AD / Instrumentation Status Mtg.
November 20, 2018

We discussed the status of the many projects that we are working on.

The text below can be expanded or collapsed at the date headings.

## Linac Toroid Firmware Update and Maintenance

### Oct. 30, 2018

Dallas reported that the Linac Toroid system had two digitizer channels, 4 and 8, that were not reading back.

### Nov. 6, 2018

Aisha and Dallas will be installing a new digitizer for the Linac Toroids. There is an issue with the timing when they shorten the number of Booster turns being delivered by the Linac. The problem needs to be reasoned through.

### Nov. 20, 2018

There is a FPGA timing issue with two of the channels on the digitizer boards. In order to provide enough digitizer channels that do not have this issue, a second digitizer was added to the crate. Alexey has given Aisha another version of the FPGA code. This new code is more streamlined than the current code in these boards. Aisha has been running some Matlab simulations on the code for different modes of operation. Mike Kucera is looking at doing some calculations in the Front End processor that are being done now in the FPGA.

### Dec. 4, 2018

All the above problems have been addressed.

Going back to the original effort to upgrade the firmware. There was a first pass on this new firmware and Aisha has provided Alexey with some additional comments on the software and some more modifications.

### Notes from Dec. 14, 2018 email.

1. Back in November there was a timing issue with two of the

digitizer channels at a certain location.

Which Linac devices or location were these channels for?

Are these working the way they should now?

It was reported that L:D7TOR grew “nosier” when the Linac was switching in between modes. After further investigation, Mike Kucera and I suspected there is a setup/hold violation in the FPGA realization of these last 2 channels. The registers were not latching any stable values, although external timing as well as  the beam signal’s amplitude and noise were consistent between the good and bad channels. We confirmed our suspicions by moving the L:D7TOR to the first ADC.  Mike and I regularly fast time plotted L:D7TOR and didn’t see the issue return. This is the only location in which we use almost all the ADC channels; usually only 1 or 2 channels are used. Ultimately, we split the High Energy Toroids across 2 digitizer cards. L:D0-3TOR on one;  L:D4TOR, L:D5TOR, and L:D7TOR on another. In addition, we moved L:D7TOR to ADC1 of the second digitizer. Since then, I have been periodically checking the datalogger and have not seen the issue on any of the High Energy Linac Toroids (L:D0-7TOR).

1. This month there was an issue (at tank 4 ?) where a beam

present gate was failing intermittently.

Did this get resolve or are you waiting for new FPGA code?

The issue at L:TO4IN is definitely related the edge detector. When the beam present signal fails,

* there are drop outs in the current readout while the intensity is holding constant
* also the scope confirms the beam present signal is absent while there is a no timing and amplitude change in the beam pulse
* as a result of missing the beam present signal, the feedback signal to the LLRF is overdriven and there are sharp increases in the downstream losses as the system tries falsely to correct for missed beam

I have found a few problems at the location, which were quickly corrected. However, none of them improved upon the beam present issues. I have been reviewing/simulating  the edge detector code as well as the schematic for that output, but I have not found any issues yet.

1. I remember hearing that you were close to having a consistent

installation of Firmware in all the toroid systems.

Do I have this right ?

All toroids reading back thru VME systems, with the exception of PXIE and IOTA, are running the same standardized system typology and firmware.

1. Alexey is writing new FPGA code.

Are these modification Linac specific or will they be more general ?

The current implementation only results in intensity measurements. The modifications are to add the current and/or pulse width measurement and the beam present output.  Although these are driven by the present Linac system, the new FPGA code is meant to be a version that can be used as part of the standard system, not location specific. These modifications will also be used at PXIE/PIPIIT

1. Where can I go and look at the Toroid firmware we are using and

intend to use ?

I believe you are referring to documentation with this question… I’ve a collection of documents for toroid systems at [\\beamssrv1\inst.bd\Public\TOROID](file:///%5C%5Cbeamssrv1%5Cinst.bd%5CPublic%5CTOROID) . In addition, Ning has a collection of firmware documentation explained at Y:\Public\NLiu\01\_Information\_on\_the\_other\_folders

### Dec. 18, 2018

Dallas will be working with Mike Kucera on replacing a digitizer for L:TO4IN. They will calibrate this toroid afterwards.

Also Alexey reported that he was working on the changes Aisha asked for and expects to be done in a couple of days.

## NUMI Toroid Calibration / Re-scaling

### Oct. 30, 2018

Dallas reported that we are still waiting for access to make the modifications that extend the high end of the measurement range of the E:TOR101 and E:TORTGT devices.

Michelle A Ibrahim

Tue 10/23, 12:33 PM

Back in 2012, the integrators for the mi/rr abort and ring toroids were modified to a full-scale of 6E13; however, somehow the numi toroids were missed.

We found a couple spares this morning and can have them ready in a week. We would probably need at a least 4hrs (though 6-8hrs would be preferred) of no beam to swap the modules and do a calibration. E:TOR101 is instrumented in MI60N and E:TORTGT is at U65.  I will put a worklist entry today, but the job could be put off until we reach higher intensity.

In addition, I would strongly urge moving the NUMI toroid to the newer VME system, which all of MI/RR and MB are using. If desired (and space permitting), we can also run the VME system in parallel with the old MADC readouts.

Philip Schlabach

Tue 10/30, 1:30 PM

For now, I have configured the ~~target profile monitor~~ (E:TORTGT?) for the NUMI beam
permit protection in place of the 101 toroid. It allows a limit of
54e12. We only need one or the other for protection and there is no
reason to prefer one over the other. Phil

### Nov. 6, 2018

This calibration of the NUMI toroids is expected to be done tomorrow, Wednesday, Nov. 7th.

### Nov. 20, 2018

All NUMI toroids were calibrated during the shutdowns over the last two weeks. Calibrations were made and double checked.

## PIP2IT ACCT and DCCT New Installation.

### Oct. 30, 2018

Dallas reported that they are waiting for some cable pulls. I believe ACCT and or DCCT devices are being purchased(?).

