SNS High Level Control Room and Physics Applications

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ORNL

ICFA mini-Workshop

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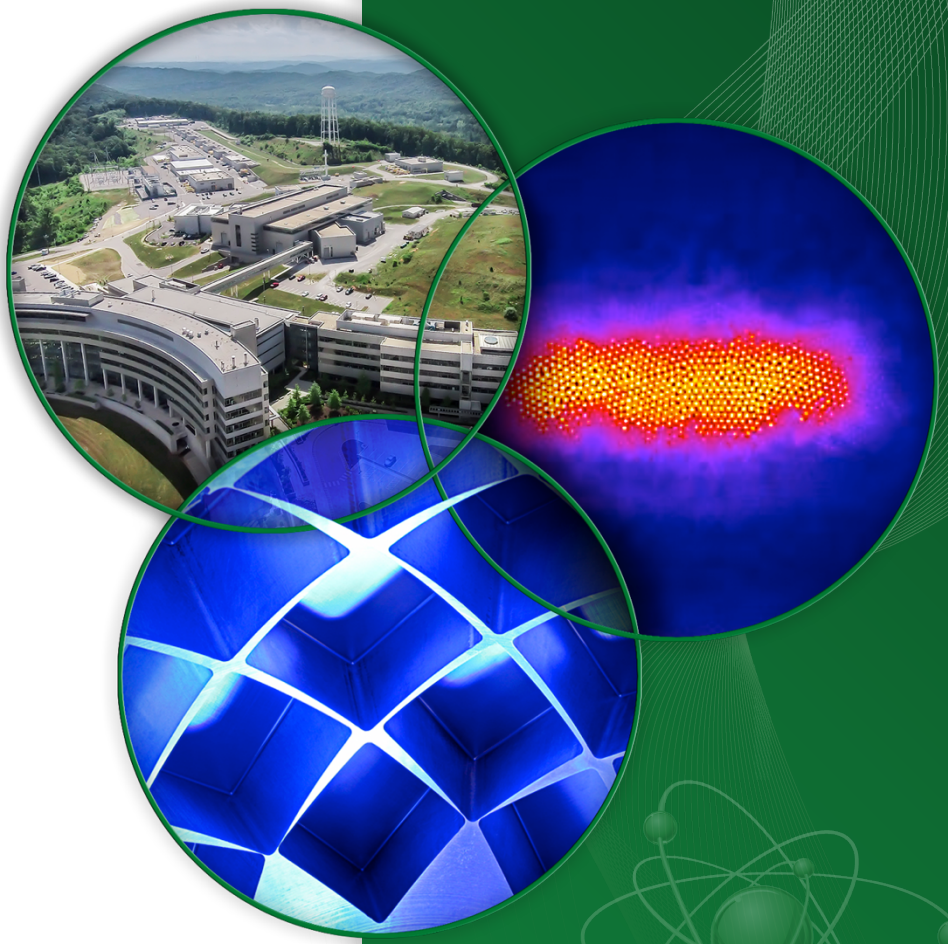

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Control Room Software

Software	*Description*	*Examples*

Control Room Software

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XAL / Open XAL	***Accelerator Physics, device based display and control, online model***	***Orbit Correction, Matching,Tuning, Scanning, Analysis, Save/Compare/ Restore***

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XAL / Open XAL	Accelerator Physics, device based display and control, online model	Orbit Correction, Matching,Tuning, Scanning, Analysis, Save/Compare/ Restore
EPICS Display Manager (EDM)	Control System, EPICS PV Display and Control	Strip tool, PV plots, PV sliders, PV fields

Control Room Software

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XAL / Open XAL	Accelerator Physics, device based display and control, online model	Orbit Correction, Matching,Tuning, Scanning, Analysis, Save/Compare/ Restore
EPICS Display Manager (EDM)	Control System, EPICS PV Display and Control	Strip tool, PV plots, PV sliders, PV fields
Control System Studio (CSS)	Control System, EPICS PV Display and Control	Strip tool, PV plots, PV sliders, PV fields, archiving

Control Room Software

Software	*Description*	*Examples*
XAL / Open XAL	***Accelerator Physics, device based display and control, online model***	***Orbit Correction, Matching,Tuning, Scanning, Analysis, Save/Compare/ Restore***

High Level Accelerator Physics Applications

Open XAL provides control room high level physics applications and services

Open XAL

- Accelerator Physics Software Platform
- Open Source International Collaboration
- Applications, scripts and services
- Many packages
  - Online Model and Simulation
  - Application Framework and GUI building
  - EPICS Channel Access support
  - Math and Statistics
  - GUI components
  - Database connection

Open XAL System Requirements

- Building
  - Java 8 JDK
  - Git 1.7.5
  - Ant 1.9
- Running
  - Java 8 Runtime
  - JRuby and Jython for scripts

Open XAL Advantages over XAL

- Open Source International Collaboration
- Site specific extensions
- Simple, zero configuration build and launch
- All compiler warnings fixed
- Many bug fixes

Open XAL Applications and Services

- Support for commissioning and operations
- Several Types
  - Accelerator Physics Analysis
  - Machine Measurement and Tuning
  - Utility
  - Controls and Diagnostics
- **Contributions from multiple physicists**

Sampling of Applications

Application	Description
Energy Manager	Energy change support
Energy Meter	Measure beam energy in linac
Knobs	Change multiple PVs in specific ratios
Launcher	Launch applications
Linac Tuning	Determine RF cavity phases
Loss Viewer	Display beam loss
Machine SImulator	Perform what-if scenarios
My Tuner Viewer	Change individual PVs
Orbit Correction	Measure and Correct beam orbit
Profile Tools and Analysis	Measure and analyze wire scans
Ring BPM Viewer	Measure and analyze BPM signals
Ring Injection	Measure and control ring injection coordinates
RTBT Wizard	Measure and analyze beam profile in RTBT
SCAN 1D/2D	Perform 1D and 2D scans over PVs
Save Compare Restore	Save, Compare and Restore machine state
Virtual Accelerator	Simulate a live machine and serve up PVs

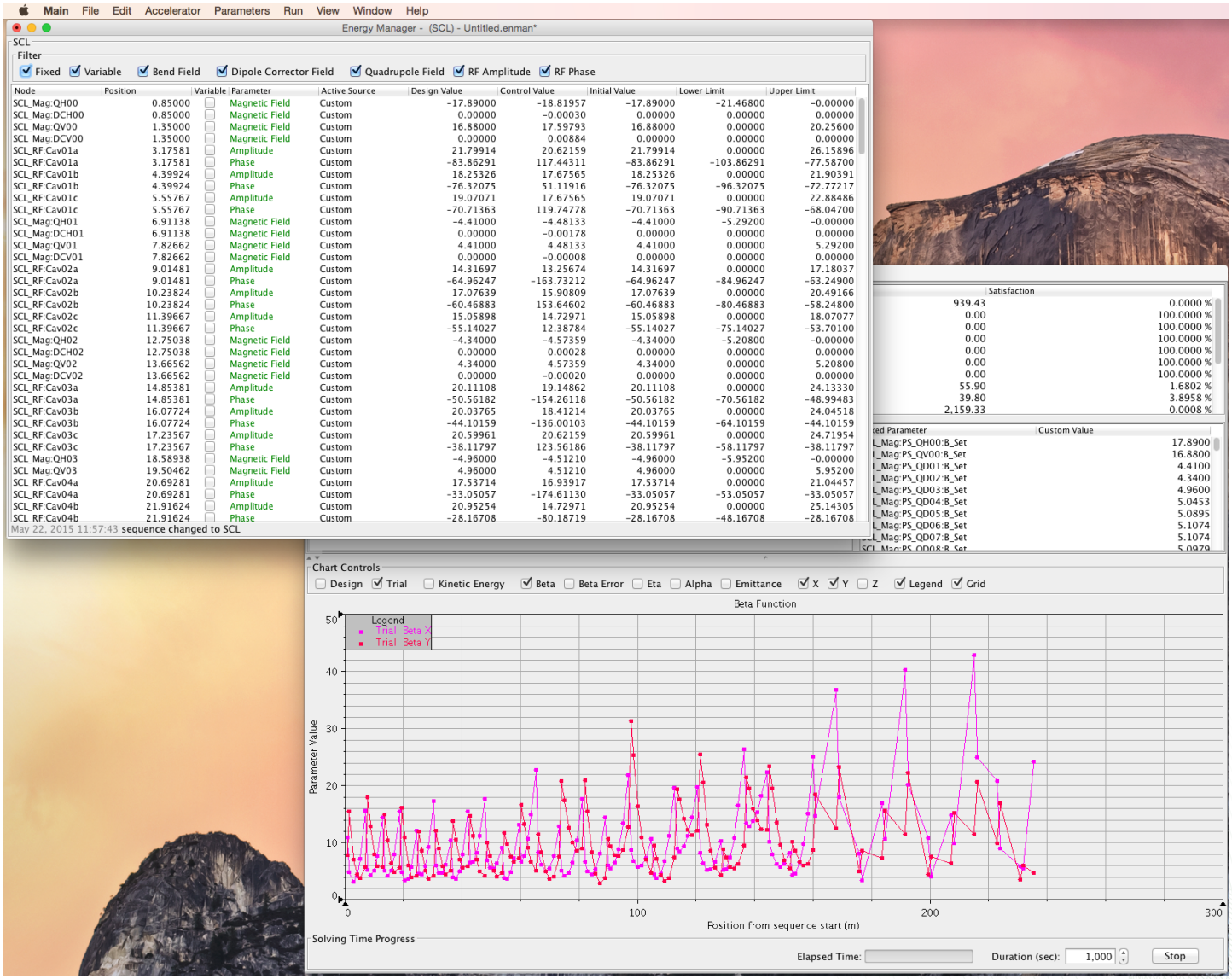
Services

Service	*Description*
Errant Beam Capture	*Monitor and Log machine state due to certain trips*
First Faults	*Monitor and log machine protection system faults clustering them by time stamp and determining the first fault*
PV Logger	*Log groups of channel access process variables both on demand and periodically*
Trip Monitor	*Monitor and Log RF Trips*

Energy Manager

- *Purpose*
  - Compensate for RF Cavity reduced field
- *Features*
  - ✓Evaluation of machine functions with trial magnet fields and RF phases and amplitudes
  - ✓Plots comparison of trial versus base machine functions
  - ✓Optimize machine parameters to account for loss of RF cavities or reduced RF cavity performance
  - ✓Compute and apply magnet field settings to account for beam energy changes

