

CeC Diagnostics

Rob Michnoff on behalf of the Instrumentation Group

Presentation primarily prepared and organized by Lenny DeSanto
with input from many group members

August 16, 2021

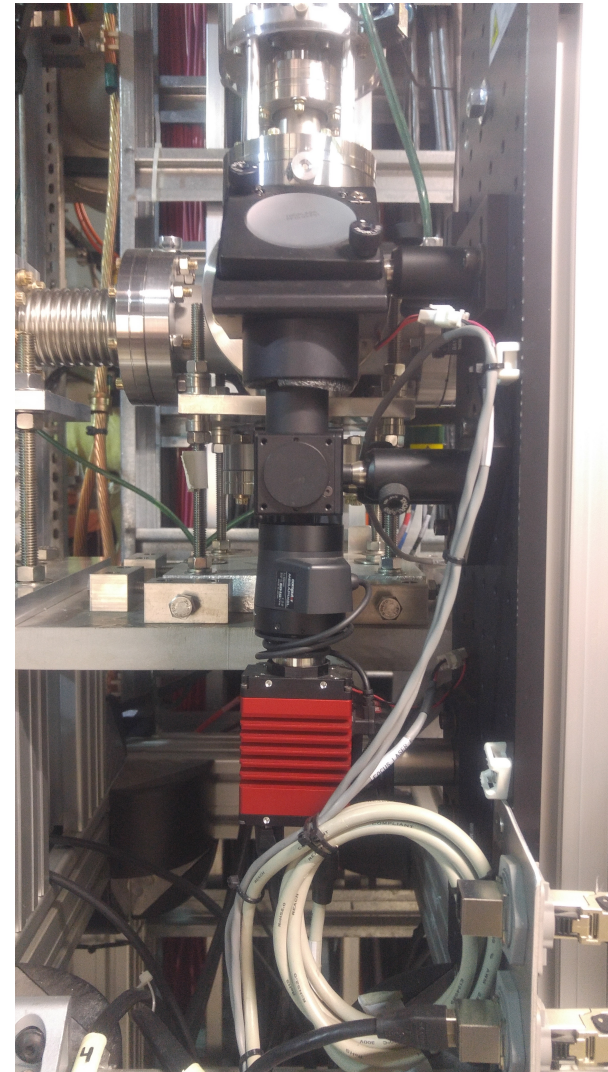
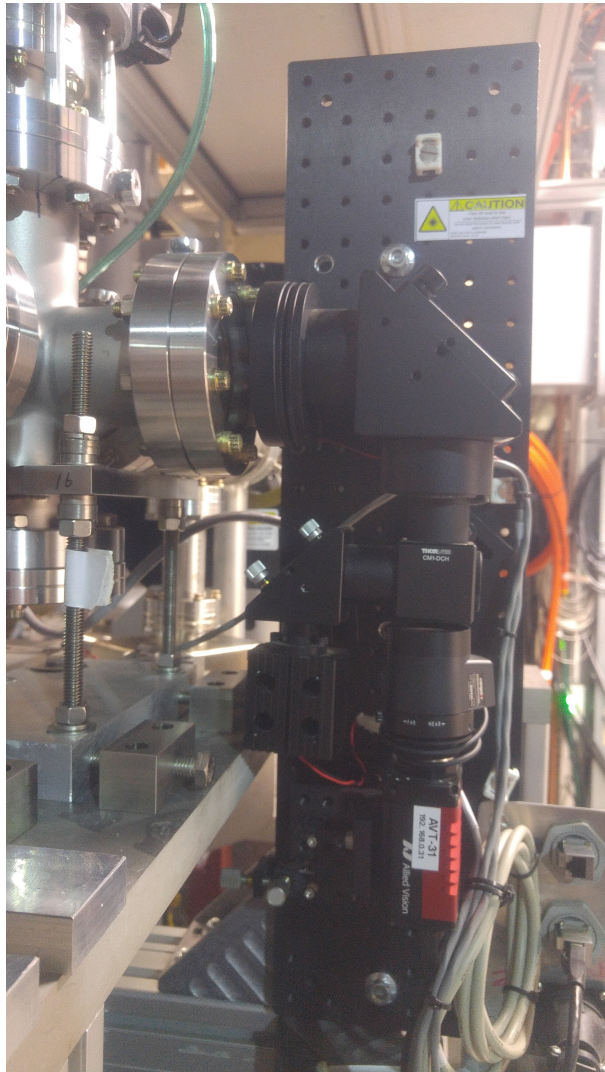
Outline

- Profile monitors
- DCCT
- Horizontal/Vertical Slit
- TROG
- ICT & Faraday Cups
- Bolometer
- BPMs
- Noise issues

CeC INSTRUMENTATION 2021 – PROFILE MONITORS

Due to the cumbersome adjustments of the original breadboard prototype optics systems we plan to reconfigured the eight profile monitors One new profile monitor will be added to the Diagnostic line.

2021 breadboard optic system.

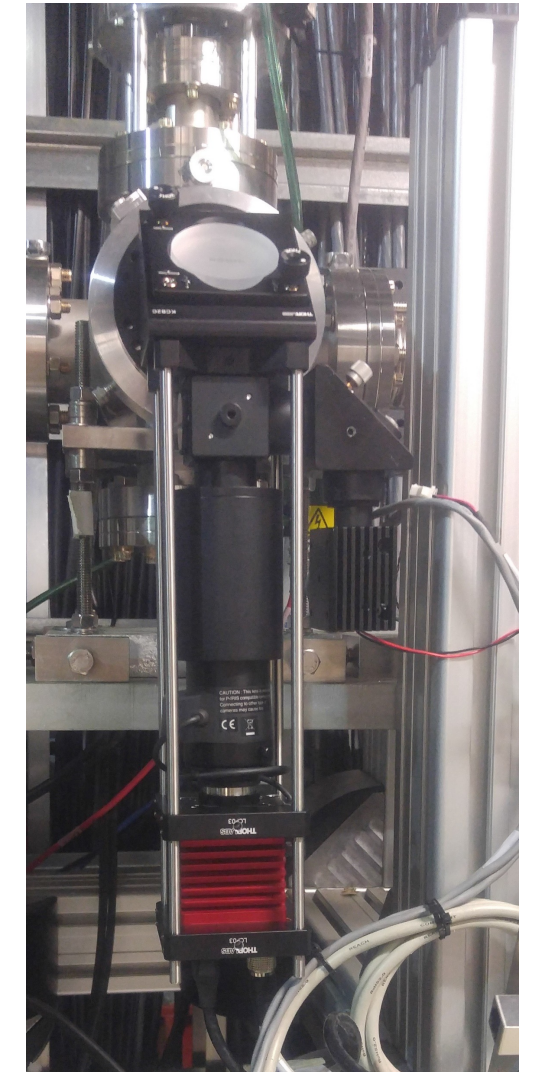
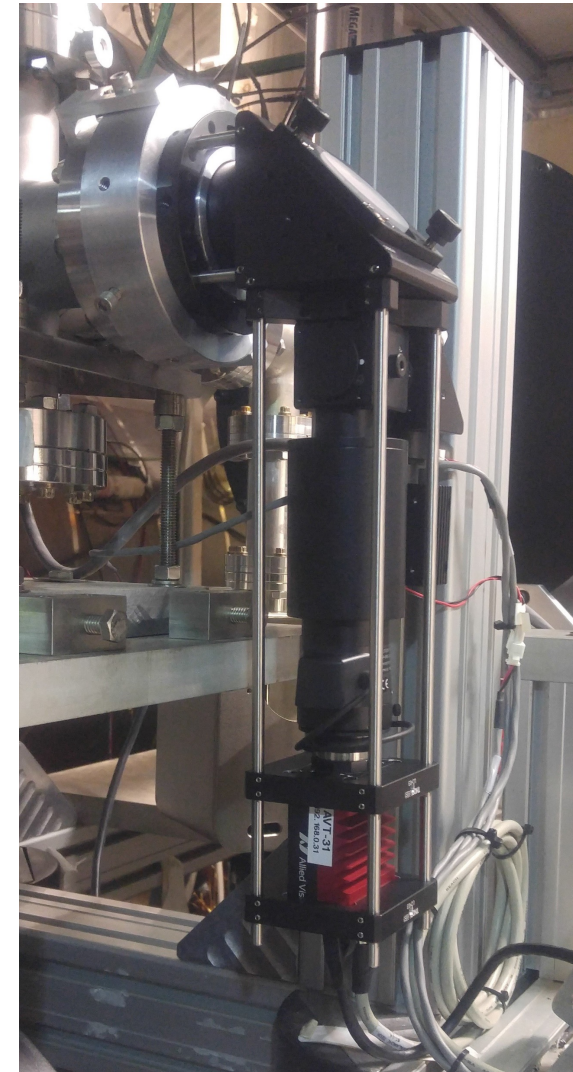


