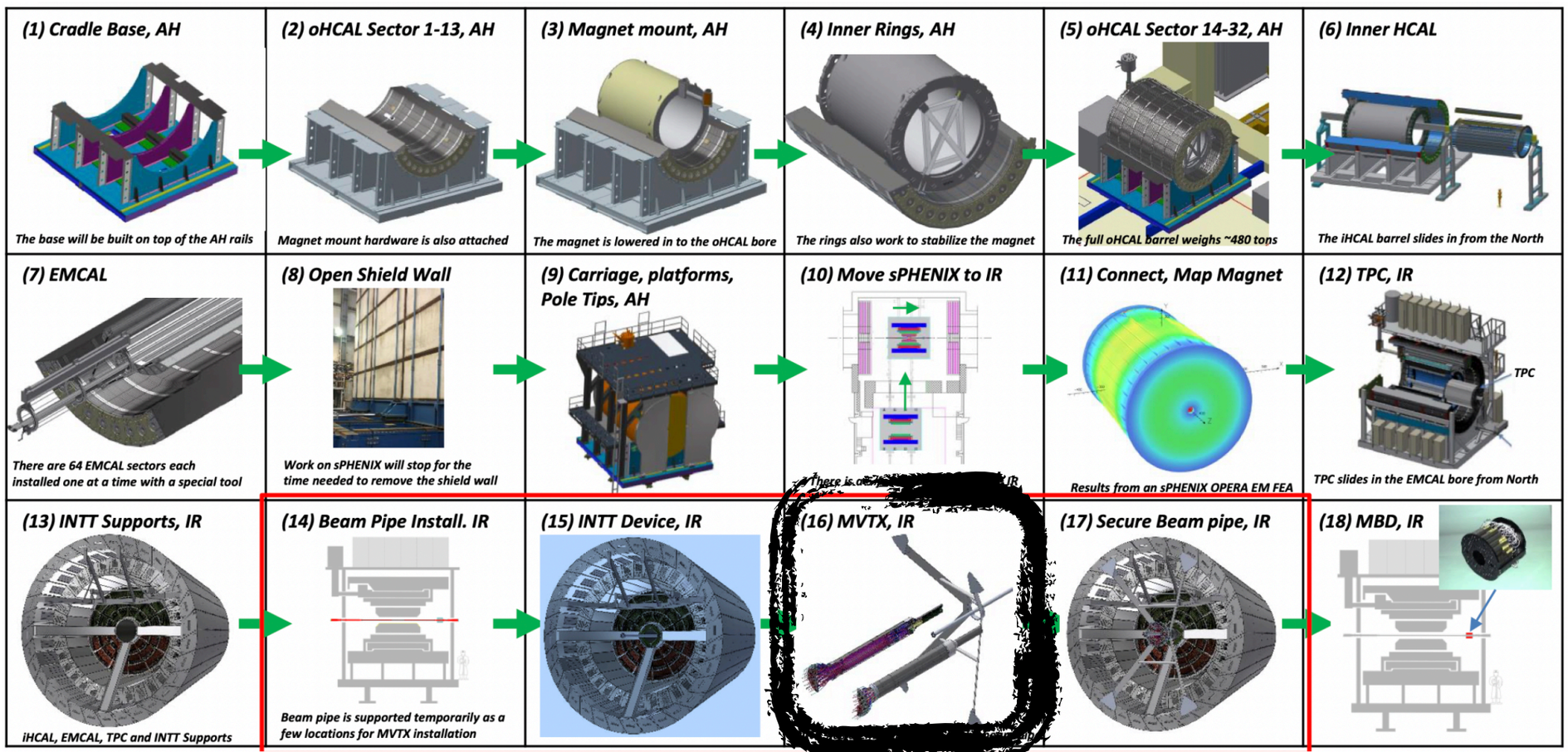
MVTX
PROJECT STATUS

IN THIS PRESENTATION…

- **Progress since last collaboration meeting**

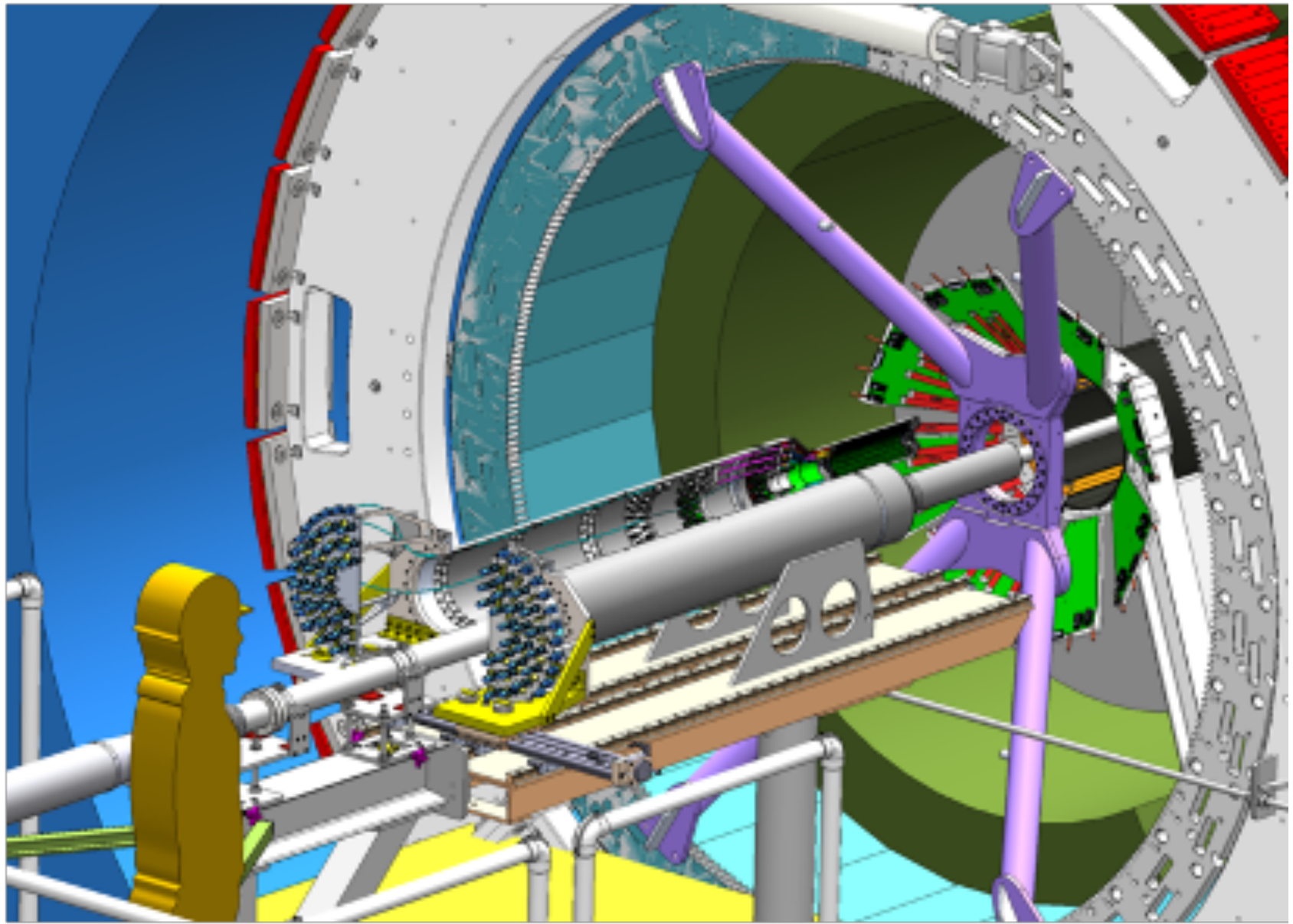
  and

- **Remaining tasks before insertion**
  - Mechanical structure
  - Insertion and support
  - Readout and control
  - Cooling systems
  - Commissioning



