

# qsUtility/eDT Update

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OPS StayTreat Presentation

# Outline

Overview of qsUtility

Changes to qsUtility

zigzag\_dataCollector Updates

analyzer Updates

matchingTool Updates

Overview of eDT

Changes to eDT

# qsUtility Overview

qsUtility consists of a set of tools for performing emittance measurements and analyzing the results:

- ▶ `zigzag_dataCollector`: Runs automated emittance measurements and formats the data for input to analyzer.
- ▶ `analyzer`: Computes emittance and Twiss parameters from data collected by `zigzag_dataCollector`.
- ▶ `matchingTool`: Automates matching to design Twiss parameters based upon measured parameters computed by `analyzer`.

## qsUtility Overview (cont.)

- ▶ The overall goal of qsUtility is to provide tools for operators to perform emittance measurements and optics matching without expert intervention.
- ▶ Transparency and flexibility are important. If there is a problem with a measurement, it should be clear what the problem is and there should be a clear path to fix the problem.
- ▶ We would like to get the time to do ORFP down to  $< 1$  hour per arc.

# zigzag\_dataCollector Screenshot

Select a Configuration File

Selected Configuration: /cs/dv/home/apps/q/qsUtility/dv/src/testFiles/IHADL07\_zigzag.xml

Reload Config File Edit Config File Help Quit

MAGNETS	
MQD0L06	MOB0L07
1199.767	-703.092
1115.078	-703.092
1030.388	-703.092
945.689	-703.092
861.010	-703.092
776.320	-703.092
691.631	-703.092

**HARP**

IHADL07

Fast Velocity: 6.0 mm/s  
Scan Velocity: 1.0 mm/s  
Gain: 3  
CW: 3-5 uAmps  
TUNE: ~25 uAxy  
3 wires: x, y  
Scan Range: 21.65mm - 31.65mm  
Plane: X

**CONTROLS**

MMS Momentum (MeV/c)  
56.422

Get momentum from EPICS

PV: MMS.MUE

Options

Cycle magnets at each step?

Prompt before each harp scan?

Fit to index instead of pot slit

Beam Off Method:

FCup1

EDM Screens

Harp

Quads

Correctors

Relative BPMs

Absolute BPMs

Start/Stop

Start

Abort

**SIGMA vs K1**

**Most recent wire scan**

**SIGMA^2 vs K1\*L**

**Normalized Phase Space**

**Progress (Most recent action at the bottom)**

```
Moving to position 21.65, speed 1.0
SA data saved to /cs/dv/home/apps/q/qsUtility/dv/src/IHADL07/IHADL07_zigzag_2015-07-07_09:31/IHADL07_test_profile_5
SigmaX = 7.328510212721187e-05 +/- 2.19855306381636e-06 m
-----Scan 7 of 7-----
Setting next BDLS
Moving to position 31.65, speed 1.0
SA data saved to /cs/dv/home/apps/q/qsUtility/dv/src/IHADL07/IHADL07_zigzag_2015-07-07_09:31/IHADL07_test_profile_6
SigmaX = 1.1164052680436739e-04 +/- 3.49215604149039e-06 m
Restoring initial BDLS and cycling
Done
```