Existing devices
have independent
X-Y-Z and Theta
adjustments on 5
optical elements

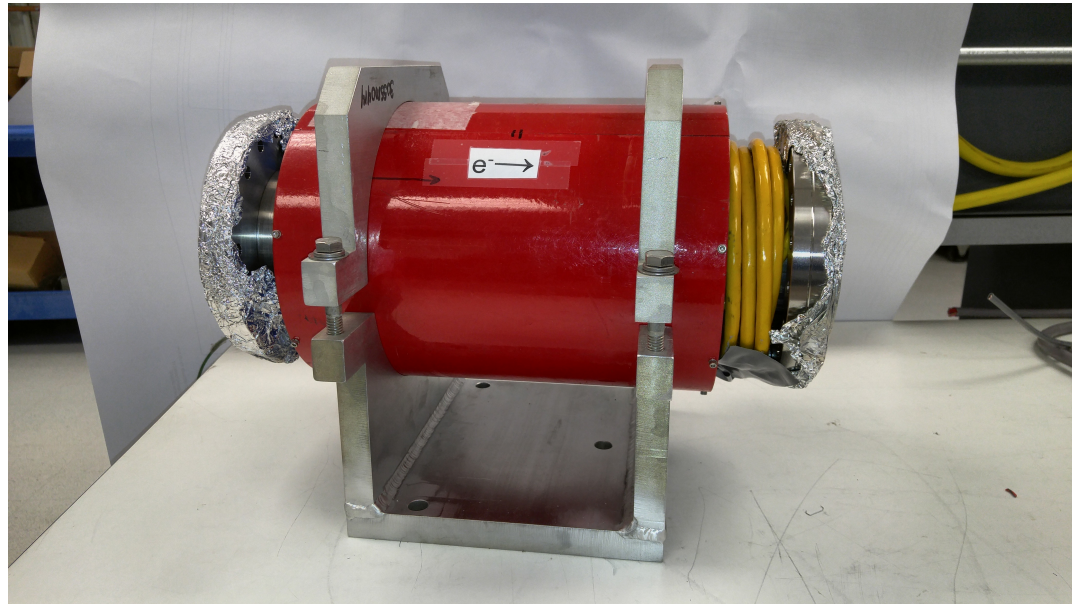


Modified units
have only X-Y
adjustments on
only 2 optical
elements →

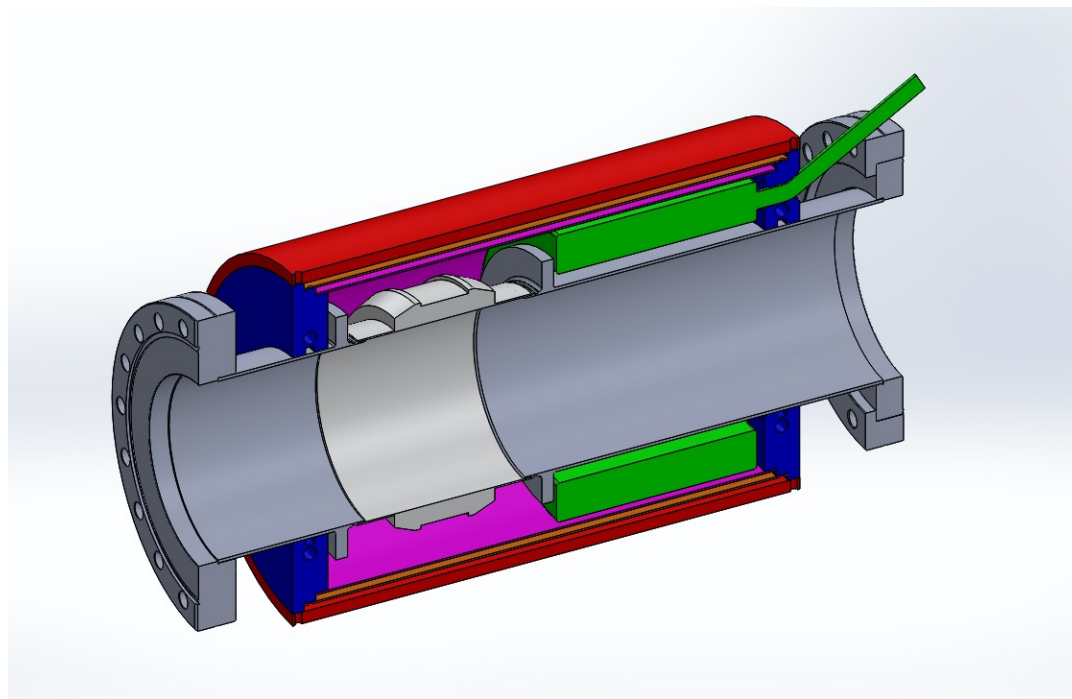
New Cage Optic System.



