

FST Latency Monitoring and Adjustment Procedure

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1. Who should be responsible for this?
On-call experts
2. When/how often should this be done?
 - a) At the beginning of each year's data taking (when we first have the beam)
 - b) During the run, on a bi-weekly bases
3. How long does it take each time?
If any change happens, 2-3 days
If no changes needed, 1 day
4. General ideas
 - a) Data selection
 - i) Choose from most recent runs
 - ii) Choose physics runs
 - iii) Run time over 20 minutes
 - iv) Include entire fills to smooth out the sudden jumps due to various activities (start the the fill, change of pedestal, laser runs, etc)
 - b) Criteria
For each APV, we first obtain the fraction of each time bin as a function of RunIdx. Then we check average fraction of each of the three time bins. If bin 1 is significantly lower than bin 0 or bin 2 ($\text{bin}_1 + 5\sigma_1 < \text{bin}_x - 5\sigma_x$, $x = 0$ or 2), then it is going to be adjusted for an attempt. Due to the accuracy of adjustment, it is possible that we will not shift the distribution by exactly 1 time bin, and after adjustment bin 1 is still not with most entries on average. We will check the fractions again with 1 day's with new LAT setting in effect and decide whether those adjustment will be kept or be reverted.
5. First time to work on this: establish the working environment
 - a) Make sure you have access to onlcs.starp.bnl.gov and daqman.starp.bnl.gov here:
<https://www.star.bnl.gov/starkeyw/>

Association status list							
Show	10	entries					
ACCOUNT	HOST	REASON	STATUS	APPLICATION DATE	EXPIRATION TS	REQUEST EXTENSION	REMOVE
evpops	daqman.starp.bnl.gov (130.199.60.86)	FST Expert	APPROVED	2022-05-10 20:13:17	never	*** no extension ***	<input type="checkbox"/>
evpops	evp.starp.bnl.gov (130.199.60.32)	FST Expert; need to look into event pool	APPROVED	2022-05-10 20:14:57	never	*** no extension ***	<input type="checkbox"/>
evpops	rs002.starp.bnl.gov (130.199.61.167)	FST Expert	APPROVED	2022-05-10 20:16:25	never	*** no extension ***	<input type="checkbox"/>
sysuser	alh.starp.bnl.gov (130.199.60.2)	FST Expert; alarm testing	APPROVED	2022-05-10 20:19:53	never	*** no extension ***	<input type="checkbox"/>
sysuser	fstesting2.starp.bnl.gov (130.199.61.18)	FST expert	APPROVED	2022-06-07 10:52:56	never	*** no extension ***	<input type="checkbox"/>
sysuser	sc5.starp.bnl.gov (130.199.60.78)		APPROVED	2022-05-10 20:09:18	never	*** no extension ***	<input type="checkbox"/>
sysuser	softoc4.starp.bnl.gov (130.199.60.51)		APPROVED	2022-05-10 20:10:02	never	*** no extension ***	<input type="checkbox"/>
zyzhang	onlcs.starp.bnl.gov (130.199.60.57)		APPROVED	2022-05-11 09:23:00	never	*** no extension ***	<input type="checkbox"/>
ACCOUNT	HOST	REASON	STATUS	APPLICATION DATE	EXPIRATION TS	REQUEST EXTENSION	REMOVE

b) The first access in a) includes access to onl[NN].starp.bnl.gov, NN = 01, 02, ... 10. Make sure you can login to onl[NN] through stargw

c) In onl[NN], copy the following directory to your own directory: /star/u/zyzhang/public/vsRunIdx
Everything is already compiled.

d) Download the following directory to your PC from onl[NN]:
/star/u/zyzhang/public/ana_vsRunIdx

6. Procedure

a) Run selection (For the beginning of a year's run, let the FST take 2-3 days data with beam on with previous settings to gain enough data)

i) Go to <https://online.star.bnl.gov/> Online QA Histograms → Calendar (at top middle)

ii) The information to decide the list of runs that we need to go over is all included in the table

