

## Application Programming

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**March 9-11, 2004**

# Application Programming Update Since March 2003

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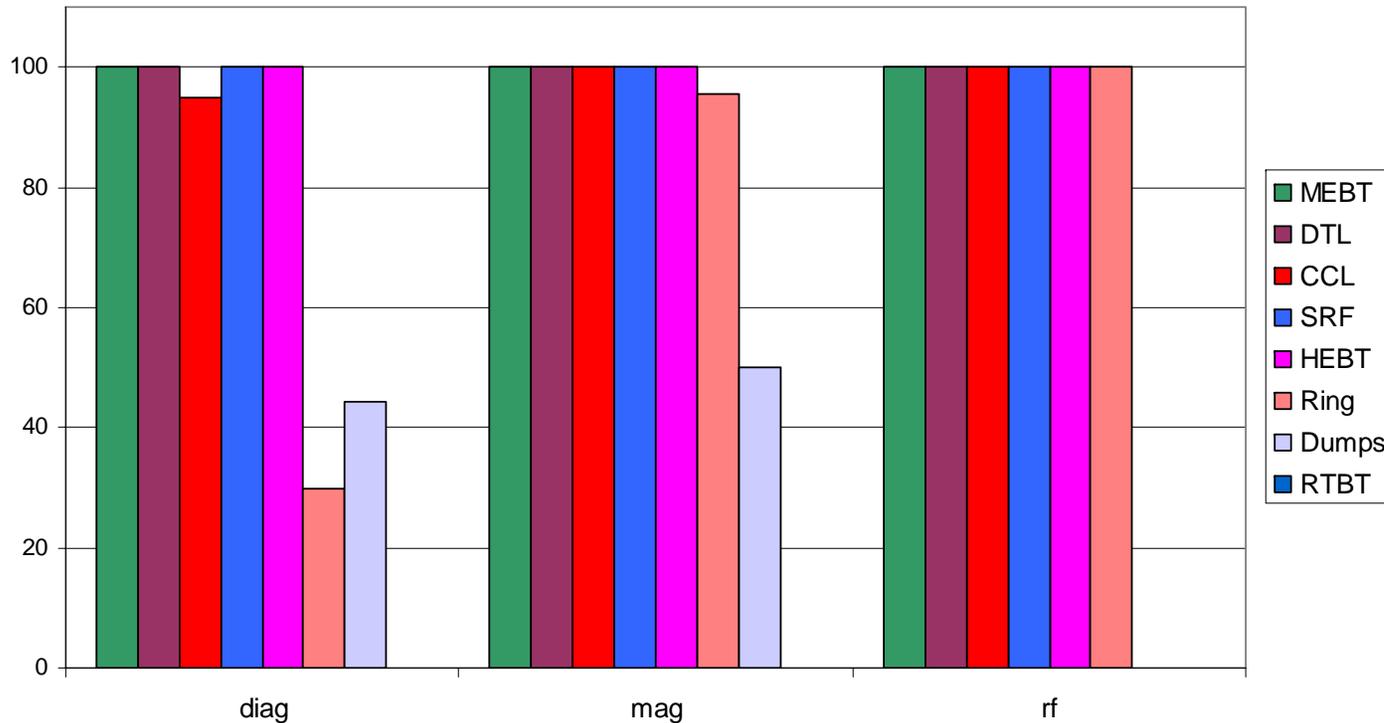


- XAL Infrastructure
  - Database population
  - Standard Application Framework
- Online model
  - Benchmarking
  - Example uses
- Applications
  - 15 XAL applications (+ 5 under active development)

# Database Population



% Beamline Elements

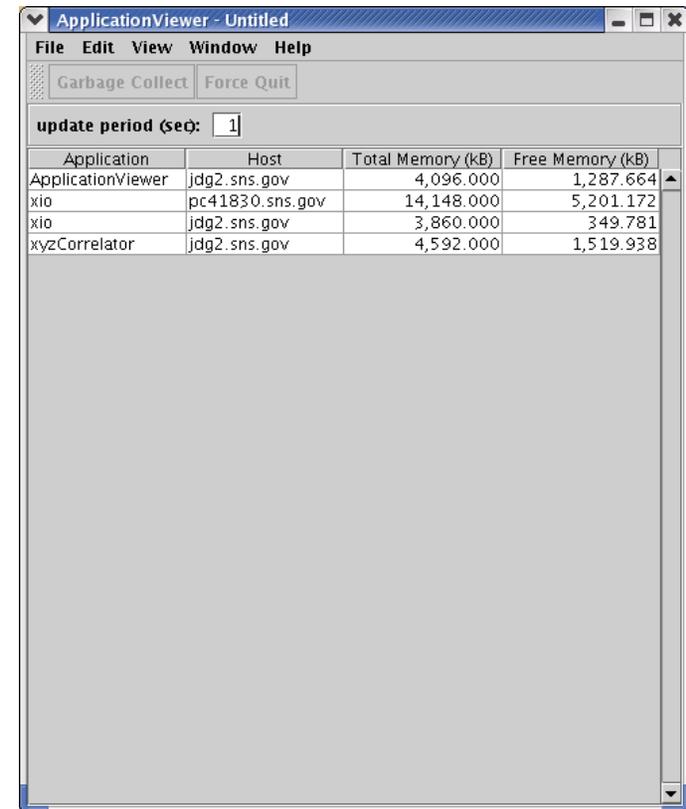


- Mostly populated for MEBT -> Ring
  - RTBT, Injection Dump and Extraction Dump are lacking
- Over 1500 beamline elements are populated

# XAL Infrastructure Progress



- Standard Application Framework
  - Starting point for all applications
- Client Server Infrastructure
  - Uses open source, supported standards for communication (Rendezvous for network details, and xml-rpc for object passing) – provides simple interface.
- Tools
  - Solver package for matching
  - Graphics package
  - Database connection



