



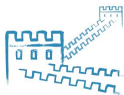
Manage the Physics Settings on the Modern Accelerator

Tong Zhang

Controls Physicist

Facility for Rare Isotope Beams, Michigan State University

E-mail: zhangt@frib.msu.edu



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Science

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1 Introduction

- Facility for Rare Isotope Beams
- PHANTASY Project

2 Manage the Data in Controls Network

- Perspective
- Data for Machine Tuning

3 Conclusions

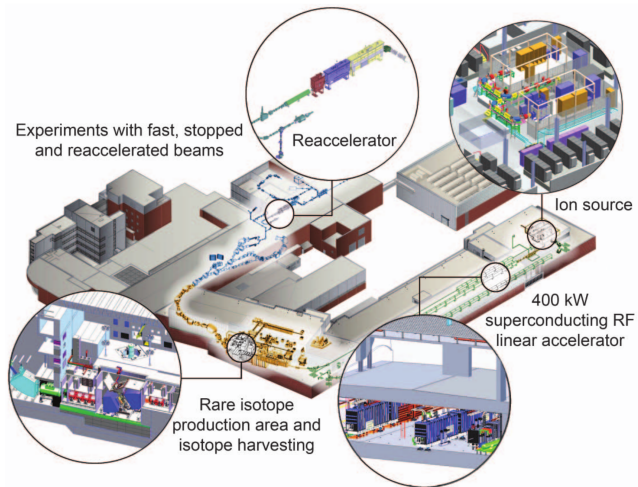
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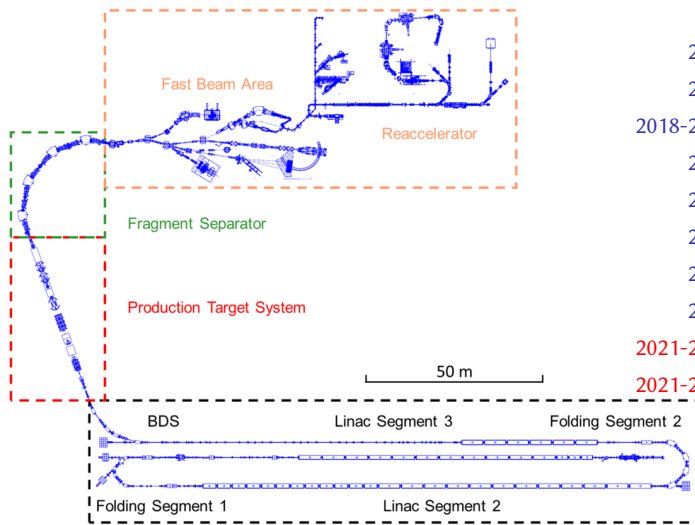
3 Conclusions

Facility for Rare Isotope Beams



▷ T. Glasmacher et al., “Facility for Rare Isotope Beams Update for Nuclear Physics News”, Nuclear Physics News, 27 (2017) 2, 28-33.

Facility for Rare Isotope Beams



Accelerator Segments, staged commissioning:

2017 ECR ion source

2017 Front-End (FE), 0.5 MeV/u

2018-2019 Linac Segment 1 (LS1), 20 MeV/u

2020 Folding Segment 1 (FS1)

2020 Linac Segment 2 (LS2), 200 MeV/u

2021 Folding Segment 2 (FS2)

2021 Linac Segment 3 (LS3), > 200 MeV/u

2021 Beam Delivery System (BDS)

2021-2022 Target Systems, rare isotope beams!

2021-2022 Fragment Separator (ARIS)

P H A N T A S Y

Physics High-level Applications and Toolkit for Accelerator System

<https://github.com/phantasy-project>

Features Highlight

- Device configuration management: [maintainability, portability](#)
- Device abstraction: [object-oriented](#)
- Online modeling: [physics model-depends machine representation](#)
- Python interactive scripting environment for high-level controls: [development and control](#)
- Virtual accelerator based on EPICS and physics model: [test physics algorithms](#)
- Web service integration (channelfinder, scanserver, archiver appliance, UNICORN ...): [extendability](#)

Deployment

- Target OS: Debian Linux, to support PyPI, conda
- Only support Python 3.x
- Meta package: **phantasy** (~20 packages)
- Physics model engines: **FLAME**



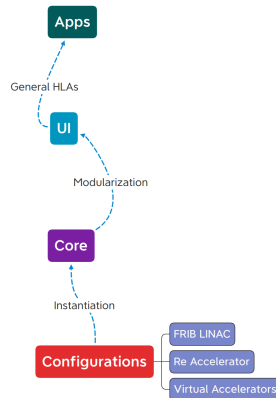
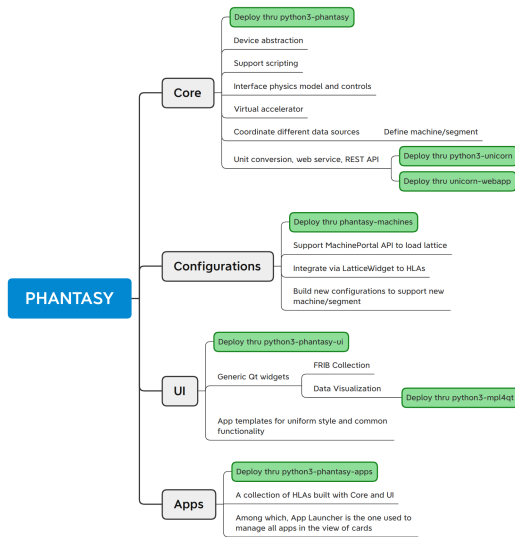
Jenkins