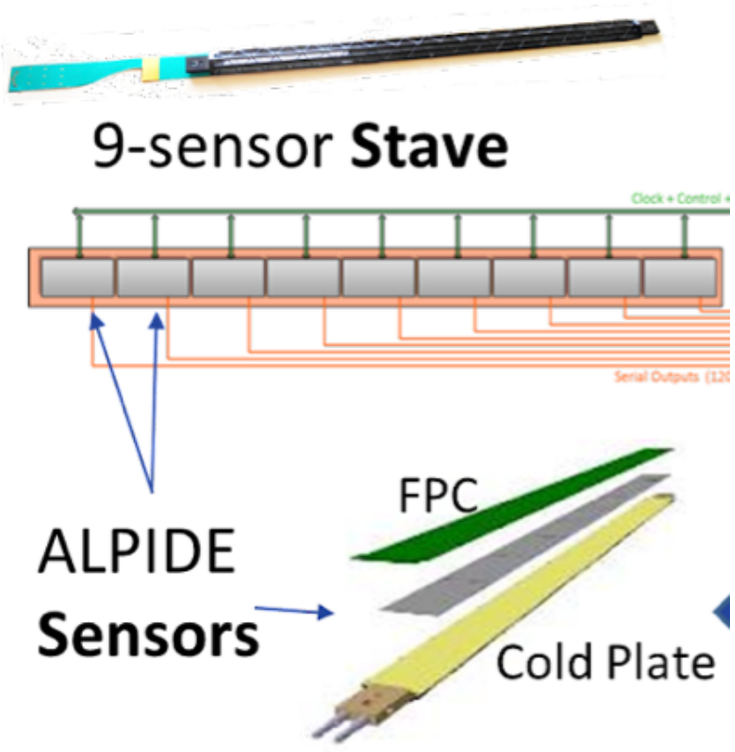
MECHANICAL STRUCTURE

- **Staves**
- **(Carbon fiber + aluminum) parts**
- **Cables**
- **Assembly**



STAVES

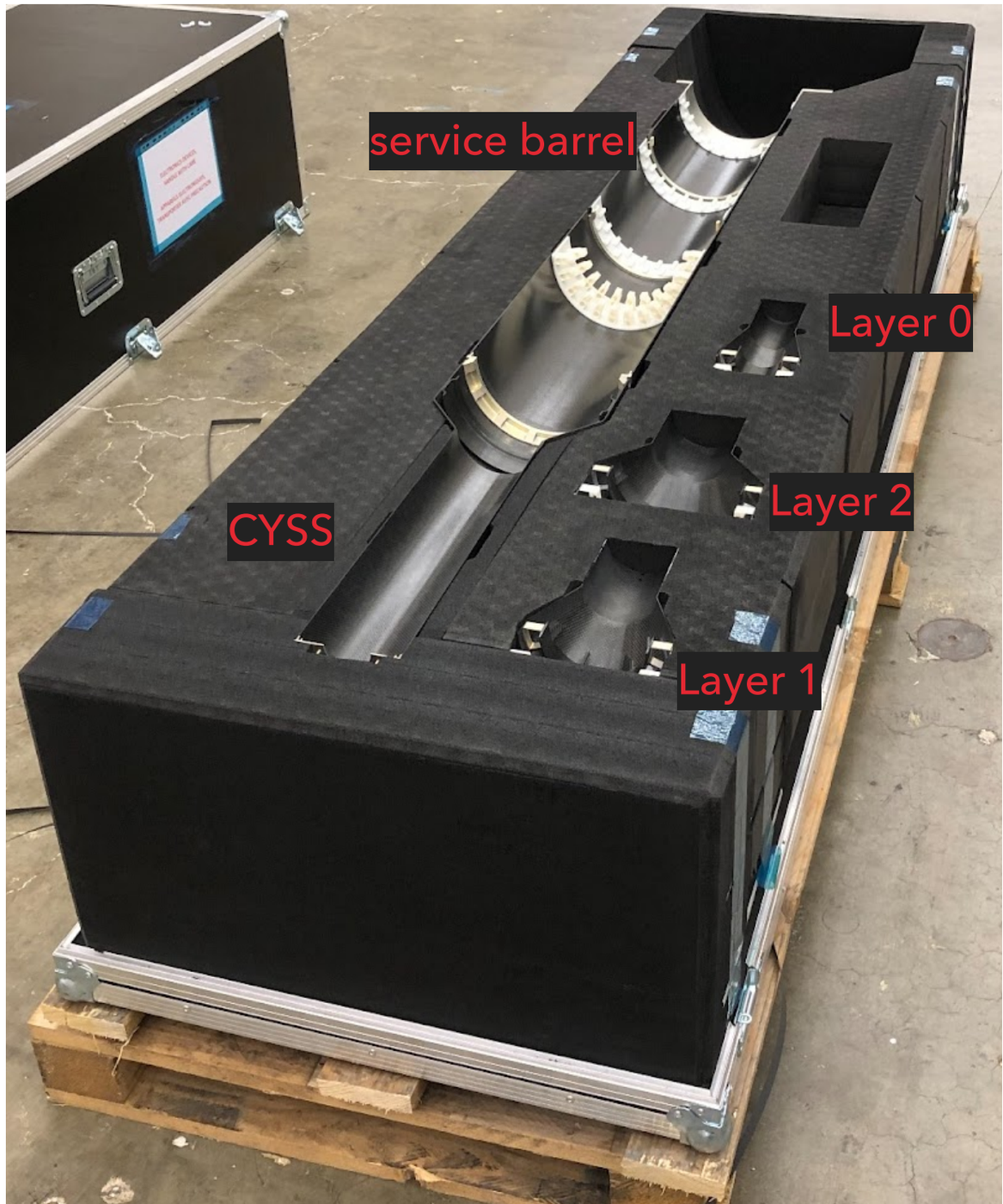
- **84 of them fabricated at CERN –>** need 48 for full 3 layers
  - finished shipping from CERN to LBL: *mid-November*
  - finished Q&A in LBL: *beginning of December*
    - **gold: 63** (75% of all) + 10 (12%) more (gold w/ at least 1 masked pixel)
    - silver @ CERN: 5 (6%)
    - gold@CERN, but silver @ LBL: 5 (6%) –> stuck pixel was masked at CERN
    - unclassified: 1 (1%) – missing metrology data



CARBON_FIBER & ALUMINUM & 3D PRINTED PARTS

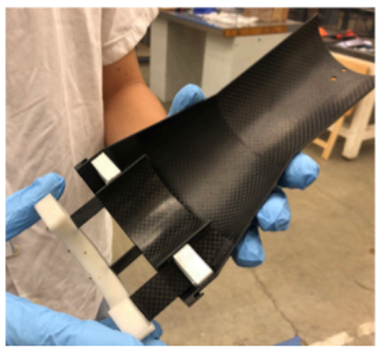
- **Layers + service barrel + inner ribs+tie_downs + patch panels**
  - all produced in France/Workshape delivered to LBL directly
    - 1st half: *arrived last week of June*
    - 2nd half: *arrived on Aug. 6th*
  - nothing missing: ready for assembly

Shipping box from France to LBL:
–> envisioned to be used also as assembly fixture
–> to be used also to ship from LBL to BNL

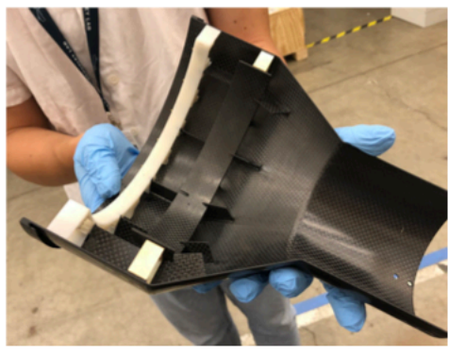


THEY ARE TINY!

