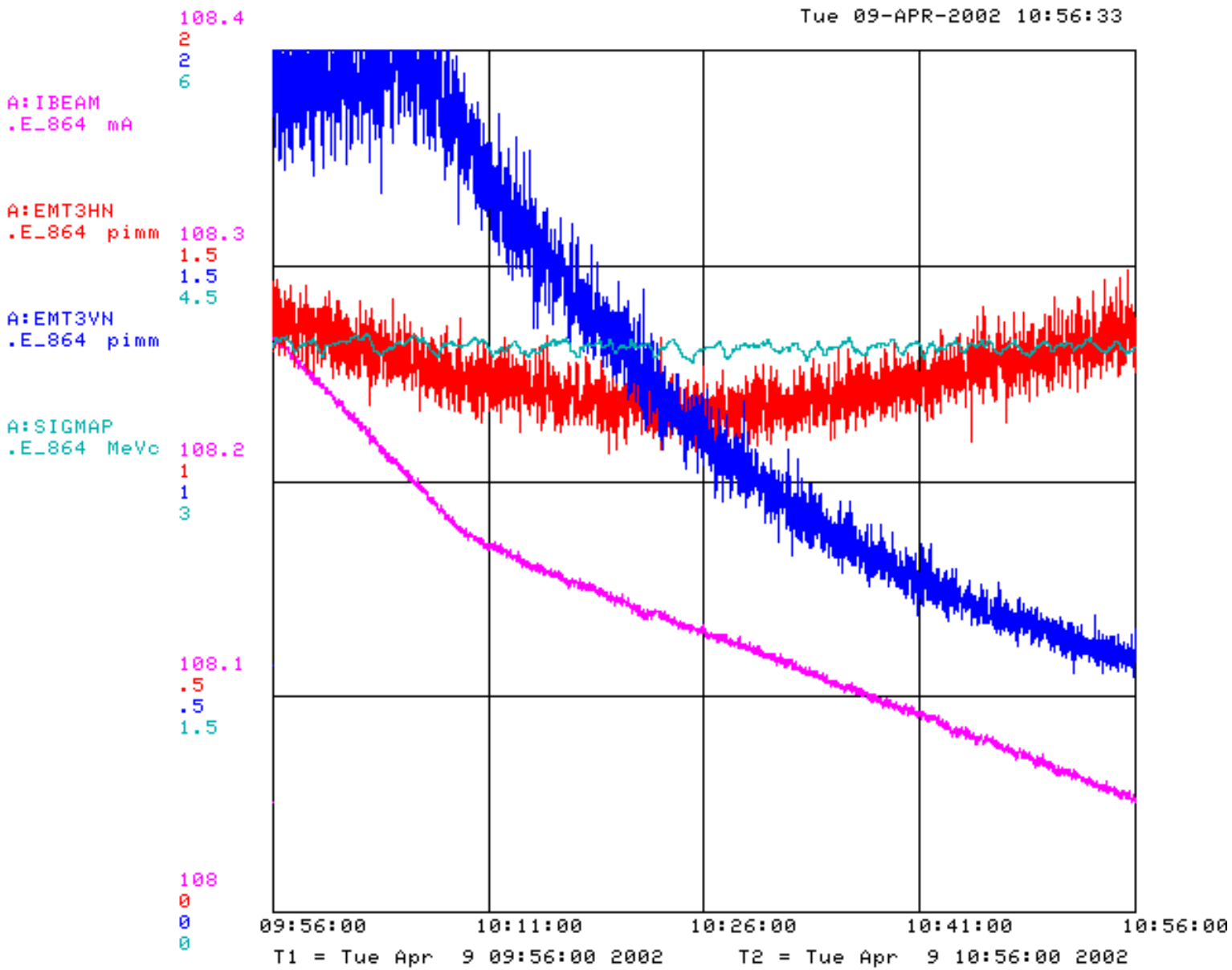
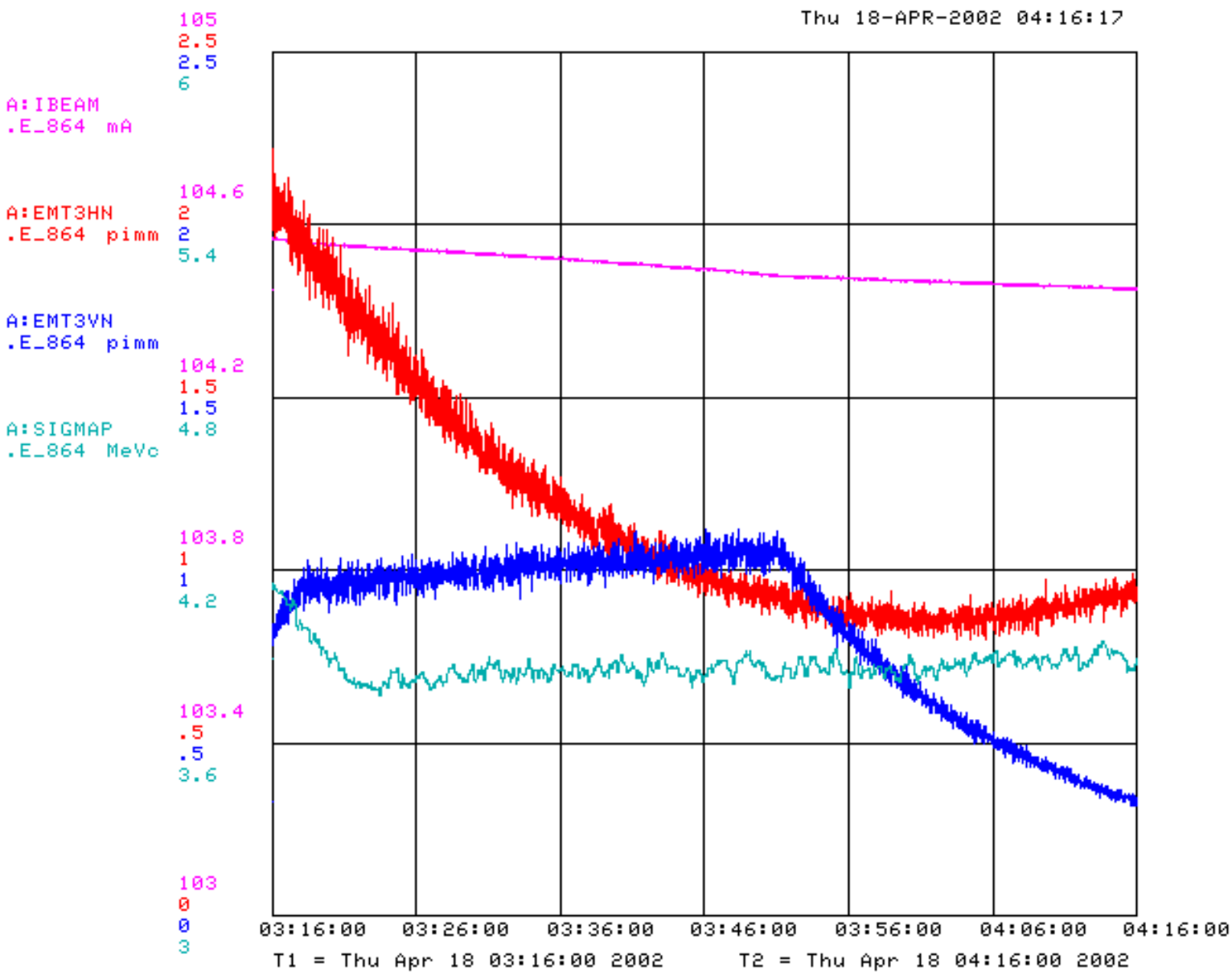
April 18, 2002

IBS Heating at Core?