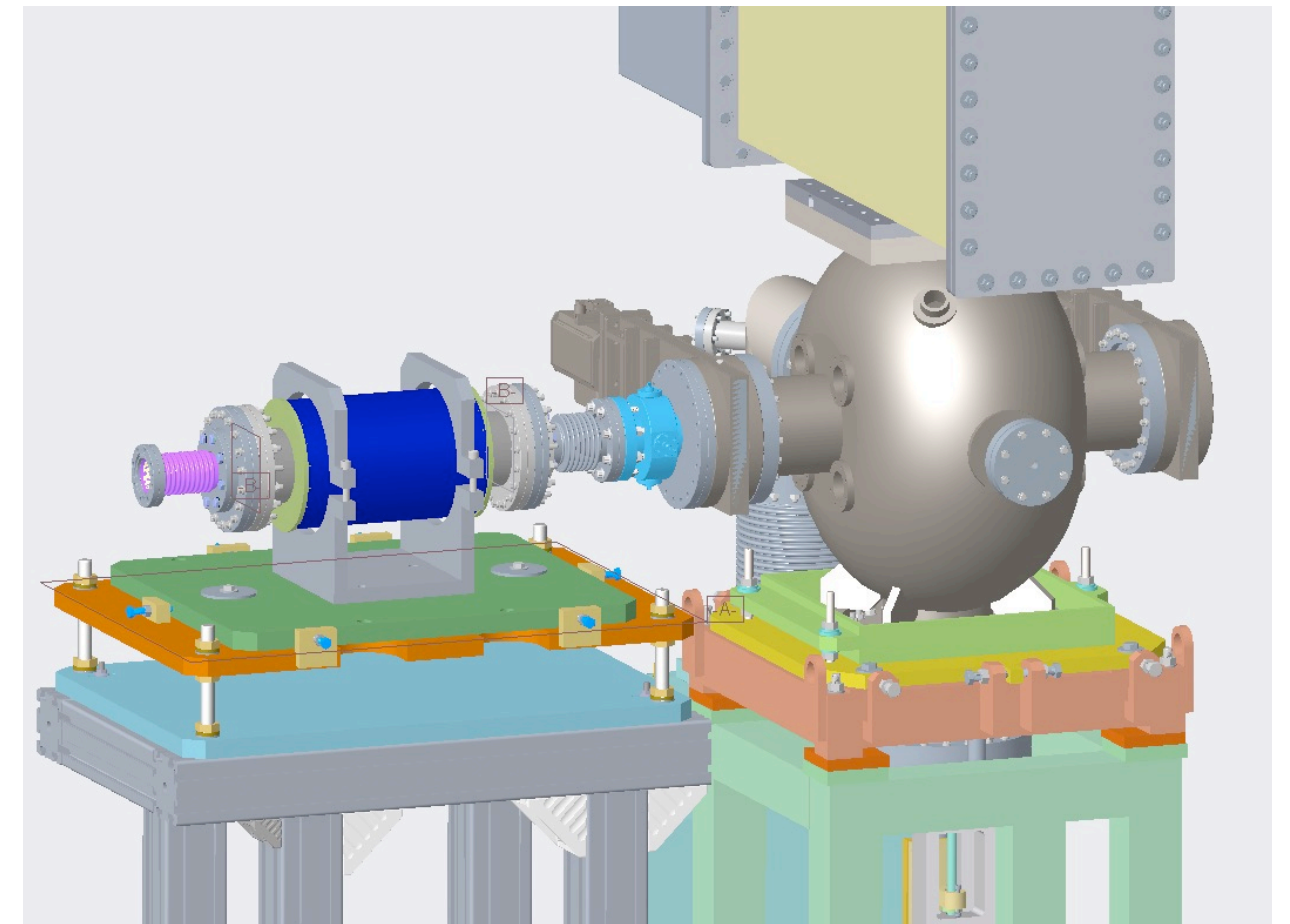
CeC INSTRUMENTATION 2021 - DCCT



The second of the two DCCTs that were used in ERL has been rebuilt to have a larger aperture than the original. It will be/is installed in place of the 500MHz cavity that was removed.

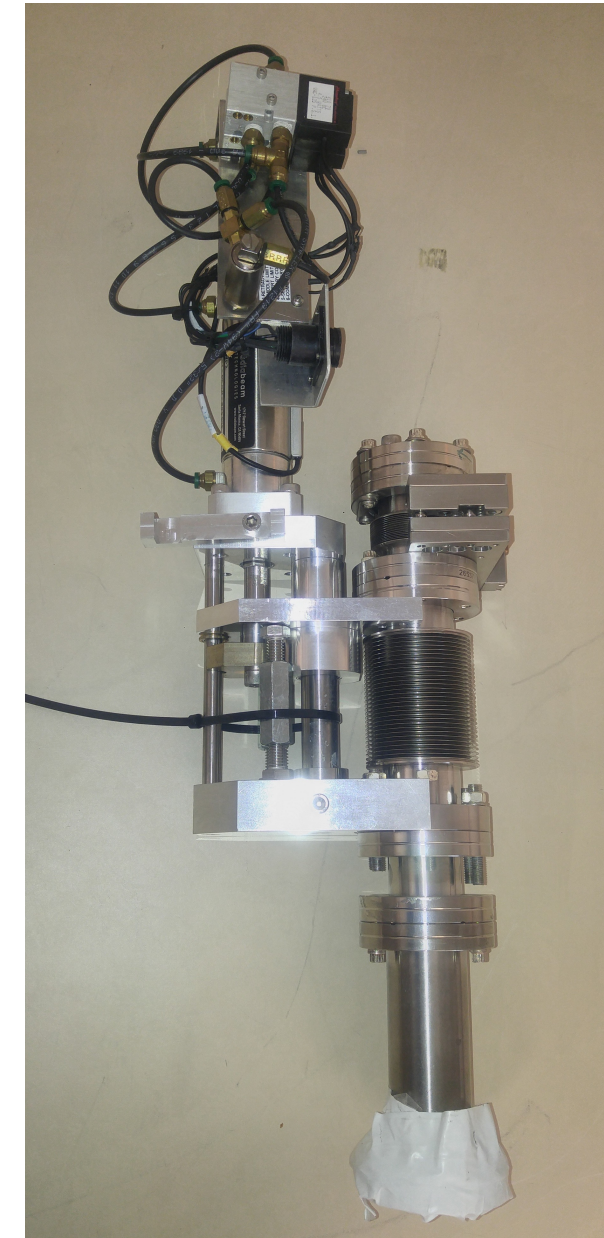
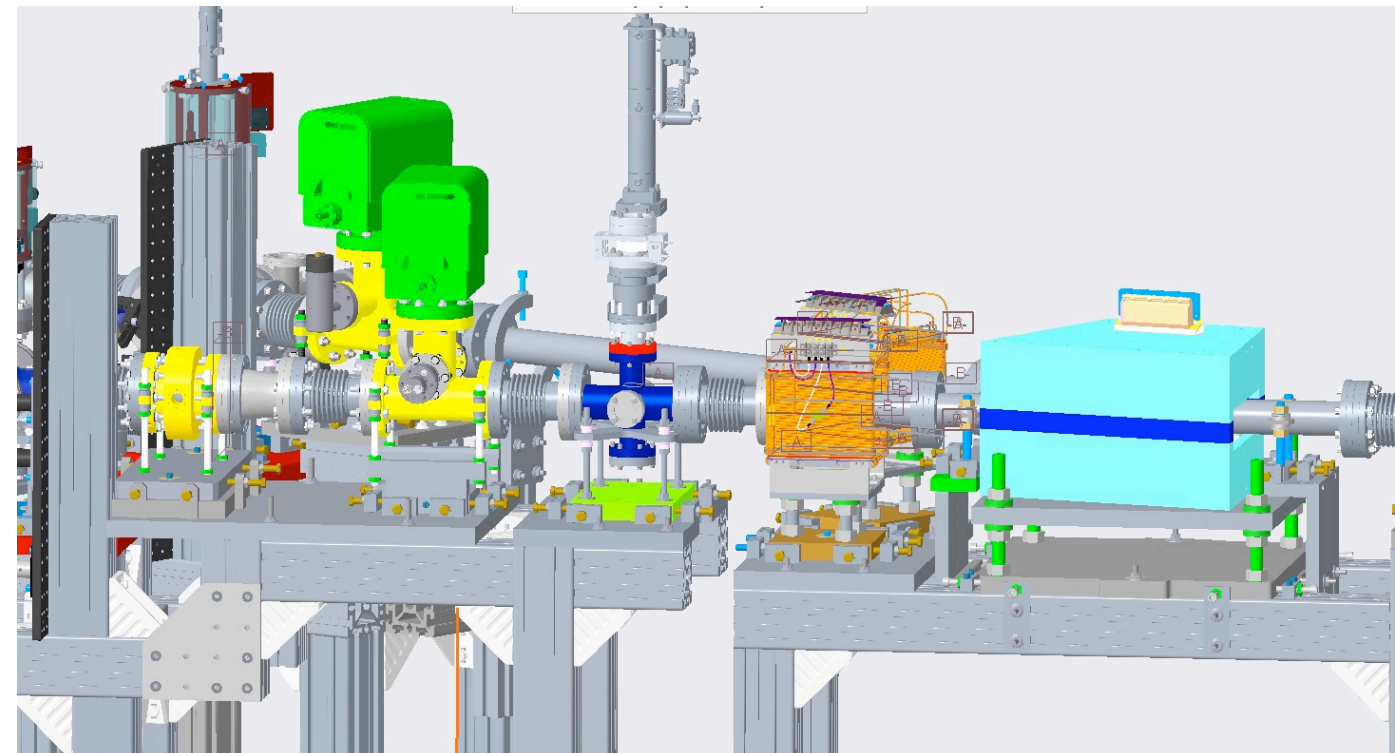
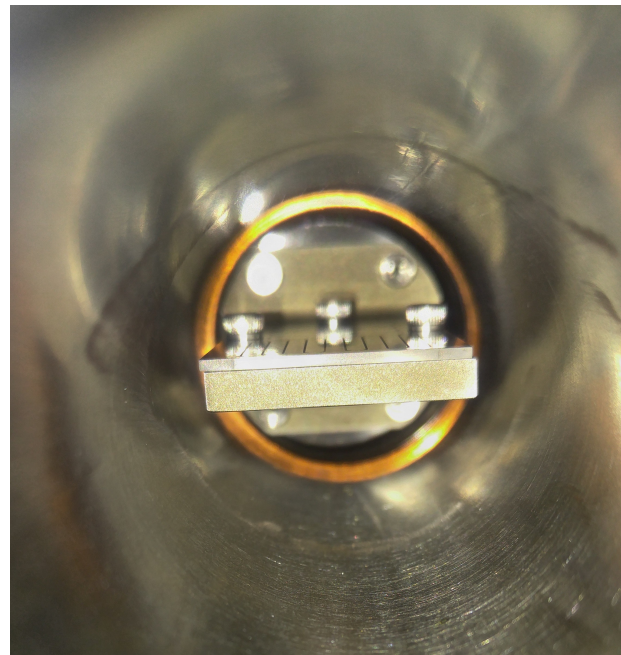


