

KEKBにおける SADアプリケーション

Workshop SAD2006(2006/09/05-07)

森田 昭夫

KEKB Commissioning Group

Contents

- KEBBでの主要なアプリケーション数
- KEBBでのアプリケーション実行環境
- SADアプリケーションの代表例

KEKBでの主要なアプリケーション数

■ KEBB Task Launcherへの登録: 757アプリケーション

- SADアプリケーション 539
- Pythonアプリケーション 176
- MEDMアプリケーション 24
 - ▶ MEDMで記述された MEDM application launcherを含む
- Tcl/Tkアプリケーション 3
 - ▶ Linac Control用の Application launcher
 - ▶ Linac Controlは Tcl/Tk中心で運用されている
- その他 15
 - ▶ xterm, Web browser, VNC viewerなど

KBLへ直接登録されていない MEDMアプリケーションを
含めても半数はSADで記述されている

KEKBでのアプリケーション実行環境

■ CPU資源

- abco[12]
 - ▶ HP-UX/HP PA-RISC
 - ▶ MEDM, Python/CA
- acsad[345]
 - ▶ Compaq Tru64/Compaq Alpha
 - ▶ File Serverを兼ねている(acsad[34])
 - ▶ SAD, Python/CA
- alsad[23]
 - ▶ Redhat Linux/Pentium 3&4
 - ▶ SAD
- amsad[1234567]
 - ▶ MacOS X/PowerPC G5
 - ▶ SAD

CPUパワーは amsad(PowerPC G5 15core)が主力
Python/CAと MEDMは実行可能なCPUが限定されている

主要なSADアプリケーション(1/2)

- Operation Parameter Management
 - KEKB Optics
 - Orbit Correction(CCC)
 - KEKB Steering
- Tune Feedback
 - Gated Tune
 - Pilot Bunch Tune Pattern Plot
 - Programmable Tune Changer
- Tuning Tools
 - IP Dispersion/Tilt
 - IR Waist
 - SX Adjuster
 - Local Bump
 - Measure Optics Parameter(Optics Correction)

ビーム制御に直接係わる部分(Optics/EPICS CAを活用)

主要なSADアプリケーション(2/2)

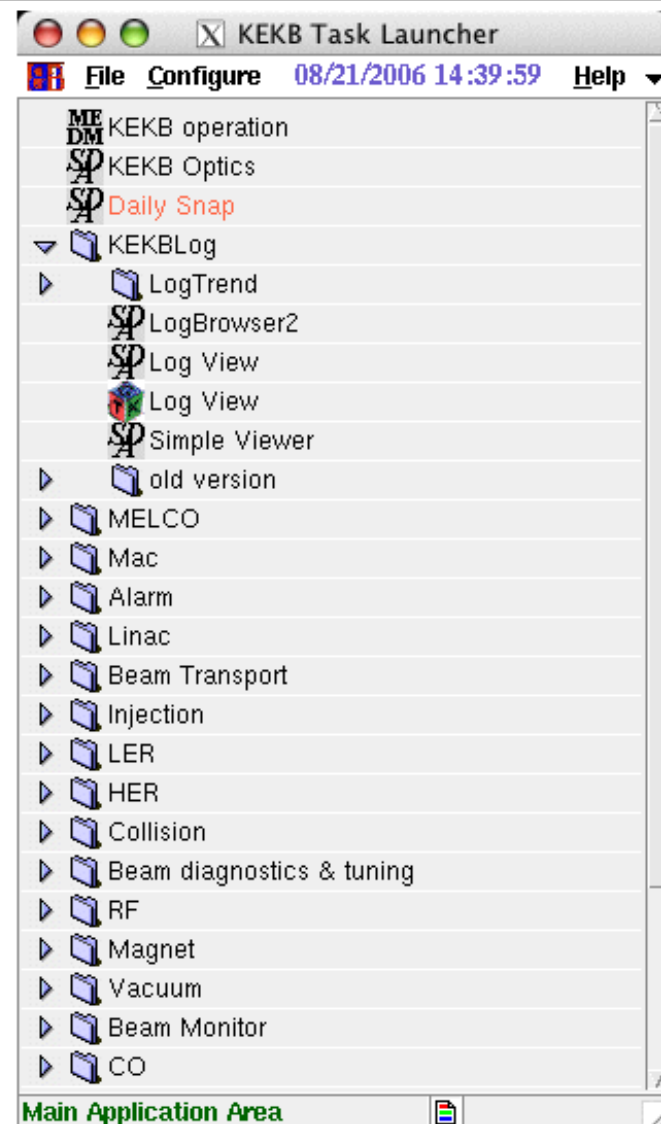
- Alarm Notify System
 - KEKB Alarm(EPICS CAからの Alarm Statusを監視・視覚化)
- Data Mining Tools
 - LogBrowser
 - LogTrend
- Tool Launcher
 - KEKB Task Launcher(KBL)

ビーム制御に直接係わらない部分(別にSADである必要性は無い)

- なんで、SADで書いてある？
 - 書き手が、SAD使いだった
 - KEKB運転システム内では可搬性の高い実行環境である
 - SAD自身のテストに成ってる(LogBrowserなど)
 - ▶ 大きなデータのハンドリング/多様なGUI部品の使用
 - ▶ 開発時は、SAD自身のバグをずいぶん踏んだ

KEKB Task Launcher

- 最も利用頻度が高いアプリ
- 機能
 - 運転アプリの立ち上げ
 - load avg.ベースの負荷分散
 - 重複起動の防止(KBFrameの標準機能)
- 規模
 - 1000行



KEKB Alarm

■ アラーム情報の集積&表示

■ 機能

● EPICSレコードのAlarm監視

● Alarm Statusの履歴記録

● 音声による通知

● 制御室の大画面に最新情報を表示

■ 規模

● 1000行/レコードテーブル12000行

The screenshot displays the KEBK Alarm software interface. At the top, there is a menu bar with 'File', 'Edit', and 'Window' options, and a status bar showing the date and time '06/29/2006 16:06:14' along with a 'Help' button. Below the menu bar, there are several filter buttons for different alarm groups: 'All Groups', 'Linac', 'Linac(RF)', 'BT(p)', 'BT(e)', 'MG(LER)', 'MG(HER)', 'RF(LER)', 'RF(HER)', 'VAC(LERp)', 'VAC(HERe)', 'Operation', 'BM', and 'Safety'. A 'Filter string:' input field and a 'Go' button are also present. The main area of the interface is a table with two columns: 'Alarm' and 'Recover'. The table contains a list of alarm events, each with a timestamp and a description. The events include various RF switch off and reflect messages, as well as BREAK DOWN messages for different RF components.