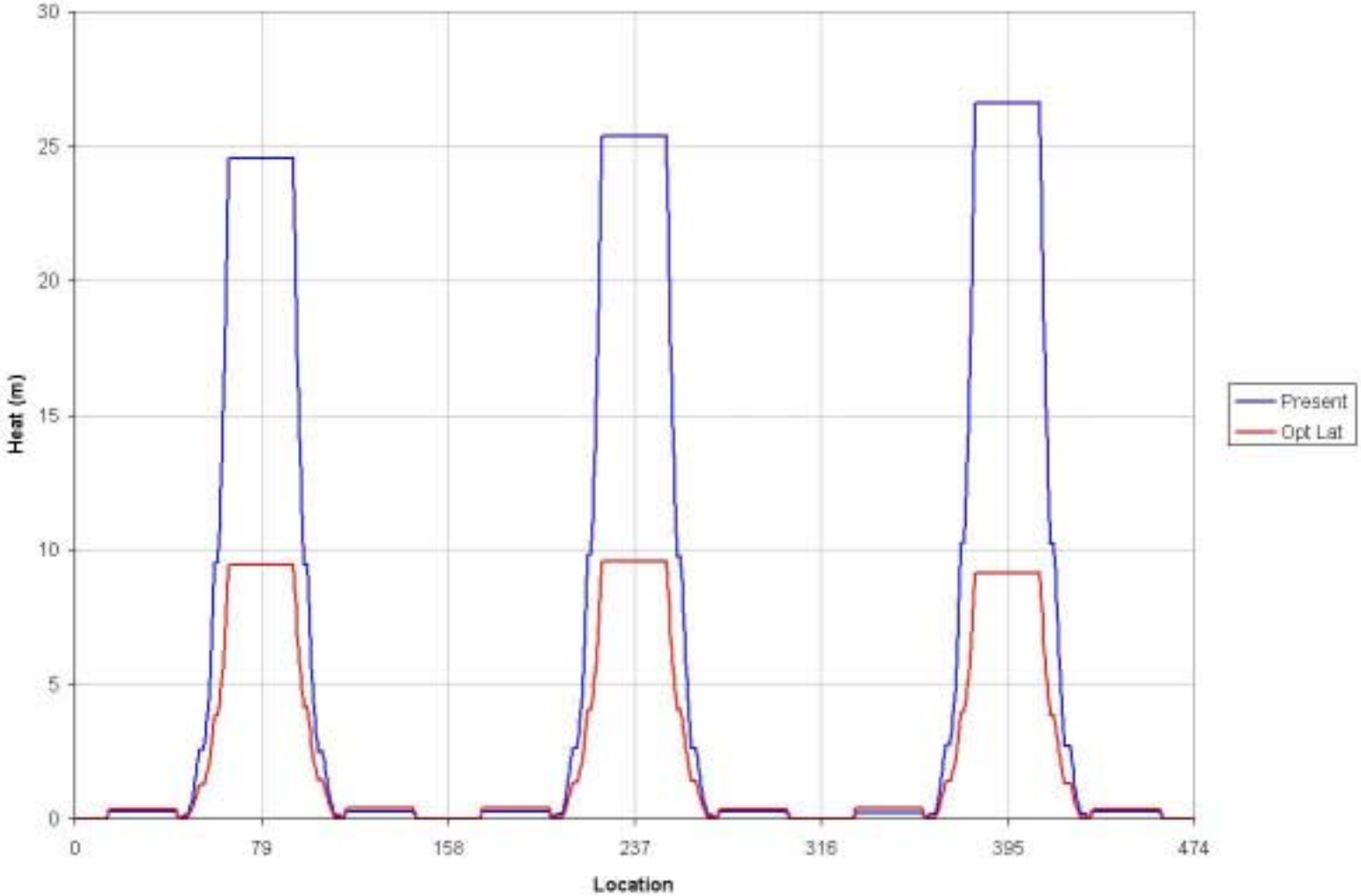


Horizontal vs Vertical II



Heating Term

$$\frac{D^2 + (\beta D' + \alpha D)^2}{\beta}$$



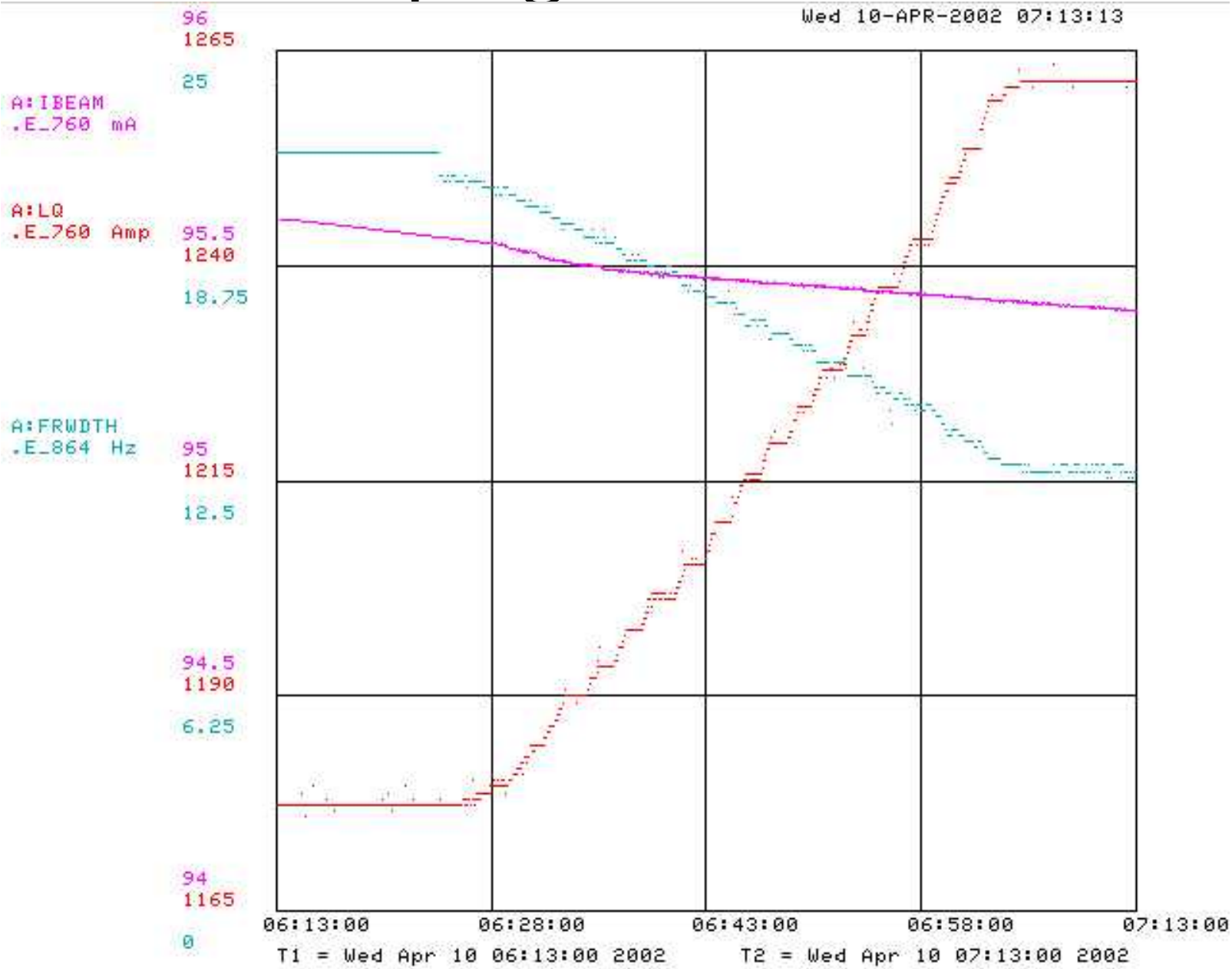
Procedure

1. Cool beam on Core. Use Thermostat. Frequency width should be 13.5.
2. Set A:RLLFS1 to A:CENFRQ. Unshort ARF3. Turn on DAC and High Level. Turn ARF3 to get about 10-20Volts.
3. Turn off 4-8 GHz Momentum cooling. Add 50 ps to trunk trombone of 4-8 Momentum system. Move plates to central orbit. Setup microwave spectrum analyzer to a harmonic of 628,848.
4. Turn off all transverse cooling
5. Bunch beam on ARF3 to 2300V (DAC 9.3). Move beam to 628848.
6. Debunch beam. Turn off ARF3. Short the gap.
7. Add 33 ps on to core settings for all transverse systems.
8. Turn on all cooling slowly (including the 4-8 Momentum)
9. Check and Adjust Signal suppression.
10. Use the Thermostat mode that DOES NOT MOVE the 4-8 Arrays.
11. Adjust chromaticity.
12. Adjust tunes – keep tunes spread by 0.010
13. Change 300 MHz Lo's
14. Adjust coupling.
15. Turn off Thermostat. Measure eta with ARF3. Turn off ARF3 when done and short the gap.
16. Set A:RCETA to measured value
17. Get frequency width to 13.5 Hz with Thermostat. Use the Thermostat mode that DOES NOT MOVE the 4-8 Arrays.
18. Reset Data logger. Make sure data logger is working.
19. Turn off Thermostat. Turn off all cooling.
20. Heat beam for 1 hour
21. Cool beam. Use Thermostat.
22. Turn off Thermostat. Reduce momentum cooling gain.
23. Change Lattice
24. Adjust tunes – keep tunes spread by 0.010
25. Change 300 MHz Lo's

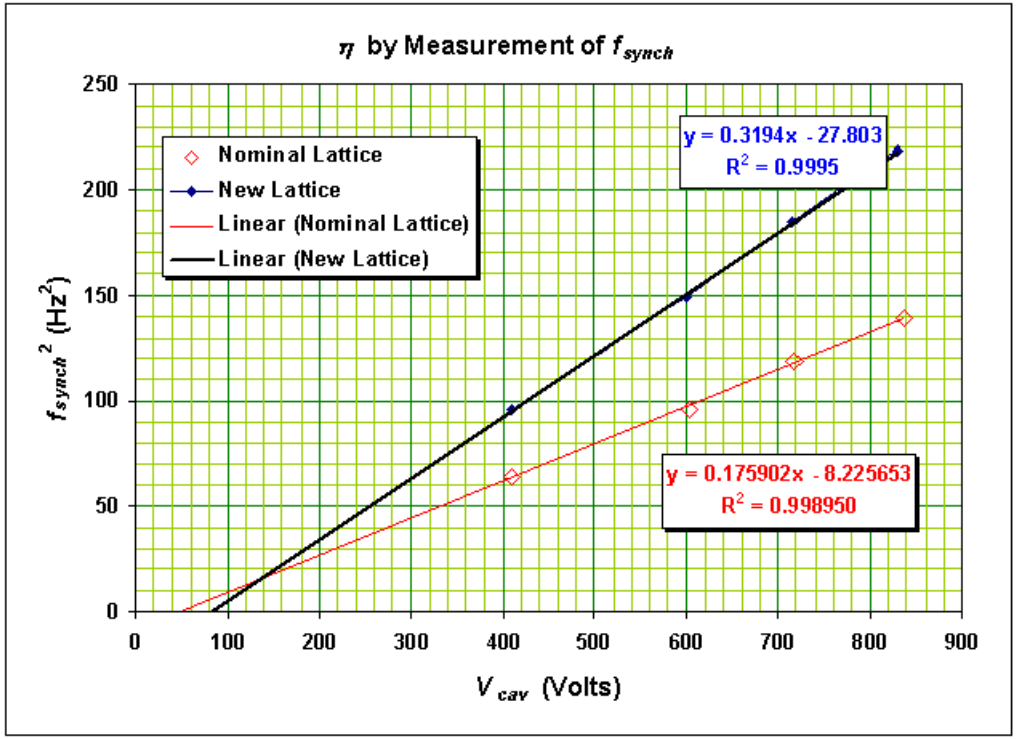
Procedure

26. Adjust coupling.
27. Turn off Thermostat. Measure eta with ARF3. Turn off ARF3 when done and short the gap.
28. Set A:RCETA to measured value
29. Get frequency width to (ETA_new / ETA_old) x 13.5 Hz with Thermostat. Use the Thermostat mode that DOES NOT MOVE the 4-8 Arrays.
30. Check and Adjust Signal suppression.
31. Cool beam to smallest emittance and record value.
32. Turn off all transverse cooling systems.
33. Mis-phase 4-8 GHz transverse cooling systems by adding or subtracting 125 ps to trunk trombones.
34. Back off on 4-8 transverse gain and turn on 4-8 GHz transverse cooling systems.
35. Slowly heat the beam until horz_emit_new_start = (12.5/13.2) x horz_emit_old_start and vert_emit_new_start = (13.4/16.1) x vert_emit_old_start
36. Turn off Thermostat. Turn off all cooling.
37. Heat beam for 1 hour
38. Remove 125ps delay change so that transverse cooling systems will cool.
39. Cool beam. Use Thermostat.
40. Turn off Thermostat. Reduce momentum cooling gain.
41. Change Lattice back to old lattice
42. IMPORTANT!!!! Remove Chromaticity changes from step 11
43. Set A:RLLFS1 to A:CENFRQ. Unshort ARF3. Turn on DAC and High Level. Turn ARF3 to get about 10-20Volts.
44. Turn off 4-8 GHz Momentum cooling. Subtract 50 ps to trunk trombone of 4-8 Momentum system. Move plates to core orbit. Setup microwave spectrum analyzer to a harmonic of 628,888.
45. Turn off all transverse cooling
46. Bunch beam on ARF3 to 2300V (DAC 9.3). Move beam to 628888.
47. Debunch beam. Turn off ARF3. Short the gap.
48. Subtract 33 ps on to core settings for all transverse systems.
49. Turn on cooling
50. Adjust Tunes and coupling