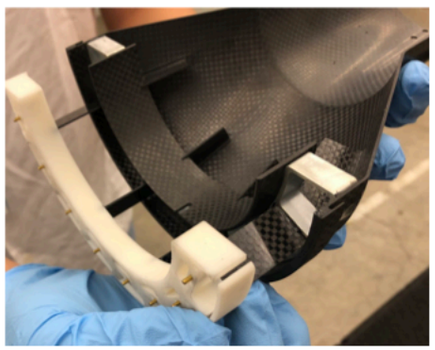
Layer 0



Layer 1

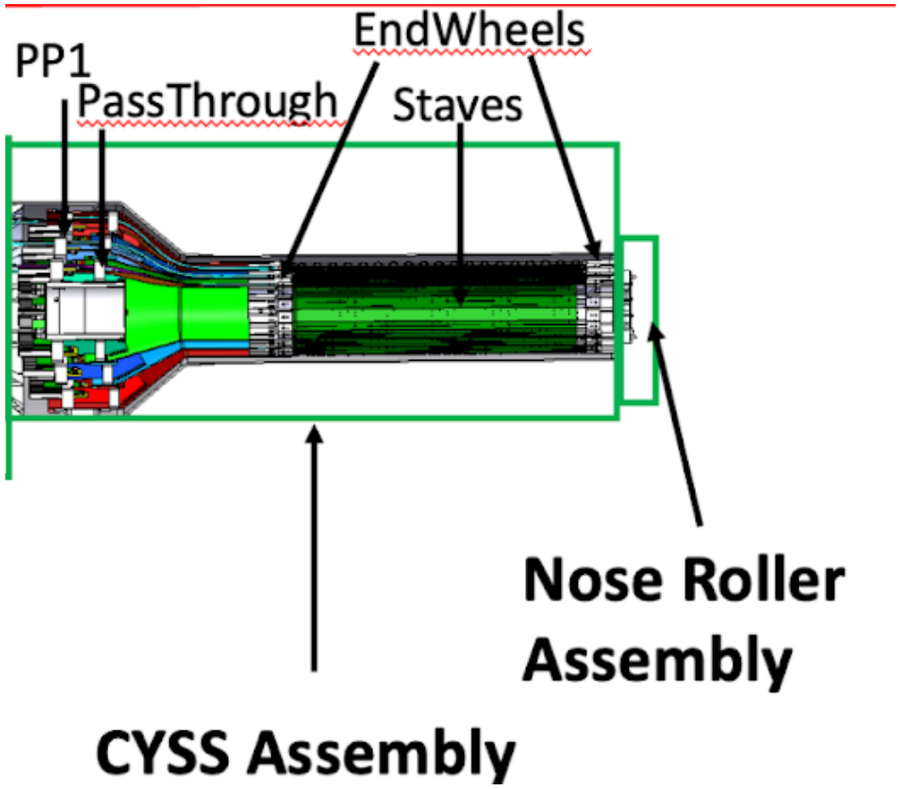


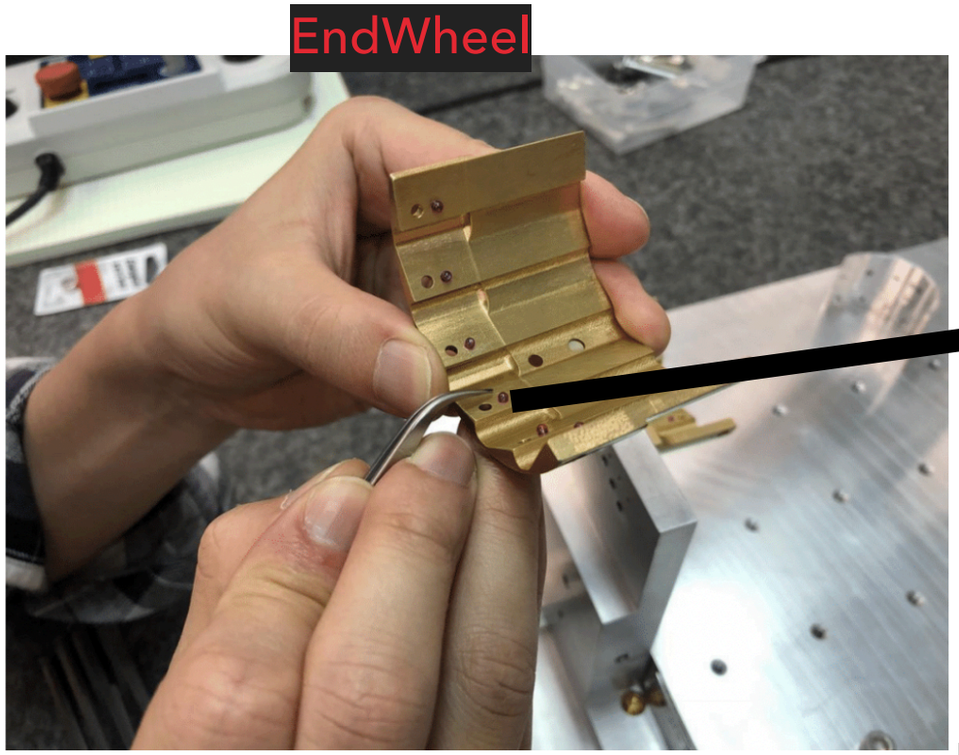
Layer 2

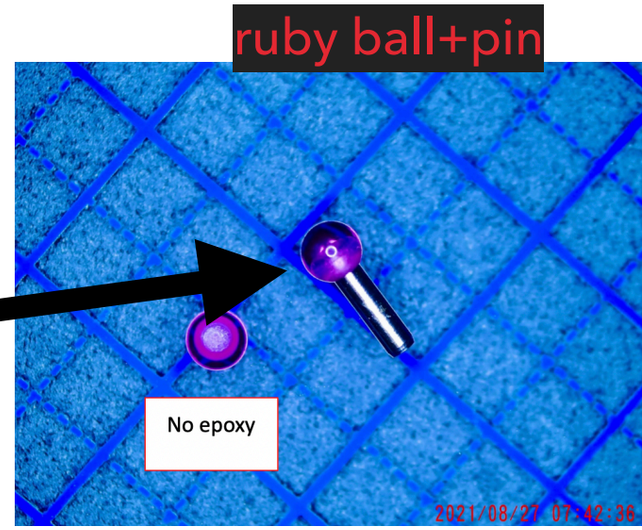


CARBON_FIBER & ALUMINUM & 3D PRINTED PARTS

- **EndWheels**
  - one of the few parts modified from the ITS design
  - the most tricky to get it done: keeps the staves in position –> high precision!



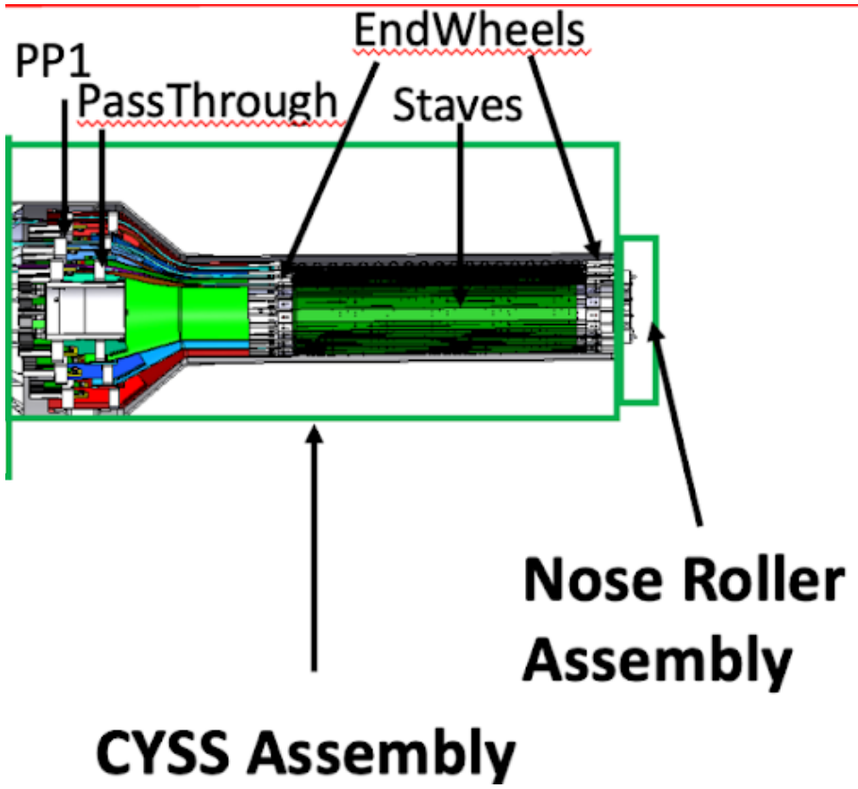


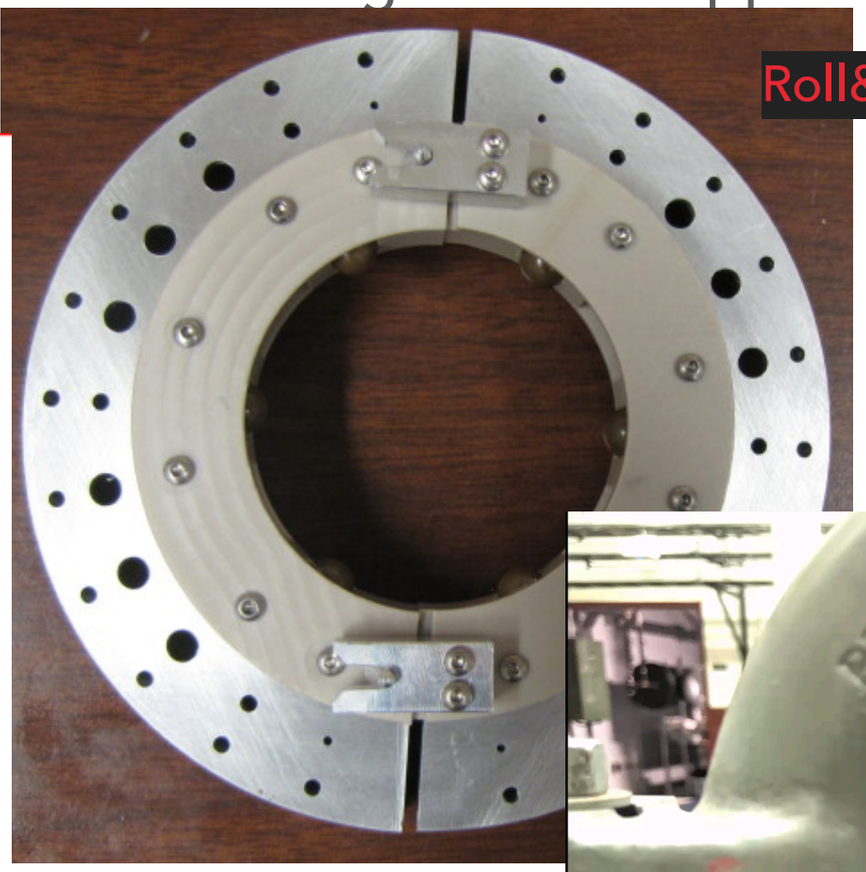


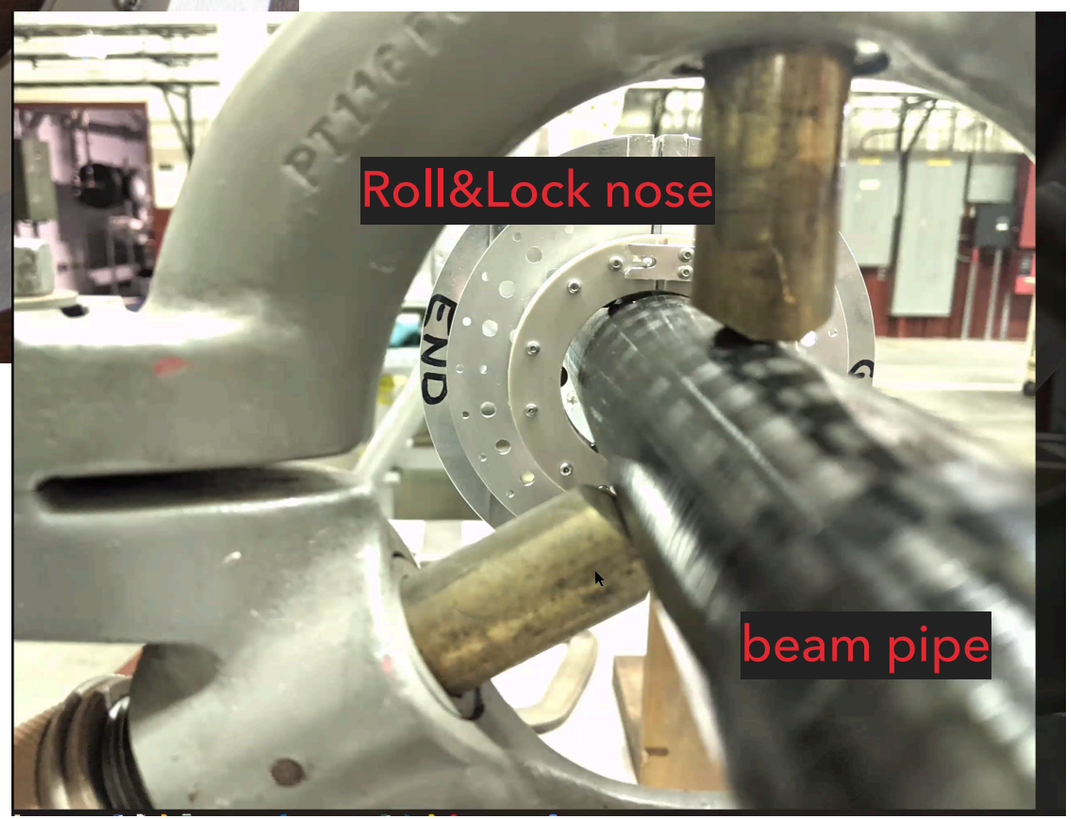
Replaced rubyBall+pin with
pins with funny head and 2 radii
(went to 2 versions, to get the right size)

