ILC International Linear Collider

Update on ILC ML Lattice Design

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for the FNAL LET group

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May 31 revision (v.3)

Main Linac

modules	without quad	with quad	without quad
RF unit (lengths in meters)	11.271	12.543	11.271

three modules

string	RF unit	RF unit	RF unit	RF unit	end box
	35.085	35.085	35.085	35.085	2.500

twelve modules plus string end box

vacuum segmentation unit	string	string	string	string	segmentation box
	142.842	142.842	142.842	140.342	2.500

48 modules plus string end boxes plus segmentation box
(segmentation box is the same as string end box
and all contain vacuum breaks)

Note: seg'n box replaces end box
hence last string shown shorter.
Similarly, service box replaces last
segmentation box below, so last
segment is shown shorter.

cryogenic unit	warm drift space	service box end	segment	segment	segment	segment	service box end	warm drift space	service box end	segment	
	6.271	2.500	571.366	571.366	571.366	568.866	2.500	6.271	2.500	571.366	etc. . . .

(192 modules plus string end boxes plus segmentation boxes
plus service boxes. One service box replaces a segmentation box.)

RTML	long (16 strings) cryogenic unit	warm drift space	long (16 strings) cryogenic unit	warm drift space	short (15 strings) cryogenic unit	undulator	short (15 string) cryogenic unit	warm rift spac	long (16 string) cryogenic unit	BDS
	2288.0	6.271	2288.0	6.271	2145.1	1200.0	2145.1	6.271	2288.0	

2291 5042

start of main linac — center of drift space — center of undulator

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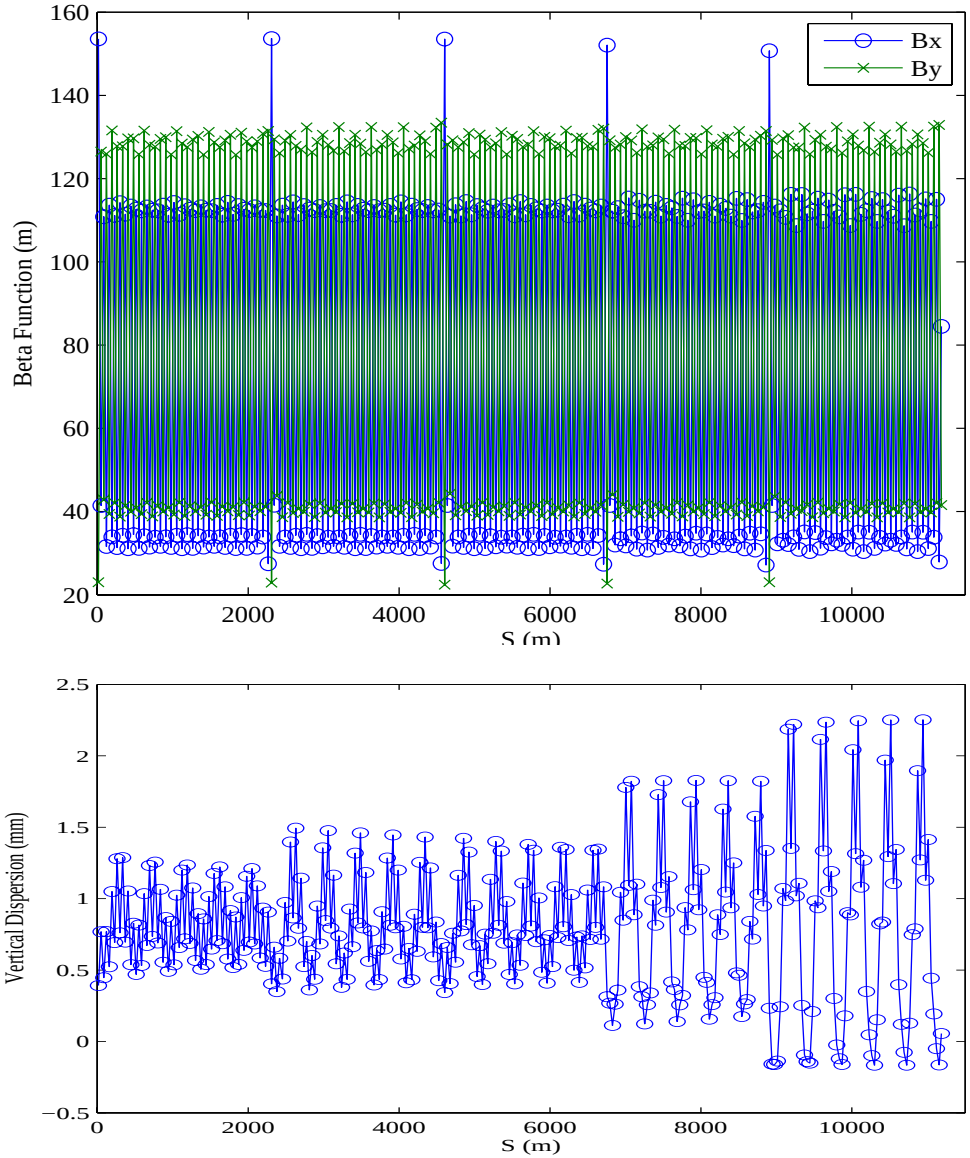
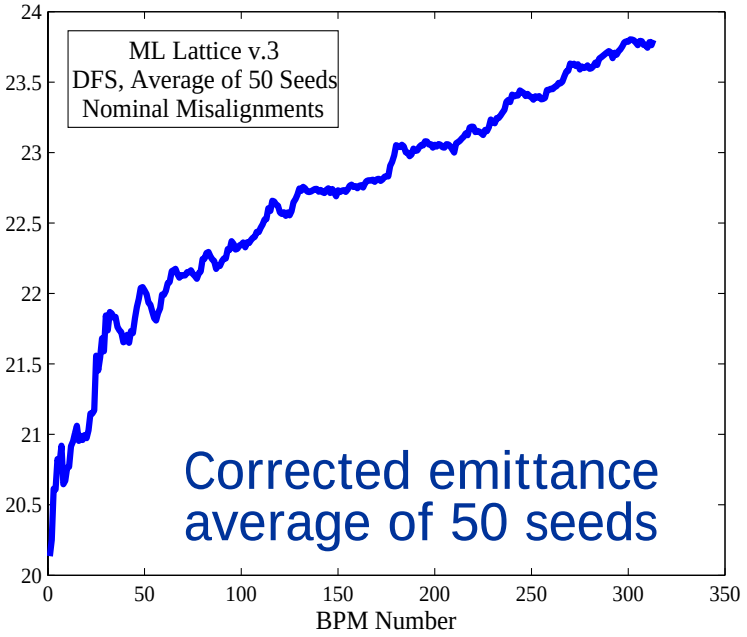
ML Lattice v.3 (Rev. May 31)