Ramping the Lattice



Eta Measurement



4/18/02	Pbar Electronic Logbook 2002 - Owl Shift					
New Lattice						
				Unconstrained	Go thru (0,0)	
P_{beam} =	8791.39	**MeV/c**	**slope =**	0.29153	0.25616	
L_{orbit} =	474.037573	**m**	**η =**	**0.02025**	**0.01779**	
f_{rev} =	628848	**Hz**	**γ_t =**	**5.6336**	**5.8669**	
Central Orbit + 8 Hz						
		AP10 FB				
A:R3LLAM	**A:R3HLFB**	**FB Pk-Pk**	**Cavity Ampl.**	**f_{synch}**	**expected**	**f_{synch}^2**
	(Volts)	**(mV)**	**(Volts)**	**(Hz)**	**(Hz)**	**(Hz^2)**
7.670	449.90	32.80	410.00	9.8125	7.5825	96.285
7.995	640.40	47.90	598.75	12.2185	9.1631	149.292
8.175	775.60	57.20	715.00	13.5935	10.0132	184.783
8.340	928.20	66.40	830.00	14.7810	10.7884	218.478

Quad Settings

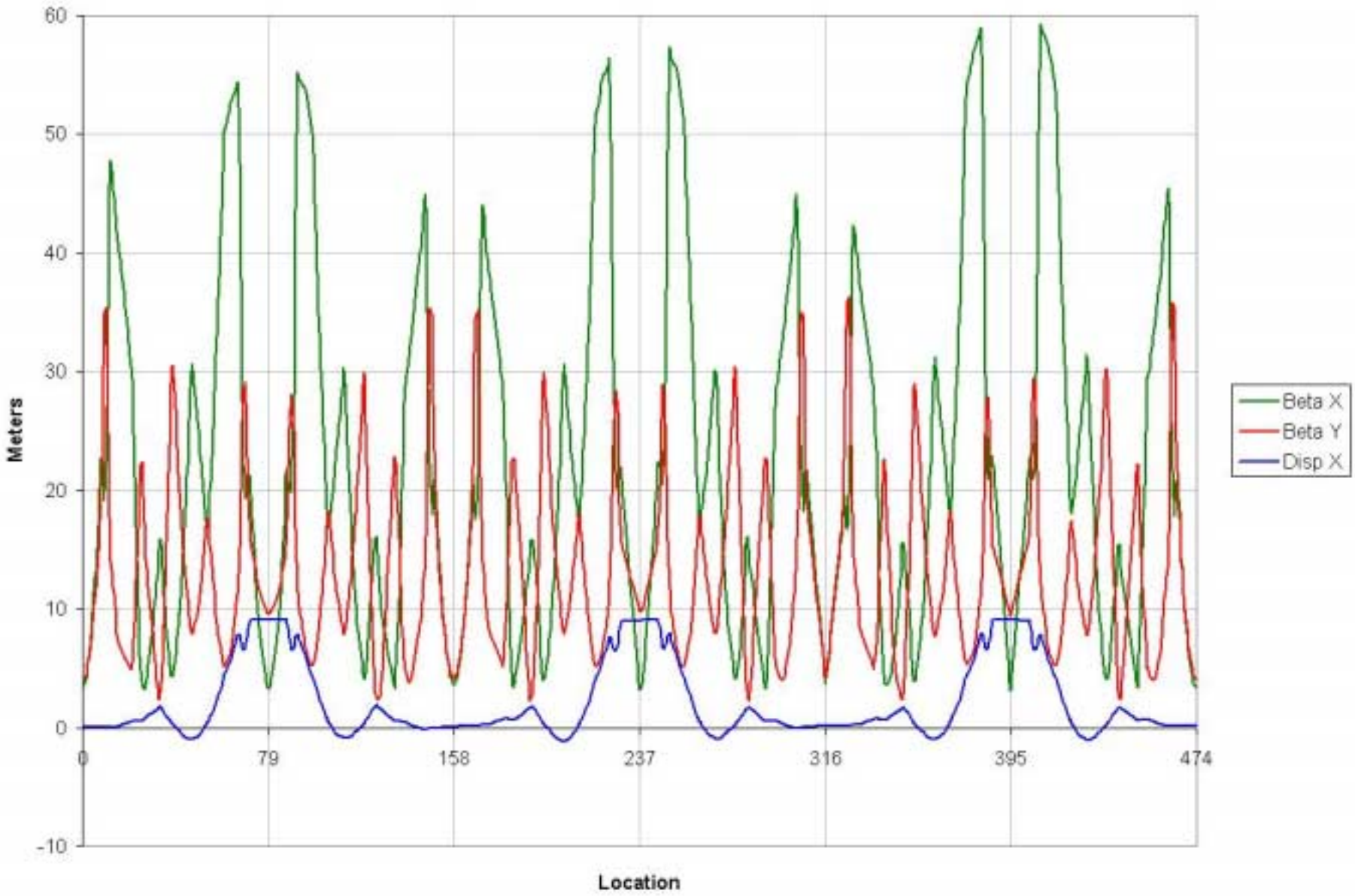
! Quad Shunt Settings			
!	latt_012	latt_022	latt_022 - latt_012
IQS103	7.013	0.001	-7.013
IQS104	0.003	0.003	0.000
IQS105	0.008	0.008	0.000
IQS106	7.000	24.900	17.900
IQS108	17.310	3.720	-13.589
IQS110	49.900	27.040	-22.860
IQS111	46.770	47.046	0.277
IQS114	12.830	2.316	-10.515
IQS203	7.457	0.224	-7.233
IQS204	0.000	0.000	0.000
IQS205	0.000	0.000	0.000
IQS206	7.674	24.610	16.936
IQS208	15.390	0.163	-15.227
IQS210	49.900	15.879	-34.021
IQS211	49.900	49.900	0.000
IQS214	20.280	7.277	-13.004
IQS303	7.046	0.001	-7.045
IQS306	8.430	22.520	14.090
IQS307	0.003	0.003	0.000
IQS308	15.580	5.921	-9.659
IQS310	49.620	49.900	0.280
IQS311	45.740	48.630	2.891
IQS314	14.430	0.001	-14.430
IQS401	0.004	0.004	0.000
IQS403	8.400	0.001	-8.399
IQS406	7.253	24.900	17.646
IQS408	17.280	2.695	-14.584
IQS410	47.620	33.390	-14.230
IQS411	46.920	49.898	2.979
IQS414	17.701	4.891	-12.809
IQS501	0.004	0.004	0.000
IQS503	7.602	1.023	-6.579

26	IQS401	0.004	0.004	0.000
27	IQS403	8.400	0.001	-8.399
28	IQS406	7.253	24.900	17.646
29	IQS408	17.280	2.695	-14.584
30	IQS410	47.620	33.390	-14.230
31	IQS411	46.920	49.898	2.979
32	IQS414	17.701	4.891	-12.809
33	IQS501	0.004	0.004	0.000
34	IQS503	7.602	1.023	-6.579
35	IQS506	10.610	24.900	14.289
36	IQS508	16.550	2.328	-14.221
37	IQS510	44.790	49.125	4.335
38	IQS511	48.530	48.151	-0.379
39	IQS514	13.420	0.455	-12.965
40	IQS603	6.016	2.292	-3.723
41	IQS606	9.200	24.900	15.700
42	IQS608	19.580	0.000	-19.579
43	IQS610	47.570	49.898	2.329
44	IQS611	43.870	36.754	-7.116
45	IQS614	12.900	12.888	-0.012
46	IQSF1	13.200	7.783	-5.417
47	IQSD	10.600	10.359	-0.241
48	IQT	266.853	261.621	-5.232
49	IQDF	249.902	256.709	6.807
50	ILQ	1263.856	1180.157	-83.699
51	ISEX3	0.000	0.000	0.000
52	ISEX7	0.000	0.000	0.000
53	ISEX9	0.000	0.000	0.000
54	ISEX10	391.992	391.992	0.000
55	ISEX12	580.994	580.994	0.000
56	IOCT10	52.009	52.009	0.000
57	IOCT12	64.036	64.036	0.000
58	!			
59	RETURN			

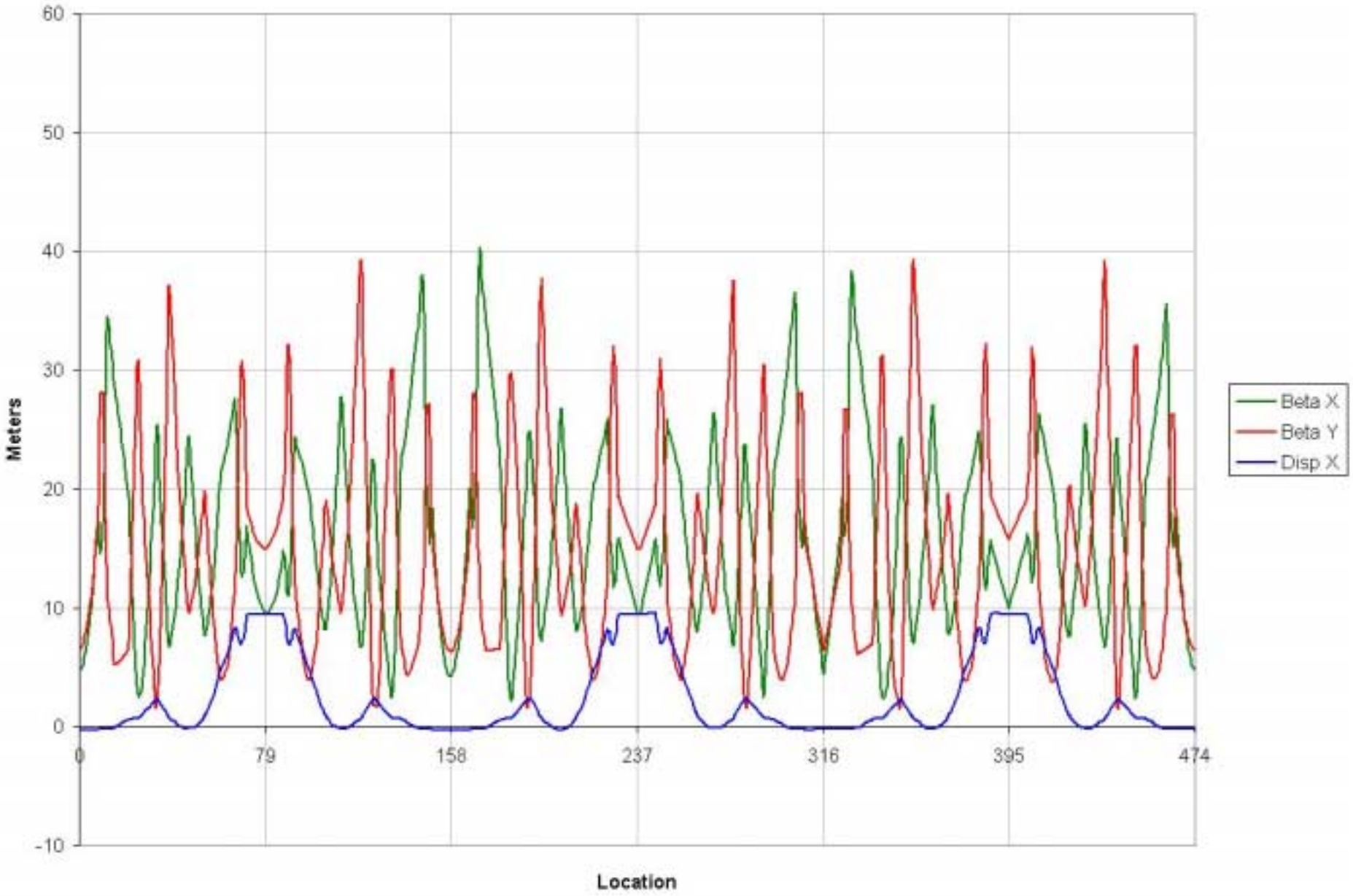
Quad Fudge Factors

! Fudge	Factor	Settings		
!		lat 012		lat 022
FIQDF	:=	-0.03218		-0.03335
FIQSF1	:=	0		-0.00177
FIQSD	:=	0		-0.02161
FIQT	:=	0.000776		0.003792
FILQ	:=	-0.00258		0.016327
FMBX_K1	:=	0.178424		0.178424
FMB3_K1	:=	-0.59588		-0.59588
FMB7_K1	:=	-0.23255		-0.23255
FMB8_K1	:=	-0.51691		-0.51691
FMB9_K1	:=	0.569868		0.569868
FMB10_K1	:=	0.122509		0.122509