CARBON_FIBER & ALUMINUM & 3D PRINTED PARTS

- **Roll&Lock nose**
  - suggested during the FDR; produced in US/NM
  - 2nd version (following discussions with ITS engineer): has been tested (insertion mock-up)–> everything works as designed and supposed to



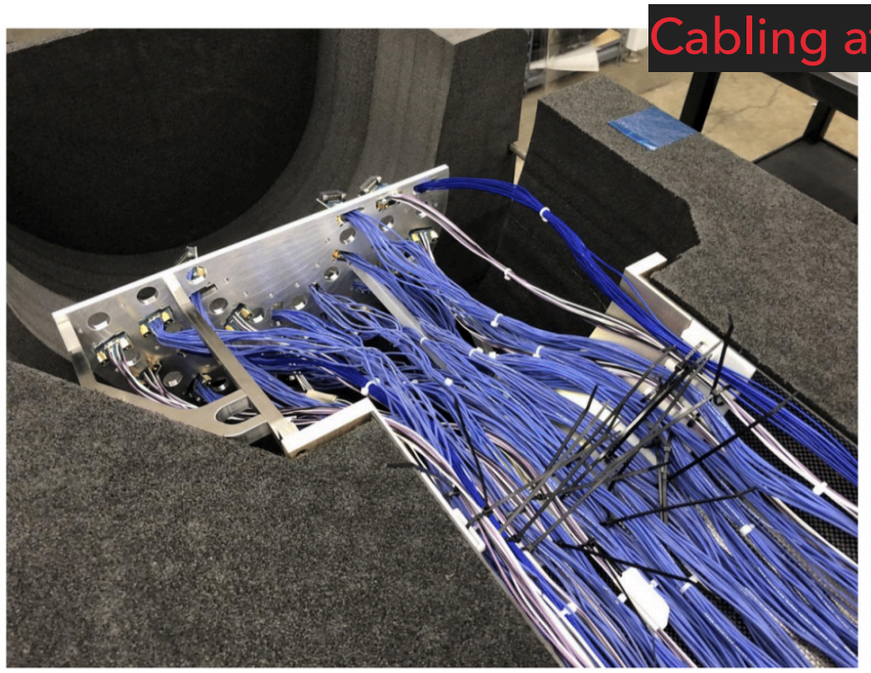




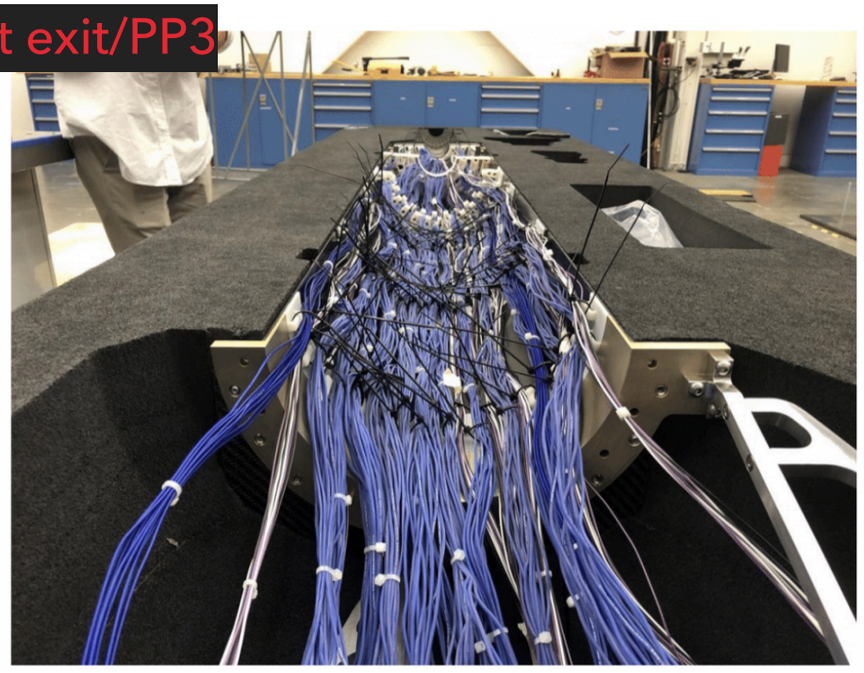
CABLES

- **Short ones (inside detector)**
  - made mock-up cables and used the real detector in LBL to get the right size –> *end of Sept placed order*
    - signal cables: *Jan 14th* (shipment to LANL)
    - power cables: *early Feb* (have already in hand 12 cables)
- **<u>Long ones (external, from detector to racks)</u>:**
  - placed order after finishing discussions w/ BNL , *mid November*
    - signal cables: *Feb 22nd* (shipment to LBL)
    - power cables: *early Feb* –> Becker Electronics will deliver half of the cables, the rest will be assembled in LBL (to avoid huge/further delays from Becker)

Cabling through service barrel

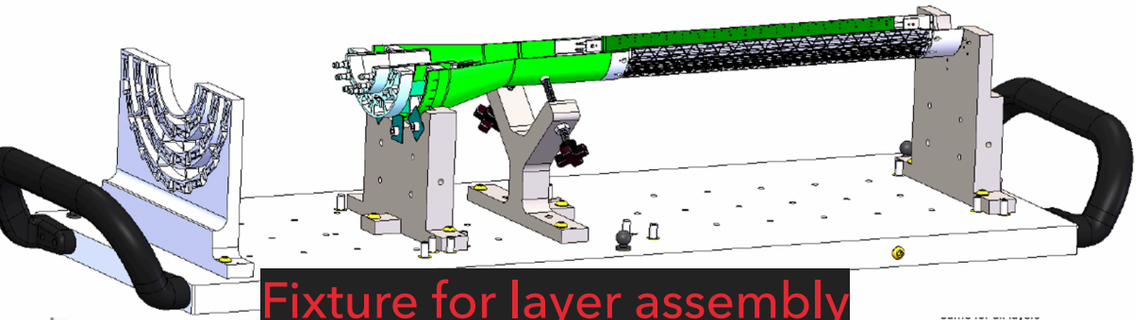


Cabling at exit/PP3



ASSEMBLY

- **Part 1**
  - Fixtures for Layer 0 + layers assembly manual: *end of July*
    - several version of manual released since (last version released today)
    - <u>assembly practice started in August!</u> (wonderful efort from LBL!)
      - 3d printed parts, (dummy) end-wheels and dummy staves
      - practiced alignment, developed CMM procedure, tested/adjusted the steps/numbers in manual



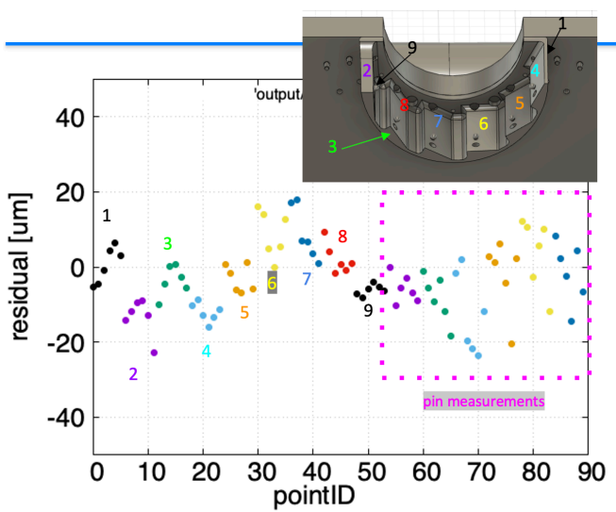
Fixture for layer assembly

3D printed cones

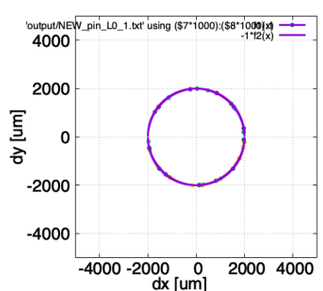
Dummy EndWheels

Dummy staves

CMM-ing

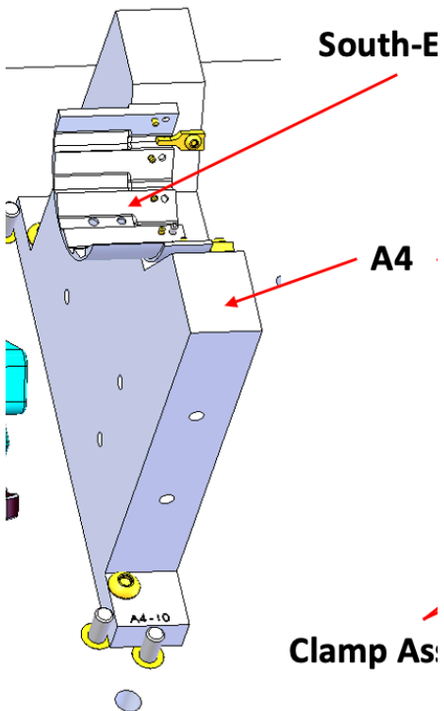


- Sequence: east edge, west edge, south rim, stave plane 1~6, stave pin 1~6
- All points used during fitting