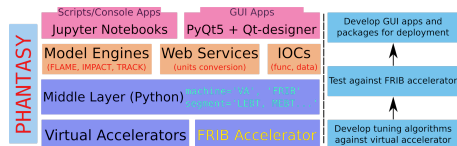
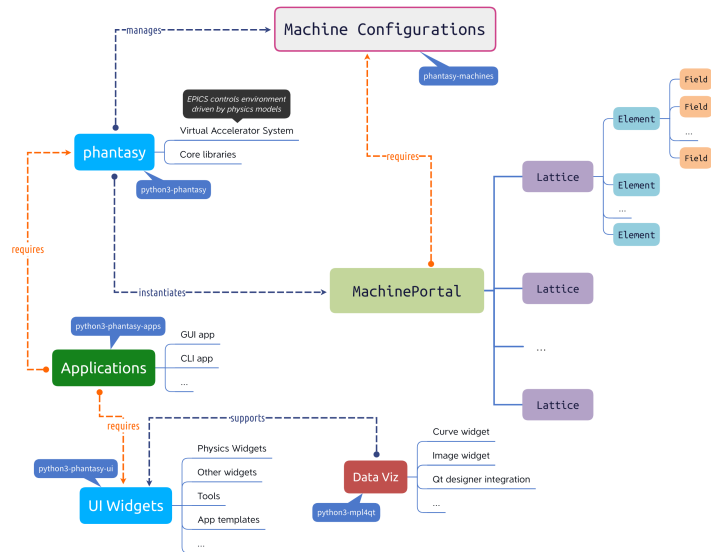
puppet



Evolution of PHANTASY Project



Evolution of PHANTASY Project



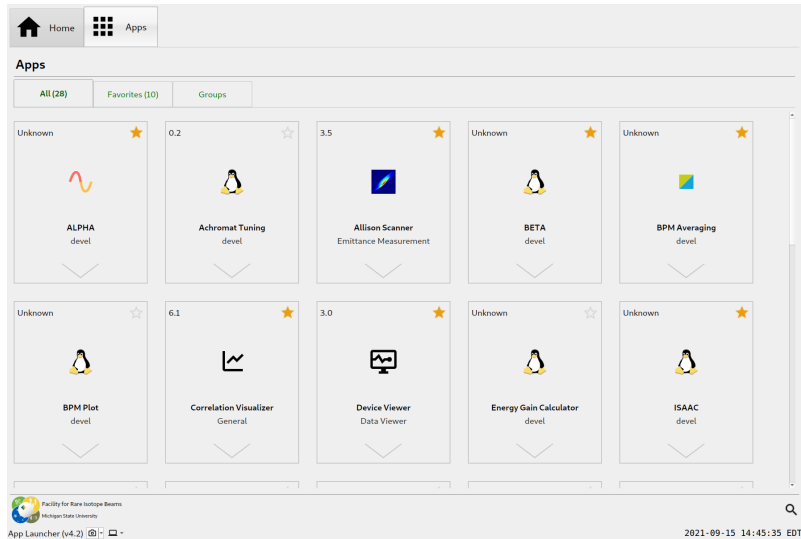
Code Facts

- Python 3, Debian Linux OS
- PHANTASY (core) ~20k LOC
- UI widgets: ~18k LOC (incl. dataviz, excl. ui)
- Apps: ~40k LOC (excl. ui)

Development Guide

- Device → Python object
- List of devices → Lattice
- Lattice manipulation
- Scripting/GUI apps (facility-agnostic)
- Package → deployment

Global Entry for All the Apps: Present and Manage the Information in A Better Way

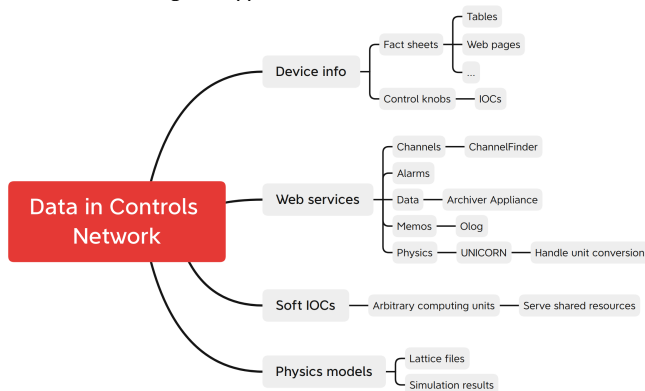


- Global endpoint: right-clicking context menu → 'Physics Apps'
- Managed by a configuration file
- Present each app in one card, click to launch it
- User favored apps as the main page
- Another page for all apps (grouped)
- Support search
- Expanded card for more actions/info: documentation, contact...