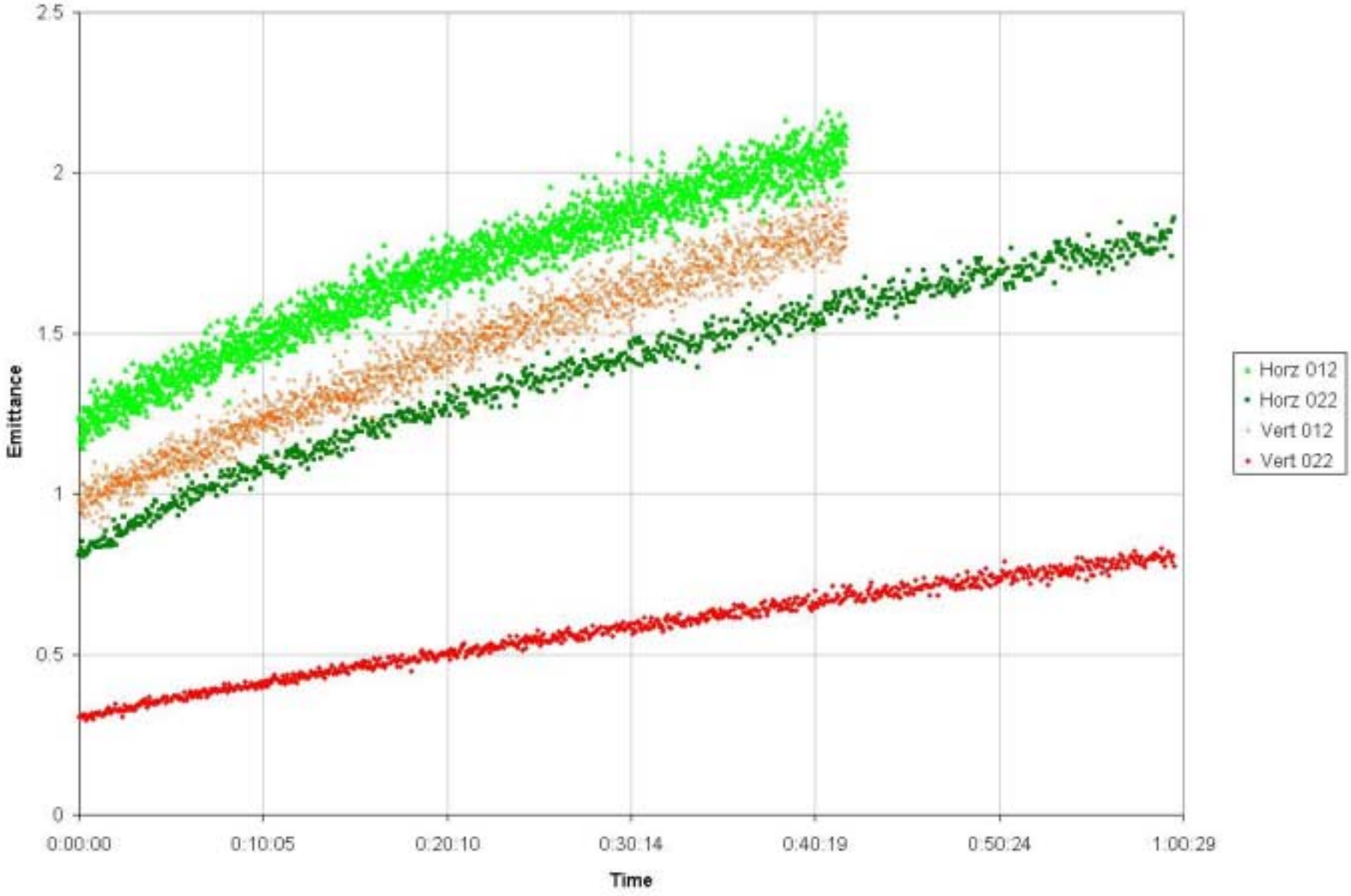
Initial Lattice



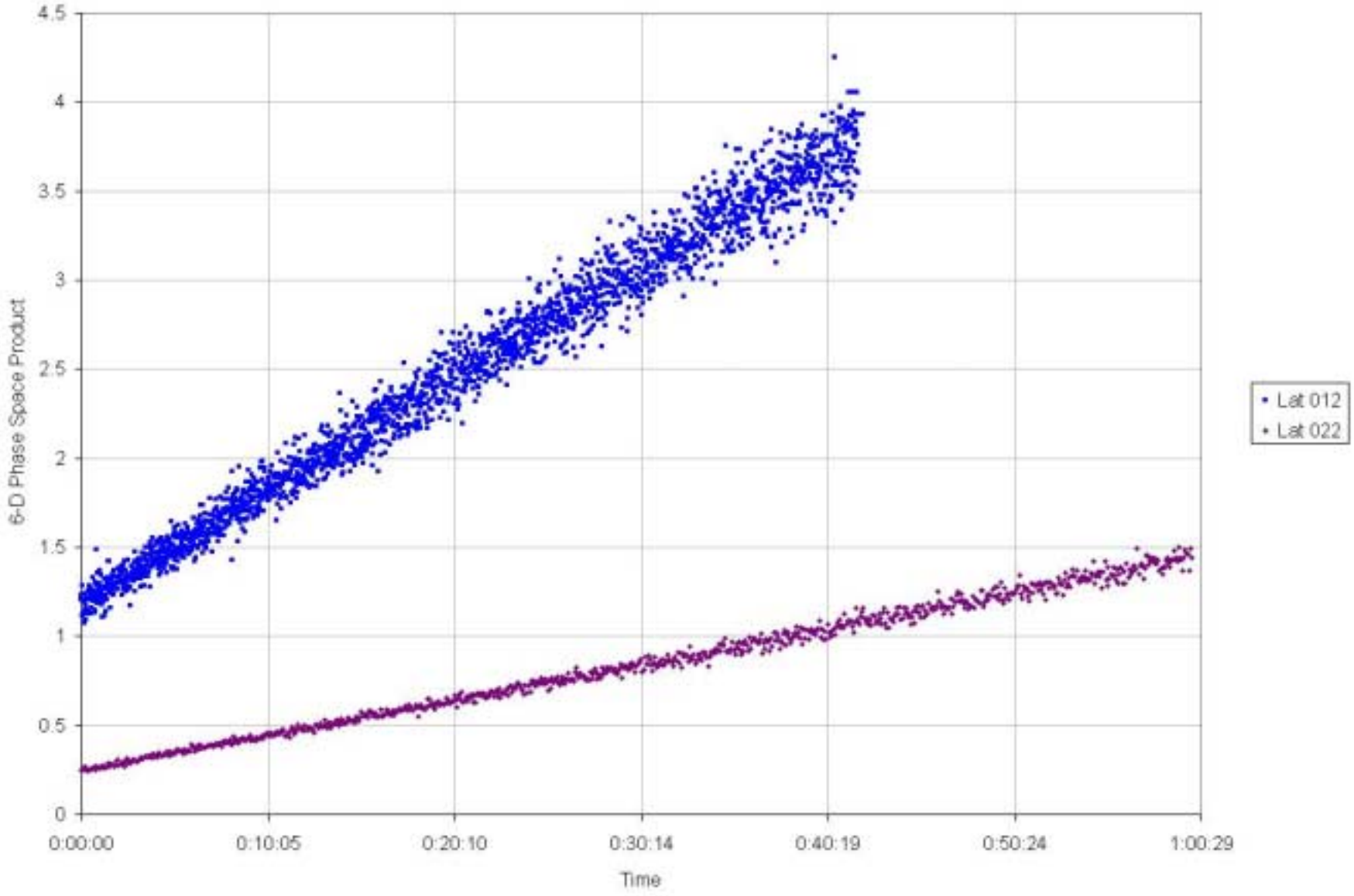
New Lattice


60
50
40
30
20
10
0
-10
Meters
0
79
158
237
316
395
474
Location
Beta X
Beta Y
Disp X