This DCCT will use an updated version of the electronics package that is designed to be more stable during thermal variations. This signal will then be processed with a spare channel in the existing Zynq system.



CeC INSTRUMENTATION 2021 – NEW H-V SLIT

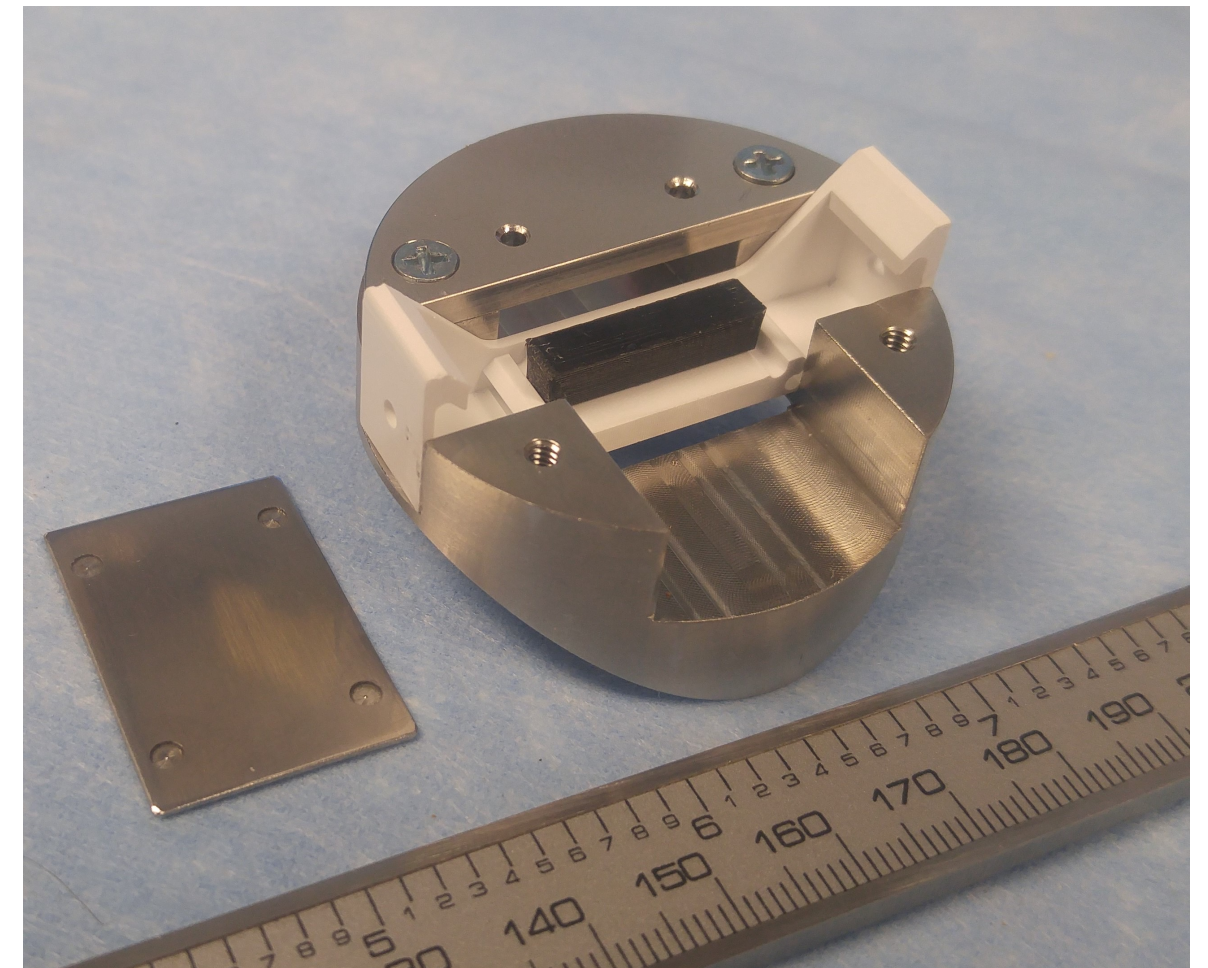
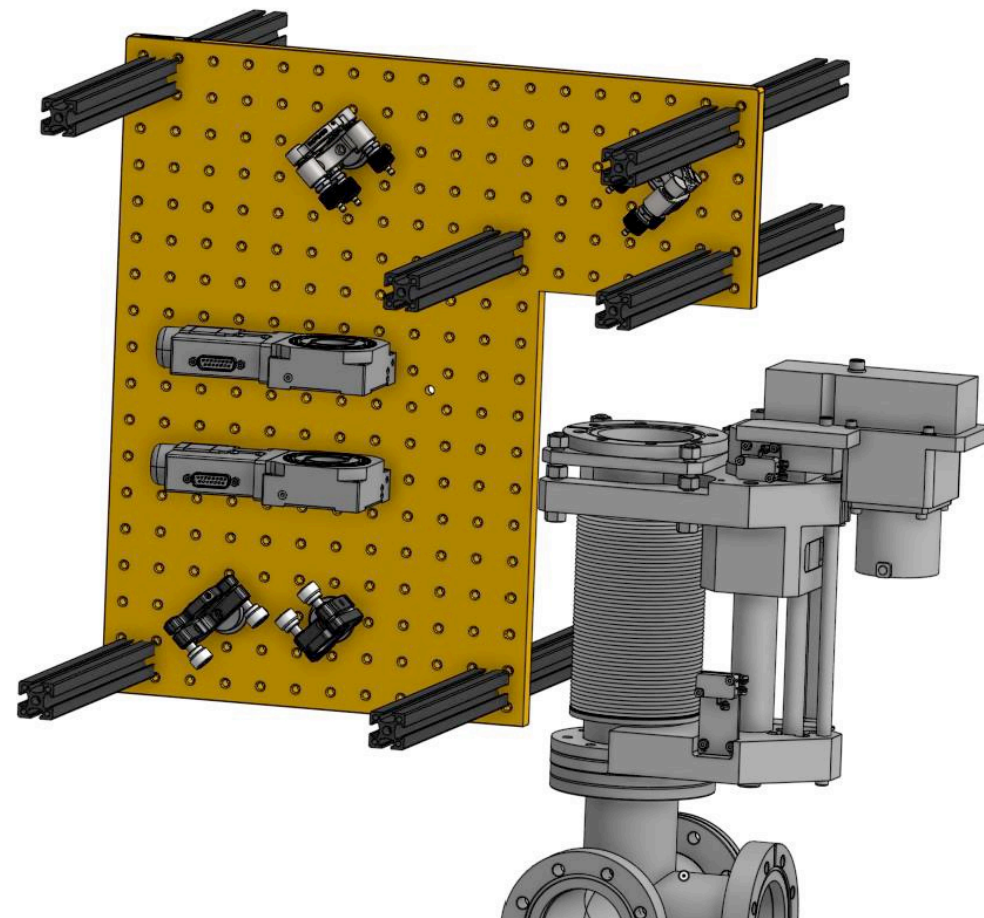
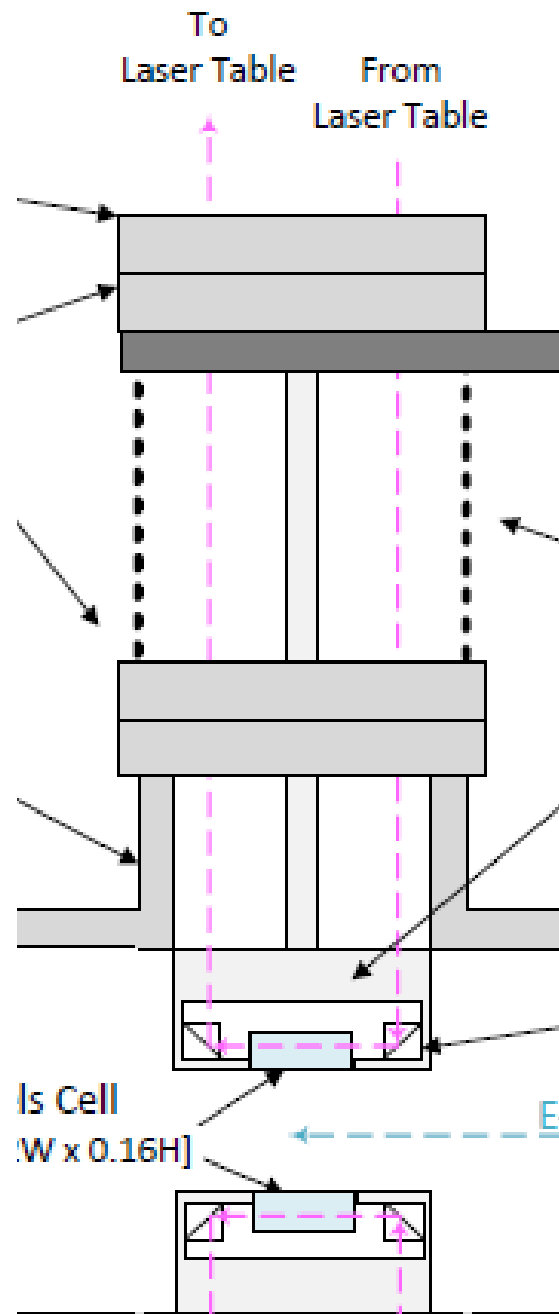
The horizontal and vertical slits that were removed from CeC last year will be reinstalled in their new location in the diagnostic line.