Alarm	Recover
06/29/2006 15:55:22.96	D06A RF Switch Off
06/29/2006 15:55:22.92	D07E RF Switch Off
06/29/2006 15:55:22.89	D07D RF Switch Off
06/29/2006 15:55:22.83	D07C RF Switch Off
06/29/2006 15:55:22.76	D07B RF Switch Off
06/29/2006 15:55:22.69	D07A RF Switch Off
06/29/2006 15:55:22.58	D07E Reflect from 1-S
06/29/2006 15:55:22.51	D07D Reflect from 2-S
06/29/2006 15:55:22.32	D07C Reflect from 1-S
06/29/2006 15:55:22.25	D07B Reflect from 1-S
06/29/2006 15:55:22.05	D07A Reflect from 2-S
06/29/2006 15:55:21.78	RF D05C RF Switch Off
06/29/2006 15:55:21.76	RF D04A MI-Du InPower
06/29/2006 15:55:21.69	RF D04C Reflect from 2-S
06/29/2006 15:55:21.51	RF D04B Reflect from 2-S
06/29/2006 15:55:21.51	RF D04C RF Switch Off
06/29/2006 15:55:21.48	RF D04B RF Switch Off
06/29/2006 15:55:21.48	RF D04A RF Switch Off
06/29/2006 15:55:21.26	RF D11D BREAK DOWN
06/29/2006 15:55:21.17	RF D11C BREAK DOWN
06/29/2006 15:55:21.08	RF D11B BREAK DOWN
06/29/2006 15:55:21.08	RF D11A BREAK DOWN
06/29/2006 15:55:21.05	RF D11D RF Switch Off
06/29/2006 15:55:21.05	RF D11C RF Switch Off
06/29/2006 15:55:21.05	RF D11B RF Switch Off
06/29/2006 15:55:21.05	RF D11A RF Switch Off
06/29/2006 15:55:21.03	RF D10D BREAK DOWN
06/29/2006 15:55:20.94	RF D10C BREAK DOWN
06/29/2006 15:55:20.82	RF D10B BREAK DOWN
06/29/2006 15:55:20.80	RF D10A BREAK DOWN
06/29/2006 15:55:20.80	RF D10D RF Switch Off
06/29/2006 15:55:20.80	RF D10C RF Switch Off
06/29/2006 15:55:20.80	RF D10B RF Switch Off

KEKB Optics

File Edit Settings Window

05/15/2006 11:23:14 Help

Optics(Bend/Quad/Sext)の管理

Convergence = .00232

$\gamma_{u,v} = 44.47518$ $\gamma_{v,u} = 41.64067$
 $\beta_{u,x} = .56000$ m $\beta_{v,y} = .00590$ m

機能 Adjust IR Normal Cell RF CRAB Chromaticity Dynamic Aperture Poincare Map Magnet

● 他のプログラムに対する Server機能

- ▶ Set Tune/Optics Reload/etc...

● Optics Matching(IR/Tune/etc...)

