

MDT DCS Offline Monitoring

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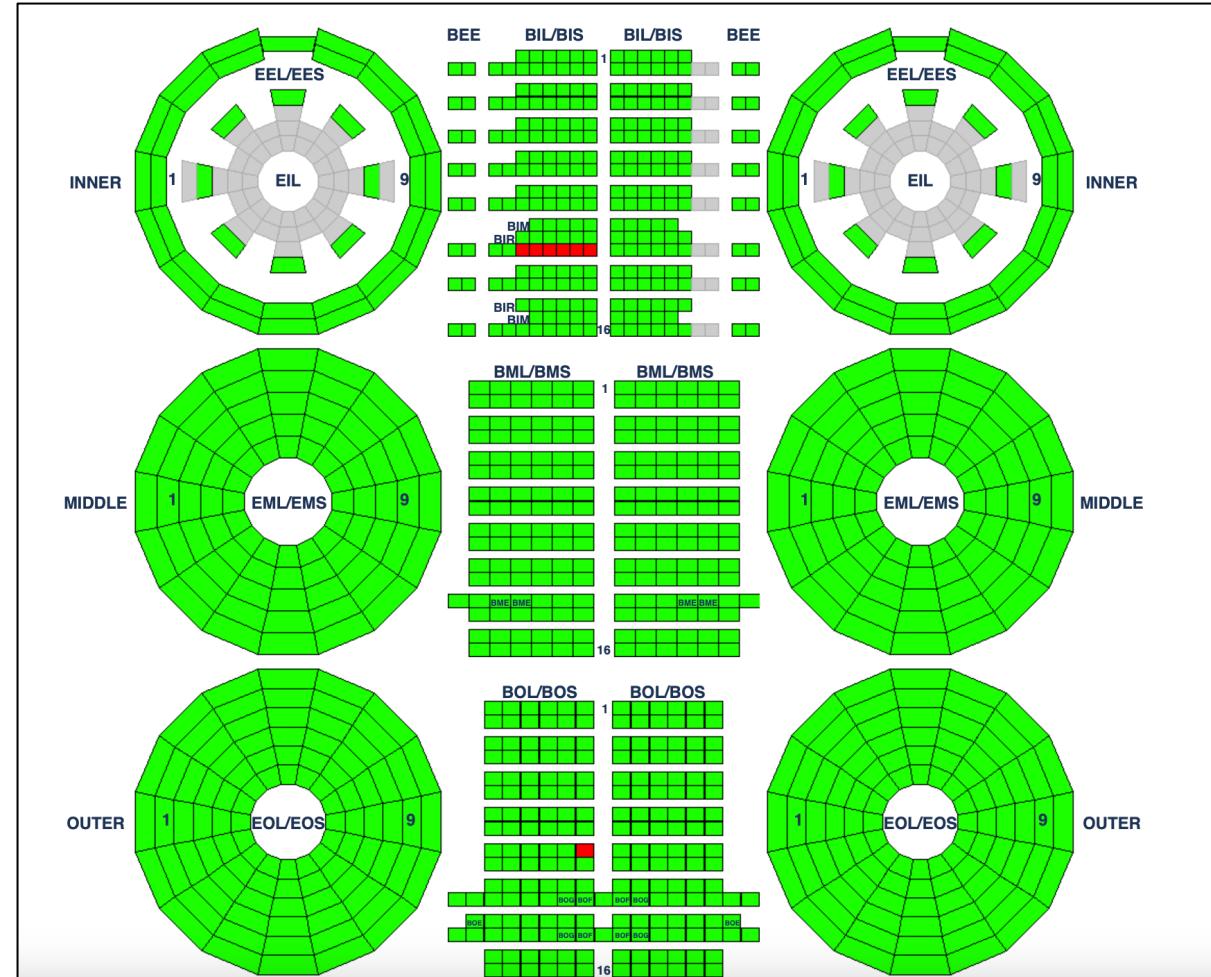


Presentation Outline:

- Overview of Project
- Explanation of each component of the project
- Demonstration of web portion
- How does this project add to MDT monitoring?
- What is still left to do?
- What have I learned?
- Travels