ML Lattice design

MatLiar: Curved Linac

DFS, nominal misalignment



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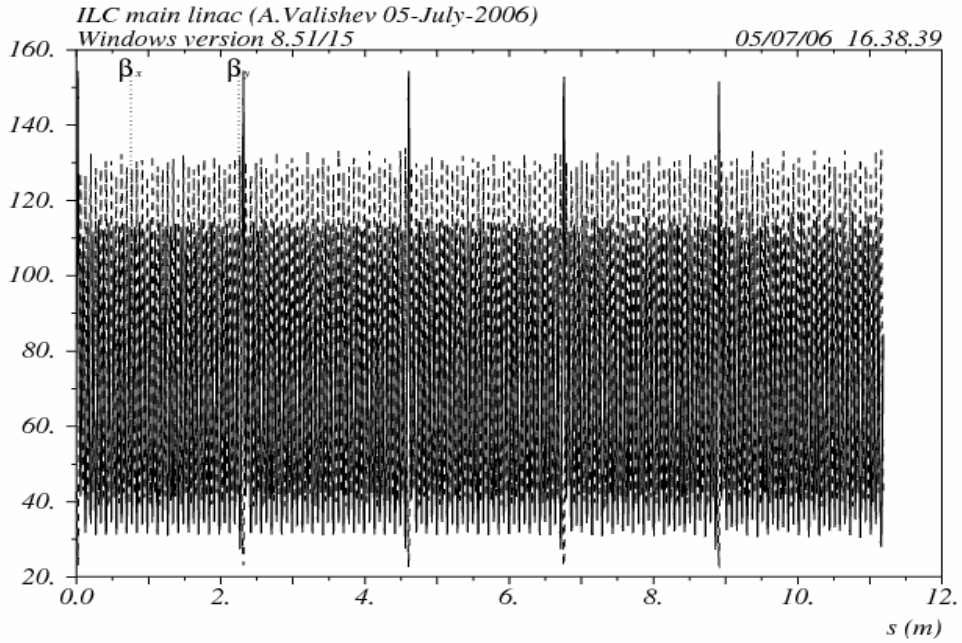
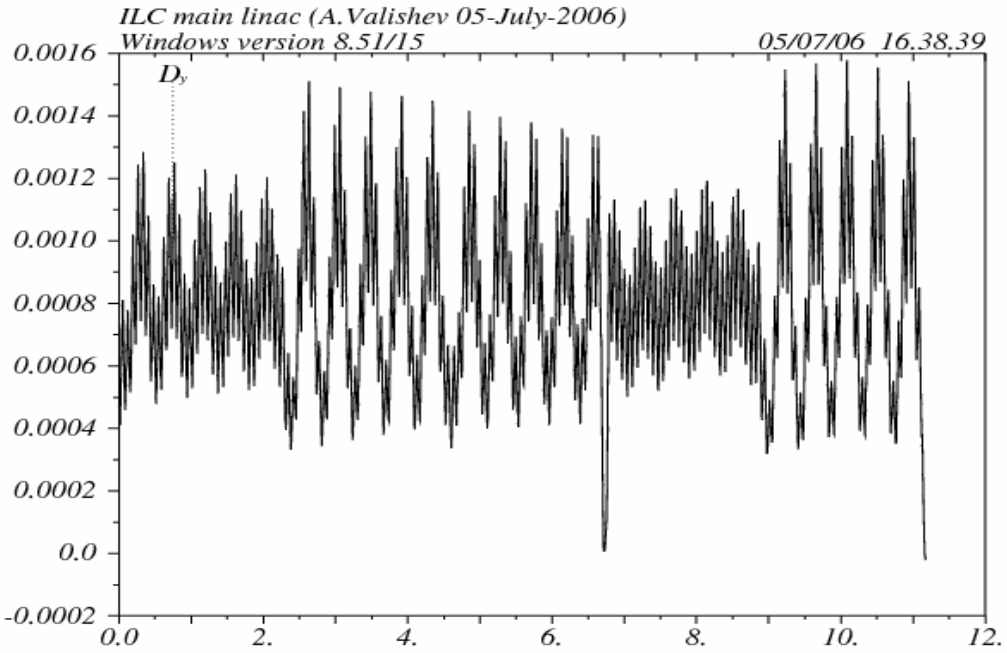
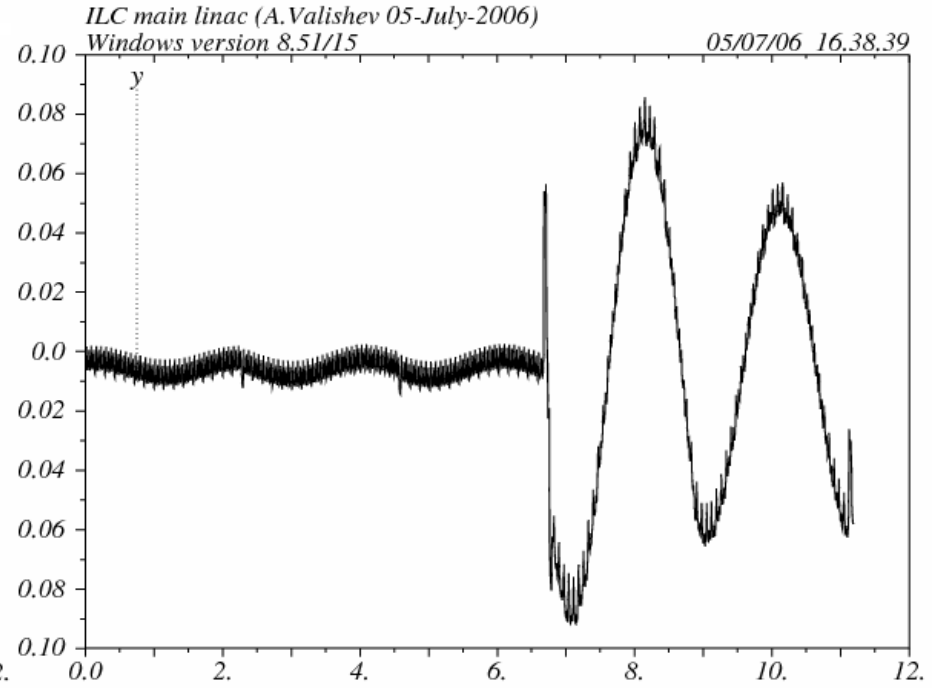
ML Lattice v.3 - MAD