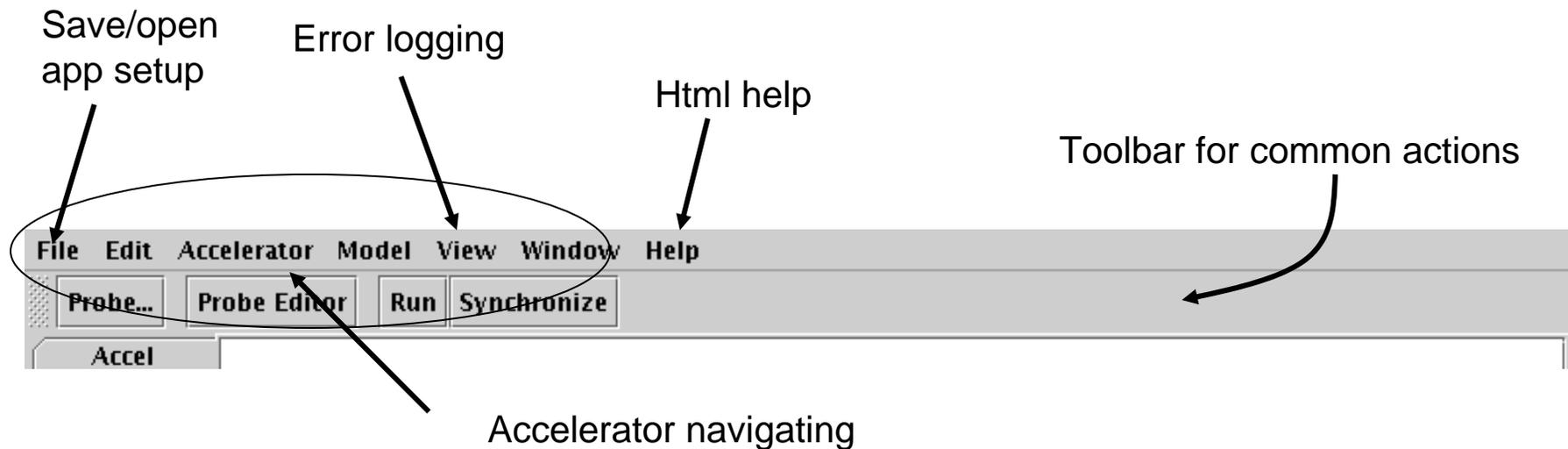
The application viewer uses the client-server capability

# Application Programming Framework

(T. Pelaia)



- An Application Framework is developed and used as a common starting point for application programs
  - Provides a common look feel for all apps
  - Quick jump-start for application development
  - Easy retro-fixes across many apps
  - Uses familiar “windows” look feel paradigm
  - Incorporates a document architecture



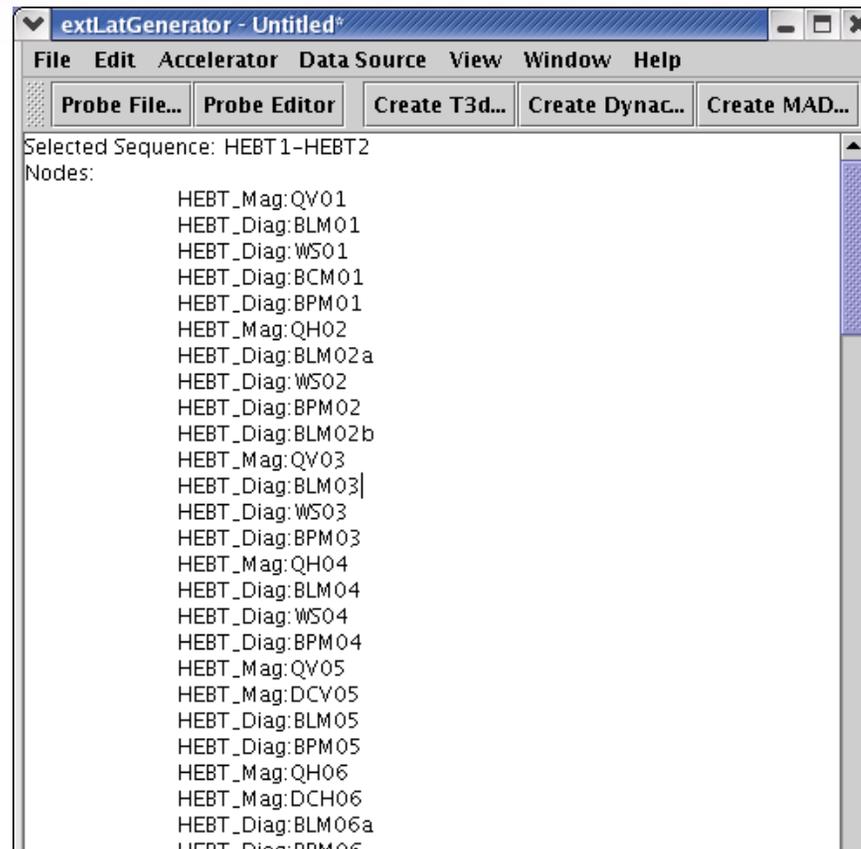
# The online model (C.K. Allen, C. McChesney, W. D. Klotz, P. Chu)