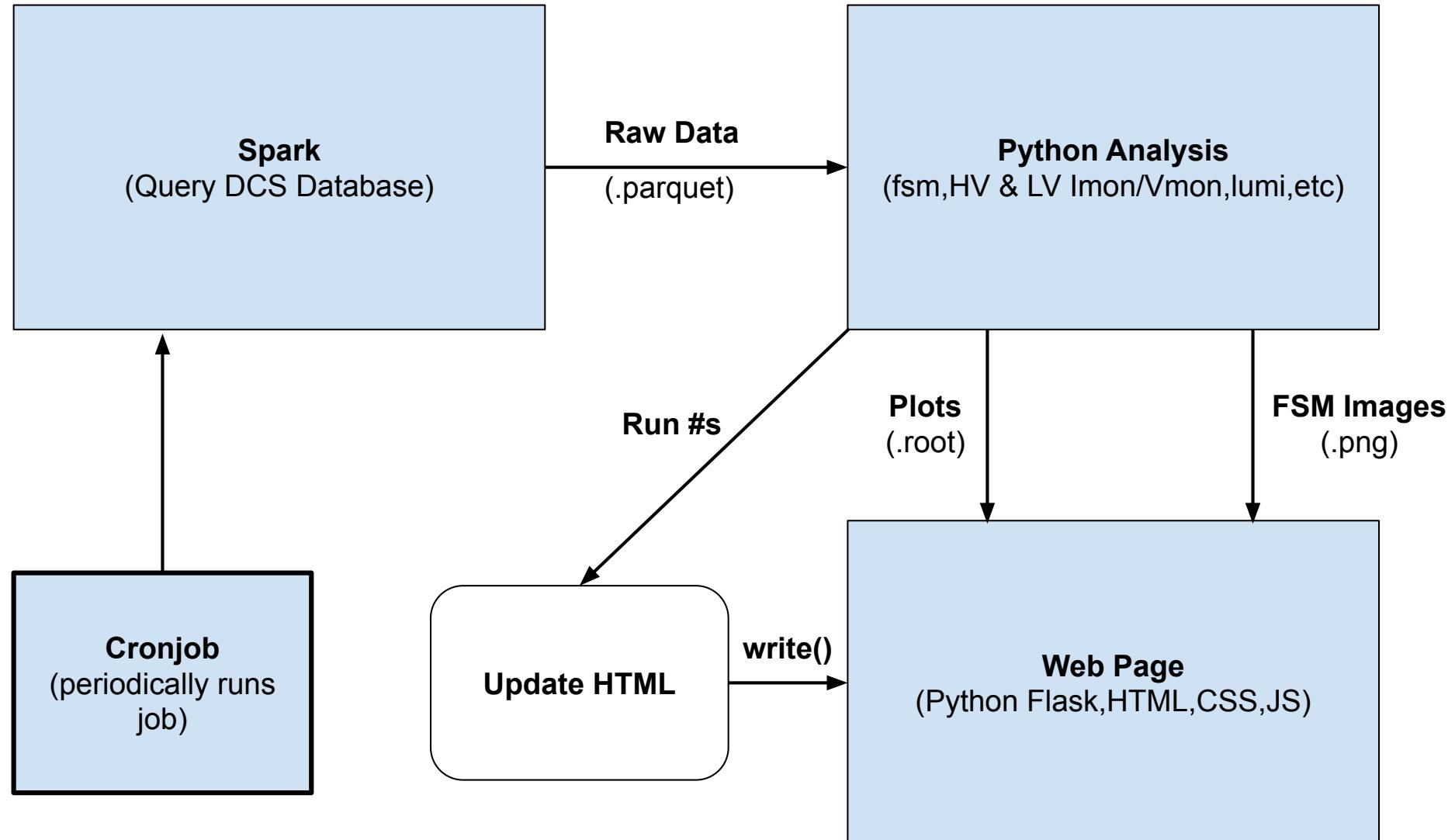
Project: MDT DCS Offline Monitoring

- Working with Zhen Yan (Boston University) and Tiesheng Dai (University of Michigan)
- **Goal of the project:** Generate figures using DCS data for offline monitoring of MDT detectors/electronics
 - Build web application to display data
- **Purpose:** Important to review detector performance from different runs (more on slide 14)



Overview:

- Will not have time to complete the entire project
- Most focus on:
 - **Spark**
 - **Analysis**
 - **Web Portion**
 - **Update HTML**



Spark:

- To query the DCS database:
 - Apache Spark (pyspark)
 - SQL
- Apache Spark is an analytics engine for large-scale data processing
 - Pyspark is the python API for the use of Apache Spark
- Data from each MDT chamber must be exported to a .parquet file to be read for analysis
- Partitioned data by run number

```
1 map0 = mapping(run numb, run numb prev, spark)
2
3
4 map0.get_data_fsm_prev()
5 map0.get_data_fsm()
6
7
8 map0.get_data_HViMon()
9 map0.get_data_HVVMon()
10
11
12 map0.get_data_LViMon()
13 map0.get_data_LVVMon()
14
15
16 map0.get_data_V0()
17 map0.get_data_VCC()
18
19
20 map0.get_data_lumi()
21
```

**FSM States
(Ex: On, Standby)**

Chamber power supply current & voltage

LV power supply current & voltage

Voltage max threshold

Voltage into CSM

LHC instantaneous luminosity

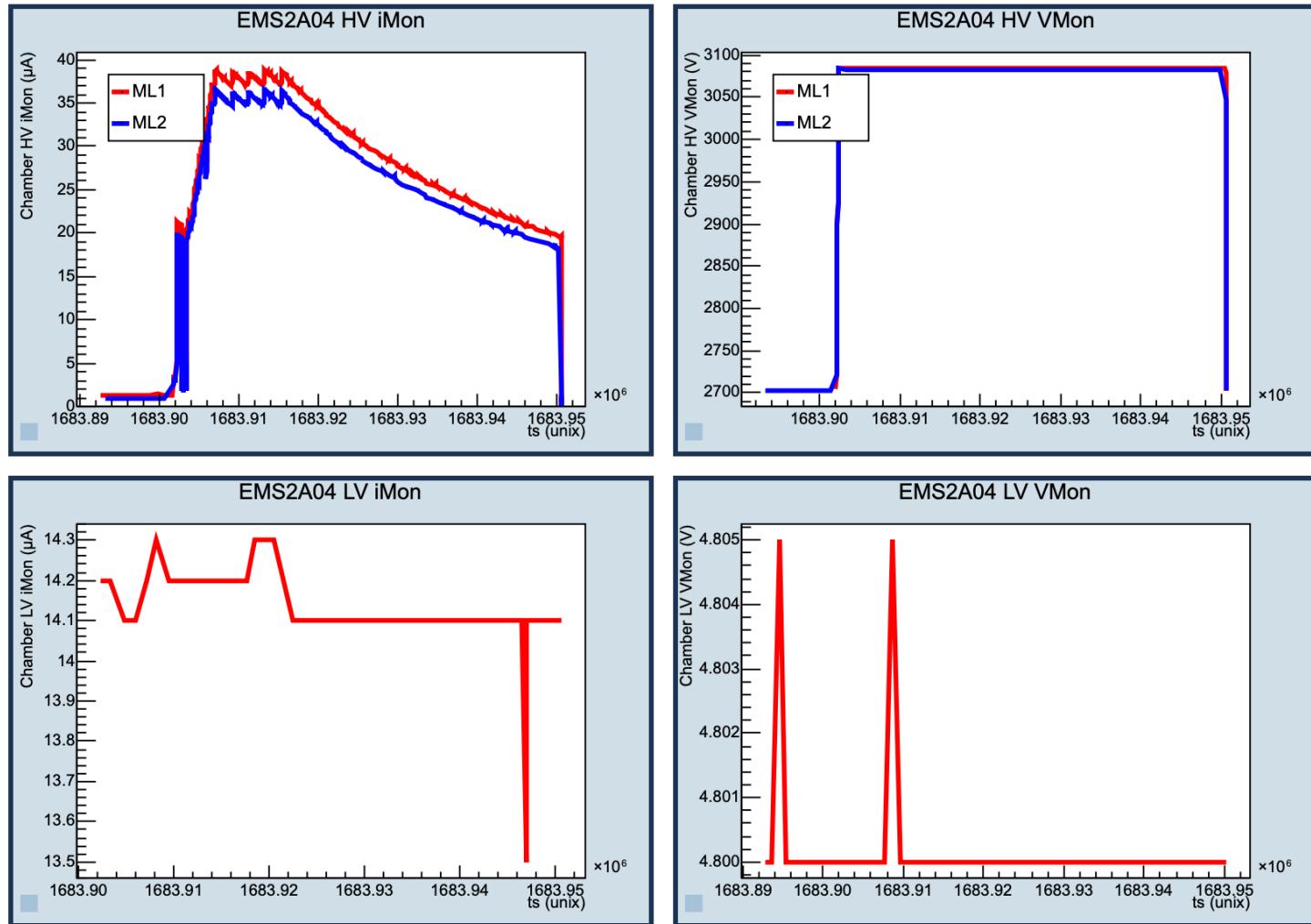
Python Analysis:

- **FSM (Finite State Machine):**
 - Important to monitor JTAG, HV power supply (PS), and LV power supply
 - Need to see chamber failures and the lumiblock they happened
 - FSM diagram and table to present information

element_name	value_string	ts
lumiBlock	117	2022-08-02 05:10:32.809005
BIL2C09 HV ML1 fsm	ON	2022-08-02 05:10:38.318000
BIL2C09 HV ML2 fsm	ON	2022-08-02 05:10:38.318000
BIL2C09 HV ML2 fsm	RAMP_UP	2022-08-02 05:10:41.204000
BIL2C09 HV ML1 fsm	RAMP_UP	2022-08-02 05:10:41.204000
lumiBlock	118	2022-08-02 05:10:56.296405
BIL2C09 HV ML1 fsm	ON	2022-08-02 05:11:16.237000
BIL2C09 HV ML2 fsm	ON	2022-08-02 05:11:16.237000
lumiBlock	803	2022-08-02 14:03:42.322945
BIL2C09 HV ML2 fsm	STANDBY	2022-08-02 14:04:01.581000
BIL2C09 HV ML1 fsm	STANDBY	2022-08-02 14:04:01.581000
BIL2C09 HV ML1 fsm	RAMP_DOWN	2022-08-02 14:04:02.474000
BIL2C09 HV ML2 fsm	RAMP_DOWN	2022-08-02 14:04:02.475000

Python Analysis:

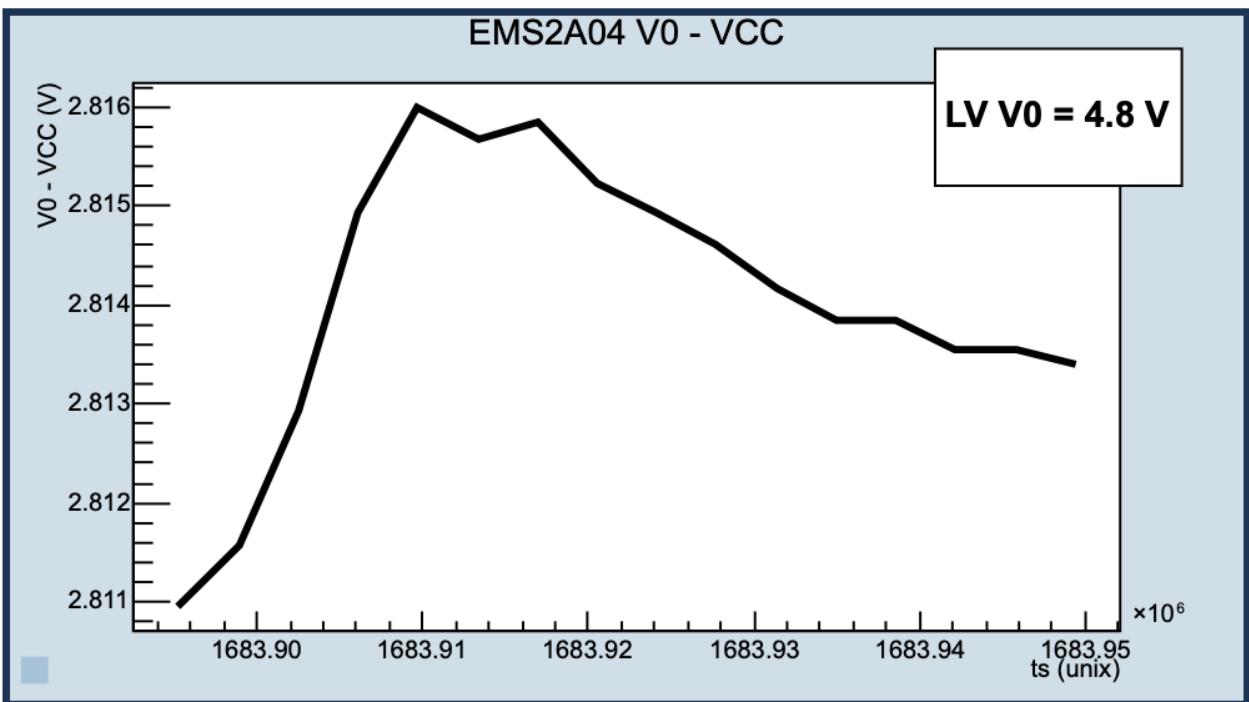
- **HV(High Voltage) iMon & Vmon:**
 - iMon = PS current output
 - Vmon = PS voltage output
 - Power sent directly to MDT detectors
- **LV(Low Voltage) iMon & Vmon:**
 - iMon = PS current output
 - Vmon = PS voltage output
 - Power sent directly to electronics for MDT readouts