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Data in the Controls Network

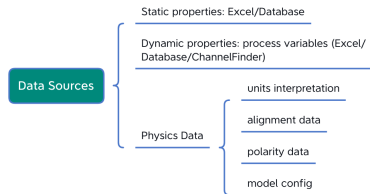
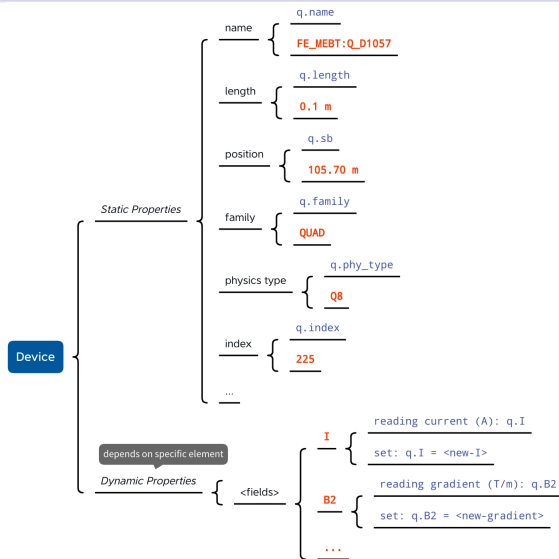
- Device information: static properties → databases/files → handled in phantasy
- Device control knobs: IOCs → distributed → handled in phantasy
- Web services: request/response → distributed → Python client packages
- Soft IOCs: support HLAs → presented as additional attributes in phantasy
- Physics models: simulation, machine tuning → support FLAME



Key Points to Address

- Device information accessibility
- Physics tuning repeatability
- Machine state data integrity

Device Information Accessibility



```
>>> from phantasy import MachinePortal
>>> mp = MachinePortal("FRIB", "LINAC")
>>> q = mp.get_element(type='QUAD', name='*1057*')[0]
```

Retrieve high-level object

Requirements

- Manage accelerator physics settings segment by segment
- Correlate various kinds of accelerator data in one place
- Quickly model with physics code
- Scaling for working with different ion species
- Features for data accessibility and availability

Design Ideas

- Manage device entities rather than process variables
 - PHANTASY defines each device has multiple controllable 'fields'
- Manage different data from different sources: live, archived
 - Aggregate data to expressive tables
- One snapshot should have all the information for:
 - Data investigation, visualization
 - Physics modeling

Settings Manager: Manage Physics Settings with Machine State and More

File Tools View Help

Load Lattice Add Devices Take Snapshot Capture Machine State Physics Fields Engineering Fields Preferences Exit

Working Directory: /files/shared/ap/settings_manager

NOTAG (172) golden (5) merged (3) LS3-phasing (2) to-scale (1) scaled (2) LEBT_MEBT (1) TO_BDS (5) LEBT_FS2 (2) DIAG (1)

LS1-phasing (70) LEBT_FS1B (1) LEBT (2) LS2-phasing (13)

Select Tags: None All

Filter between 2021-05-14 and 2021-05-14 Filter Note

Timestamp - Ion Z A Q User Tags Note

2021-05-14 Friday

2021-05-14T17:02:51 Xe 54 124 26 zhangt Input note ...

2021-05-13 Thursday

2021-05-13T23:08:48 Xe 54 124 26 maruta TO_BDS Twiss matching to LS1 and trajectory in LS1 are tuned, Load 22:11:11 setting and then o...

Check All Invert Checkstate

Stripper 223.74 m

Device	Field	Type	Pos [m]	Setpoint(x ₀)	Live Readback(x ₁)	Live Setpoint(x ₂)	$\Delta(x_0, x_2)$	$\Delta(x_1, x_2)$	x ₂ /x ₀	Power
FE_ISRCL:BEAM	A	ION	0.0000	124.000	124.000	124.000	0.000	0.000	1.000	
FE_ISRCL:BEAM	Q	ION	0.0000	26.000	26.000	26.000	0.000	0.000	1.000	
FE_ISRCL:BEAM	Z	ION	0.0000	54.000	54.000	54.000	0.000	0.000	1.000	
FE_ISRCL:HVP_D0679	V	HVP	67.9000	15000.000	14978.819	15000.000	0.000	-21.181	1.000	
FE_ISRCL:PSEL_D0679	V	SEL	67.9000	0.000	0.000	0.000	0.000	inf	1.000	
FE_ISRCL:PSX_D0679	V	SX	67.9000	0.000	0.000	0.000	0.000	inf	1.000	
FE_ISRCL:PSB_D0679	V	SB	67.9000	-200.000	-200.000	-200.000	0.000	0.000	1.000	
FE_ISRCL:SOLR_D0682	I	SOL	68.2000	518.000	517.836	518.000	0.000	-0.164	1.000	
FE_ISRCL:SOLR_D0685	I	SOL	68.5000	513.000	512.910	513.000	0.000	-0.090	1.000	
FE_ISRCL:PSE_D0686	V	SE	68.6000	-2000.000	-2000.978	-2000.000	0.000	-0.978	1.000	
FE_ISRCL:DRV_D0686:POS	POS	PV	68.6000	0.000	39.897	0.000	0.000	39.897	inf	
FE_ISRCL:SOLR_D0690	I	SOL	69.0000	93.626	93.550	93.626	-0.000	-0.076	1.000	
FE_ISRCL:DCM_D0695	I	HCOR	69.4794	-0.000	0.000	-0.000	0.000	inf	1.000	
FE_ISRCL:DCV_D0695	I	VCOR	69.4794	0.000	0.000	-0.000	-0.000	inf	1.000	
FE_ISRCL:PSEL_D0698	V	SEL	69.8000	-2000.000	-2000.090	-2000.000	0.000	-0.090	1.000	
FE_ISRCL:HVP_D0698	V	HVP	69.8000	42286.000	42291.300	42286.000	0.000	5.300	1.000	
FE_SCS1:SOLR_D0704	I	SOL	70.2070	0.000	0.009	0.000	0.000	0.009	inf	
FE_SCS1:DCM_D0709	I	HCOR	70.9469	-0.306	-0.306	-0.306	0.000	0.000	1.001	
FE_SCS1:DCV_D0709	I	VCOR	70.9469	-2.143	-2.149	-2.143	0.000	-0.006	1.000	
FE_SCS1:DH_D0717	I	BEND	71.1819	77.897	77.953	77.897	0.000	0.056	1.000	
FE_SCS1:DCM_D0723	I	HCOR	72.3442	-0.797	-0.801	-0.797	-0.000	-0.004	0.999	
FE_SCS1:DCV_D0723	I	VCOR	72.3442	0.560	0.564	0.560	-0.000	0.004	1.000	
FE_SCS1:QHE_D0726	V	EQUAD	72.5293	3290.610	3290.603	3290.610	-0.000	-0.007	1.000	