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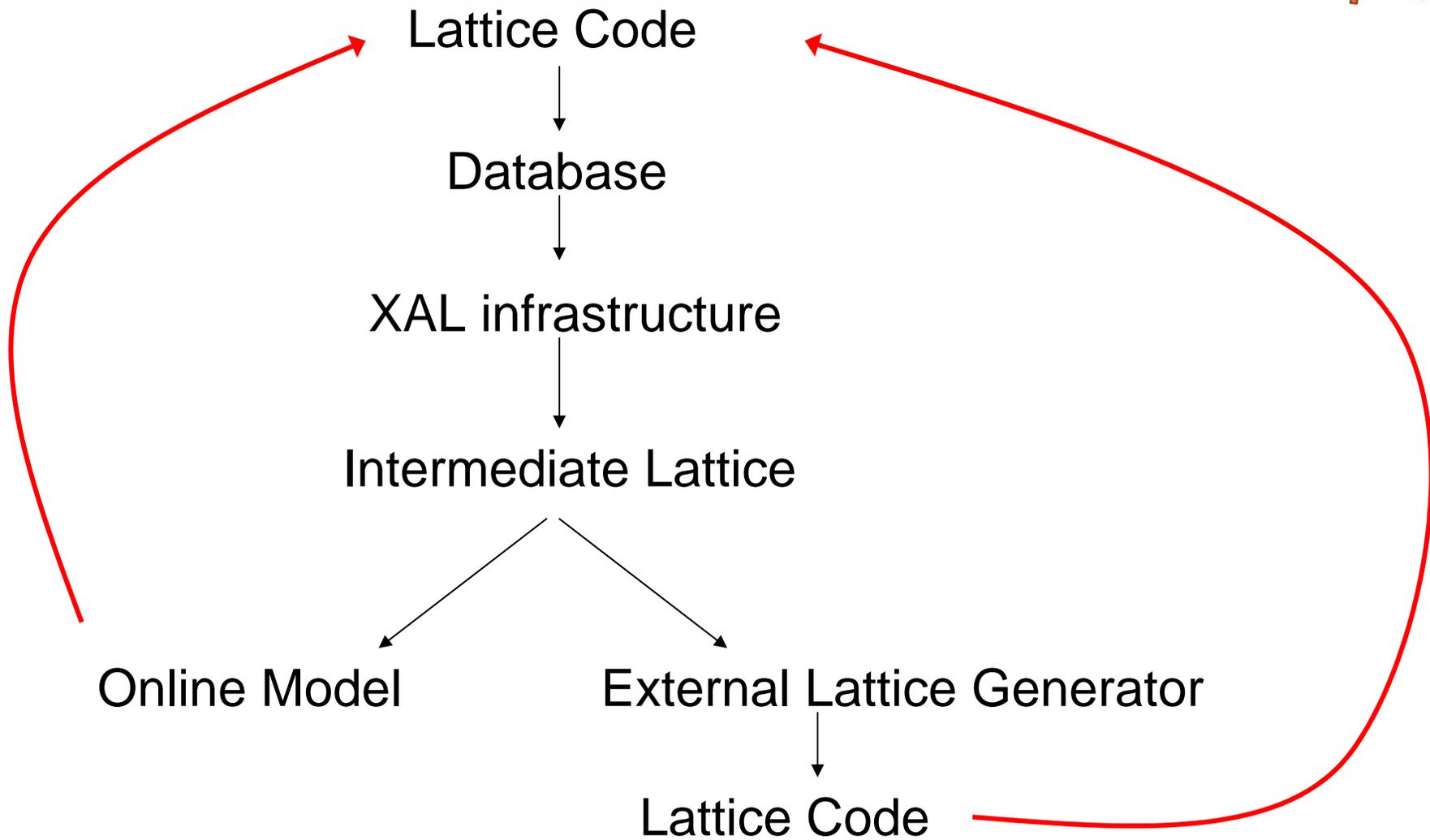
- The model is meant to provide quick modeling capability in the control room
  - Tracks either envelope (with space charge) or single particles
- Automatic lattice generation from the “Xal” infrastructure
  - Usual splitting of elements
- Lattices can be configured using:
  - Default values (data base)
  - Live values (EPICS)
  - User defined “what ifs”
- Can be run via a GUI application or via scripts
- Benchmarked with Trace 3D and parmila for the linac and MAD for the Ring / HEBT

# Lattice Generation Application (*P. Chu*)

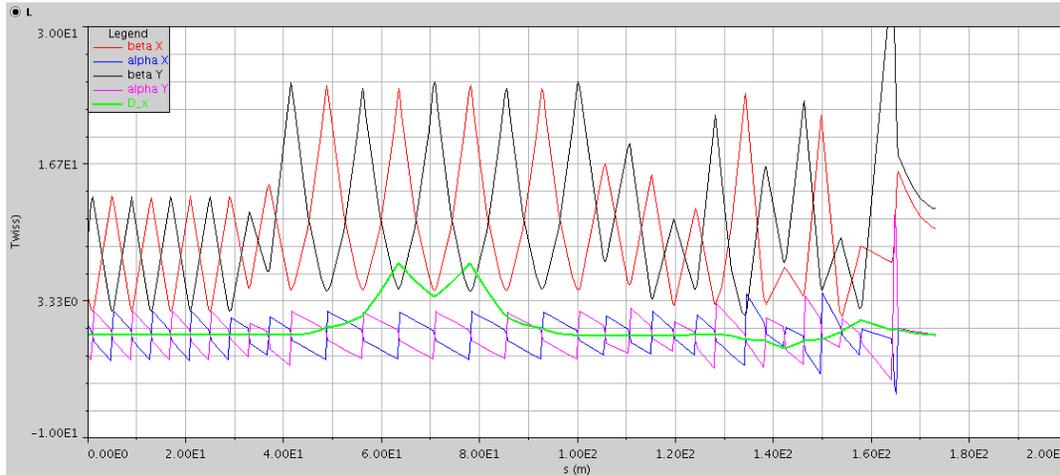


- External Lattice Generator application can generate input files for:
  - Trace 3D, Dynac and MAD
  - For design or live values