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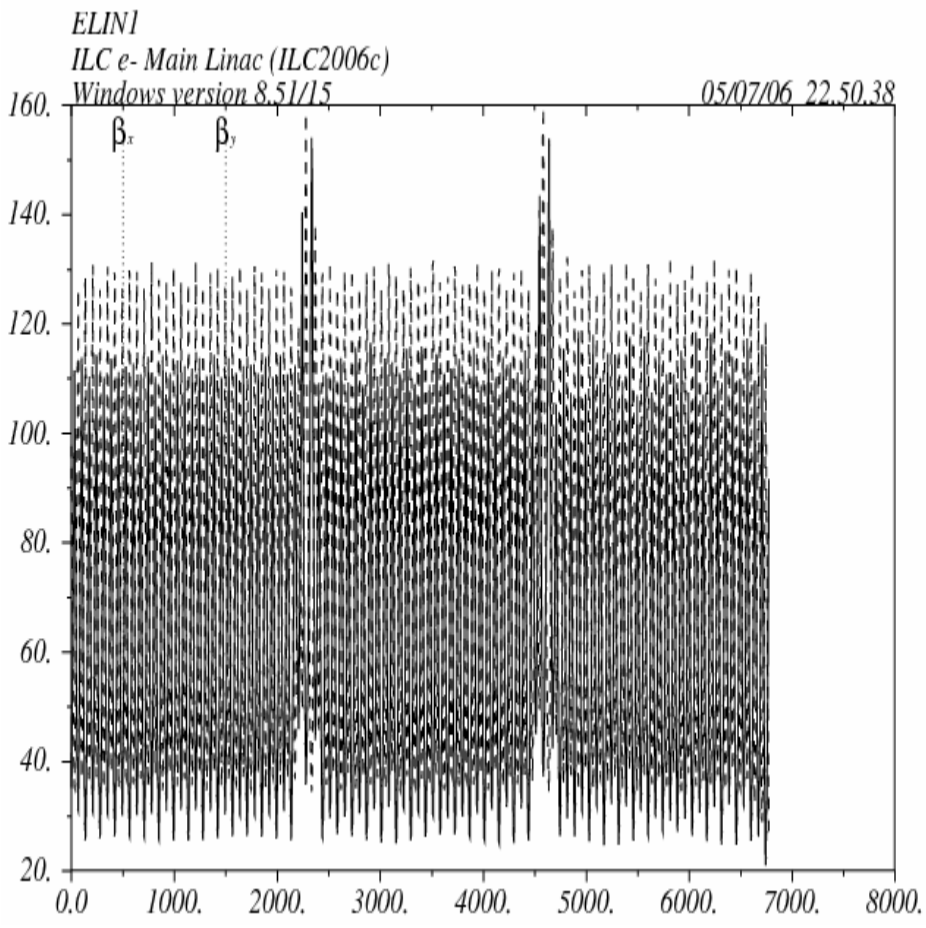
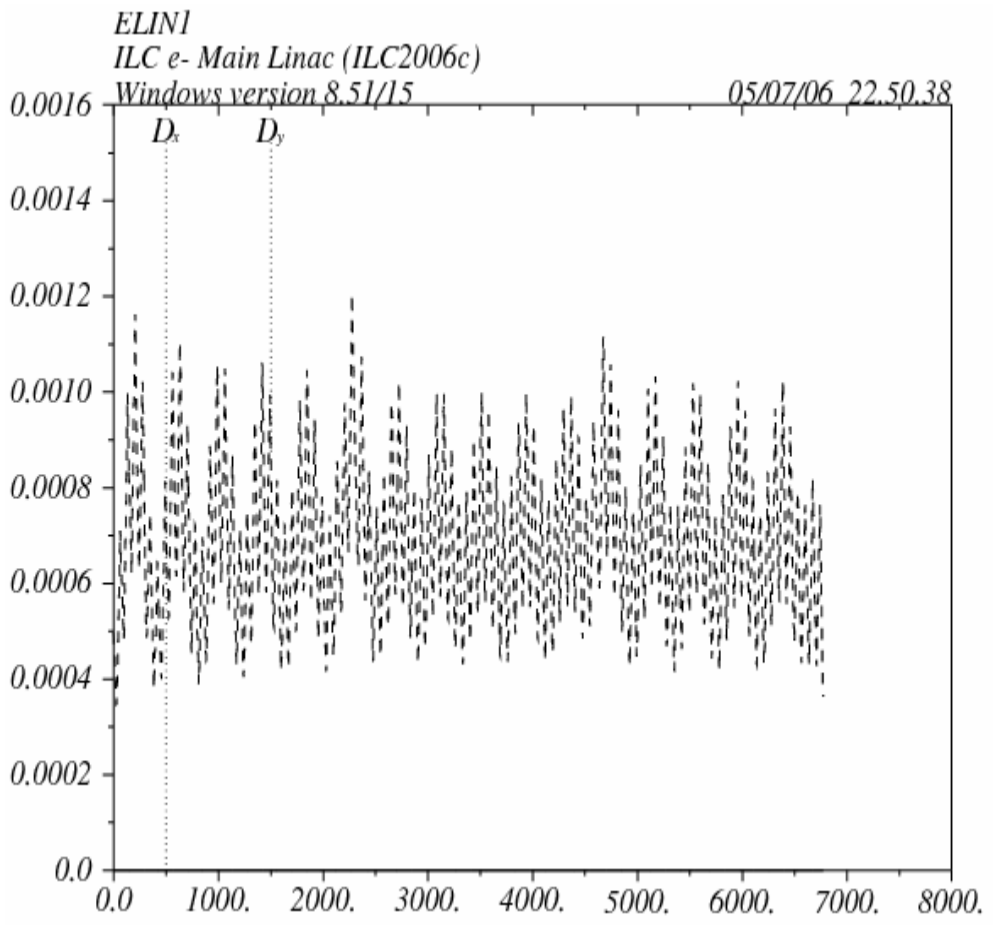
ML + Undulator + BDS in MAD: ML Part 1