Python Analysis:

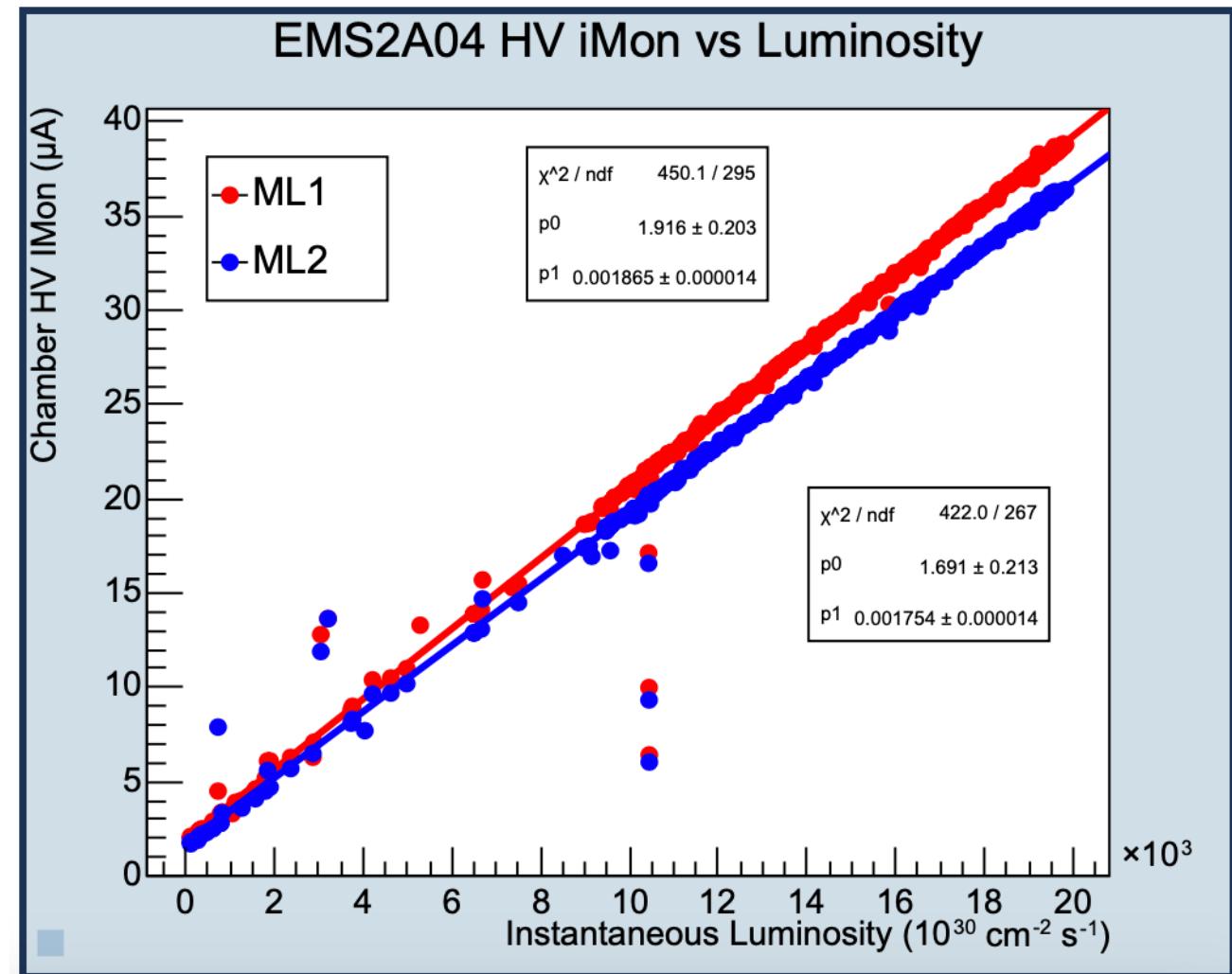
- **LV V₀ – CSM VCC:**

- V₀ is the maximum voltage threshold for the LV electronics
 - Causes shutoff
- VCC is the voltage read from the CSM (Chamber Service Module)
 - Receiving power form LV PS
- Represents how close LV electronics are getting to the threshold