### Nov. 6, 2018

No change

### Nov. 20, 2018

The ACCT has been purchased and the order for the DCCT is now in purchasing.

Had a visit from Bergoz to talk about CWCTs. Several people thought that this device would be useful, especially for the Muon slow spill extraction. Further consideration should be given, and someone will need to find it sufficiently impelling to put out the money for this. Brian Fellenz is going to see if Bergoz would be willing to lends us one of these devices for testing and evaluating.

## FAST IOTA DCCT Calibration

### Nov. 20, 2018

This calibration work has gone on several times. The toroid was picking up a lot of 720Hz noise, even after remounting the toroid and cleaning up the grounding. Power supplies for the machine were fixed and the noise went away, but something was done with the cavity and now the noise is back. This issues is being pursued.

## MI / RR DCCT Update Obsolete Chassis.

### Oct. 30, 2018

This job is in progress. The requisition for PCBs for the transition modules has just gone out.

### Nov. 6, 2018

Work in progress. Actually, ICs on the transition modules are obsolete so a replacement is being fabricated.

### Nov. 20, 2018

New PCBs have arrived, and they are waiting on a few more parts.

## Delivery Ring RFKO Slow Extraction

### Oct. 30, 2018

There was recently a Construction Readiness Review. The reviewers asked about the fiber optic cable that will be used for transmitting data. This cable will be run through beam enclosures and will be subjected to radiation. Peter said that they expect to use a rad-hard multimode fiber. Some have suggested using a cable used by CERN. They will be deciding on the cable soon.

### Nov. 6, 2018

No change

### Nov. 20, 2018

Approval from the Construction Readiness Review has come, and Peter and Aisha are able to spend some money now. The project allocation for the Front-End programmers’ time is being reviewed and will need to be increased to 1.5 FTE. Vladimir is trying to work this in, but the budget manager is not directly approving this. They are expecting that John Diamond and Kevin Martin will be working on this, but not in FY19.

The first efforts on this system will involve learning to use the Xilinx tools with the new hardware and working out the method of communication between the various parts of the system. There may be some need for John’s time 6 months from now.

Some of the collaborators for the project do not want us to use the old Tevatron QPM nodes. However, no one is currently willing to put up the money for something else.

## Muon Toroid Upgrade

### Oct. 30, 2018

Dallas and Aisha may be meeting with Muon to discuss this upgrade soon.

### Nov. 6, 2018

Dallas and Aisha met with Dave Peterson to discuss upgrading the older toroid electronics in Muon. Aisha reported that our green integrator modules are much like these old electronics they want to replace. Once funding is available, they can start installing the newer electronics.

### Nov. 20, 2018

Aisha had provided Jerry Annala an updated cost estimate for the equipment and electronics need to build an upgraded system. Nothing has proceeded from this point.

The trigger for TORF16 had been removed so that Bobby Santucci could work on the Front-End associated with this toroid. Aisha has reconnected everything and recalibrated the toroid.

## 125 MHz Digitizer Firmware Upgrade

### Nov. 20, 2018

Alexey says that we will need to make a plan to update all of the 125 MHz digitizers in the field with the latest firmware. We should consider developing the ability to remotely update the firmware in these modules.

## PIP2IT BPM Electronics Upgrade

### Oct. 30, 2018

John Van Bogaert reported that the PIP2IT BPM system is expected to inherit transition boards from FAST and FAST will be making new ones. They are currently procuring 5 prototype transition boards.

Parts are being bought for 35 new 250MHz digitizers using a combination of Booster and PIP-II money. John also warned that distributors have long lead-times on many discrete components like capacitors. If you are needing these components for a project you should check the lead-times early.

### Nov. 6, 2018

No change

### Nov. 20, 2018

PCBs for these 35 digitizers have been received and we are waiting on a few of the components before sending these boards out to be assembled. Alexey has test stands for testing these boards when they are received from the assembler. These are the 250Mhz, 16 bit, 8 channel, Arria FPGAs type digitizers. These were bought using a mix of PIP2IT and Booster money. The PCBs were fabricated by San Francisco Circuits. John mentioned that we need to be careful about the materials that we make our PCBs with. These materials, like FR-408, need to be rated for the temperatures experienced in the assembly processes, the temperature profiles for the parts going on the board.

### Dec. 18, 2018

John Van Bogaert reported that they are waiting on PIP2IT money to send out the digitizers for assembly. All of the parts are now in.

There are five prototype transition boards and 10 existing boards from PIP2IT are moving over to FAST/IOTA. The boards that are taken from PIP2IT need to be replaced by someone other than PIP2IT since they will not pay for these boards again (Vic). John Van Bogaert mentioned that there are FAST transition boards that they expect to make that can go back to PIP2IT. Vic mentioned that if new boards are being made that will go back into PIP2IT that there may be some modifications that can be made. There were details that Vic and John and Brian and Nathan will be considering.

## Future PIP-II Instrumentation System Specification

### Dec. 18, 2018

The question as to what the final digitizer / FE processor / data link configuration is going to be, was brought up. The current VME backplane data transfer is not expected to be the future system. Nathan offered that the ethernet connection on each digitizer could be used through a switch. This is something that could be tested. John Diamond said that we could also consider a direct PCIe connection to the processor card through a daughter board, like what is proposed for the delivery ring extraction.

Nathan said that he would like to demonstrate the ethernet to switch to processor topology in either Booster or IOTA in the near future.

Craig proposed that we start having meetings starting in mid-January. There was general agreement to this.

## PIP2IT BPM Linux Upgrade

### Oct. 30, 2018

We will need to procure more processors. This is waiting on PIP-II money. To develop the code, they will need specifications regarding the firmware on the digitizers and soon after some digitizers running the firmware to develop/test the new code.

### Nov. 6, 2018

No change

### Dec. 18, 2018

New processors is still waiting on PIP-II money. Vic mentioned that the PIP2IT schedule has them running beam in April 2020. We need to have things put together by then.