β-functions

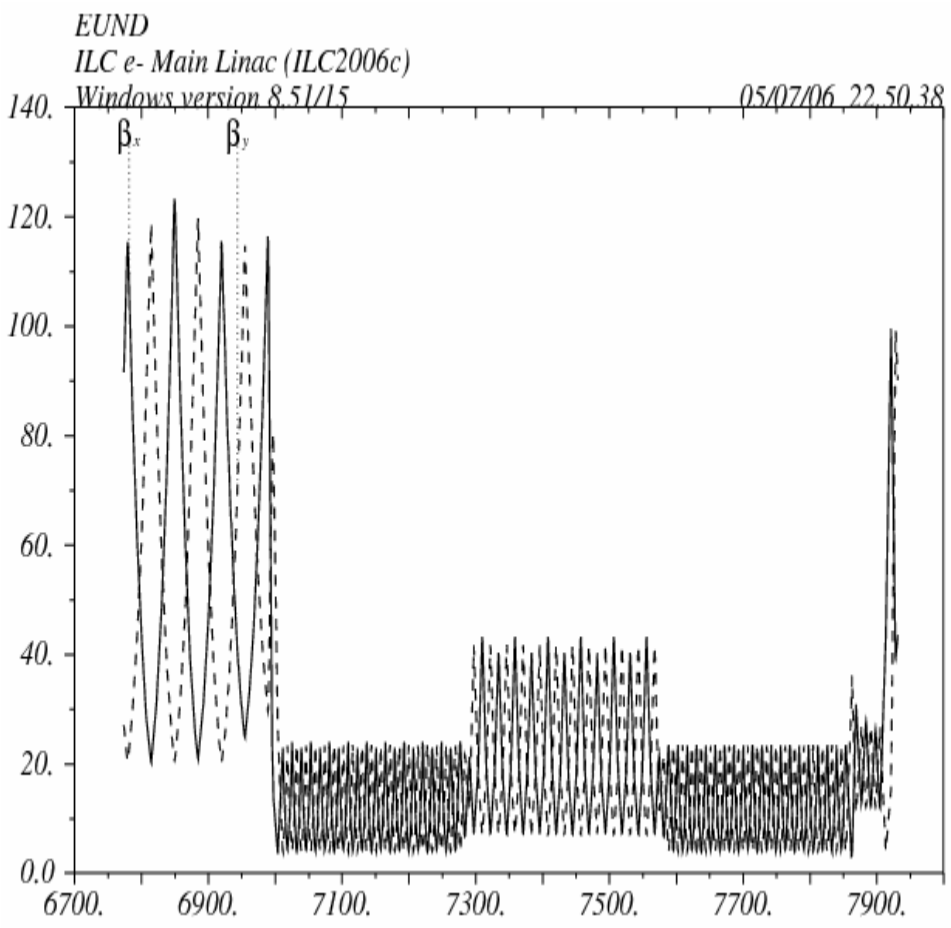


dispersion

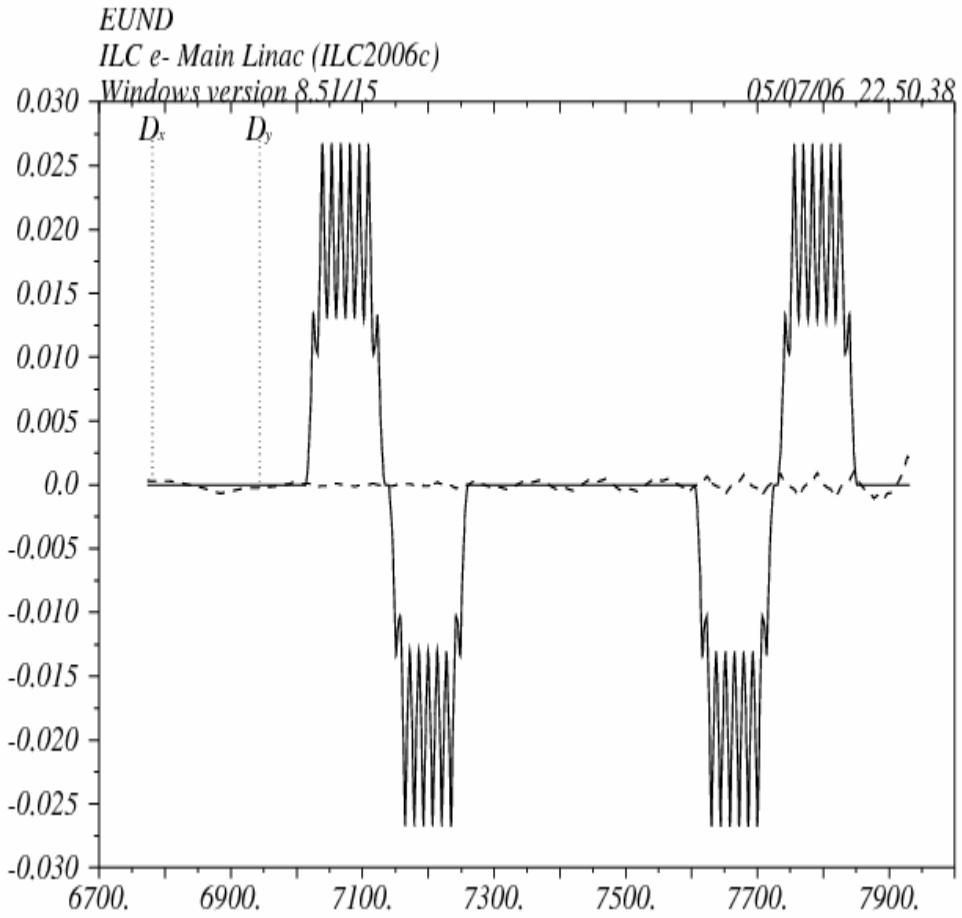


ML + Undulator + BDS in MAD: Undulator

β-functions



dispersion



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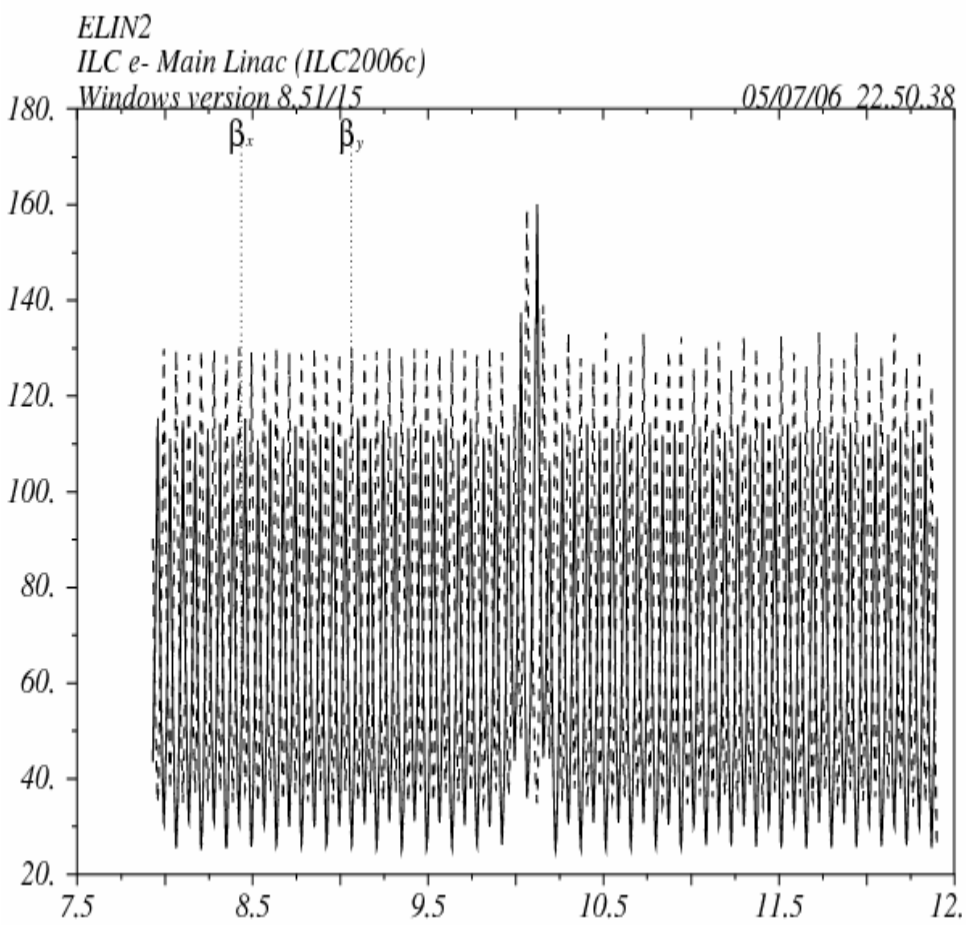
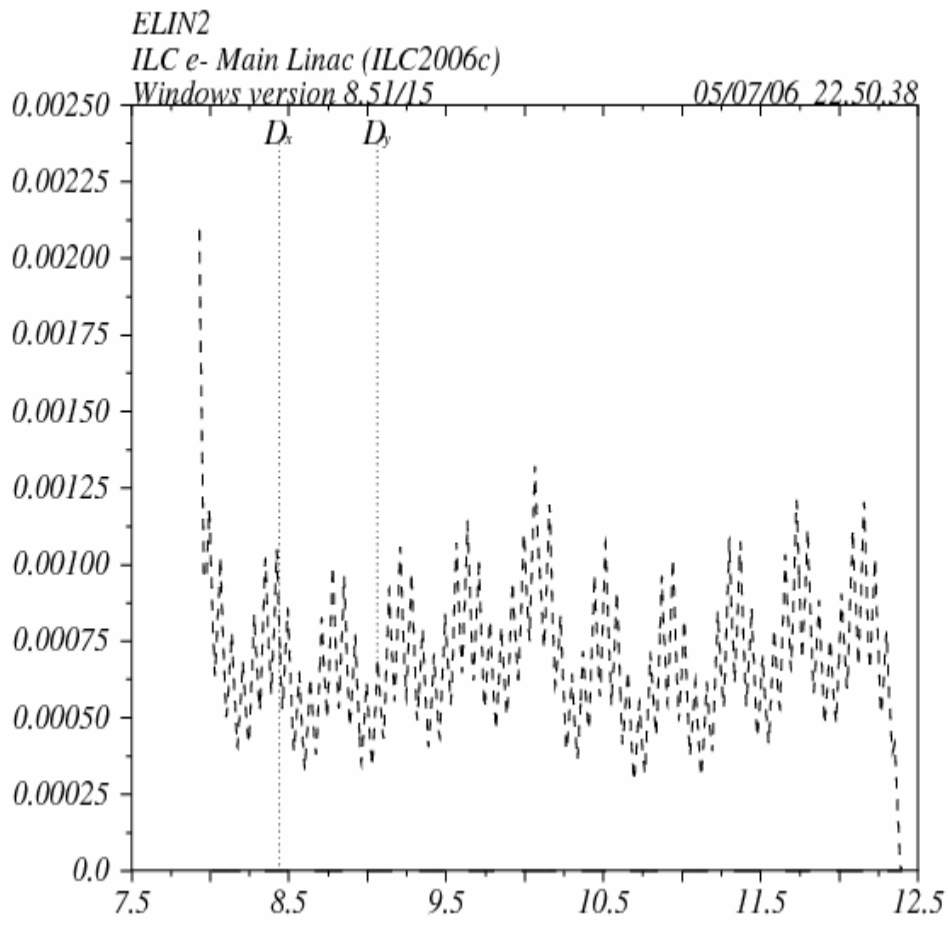
ML + Undulator + BDS in MAD: ML Part 2