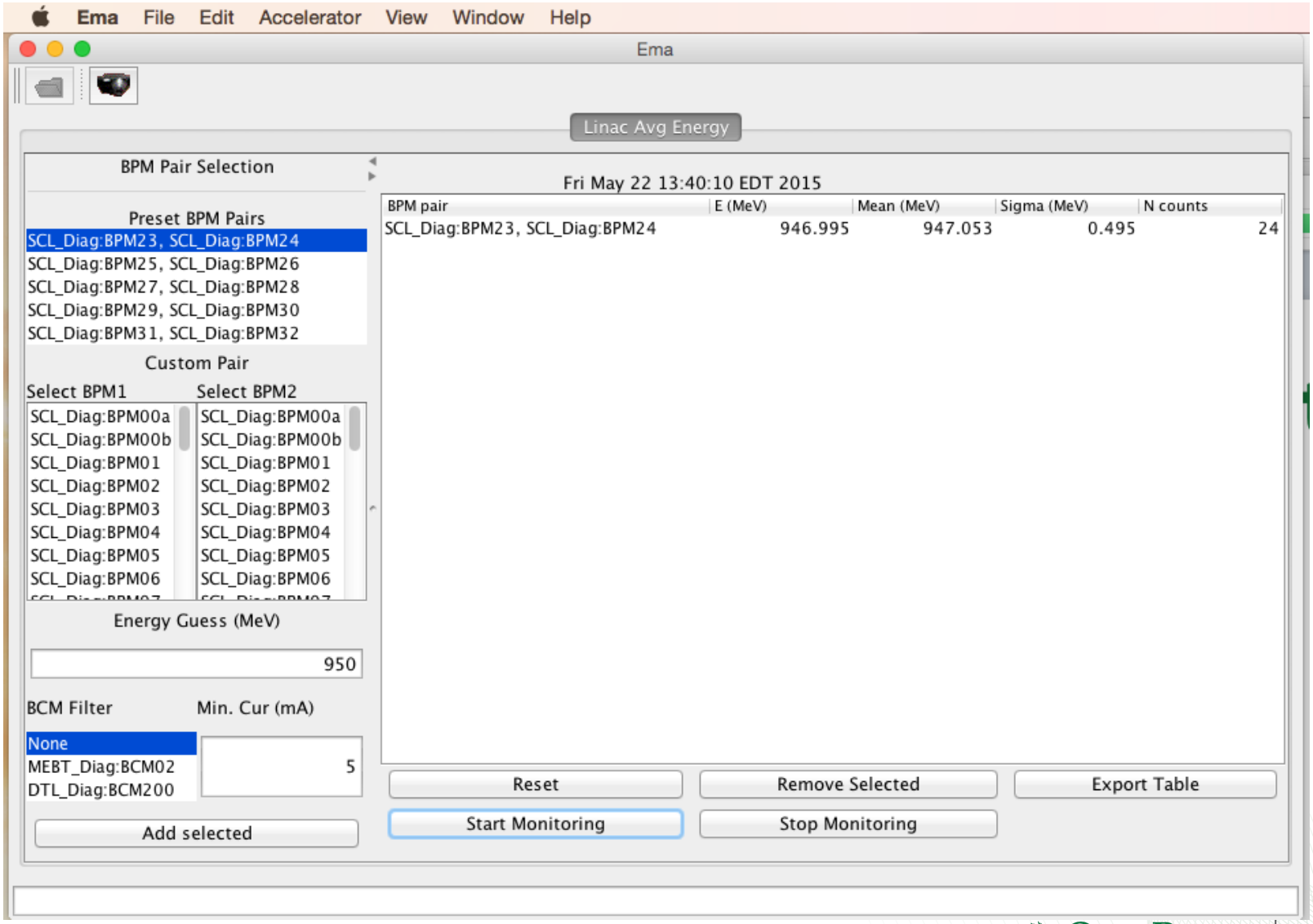
Energy Manager



Energy Meter

- *Purpose*
  - Compute and display the live linac beam energy
- *Features*
  - ✓Uses beam phase differences measured with beam position monitor (BPM) pairs
  - ✓Performs live averaging over beam pulses
  - ✓Displays results from multiple BPM pairs

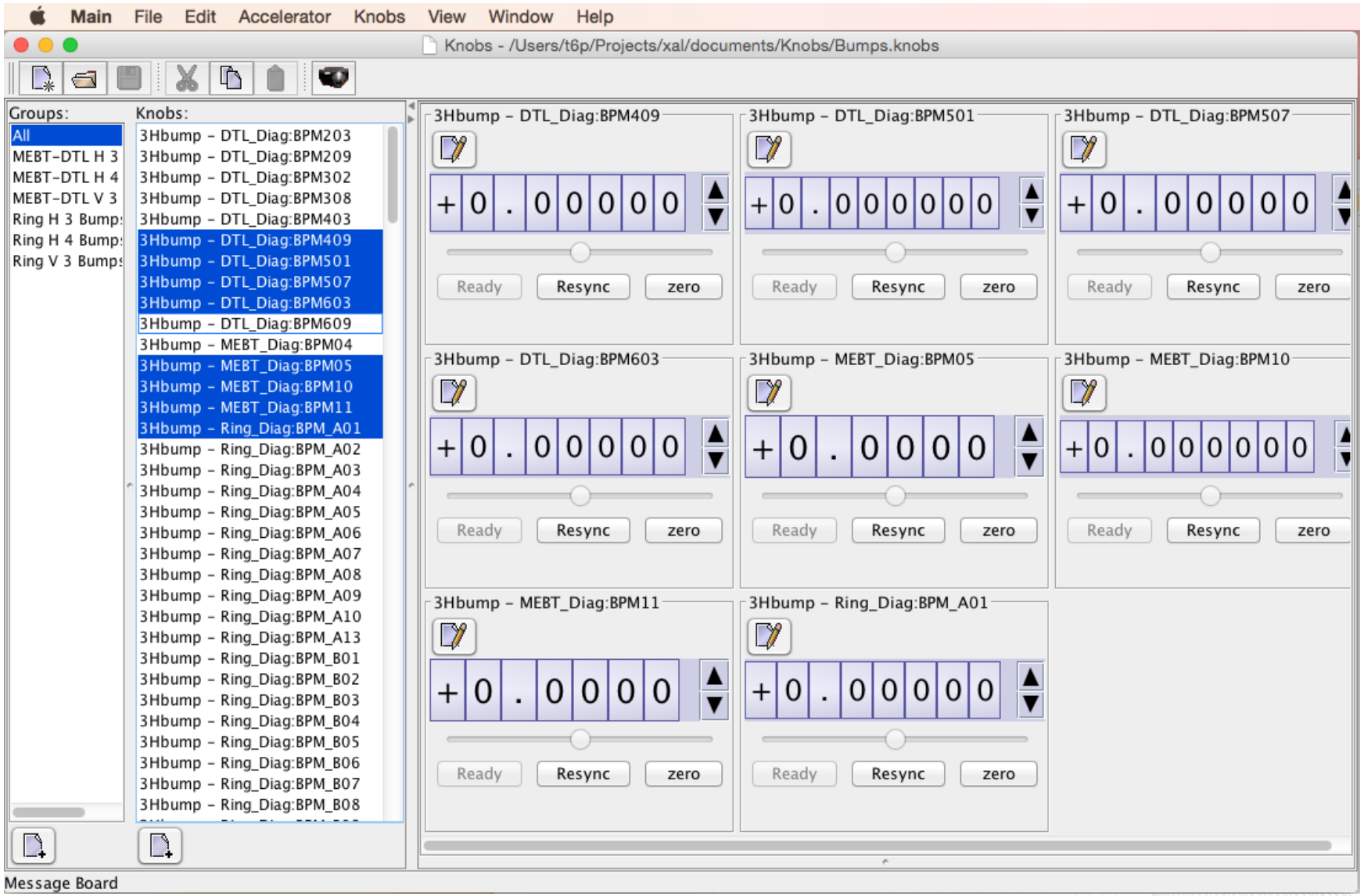
Energy Meter



Knobs

- *Purpose*
  - Provide common knob for changing a group of process variables (PVs)
- *Features*
  - ✓Multiple process variables (PVs) controlled through a single wheel switch
  - ✓Each PV assigned a coefficient for change relative to master knob
  - ✓Generates knobs for closed angle and offset bumps
  - ✓Generate a knob from initial and final machine states

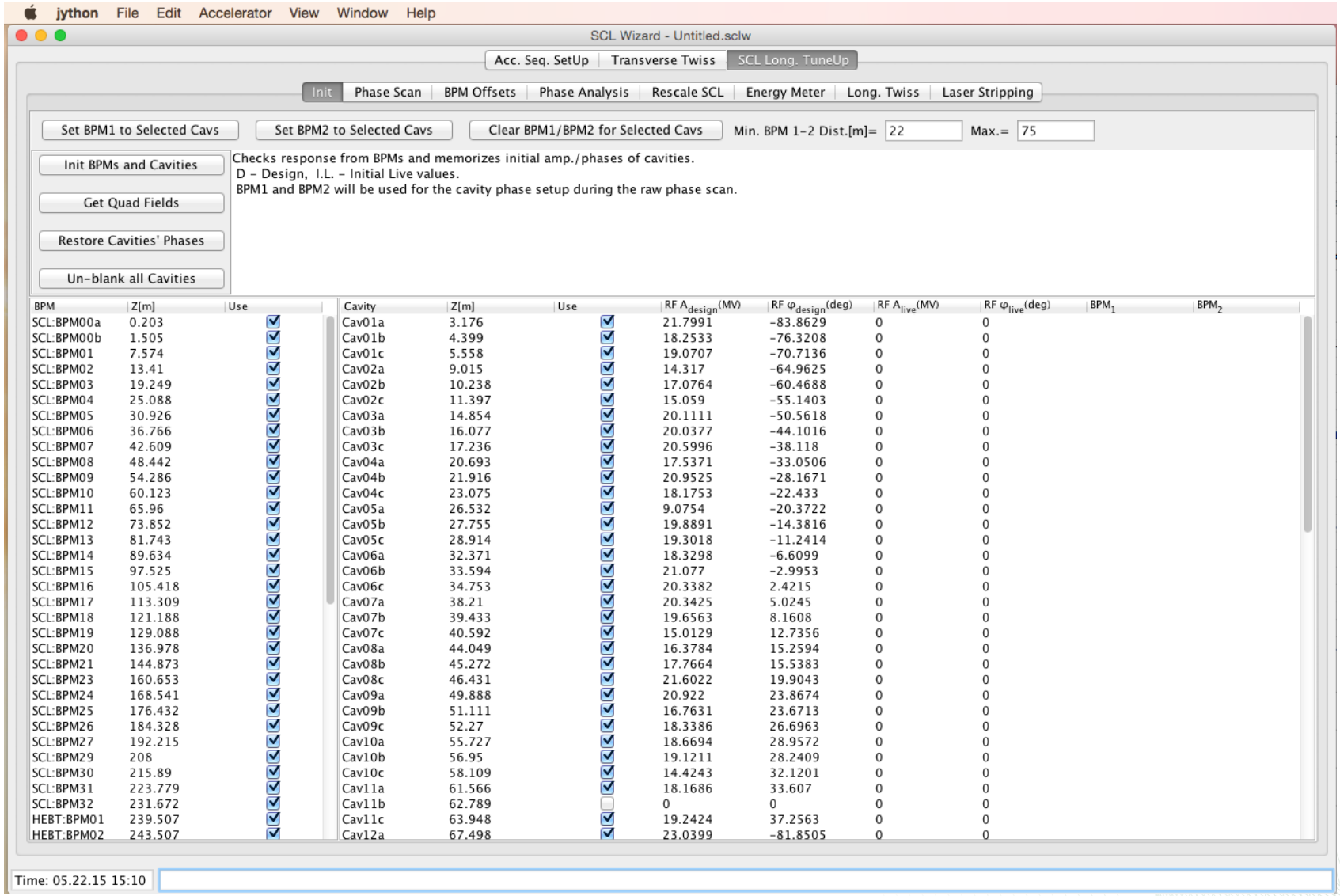
Knobs



Linac Tuning

- *Purpose*
  - Measure and set the amplitude and phase for each RF Cavity
- *Features*
  - ✓Separate warm and cold linac applications
  - ✓Measure downstream BPM phases to compute optimal RF Cavity amplitude and phase
  - ✓Compute output energy
  - ✓About One hour to tune warm linac
  - ✓About a Half hour to tune cold linac