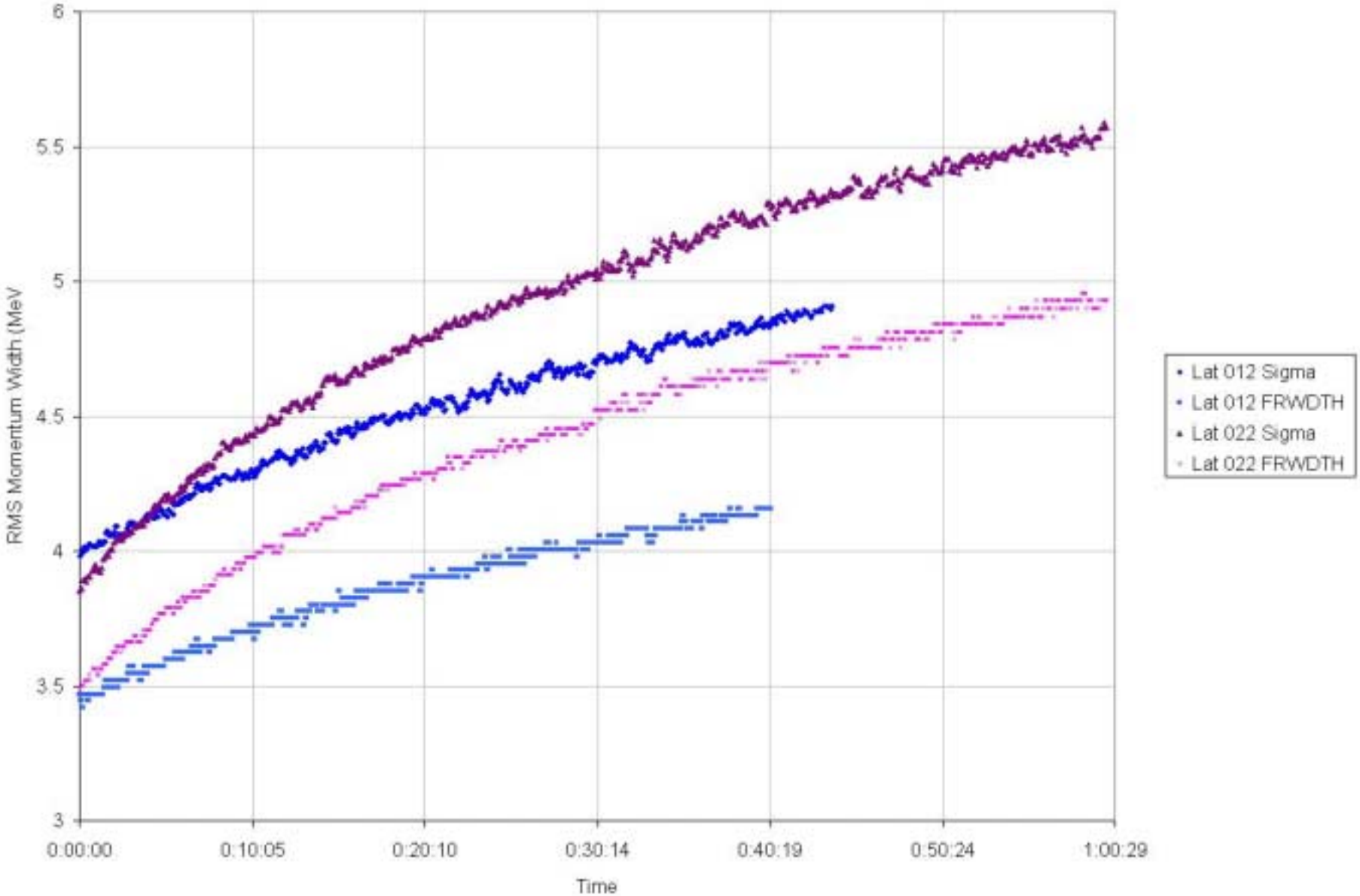
Emittance Growth



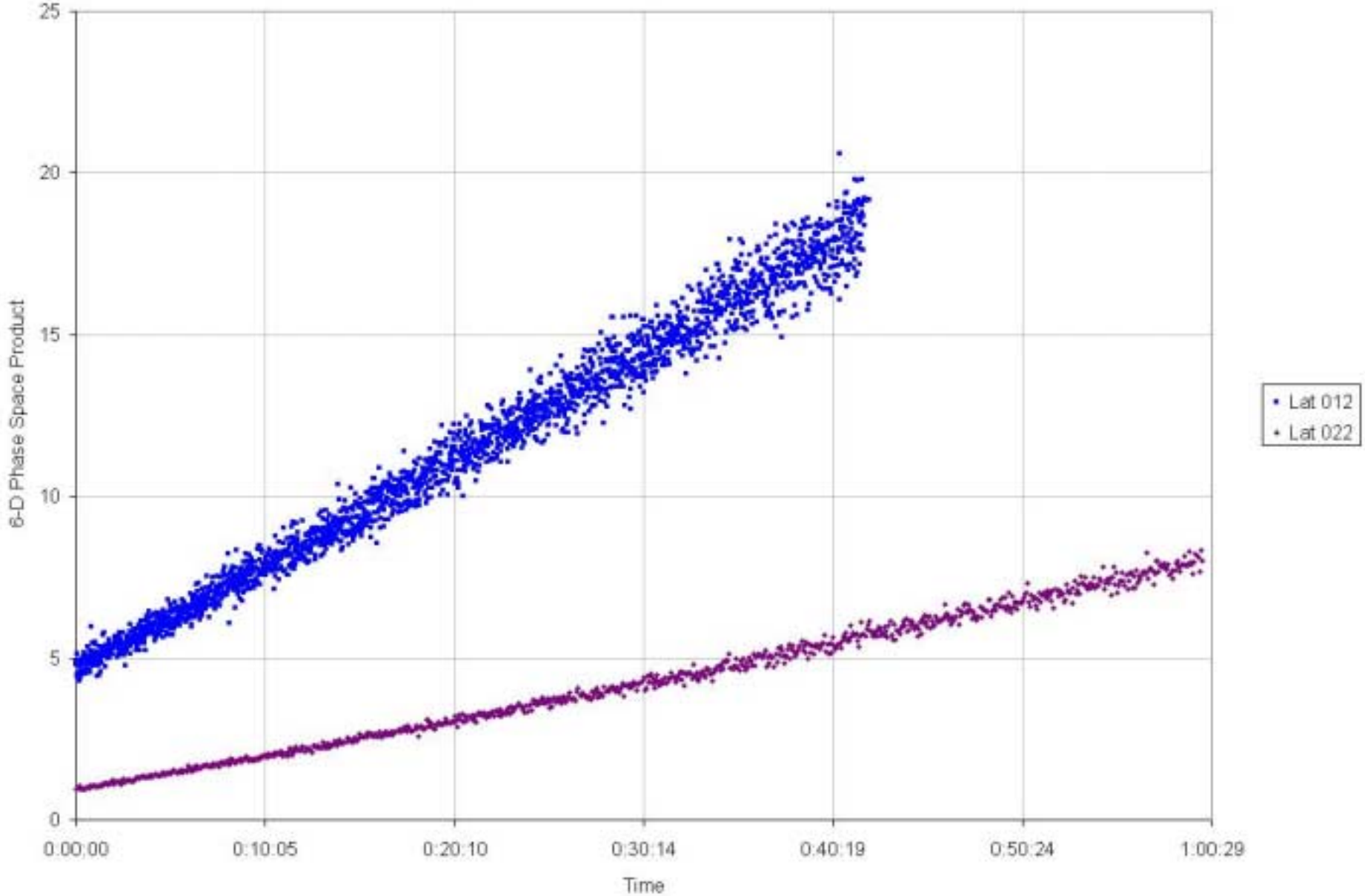
4-D Phase Space Growth



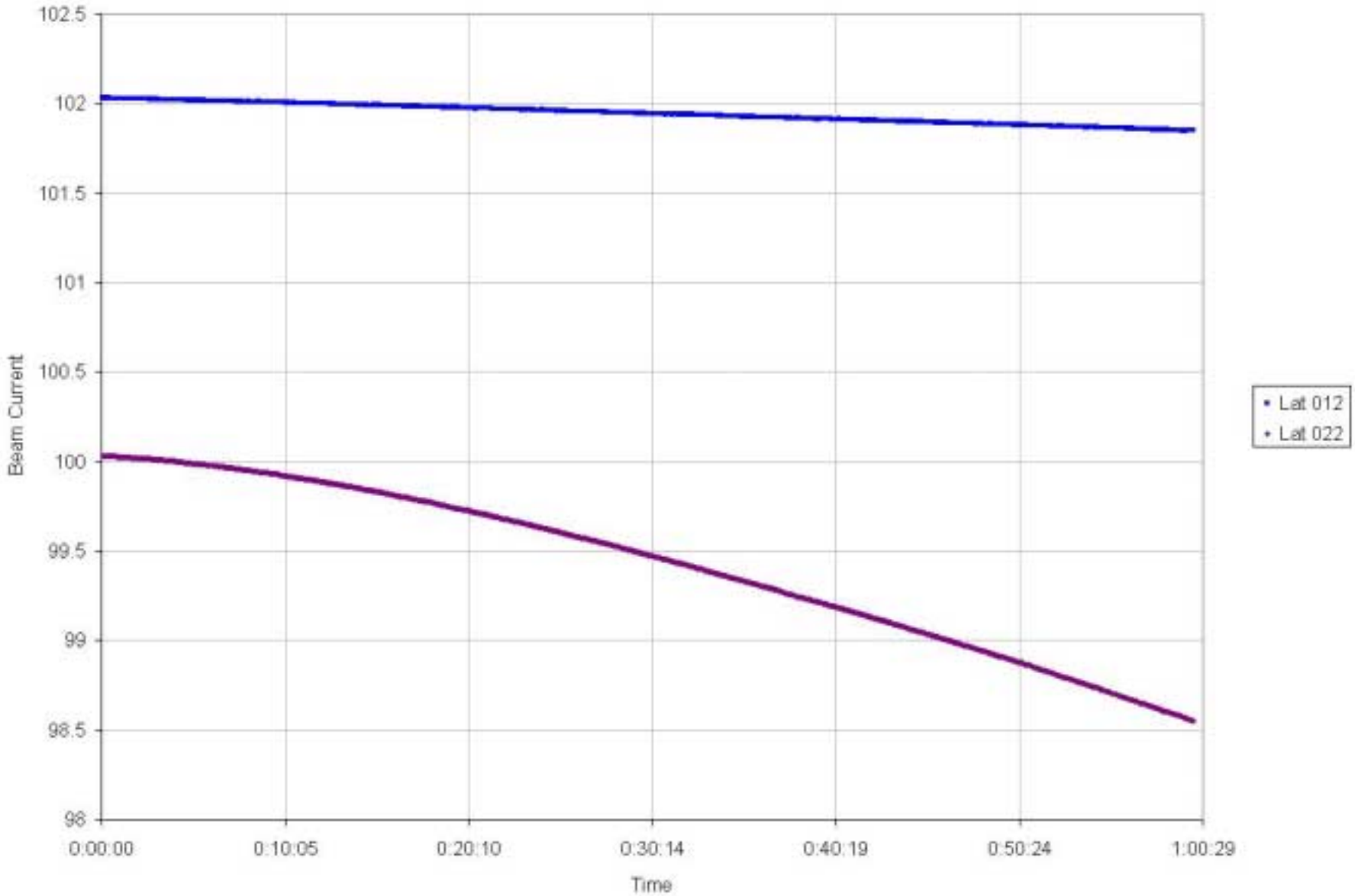
Longitudinal Growth



6-D Phase Space Growth



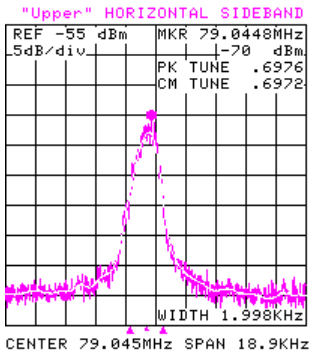
Beam Lifetime



Conclusions

- 4-D growth rate seems to be reduced by a factor of 3 with new lattice
- However:
  - Initial emittances were not the same
  - Tunes were close together (not at nominal)
    - Coupling
    - Emittance monitors
  - Horizontal chromaticity at central orbit was large