β-functions



dispersion



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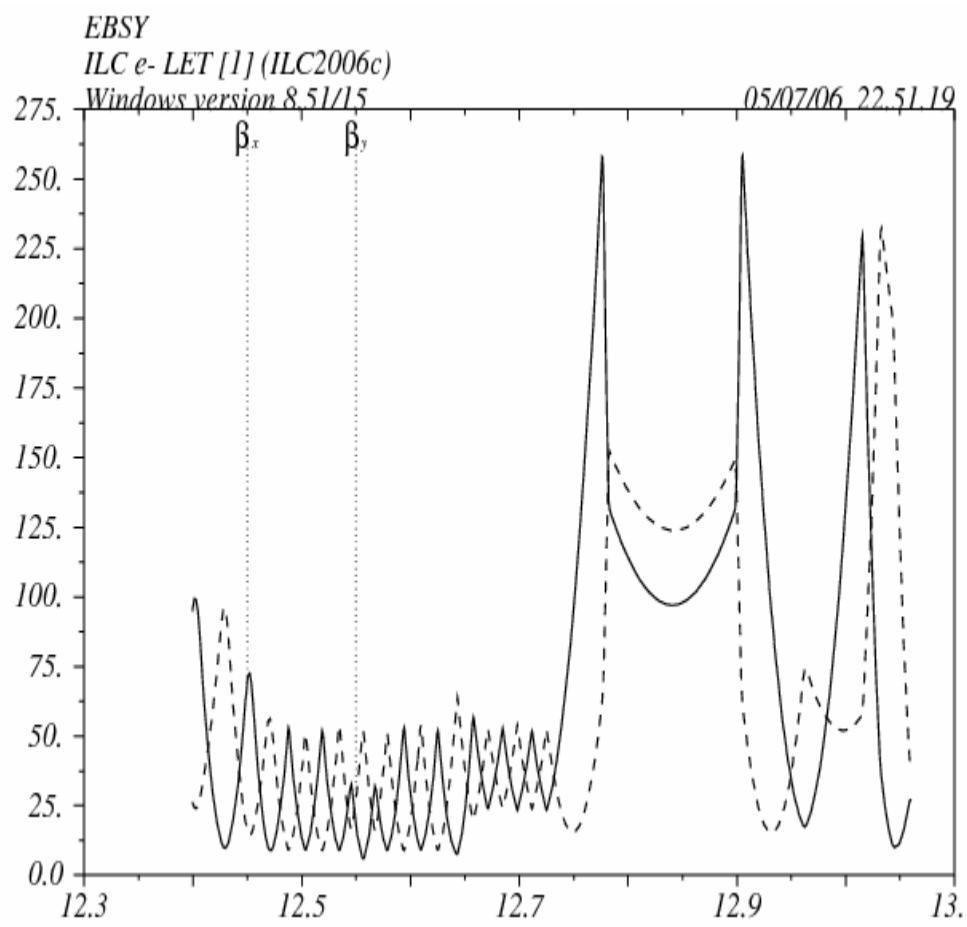
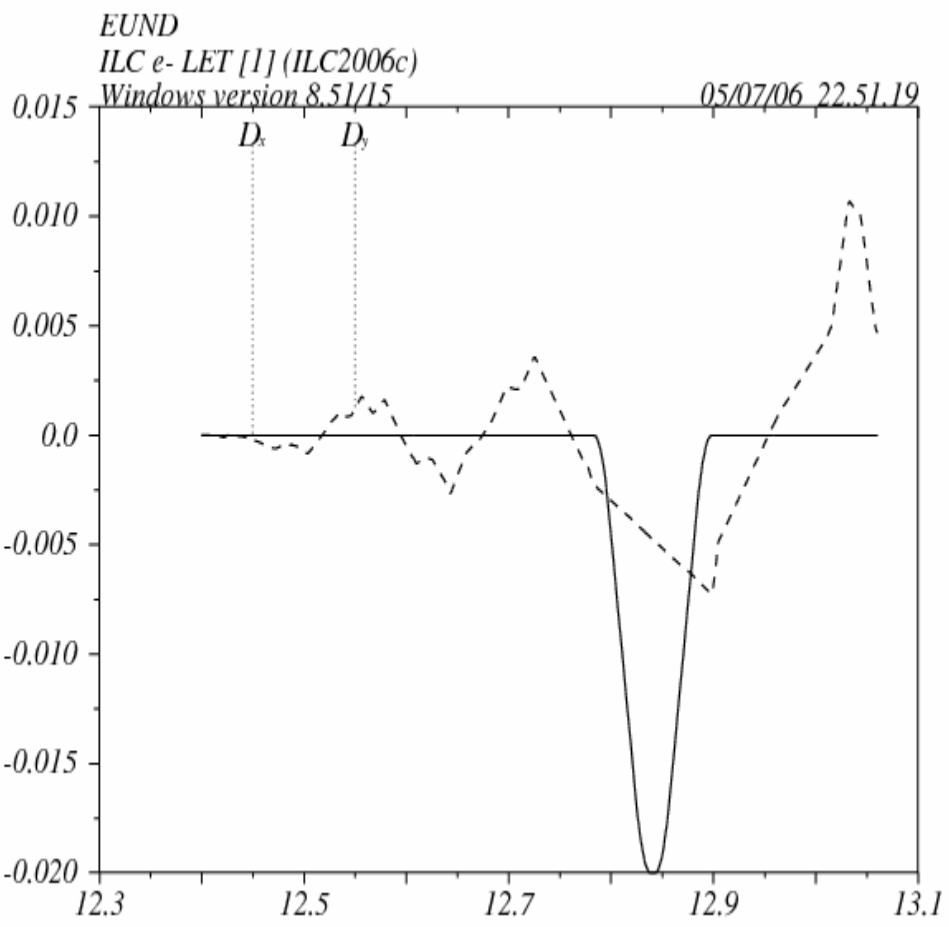
ML + Undulator + BDS in MAD: BDS