Year Summary	Run List	Mon Jul 03, 2023 Info
Select configuration type: production	run	Configuration
Select Configuration file: any	24184025 (Details)(Run Log)(Shift Histograms)	CosmicLocalClock_FieldOn
production_AuAu_2023	24184024 (Details)(Run Log)(Shift Histograms)	CosmicLocalClock_FieldOn
production_AuAu_HellField_20	24184023 (Details)(Run Log)(Shift Histograms)	pedAsPhys_tcd_only
production_AuAu_500A_2023	24184022 (Details)(Run Log)(Shift Histograms)	fcs_led_tcd_only
	24184021 (Details)(Run Log)(Shift Histograms)	prom_check
	24184020 (Details)(Run Log)(Shift Histograms)	pedestal_tcd_only
	24184019 (Details)(Run Log)(Shift Histograms)	pedestal_rhiccok_clean
	24184018 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184017 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184016 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184015 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184014 (Details)(Run Log)(Shift Histograms)	pedAsPhys_tcd_only
	24184013 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184012 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184011 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184010 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184009 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184008 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184007 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184006 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184005 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184004 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184003 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184002 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023
	24184001 (Details)(Run Log)(Shift Histograms)	production_AuAu_2023

iii) The expert needs to manually filter the runs: configuration - production runs only; duration – more than 10 min; covering 2-3 continuous days in total (include entire fills from start of the fill till a long down time; down time due to either scheduled beam dump or unexpected lost of beam). The expert will find his own way to get this run list efficiently.

vi) Save this **Production RunID** list in vsRunIdx/prodRun.list on onl[NN], each RunId in a single line.

b) Loop over runs, submit condor jobs to process daq file directories and obtain the fractions and save it in root files, utilizing the online monitoring plots generator. The working directory will be under ./vsRunIdx you copied from zyzhang

i) Download the related pedestal text files from daqman.starp.bnl.gov to ./fst/bk/ :

/net/fst0[n]/RTScache/fst_s[n]_pedestals_[RunID]_GOOD.txt

n = 1, 2, n = 1 and n = 2 come in pairs; RunID = YYDDNNNN

Example of pedestal files: /net/fst01/RTScache/fst_s1_pedestals_23041044_GOOD.txt

Note: partial screenshot of `ls /net/fst01/RTScache/`

```
fst_sl_pedestals_24172041_GOOD.txt    fst_sl_pedestals_cmn_23164001_GOOD.txt
fst_sl_pedestals_24172042_GOOD.txt    fst_sl_pedestals_cmn_23164002_GOOD.txt
fst_sl_pedestals_24173048_BAD.txt      fst_sl_pedestals_cmn_23361006_GOOD.txt
fst_sl_pedestals_24173049_GOOD.txt    fst_sl_pedestals_cmn_23361007_GOOD.txt
fst_sl_pedestals_24174038_GOOD.txt    fst_sl_pedestals_cmn_24015001_GOOD.txt
fst_sl_pedestals_24175031_GOOD.txt    fst_sl_pedestals_cmn_24015002_GOOD.txt
```

“BAD” ones are not ever used; files with “cmn” and without “cmn” come in pairs. For our purpose, we only **need those without** “cmn”. A production run uses the latest “GOOD” pedestal file, ie. the “GOOD” txt file with the greatest RunID but smaller than the subject production run. This is how one decides which ones of the text files need to be downloaded to onl[NN]:\${path}/vsRunIdx/fst/bk
It is recommended to only download needed files. **In case you want a no brainer**, just use wildcards /net/fst0[n]/RTScache/fst_s[n]_pedestals_24*_GOOD.txt, n = 1, 2.

ii) Run the script run.sh. This will submit condor jobs to process daq files. There will be 2 categories of output: the ROOT files saved under output/ROOT/ and the header file prodRunId.h saved under ./