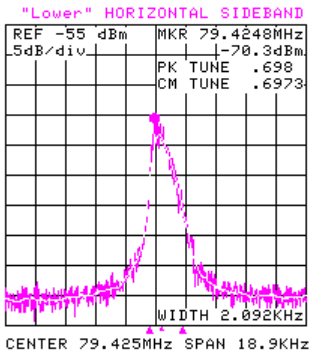
Tunes & Chromaticity

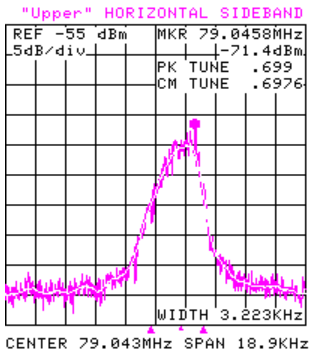


ACCUMULATOR

04/17/02 1902

BEAM CURRENT	106.8 mA
HARMONIC NUMBER	126
REV FREQUENCY	628849 Hz
DELTAP/P	.2208 %
HORIZONTAL TUNE	.6973
VERTICAL TUNE	.6831
HORZ CHROMATICITY	.0253
VERT CHROMATICITY	-.0083

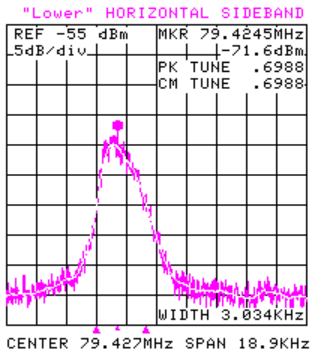


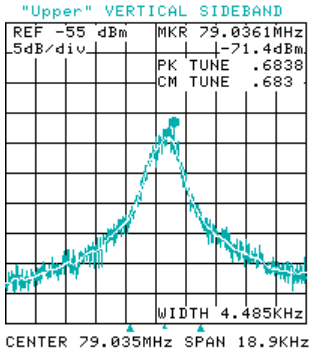


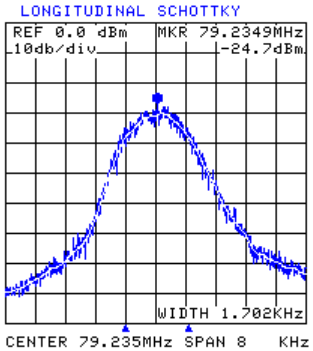
ACCUMULATOR

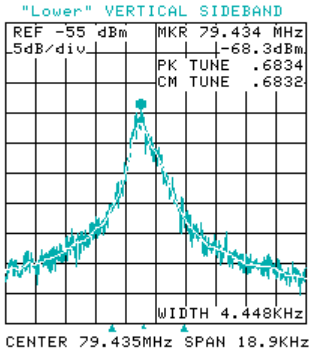
04/17/02 2344

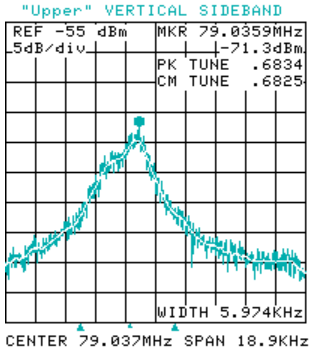
BEAM CURRENT	106 mA
HARMONIC NUMBER	126
REV FREQUENCY	628850 Hz
DELTAP/P	.3887 %
HORIZONTAL TUNE	.6982
VERTICAL TUNE	.6831
HORZ CHROMATICITY	-.0399
VERT CHROMATICITY	-.0492