# analyzer Screenshot

IHA0L07_2014-03-11_02:00.sdds										
X Data		Y Data								
Scan	Plot	Omit?	Harp	Sigma (m)	Error (m)	R11	R12 (m/rad)	MQD0L06.K1 (1/m <sup>2</sup> )	MQB0L07.K1 (1/m <sup>2</sup> )	
0	Plot	<input type="checkbox"/>	IHA0L07	2.9411e-04	6.9662e-06	0.0000e+00	0.0000e+00	4.4088	-2.3222	
1	Plot	<input type="checkbox"/>	IHA0L07	2.4471e-04	4.7245e-06	0.0000e+00	0.0000e+00	4.0186	-2.3222	
2	Plot	<input type="checkbox"/>	IHA0L07	1.9607e-04	2.9446e-06	0.0000e+00	0.0000e+00	3.6149	-2.3222	
3	Plot	<input type="checkbox"/>	IHA0L07	1.5610e-04	2.2571e-06	0.0000e+00	0.0000e+00	3.2392	-2.3222	
4	Plot	<input type="checkbox"/>	IHA0L07	1.1021e-04	1.7322e-06	0.0000e+00	0.0000e+00	2.8225	-2.3222	
5	Plot	<input type="checkbox"/>	IHA0L07	8.3745e-05	7.7205e-07	0.0000e+00	0.0000e+00	2.5453	-2.3222	
6	Plot	<input type="checkbox"/>	IHA0L07	7.3866e-05	7.5022e-07	0.0000e+00	0.0000e+00	2.3983	-2.3222	
7	Plot	<input type="checkbox"/>	IHA0L07	6.5173e-05	4.6431e-07	0.0000e+00	0.0000e+00	2.0514	-2.3222	
8	Plot	<input type="checkbox"/>	IHA0L07	6.3050e-05	4.6028e-07	0.0000e+00	0.0000e+00	1.9105	-2.3222	
9	Plot	<input type="checkbox"/>	IHA0L07	6.7158e-05	5.1252e-07	0.0000e+00	0.0000e+00	1.7635	-2.3222	
10	Plot	<input type="checkbox"/>	IHA0L07	7.6922e-05	6.7747e-07	0.0000e+00	0.0000e+00	1.6166	-2.3222	
11	Plot	<input type="checkbox"/>	IHA0L07	9.0437e-05	9.0010e-07	0.0000e+00	0.0000e+00	1.4696	-2.3222	
12	Plot	<input type="checkbox"/>	IHA0L07	1.0264e-04	1.0249e-06	0.0000e+00	0.0000e+00	1.2845	-2.3222	
13	Plot	<input type="checkbox"/>	IHA0L07	1.3919e-04	2.0064e-06	0.0000e+00	0.0000e+00	1.0375	-2.3222	
14	Plot	<input type="checkbox"/>	IHA0L07	1.4945e-04	1.7078e-06	0.0000e+00	0.0000e+00	0.8906	-2.3222	
15	Plot	<input type="checkbox"/>	IHA0L07	1.6435e-04	2.2329e-06	0.0000e+00	0.0000e+00	0.7436	-2.3222	

  

<input type="checkbox"/> Apply wire size correction?	Plot Sigma vs K1	Plot Sigma <sup>2</sup> vs K1 <sup>2</sup> L	Recompute Twiss	Plot Phase Space	Plot Normalized Phase Space
<b>BEAM PARAMETERS</b>		<b>emittance (m<sup>2</sup>rad)</b>		<b>beta (m)</b>	
<b>Momentum (MeV)</b>		<b>norm emittance (m<sup>2</sup>rad)</b>		<b>alpha</b>	
<b>MultiWire Results</b>		7.3044e-09 +/- 3.1100e-14		1.6130e-06 +/- 6.6678e-12	
<b>sddsmitproc Results</b>		1.6478e-06 +/- 5.8017e-09		1.2491e+01 +/- 3.6003e-05	
<b>Average</b>		1.6303e-06 +/- 2.9008e-09		1.4823e+00 +/- 6.5980e-06	
<b>Design</b>		1.2782e+01 +/- 2.4840e-02		1.5182e+00 +/- 6.9105e-03	
112.64		4.1683e-09		1.4903e+00 +/- 3.4553e-03	
		9.2047e-07		1.0000e+00 +/- 3.3774e-05	
				1.0000e+00 +/- 3.4567e-02	
				1.0000e+00 +/- 1.7045e-02	
				-1.3724e+00	
				1.0000e+00	

# matchingTool Screenshot

**Selected Configuration:** /a/devdata/dvfileio/fileio/q/qsUtility/match\_config/F3-0/INJ\_NL\_match\_example.xml Help Quit