Loaded Lattice FRIB LINAC

Update Rate 1.0 Hz Refresh Data Apply 1

Auto Precision number 3 Initialize with loaded lattice

Settings Manager (v8.0)

2021-05-14 17:04:00 EDT

- Pull device info and live state, refer to phantasy project
- ‘Take Snapshot’: fetch machine state or not
- Fetched machine state presented as a new table along with the physics settings
- Both are stored in one new database record
- Users can export it to various file formats: XLSX, CSV, HDF5, etc.
- Filter buttons for snapshot records and physics settings
- Integration for Archiver Appliance through **pyarchappl**

Settings Manager: Manage Physics Settings with Machine State and More

Snapshots

Working Directory: /Files/shared/ap/settings_manager Total 358

NOTAG (230) | LEBT_F52 (2) | to-scale (1) | merged (3) | LSI-phasing (70) | phasing (16) | DIAG (1) | ARIS (1) | test (0) | LEBT_F51B (2) | golden (6)

TO_BDS (6) | scaled (2) | LS2-phasing (13) | LEBT (2) | LS3-phasing (2) | LEBT_MEBT (1)

Select Tags: None All

Filter between 2021-09-15 and 2021-09-15 Filter Note

Timestamp	Ion	Z	A	Q	User	Tags	Note
2021-09-15 Wednesday							
2021-09-15T16:37:36	Xe	54	129	35	zhangt	ARIS, test	Snapshot template for ARIS/F1 devices.
2021-08-18 Wednesday							
2021-08-18T11:48:37	Kr	36	78	17	maruta		78Kr17+, stiff mode optics calculated from previous 48Ar9+
2021-08-17 Tuesday							
2021-08-17T14:21:10	Kr	36	78	17	maruta		Input note ...
2021-08-17T13:14:41	Kr	36	78	17	maruta		78Kr17+, 25 euA, only U-LEBT, trajectory tuned, QE_D0770 and D0776 are wrong setting
2021-08-12 Thursday							
2021-08-12T21:04:41	Kr	36	78	17	maruta		78Kr17+, Front-end, DCHV_D0948, D0964, D0979 and D0992 are tuned to get same MEBT BPM p...
2021-08-12T20:44:22	Kr	36	78	17	maruta		78Kr17+, Front-end, DCHV_D0964, D0979 and D0992 are tuned to get same MEBT BPM pos and ...
2021-08-12T20:21:46	Kr	36	78	17	maruta		78Kr17+, Front-end, DCHV_D0709 and D0723 are tuned to get same MEBT BPM pos and phase a...
2021-08-12T16:47:41	Kr	36	78	17	maruta		78Kr17+, Front-end, 27euA@LEBT, 23euA@MEBT, snapshot with setting at 2021-08-10 22:20:20
2021-08-11 Wednesday							
2021-08-11T16:51:16	Kr	36	78	17	maruta		78Kr17+, Front-end, snapshot with setting at 2021-08-10 22:20:20
2021-08-11T16:33:29	Kr	36	78	17	maruta		78Kr17+, Front-end, snapshot with setting at 2021-08-10 22:20:20 but HVP_D0698 is diffe...
2021-08-10 Tuesday							
2021-08-10T22:31:07	Kr	36	78	17	maruta		Input note ...
2021-08-10T22:20:20	Kr	36	78	17	maruta	golden	78Kr17+, Front-end, 22 euA@U-LEBT, 18.7 euA@MEBT, L-LEBT trajectory was tuned by a pyth...
2021-08-10T21:59:48	Kr	36	78	17	maruta		78Kr17+, Front-end, 22 euA@U-LEBT, 18 euA@MEBT
2021-08-10T19:49:58	Kr	36	78	17	maruta		Input note ...
2021-08-10T19:06:20	Kr	36	78	17	maruta		78Kr17+, 22 euA. tmp
2021-08-10T18:51:33	Kr	36	78	17	maruta		78Kr17+, 22 euA. After loading scaled setting of 86Kr17+ at 2021-07-14