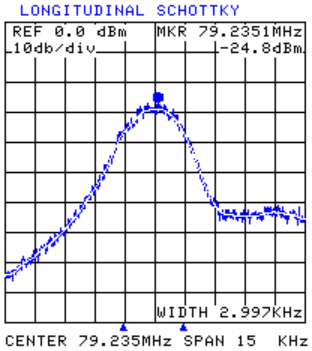


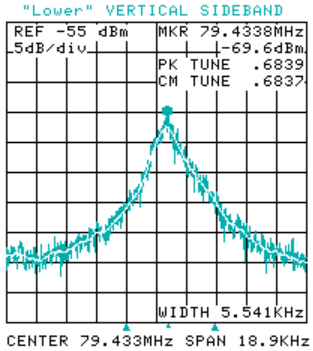








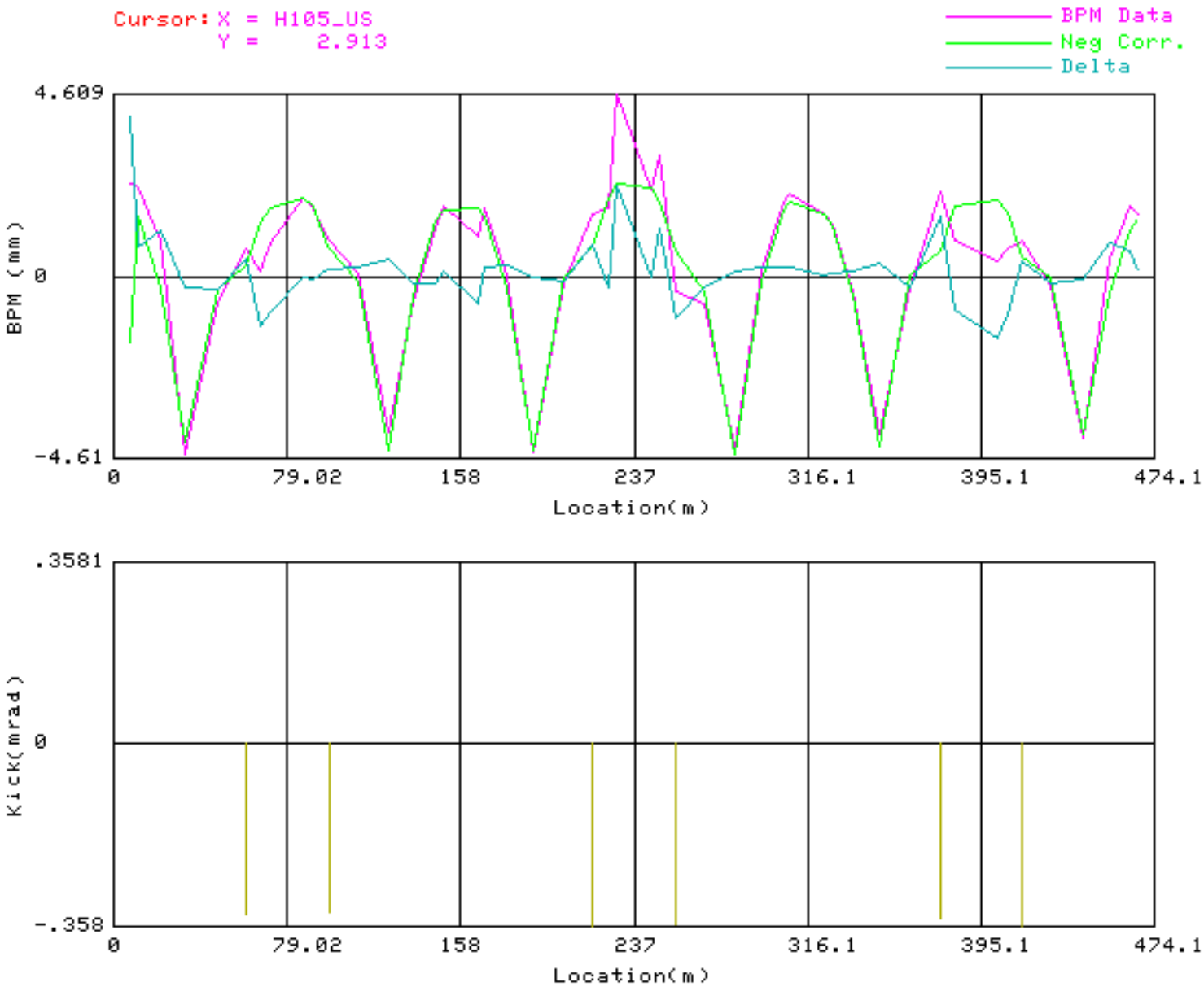




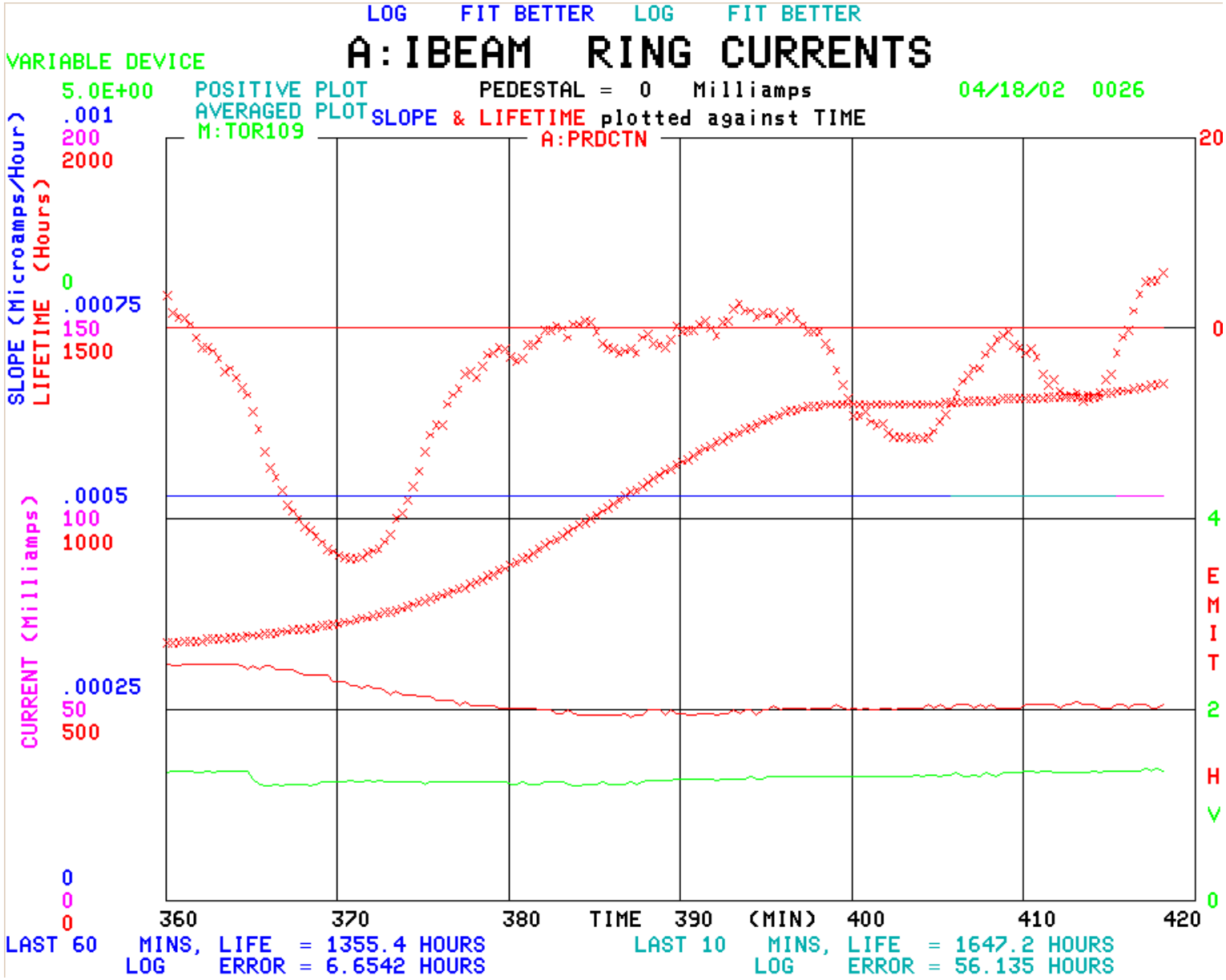
Lattice 012

Lattice 022

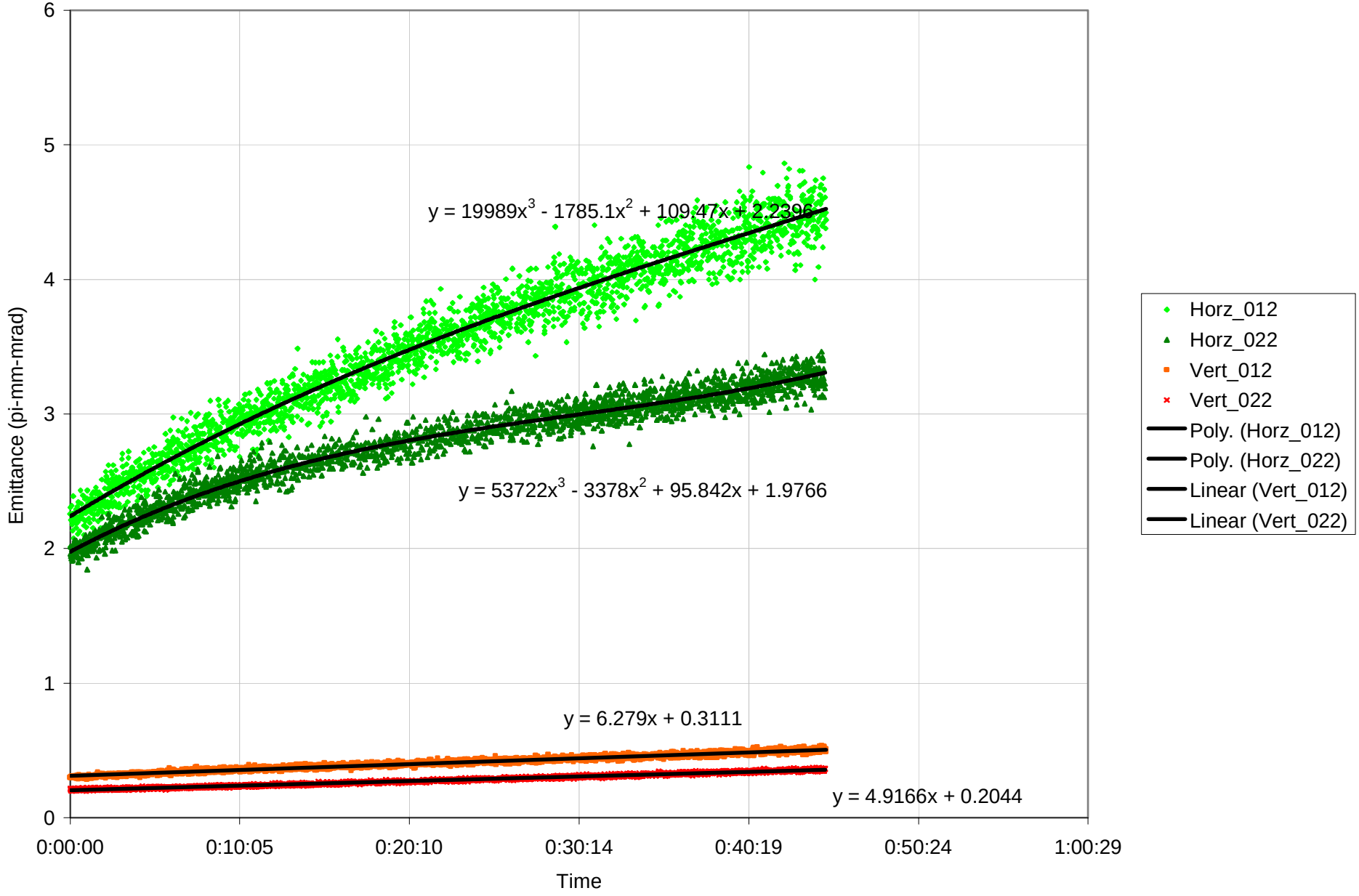
Sextupole Feed-down



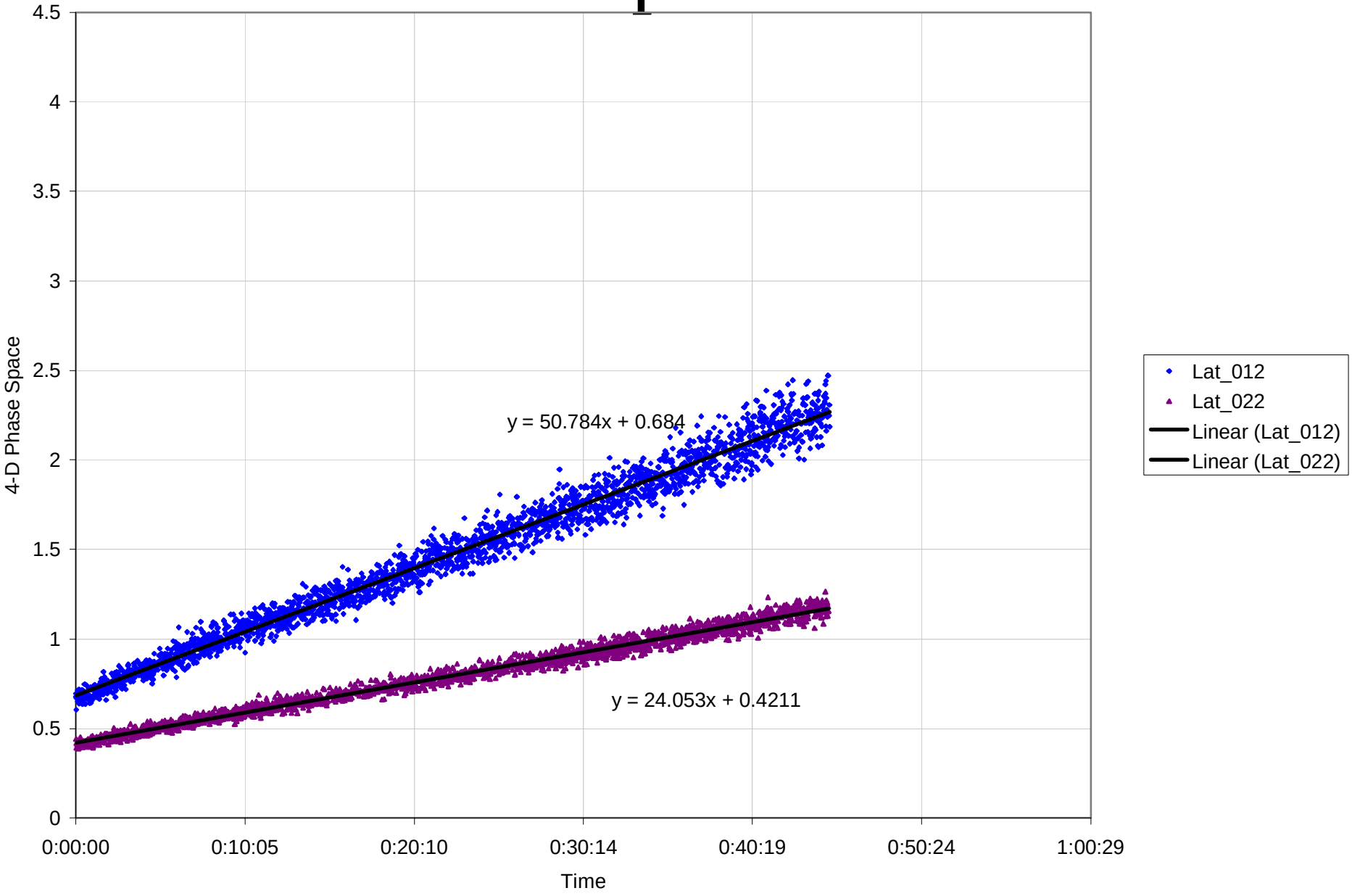
Lifetime II


LOG FIT BETTER LOG FIT BETTER
A:IBEAM RING CURRENTS
VARIABLE DEVICE
5.0E+00
POSITIVE PLOT
AVERAGED PLOT
M:TOR109
PEDESTAL = 0 Milliamps
04/18/02 0026
SLOPE & LIFETIME plotted against TIME
A:PRDCTN
SLOPE (Microamps/Hour)
LIFETIME (Hours)
CURRENT (Milliamps)
.001
200
2000
0
.00075
150
1500
.0005
100
1000
.00025
50
500
0
0
0
20
0
4
2
0
EMIT
HV
360
370
380
TIME
390
(MIN)
400
410
420
LAST 60 MINS, LIFE = 1355.4 HOURS
LOG ERROR = 6.6542 HOURS
LAST 10 MINS, LIFE = 1647.2 HOURS
LOG ERROR = 56.135 HOURS