1: Select a Configuration File		
2: Enter Input Twiss Parameters ----->		
3: Create Lattice & Command File		
3a: Edit Command File (optional)		
4: Go		

Input Twiss at MQD0L06		Design Twiss at MQD0R09	
betax (m)	12.782	betax (m)	1.941303
alphax	1.4903	alphax	-.6854467
betay (m)	10.83	betay (m)	20.49233
alphay	1.213	alphay	2.28783

Expert Options (Be Careful)

Allow optimizer to change quad signs? (Default is NO)

Start with present machine settings instead of design? (Default is NO)

**Progress (most recent action at the top)**

Click 'Create Lattice & Command File' to build the lattice with the input twiss parameters  
Config file /a/devdata/dvfileio/fileio/q/qsUtility/match\_config/F3-0/INJ\_NL\_match\_example.xml loaded  
Getting design Twiss parameters at MQD0R09 from CED  
Reading config file /a/devdata/dvfileio/fileio/q/qsUtility/match\_config/F3-0/INJ\_NL\_match\_example.xml  
Select a configuration file to begin

## zigzag\_dataCollector Updates

The “ZigZag” harp data collection protocol has finally been implemented. We used it successfully during the last run. An emittance measurement now takes a few minutes rather than an 45 minutes to an hour. Upcoming improvements include:

- ▶ One SA data file per wire scan vs. One Big File for entire measurement
  - ▶ Simplifies harp data processing by eliminating troublesome peak finding
  - ▶ Allows better monitoring of measurement progress. Plots of beam size, etc. for each measurement step can now be provided.
  - ▶ Eliminates danger of harp buffer overflow in normal use cases.
- ▶ Provide selection for “beam off” method (FC1, FC2, Laser mode, etc)
  - ▶ Provides flexibility in taking measurements with multiple beams in play, e.g. allows one to take measurements for one hall while not interrupting beam to another.

## zigzag\_dataCollector Updates (cont.)

- ▶ Provide an option to compute wire position from DAC rate and wire speed rather than pot signal.
  - ▶ Allows reasonable measurements to be taken by harps with ratty potentiometer readbacks.

# analyzer Updates

- ▶ Provide additional data on the GUI (e.g.  $R$  matrix elements).
  - ▶ More useful to optics experts than operators.
- ▶ Provide a method to backpropagate Twiss parameters directly on the GUI.
  - ▶ Simplifies backpropagation for matching.

## matchingTool Updates

- ▶ Option to start from present machine settings vs design.
  - ▶ Allows for iterative matching.
- ▶ Provide ability to match to parameters other than  $\beta$  and  $\alpha$ .
  - ▶ Match to beam size  $\sigma$  or any other parameter generically.

## eDT Overview

eDT (elegant Download Tool) computes design BDL setpoints for all quadrupole and dipole magnets in CEBAF.

- ▶ Provides operators with a visual tool for comparing design BDLs to those presently in the machine.
- ▶ Creates BURT snapfiles for downloading design setpoints
- ▶ Allows “overlays” to be loaded on top of the design setpoints to allow for off-design configurations (e.g. Injector Chicane  $M_{56}$ , Hall Compton Chicane vs Straight-Ahead).
- ▶ Provide other functions such as corrector zeroing, dogleg “design” setpoints, etc.

# eDT Screenshot

INJ-R
BSY2
BSY4
BSY6
BSY8
BSYA

HALLA
HALLB
HALLC
HALLD
BSY\_DUMP

**Step 1: Select an endpoint:**

**Step 2: Set up the MMS entries (or use the defaults from EPICS)**

Preinjector	6.000	MMSINJEGAIN	56.422	MMSLIN1EGAIN	500.000	MMSLIN2EGAIN	500.000
Hall A Pass	2	Hall B Pass	1	Hall C Pass	2	Hall D Pass	5.5

Reload MMS values from EPICS

(Currently using default MMS values from EPICS)