CeC INSTRUMENTATION 2021 – TROG (Time Resolved Optical Gating)

(Matt Paniccia,
Lenny Desanto,
Patrick Inacker)

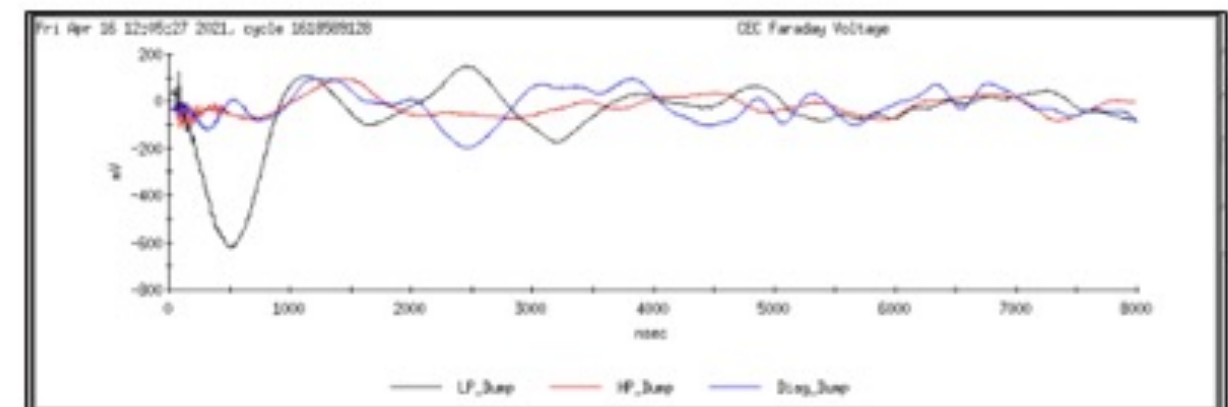
The electric field of the passing particle bunch drives a Pockels Cell, modulating the polarization of the passing Laser Beam. An analyzing polarizer is used to translate the polarization modulation to an intensity modulation which is then detected.



TROG sensor assembly: stainless steel body with Boron insulating crystal/mirror holder.