● Chromaticity Matching

● Dynamic Aperture/Poincare Mapの視覚化

● OpticsのLoad/Store

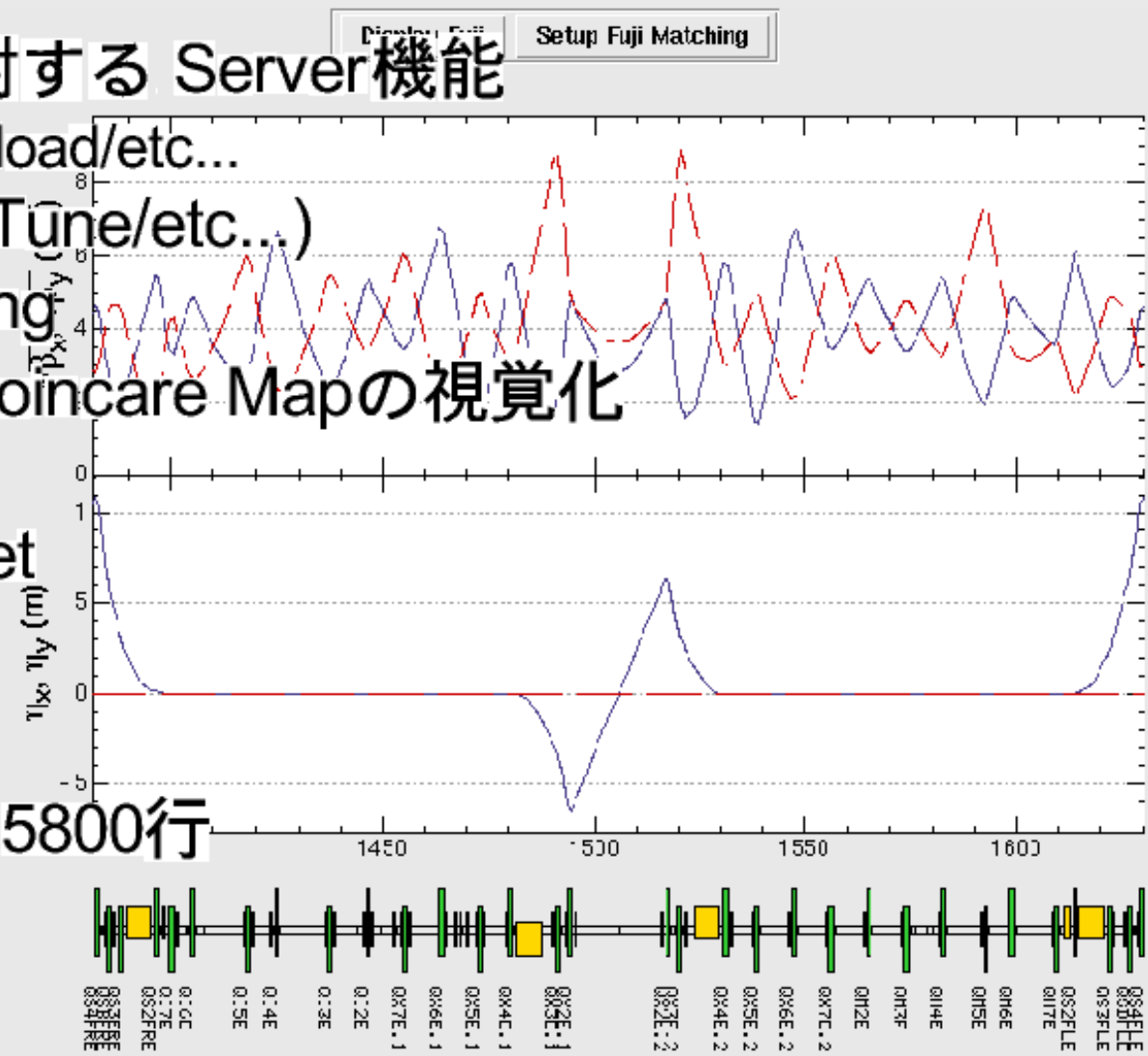
● MagnetへのRead/Set

● Magnet電源の監視

● 規模

● 1400行/ライブラリ 5800行

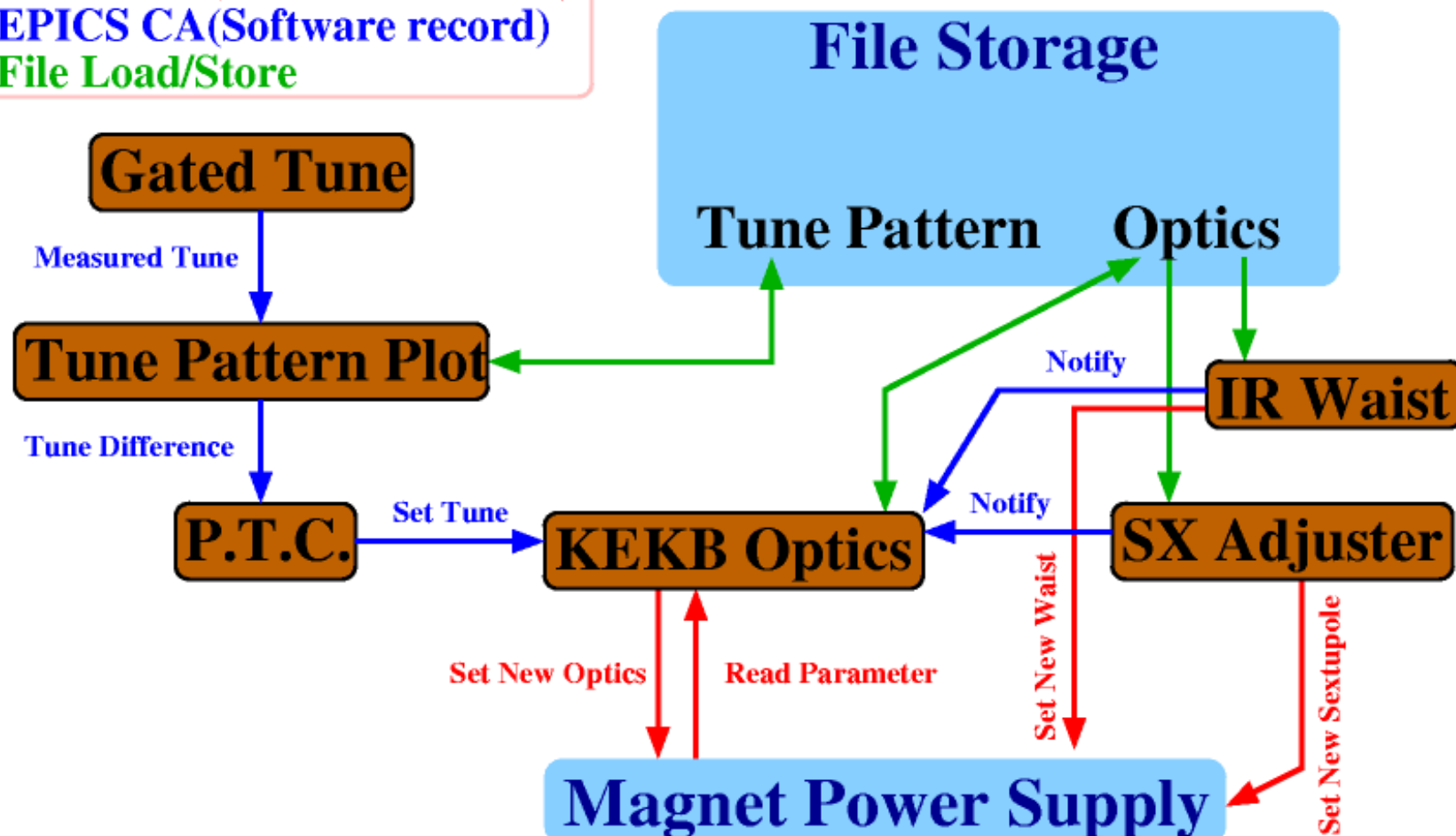
$R_{12}(K2 \rightarrow INJ): 26.044$ m $R_{12}(INJ \rightarrow K1): 27.163$ m



Save Optics LER HER BEAST Crab Optics Couple RF Base Lattice: Default

KEKB Optics関連のデータフロー

EPICS CA(Hardware record)
EPICS CA(Software record)
File Load/Store



Gated Tune

■ 機能

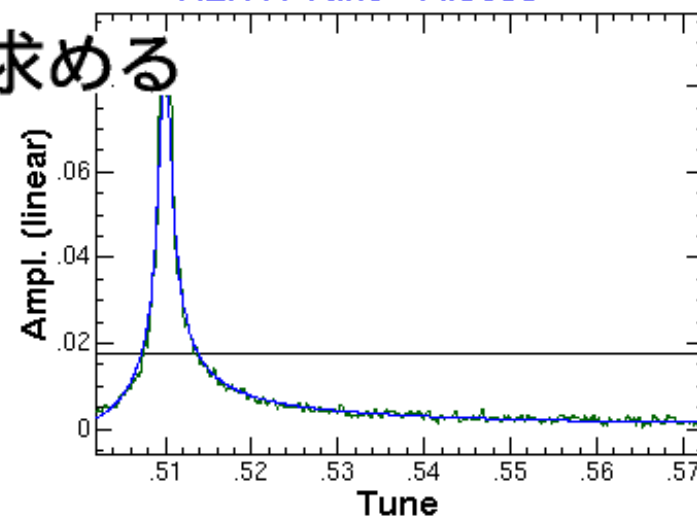
- TuneスペクトルからFittingでTuneを求める

■ 規模

- 62行/ライブラリ 400行

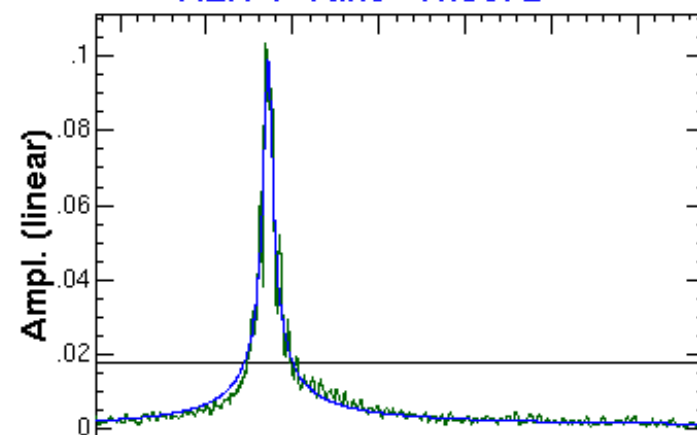
File Edit Settings Window 06/30/2006 01:00:14 Help

HER H Tune 44.5099



Thres(dB)		-35
Width .004	.001	.01
Tune (Low&Up)	.502	.572
B.C. (mA)	.9	.3
Fit Center		.00000