## IOTA BPM Operation

### Oct. 30, 2018

Brian Fellenz reported that they will need new transition boards next year when they expect to switch from accelerating electrons to accelerating protons. This will be a new transition board circuit for which they do not have all the information for yet. We should discuss with Jerry Leibfritz whether they have money in their project for these.

### Nov. 6, 2018

Nathan reported that IOTA was previously only measuring the injected beam, but now need beam position measurements for the orbit and kicked beam. He estimated a week of work to start getting these measurements. They currently have new firmware and they need to get the new FE software to go with this.

### Nov. 20, 2018

There have been some Firmware updates. Alexey mentioned that they are working to keep the digitizer sampling in sync with the beam, but there have been changes to the RF that forced them to go back into the FPGA code. It was previously expected that the RF would be at a fixed frequency.

### Below is a note from Nathan just before Thanksgiving week.

Hello,

The new firmware for digitizers and timing board has been installed in IOTA. The new system allows injection tbt, stored beam tbt via kick (trigger not hooked up yet), and stored beam orbit tbt. The stored beam measurements rely on the injection measurement for timing and to calculate baseline for each adc channel for background subtraction. For the background subtraction to work properly, the ring needs to be empty on injection – ie, inject with no beam to clear ring, then inject with beam. Preliminary software was also installed today which collects the injection data on the $A6 nml clk event and reports the data back to ACNET. The plan –

- Fix some issues found with current readout (John working on)

- Implement scheme to request stored beam tbt (orbit tbt) via the system state device (John and Chip can set this up)

- Implement the stored beam kick measurements after Thanksgiving

The data for each measurement is readback via array devices for each bpm as before

- N:IBxxxH[0:2095] horizontal position

- N:IBxxxV[0:2095] vertical position

- N:IBxxxS[0:2095] intensity

Where 0 is a placeholder for the future and element 1 is the first turn, etc. The devices should update after each measurement.

I didn’t get a chance to adjust the analog input attenuators. To improve S/N on stored beam these can be set to 0. Brian Fellenz can set this for the A2R-A2L bpms on request. Note, the A1C bpm is a special case and can be set via the nmlbp3 front-end using the board 2 address.

I will be reachable via text or email if trouble shooting is needed. The local experts –

System Infrastructure (pickups, cables, etc) – John Van Bogaert

Analog Modules – Brian Fellenz

Digitizers – Alexey Semenov

Front-end and ACNET – John Diamond

Backdoor diagnostics – Duane Voy

Regards,

n

### Dec. 18, 2018

There has been some success with improving the signal to noise on the IOTA BPMs by adding a pre-amplifier. At this time there are 6 BPMs with pre-amplifiers. With these they were able to collect TBT data and measure a tune for the first time.

There was also a non-linearity found in the log intensity measurement being made on the BPM transition board. They are considering, possibly, linearizing each module with a look up table. The solution is still under consideration. The linearity issue had not shown up in the original bench testing, but the changing beam intensity uncovered the response.

### Procurement Issue Raised by Jerry Leibfritz

**From:** Jerry R Leibfritz <leibfritz@fnal.gov>
**Sent:** Wednesday, December 19, 2018 2:49 PM
**To:** Craig C Drennan <cdrennan@fnal.gov>; Alexander A Valishev <valishev@fnal.gov>
**Cc:** Jerry R Leibfritz <leibfritz@fnal.gov>
**Subject:** Fwd: Purchase Requisition is ready for FAST BPM's - for additional channels.

Hi Sasha and Craig,

I just received a couple req’s from Bogie for FAST BPM’s ($2.6k & $2k).  Year to date we have spent ~ $16k on BPM hardware for FAST and these will bring that total to ~ $20k.  With the potential scope changes at FAST/IOTA due to budget issues, I wanted to make sure that everyone was on the same page as to what the plan is for BPM’s this year.  I personally am not sure what the current plan is, so that is why I am sending this email.  I will hold off on approving these until I receive further guidance.

Thanks,

- Jerry

## Booster BPM Upgrade

### Oct. 30, 2018

Many things have been fixed. There is currently a data collection problem where data collection will fail between 1 minute to 30 minutes after starting. Peter mentioned an issue related to when they give an enable to acquire the data.

Peter believes the problems with the Timing Cards have been solved.

The port of the Linux Front-End to the 8100s is completed and John Diamond is happy with the way it has been working. All the BPM houses in booster are using the 8100s now. They have reclaimed all the x86 nodes.

### Nov. 6, 2018

Peter reported that the previous data collection failures have been cleared up. Now they are troubleshooting an issue with differences between when sets of data from different houses are collected and/or time stamped. The are seeing 2ms differences between houses on event $1D Booster cycles and as much as 100ms on event $13 Booster cycles. John Diamond is spending time on this.

### Nov. 20, 2018

Peter has been working to design the perfect TClk decoder for his timing module, but things work upstairs but not in the Booster Gallery. He has requested some hands on help from Greg Vogel in AD/Controls.

### Dec 18, 2018

Booster BPM front-end processing has an issue where a process is getting into a loop taking to much time. John Diamond is currently working on this. Otherwise the system is taking data and we are now looking into calibrations of the individual BPM measurements.

## PIP2IT RF Interlocks (HWR / SSR1)

### Oct. 30, 2018

Jim Galloway has been procuring parts and preparing to build one of the boards for the HWR interlocks. This is a lowpass filter on the forward/reflected power measurement (?). They are currently not working on the FPGA board. The RF interlocks for the HWR need to be ready to test in January 2019. The SSR1 RF interlock system still needs a budget and we are not cleared to purchase parts for this system.

### Nov. 6, 2018

In progress.

### Nov. 20, 2018

Jim Galloway is continuing to build and test boards for the interlocks. John Seraphin has been designing and has ordered top feedthrough panels for the electronics racks.

Peter also made a request for some of Yesenia’s time for assembly of RF interlock boards.

The current schedule for RF testing where the RF interlocks need to be in place is April 1, 2019 for the HWR testing and January-February 2020 for the SSR1.