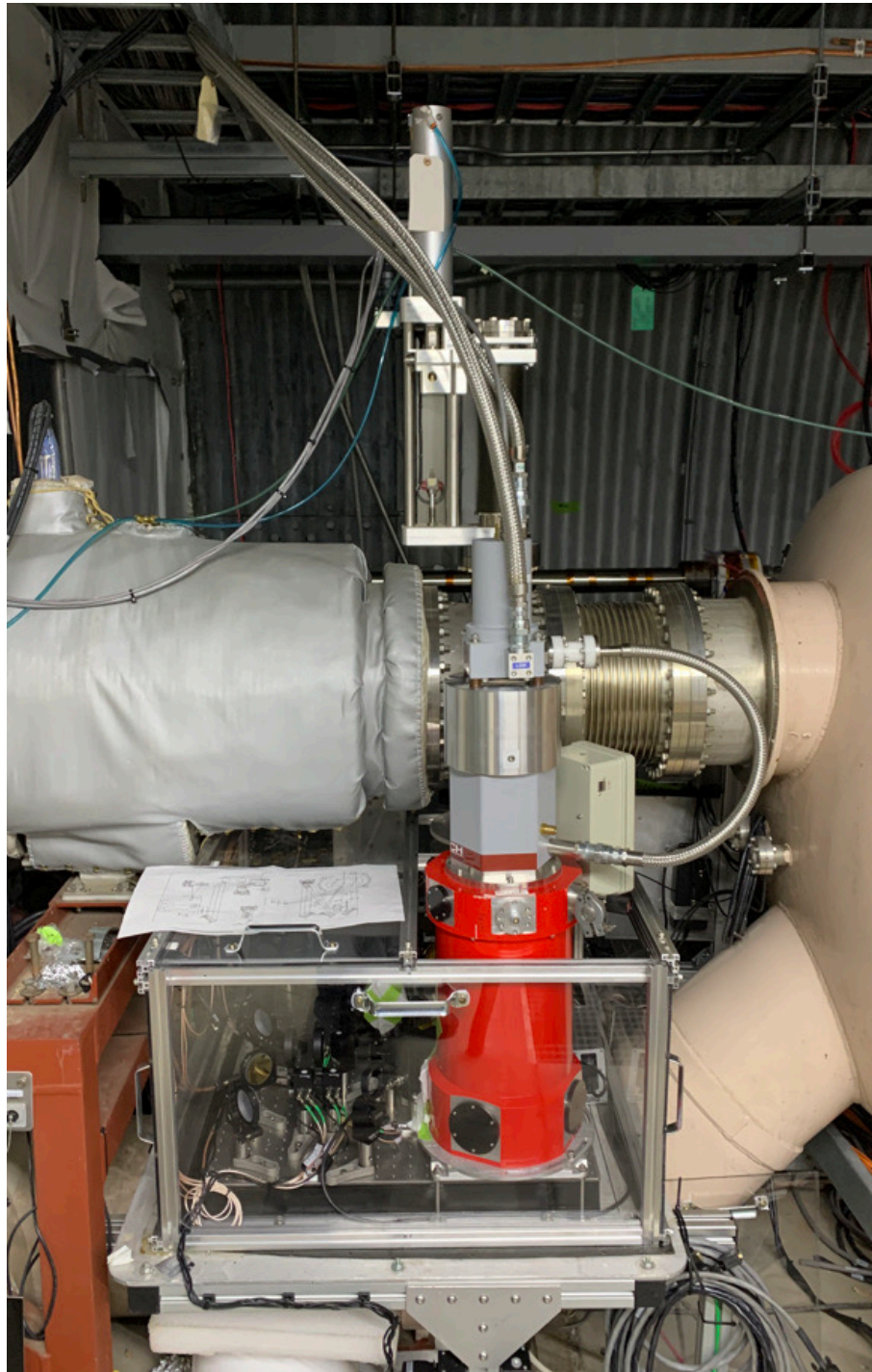
ICT & Faraday Cups

- New for Run 21
 - Added Diagnostic Dump ICT and Faraday Cup
 - Added MPS monitoring for new ICT
 - Added gain control for ICT
- Issues from Run 21
 - False MPS trips
 - Excessive noise limiting low charge measurements and Faraday Cup measurements
- New for Run 22
 - Updated Zynq processing for 1 MHz



CeC INSTRUMENTATION 2021 – BOLOMETER

(Chris Degen)



Previous Run

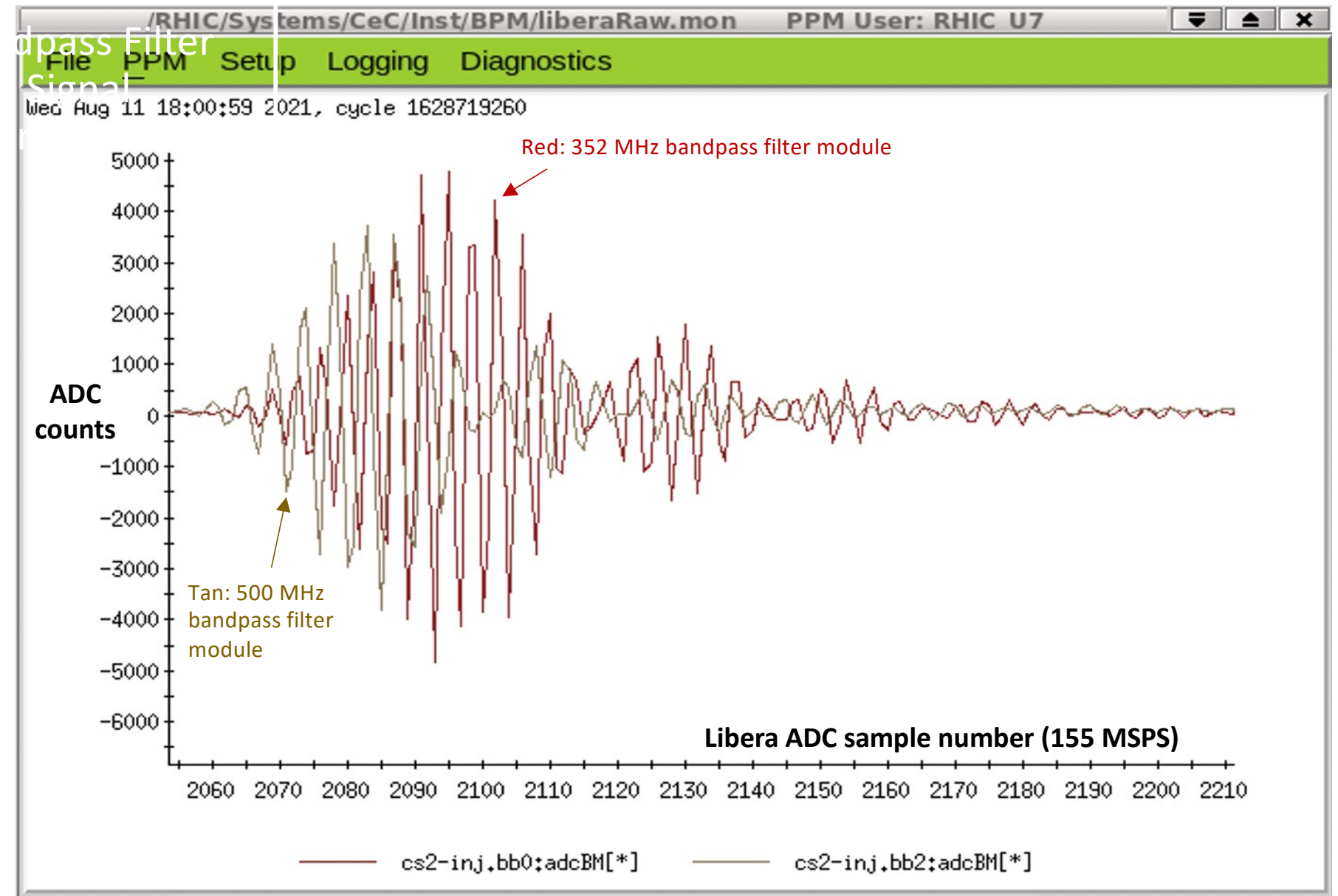
- Highly customized Superconducting TES Bolometer procured from QMC Instruments in UK for IR diagnostics.
- Bolometer installed in sector 2 on March 3rd.
- Several days after installation, cryostat helium contamination was identified.
- Several unsuccessful attempts to mitigate issue were performed at BNL under direction of QMC.
- Unit shipped back to QMC instruments in UK for repair on March 31st.
- Cold head component required shipment to Cryomech in Syracuse NY for repair, then back to UK for reintegration with bolometer.
- US & UK Customs significantly slowed the repair process.