HER V Tune 41.5672



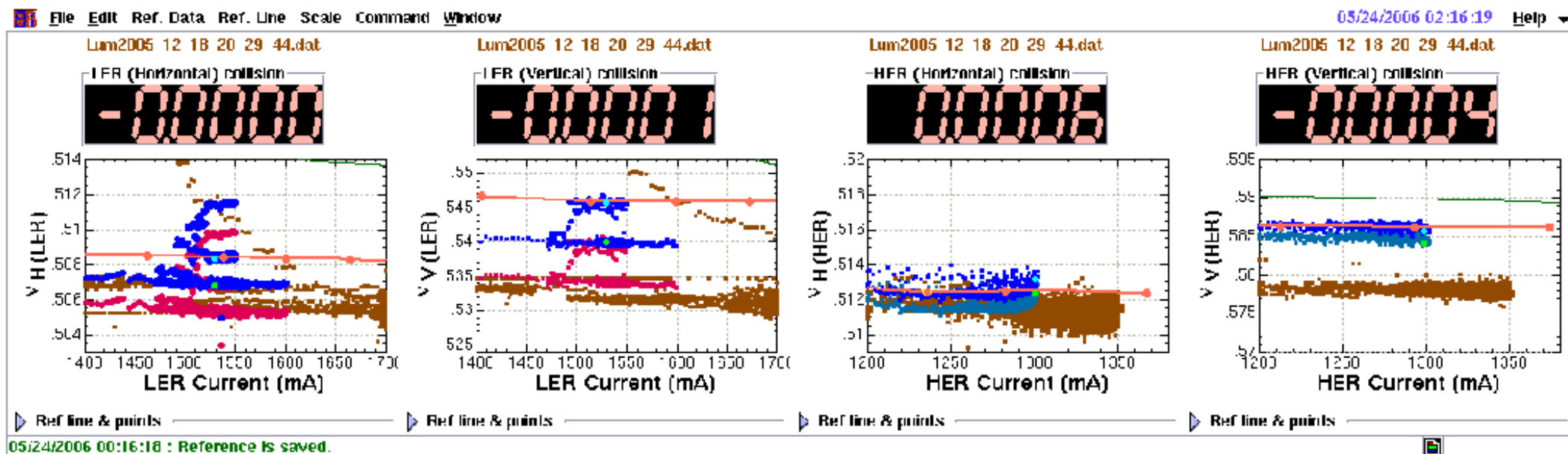
Pilot Bunch Tune Pattern Plot

■ 機能

- 測定Tuneと基準値の差をPTCに伝える
- 物理Runと入射の2種の基準線を管理

■ 規模

- 1200行/ライブラリ 22行



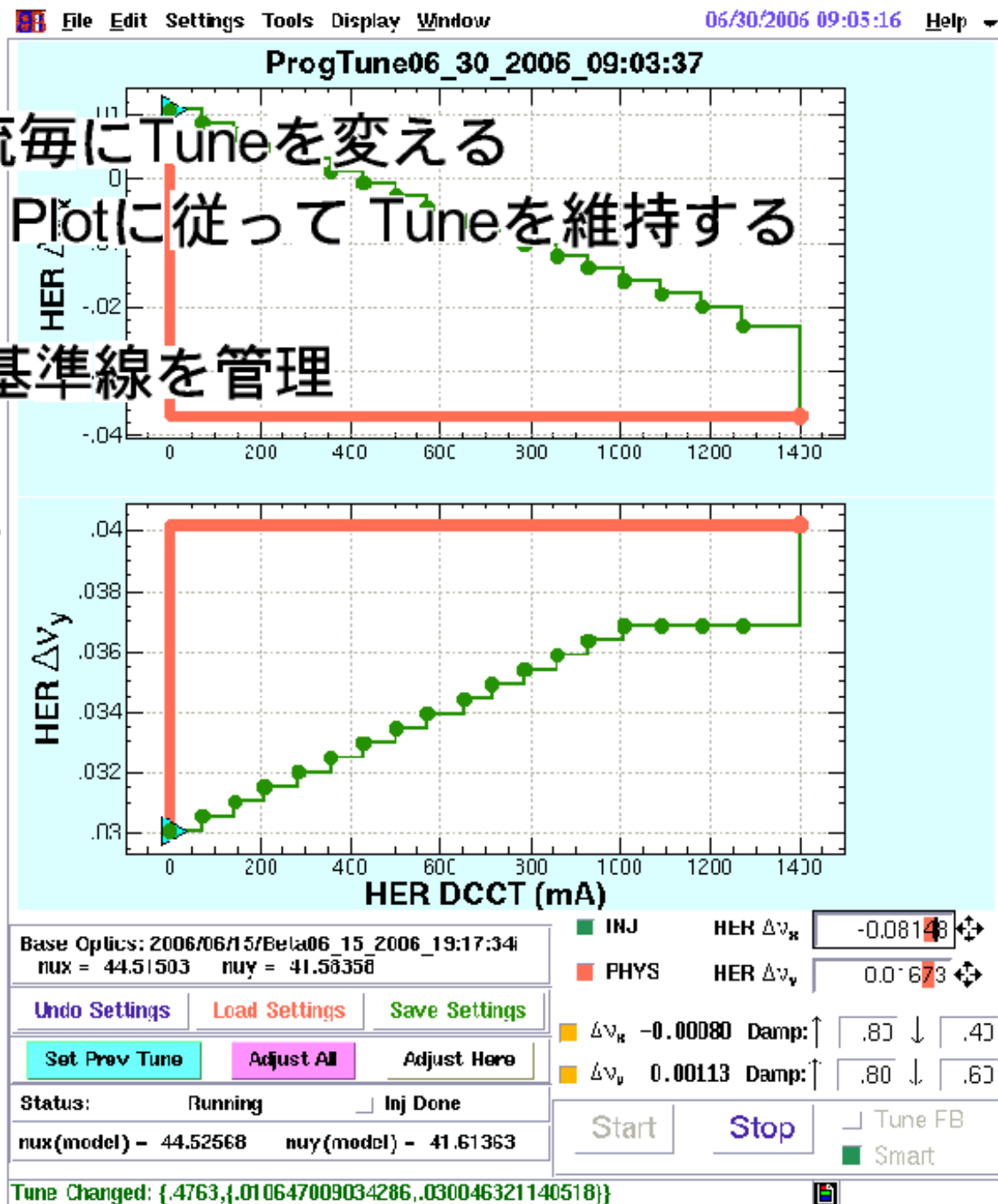
Programmable Tune Changer

■ 機能

- プログラムに従って電流毎にTuneを変える
- Pilot Bunch Tune Pattern Plotに従って Tuneを維持する (Tune Feedback)
- 物理Runと入射の2種の基準線を管理

■ 規模

- 20行/ライブラリ 4600行



IR Waist

■ 機能

- β 関数のWaistの位置を変更する

■ 規模

- 230行/ライブラリ 2800行

The screenshot shows the IR Waist software interface. At the top, there is a menu bar with 'File', 'Edit', 'Window', '06/08/2006 16:39:17', and 'Help'. Below the menu bar, the main window is titled 'FudgeFactors' and contains several input fields for parameters:

Parameter	Value
QCSL_K1:AF(L)	.996767
QCSR_K1:AF(L)	.998066
QCSL_K1:AF(H)	.996767
QCSR_K1:AF(H)	.998066
HER	
QCILE:AF	1.004231
QCIRE:AF	1.006940

Below these fields, there are two more input fields with spinners and their absolute values:

Parameter	Value	Absolute Value (mm)
HER ds* (mm)	-0.10	abs. 5.3979185
LER ds* (mm)	0.00	abs. 1.9039318

At the bottom of the main window, there are two buttons: 'Calc' and 'Set'. Below these buttons, there is a 'Label' section with two radio buttons: 'LER Waist' (selected) and 'HER Waist'. At the very bottom, there are two more buttons: 'Start' and 'Pause / Resume'. The status bar at the bottom left shows 'Hard Copy' and a printer icon.