### Dec. 18, 2018

The PO’s for the SSR1 are being made. We are waiting for PIP2IT money to by the PCBs and assembly for the HWR interlocks. HWR interlocks are expected to be in place by April 1, 2019.

Peter is redesigning the Quench Protection Circuits. Peter did some tests with Elvin, quenching the LCLS system. He could see the signals so that he understood the signals he needs to design inputs for. Brian Fellenz will be re-laying out some input channels for Peter.

## Mu2e Delivery Ring BPM Upgrade

### Oct. 30, 2018

Mu2e needs to come up with money and help provide a specification of the new system. Niral reported that the current system is only able to record up to 7 turns of beam. Duane Voy has looked at the code and felt that they may be able to get up to 15 turns, but no more.

### Nov. 6, 2018

No change

### Nov. 20, 2018

Niral mentioned that they finally have been going around the delivery ring without losing its structure and they will now start looking more closely at the BPMs. Last week they had found BPM channels not working. There were 3 bad ones in the transfer line. Two of these were due to cable/connector issues that Yesenia helped fix. Then they had to change out some electronics in the delivery ring. There was also a bad power supply capacitor on a backplane.

Craig asked about how digitizer channels typically fail. Alexey said that it is often a broken connector or a component on the backside of the board that was damaged while inserting or removing the boards.

Q: Delivery Ring BPM system remote reboot? DBPM50 (Duane)

### Dec. 4, 2018

Niral is planning to setup test stands for developing this Mu2e BPM upgrade.

## Current Delivery Ring BPM FE Code

### Oct. 30, 2018

Waiting. Peter mentioned that we were going to try to write code to build a closed orbit with the system we have now.

### Nov. 6, 2018

No change

### Nov. 20, 2018

No change.

### Dec. 4, 2018

Niral reported that they had met with the machine folks last Friday. There was a request to be able to provide an on demand orbit snapshot measurement. Duane has been working on this.

### Dec. 18, 2018

Currently we are unable to get the enough of the UCD PMC timing boards we need for the Delivery Ring BPM systems. The machine physicists are requesting more orbits be measured. Craig McClure is currently redesigning his TCLK decoder. There is a concern that he will be leaving town next week.

## VxWorks 5.5 to 6.4 Conversion

### Oct. 30, 2018

Bobby Santucci has joined us and has started on this effort. He has begun inventorying the nodes that need the conversion. He has identified 100+ front-ends.

### Nov. 6, 2018

In progress

### Nov. 20, 2018

Bobby has been setting up crates to prepare for testing three types of systems. He has code compiled for these three different systems that is ready for testing. The three systems are Recycler BPMs, MI Beam and MI BPMs. He has the test stand mostly setup and is waiting to cable in timing signals.

### Dec. 4, 2018

The work is progressing. There are Kernel issues. Bobby is putting together a list of the things that need to be addressed. He is hoping to develop a general purpose Kernel (MVME 5500). These things are being discussed with Dennis Niklaus. There are issues with the licensing and the platforms we are using VxWorks on. Mike Slizniak is working on these things for some time. One issue is that Recycler and Main Injector BPM systems use a kernel written by the Computing Division separate from the AD/Controls department. As a result, there are issues trying to use the 6.4 5500 kernal from the Controls department for these BPM systems.

Currently, the only programmer in the Controls department is Mike Slizniak. We are trying to raise the level of attention for this kernel work.

### Dec. 18, 2018

The list of things to address with the MI/RR BPM 5500 kernel is getting longer. Bobby is find some work arounds to move forward until a new kernel is available.

## PIP2IT Wire Scanner Negative-Bias Circuit and PIP2IT Intensity Monitors (Scrapers, Ring Pickups, Faraday Cup, etc.) 50 Ohm Modifications

### Oct. 30, 2018

Andrea is working on this currently and needs to complete this project by January 2019.

### Nov. 6, 2018

In progress.

### Nov. 20, 2018

Andrea has designed a negative biased version of the transimpedance amplifier circuit. She is getting close to sending out for the new PCB.

Additionally, there is absorber instrumentation to be put together, as well as updates to the Machine Protection System.

### Dec. 4, 2018

Andrea has recently made changes to the schematic and board layout. She is ordering the new PCBs and will soon be ordering the parts for the boards and then the parts for the chassis.

### Dec. 18, 2018

Parts have been ordered, boards are on order. There was some difficulty ordering the parts from Newark, through eMarketPlace. Andrea is currently working with Mechanical for the chassis layout. Vic pointed out that the run schedule for PIP2IT had changed from running in Jan. 2019 to April 2020. Andrea said she wants to push ahead and get this project completed.

## PIP2IT Schedule

### Nov. 20, 2018

### >>> New Project Schedule

**From:** Fernanda G Garcia <fgarcia@fnal.gov>
**Sent:** Saturday, November 17, 2018 1:49 PM
**Subject:** PIP2IT program - New end date \*\*OCT'20\*\* to support HB650 protoCM test

Hi all,

After a careful and extensive discussion among Project Office members and all L2s, the plan for PIP2IT was changed yesterday.

Modifications:
1) Beam run period originally scheduled for Jan-Mar'19 was canceled
2) PIP2IT will run beam thru both HWR and SSR1 as schedule in **April'20**
3) Beam running period will be **6 mths** rather than 12 mths
4) PIP2IT program **ends late Q4FY20**

With these changes, the Resonance Control and LW, which are part of the critical technology map, will be demonstrated by end of FY20.

Based on all scenarios discussed, I am glad that we were able to secure the 25 MeV beam running demonstration at PIP2IT. We are positive that with the continue support of all of your hard work and dedication to the project, the next beam run period will be as successful as the previous one.

Cheers,
Fernanda and Paul

### Dec. 4, 2018

Nathan mention that if PIP2IT will not be running beam this year he may borrow the BPM transition modules for use in IOTA.

## High Radiation Cables and Connectors

### Nov. 20, 2018

Andrea is investigating the procurement of radiation hardened connectors that use Rexolite instead of Teflon. SHV Connectors using Rexolite have been used by the vacuum pumps and found to last longer. Andrea is currently trying to get a distributer and a quote for buying some of these connectors. There is not currently a known part number for a BNC version of the connector (true?).