Linac Tuning



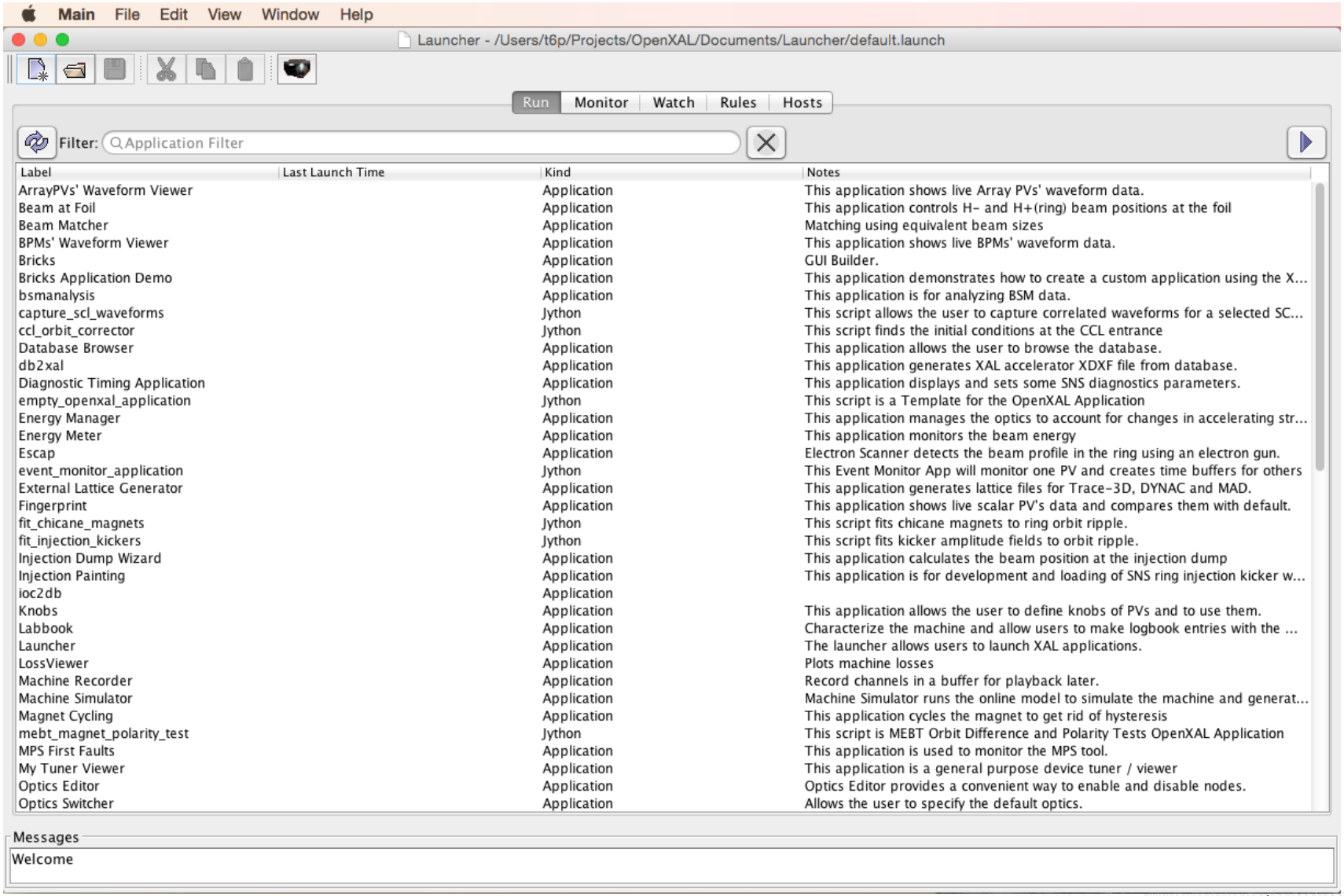
BPM	Z[m]	Use
SCL:BPM00a	0.203	☑
SCL:BPM00b	1.505	☑
SCL:BPM01	7.574	☑
SCL:BPM02	13.41	☑
SCL:BPM03	19.249	☑
SCL:BPM04	25.088	☑
SCL:BPM05	30.926	☑
SCL:BPM06	36.766	☑
SCL:BPM07	42.609	☑
SCL:BPM08	48.442	☑
SCL:BPM09	54.286	☑
SCL:BPM10	60.123	☑
SCL:BPM11	65.96	☑
SCL:BPM12	73.852	☑
SCL:BPM13	81.743	☑
SCL:BPM14	89.634	☑
SCL:BPM15	97.525	☑
SCL:BPM16	105.418	☑
SCL:BPM17	113.309	☑
SCL:BPM18	121.188	☑
SCL:BPM19	129.088	☑
SCL:BPM20	136.978	☑
SCL:BPM21	144.873	☑
SCL:BPM23	160.653	☑
SCL:BPM24	168.541	☑
SCL:BPM25	176.432	☑
SCL:BPM26	184.328	☑
SCL:BPM27	192.215	☑
SCL:BPM29	208	☑
SCL:BPM30	215.89	☑
SCL:BPM31	223.779	☑
SCL:BPM32	231.672	☑
HEBT:BPM01	239.507	☑
HEBT:BPM02	243.507	☑

Cavity	Z[m]	Use	RF A_{design}(MV)	RF φ_{design}(deg)	RF A_{live}(MV)	RF φ_{live}(deg)	BPM_1	BPM_2
Cav01a	3.176	☑	21.7991	-83.8629	0	0		
Cav01b	4.399	☑	18.2533	-76.3208	0	0		
Cav01c	5.558	☑	19.0707	-70.7136	0	0		
Cav02a	9.015	☑	14.317	-64.9625	0	0		
Cav02b	10.238	☑	17.0764	-60.4688	0	0		
Cav02c	11.397	☑	15.059	-55.1403	0	0		
Cav03a	14.854	☑	20.1111	-50.5618	0	0		
Cav03b	16.077	☑	20.0377	-44.1016	0	0		
Cav03c	17.236	☑	20.5996	-38.118	0	0		
Cav04a	20.693	☑	17.5371	-33.0506	0	0		
Cav04b	21.916	☑	20.9525	-28.1671	0	0		
Cav04c	23.075	☑	18.1753	-22.433	0	0		
Cav05a	26.532	☑	9.0754	-20.3722	0	0		
Cav05b	27.755	☑	19.8891	-14.3816	0	0		
Cav05c	28.914	☑	19.3018	-11.2414	0	0		
Cav06a	32.371	☑	18.3298	-6.6099	0	0		
Cav06b	33.594	☑	21.077	-2.9953	0	0		
Cav06c	34.753	☑	20.3382	2.4215	0	0		
Cav07a	38.21	☑	20.3425	5.0245	0	0		
Cav07b	39.433	☑	19.6563	8.1608	0	0		
Cav07c	40.592	☑	15.0129	12.7356	0	0		
Cav08a	44.049	☑	16.3784	15.2594	0	0		
Cav08b	45.272	☑	17.7664	15.5383	0	0		
Cav08c	46.431	☑	21.6022	19.9043	0	0		
Cav09a	49.888	☑	20.922	23.8674	0	0		
Cav09b	51.111	☑	16.7631	23.6713	0	0		
Cav09c	52.27	☑	18.3386	26.6963	0	0		
Cav10a	55.727	☑	18.6694	28.9572	0	0		
Cav10b	56.95	☑	19.1211	28.2409	0	0		
Cav10c	58.109	☑	14.4243	32.1201	0	0		
Cav11a	61.566	☑	18.1686	33.607	0	0		
Cav11b	62.789	☐	0	0	0	0		
Cav11c	63.948	☑	19.2424	37.2563	0	0		
Cav12a	67.498	☑	23.0399	-81.8505	0	0		

Launcher

- *Purpose*
  - Launch and monitor applications
- *Features*
  - ✓Automatically displays built applications and scripts with description
  - ✓Can launch executables round robin across servers
  - ✓Monitors currently running applications
    - Covers local network
    - Displays name, launch time, memory usage and server
    - Bring forward and force quit options

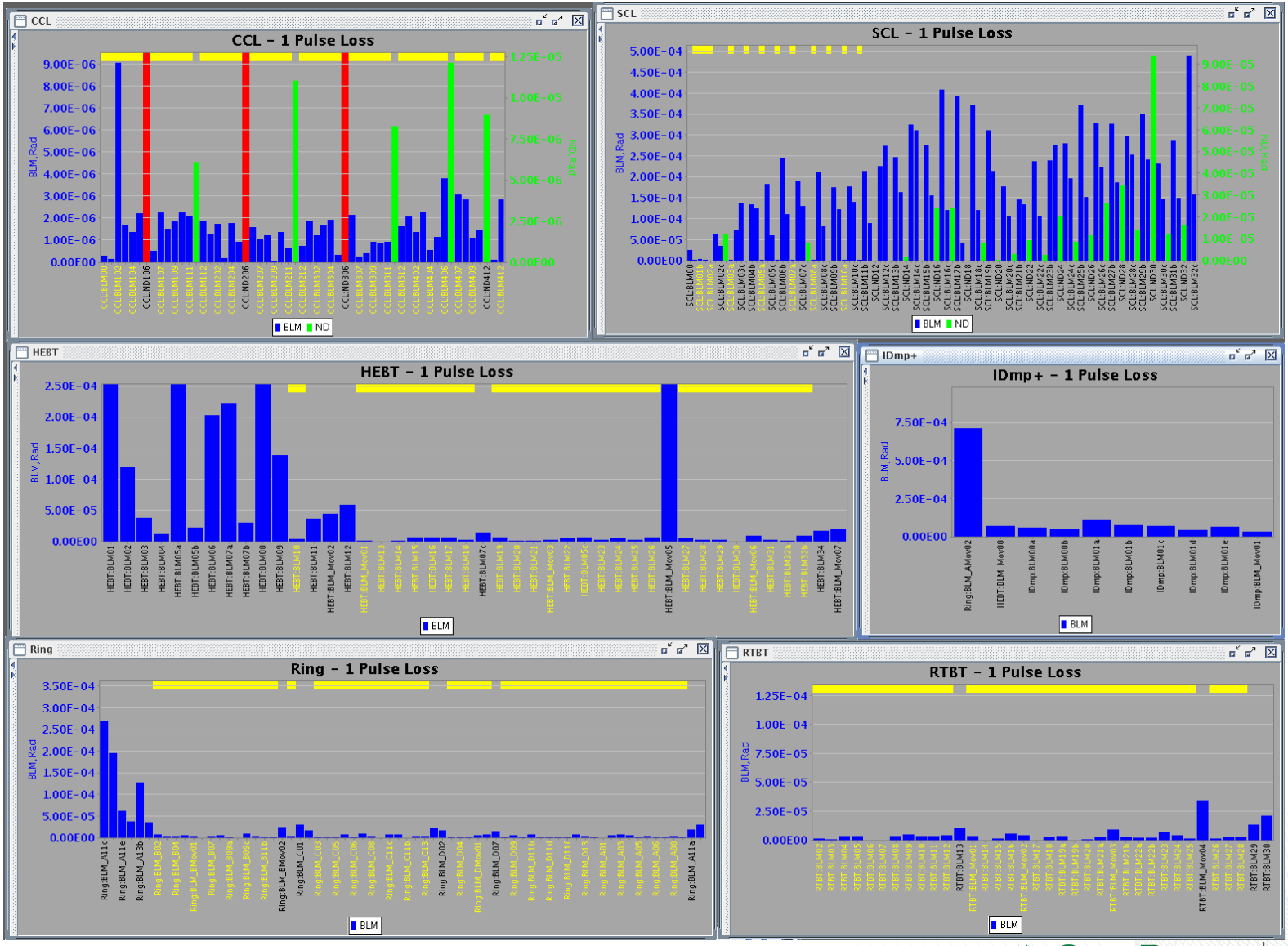
Launcher



Loss Viewer

- *Purpose*
  - Monitor and display beam loss throughout machine
  - Administratively required during machine studies
  - Tuning machine to reduce beam loss
- *Features*
  - ✓Input
    - Beam Loss Monitor (BLM) Ionization Chambers
    - Neutron Detectors (ND)
  - ✓Table and plot views
  - ✓Averaging and Charge Normalization options
  - ✓Trip limits display