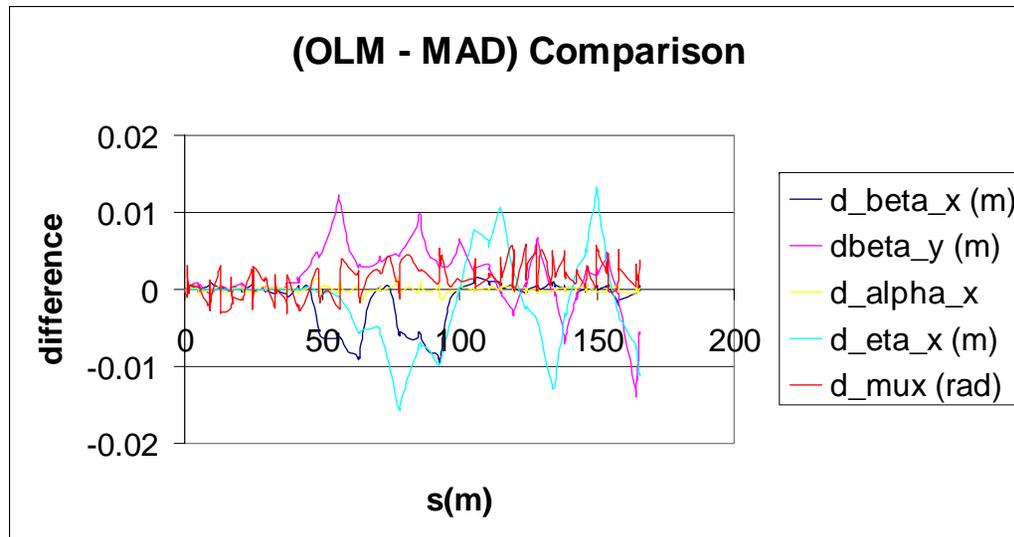
# External Lattice Check Procedure



# HEBT Lattice Check

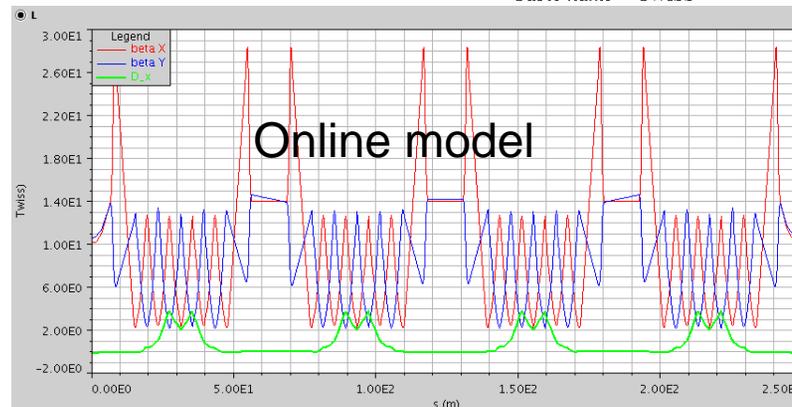
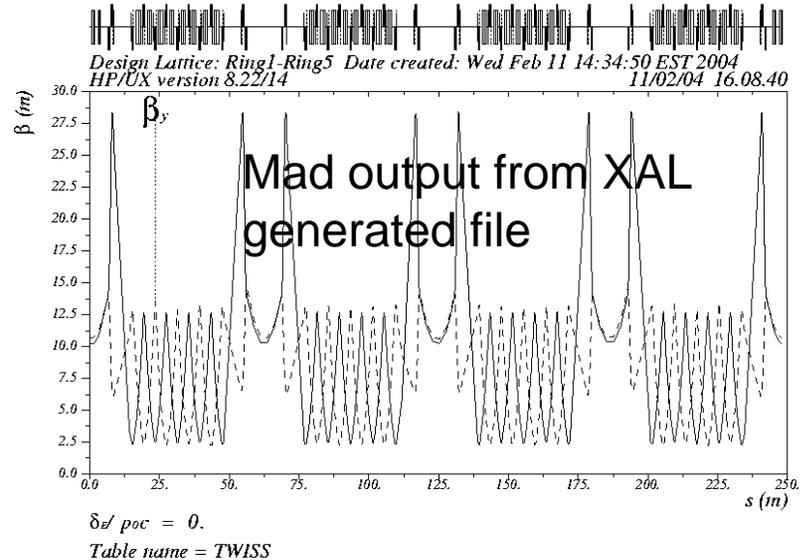
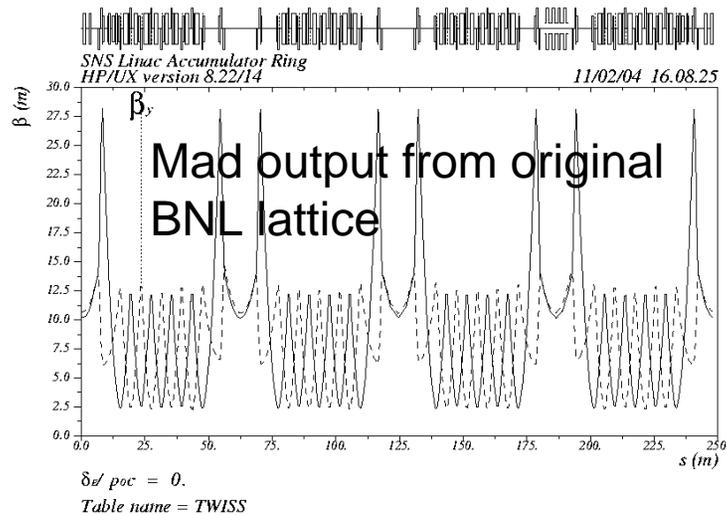


Online model  
HEBT results



Comparison of  
online model and  
MAD results

# Ring Lattice Check (P. Chu, S. Couseneau)



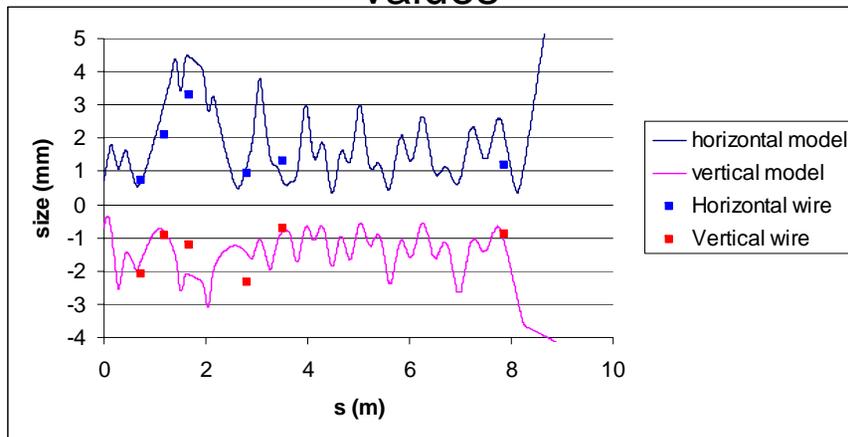
- Good agreement in MAD results, comparing the original starting point and a file generated with XAL (using default values from the database), and the online model.