Andrea is also looking into the other sorts of rad hardened connectors.

### Dec. 18, 2018

Andrea got a price from Winchester on some connectors that would be $130 each. Vic mentioned that the high radiation components would apply to the rewiring of the **PIP2IT dump**. He expects this area to be hard hit in the future. The dump will get a lot of beam and become very hot. The current dump will be reused.

## Laser Profile Monitor

### Oct. 30, 2018

Vic was not available to comment, but Todd Johnson reported that he had provided Vic some CCD sensors. They plan to have more discussions soon.

### Nov. 6, 2018

Vic reported that they are putting together pieces of the laser profiler in the A0 laser lab and doing some testing. The laser hut is together, and they are needing to do some work on the design of the interlocks. PIP2IT is not expecting beam until early 2020.

## Linac Laser Notcher

### Oct. 30, 2018

Todd reported that they had made some timing changes before they reinstalled it and that has improved the readbacks of the laser posit*ion*. Working on the new laser notcher LDRD.

Todd has received additional requests from NOVA to resurrect the old Tevatron hydro static level for their beam line. He has found some of the heads and some of the readback chassis. He is hoping to hand this all over to NOVA people. He has also received requests from Mu2e to provide temperature readbacks for their target.

### Nov. 6, 2018

Todd reported that nothing new has been done with the laser notcher this week, but it has only been running at half power since it was turned on after the shutdown. They have a crack in one of their stacker crystals. They are expecting to receive a replacement in the next week or two.

### Nov. 20, 2018

Todd Johnson reported that they have received the spare/replacement for the cracked stacker crystal. This cracked crystal has been preventing them from running the laser notcher at full power. They will need a couple hours of down time to install this. Dave Johnson is wanting to prepare a spare cavity just in case the mirrors are burned again when they go to full power. They are currently setting up a test stand at A0 to get this cavity aligned and ready to go.

### Dec. 4, 2018

Todd Johnson is waiting for an opportunity to install a new cavity with a new stacker crystal into the Laser Notcher system. The current one is cracked preventing them from running at more that half power. This is expected to be a quick change.

There are thermal effects causing movement of the laser trajectory position detectors. The opening of the roll-up doors is contributing to the temperature swings. This is not completely unmanageable since the RFQ will trip off, with the temperature change before the laser notcher.

### Dec. 18, 2018

Todd Johnson was able to access the laser notcher and replace the stacker crystal and a special mirror component whose coating had begun to peel off. An email on this is below. The laser notcher is back in service.

### From: Todd R Johnson <tjohnson@fnal.gov>

Sent: Thursday, December 13, 2018 9:58 AM

To: Craig C Drennan <cdrennan@fnal.gov>

Subject: Laser damage FYI

Hi Craig.

   I thought you'd be interested in seeing what the problem was with the notcher on Monday.  This is the first mirror after the final amp stage, but it's not the highest power density point in the system.  The coating was hanging off in shreds.

We have determined that this mirror came from a different mfr than most of the ones we use, and their damage specs are quite a bit lower than the other mirrors. This one had probably seen almost a year of service though.  One remaining problem to address is that we were sending leakage light from the back of this mirror to a photodiode and integrating sphere, and these devices seem to have suffered a bit. I guess they didn't like getting 70% of the laser power instead of 0.1%.

We'll probably open things up again on Tuesday during the maintenance period, check the other mirrors, and swap out the photodiode.

## Laser Notcher Labview

### Dec. 4, 2018

David Slimmer has been working on the Labview code for the Laser Notcher. We will eventually need to train someone else in maintaining the code, or we will need a replacement readout system.

## Laser Working Group

### Nov. 6, 2018

Vic is currently organizing a laser working group. Their first meeting may take place next week. The email list for this group currently includes Vic Scarpine, Randy Thurman-Keup, James Santucci, Todd Johnson, David Johnson and Craig Drennan.

## Laser Momentum Collimation LDRD

### Dec. 4, 2018

With regard to the new LDRD to investigate the laser momentum collimation, a requisition for some custom optics had been made, but it was found that procurement had not yet put the PO in. There is expected to be an 8 week lead time on this order. The requisition was put in 8 weeks ago. It seems that there was a typo on the part number and procurement had set it aside and not contacted Todd to correct the part number.

## Muon Schottky Tune Measurement

### Oct. 30, 2018

Brian and Vic will be trying to coordinate beam studies in the Muon beam line.

### Nov. 6, 2018

Vic is planning to give Brian Drendel and the rest of the Muon people a plan with regard to the beam requirements for doing the testing. 8GeV protons in the delivery ring are required.

### Nov. 20, 2018

Muon Schottky detector measurements are being made this week. 8 GeV beam has been established. Brian Fellenz was finally able to see a tune signal. The signal levels are extremely low. The operators would detune the ring and he was able to see the tune signal move. The detector is tuned to a specific, narrow, frequency range and they modified the RF frequency to be within this range. The tune was found at 0.85, where they were expecting it to be at 0.65. The revolution frequency is around 590kHz. They look between the 36th and 37th harmonics of the revolution frequency (~21MHz). There is an issue of the pre-amplifiers saturating. More study will be going on next week.

### Dec. 4, 2018

Brian Fellenz reported that previously they had been looking at the lower tunes and then they moved the detector resonance to capture the upper tunes. The upper tunes came up stronger. They are currently looking at the signals above 21 MHz. Last Friday, Nov. 30th, they down-converted this 21 MHz signal down to baseband (~300kHz to 400kHz). Vic Scarpine had bought a 24 bit digitizer evaluation module. Craig asked about the expectation to create a requirements document that spells out the trade off between achieving a certain signal to noise for the measurement versus how fast the measurement can be made.