Future Plans

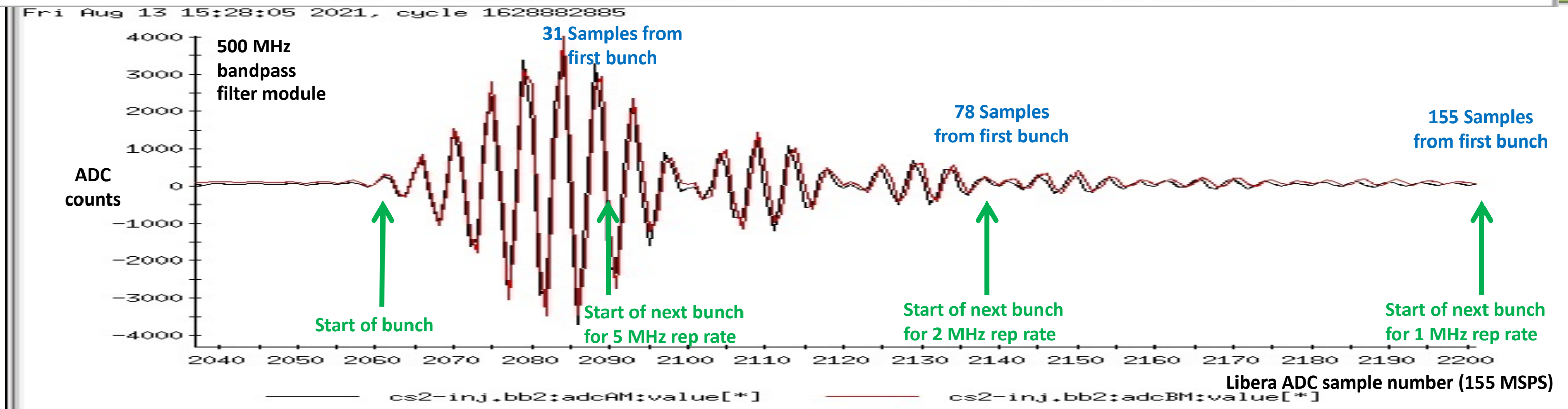
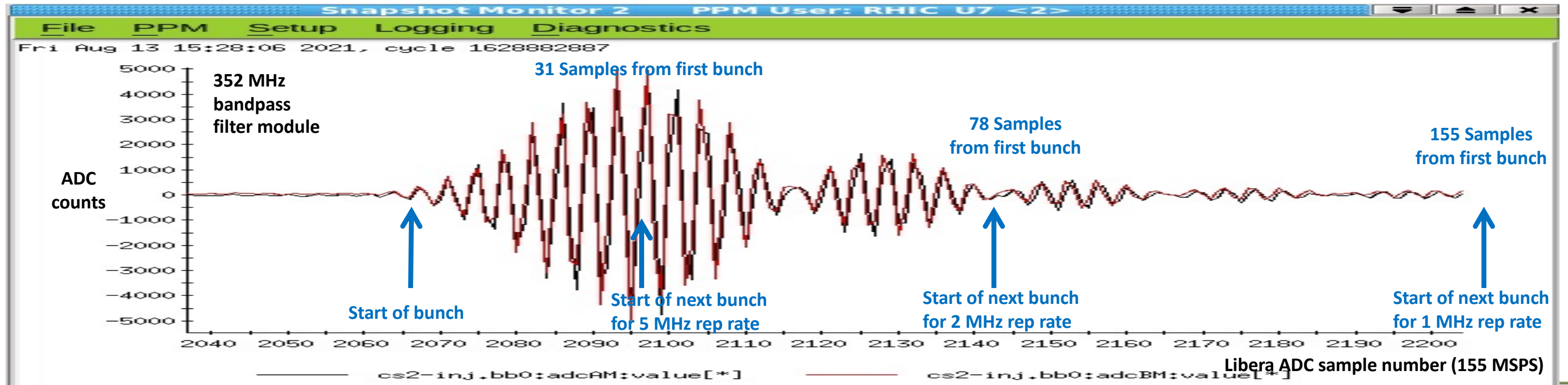
- The manufacturer has determined that the failure was the result of a manufacturing error in the PTC head that caused the leak.
- Unit is repaired and undergoing testing at QMC in UK.
- Zoom teleconference for acceptance review expected about mid August.
- ADO manager is in development.
- Unit should be shipped back to BNL sometime in early September.

Bench-testing the following:

- 1 Hz single bunch noise and drift
- 78 kHz CW
- 1-5 MHz CW, including signal mixing with closely spaced bunches, especially the 352 MHz bandpass filter response
- Position measurements with different attenuator settings
- Setup for multi-bunch flavor and dense flavor, focusing on the following Libera parameters:
 - Num_of_bunches
 - data_averaging
 - spe_group_size



Libera BPM raw data - 500 MHz bandpass filter vs. 352 MHz bandpass filter response with markers showing where next bunch begins for 1 MHz, 2 MHz and 5 MHz rep bunch repetition rates



CeC INSTRUMENTATION 2021 –BPM enhancements under consideration

- Bunch-by-bunch position measurements at dogleg BPM to measure energy variations
 - Need to determine if this is possible with the Libera module (we are suspecting it is not)
 - V301 BPM module may be needed
- BPM button switching, similar to what was done for LEReC. Details that still need to be addressed include:
 - availability of hardware
 - how to implement control of the switching - new cables may need to be pulled
 - software modifications to control the switching and process the measurements based on the switch setting
 - acceptable rate of switching based on the CeC bunch repetition rate
- Installation of additional BPM modules in cooling section for ion beam measurements
 - V301s would be used (need to determine if modules are available)
 - Need to determine if one hardware module can be used to measure both electrons and ions