SX Adjuster

■ 機能

● Chromaticityを変更する

- ▶ 各種Linear Chromaticityの変更
- ▶ 個別の6極磁石の変更

■ 規模

● 910行/ライブラリ 2800行

The screenshot displays the SX Adjuster software interface. At the top, the menu bar includes File, Edit, Command, and Window. The status bar shows the date and time: 06/29/2006 13:27:41. The main window title is LER. The interface is divided into several sections:

- Top Panel:** Contains a date/time stamp (2006/06/15/Beta06 15 2006 10:05:10i), a checkbox for "with sext", and a "Load optics" button.
- Chromaticity Plots:** Six line graphs showing the relationship between chromaticity and relative momentum deviation ($\Delta p/p$). The top row shows $\Delta\zeta_x$ and $\Delta\eta_x/\beta_x$. The bottom row shows $\Delta\zeta_y$ and $\Delta\eta_y/\beta_y$. A central value $\zeta_x = 2.128$ is displayed.
- Control Panel (LER):**
 - Beta and Tune:** $\beta_x = .59$, $\beta_y = .0056$. Sliders for ν_x (45.57427) and ν_y (40.54027). $\Delta p/p$ is set to .0100. A "Display" button is present.
 - Sextupole Control:** A dropdown menu is set to "K2".
 - IP:** A dropdown menu is set to "PMID".
 - Parameters:** A list of parameters with sliders, including ξ_x (0.3) at 2.1364E, ξ_y (0.3) at 0.11127, and various $\partial\alpha^*/\partial\delta$ and $(\partial\beta^*/\partial\delta)/\beta^*$ terms.
 - Buttons:** "Set", "Read", "Save as ref", "Recall ref", "with fudge", "Load from file", and "Use 31*".
 - Scan control:** "Start", "Pause/Resume", and "Scan: Resume" buttons.
- Bottom Panel:** A bar chart showing the K2 values for various magnets. The y-axis is labeled "K2 [1/m²]" and ranges from -0.1 to 2. The x-axis lists magnet names such as S11L1, S11L2, S11R1, S11R2, S12L1, S12L2, S12R1, S12R2, S13L1, S13L2, S13R1, S13R2, S14L1, S14L2, S14R1, S14R2, S15L1, S15L2, S15R1, S15R2, S16L1, S16L2, S16R1, S16R2, S17L1, S17L2, S17R1, S17R2, S18L1, S18L2, S18R1, S18R2, S19L1, S19L2, S19R1, S19R2, S20L1, S20L2, S20R1, S20R2, S21L1, S21L2, S21R1, S21R2, S22L1, S22L2, S22R1, S22R2, S23L1, S23L2, S23R1, S23R2, S24L1, S24L2, S24R1, S24R2, S25L1, S25L2, S25R1, S25R2, S26L1, S26L2, S26R1, S26R2, S27L1, S27L2, S27R1, S27R2, S28L1, S28L2, S28R1, S28R2, S29L1, S29L2, S29R1, S29R2, S30L1, S30L2, S30R1, S30R2, S31L1, S31L2, S31R1, S31R2, S32L1, S32L2, S32R1, S32R2, S33L1, S33L2, S33R1, S33R2, S34L1, S34L2, S34R1, S34R2, S35L1, S35L2, S35R1, S35R2, S36L1, S36L2, S36R1, S36R2, S37L1, S37L2, S37R1, S37R2, S38L1, S38L2, S38R1, S38R2, S39L1, S39L2, S39R1, S39R2, S40L1, S40L2, S40R1, S40R2, S41L1, S41L2, S41R1, S41R2, S42L1, S42L2, S42R1, S42R2, S43L1, S43L2, S43R1, S43R2, S44L1, S44L2, S44R1, S44R2, S45L1, S45L2, S45R1, S45R2, S46L1, S46L2, S46R1, S46R2, S47L1, S47L2, S47R1, S47R2, S48L1, S48L2, S48R1, S48R2, S49L1, S49L2, S49R1, S49R2, S50L1, S50L2, S50R1, S50R2, S51L1, S51L2, S51R1, S51R2, S52L1, S52L2, S52R1, S52R2, S53L1, S53L2, S53R1, S53R2, S54L1, S54L2, S54R1, S54R2, S55L1, S55L2, S55R1, S55R2, S56L1, S56L2, S56R1, S56R2, S57L1, S57L2, S57R1, S57R2, S58L1, S58L2, S58R1, S58R2, S59L1, S59L2, S59R1, S59R2, S60L1, S60L2, S60R1, S60R2, S61L1, S61L2, S61R1, S61R2, S62L1, S62L2, S62R1, S62R2, S63L1, S63L2, S63R1, S63R2, S64L1, S64L2, S64R1, S64R2, S65L1, S65L2, S65R1, S65R2, S66L1, S66L2, S66R1, S66R2, S67L1, S67L2, S67R1, S67R2, S68L1, S68L2, S68R1, S68R2, S69L1, S69L2, S69R1, S69R2, S70L1, S70L2, S70R1, S70R2, S71L1, S71L2, S71R1, S71R2, S72L1, S72L2, S72R1, S72R2, S73L1, S73L2, S73R1, S73R2, S74L1, S74L2, S74R1, S74R2, S75L1, S75L2, S75R1, S75R2, S76L1, S76L2, S76R1, S76R2, S77L1, S77L2, S77R1, S77R2, S78L1, S78L2, S78R1, S78R2, S79L1, S79L2, S79R1, S79R2, S80L1, S80L2, S80R1, S80R2, S81L1, S81L2, S81R1, S81R2, S82L1, S82L2, S82R1, S82R2, S83L1, S83L2, S83R1, S83R2, S84L1, S84L2, S84R1, S84R2, S85L1, S85L2, S85R1, S85R2, S86L1, S86L2, S86R1, S86R2, S87L1, S87L2, S87R1, S87R2, S88L1, S88L2, S88R1, S88R2, S89L1, S89L2, S89R1, S89R2, S90L1, S90L2, S90R1, S90R2, S91L1, S91L2, S91R1, S91R2, S92L1, S92L2, S92R1, S92R2, S93L1, S93L2, S93R1, S93R2, S94L1, S94L2, S94R1, S94R2, S95L1, S95L2, S95R1, S95R2, S96L1, S96L2, S96R1, S96R2, S97L1, S97L2, S97R1, S97R2, S98L1, S98L2, S98R1, S98R2, S99L1, S99L2, S99R1, S99R2, S100L1, S100L2, S100R1, S100R2.

Orbit Correction(CCC)

■ KEKBでの軌道管理の中心

■ 機能

● 軌道の管理

- ▶ Local Bumpや Tuning用Bumpを設定する
- ▶ IP Dispersion/Tiltなど
- ▶ CCCから独立した局所的軌道制御からの取り込み
- ▶ iBump/iSizeなど

● 軌道補正(30~60秒周期)