β-functions



dispersion



Summary

- ML Lattice (originally from Mark Woodley) modified according to the latest cryo configuration
- Earth curvature included
- Betas and dispersion matched
- Two versions – GKICK and MAD do not match (see below)

Implementation of Curvature

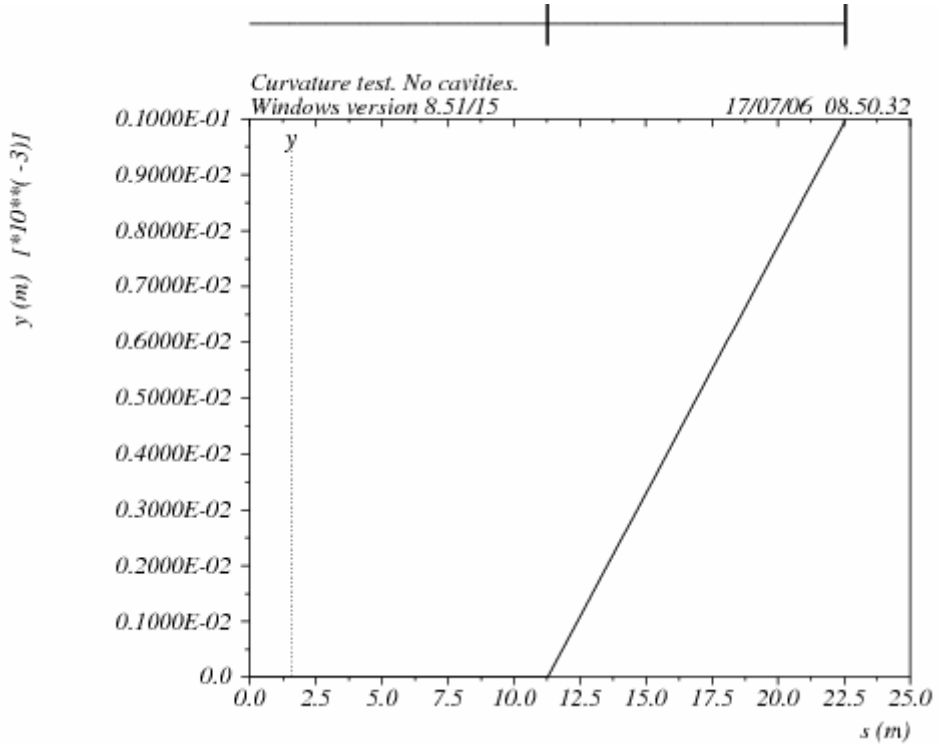
- **Beam line geometry definition differs for MatLIAR and MAD. A method to have one set of decks and still be able to work with two codes was proposed by M.Woodley:**
  - » One common XSIF file, defining beam line, all common elements, and 'KINK' elements at the ends of cryomodules.
  - » Two different files defining KINK elements to be used in MatLIAR and MAD. One of the files is CALLed from the main file depending on the software used.
- **Beam trajectory in both cases is changed by VKICK elements.**

Implementation of 'KINKs'

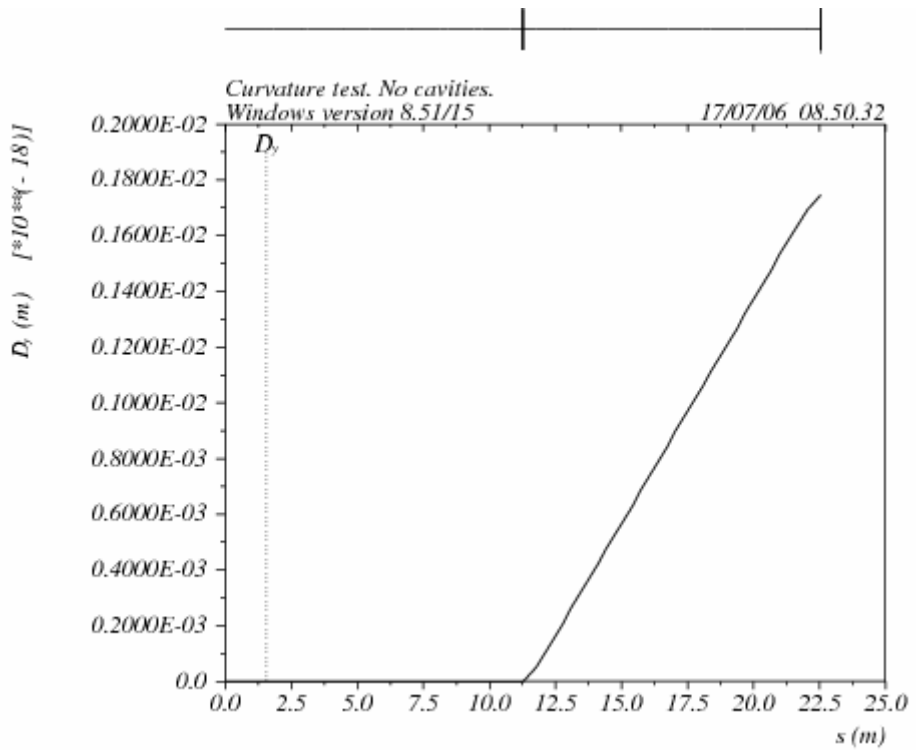
- **MatLIAR: Thin 'dispersion-free kick' GKICK, which pitches the coordinate system.**
- **MAD: Combination of**
  - » General thin multipole n=0, changes both the beam trajectory and the coordinate system
  - » VKICK of the opposite sign

realization of this in MAD has problems!