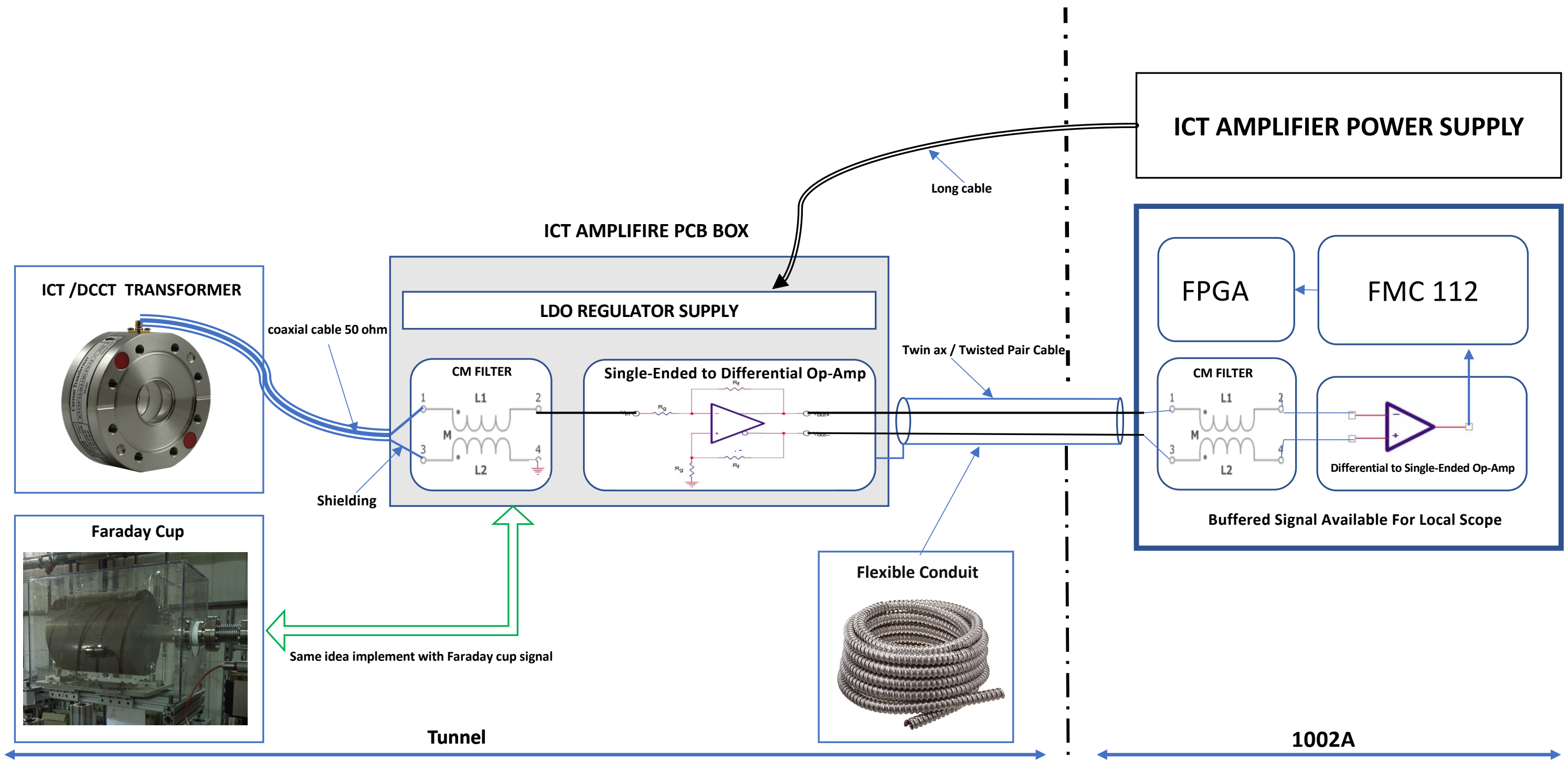
CeC INSTRUMENTATION 2021 –NOISE ISSUES

(Syed Hafeez)

- The ICT magnetic cores and associated windings are essentially noise-free.
- Cables & connectors Pick up the noise (EMP) from the environment. The tunnel amplifier box only providing signal amplification right now.
- The in-flange model's mechanical parts are in direct electrical contact with the vacuum chamber. It becomes important to equip every section of the coaxial cable with common-mode filters.
- Tunnel ICT Amplifier getting supply from service building 1002A with long wire also creates noise, add Linear Regulator IC to overcome this problem.
- Tunnel ICT Amplifier PCB supply ground connected with BOX creates a long ground loop and adds more noise to the system.
- We must consolidate the system to cut down the unnecessary cable and connections.
- Differential pair signal and cable options provide a more noise immune system.
- An isolated amplifier will work on DCCT, IR2, and Faraday cup.
- Currently, we use the Current feedback op-amp. This is a good option to use due to constant bandwidth over gain. Still, simultaneously, the input impedance is low and sensitive to noise. Adding common mode choke before the op-amp will help to reduce the noise sensitivity.
- IR2 table power and signal cable should be separately routed.
- IR2 and Faraday cup receiver circuits are not properly terminated. BNC tees should not be used to split signals(on oscilloscopes).
- Tunnel to service building signal cable needs to be better shielded

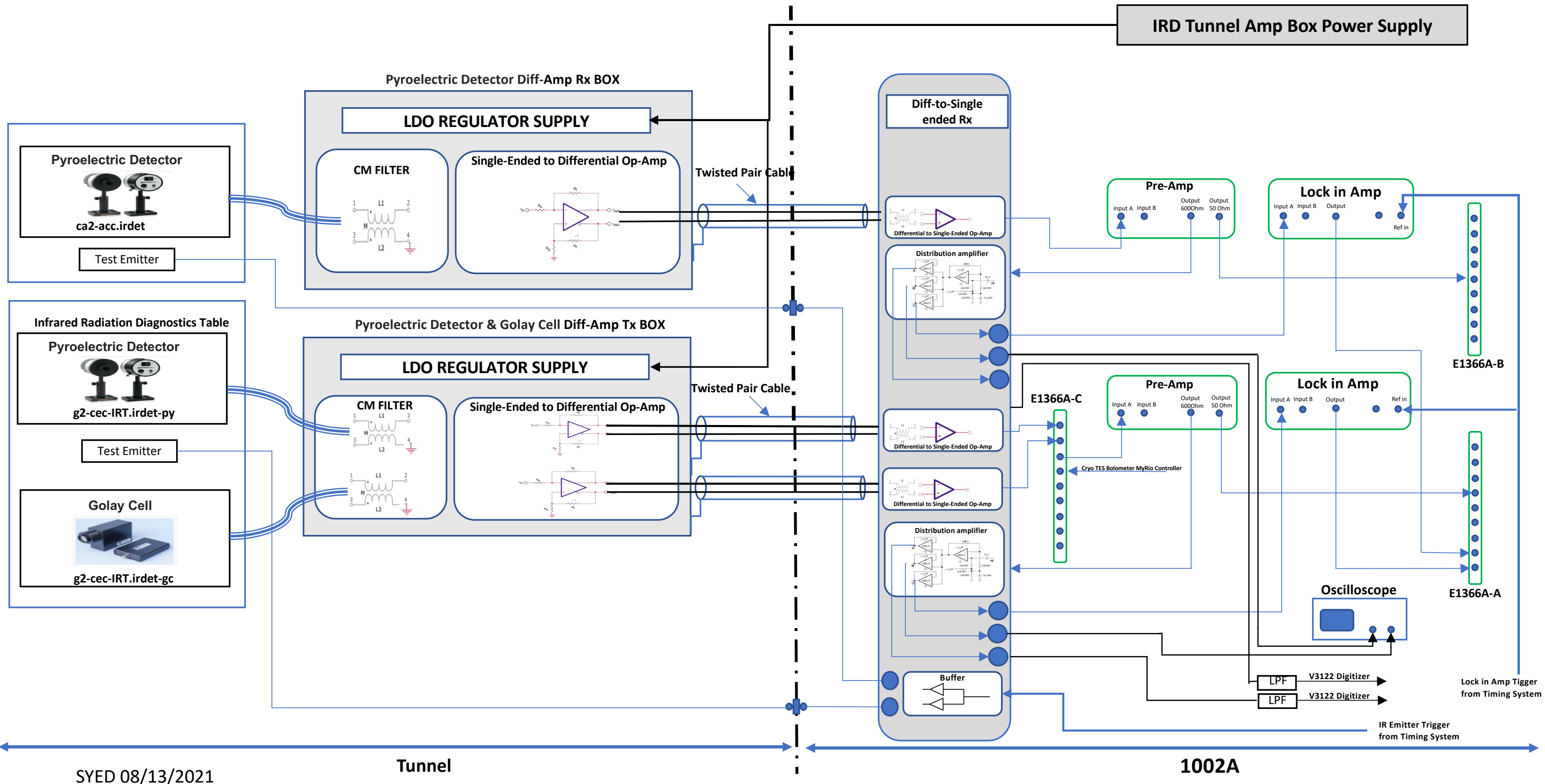
ICT Existing system Improvement with Differential

(Syed Hafeez)



SYED 08/09/2021

IRD System Improvement with Differential Tx & Rx



SYED 08/13/2021

Tunnel

1002A

Summary

- Beam diagnostic systems are providing important measurements for CeC operation
- Enhancements to presently installed systems continue
 - To provide additional operational modes
 - To make measurements less susceptible to noise induced on signals from outside sources
- New systems are being installed this shutdown
 - DCCT
 - Horizontal/Vertical slit
 - Profile monitor
 - TROG

CeC INSTRUMENTATION 2021

The End