- ▶ RF Freq./Chicaneによる周長補正を含む

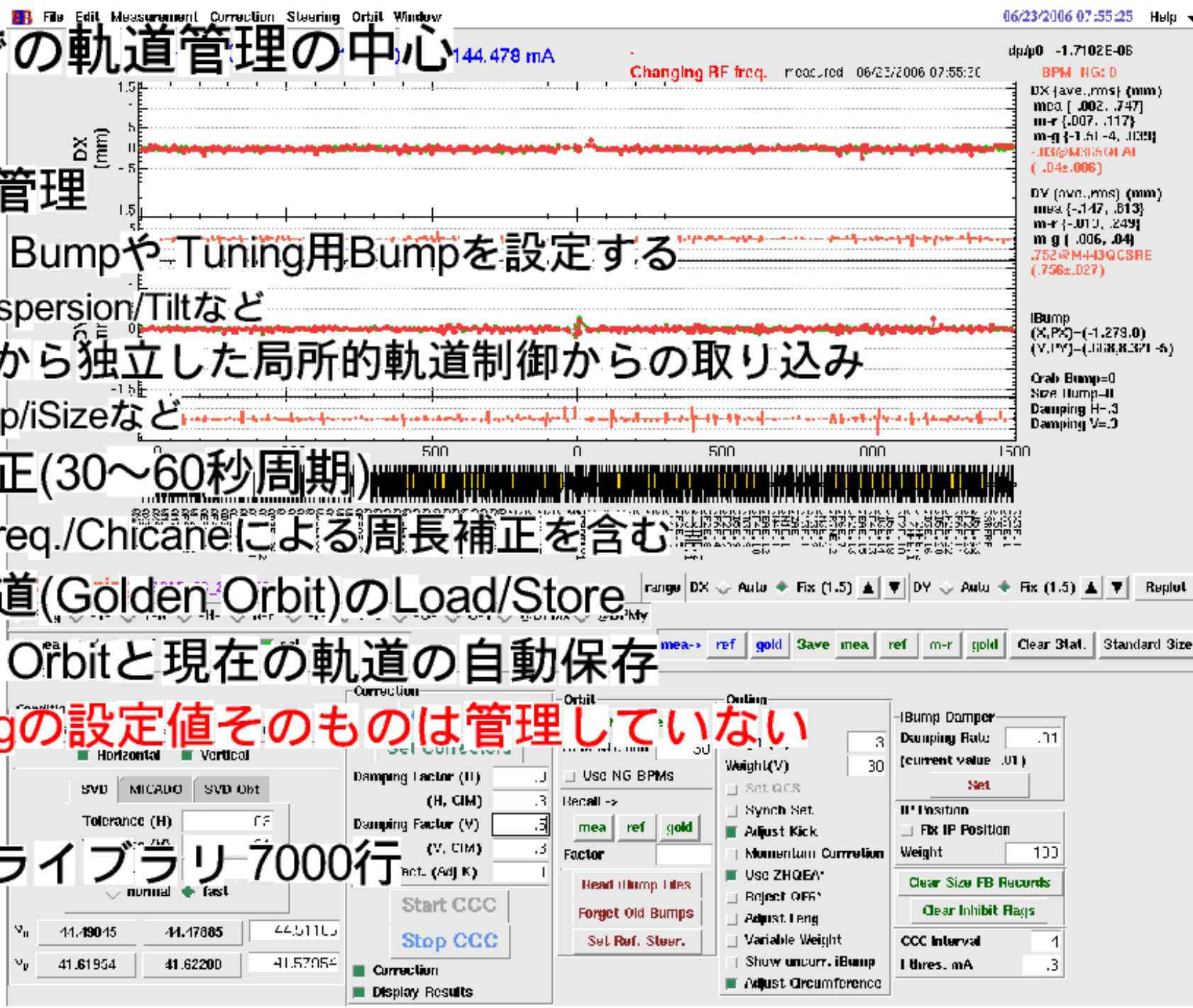
● 基準軌道(Golden Orbit)のLoad/Store

● Golden Orbitと現在の軌道の自動保存

● Steeringの設定値そのものは管理していない

■ 規模

● 150行/ライブラリ7000行



KEKB Steering

File Edit Window

04/04/2006 10:55:49 Help

CCCに不足しているSteering管理を補間する

機能

- Steeringの設定値のLoad/Store
- Steeringの設定値監視
- 個別のSteeringの設定値操作
- Steeringの現在値の自動保存

規模

- 47行/ライブラリ 4400行

Display HER Steering



Ring -T- T-N -N- N-F -F- F-O -O- O-T

ostnar K0(mrad): pvalue kick Set ▲ ▼ Replt.

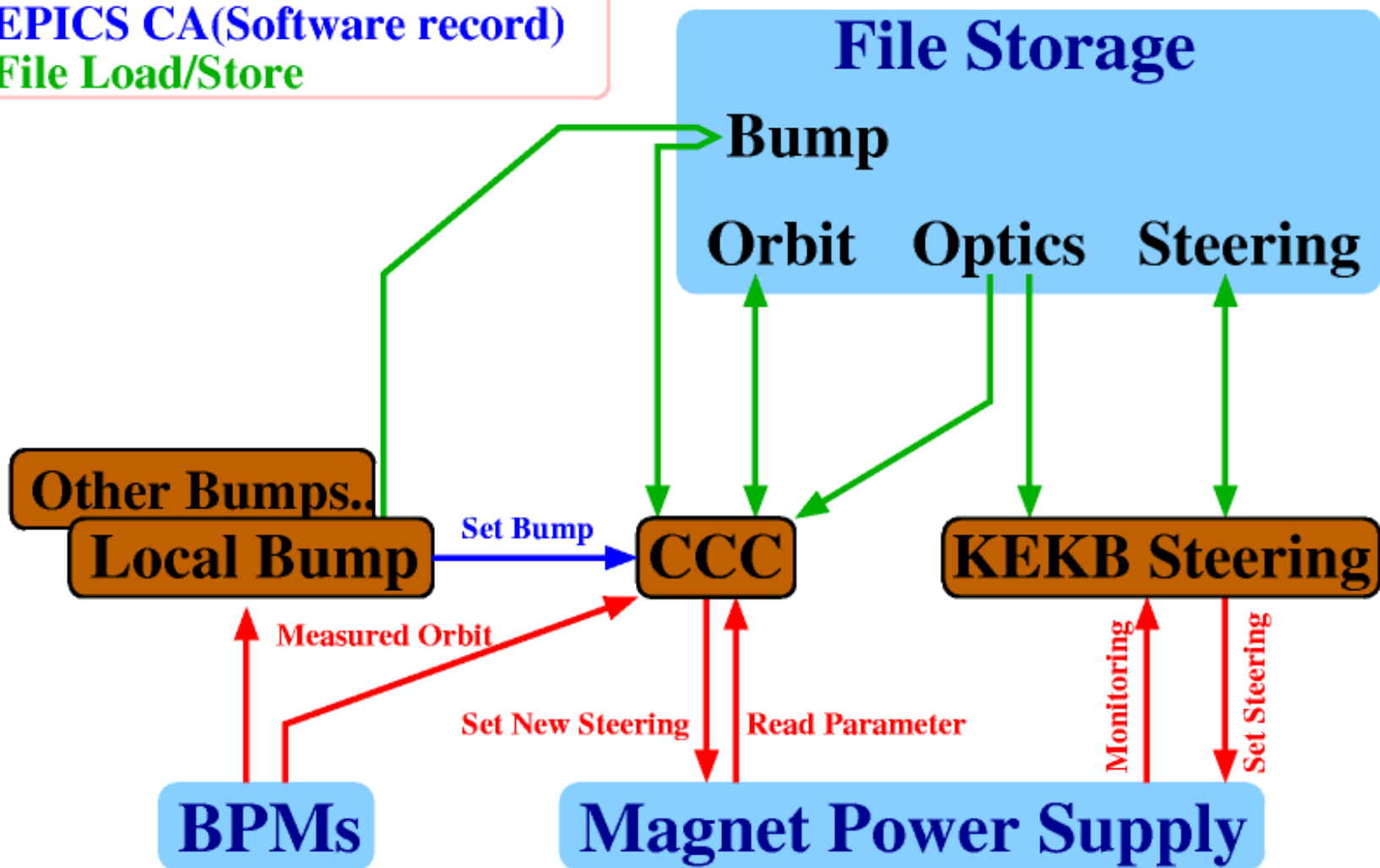
Name: STR_03_01_2006_08:59:05

Save Steering

Damp H Steering

CCC関連のデータフロー

EPICS CA(Hardware record)
EPICS CA(Software record)
File Load/Store



Local Bump

■ 機能

- 所定の条件を満たす Closed Bump を作る
 - ▶ 主に BPM での $\Delta x, \Delta x', \Delta y, \Delta y'$ を指定する
- 特定の目的に特化した Local Bump Tool もある