Simple Test Lattice 1 (MAD)
Drifts and KINK, No cavities

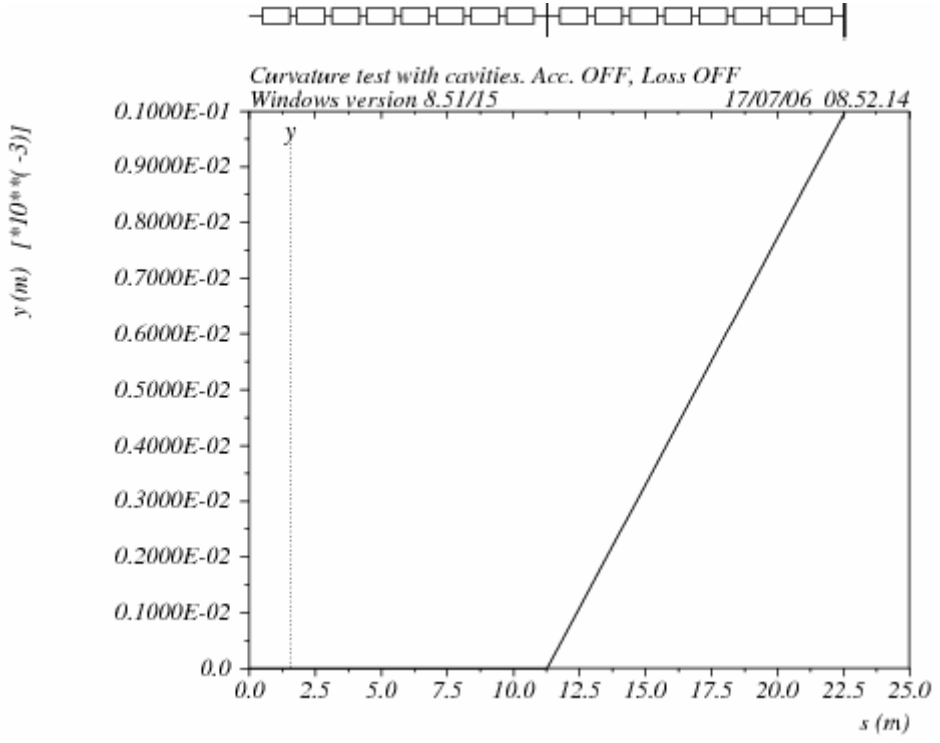


Vertical orbit

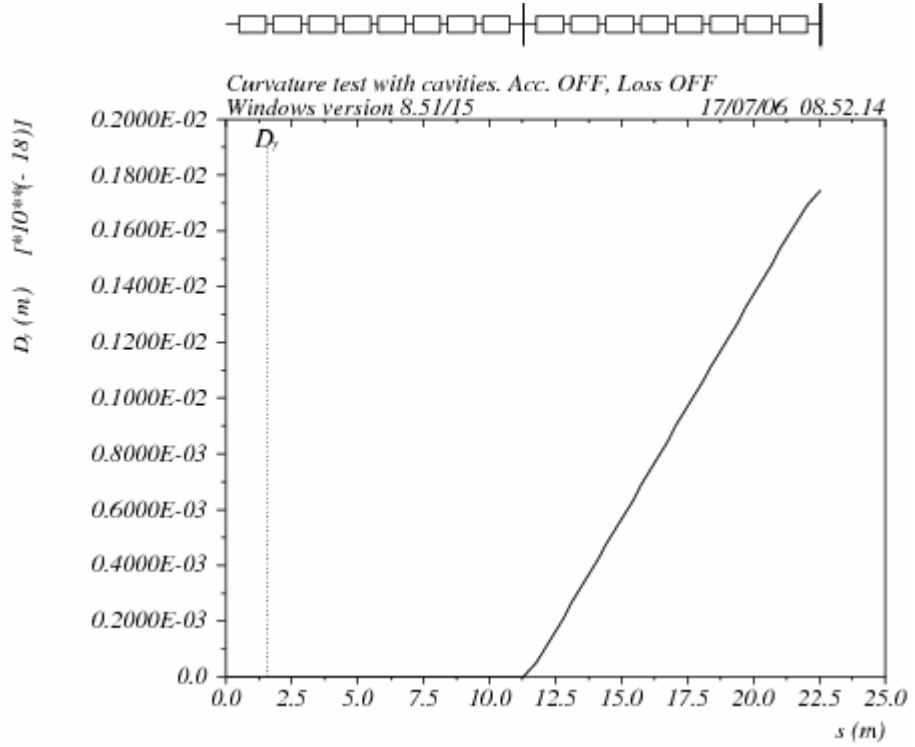


Vertical dispersion
Note the scale = 1e-18m

Simple Test Lattice 2 (MAD)
2 no-quad CM + KINK, Acceleration=OFF

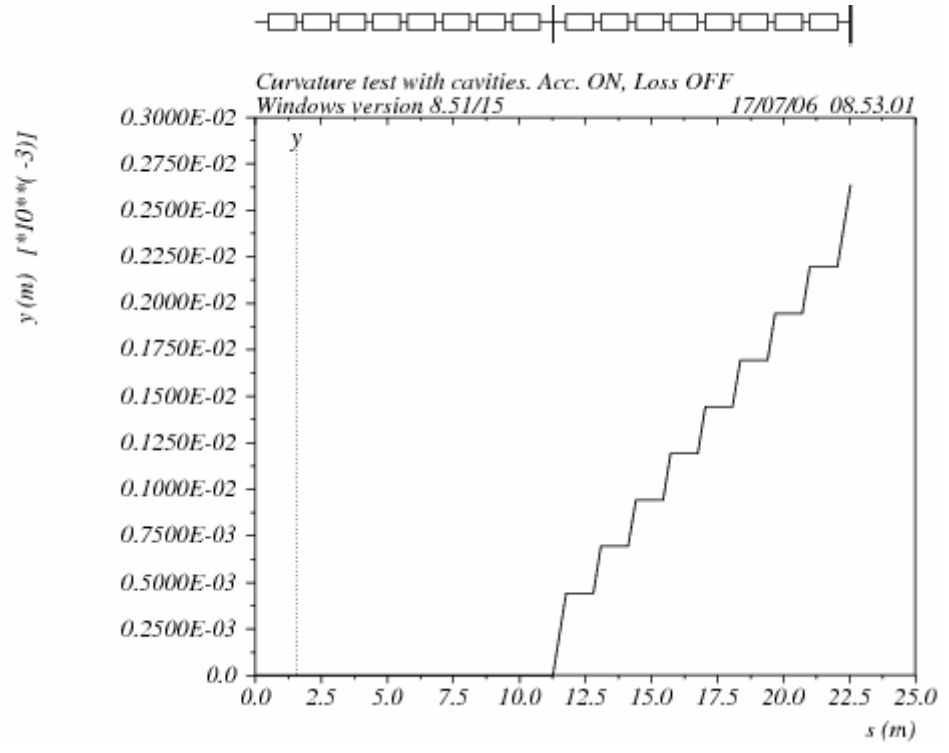


Vertical orbit

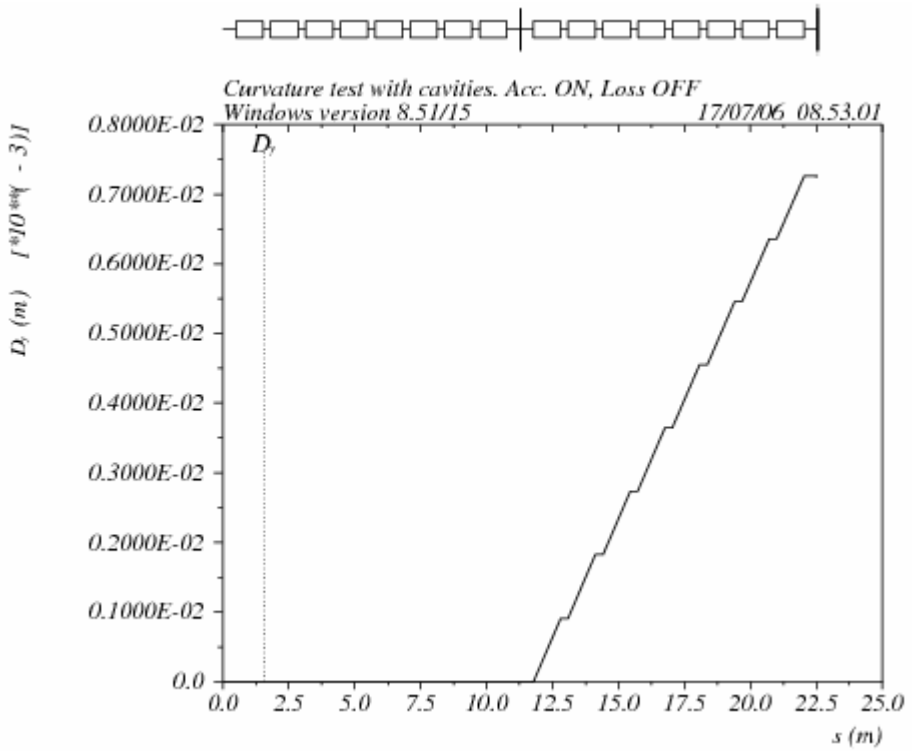


Vertical dispersion
Note the scale = 1e-18m

Simple Test Lattice 3 (MAD)
2 no-quad CM + KINK, Acceleration=ON

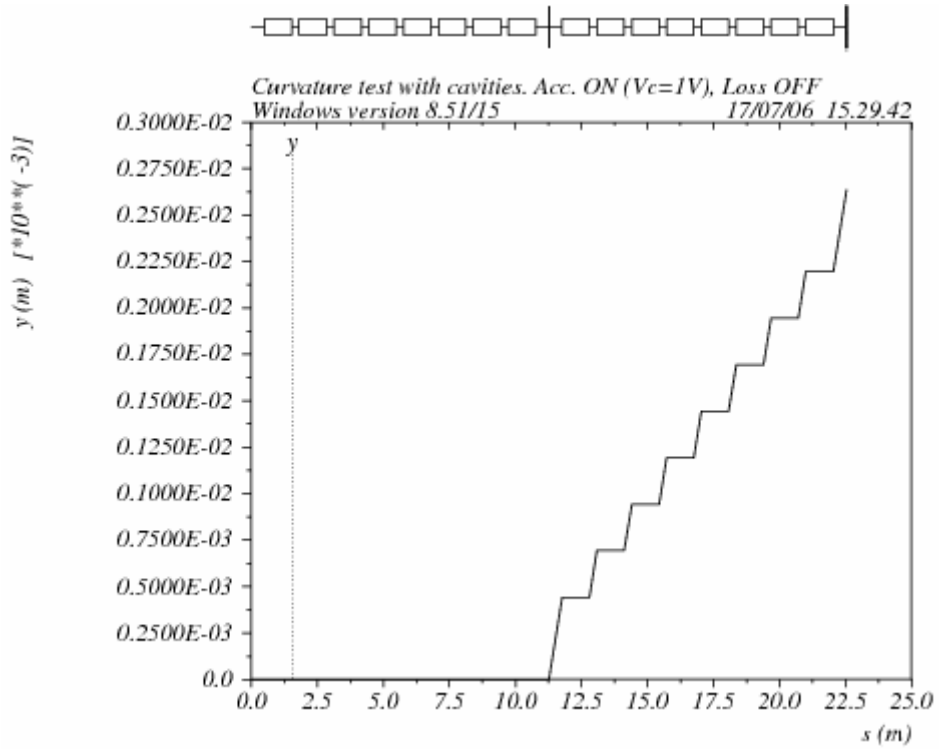


Vertical orbit