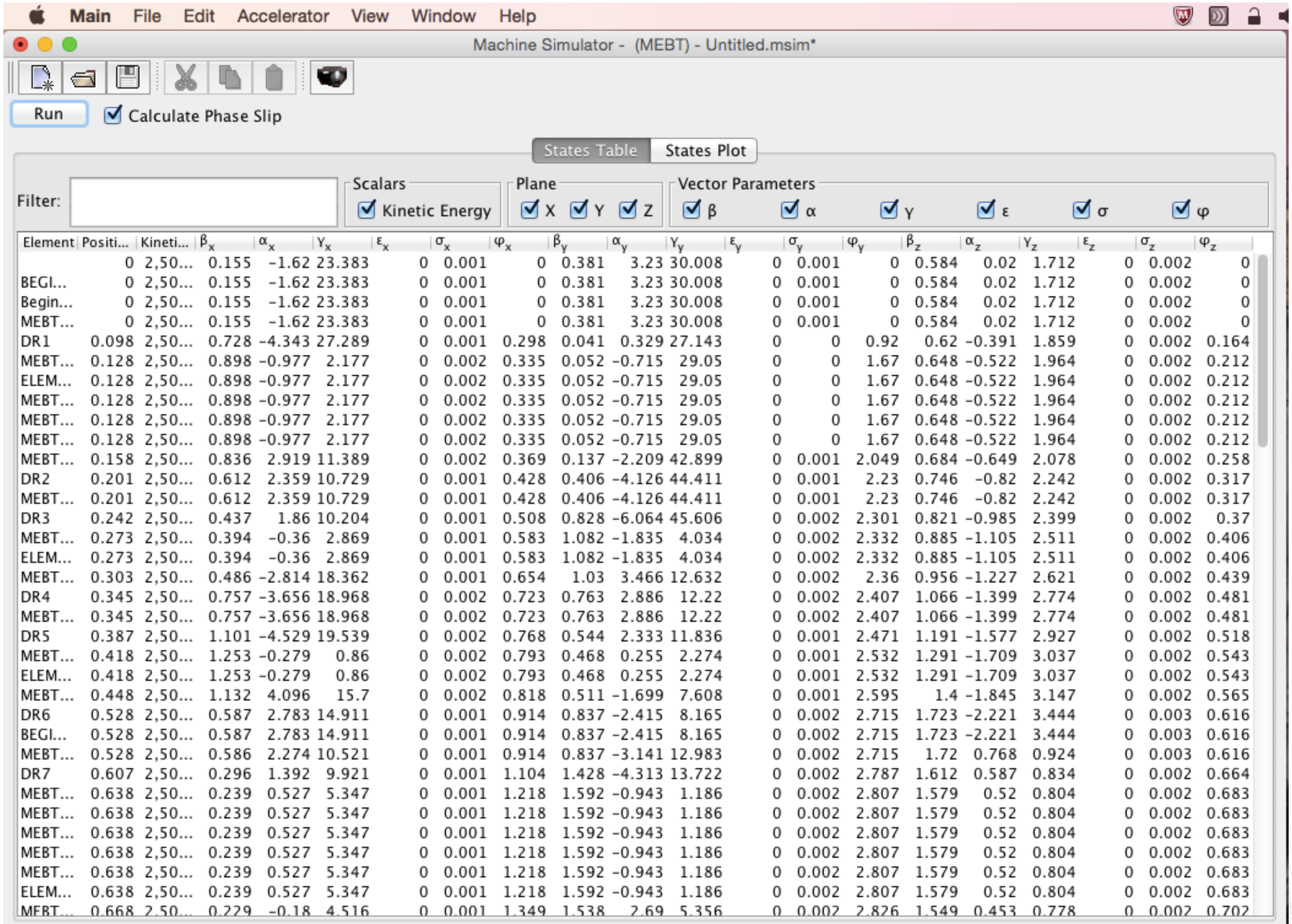
Loss Viewer



Machine Simulator

- *Purpose*
  - Calculate and display machine computations
  - Diagnose magnet and BPM polarity errors
- Still under development
- *Current Features*
  - Replacement for XAL MPX application
  - Calculates and Displays beam energy and twiss parameters
- *Future Features*
  - What-If computations
  - Difference calculations