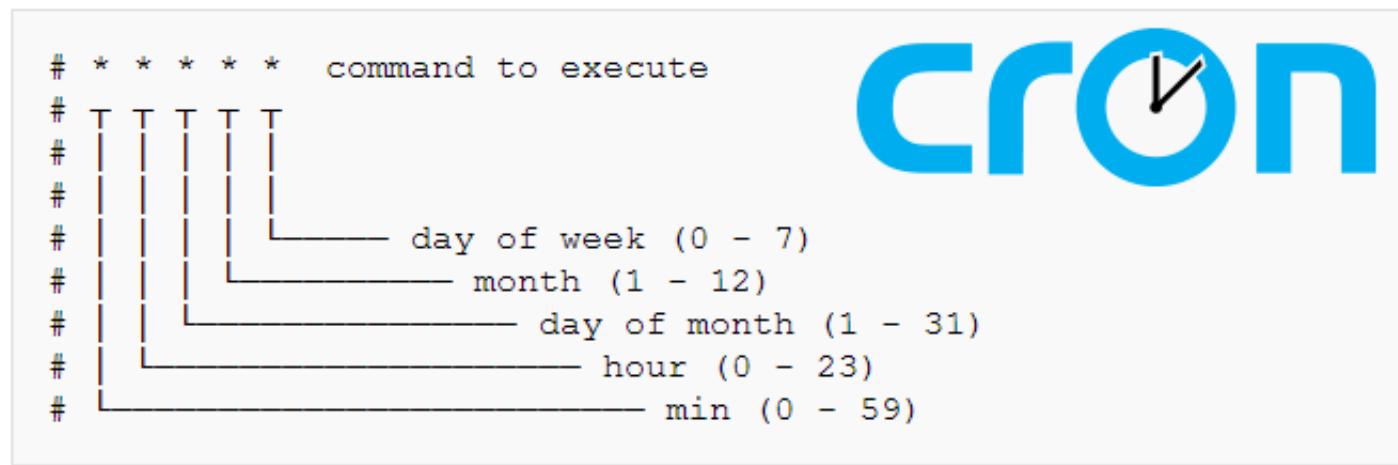
Python Analysis:

- HV iMon vs LHC Instantaneous Luminosity:
 - iMon should increase linearly with luminosity
 - Lines of very different slopes indicate a problem
 - Data constrained by stable beam flag and Atlas good physics flag