■ 規模

- 85行/ライブラリ 5600行

HER Local Bump measured 05/01/2006 15:32:35

$r.m.s. = .724 \text{ mm}$
 $\text{max} = 3.524 \text{ mm}$
 @ M0C5QD3LE
 $\text{min} = -3.172 \text{ mm}$
 @ M0E1QT2TNE
 $.127 \text{ mm}$
 @ M0C1QCSLE
 $(.127/\pm 2.57244 = 9\text{mm})$

$r.m.s. = .65 \text{ mm}$
 $\text{max} = 2.691 \text{ mm}$
 @ M0C5QD3LE
 $\text{min} = -3.660 \text{ mm}$
 @ M2T1QK7E
 $.764 \text{ mm}$
 @ M1S3QD5E
 $(.764/10\text{mm})$

CCC running: GOLD_05_01_2006_09:34:59

Jump to: IPMD09V1 range DX Auto Fix (5) DY Auto Fix (2) Replot

Ring T TTN TM THN N NNF NF NFF F FFO FO O OOT OT OTT @BPMx @BPMy

mea sta ref m-r s-r cal gold m-g mea-> ref gold Save me ref m-r gold Clear Stat. Standard Size

position	dx	dpx	ex	epx	dy	dpy	ey	epy	
M193QD5E	<input type="checkbox"/> 0	<input type="checkbox"/> 0	<input type="checkbox"/> -	<input type="checkbox"/> 0	<input checked="" type="checkbox"/> -2	<input type="checkbox"/> 0	<input type="checkbox"/> 0	<input type="checkbox"/> -	del
M196QD3E	<input type="checkbox"/> 0	<input type="checkbox"/> 0	<input type="checkbox"/> -	<input type="checkbox"/> 0	<input checked="" type="checkbox"/> 0	<input type="checkbox"/> 0	<input type="checkbox"/> 0	<input type="checkbox"/> -	del
M19/QF2E	<input type="checkbox"/> U	<input type="checkbox"/> U	<input type="checkbox"/> -	<input type="checkbox"/> U	<input checked="" type="checkbox"/> U	<input type="checkbox"/> U	<input type="checkbox"/> U	<input type="checkbox"/> -	del

Control: Head Orbit Calculate Bump Clear Conditions Set Ref. Here dispersion sextupole