Machine Simulator

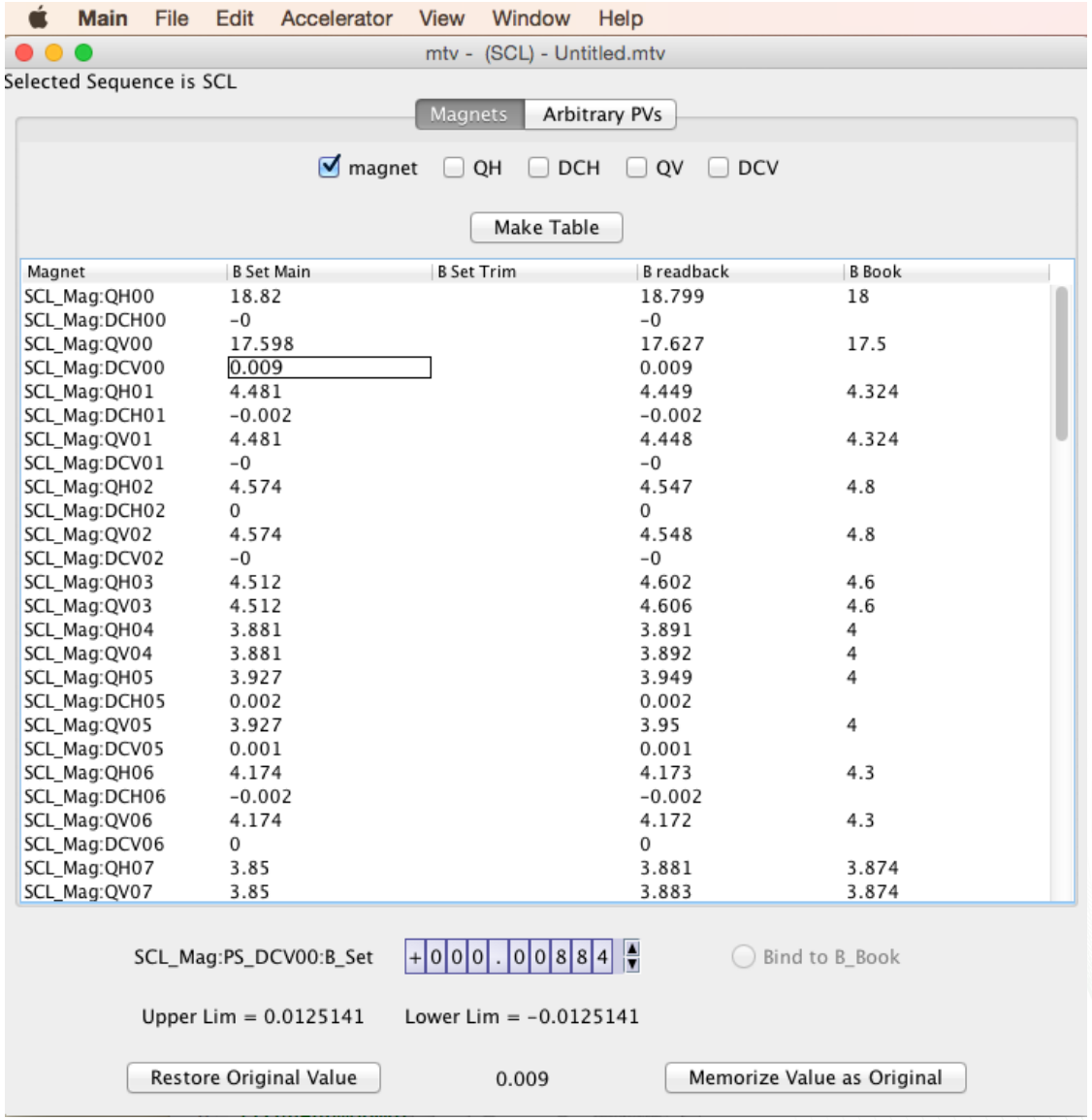


Element	Positi...	Kineti...	β_x	α_x	γ_x	ϵ_x	σ_x	φ_x	β_y	α_y	γ_y	ϵ_y	σ_y	φ_y	β_z	α_z	γ_z	ϵ_z	σ_z	φ_z
	0	2,50...	0.155	-1.62	23.383	0	0.001	0	0.381	3.23	30.008	0	0.001	0	0.584	0.02	1.712	0	0.002	0
BEGI...	0	2,50...	0.155	-1.62	23.383	0	0.001	0	0.381	3.23	30.008	0	0.001	0	0.584	0.02	1.712	0	0.002	0
Begin...	0	2,50...	0.155	-1.62	23.383	0	0.001	0	0.381	3.23	30.008	0	0.001	0	0.584	0.02	1.712	0	0.002	0
MEBT...	0	2,50...	0.155	-1.62	23.383	0	0.001	0	0.381	3.23	30.008	0	0.001	0	0.584	0.02	1.712	0	0.002	0
DR1	0.098	2,50...	0.728	-4.343	27.289	0	0.001	0.298	0.041	0.329	27.143	0	0	0.92	0.62	-0.391	1.859	0	0.002	0.164
MEBT...	0.128	2,50...	0.898	-0.977	2.177	0	0.002	0.335	0.052	-0.715	29.05	0	0	1.67	0.648	-0.522	1.964	0	0.002	0.212
ELEM...	0.128	2,50...	0.898	-0.977	2.177	0	0.002	0.335	0.052	-0.715	29.05	0	0	1.67	0.648	-0.522	1.964	0	0.002	0.212
MEBT...	0.128	2,50...	0.898	-0.977	2.177	0	0.002	0.335	0.052	-0.715	29.05	0	0	1.67	0.648	-0.522	1.964	0	0.002	0.212
MEBT...	0.128	2,50...	0.898	-0.977	2.177	0	0.002	0.335	0.052	-0.715	29.05	0	0	1.67	0.648	-0.522	1.964	0	0.002	0.212
MEBT...	0.128	2,50...	0.898	-0.977	2.177	0	0.002	0.335	0.052	-0.715	29.05	0	0	1.67	0.648	-0.522	1.964	0	0.002	0.212
MEBT...	0.158	2,50...	0.836	2.919	11.389	0	0.002	0.369	0.137	-2.209	42.899	0	0.001	2.049	0.684	-0.649	2.078	0	0.002	0.258
DR2	0.201	2,50...	0.612	2.359	10.729	0	0.001	0.428	0.406	-4.126	44.411	0	0.001	2.23	0.746	-0.82	2.242	0	0.002	0.317
MEBT...	0.201	2,50...	0.612	2.359	10.729	0	0.001	0.428	0.406	-4.126	44.411	0	0.001	2.23	0.746	-0.82	2.242	0	0.002	0.317
DR3	0.242	2,50...	0.437	1.86	10.204	0	0.001	0.508	0.828	-6.064	45.606	0	0.002	2.301	0.821	-0.985	2.399	0	0.002	0.37
MEBT...	0.273	2,50...	0.394	-0.36	2.869	0	0.001	0.583	1.082	-1.835	4.034	0	0.002	2.332	0.885	-1.105	2.511	0	0.002	0.406
ELEM...	0.273	2,50...	0.394	-0.36	2.869	0	0.001	0.583	1.082	-1.835	4.034	0	0.002	2.332	0.885	-1.105	2.511	0	0.002	0.406
MEBT...	0.303	2,50...	0.486	-2.814	18.362	0	0.001	0.654	1.03	3.466	12.632	0	0.002	2.36	0.956	-1.227	2.621	0	0.002	0.439
DR4	0.345	2,50...	0.757	-3.656	18.968	0	0.002	0.723	0.763	2.886	12.22	0	0.002	2.407	1.066	-1.399	2.774	0	0.002	0.481
MEBT...	0.345	2,50...	0.757	-3.656	18.968	0	0.002	0.723	0.763	2.886	12.22	0	0.002	2.407	1.066	-1.399	2.774	0	0.002	0.481
DR5	0.387	2,50...	1.101	-4.529	19.539	0	0.002	0.768	0.544	2.333	11.836	0	0.001	2.471	1.191	-1.577	2.927	0	0.002	0.518
MEBT...	0.418	2,50...	1.253	-0.279	0.86	0	0.002	0.793	0.468	0.255	2.274	0	0.001	2.532	1.291	-1.709	3.037	0	0.002	0.543
ELEM...	0.418	2,50...	1.253	-0.279	0.86	0	0.002	0.793	0.468	0.255	2.274	0	0.001	2.532	1.291	-1.709	3.037	0	0.002	0.543
MEBT...	0.448	2,50...	1.132	4.096	15.7	0	0.002	0.818	0.511	-1.699	7.608	0	0.001	2.595	1.4	-1.845	3.147	0	0.002	0.565
DR6	0.528	2,50...	0.587	2.783	14.911	0	0.001	0.914	0.837	-2.415	8.165	0	0.002	2.715	1.723	-2.221	3.444	0	0.003	0.616
BEGI...	0.528	2,50...	0.587	2.783	14.911	0	0.001	0.914	0.837	-2.415	8.165	0	0.002	2.715	1.723	-2.221	3.444	0	0.003	0.616
MEBT...	0.528	2,50...	0.586	2.274	10.521	0	0.001	0.914	0.837	-3.141	12.983	0	0.002	2.715	1.72	0.768	0.924	0	0.003	0.616
DR7	0.607	2,50...	0.296	1.392	9.921	0	0.001	1.104	1.428	-4.313	13.722	0	0.002	2.787	1.612	0.587	0.834	0	0.002	0.664
MEBT...	0.638	2,50...	0.239	0.527	5.347	0	0.001	1.218	1.592	-0.943	1.186	0	0.002	2.807	1.579	0.52	0.804	0	0.002	0.683
MEBT...	0.638	2,50...	0.239	0.527	5.347	0	0.001	1.218	1.592	-0.943	1.186	0	0.002	2.807	1.579	0.52	0.804	0	0.002	0.683
MEBT...	0.638	2,50...	0.239	0.527	5.347	0	0.001	1.218	1.592	-0.943	1.186	0	0.002	2.807	1.579	0.52	0.804	0	0.002	0.683
MEBT...	0.638	2,50...	0.239	0.527	5.347	0	0.001	1.218	1.592	-0.943	1.186	0	0.002	2.807	1.579	0.52	0.804	0	0.002	0.683
MEBT...	0.638	2,50...	0.239	0.527	5.347	0	0.001	1.218	1.592	-0.943	1.186	0	0.002	2.807	1.579	0.52	0.804	0	0.002	0.683
ELEM...	0.638	2,50...	0.239	0.527	5.347	0	0.001	1.218	1.592	-0.943	1.186	0	0.002	2.807	1.579	0.52	0.804	0	0.002	0.683
MEBT...	0.668	2,50...	0.229	-0.18	4.516	0	0.001	1.349	1.538	2.69	5.356	0	0.002	2.826	1.549	0.453	0.778	0	0.002	0.702

My Tuner Viewer (MTV)

- *Purpose*
  - Utility for changing process variables (PVs)
- *Features*
  - ✓Displays Process Variables (PV) for magnet fields
  - ✓Convenient wheel switch control of selected PV
  - ✓Can change PV's Machine Protection System (MPS) target (B_Book)
  - ✓Optionally bind field setting to B_Book
  - ✓Memorize and restore values

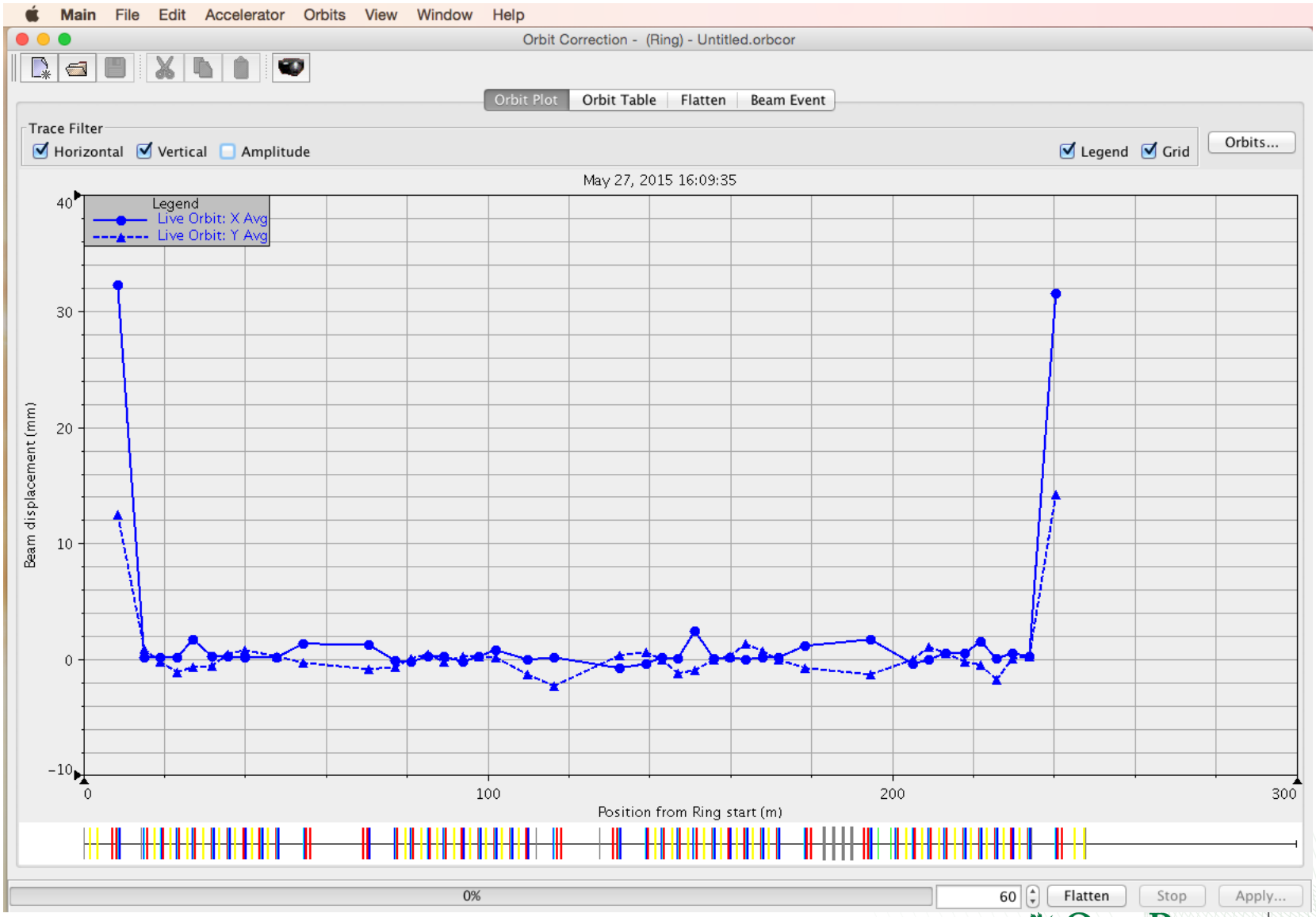
My Tuner Viewer



Orbit Correction

- *Purpose*
  - Measure and correct the transverse orbit
- *Features*
  - ✓Monitor and display live orbit (x, y and amplitude averages)
  - ✓Save snapshot orbit and compute difference orbit
  - ✓Manually specify custom orbit
  - ✓Flatten orbit to reference and optionally apply fraction of correction
  - ✓Batch setting of corrector field and limits