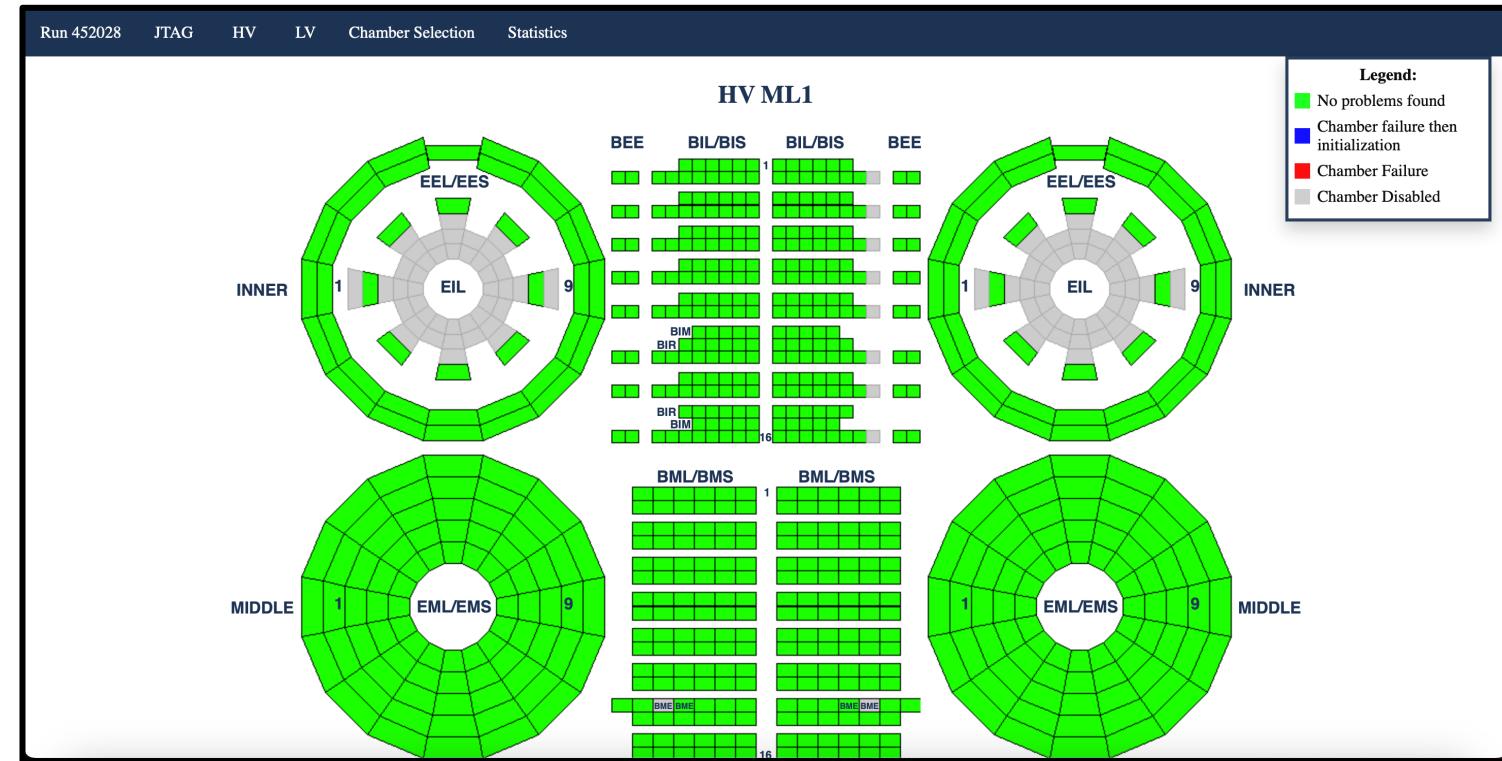
Cronjob:

- For use when web server is operational
 - Every few days a job must be run to grab the new MDT DCS data and run the analysis for each new run
 - For website to be up to date
 - **Unfinished**



Web & Update HTML:

- Uses Python Flask for backend and to interact with python pyspark and analysis
- Web template designed with HTML & CSS
- JS used for some frontend functionality
- Update HTML updates web home page with links to new run analysis
- Can only run on local server as of now



Demonstration

(Must share screen)

How this adds to MDT monitoring:

- MDT Online & Offline monitoring exists
 - A study of the MDT DCS Offline data does not exist
 - Limited online monitoring for MDT
 - DCS Data view shows raw data
 - Supplementary study for MDT detector condition

DCS Data Viewer

Select the identifier and time period

Data Descriptor
 Alarms Element name
 Log Alias

Select Period:
Start Time:
Stop Time:

Select Hours Period:
Last Hours:

Select Invalids Local Time
 Select NaNs UTC Time
 Use RdbAPI

Navigate **Search** **Configure Data Request** Show Deleted Elements **Metadata History** **System Archiving Rate** **DPE Archiving Rate**

LARSR	ATLMDTMDM2	MDT	PS	BA	BML1A15	ML1	HV	HVmaxError
LUC	ATLMDTMDM3			BC	BML2A01	ML2		Imon
MDT	ATLMDTMDM4			HVboard	BML2A03		I	On
MMG	ATLMDTMDM5			LVboard	BML2A05			OverCurrent
MUO	ATLMDTMDM6			PS2	BML2A07			OverVoltage
PIX	ATLMDTMDM7			spare	BML2A09			OverVoltageProtection
PSR1	ATLMDTMDM8				BML2A11			PowerFail
RPC	ATLMDTMDM9				BML2A13			Status
RPO	ATLMDTMDM9				BML2A15			TemperatureError
RPO	ATLMDTMON				BML3A01			Tripped
SCT	ATLMDTMTM				BML3A03			UnderVoltage
SCTS	ATLMDTPS2				BML3A05			Unplugged
STG	ATLMDTPS3				BML3A07			Vmon
TDQ	ATLMDTSCS							