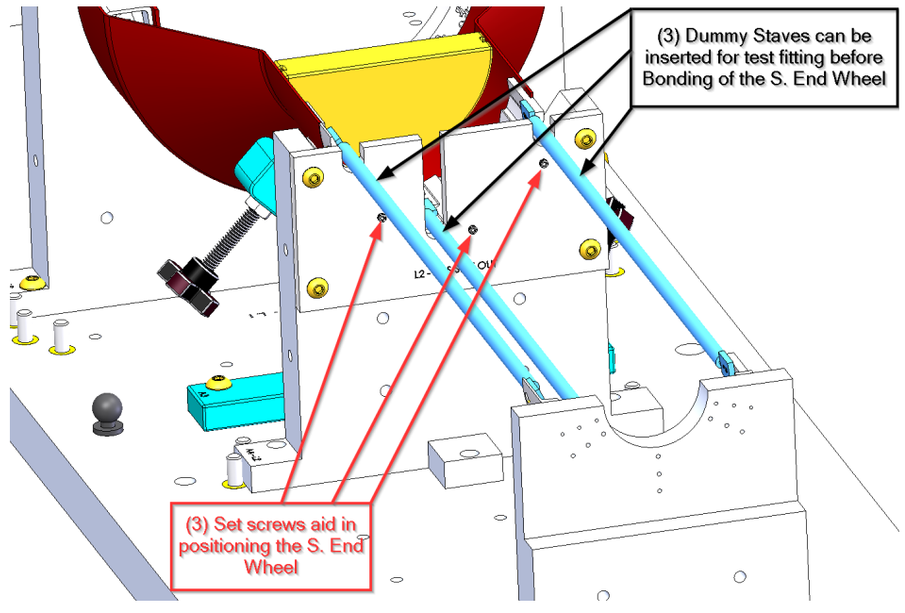


ASSEMBLY

- **Part 2**
  - Assembly review: Sept 9th
    - in person (LBL: Bates+LANL+LBL designers+reviewers) and zoom (Russ, JohnH, …)
    - agreed on some changes (pins that keep the staves in place, and a few for the fixture itself) and placed orders
      - the pins went since Sept through another version/order (same design, but different size)-- *all in hand since beginning of Dec*
      - the fixtures→ a prioritized multi-part order –> last parts are scheduled for pick-up *TODAY*
  - ETA for finishing assembly of 2 halves: ~1 month
    - BUT: *uphold 4, does not seem to keep the cone in place as desired–> unreliable CMM results*
    - *had to design a 'patch' –> finished during the break, now we are looking for a shop to produce the pieces asap*