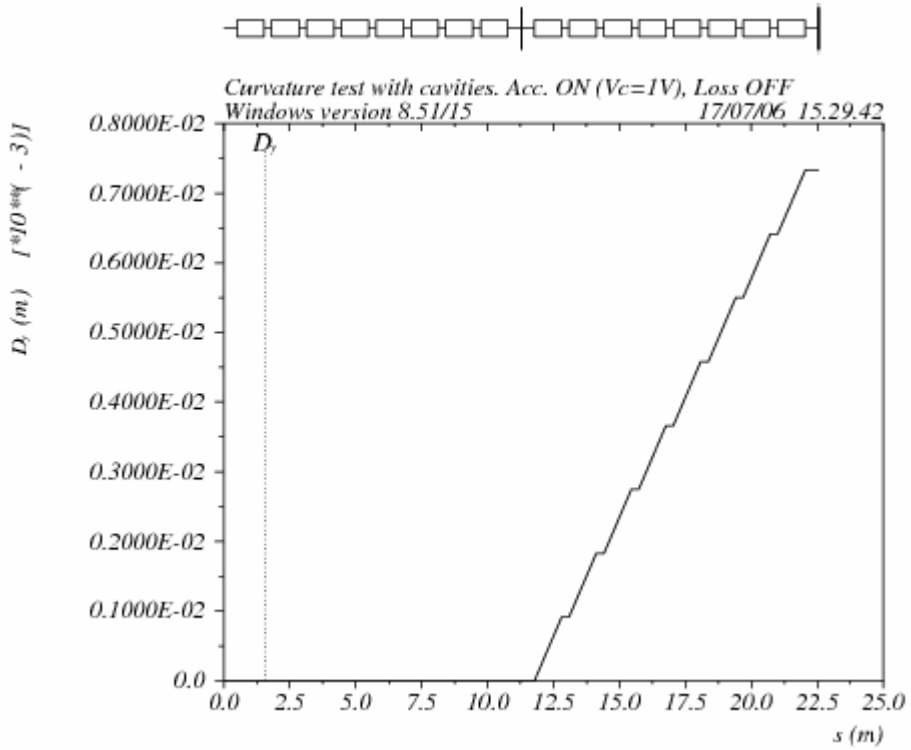


Vertical dispersion
Note the scale = 1e-3m

Simple Test Lattice 4 (MAD)
2 no-quad CM + KINK, Acceleration=ON, Vc=1V



Vertical orbit



Vertical dispersion
Note the scale = 1e-3m

Conclusions

- **In MAD, propagation through a cavity with pitch angle and acceleration does not work correctly**
- **Possible cures**
  - » Fix the code
  - » Simulate curvature using 0-multipoles only. In that case the linac bending will occur at locations of y-correctors, not at the ends of cryomodules.