### Dec. 18, 2018

Vic and Brian have the 24 bit ADC eval wired in, but they have not had a chance to test this yet. A lot of time has been taken by PIP-II meetings and other things. They have been talking to the Mu2e people to get some more study time to get some better numbers, to complete the system design. They hope to go out again this week. After g-2 experiment starts up again, study time for the Schottky measurement will be rare.

## PIP2IT New RWCM / Toroid

### Oct. 30, 2018

This wall current monitor has not been decided on yet and specification will be needed before Brian can move forward with this.

### Nov. 6, 2018

Vic reported that a new wall current monitor is going to be designed. Brian Fellenz and Aisha will be involved in the design work.

### Nov. 20, 2018

No change

### Dec. 18, 2018

Vic has money in the budget estimates for this wall current monitor, but whether they get it or not is not yet known.

## MI BLM Code Modifications & Studies

### Oct. 30, 2018

Randy will be looking to do turn-by-turn loss studies in the future.

### Nov. 6, 2018

No Change

### Nov. 20, 2018

No Change

## LBNF Hadron Monitor

### Oct. 30, 2018

Randy has been holding monthly meetings. There are no plans yet, to do prototyping or prototype testing here at Fermilab.

### Nov. 6, 2018

No Change

### Dec. 18, 2018

Randy reported that the Chinese are working on their physical mockup of the monitor strips to test for sag and deformity due to temperature changes. He has held off having meetings until they get results from this test.

## Muon Beam Loss Monitor (BLM) work.

### Nov. 20, 2018

The Muon BLM work is still proceeding. All of the cables have been run but has only been terminated with ion chambers installed where beam line elements had been installed during the shutdown or previously. We are in need of assembled and tested ion chambers. All ion chambers need to be put under high voltage for an extended amount of time and observed to see if the capacitors are going to leak. Some ion chambers need to be radiation source tested. Some ion chambers need to have their connectors repaired.

### Dec. 18, 2018

No Change

## Muon PWC and Ion Chamber work.

### Oct. 30, 2018

All the PWCs and Ion chambers have been hooked up except for PWCs 020, 021, 025 and ion Chamber 025. These are waiting for access.

### Nov. 6, 2018

Waiting for access.

### Nov. 20, 2018

Muon had some reverse polarity PWC they wanted to use and had the application software modified. They had trouble seeing displays after this and asked Dan, Rick and Gianni to source test the PWCs and wring-out their electronics. The applications developer finally found an error in their code and corrected the problem.

There is a PWC currently being assembled at NWA. Dan and Gianni are expecting to go out there today to run some corona tests on this unit. They will also be doing a source test.

There is another PWC going into Muon that has 48 wires instead of the usual 30 wires. Dan is looking into the best way to cable this up top the scanners.

ADDITIONALLY:

There has been some on-going work to keep the gas from the Fixed-Target style PWCs used by the Muon beam lines from leaking into the high vacuum of the Muon beam pipe. The PWC seals and cans were designed for use in lower vacuum applications. People are currently experimenting with different gases. They are using nitrogen purges in the secondary vacuum (the vacuum between the wire space where the gas is and the vacuum of the beam pipe.

### Dec. 18, 2018

PWCs 020, 021, 025 and ion Chamber 025 were on hold waiting for access. There is new safety training that must be taken to gain access. Brian Drendel may have gone in on his own to do some of the work. Dan and Rick and or Carl will be going out in the near future. Brian Drendel has a status update meeting on January 3rd.

## NUMI Target Alignment BLMs

### Oct. 30, 2018

Gianni reported that the target alignment BLMs will be undergoing refurbishment and testing at TSB. Katsuya, from the Target Systems Department will be developing new testing procedures to be used before the BLMs are installed for future target alignments.

### Nov. 6, 2018

Waiting for access to retrieve the BLM detectors from the target hall. Then they will do a post-mortem on these detectors.

### Nov. 20, 2018

Gianni and Dan have been working with YONEHARA, KATSUYA to develop these alignment BLMs. They have been looking into calibration of the detectors and readouts.

### Dec. 17, 2018

Dan and Gianni are working on the NUMI horn BLM testing and rebuild for Hiep Le.

## Meson Ion Chamber and Digitizer Upgrade and Meson Electronics Update. ($50k in FWP)

### Oct. 30, 2018

Craig related that Tom Kobilarcik had specified money for upgrades in the FWP budget document. Dan said that he had not heard of a need for new BLM electronics, but had gotten requests for new Ion Chambers and SEMs. All the new digitizers for these devices have already been built. These are calibrated and ready to go. Ion chambers will need to be assembled. Dan said he is just waiting for the go ahead from the M-Test / Switchyard people. When the money comes through, they can send out for the parts for the SEMs. We can get the parts in house, get the SEMS assembled and go out and install them.

### Nov. 6, 2018

No Change. Dan has not heard anything new for this.

### Dec. 17, 2018

Dan is preparing for the replacement of the fixed target ion chambers and current digitizers. Dan has components ready to be assembled. Tom Kobilarcik or the machine people have not provided details on what should be upgraded first.

## BNB Expand Target Cooling Instr. Rack

### Oct. 30, 2018

This is a long term item that is waiting. This will probably not be done this year.

### Nov. 6, 2018

No Change

### Dec. 18, 2018

Dan will be working on the BNB target cooling documentation soon.

## BNB Horn 5 Multiwire (money?)

### Oct. 30, 2018

This is waiting. Tom Kobilarcik has mentioned that he would like to change the design of the multiwire but has not come back with how he wants it.

### Nov. 6, 2018

No Change

## MI-8 (BNB) Horn 4 Target Multiwire (cable termination)

### Oct. 30, 2018

Dan reported that they want to replace the 10 foot ribbon cable connection with discrete wires. Dan has gotten cost estimates for this. Chris Kelly was contacted for approval and will give Dan the cost code to go ahead and order the wire.

### Nov. 6, 2018

No Change

### Dec. 18, 2018

Dan expects to begin working on this project in the near future. Tom Kobilarcik wants to replace the ribbon cables on the multiwire with individual wires. This will require pulling and terminating 100 little wires and terminating them on both ends with 50 pin DSUB connectors. This will probably require electricians. Horn 4 is a spare for Horn 3 and needs to be ready when Horn 3 fails or otherwise reaches its end of life. Horn 3 is fairly new and might work for a couple more years, but we need to be ready.