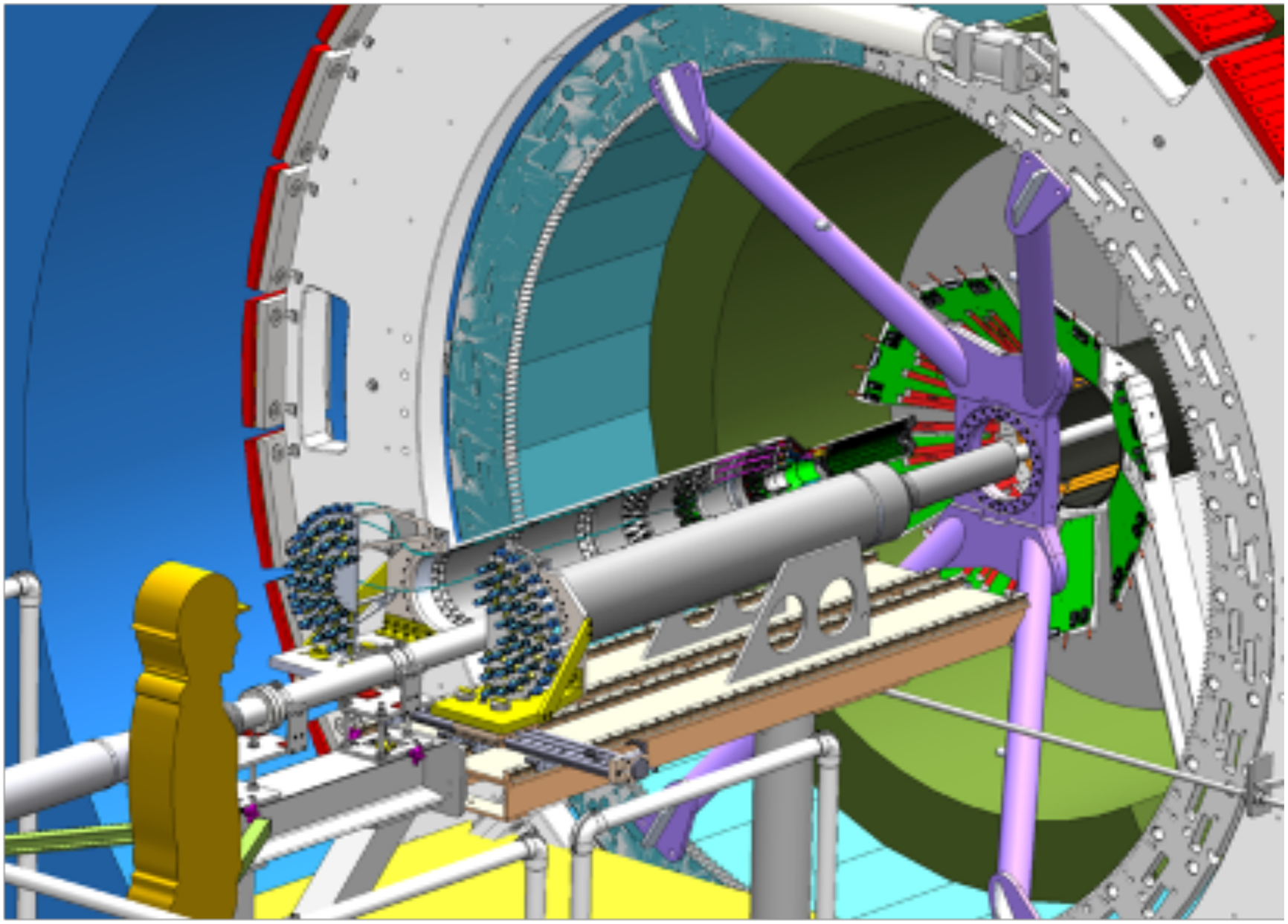


New pusher on the back of A4



INSERTION AND SUPPORT

- **X-wing (support)**
- **Insertion**

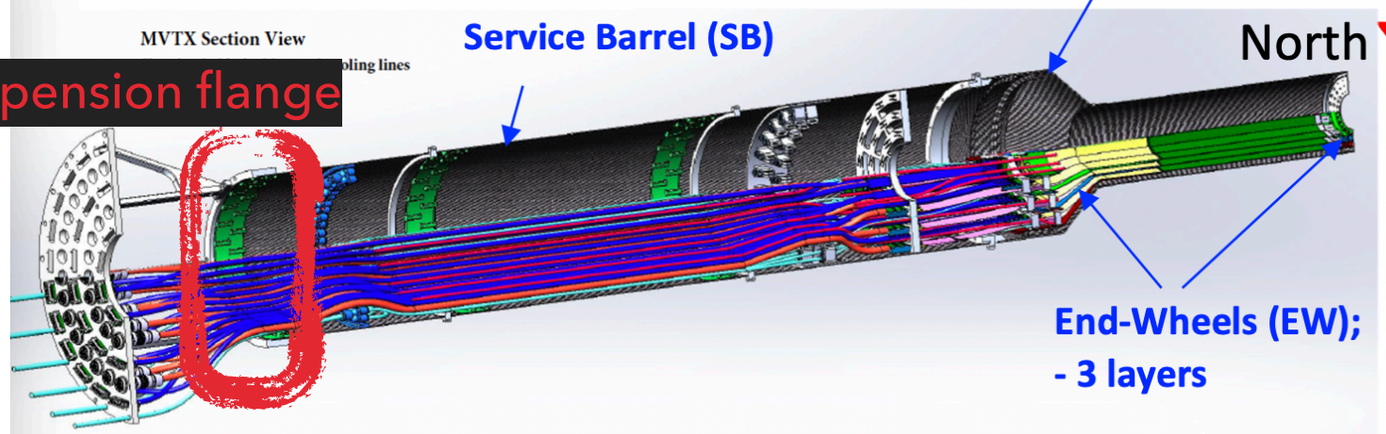


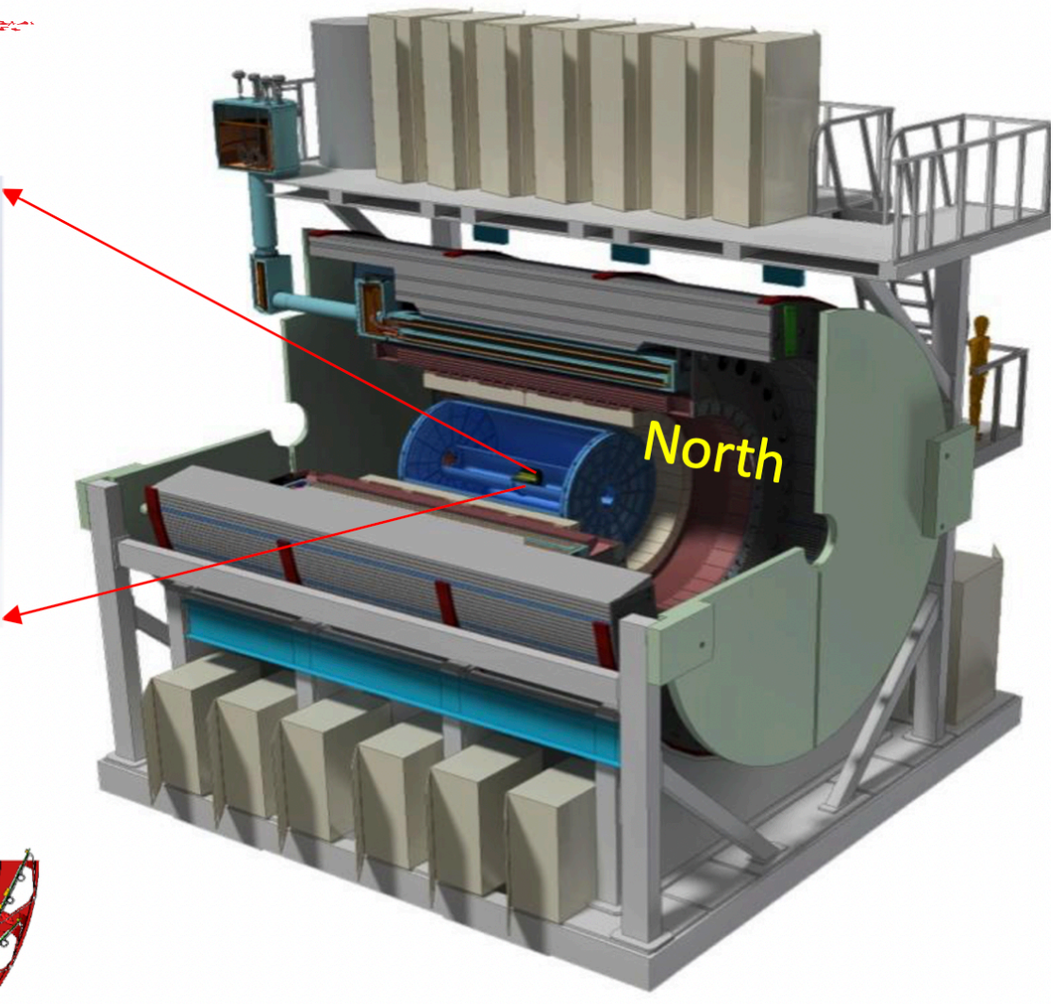
INSERTION AND SUPPORT

MVTX Detector: inner-most sPHENIX subsystem

Cantilevered detector: only on the S-side of sPHENIX

Carb. Fib. Comp./CFC = EW, CYSS, SB



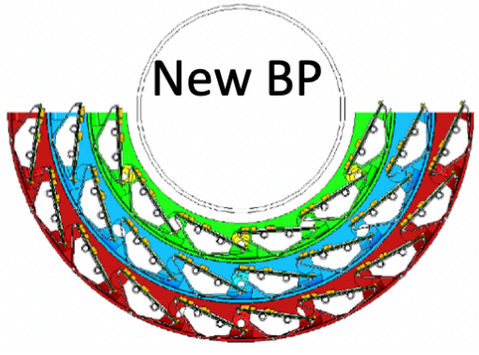


Total Weight: ~24 kg (sensors: ~3 kg)

Sensor Length: 271mm

R (mm)	min	mid	max
Layer 0	24.61	25.23	27.93
Layer 1	31.98	33.35	36.25
Layer 2	39.93	41.48	44.26

3-layer sensor barrel
- 48 staves, 432 chips



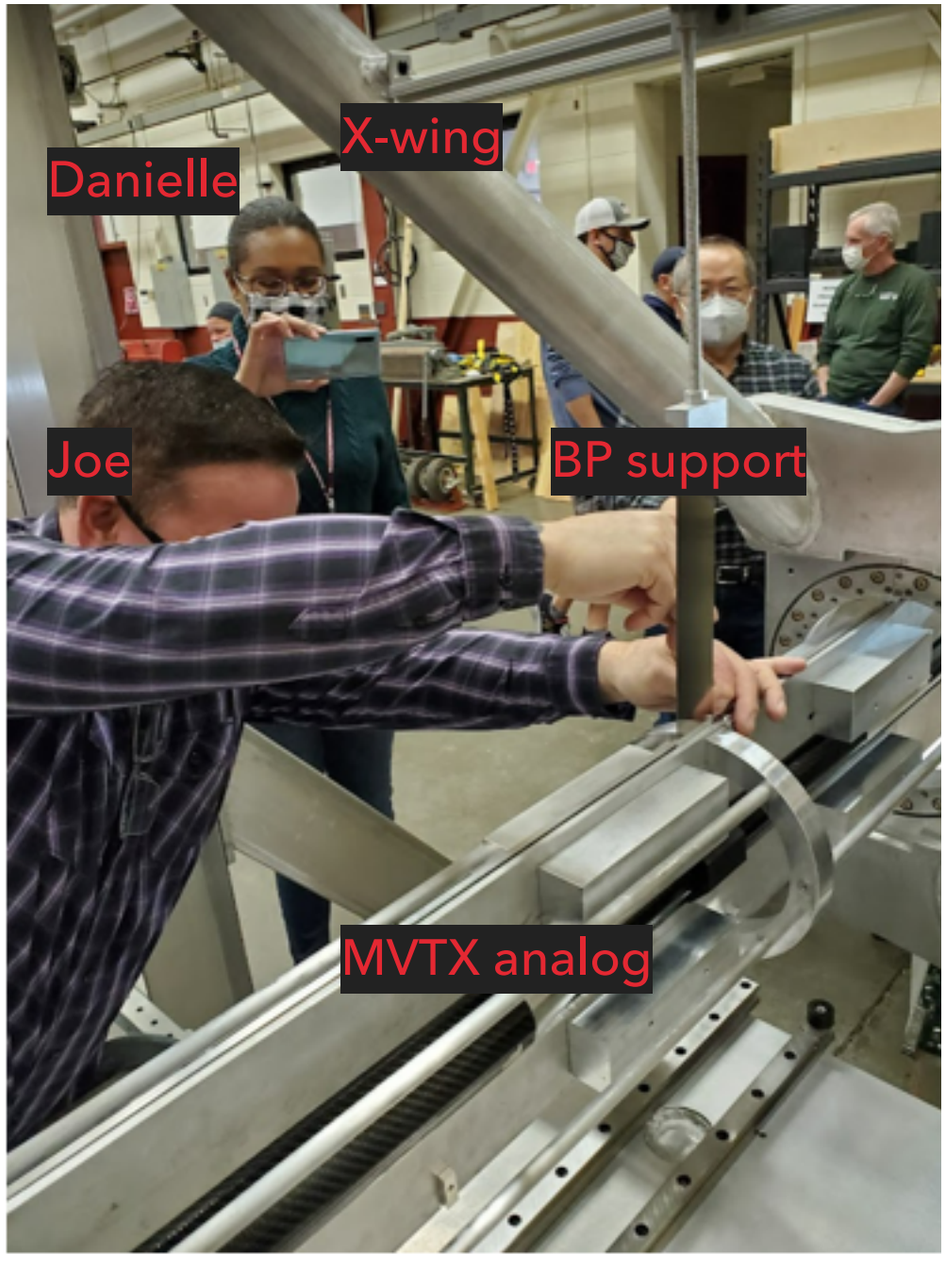
It's TRICKY business !

–> inner layer 0.97inch close to the BP (and 1.74inches on the outer radius)

–> nose of the detector is .. in the air –> detector suspended only on the S-side of sPHENIX!

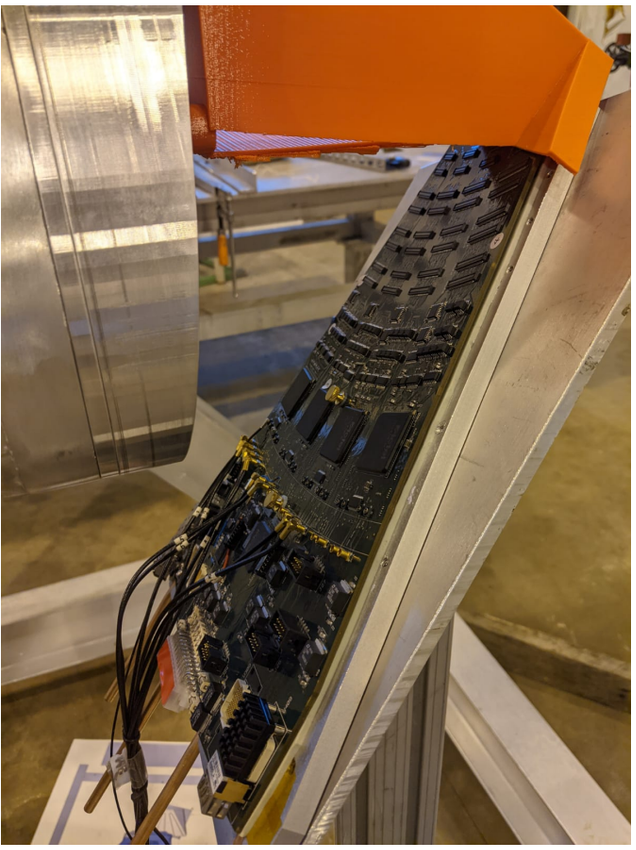
MOCK-UP

- **Parts (X-wing, rails, handles, …):**
  - all in hand *mid-November* –> practice, practice, practice ….
- **Review in Bates in person – *Dec. 14th***
  - Attendance: BNL–Russ&Brian, Survey team (Matt&Joe), LANL– Ming&Yasser, Bates crew
  - A prolific meeting
    - checked that the new beam-pipe supports and the MVTX can live together
    - *check access (to INTT and MVTX)*
    - fully exercised the full insertion procedure (with transfer from rails to X0wing);
      - identified possible improvements
    - got suggestions for tweaks to X-wing to increase position-tuning options
      - no need for another order, just refurbishes of the existing X-wing
    - great discussion on the survey options, w/ a plan for survey
      - tests to be done w/ real detector, in BNL, in spring/summer 2022