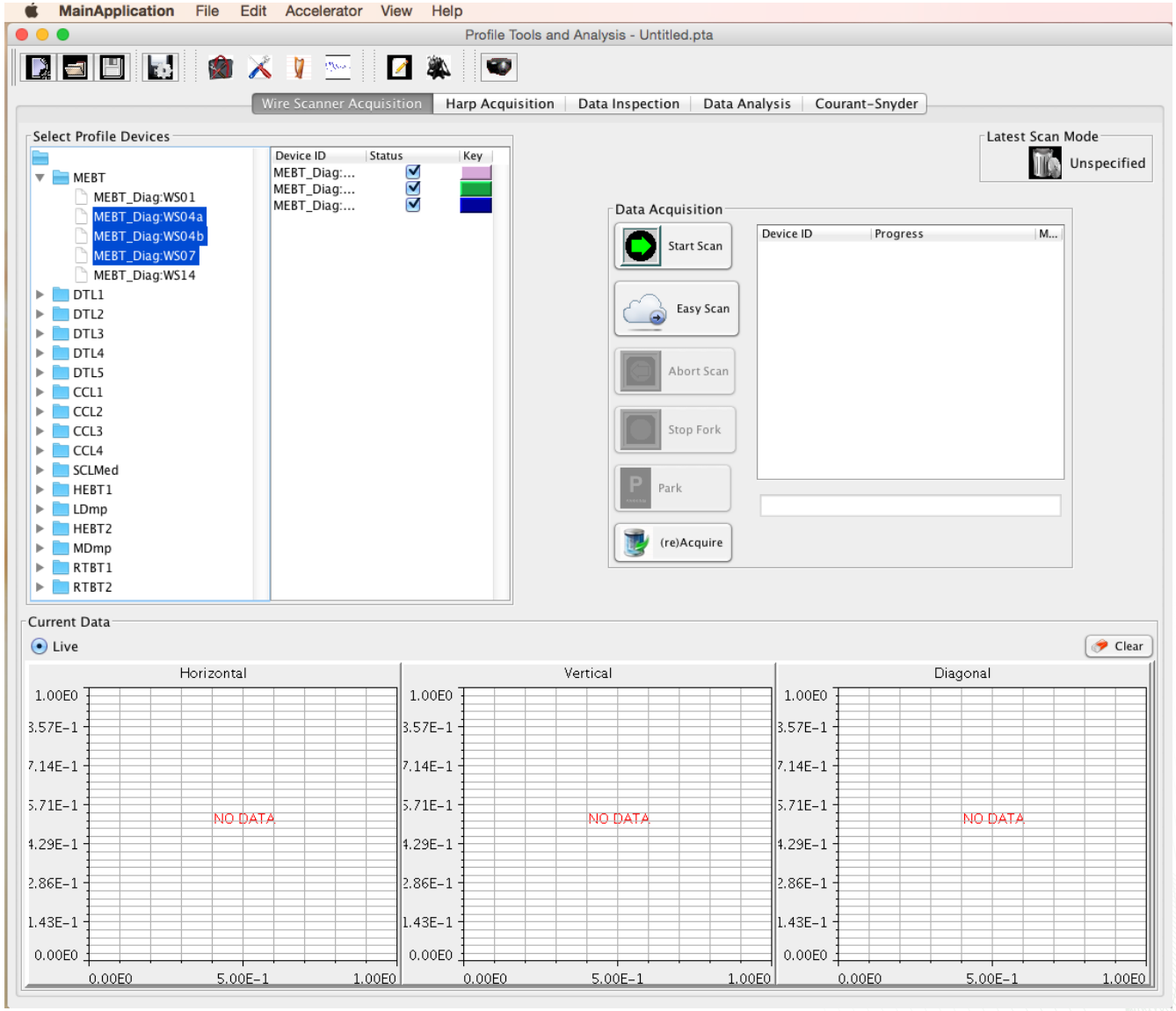
Orbit Correction



Profile Tools and Analysis

- *Purpose*
  - Wire scan and analysis
- *Features*
  - ✓Perform wire scan and wire harp data acquisition
  - ✓Display scan statistics
  - ✓Analyze the scans
  - ✓Perform matching

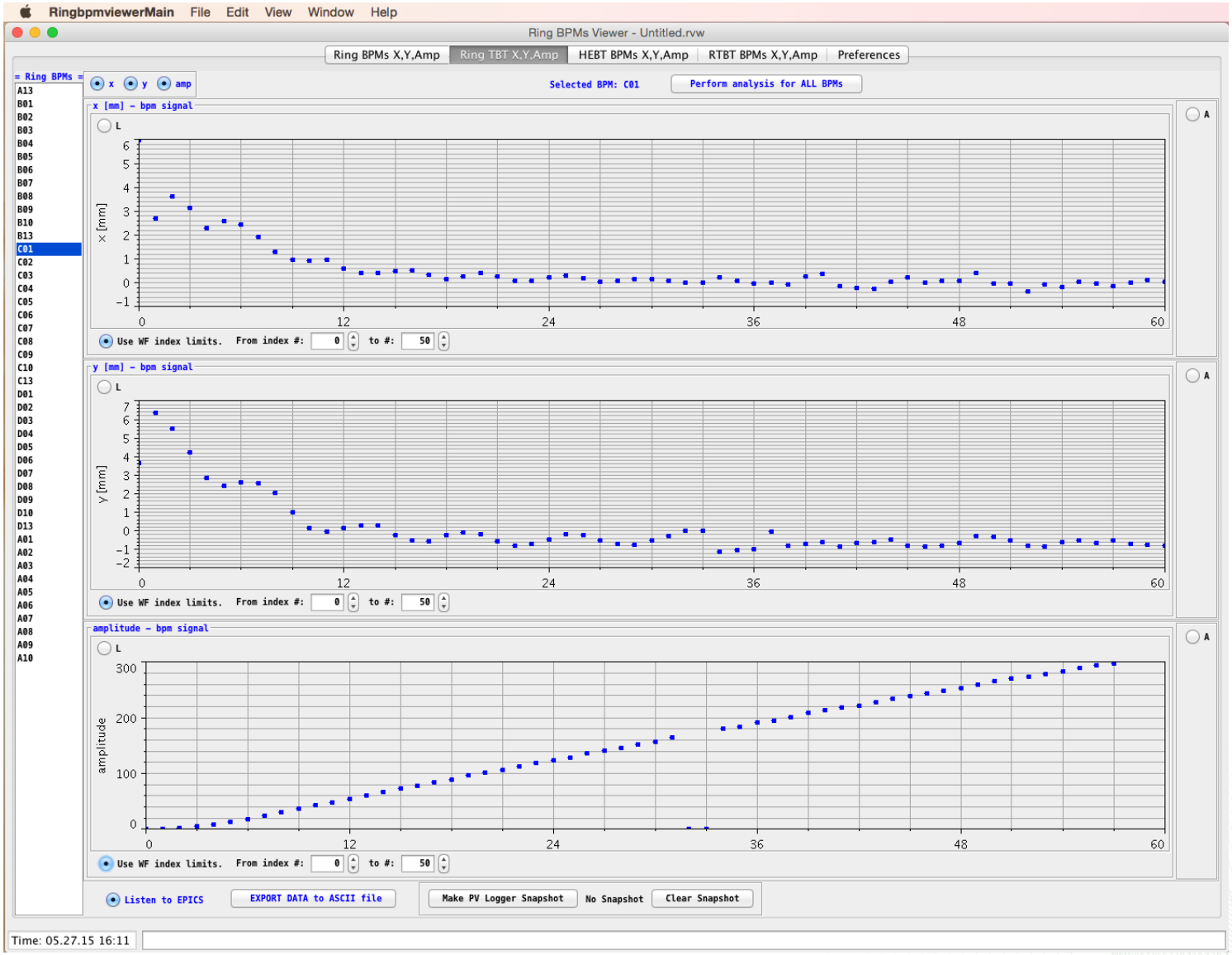
Profile Tools and Analysis



Ring BPM Viewer

- *Purpose*
  - Measure beam position attributes in the Ring
- *Features*
  - ✓Monitor and Display Beam Position History
  - ✓Monitor and Display Beam Position Turn by Turn Waveforms
    - Suitable for single bunch injection
    - Damped Sinusoid parameter fitting

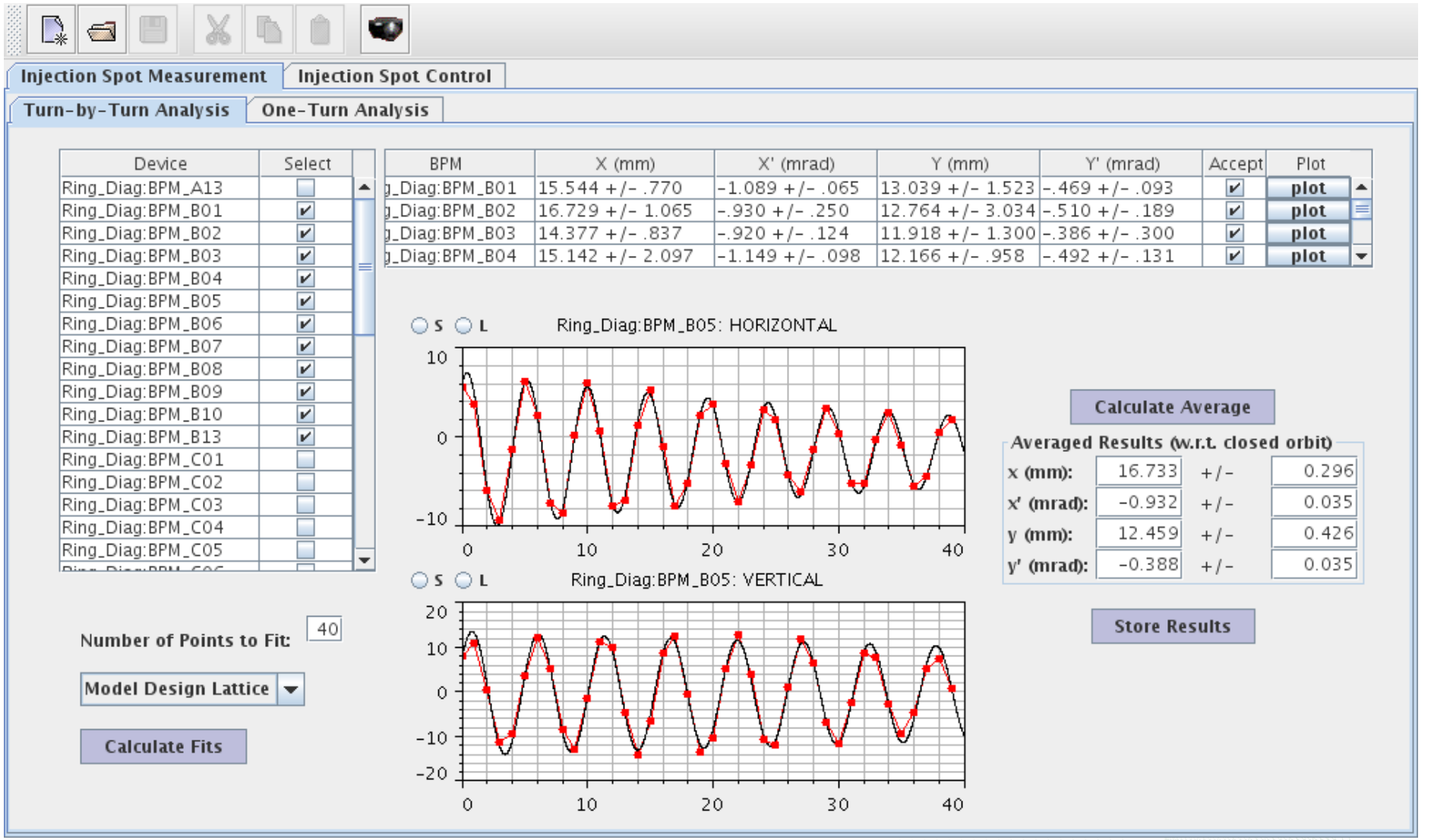
Ring BPM Viewer



Ring Injection

- *Purpose*
  - Measure and correct the beam injection position and angle
- *Features*
  - ✓Measure single bunch turn by turn beam positions
  - ✓Compute position and angle at injection spot from measurements at beam position monitors and online model projections
  - ✓Solve for corrector fields to adjust injection spot position and angle