## Ming-Jen Secondary Emission Sweeping Field Test

### Dec. 18, 2018

Ming-Jen has asked Dan and Gianni to apply a high voltage to one of the planes in one of the new 8GeV multiwires. Dan made up some adapters and has applied a bias voltage to the vertical wires (disconnected from the scanner). Ming-Jen will readout the horizontal wires to see the effect of the bias voltage. This particular multiwire is acting differently from the others, so they are looking to see if there is a secondary emission problem.

## SeaQuest Experiment SWIC and Ion Chamber Installation

### Dec. 18, 2018

Dan has this job on his list.

## UTA Multiwires (4 each)

### Oct. 30, 2018

Dan reported that there are 6 University of Texas multiwires that can be refurbished. These may cost $2k each to refurbish, plus the cost of new motors.

### Nov. 6, 2018

No Change

## Ion Profile Monitors, IPMs

### Nov. 6, 2018

Greg Saewert is currently working on a high voltage switch for the control grid of the IPM’s. Alex Lumpkin visited Argonne last week to talk with the folks who are doing the refurbishment, recoating of the micro-channel plates (MCPs). Alex reported that Argonne has an atomic layer deposition system with which they can recoat MCPs, up to 8 inch squares. He also found out that HEP Detector Development Group at Argonne has an MCP detector lab.

### Note on MCPs from Alex Lumpkin

Hi Randy and Carl,

  I visited ANL last week and in the course of a tour of their MCP lab with Junqi Xie (HEP), we discussed their microchannel plate (MCP) characterization options and also atomic layer deposition (ALD) done by Anil Mane (Energy Syst.). It is proposed that rejuvenating the FNAL MCPs that have too low gain with ALD techniques should work.

  Junqi asked for manufacturer (Hamamatsu or other), MCP dimensions, core or channel diameter, and thickness of plate. He has a MCP gain test setup for items up to 33 mm diam (?), but may be able to adjust to the larger FNAL samples. I resisted Junqi's initial comment to cut the MCP to size  for gain testing, but Randy has indicated a sacrificial test sample may be discussed.

  In a telecon with Anil on Monday, he noted he can coat up to 8" square MCPs in his system with either Aluminum oxide (low gain, 10^5) or Magnesium oxide (high gain, 10^6). The MCPs need to have some proper high resistance and not be shorted. In this case in another run, he could probably coat two FNAL ~3-4" size MCPs in one run.

    At the moment, it is proposed that the one test MCP sample be provided by FNAL with the gain pretest, coating, and final gain test  being done as an ANL courtesy in a collaborative effort in the next 2-3 weeks. (Junqi was to check with Bob Wagner.) If the test case is successful, FNAL would prepare a purchase order/contract to cover the ANL costs of more FNAL MCP rejuvenations. It is expected this option will be less than the purchase of new MCPs.

    Hopefully, I have presented the ANL perspective properly from my notes, and you can contact Junqi (630-252-1868) and Anil (630-252-7014) or by email for details and when to provide the MCP sample for the ALD test.

    Good luck to all,

Alex L.

### Dec. 4, 2018

Randy with help from Alexey has been looking into the operation of the IPM board that provides a gate to bias grid switch. Troy Petersen had made some firmware modifications just before he left the lab, but the boards were still not completely debugged. Alexey Semenov had a look at the firmware and fixed it.

### Dec. 18, 2018

Alexey fixed the IPM switch controller.

## FAST Linac Short Range Wake Field Study Proposal

### Dec. 4, 2018

### Note from Alex Lumpkin

Hi Sasha, Dan, and Giulio,

 I attach a draft studies proposal on the topics of TESLA Cavity short range wakefield effects within a micro-pulse  (y-t) and an assessment of E-t longitudinal phase space in the linac beam. Both experiments rely on the X121 synchroscan streak camera viewing OTR from the X121 screen and the X124 screen (with the new optical transport), respectively. We indicate we may need adjustments of Q118-120 to match to X121 or X124, higher charges, and 1-50 b. I included some of the calculated cavity transverse wakefield kick angles within a micro-pulse  from V. Lebedev.

  Please advise if other information is needed. We propose to start with three shifts on each topic.

Thank you,

Alex Lumpkin

## Switchyard Resonant BPM Repairs

### Nov. 6, 2018

Niral reported that he and John Seraphin will be working to repair a noisy resonant BPM, HP100. He will be getting this job on the worklist and will be waiting for an access.

### Nov. 20, 2018

The noise problem did not change after the BPM cable connections were repaired. It was found that there was a problem with two of the digitizer channels on the 125MHz digitizer they use in the application. The BPM signals were moved to two other channels on the same board and the Front-End and ACNET devices were modified to readout this BPM.

**Niral is now programming a spare digitizer to swap the bad digitizer out. This is at location TG9.**

### Dec. 18, 2018

Kyle Hazelwood and Adam Watts has been pushing to get the instrumentation in the Switchyard working so that the beam line auto-tune program would work. Elliott McCrory has made some progress on this BPM Front-End. Elliott is still working on this. The firmware in the digitizers were first done by Ning Liu and then handed off to Troy Petersen. It is believed that there may be an overflow in the FIR filter in the firmware. The problem shows up as what seems like good position data but is not actually tracking beam. We have not started digging into the firmware, yet.

## Switchyard BLM Pedestal Issues

### Nov. 20, 2018

A couple weeks ago Gordon Koizumi got help from Randy to have a new Ion Chamber installed. The previous one had a bad pedestal bias.

Randy also mentioned that he believes that there are some software things that could be done for the switchyard BLMs.

## Updating Firmware in the 125MHz Digitizers

### Nov. 20, 2018

Alexey brought up that there are many 125MHz digitizers being used in various applications and there is now a new version of the firmware that runs in these digitizers. We will try to hold a meeting to discuss the plan and manpower for loading and testing this new firmware version in all our 125MHz boards.