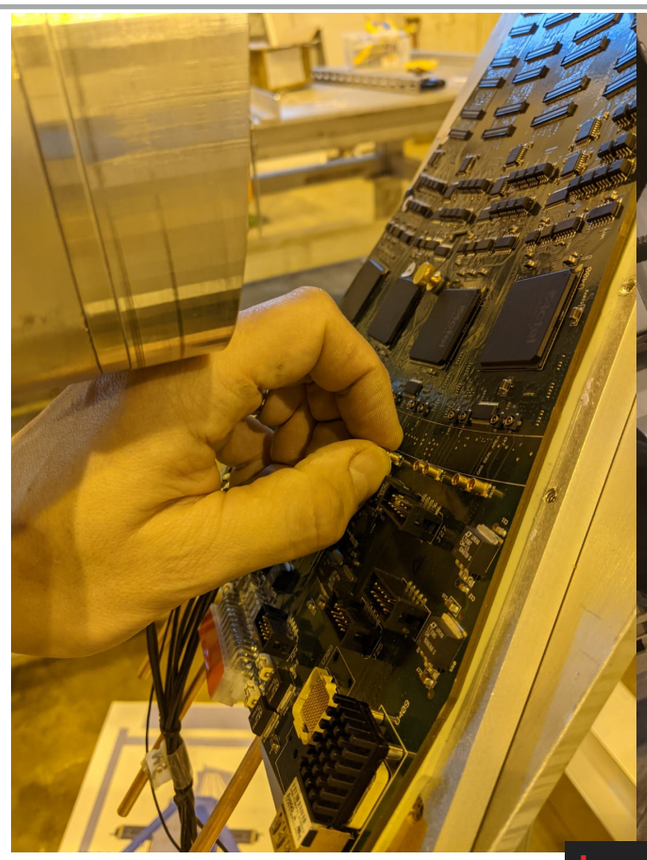


ACCESS TO THE INTT ROC

Last remaining ToDo w/ the mock-up in Bates: finished 8.30am today



INTT ROC+cables @ closest distance from X-wing



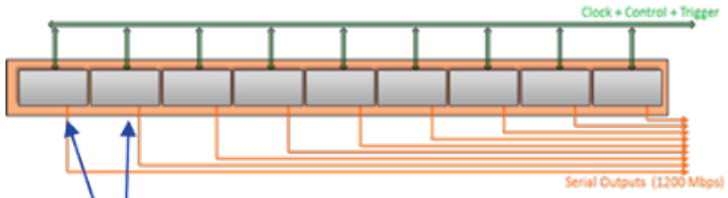
Jason's hand

Jason's hand is "huge" (his qualification)

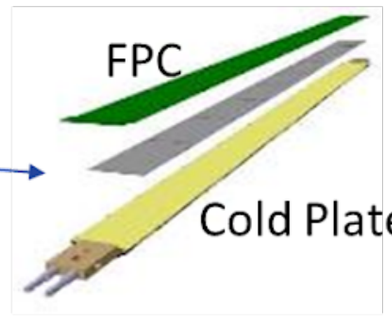
Thank you, Rachid&Dan for shipping the INTT parts!

READOUT AND CONTROL

9-sensor **Stave**



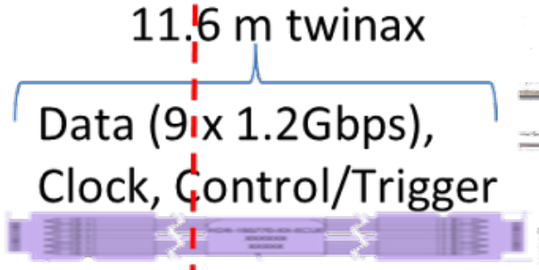
ALPIDE **Sensors**



Regulated power
13.3m

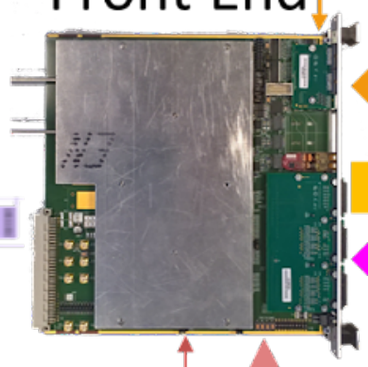
11.6 m twinax

Data (9 x 1.2Gbps),
Clock, Control/Trigger



Power Board

Readout Unit
Front End



CANbus

85m
GBT Optical Links

Control

Data (3x3.2 Gbps)

Trigger

Power

Power

CAEN Power Supplies

FELIX
Back End

PCIe

DAQ and Slow Control

Clock/Trigger

sPHENIX GTM

Interaction Region

Experimental Hall

DAQ Room

READOUT AND CONTROL

- **MANY tasks have been completed:**
  - Had an Electrical Safety Review
  - FELIX & RU firmware
    - FELIX production also completed (still to be tested)
  - Full readout chain testing via streaming readout with proper time framing
  - Control and test of CAEN system
  - Porting of ALF, Low-level Arbitration, & ITSCommLayer Software from ITS
  - WinCC Order finished—> *have everything in hand since mid-November*
  - PLC order —> *delay in delivery until end of January*
  - GTM integration into readout chain (via SFP)
  - Fiber routing & order of prototype fibers
  - CANbus control and monitoring of Readout Units

READOUT AND CONTROL

- **Still to be done (by ~end of winter)**
  - RCDAQ integration of MVTX streaming readout
  - Possible repair of all VTRx flex circuits
    - new problems discovered during recent retest
  - WinCC
    - porting from ITS
    - Integration of CAEN & PLC system control into WinCC
  - PLC programming
  - Finite State Machine Porting from ITS
  - GTM trigger output over minipods
    - so far unsuccessful over minipod, but works over SFP
  - "Busy feedback" over FELIX and GTM to trigger system
  - Testing:
    - FELIX production
    - Full fiber chain testing & final order of fibers
    - Samtec/signal cable testing

COOLING

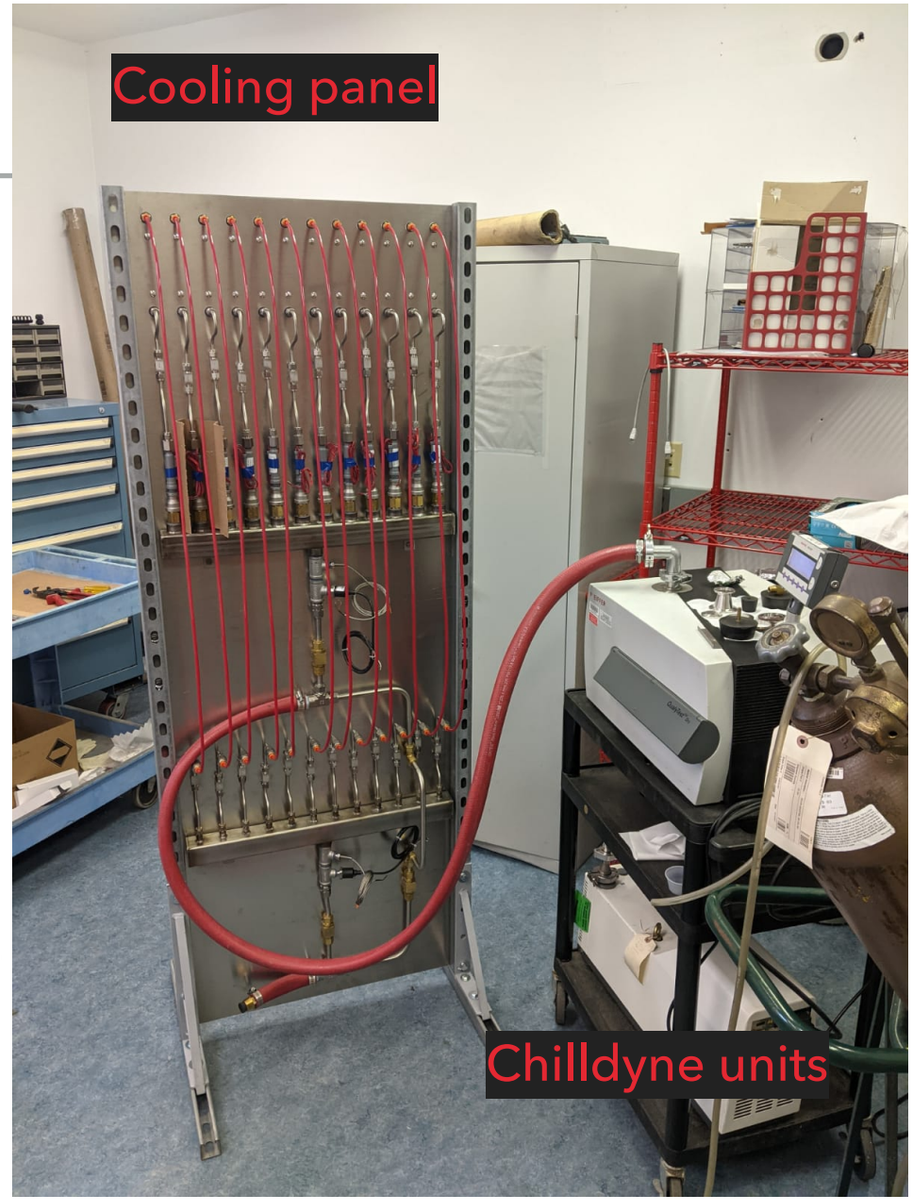
Aim to do much better than this…

COOLING

- **Designed 2 systems**
  - one for cooling the detector (Bates) – 1 panel
  - one for cooling the 2 electronics racks (LANL) – 2 panels/circuits
- **To be done:**
  - on-going discussions w/ BNL for optimal design+placement of the 3 panels, which 2 need to be close to the racks and 1 to the det. entrance
  - tests