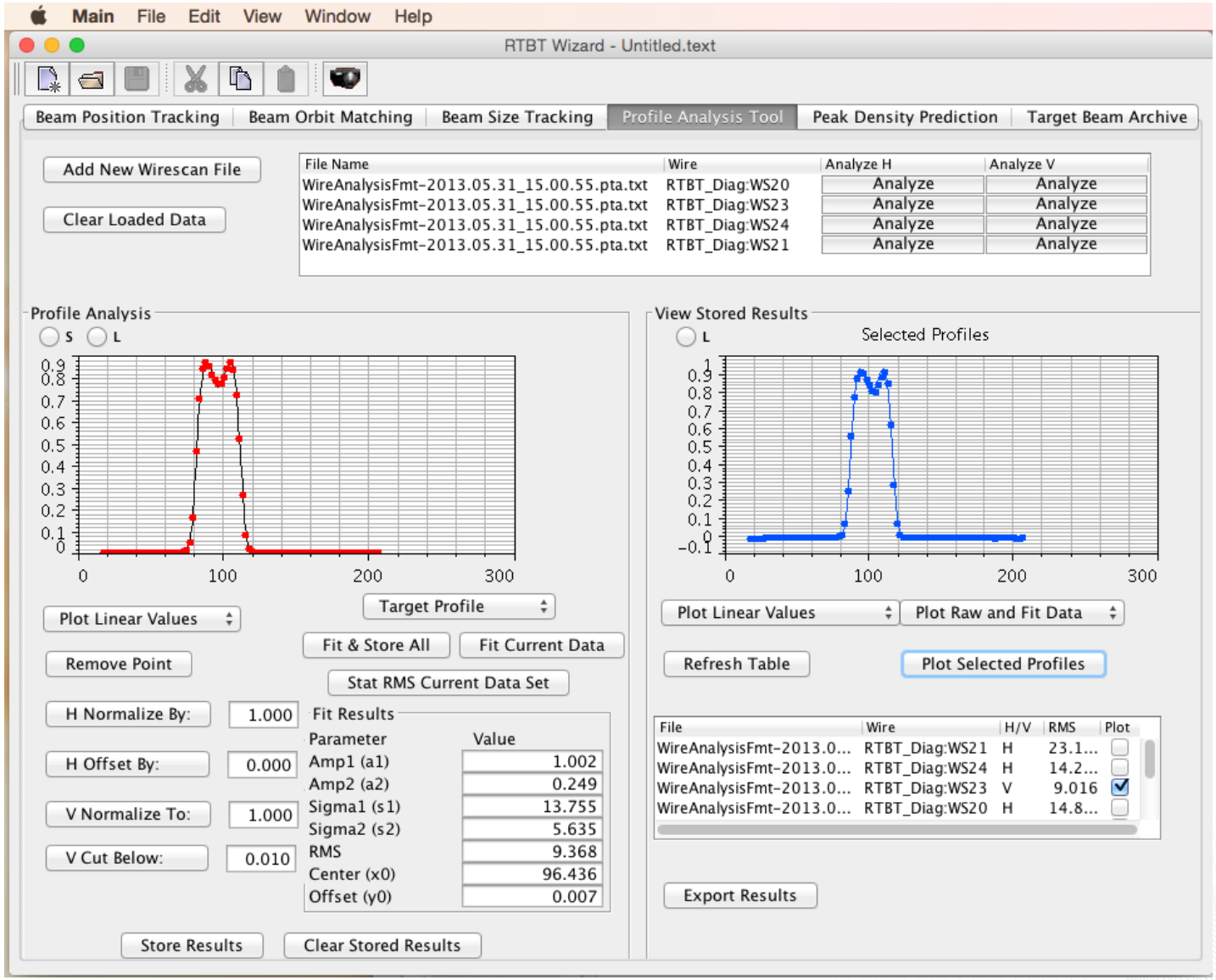
Ring Injection



RTBT Wizard

- *Purpose*
  - Measure and tune beam in Ring to Target Beam Transferline (RTBT)
  - Measure beam characteristics on target
- *Features*
  - ✓Project Target beam parameters from RTBT and Harp measurements
    - Beam position
    - Beam width, height and rotation
    - Beam density
  - ✓Archive projected Target beam parameters

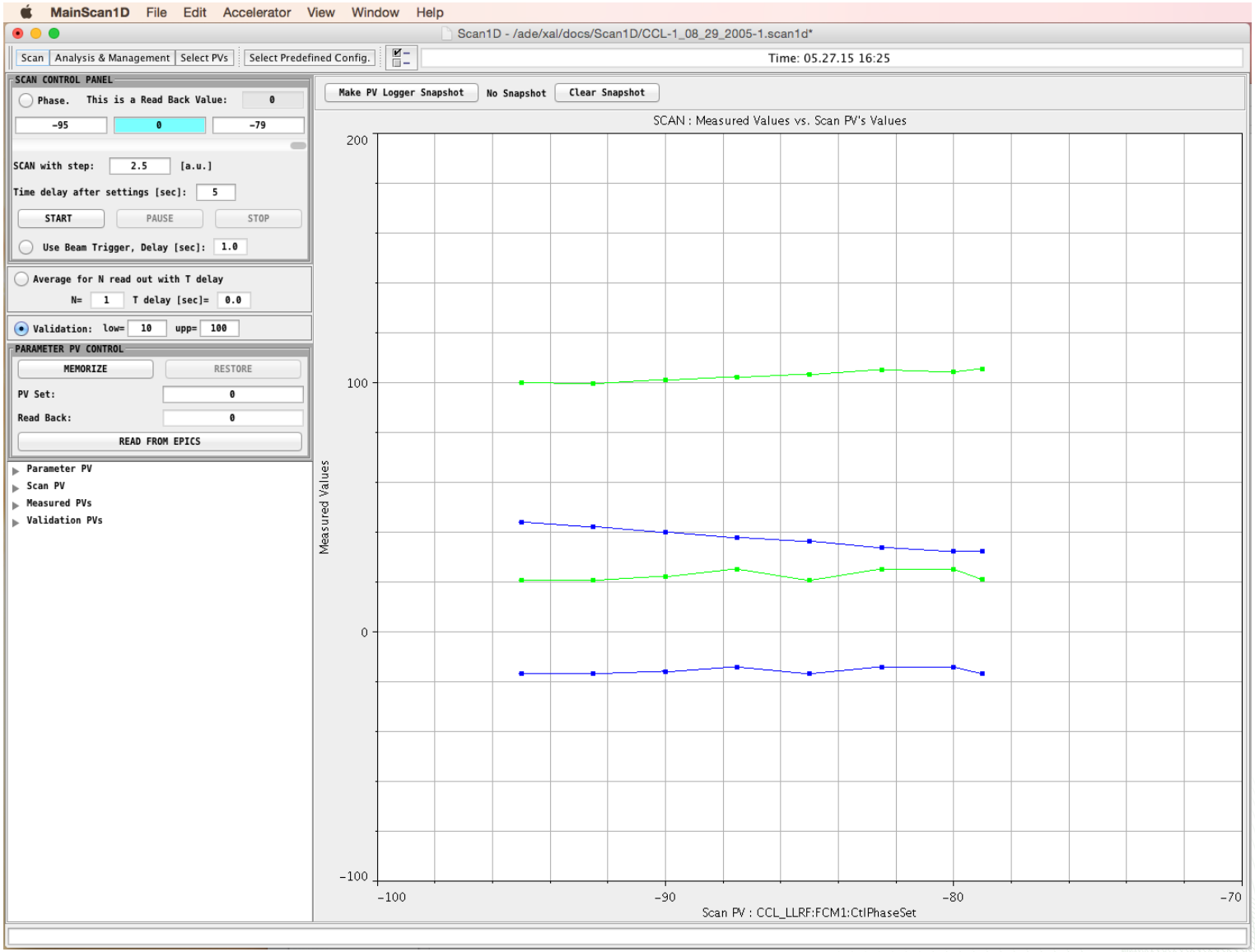
RTBT Wizard



SCAN 1D/2D

- *Purpose*
  - Scan 1 (or 2) process variables (PVs) and measure other PVs
- *Features*
  - ✓Vary 1 (or 2) process variables (PVs) over a range
    - Varies the scan PV by specified step
    - Validation PV for good data
    - Records other PVs for each step
  - ✓Data Analysis
  - ✓Data Export
  - ✓Very useful for general machine studies
  - ✓Common 1D/2D scan packages incorporated into multiple applications
  - ✓Standalone 1D/2D applications

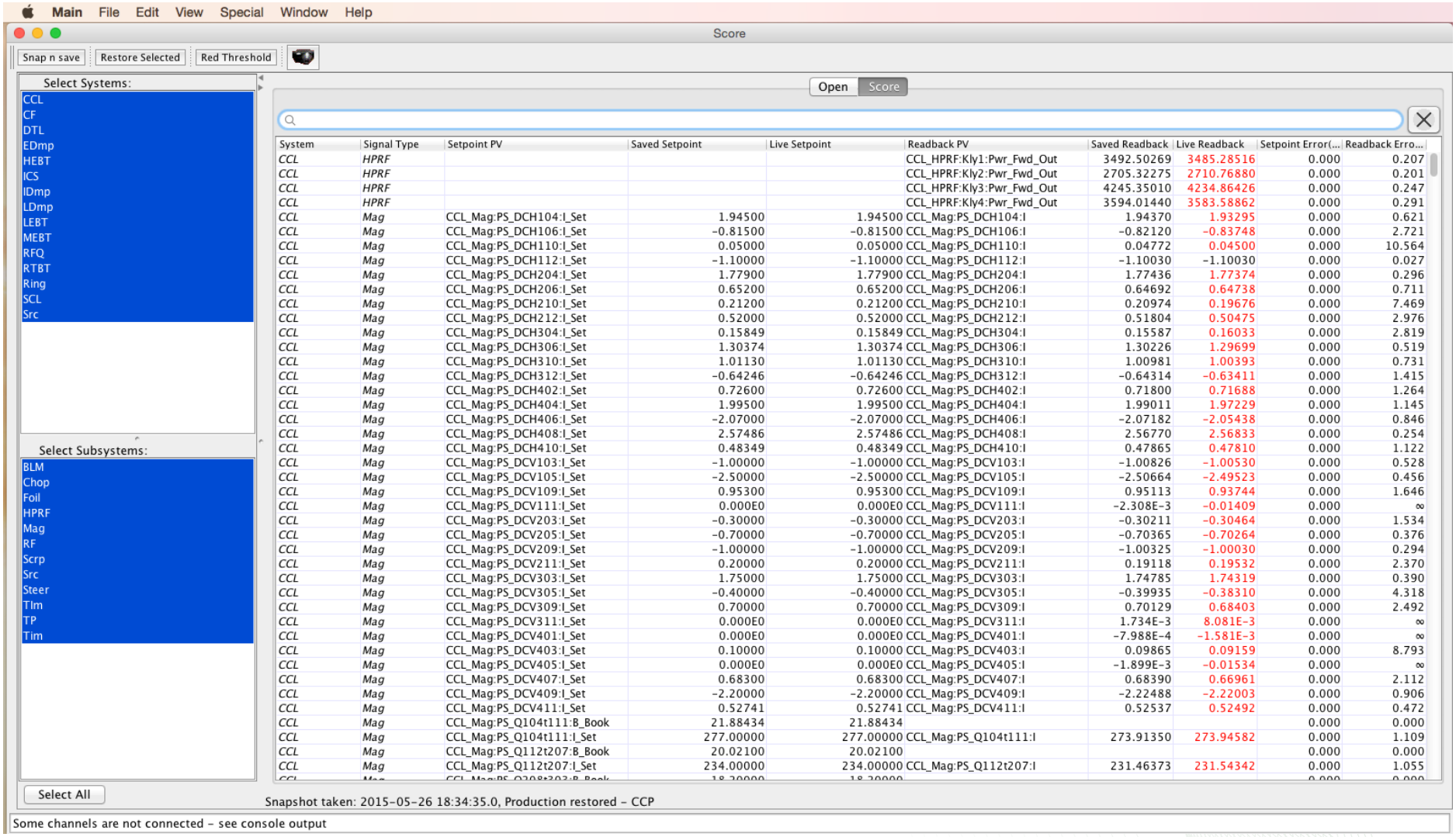
SCAN 1D



Save Compare Restore (SCORE)