# Matching with the Online Model

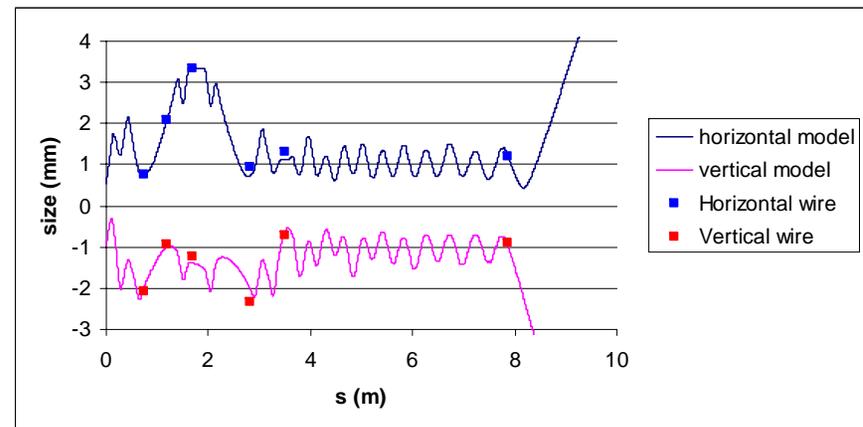


Vary the initial twiss parameters so that the model predicted beam size best matches the wire profile measurements (in MEBT)

Beam size using initial default twiss values



Beam size using “matched” initial twiss parameters



- Done offline with a jython script program

# The Online Model Application (W. D. Klotz, P. Chu)



1 – pick an accelerator sequence

2 – pick a probe

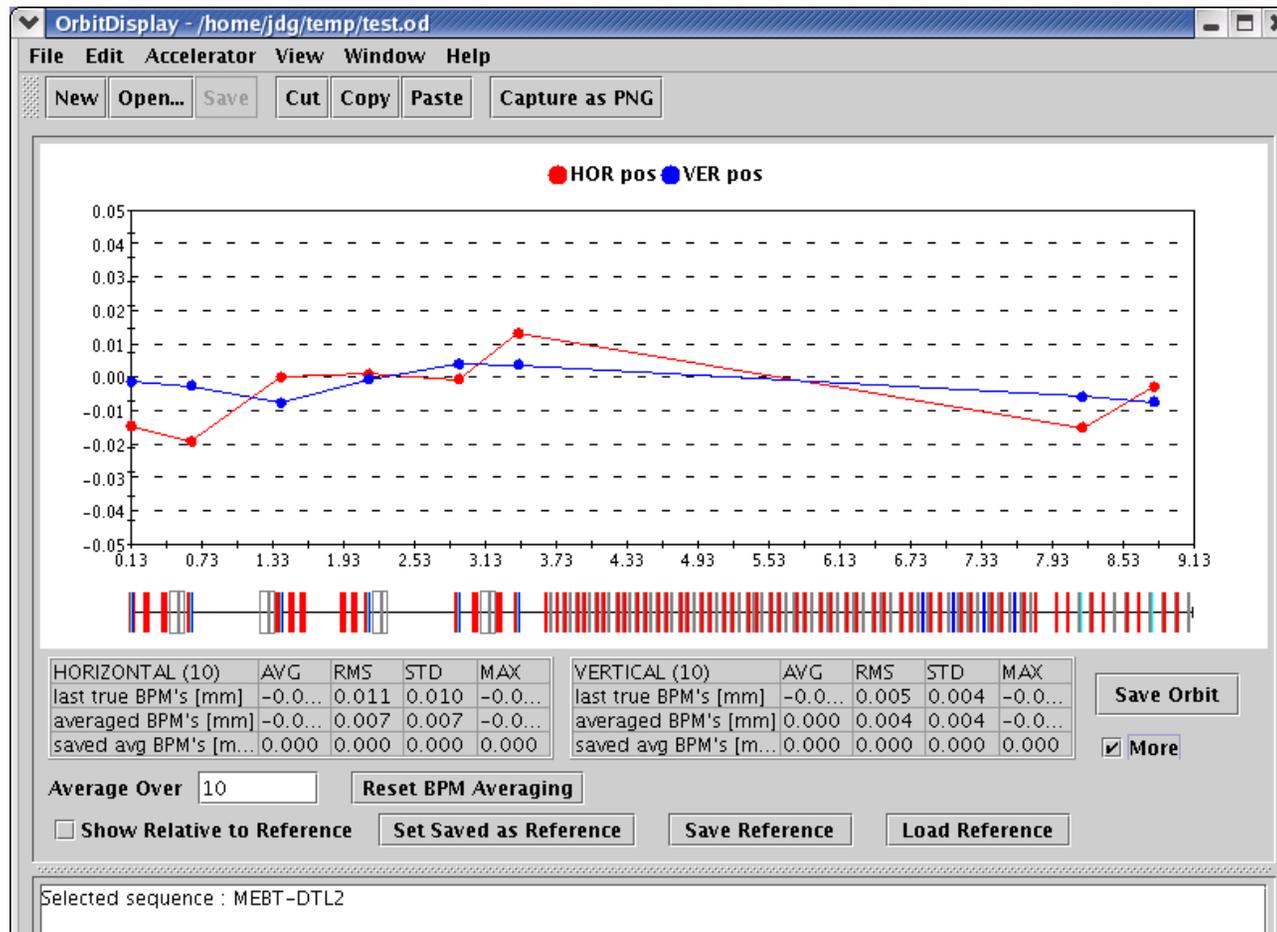
3 – run the model

using live data

/home/jdg/work/scripts/xalScripts/baseline/main\_lebt-hebt.xal; NEW LATTICE: MEBT-DTL3; NEW PROBE: /home/jdg/work/scripts/xalScripts/baseline/MEBT\_Trace\_E