Steering: Set Reset QCSL QCSR inside bump no of steerings 4

LogBrowser

■ 汎用のData Mining Tool

■ 機能

File Edit Channel Data Window

06/05/2006 16:52:33 Help

● KEKBlogの読み出し

● レコードへの演算処理

● 相関グラフ

● Trend Chartにも使える

● 現在、2世代目のコード

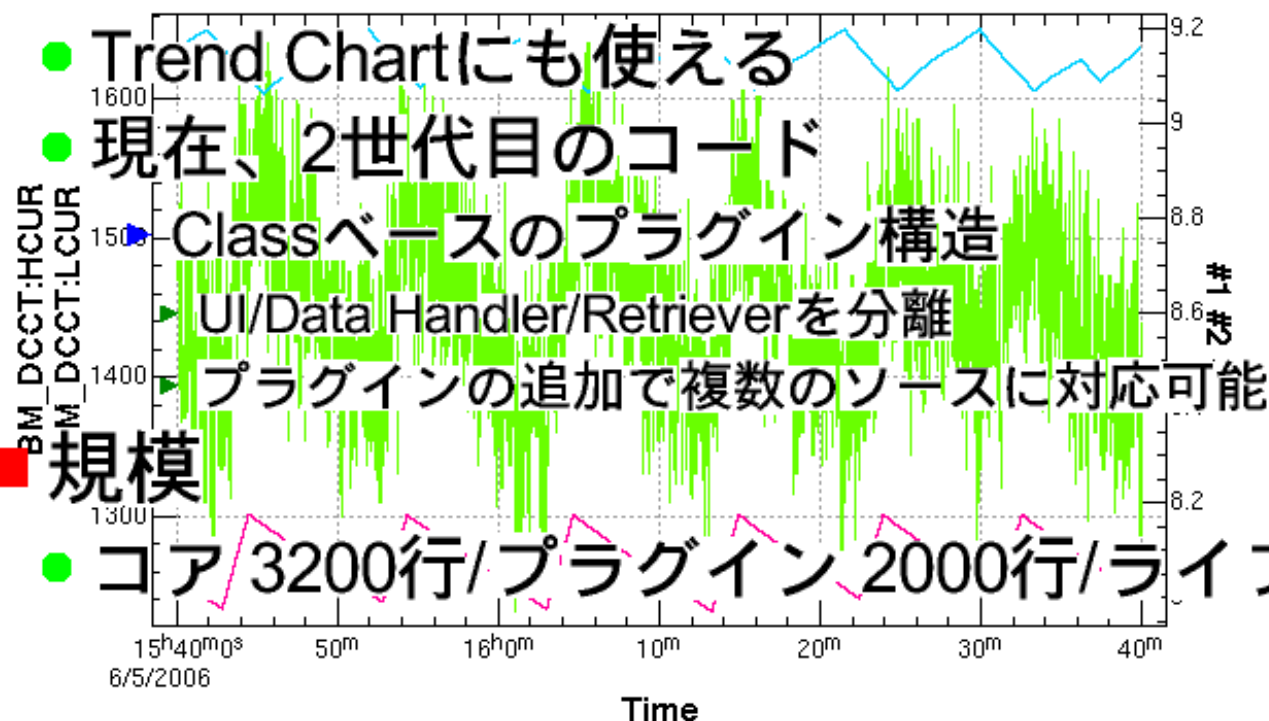
● Classベースのプラグイン構造

● UI/Data Handler/Retrieverを分離

● プラグインの追加で複数のソースに対応可能

■ 規模

● コア 3200行/プラグイン 2000行/ライブラリ 2800行



Channel Selector

KEKBlog

CaMonitor

Function

TimeLine

Channel Information

Channel #2 Archived Single Record

KEKBlog://BM/BMOthers/FB_TB5:PHASE:CH2:PS

Time Range: 2006/06/05 15:40:00 - 2006/06/05 16:40:00

a 1 FB_TB5:PHASE:CH1:PS
a 2 FB_TB5:PHASE:CH2:PS
M 3 #1 #2 -
A 4 BM_DCCT:HCUR
A 5 BM_DCCT:LCUR

Auto Repeat

Draw



LogTrend

■ KEKBLog用のTrend Chart Library

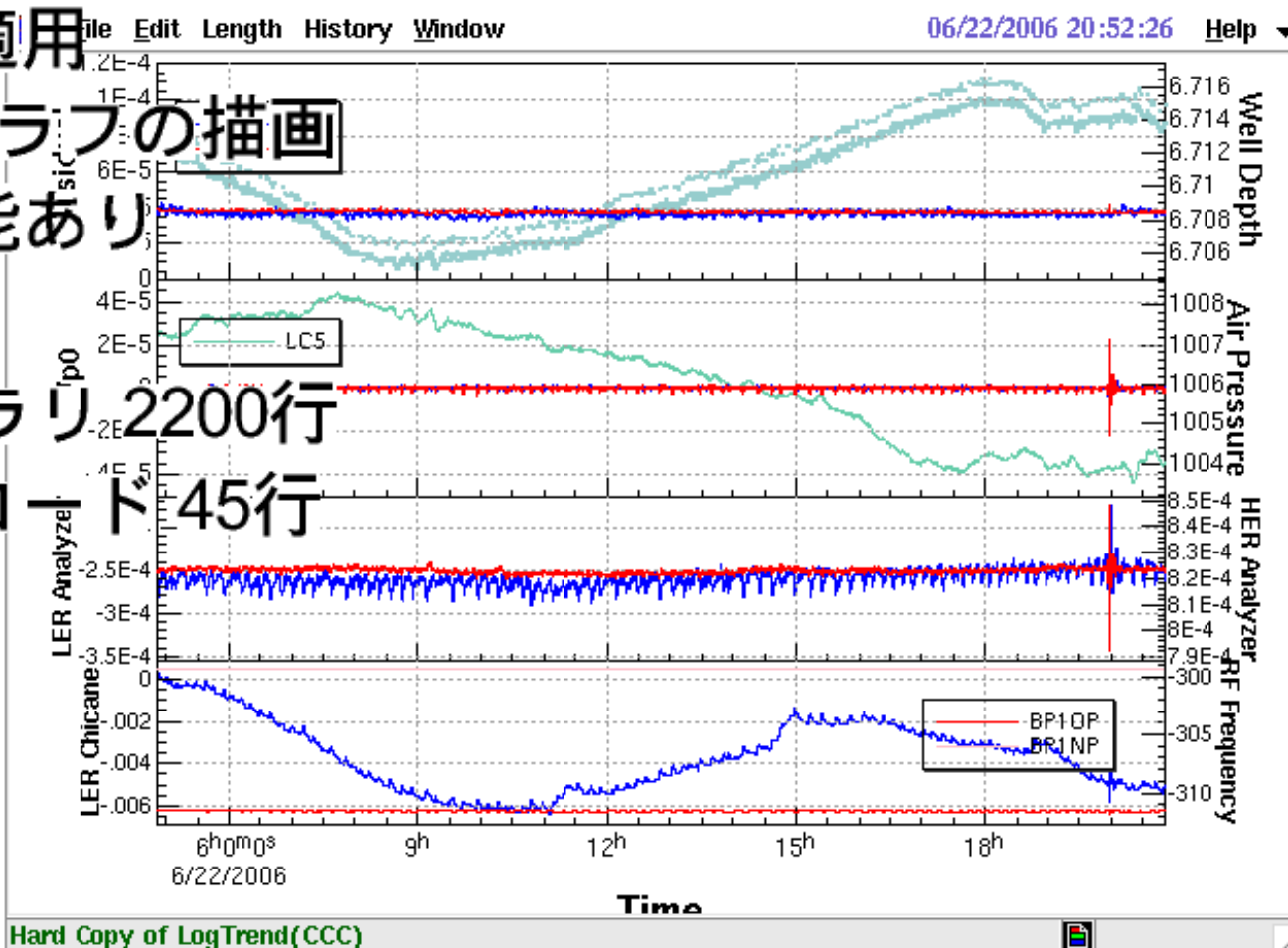
- 各種レコードの監視に活躍

■ 機能

- KEKBLogの読み出し
- レコードへの関数適用
- 段組みされた2軸グラフの描画
- 過去の履歴表示機能あり

■ 規模

- コア 630行/ライブラリ 2200行
- 右図のパネル本体コード 45行



LogTrend(CCC Trend Chart)

```
#!/usr/bin/env /SAD/bin/gs

STACKSIZ=10*STACKSIZ;

FFS;

Library@Require["etc/KEKBTrendGraphConfig", "Log/LogTrend"];

logTrend=LogTrend["CCC", {
  {{{"Misc/Misc/CGHOBTC:CCC:RESIDUALFROMGOLD"},
   {"Misc/Misc/CGLOBTC:CCC:RESIDUALFROMGOLD"},
   {"CO/Env/EN_ENVM:LC5:well_depth"}},
  Title->{"Residual", "Well Depth"}, Legend->{"HER", "LER"}, DrawFirst->2,
  Range->{RangeResidual$CCC, Automatic},
  Color->{"blue", "red", "PaleTurquoise3"},
  YAxis->{1, 1, 2}, Style->{StepsDots, StepsDots, Dots}},
  {{{"CO/Env/EN_ENVM:LC5:atom_p", Index->1, Filter->(0<#<2000&)},
   {"Misc/Misc/CGHOBTC:CCC:RESIDUALFROMGOLD"},
   {"Misc/Misc/CGLOBTC:CCC:RESIDUALFROMGOLD"},
   {"Misc/Misc/CGHOBTC:CCC:RESIDUALFROMGOLD", Filter->(Abs[#]>3E-5&)},
   {"Misc/Misc/CGLOBTC:CCC:RESIDUALFROMGOLD", Filter->(Abs[#]>3E-5&)}},
  Title->{"dp/p0", "Air Pressure"}, Legend->{"LC5"}, DrawFirst->2,
  Range->{RangeDP$CCC, Automatic}, Index->5,
  Color->{"aquamarine3", "blue", "red", "blue3", "red3"},
  YAxis->{2, 1, 1, 1, 1}, Style->{Lines, Steps, Steps, Points, Points}},
  {{{"Misc/Misc/CGHOBTC:CCC:RESIDUALFROMGOLD"},
   {"Misc/Misc/CGLOBTC:CCC:RESIDUALFROMGOLD"}},
  Title->{"LER Analyzer", "HER Analyzer"}, Index->6, Filter->(Abs[#]<3E-3&),
  YAxis->{2, 1}, Color->{"blue", "red"}, Style->Steps},
  {{{"Misc/KCG/MGLPS:BP1OP_8:BF"},
   {"Misc/KCG/MGLPS:BP1NP_8:BF"},
   {"Misc/KCG/RF_MO:RB:FREQ", Function->(# - 508886079.8&)},
   Null[]},
  Title->{"LER Chicane", "RF Frequency"},
  Legend->{"BP1OP", "BP1NP"},
  Color->{"red", "pink", "blue"}, YAxis->{1, 1, 2}, Style->Steps},
  ScreenWidth->630, ScreenHeight->420,
  FrameHeight->{0.29, 0.29, 0.22, 0.22},
  Resolution->20, Period->16 * 3600, Wait->40},
  ScrXmin->-0.06, ScrXmax->1.00];

TkWait[];
Exit[];

! End of File
```