- *Purpose*
  - Record and restore machine state
- *Features*
  - ✓Record snapshot PVs to database
  - ✓Compare snapshot with live state
  - ✓Filter by system, subsystem and PV
  - ✓Restore selected PV values from snapshot

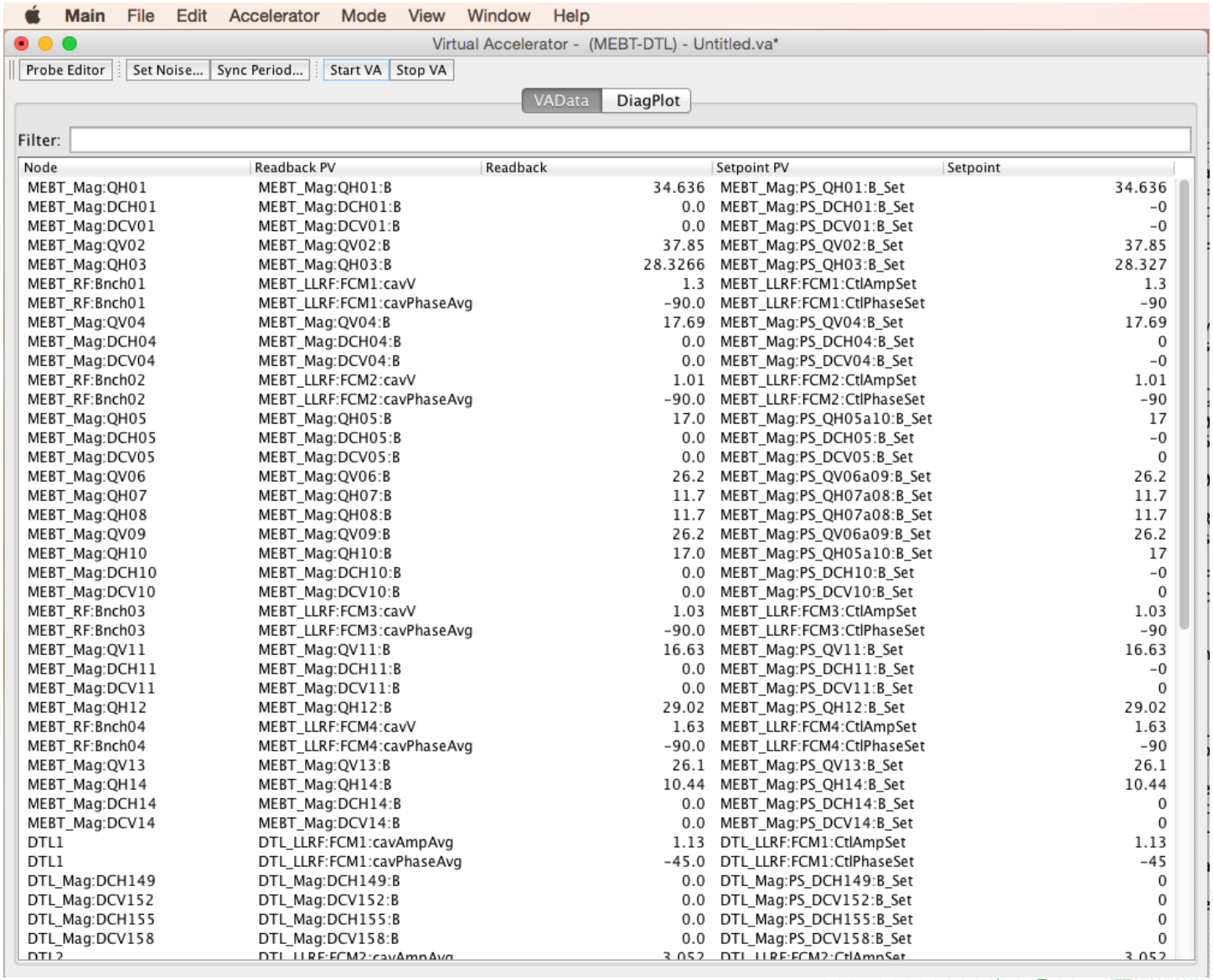
Save Compare Restore



Virtual Accelerator

- *Purpose*
  - Simulate a live machine for debugging applications offline
- *Features*
  - ✓Add noise and offsets
  - ✓Manually edit process variables (PVs)
  - ✓Critical for application testing!

Virtual Accelerator



Node	Readback PV	Readback	Setpoint PV	Setpoint
MEBT_Mag:QH01	MEBT_Mag:QH01:B	34.636	MEBT_Mag:PS_QH01:B_Set	34.636
MEBT_Mag:DCH01	MEBT_Mag:DCH01:B	0.0	MEBT_Mag:PS_DCH01:B_Set	-0
MEBT_Mag:DCV01	MEBT_Mag:DCV01:B	0.0	MEBT_Mag:PS_DCV01:B_Set	-0
MEBT_Mag:QV02	MEBT_Mag:QV02:B	37.85	MEBT_Mag:PS_QV02:B_Set	37.85
MEBT_Mag:QH03	MEBT_Mag:QH03:B	28.3266	MEBT_Mag:PS_QH03:B_Set	28.327
MEBT_RF:Bnch01	MEBT_LLRF:FCM1:cavV	1.3	MEBT_LLRF:FCM1:CtlAmpSet	1.3
MEBT_RF:Bnch01	MEBT_LLRF:FCM1:cavPhaseAvg	-90.0	MEBT_LLRF:FCM1:CtlPhaseSet	-90
MEBT_Mag:QV04	MEBT_Mag:QV04:B	17.69	MEBT_Mag:PS_QV04:B_Set	17.69
MEBT_Mag:DCH04	MEBT_Mag:DCH04:B	0.0	MEBT_Mag:PS_DCH04:B_Set	0
MEBT_Mag:DCV04	MEBT_Mag:DCV04:B	0.0	MEBT_Mag:PS_DCV04:B_Set	-0
MEBT_RF:Bnch02	MEBT_LLRF:FCM2:cavV	1.01	MEBT_LLRF:FCM2:CtlAmpSet	1.01
MEBT_RF:Bnch02	MEBT_LLRF:FCM2:cavPhaseAvg	-90.0	MEBT_LLRF:FCM2:CtlPhaseSet	-90
MEBT_Mag:QH05	MEBT_Mag:QH05:B	17.0	MEBT_Mag:PS_QH05a10:B_Set	17
MEBT_Mag:DCH05	MEBT_Mag:DCH05:B	0.0	MEBT_Mag:PS_DCH05:B_Set	-0
MEBT_Mag:DCV05	MEBT_Mag:DCV05:B	0.0	MEBT_Mag:PS_DCV05:B_Set	0
MEBT_Mag:QV06	MEBT_Mag:QV06:B	26.2	MEBT_Mag:PS_QV06a09:B_Set	26.2
MEBT_Mag:QH07	MEBT_Mag:QH07:B	11.7	MEBT_Mag:PS_QH07a08:B_Set	11.7
MEBT_Mag:QH08	MEBT_Mag:QH08:B	11.7	MEBT_Mag:PS_QH07a08:B_Set	11.7
MEBT_Mag:QV09	MEBT_Mag:QV09:B	26.2	MEBT_Mag:PS_QV06a09:B_Set	26.2
MEBT_Mag:QH10	MEBT_Mag:QH10:B	17.0	MEBT_Mag:PS_QH05a10:B_Set	17
MEBT_Mag:DCH10	MEBT_Mag:DCH10:B	0.0	MEBT_Mag:PS_DCH10:B_Set	-0
MEBT_Mag:DCV10	MEBT_Mag:DCV10:B	0.0	MEBT_Mag:PS_DCV10:B_Set	0
MEBT_RF:Bnch03	MEBT_LLRF:FCM3:cavV	1.03	MEBT_LLRF:FCM3:CtlAmpSet	1.03
MEBT_RF:Bnch03	MEBT_LLRF:FCM3:cavPhaseAvg	-90.0	MEBT_LLRF:FCM3:CtlPhaseSet	-90
MEBT_Mag:QV11	MEBT_Mag:QV11:B	16.63	MEBT_Mag:PS_QV11:B_Set	16.63
MEBT_Mag:DCH11	MEBT_Mag:DCH11:B	0.0	MEBT_Mag:PS_DCH11:B_Set	-0
MEBT_Mag:DCV11	MEBT_Mag:DCV11:B	0.0	MEBT_Mag:PS_DCV11:B_Set	0
MEBT_Mag:QH12	MEBT_Mag:QH12:B	29.02	MEBT_Mag:PS_QH12:B_Set	29.02
MEBT_RF:Bnch04	MEBT_LLRF:FCM4:cavV	1.63	MEBT_LLRF:FCM4:CtlAmpSet	1.63
MEBT_RF:Bnch04	MEBT_LLRF:FCM4:cavPhaseAvg	-90.0	MEBT_LLRF:FCM4:CtlPhaseSet	-90
MEBT_Mag:QV13	MEBT_Mag:QV13:B	26.1	MEBT_Mag:PS_QV13:B_Set	26.1
MEBT_Mag:QH14	MEBT_Mag:QH14:B	10.44	MEBT_Mag:PS_QH14:B_Set	10.44
MEBT_Mag:DCH14	MEBT_Mag:DCH14:B	0.0	MEBT_Mag:PS_DCH14:B_Set	0
MEBT_Mag:DCV14	MEBT_Mag:DCV14:B	0.0	MEBT_Mag:PS_DCV14:B_Set	0
DTL1	DTL_LLRF:FCM1:cavAmpAvg	1.13	DTL_LLRF:FCM1:CtlAmpSet	1.13
DTL1	DTL_LLRF:FCM1:cavPhaseAvg	-45.0	DTL_LLRF:FCM1:CtlPhaseSet	-45
DTL_Mag:DCH149	DTL_Mag:DCH149:B	0.0	DTL_Mag:PS_DCH149:B_Set	0
DTL_Mag:DCV152	DTL_Mag:DCV152:B	0.0	DTL_Mag:PS_DCV152:B_Set	0
DTL_Mag:DCH155	DTL_Mag:DCH155:B	0.0	DTL_Mag:PS_DCH155:B_Set	0
DTL_Mag:DCV158	DTL_Mag:DCV158:B	0.0	DTL_Mag:PS_DCV158:B_Set	0
DTL2	DTL_LLRF:FCM2:cavAmpAvg	3.052	DTL_LLRF:FCM2:CtlAmpSet	3.052