## Cabling up the Cryo-Modules for LCLS

### Nov. 6, 2018

John Seraphin had reported that a lot of work was being done to cable up the new cryo-modules for LCLS out at CMTF.

## Broken VME Crates

### Next Time

Q: Do we have broken VME Crates that we can fix?

## LabView Motion Control for BPM Wire Scanner

Dec. 4, 2018

The BPM wire scanner test stand is used to map the response of BPM detectors. The motion control for this test stand uses PCI cards and a LabVIEW interface. Jim Fitzgerald stated that there were driver support issues with National Instruments and that this needs to be investigated. The new PC we got to upgrade the computer for this test stand only had one PCI slot and we need more for the current setup. We will look into USB motion controllers or some other solution to carry us forward.

# **INACTIVE PROJECTS**

## Booster CHG-0 Bergoz DCCT.

### Oct. 30, 2018

Craig reported that Mary Convery told him that the AIP for this device will not be going through this year.

## Booster Damper AIP (Transverse / Longitudinal)

### Oct. 30, 2018

Craig reported that Mary Convery told him that the AIP for this device will not be going through this year.

### Nov. 20, 2018

Chandra mentioned that the AIP for these devices will be going through this year

## Current Booster Damper Operation

### Oct. 30, 2018

Nathan was not available to report on this.

### Nov. 6, 2018

Dampers are working, but Booster believes they were working better before the shutdown. The mode 2 damper has been turned off until more analysis can be made as to how the curves are setup.

### Nov. 20, 2018

No change.

## Recycler BPM Data Upgrade

### Oct. 30, 2018

Waiting.

## Recycler BPM Calibrations

### Oct. 30, 2018

Waiting. Could not recall what the issue here is.

## Switchyard Resonant BPM Intensity Calibration

### Oct. 30, 2018

Waiting.

## NUMI Button BPM FE Code

### Oct. 30, 2018

Waiting. There needs to be new hardware, firmware, processors and application specifications for this effort. NUMI has hopes to use these BPM in their machine protection at some point.

### Nov. 6, 2018

No change

## 8 GeV BPM FE Code Upgrade

### Oct. 30, 2018

Currently waiting on a specification and then people to work on it.

## 8 GeV BLM Log Amp Boards

### Oct. 30, 2018

Andrea will be working on this later in the year, after the PIP2IT run is completed.

## MI-62 Electron Beam Profiler

### Oct. 30, 2018

Waiting

## FAST Bunch Length System Studies

### Oct. 30, 2018

Waiting for machine approval to do the studies.

## MTA Refurbishment (2 BLMs, 9 multiwires)

### Oct. 30, 2018

Re-establishing MTA as a user’s radiation testing facility is still just a rumor as far as we know.

## Upgrade Gloor Multiwires to Gloor II (8 each)

### Oct. 30, 2018

This is not an active project but is on the back burner.

# **COMPLETED PROJECTS**

## MI-8 Multiwire Repairs (switch, cable swap)

### Oct. 30, 2018

Waiting for access.

### Nov. 6, 2018

These issues will be addressed during this week’s shutdown on Wednesday

### Nov. 20, 2018

This item was corrected.

## MI12A Dehumidifier Sensors

### Oct. 30, 2018

Dan reported that this work is now complete. Munter dehumidifiers in the upstream of MI-12

## MI-12B Target Sump Water Level

### Oct. 30, 2018

Dan reported that this has been installed.

## M-Test Fiber PWCs

### Oct. 30, 2018

Dan reported that old scintillator profile monitors in the M-Test line are being replaces with PWCs. There will be some time on Wednesday, November 7, to go down and finish the hookup of these PWCs. Dan is interfacing with Jason St. James.

### Nov. 6, 2018

These issues will be addressed during this week’s shutdown on Wednesday

### Nov. 20, 2018

Investigations and preparations for the hook-up of M-Test PWCs has been going on during the one-day shutdowns. Final hook-up is expected tomorrow.

### Nov. 21, 2018

### Project was completed.

On Wed, Nov 21, 2018 at 12:18 PM Daniel P Schoo <schoo@fnal.gov> wrote:

Gianni and I removed the experimental SPWC in the air gap just downstream of MT5FP1 and transferred the services; gas, bias, wire plane signals and motor control, back to the SPWC in the original MT5FP1 location. At the MT4FP location there used to be a Fenker Proportional Wire Chamber and all of the services were still there at that location. Gianni and I reconnected everything to the new SPWC. MT5FP2, the third FPM, is still in place but no longer in service.

Everything should be ready to go when you get beam. We set the HV bias on MT5PF1 down to 1000 volts That should be good to start.

From: Jason Michael St. John <stjohn@fnal.gov>

Sent: Saturday, November 24, 2018 11:16 AM

To: Daniel P Schoo <schoo@fnal.gov>

Subject: Re: Meson beam off Wed

Thanks again, y'all. New instruments are being called MT4FP and MT5FP1, and they read out very nicely. See the profiles they contribute in the window-grab at https://www-bd.fnal.gov/Elog/?orEntryId=144539.

When I get a chance, I might be able to tweak the HV level this coming week.

Cheers,

-jmsj

## Flying Wire Storage

### Dec. 18, 2018

Carl Lundberg has these stored out at the warehouse.

## Multiwire Work for Others

### Oct. 30, 2018

Gianni mentioned the multiwire slides (linear positioner) that Gianni and Matt Alvarez are designing for Japan

Two prototype multiwires for a university in Finland. The process of getting approvals through the DOE has been difficult.

### Nov. 6, 2018

Gianni is putting together an up-to-date cost estimate and then should be able to finalize everything. He believes that by the end of December they will be able to start ordering parts for the multiwires. Two to three months later, they should be able to start building the wire-plain assemblies.

### Dec. 18, 2018

Gianni reported that the paperwork for the Finland wire planes has been completed and after some signatures, the will begin to order the components to build these wire planes.