- Pull device info and live state, refer to phantasy project
- ‘Take Snapshot’: fetch machine state or not
- Fetched machine state presented as a new table along with the physics settings
- Both are stored in one new database record
- Users can export it to various file formats: XLSX, CSV, HDF5, etc.
- Filter buttons for snapshot records and physics settings
- Integration for Archiver Appliance through **pyarchappl**

[Click to view one captured snapshot in xlsx](#)

Settings Manager: Manage Physics Settings with Machine State and More

The screenshot displays the 'Settings Manager: Manage Physics Configurations of Accelerator System' window. The interface includes a menu bar (File, Tools, View, Help), a toolbar with icons for Load Lattice, Add Devices, Take Snapshot, Capture Machine State, Physics Fields, Engineering Fields, Preferences, and Exit. Below the toolbar is a 'Working Directory' field and a 'Total' count of 358. A list of configurations is shown, including NOTAG (230), LEBT_PS2 (2), scaled (2), golden (6), LS2-phasing (13), LS1-phasing (70), phasing (16), LEBT_MEBT (1), test (0), to-scale (1), ARIS (1), merged (3), DIAG (1), LEBT_PS1B (2), LEBT (2), TO_BDS (6), and LS3-phasing (2). A 'Select Tags' dropdown is set to 'None', and 'Filter Note' is empty. A 'Filter between' date range is set from 2021-09-15 to 2021-09-15. A table of snapshots is visible, with columns for Timestamp, Ion, Z, A, Q, User, Tags, and Note. A context menu is open over the 2021-08-18 snapshot, showing options like Load, Copy Data, Copy Text, Read, Show in Files, Export, and Delete. Below the snapshots table is a 'Check All' button and an 'Invert Checkstate' button. The main table displays device settings with columns: Device, Field, Type, Pos [m], Setpoint(x₀), Live Readback(x₁), Live Setpoint(x₂), Δ(x₀,x₂), Δ(x₁,x₂), x₂/x₀, and Power. The table lists various devices like FE_ISRC1:BEAM, FS_FIS1:Q_D1013, and FS_FIS1:Q_D1148. At the bottom, there is an 'Update Rate' dropdown set to 1.0 Hz, a 'Refresh Data' button, an 'Apply' button, and a 'Precision number' dropdown set to 3. The status bar at the bottom indicates 'Settings Manager (v8.0)' and the date/time '2021-09-15 17:14:05 EDT'.

- Pull device info and live state, refer to phantasy project
- ‘Take Snapshot’: fetch machine state or not
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- Filter buttons for snapshot records and physics settings
- Integration for Archiver Appliance through *pyarchappl*

Settings Manager: Manage Physics Settings with Machine State and More

```
tong ~ pyarchappl-get -h
usage: pyarchappl-get [-h] [--url URL] [--pv PV_LIST] [--pv-file PV_FILE]
                    [--from FROM_TIME] [--to TO_TIME] [--resample RESAMPLE]
                    [--verbose] [-o OUTPUT] [-f FMT]
                    [--format-args FMT_ARGS]

Retrieve data from Archiver Appliance and export as a file.

optional arguments:
  -h, --help            show this help message and exit
  --url URL             URL of Archiver Appliance, default is FRIB FTC
                        archiver (default: None)
  --pv PV_LIST          List of PVs for retrieval, each define with --pv
                        (default: None)
  --pv-file PV_FILE     A file for PVs, one PV per line (skip line starts with
                        #), append each to pv_list (default: None)
  --from FROM_TIME      A string of begin time in ISO8601 format (default:
                        None)
  --to TO_TIME          A string of end time in ISO8601 format (default: None)
  --resample RESAMPLE   The offset string/object representing target
                        conversion, e.g. '1S' for resample with 1 second
                        (default: None)
  --verbose, -v         Verbosity level of the log output, 0: no output,
                        1(-v): output progress, 2(-vv): output progress with
                        description (default: 0)
  -o OUTPUT, --output OUTPUT
                        File path for output data, print to stdout if not
                        defined (default: None)
  -f FMT, --output-format FMT
                        File format for output data, supported: csv, hdf,
                        excel, html, ... (default: csv)
  --format-args FMT_ARGS
                        Additional arguments passed to data export function in
                        the form of dict, e.g. '{"key": "data"}' (for hdf
                        format) (default: {})
```