Id	Delete	Configuration
MDT PS BA BML2A09 I BML3A09 LV Imon		
MDT PS BA BML2A09 I BML3A09 LV Vmon		
MDT PS BA BML2A09 ML1 HV Imon		
MDT PS BA BML2A09 ML1 HV Vmon		

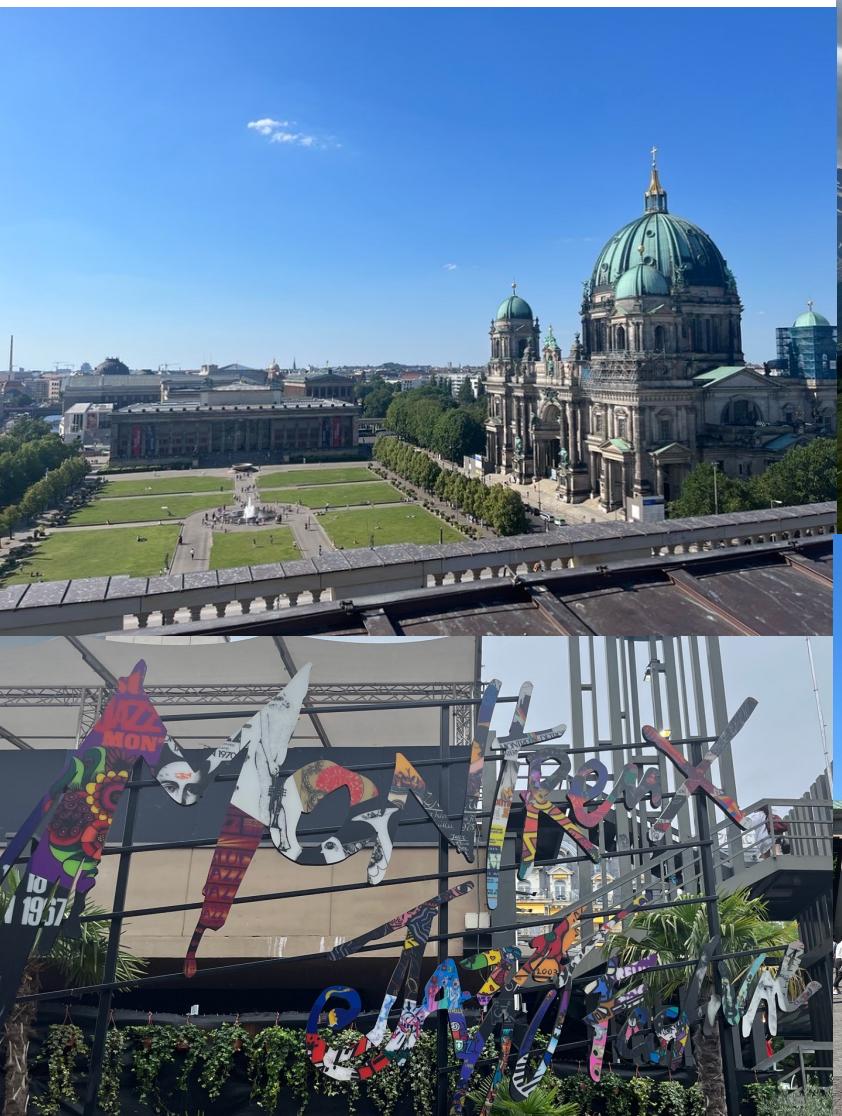
Still left to do:

- Documentation (README, code comments, code organization, error management)
 - Optimization (Spark & analysis)
 - Provide Gitlab with DCS data and analysis from all Run3 ATLAS runs so far (~250 runs)
-
- Chamber selection page => Chamber summary
 - Home page run table
 - Statistics page
 - Cronjob and CERN web server launch
 - Speak with MDT experts about additional plots for analysis
 - Speak with DCS experts about optimization of Spark

What I have gained from this:

- Working with dataframes/databases
 - SQL (Structured Query Language)
 - Python pandas
- Improved project organization skills
- Web design (frontend & backend)
- Improved ROOT skills

Travel:



Thank you!