Download the ROOT files to ana_vsRunIdx/RootFiles/ and the prodRunId.h to ana_vsRunIdx/ on your PC

c) Analyze the histograms: this is conducted under ana_vsRunIdx on your PC. Run the script getLATAdj.sh. There are 2 categories of output: a text file APV_list.txt under ana_vsRunIdx and ./plots/3tb.pdf

The following is an example screenshot of APV_list.txt

```
-----
| Welcome to ROOT 6.26/10                                https://root.cern |
| (c) 1995-2021, The ROOT Team; conception: R. Brun, F. Rademakers |
| Built for linuxx8664gcc on Nov 16 2022, 10:42:54 |
| From tags/v6-26-10@v6-26-10 |
| With c++ (GCC) 11.2.1 20210728 (Red Hat 11.2.1-1) |
| Try '.help', '.demo', '.license', '.credits', '.quit'/'.' |
|-----|

Processing GetFracVsRunIdx_3tb_simple.C...
RDO1_ARM1_GROUP1_APV0 Bin 0 significantly higher than Bin 1: 0.495302-0.005137 > 0.476031+0.005131
RDO2_ARM1_GROUP0_APV4 Bin 0 significantly higher than Bin 1: 0.495521-0.007959 > 0.467996+0.007943
RDO3_ARM1_GROUP1_APV2 Bin 0 significantly higher than Bin 1: 0.499284-0.004900 > 0.471938+0.004892
RDO3_ARM1_GROUP1_APV3 Bin 0 significantly higher than Bin 1: 0.506944-0.004881 > 0.464043+0.004868
```

The plots/3tb.pdf is for reference and observation

d) Make List 1. List 1 includes all the APVs in the APV_list.txt above. The list should include key information: APV identification, max time bin number, important fractions and uncertainty, original and (to-be) adjusted LAT.

The RDO configuration file is daqman.starp.bnl.gov:/RTS/conf/fst/fst_rdo_conf.txt in which LAT is defined. You will need to check this file in order to complete the List 1. Write List 1 in the operation log on Drupal. **Make a copy of the RDO configuration file before any changes to it.** Then adjust the latency based on APV_list.txt (or effectively List 1) (Note: increase LAT by 1 will move the distribution towards right by approximately 1 time bin while hold the x Axis)

Please see the example operation log here: <https://drupal.star.bnl.gov/STAR/blog/zyzhang/FST-Operation-Log-May-10-July-4-2023>, July 2nd entry. Attach and provide a link to 3tb.pdf for reference.

Note: The RDO configuration file is read-in when the run initiated by the Shift Leader, therefore changes during the run will not be effective until a new run starts.

Note: The RDO configuration file is read-in line after another. Later settings will overwrite the previous lines.

Note: **For our purpose, we only modify LAT.** The “default” LAT is 89 for all APVs.

Under “SPECIFIC SETTINGS FOR CERTAIN” “section” we define specific settings for certain APVs. Please also **read Gerard’s notes at top and my notes right under “SPECIFIC SETTINGS FOR CERTAIN”**

Note: remember to make a copy of plots/3tb.pdf and APV_list.txt as well!

e) Take data with new LAT for a day (entire fills), then:

i) Repeat what is done to the old data, but using the new data as input – to recap, manually get the run list, transfer pedestal text files from daq to onl[NN], clear the vsRunIdx/output/ , run submit.sh, wait for the condor jobs to finish, download the resulting ROOT files and the prodRunId.h to your PC, run getLATAdj.sh, and you will get the raw version of List 2 in APV_list.txt . Make List 2, but List 2 won’t need the “original LAT and (to-be) adjusted LAT” columns. See example in the same operation log, July 3rd entry.

ii) Compare items in List 1 and List 2. If an RDO:

Exists both in List 1 and List 2: check averages and decide which setting is better. Revert if needed.

Exists only in List 1, this means the adjustment is indeed an improvement

Exists only in List 2, these are just ones crossed the threshold of being identified as “problematic” in the past run, or simply fluctuation. Because the LAT drift is very slow and these are newly developed, we can leave them for now and reference from the List 2 when the next bi-weekly FST Latency Monitoring comes.