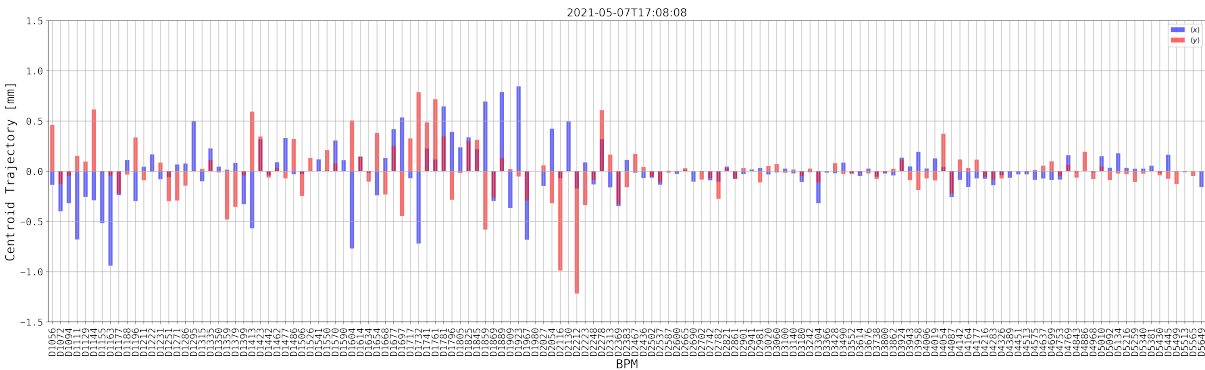
Examples:

```
# Retrieve raw PV data in the defined time frame
$ pyarchappl-get -o data.csv -v \
  --pv LS1_CA01:BPM_D1129:XPOS_RD --pv LS1_CA01:BPM_D1129:YPOS_RD \
  --from 2021-04-15T20:10:00.000Z --to 2021-04-15T21:25:00.000Z \

# Align the timestamps, resample at 1 second
$ pyarchappl-get -o data.csv -v \
  --pv LS1_CA01:BPM_D1129:XPOS_RD --pv LS1_CA01:BPM_D1129:YPOS_RD \
  --from 2021-04-15T20:10:00.000Z --to 2021-04-15T21:25:00.000Z \
  --resample 1S
```

- Pull device info and live state, refer to [fantasy project](#)
- ‘Take Snapshot’: fetch machine state or not
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Settings Manager: An Example of Machine State Data (BPM group)



Settings Manager: Pre-generate Settings from Physics Model for Commissioning

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V		
4	132	Transport	19.8	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80	
5	132	CC05	#1	20.31	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
6			#2	20.52	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
7			#3	20.52	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
8			#4	21.05	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
9			#5	21.05	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
10			#6	21.98	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
11	132	CC02	#1	22.57	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
12			#2	22.56	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
13			#3	23.11	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
14			#4	23.67	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
15			#5	24.23	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
16			#6	24.80	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
17	132	CC03	#1	25.50	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
18			#2	25.95	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
19			#3	26.54	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
20			#4	27.32	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
21			#5	27.71	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
22			#6	28.31	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
23	132	CC04	#1	28.90	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
24			#2	29.50	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
25			#3	30.11	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
26			#4	30.71	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
27			#5	31.32	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
28			#6	31.93	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
29	132	CC05	#1	32.42	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
30			#2	33.03	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
31			#3	33.65	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
32			#4	34.26	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
33			#5	34.88	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
34			#6	35.50	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
35	132	CC06	#1	36.12	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
36			#2	36.73	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
37			#3	37.36	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
38			#4	37.98	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80
39			#5	38.60	73.61	104.74	77.70	78.46	97.48	71.83	88.82	91.27	69.97	81.36	83.02	57.98	41.64	45.92	50.16	54.29	44.45	48.81	36.80

From Physics Model

Convert xlsx sheet settings as files/database records for Settings Manager to load

Load

Check device to apply the settings, w/ scaling factor if needed

Significantly saved effort to set the optics during cavity tuning to maintain beam envelope