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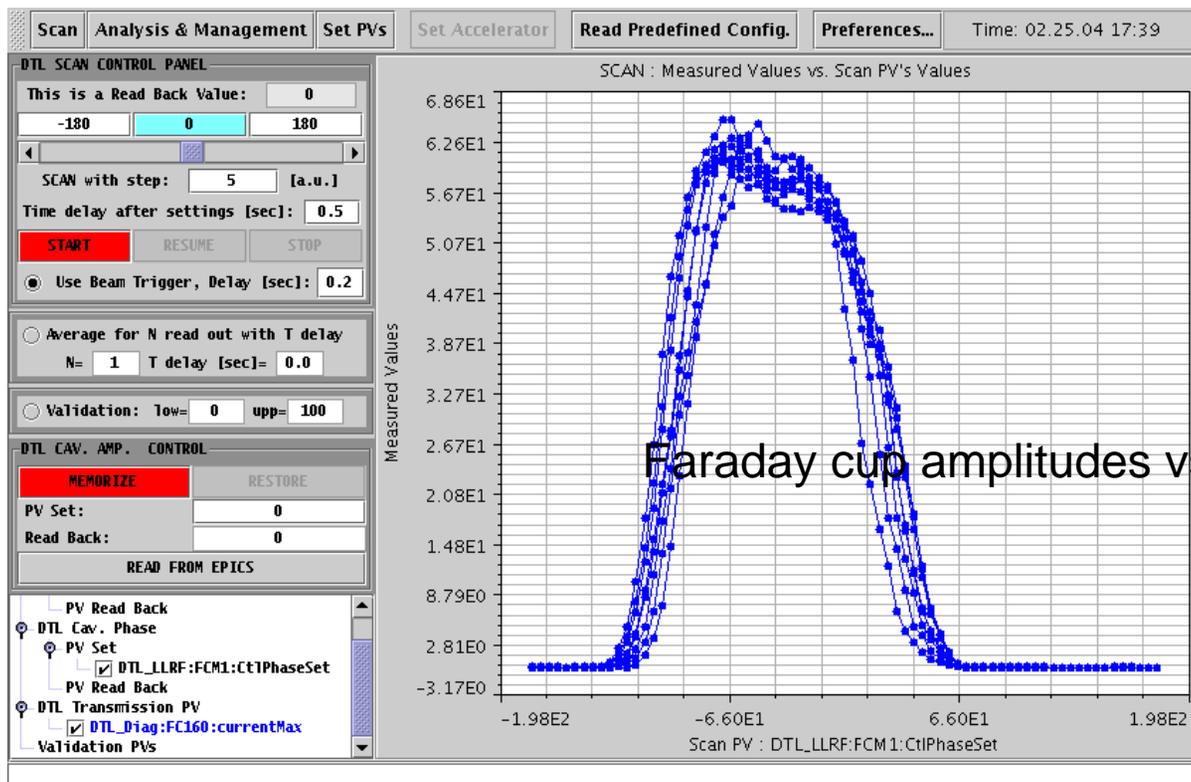
# Orbit Display (Cosylab)



- Uses the XAL application framework
- Provides statistics
- Can save the setup

# 1-D Scan Application *(A. Shishlo)*

- Provides an easy way to scan one quantity and monitor others
- Can average over pulses, scan multiple times, pause
- Analysis includes fitting, intersection finding, min/max, etc.
- Easy way to do a quick unanticipated experiment
- Predefined scans with specialized analysis are possible
  - DTL and MEBT phase + amplitude setting applications