Goals of the cooling test:

1. Ensure all connections are leak-tight – done
2. Establish system filling procedures
3. Ensure operation of all 12 flow switches
4. Ensure operation of temperature and pressure sensors
5. Connect system to test resistance and establish operating curve of flow vs. pressure (including expected pressure drop across staves)
6. Test leak detection capability of the cooling unit
7. Verify ability to shut off one leaking circuit and keep rest of system running
8. Operate system under heat load
9. Read out internal sensors from Chilldyne unit using SNMPv1 or Modbus TCP/IP
10. Test PLC connection



- **Schedule:**
  - *January 2022*: finishing tests
    - buy: 2 more chilldyne units (if found appropriate)
  - *Spring*: ship everything to BNL

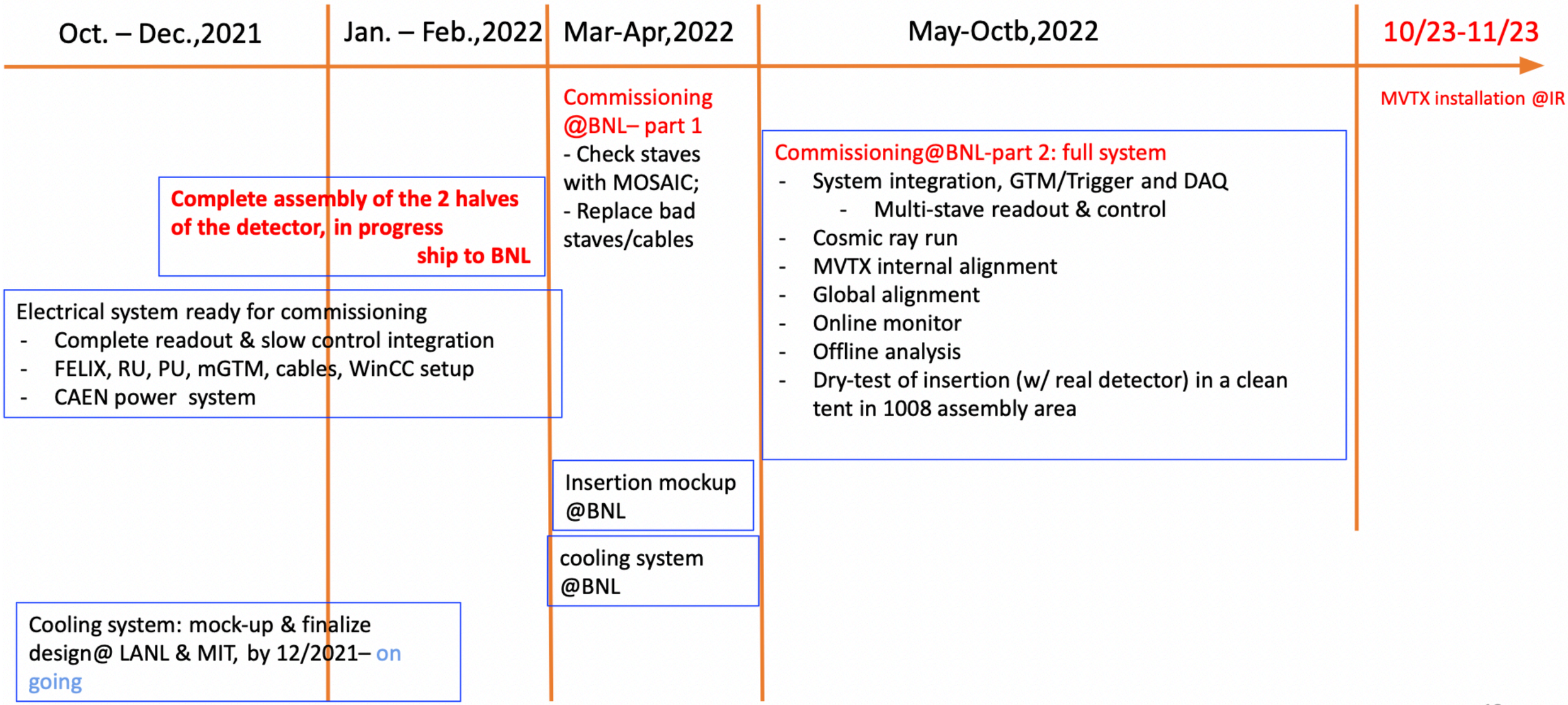
COMMISSIONING

“UNTIL TESTED, IT DOESN’T WORK”

COMMISSIONING

- **2 phases envisioned so far**
  - Phase 1: Spring 2022 (once detector arrives in BNL from LBL)
    - Check staves with MOSAIC;
    - Replace bad staves/cables
    - cooling and insertion+support/insertion systems shipped to BNL
  - Phase 2: Summer-Fall 2022
    - Insertion dry-tests w/ real detector in a clean tent
    - System integration, GTM/Trigger and DAQ
      - Multi-stave readout & control
    - Alignment:
      - MVTX internal alignment
      - Global alignment
    - Cosmic ray run
    - Online monitoring
    - Offline analysis
- Already people (Cameron) on-site
  - he’s looking for real-estate for our clean tent in 1008 :D

SUMMARY



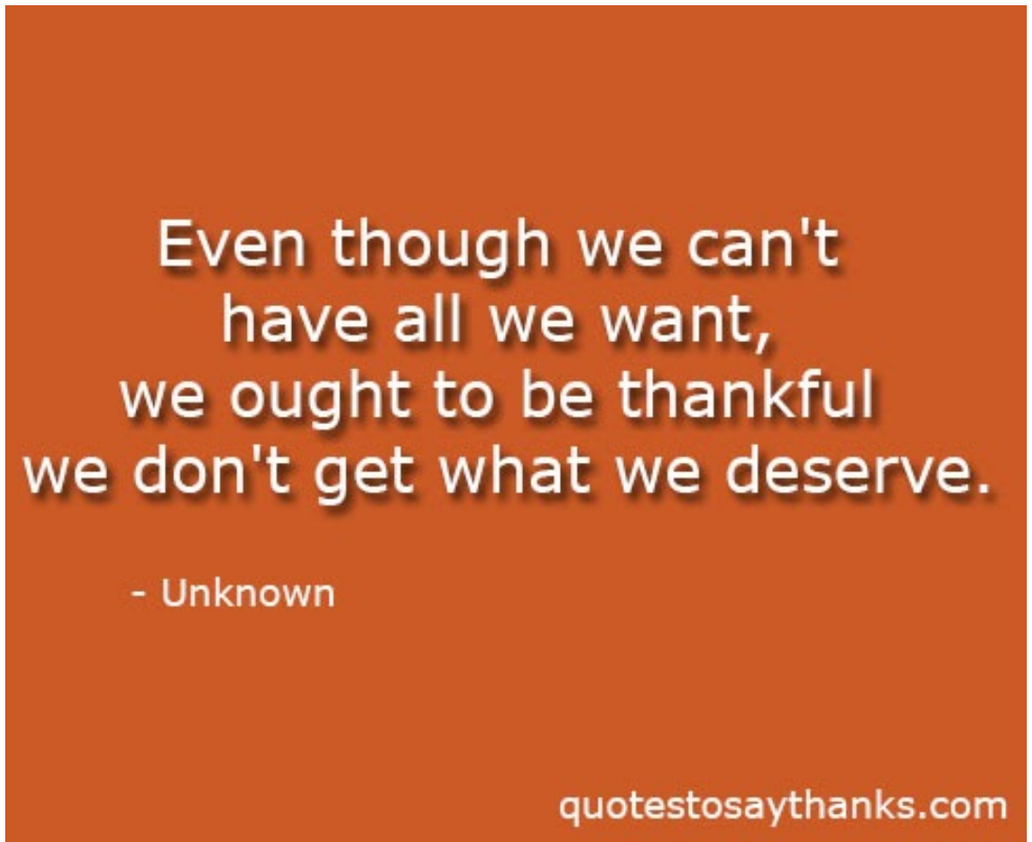
A lot accomplished & Plenty left to do!

But, we do not see (at this moment) any serious possible sources of delays.

END

The MVTX team would really like to thank all the BNL masters, who work with us, help us, and do all they can so the MVTX project is a success: it has money (Ed), it fits (Russ et co), it's cooled (Rob et co), it's cabled (Joel et co), and it's on schedule :D.

THANK YOU !



EXTRA

STAVES

Stave test (from LBNL report 12/20/2021)

No metrology										
Gold	A201	A203	A204	A205	A206	B201	B205	B206	E204	F202
	G202	I202	I205	L203	S201	U202	S205	J206	K205	L204
	H202	J202	K202	K206	H203	K203	L201	S203	H204	J204
	K204	L202	S204	S206	X201	Q202	U205	U201	X202	R201
	U206	Q201	T202	T201	T205	R202	U203	X204	A305	O206
	Z203	A301	Z204	O201	B305	B306	A304	B304	B204	M205
	A303	O205	P204							
Silver from CERN	B204	B301	W203	Z201	Z202					
Silver	B203	E206	H205	W205						
Pixel masking										
Silver + stuck pixel	I203	L205	J203	T204	R203	T206	X206	X205	O203	A306
	Z206									
Unclassified	W204									

- 84 staves (5 Silver from CERN)
- Readout test - Not for stave classification
- Silver staves with stuck pixels were gold at CERN because stuck pixels were masked for the test
- 4 silver staves due to noise issue in threshold scan
- A few staves without metrology data
- 63 (Good) Gold staves