Settings Manager: Manage Physics Configurations of Accelerator System

Settings Take Snapshot Physics Fields Engineering Fields Preferences Exit

Search

Filter Shortcuts

135 Items All Selected

Type	Pos [m]	Setpoint(x,s)	Live Readback(x,s)	Live Setpoint(x,s)	$\Delta(x,s)_1$	$\Delta(x,s)_2$	$\Delta(x,s)_3$	Tolerance
QUAD	105.0954	68.580	0.000	68.580	0.000	0.000	0.000	-68.580 0.150
QUAD	105.0954	76.076	0.000	76.076	0.000	0.000	0.000	-76.076 0.150
QUAD	106.1454	73.699	0.000	73.699	0.000	0.000	0.000	-73.699 0.150
QUAD	107.3496	57.106	0.000	57.106	0.000	0.000	0.000	-57.106 0.150
QUAD	107.5496	70.796	0.000	70.796	0.000	0.000	0.000	-70.796 0.150
QUAD	107.7996	66.364	0.000	66.364	0.000	0.000	0.000	-66.364 0.150
QUAD	109.4918	64.673	0.000	64.673	0.000	0.000	0.000	-64.673 0.150
QUAD	109.6918	66.283	0.000	66.283	0.000	0.000	0.000	-66.283 0.150
QUAD	109.9418	50.912	0.000	50.912	0.000	0.000	0.000	-50.912 0.150
QUAD	111.2068	59.224	0.000	59.224	0.000	0.000	0.000	-59.224 0.150
QUAD	111.4068	60.285	0.000	60.285	0.000	0.000	0.000	-60.285 0.150
QUAD	111.6568	42.166	-0.002	42.168	0.000	0.000	0.000	-42.168 0.150
SOL	113.0099	30.205	20.211	-9.994	0.150	0.150	0.150	-9.994 0.150
SOL	114.4761	33.316	23.320	-9.996	0.150	0.150	0.150	-9.996 0.150
SOL	116.3740	36.395	26.398	-9.997	0.150	0.150	0.150	-9.997 0.150
SOL	117.8484	39.389	29.393	-9.996	0.150	0.150	0.150	-9.996 0.150
SOL	119.7471	32.245	22.253	-9.992	0.150	0.150	0.150	-9.992 0.150
SOL	121.2223	33.968	0.007	33.961	23.968	0.000	0.000	-9.993 0.150
SOL	123.2662	26.705	0.010	26.695	16.705	0.000	0.000	-9.990 0.150
SOL	125.2639	28.329	0.005	28.324	18.329	0.000	0.000	-9.995 0.150
SOL	127.2617	32.407	0.007	32.400	22.407	0.000	0.000	-9.993 0.150
SOL	129.6366	33.147	0.008	33.139	23.147	0.000	0.000	-9.992 0.150
SOL	131.6364	34.222	0.005	34.222	24.222	0.000	0.000	-9.995 0.150
SOL	133.6341	38.396	0.006	38.390	28.396	0.000	0.000	-9.994 0.150
SOL	136.0111	40.447	0.001	40.445	30.447	0.000	0.000	-9.998 0.150
SOL	138.0088	38.894	-0.000	38.894	28.894	0.000	0.000	-10.000 0.150
SOL	140.0065	43.704	0.005	43.699	33.704	0.000	0.000	-9.995 0.150
SOL	142.3835	43.301	0.004	43.297	33.301	0.000	0.000	-9.996 0.150
SOL	144.3812	42.295	0.018	42.285	32.295	0.000	0.000	-9.990 0.150
SOL	146.3789	46.775	0.006	46.779	36.775	0.000	0.000	-9.994 0.150
SOL	148.7559	46.754	0.005	46.749	36.754	0.000	0.000	-9.995 0.150
SOL	150.7536	41.812	0.005	41.807	31.812	0.000	0.000	-9.995 0.150
SOL	152.7514	47.994	0.005	47.989	37.994	0.000	0.000	-9.995 0.150
SOL	155.1283	47.474	0.012	47.462	37.474	0.000	0.000	-9.988 0.150
SOL	157.1261	46.080	0.003	46.077	36.080	0.000	0.000	-9.997 0.150

Load Settings File

Loaded data from /files/shared/ap/settings_support_cavity_tuning/L52/I73-Full acceleration-0-250.5

Retrieve Archived Data: Machine State and Physics Settings

pvlist.txt buffers

```
1 # a column of 150 PVs
2 # each row for one PV
3 # line starts with # is bypassed
4 VA:LS1_CA01:BPM_D1129:X_RD
5 VA:LS1_CA01:BPM_D1129:Y_RD
6 VA:LS1_CA01:BPM_D1144:X_RD
7 VA:LS1_CA01:BPM_D1144:Y_RD
8 VA:LS1_WA01:BPM_D1155:X_RD
9 VA:LS1_WA01:BPM_D1155:Y_RD
10 VA:LS1_CA02:BPM_D1163:X_RD
11 VA:LS1_CA02:BPM_D1163:Y_RD
12 VA:LS1_CA02:BPM_D1177:X_RD
13 VA:LS1_CA02:BPM_D1177:Y_RD
14 VA:LS1_WA02:BPM_D1188:X_RD
15 VA:LS1_WA02:BPM_D1188:Y_RD
16 VA:LS1_CA03:BPM_D1196:X_RD
17 VA:LS1_CA03:BPM_D1196:Y_RD
18 VA:LS1_CA03:BPM_D1211:X_RD
19 VA:LS1_CA03:BPM_D1211:Y_RD
20 VA:LS1_WA03:BPM_D1222:X_RD
21 VA:LS1_WA03:BPM_D1222:Y_RD
22 VA:LS1_CB01:BPM_D1231:X_RD
23 VA:LS1_CB01:BPM_D1231:Y_RD
24 VA:LS1_CB01:BPM_D1251:X_RD
25 VA:LS1_CB01:BPM_D1251:Y_RD
26 VA:LS1_CB01:BPM_D1271:X_RD
27 VA:LS1_CB01:BPM_D1271:Y_RD
28 VA:LS1_WB01:BPM_D1286:X_RD
29 VA:LS1_WB01:BPM_D1286:Y_RD
30 VA:LS1_CB02:BPM_D1295:X_RD
31 VA:LS1_CB02:BPM_D1295:Y_RD
32 VA:LS1_CB02:BPM_D1315:X_RD
33 VA:LS1_CB02:BPM_D1315:Y_RD
34 VA:LS1_CB02:BPM_D1335:X_RD
35 VA:LS1_CB02:BPM_D1335:Y_RD
36 VA:LS1_WB02:BPM_D1350:X_RD
37 VA:LS1_WB02:BPM_D1350:Y_RD
38 VA:LS1_CB03:BPM_D1359:X_RD
39 VA:LS1_CB03:BPM_D1359:Y_RD
40 VA:LS1_CB03:BPM_D1379:X_RD
```