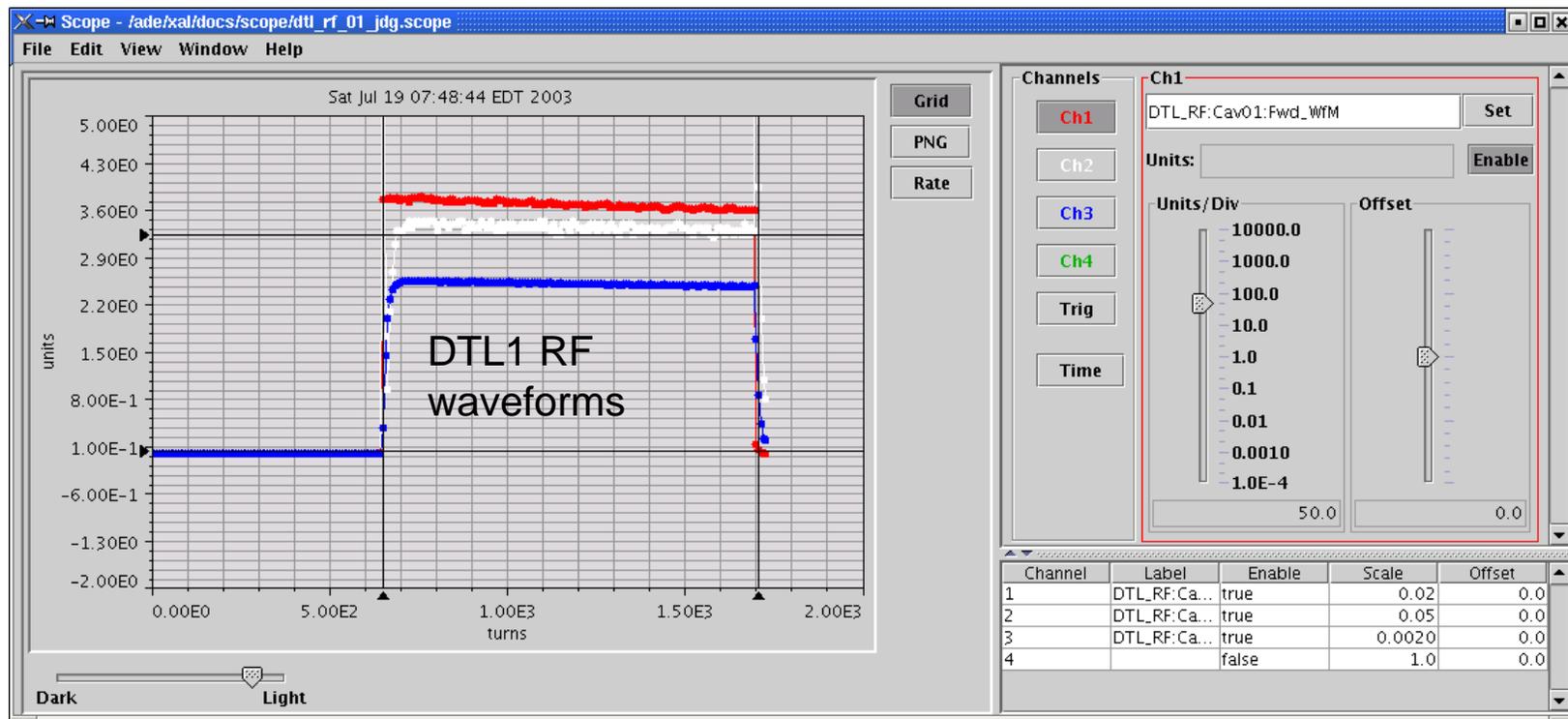


Faraday cup amplitudes vs. DTL RF settings

# Scope Application (T. Pelaia)



- A Digital Oscilloscope – with a similar user interface as analog scopes
- Displays array waveforms vs. time (NOT vs arbitrary units)
- Uses the time correlator, has built-in math capability, FFT, triggered data acquisition
- Will use this for comparing waveforms from RF, diagnostics, etc.
- Requires input from signal providers describing how the array information is packaged, and offset from the cycle start + accurate timestamps on signals

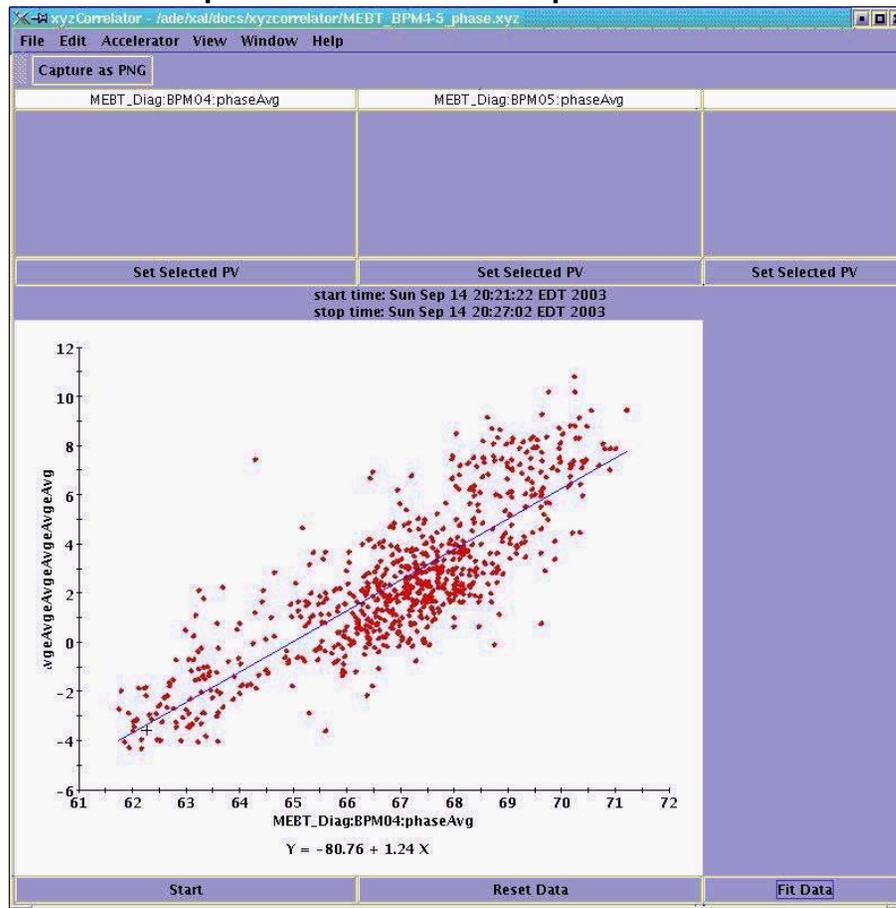


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# XYZ Correlator Application (P. Chu)



- Pick 2 (or three) signals and monitor them together
- Can use the time correlator to ensure signals are from the same pulse
- Added customization features + added to the framework
- Can export or fit the acquired data



Correlation between phase measurements of 2 BPMs

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# Save-Compare-Restore (Score) Application



- Provides a means to capture machine setup, compare live values to a saved set, and to restore values to a saved set
  - Grabs settable + readback signals
- Can sort by system and device type

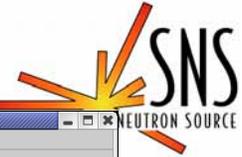
- This is the primary means to snap-shot the machine state

Load devices/types		Open...	Save As...	Snapshot Machine	Restore	Capture as PNG	
Select Systems		RFQ	MEBT	DTL	Timing	FE	DPlate
Type	Setpoint name	SP Save Val	SP live Val	Readback Name	RB Save Val	RB live Val	
<i>RF</i>	RFQ:RF:Gain	0.3500	0.3500				
	RFQ:RF:Gain_Rot	116.9083	116.9083				
	RFQ:RF:Int_scale	7000.0000	7000.0000				
	RFQ:RF:Loop	1.0000	1.0000				
	RFQ:RF:cavAmpSet	0.5512	0.5512	RFQ:RF:cavAmpAvg	0.5488	0.5493	
	RFQ:RF:cavPhaseSet	24.3920	24.3920	RFQ:RF:cavPhaseAvg	24.3090	24.2417	
	RFQ_HPRF:Mod1:VCTL_Set	130.0000	130.0000	RFQ_HPRF:Mod1:V_Mon	100.3780	100.3750	
				RFQ:RF:FwdPower	686.1238	673.1348	
				RFQ:RF:RflPower	9.4841	9.0523	
				RFQ_HPRF:Mod1:L_Mon	48.8328	48.8791	
<i>Temp</i>							
	RFQ:ChIlr_2:T_Set	24.2000	24.2000	RFQ:ChIlr_2:T	25.2192	25.3264	
				RFQ:ChIlr_2:T_LB	24.1819	24.1849	
<i>Vac</i>							
				RFQ_VacIG_2:P	2.710E-7	2.694E-7	
				RFQ_VacXV:Sts	1.0000	1.0000	