**Step 2a (optional): Select an SDDS file to overlay**

Selected File: None

**Step 3: Click the "GO" Button below**

OR

**Step 4: Do other stuff**

Reload Current BDLs
Save/Download Design BDLs
Save/Download Tuning Limits
Print Selection
Log Selection

Selected Magnets (click header buttons to sort, click and then double-click on a magnet to deselect it)

Name	Usage	Design BDL	Current BDL	Absolute Diff	Percent Diff	S Coordinate	Momentum
MGD1L02	Prohibited	420.57	2.00	-418.57	-99.52	111	56.441
MXG1S01	Dipole	603882.62	6800.64	-597081.98	-98.67	354	556.670
MXJ1S03	Dipole	-603882.56	-6798.26	597084.30	-98.67	359	556.670
MQB1S01	V Dispersion	-2743.89	166.67	2912.56	-106.15	360	556.670
MQL1S02	Prohibited	5873.98	77.43	-5796.54	-98.68	366	556.670
MQN1S03	Prohibited	-10438.76	435.12	10873.68	-104.17	368	556.670
MXI1S05	Dipole	608917.16	6834.96	-602082.19	-98.86	370	556.669
MXJ1S06	Dipole	-608917.16	-6840.93	602076.23	-98.86	371	556.669
MQN1S04	Matching	-6183.06	435.12	6618.18	-107.04	372	556.669
MQL1S05	Matching	7282.01	77.43	-7204.58	-98.94	374	556.669
MQB1S06	Matching	-4924.68	166.67	5093.35	-103.43	376	556.669
MQL1S07	Prohibited	-1485.19	77.43	1562.62	-105.21	380	556.669
MQL1S08	Matching	1896.42	77.43	-1618.99	-95.92	386	556.669
MQL1S09	Matching	-1654.36	77.43	1731.81	-104.68	392	556.669
MQB1S10	Matching	1151.34	166.67	-982.67	-85.35	398	556.669
MQB1E01	Prohibited	-1300.06	166.67	1468.74	-112.97	415	556.669
MQB1E02	Prohibited	1201.51	0.00	-1201.51	100.00	431	556.669
MQB1E03	Prohibited	-1155.08	0.00	1155.08	1155.08	448	556.669
MQB1A01	Prohibited	1832.30	0.00	-1832.30	-1832.30	464	556.669
MQB1A02	Prohibited	772.92	0.00	-772.92	-772.92	467	556.669
MARCA1A	Dipole	364582.35	364582.34	-0.01	-0.00	471	556.669
MQB1A03	Prohibited	-3100.98	0.00	3100.98	3100.98	477	556.669

**Progress (Most Recent Action at the Top)**

698 out of 727 selected.  
 698 out of 727 selected.  
 MRSEP8A.S ... not connected so no ca\_array\_get\_callback()  
 MTAG5C.BDL ... not connected so no ca\_array\_get\_callback()

**FILTERS**

Zone Filters  
(Double click to select/deselect)

- ALL
- INJ-L
- INJ-R
- LINAC1
- LINAC2
- REINJ
- ARC1
- ARC2
- ARC3
- ARC4
- ARC5
- ARC6
- ARC7
- ARC8
- ARC9

Usage Filters

- ALL
- Dipole
- Aperture/Steering
- Baseline
- H Beta
- H Disp/M5,6
- H Dispersion
- Inj/Steering
- M5,6
- Matching
- Orbit/Adjust
- PrimaryFocus
- SecondaryFocus
- Skew
- V Beta
- V Dispersion
- Prohibited

Show magnets from SDDS file only

Exclude injector magnets

Apply Filters

Other Filters

Regular Expression:

|Absolute Diff| >=

|Percent Diff| >=

Clear All Filters

**MISC**

Other Actions (Be careful!)

Help (READ THIS!)

Quit

# eDT Updates

- ▶ eDT is mostly static at this point.
- ▶ Expect speed improvements with upcoming changes to elegant decks to CED import.
- ▶ Possibility of incorporating design setpoints into the alarm handler or other methods to warn of or prevent inadvertently blowing away a good setup.

End.