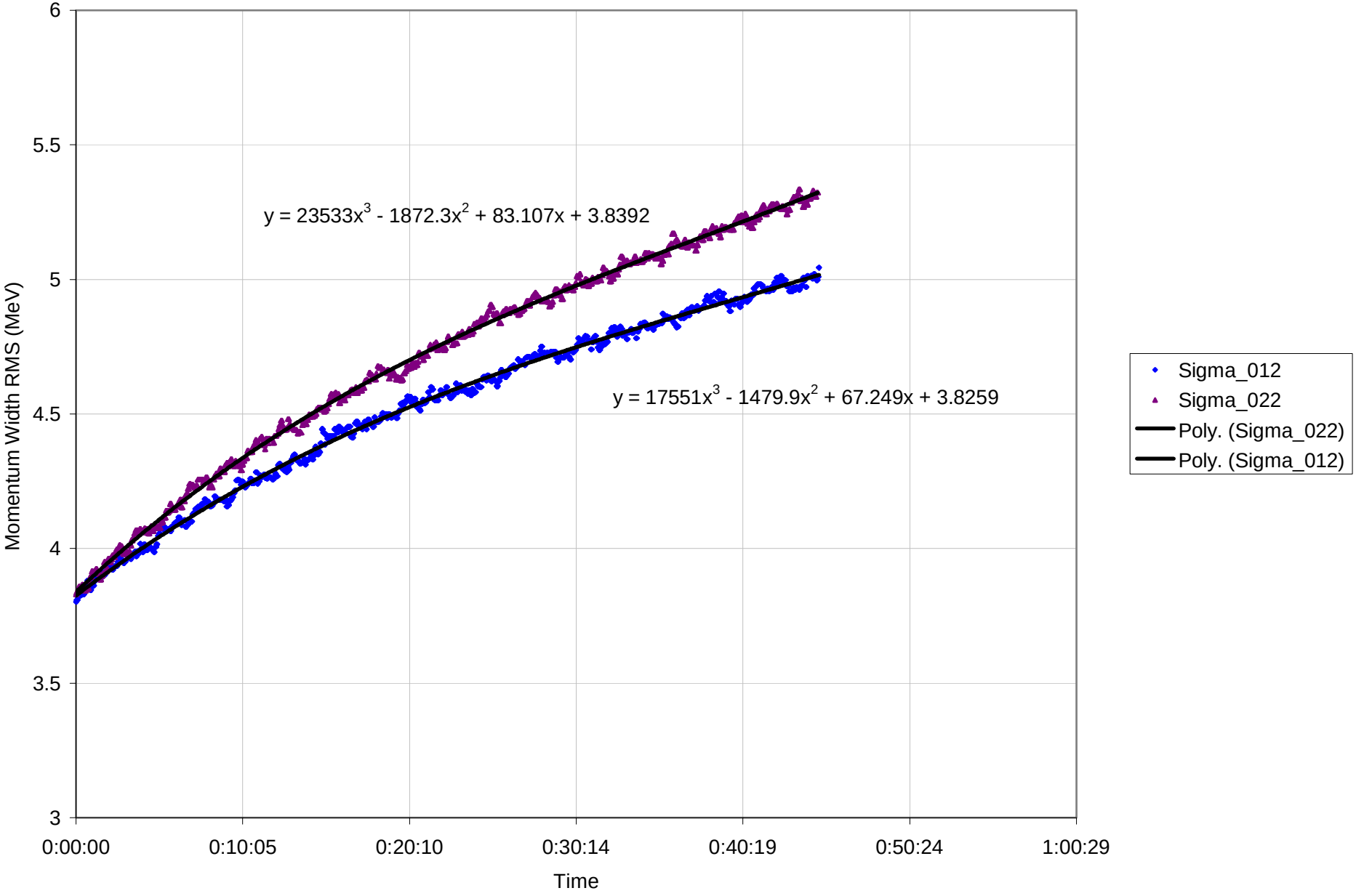
Emittance Growth II



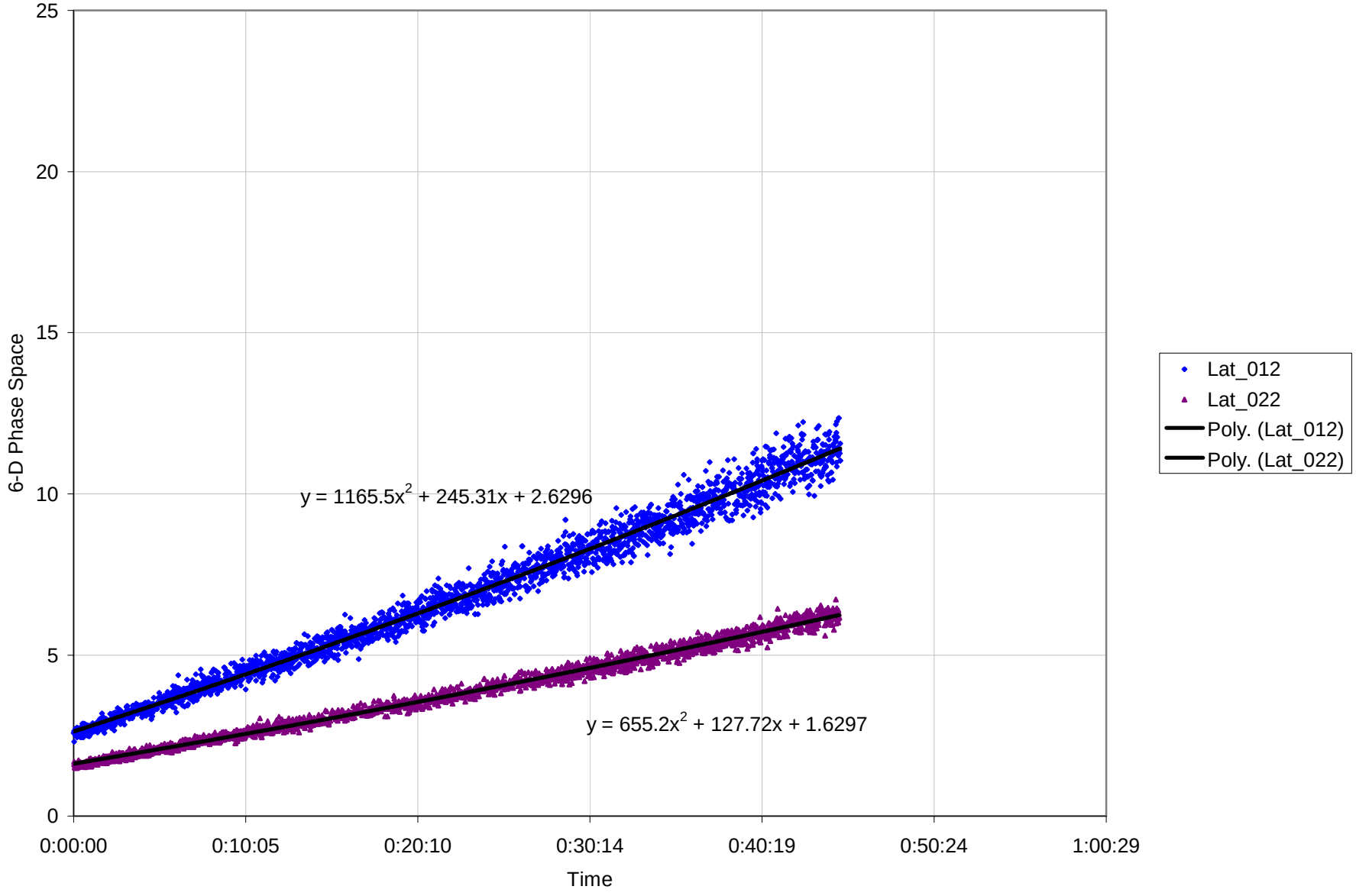
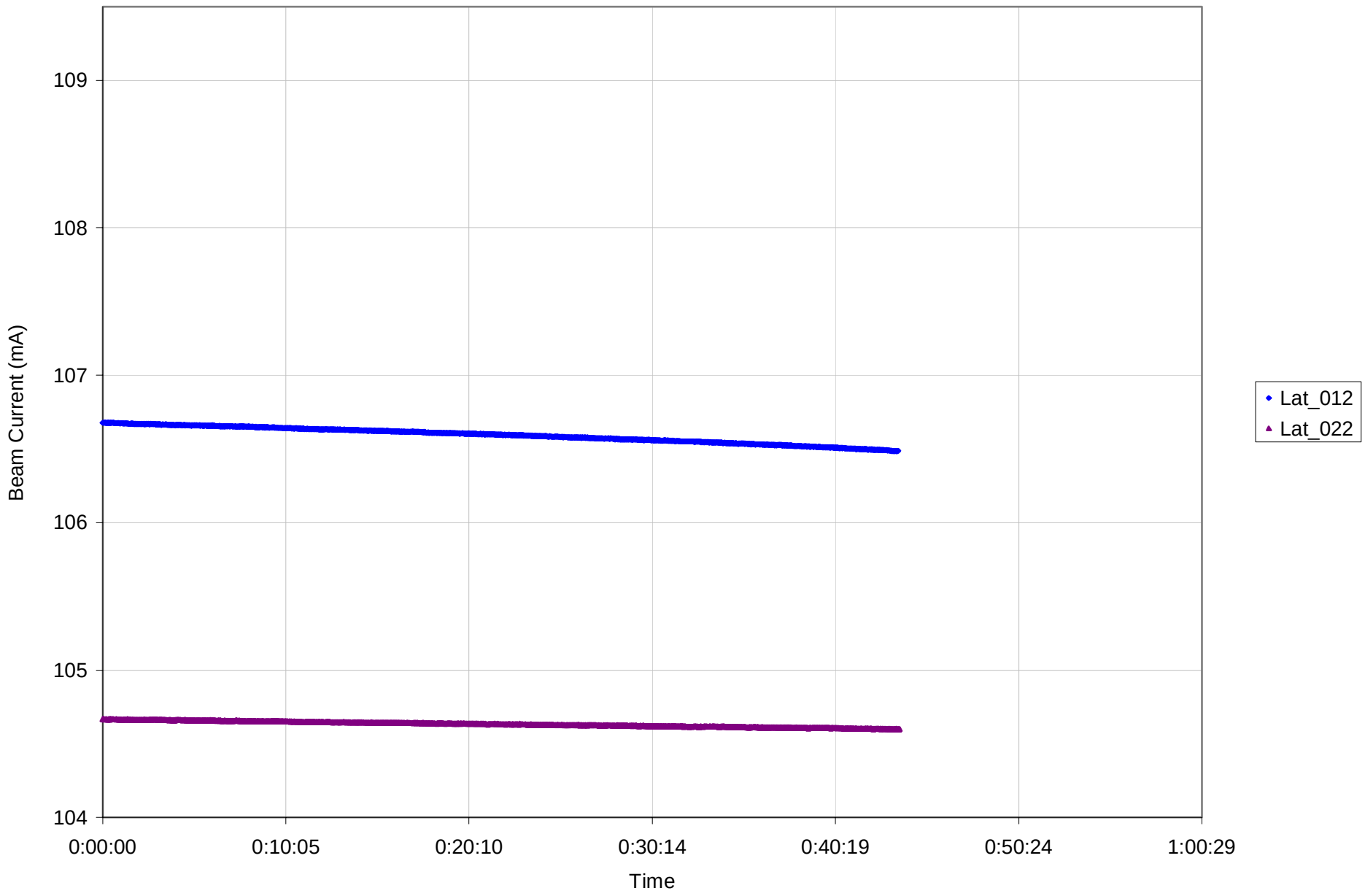
4-D Phase Space Growth II



Longitudinal Growth II



6-D Phase Space Growth II



Beam Lifetime II