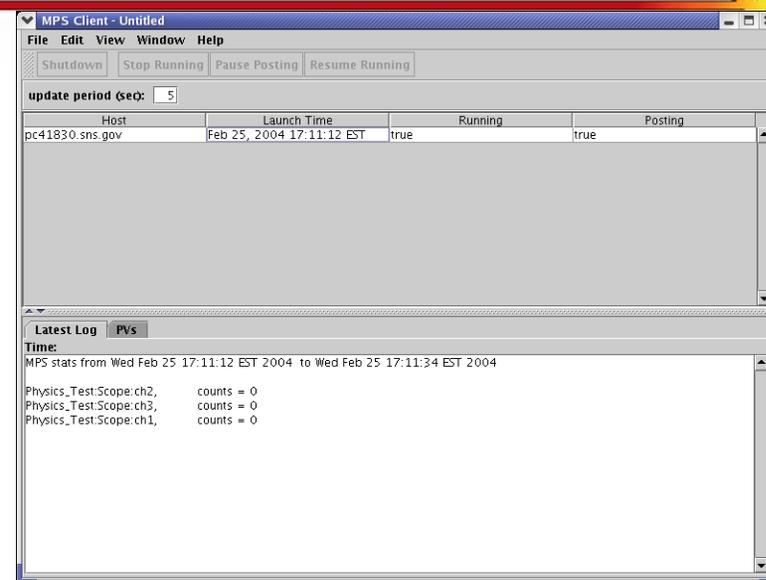
Machine data saved at Sat Aug 30 19:36:59 EDT 2003

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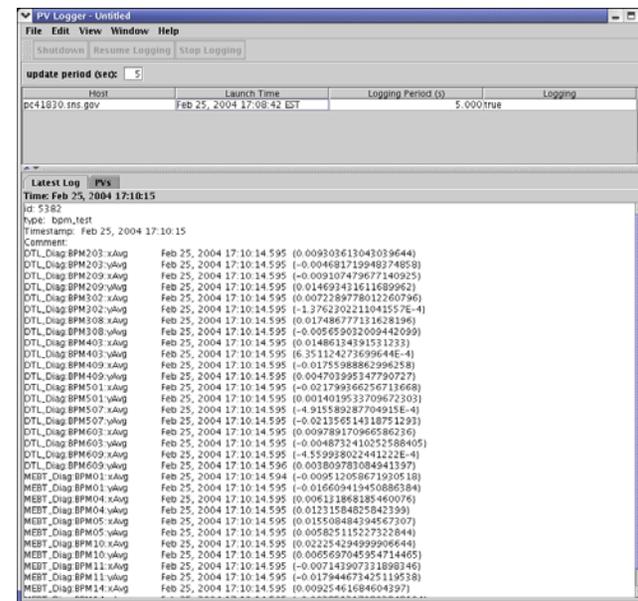
# Service Applications (T. Pelaia)



- MPS post mortem
  - monitors MPS events and sorts the signals in order of occurrence – i.e. determines the root cause of a trip
  - keeps statistics



- PV Logger – periodically grabs sets of “physics” data and stashes them in the database
  - Magnet and RF settings, BPM data
  - Can be triggered by other applications
  - Data to be used by other applications



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# Loss Viewer Application (S.Cousineau)



New Open... Save Cut Copy Paste Capture as PNG

84.2287  
44.6299  
DTL

Average of BLMs  
Maximum of BLMs

% of threshold

DTL Tanks

Status OK

Device	Value
DTL_Diag:BLM00	99.6562
DTL_Diag:BLM130	41.1906
DTL_Diag:BLM160	54.7499
DTL_Diag:BLM224	96.0268
DTL_Diag:BLM248	17.2615
DTL_Diag:BLM317	37.6952
DTL_Diag:BLM334	79.1418
DTL_Diag:BLM414	13.3742
DTL_Diag:BLM428	90.0643
DTL_Diag:BLM512	58.7722
DTL_Diag:BLM524	84.0758
DTL_Diag:BLM610	25.2960

Stop Plot

Position

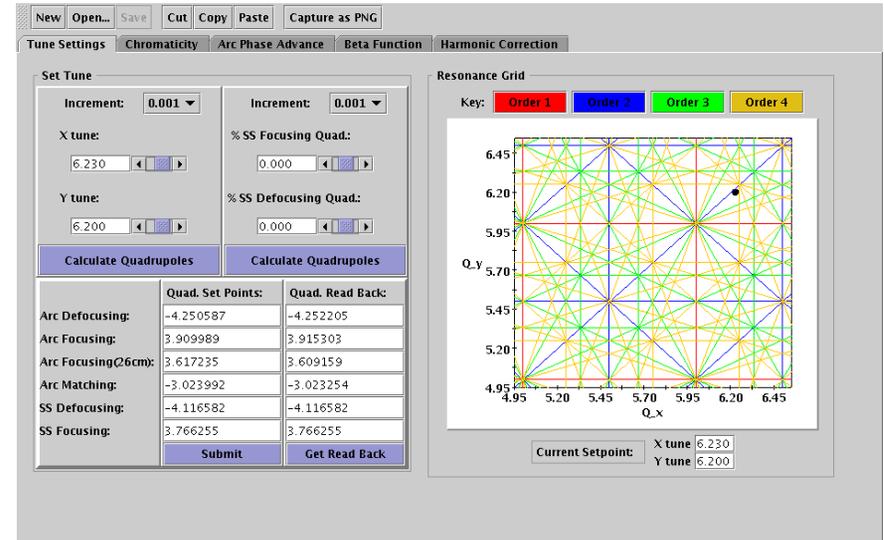
100.0  
88.8  
77.6  
66.3  
55.1  
43.9  
32.7  
21.4  
10.2  
-1.0

- View a summary of beam loss by machine section
  - “Zoomable” to specific BLMs
  - Viewable as fraction of permissible loss

# Starting on Ring Apps



- Members of the AP group (S. Danilov, S. Cousineau) are preparing Ring applications using XAL tools
- HEBT matching algorithms
- Ring Optics settings
- Injection



# Summary

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- The XAL application programming infrastructure is in place and working.
  - ~ 15 applications written
  - Online modeling is available
- Directions
  - Starting on Ring applications
  - Getting more detailed information in the database
  - Moving towards service applications