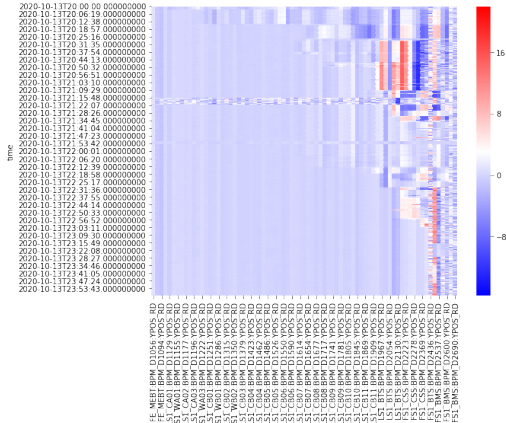
run.sh buffers

```
3 # CAUTION: run the following script after removing all the trailing comments!
4 # here is to explain the command
5 pyarchappl-get -vv \                # show progress bar and more output
6   --pv-file pvlist.txt \           # load PVs from external file
7   --from 2021-04-15T20:10:00.000Z \ # begin time in GMT timezone
8   --to 2021-04-15T17:25:00.00-04:00 \ # end time in America/New_York, demo only
9   \                                # usually use the same timezone, i.e.
10  \                                # 2021-04-15T21:25:00.000Z
11  --url http://127.0.0.1:17665 \     # define the address of a local archiver
12  --resample 1S \                   # align data with interval of 1 second
13  --output data.h5 \                 # save data as a hdf5 file
14  --output-format hdf \              # define file format
15  --format-args '{"key":"Trajectory"}' # required for 'hdf' format
```

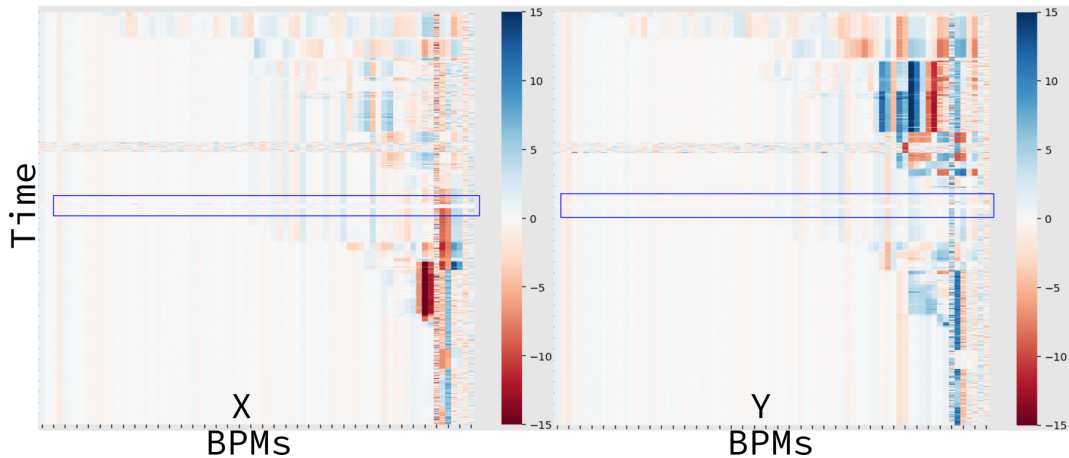
140514 /home/tong/Dropbox/pyarchappl/main/scripts/examples

```
tong master ... > main > scripts > examples pyarchappl-get -vv \
--pv-file pvlist.txt \
--from 2021-04-15T20:10:00.000Z \
--to 2021-04-15T17:25:00.00-04:00 \
--url http://127.0.0.1:17665 \
--resample 1S \
--output data.h5 \
--output-format hdf \
--format-args '{"key":"Trajectory"}'
Fetched VA:FS1_BMS:BPM_D2702:Y_RD: 100%| 150/150 [00:13<00:00, 11.28it/s]
[2021-04-20T17:01:33.889305] Fetched all, time cost: 14.8 seconds.
tong master ... > main > scripts > examples pyarchappl-get -vv --pv-file pvlist.txt
--from 2021-04-15T20:10:00.000Z --to 2021-04-15T17:25:00.00-04:00 --url http://127.0.0.1:
17665 --resample 1S --output data.csv
Fetched VA:LS1_CB07:BPM_D1634:X_RD: 46%| 69/150 [00:03<00:03, 22.37it/s]
```

pyarchappl project, “Pull, Visualize and Play the data from Archiver Appliance”



Retrieve Archived Data: Machine State and Physics Settings



- 1 Introduction
- 2 Manage the Data in Controls Network
- 3 Conclusions

- Overviewed the status of Python-based software framework “phantasy” project for the high-level physics controls for FRIB LINAC
- Overviewed the different data categories in the controls network
- Proposed and developed software for the data management for machine tuning
- Overviewed the developed tools for machine state data management

Thank you for your attention!