# Near Electronics Integration and Test Considerations

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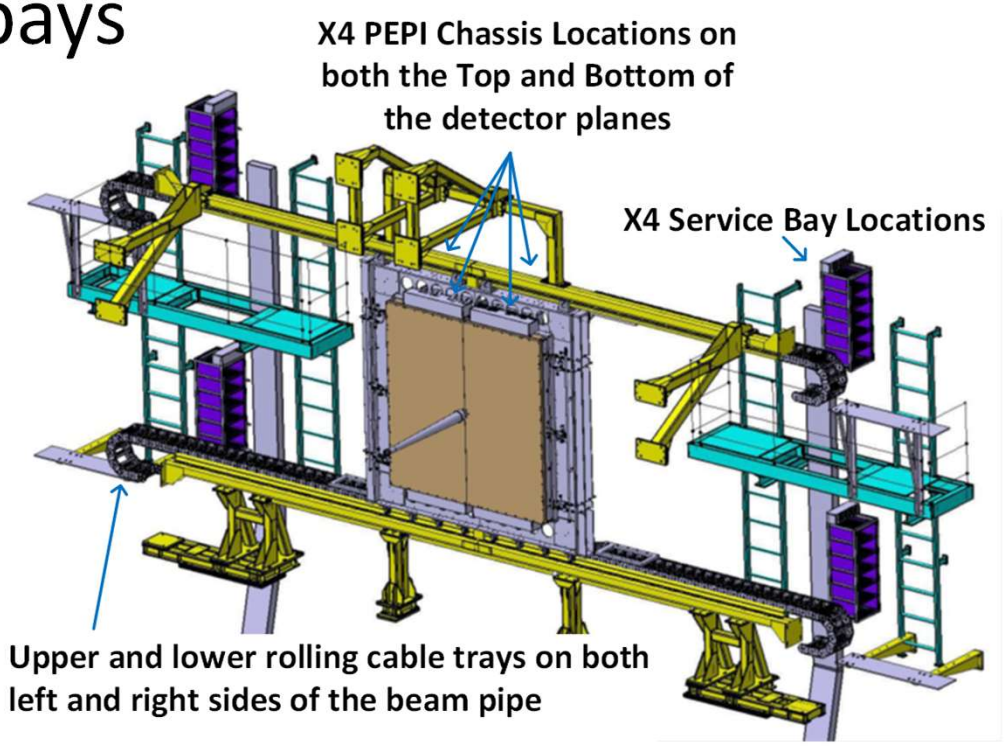
# Assemblies Considered

- PEPI chassis
- Power subsystem located service bays



# PEPI to Service Bay Connection Categories

- Power wire pairs for 4-ASIC loads
- PEPI ground reference braid for SMCU
- Ganged regulator lines for PEPI backplane power groups
- Optical fibers
- System control and sense cable
  - Local environmental failsafe sensors for SMCU use
  - Secondary elink control interface for GBT-SCAs

Lots of electrical interfaces and corresponding cables that need 100% in-situ test before ready to control clean-room integrated UT detector + PEPI assembly

# Considerations on Initial Assembly and Maintenance

- Two opposing integration main approaches considered to-date
  (1) Integrate PEPI and slide-in-place, then plug-in pigtails
  (2) Assemble PEPI board-by-board with tested and integrated Staves in clean room
- Final decision could impact in-situ repair options and approach
- Pigtails appear to be the actual limiting component that force an approach—just want to make sure we understand the end resulting constraints to maintenance
  - Access space along backplane edge for pigtail mating is very constrained and dense
    - Some options may be available to reduce the backplane Y dimension
  - Flex-circuit-based pigtail basically captivated by UT frame access slots
    - May not be able to remove with PEPI boards and cooling plates in place—ie removing a stave may require removing the pigtail(s) which may require removing the PEPI hardware
- Dismantling the PEPI in-situ may necessitate removing the water jacket(s) and all boards connected to it via wedge-locks

# Backplane Connectors

- SEAM8 connectors are present baseline on backplane
  - Pigtails use 40x10 contact configuration
    - 4,800 connections per backplane
  - Boards use 50x10 contact configuration
    - 6,500 connections per backplane
  - *Total PEPI SEAM8 = 33,900 connections*
- Samtec Long life product rated for 1,000 mating cycles with limited degradation in contact resistance
  - Assumes 33,900 PCB ball attachments unaffected by mechanical flexing and thermal cycle stresses
  - Requires special nitrogen reflow process for attachment
  - Have not yet specifically located similar test data for the corresponding right angle connector, but assume similar results
- Mate/de-mate forces range between 12 to 35 pounds for 50x10 connector depending upon humidity, number of cycles performed, and mate vs un-mate
  - Force characterization test also reports that mate/de-mate force increases up to the maximum tested limit of 25 cycles
- Each PEPI board has at least 7 BGAs plus the 500 connector solder pads (another >3,000 contacts per board)
  - ALL boards must be designed for minimal flexing when being handled for mating/de-mating

Lots of BGA-Style contacts,
PCBs must have minimal deflections

# Near Electronics Integration Flow

- 3 main component subsystems to test
  - Power sub-system in service bays
  - Populated PEPI chassis
  - Populated PEPI chassis + Populated Staves
- Power subsystem and PEPI boards to be separately tested and burned in at UMD
- Integrate and test complete power system final installation in-situ before connecting to PEPI and detector assemblies
  - *Verify all grounds are isolated from facility grounds when the single point earth ground is disconnected*
  - Verify all power groups under load, but not necessarily simultaneously
  - Test SMCU control and sense cables
  - Verify optical fibers if repairs require partially dismantling the cable trays
- PEPI can be integrated board-by-board with Staves during initial clean room assembly
- Integrate Service bays with pre-assembled PEPI chassis and Staves in-situ

# Stave Assembly Comments

- Verify that hybrid grounds are isolated from stave components (eg cooling tubes, carbon foam, etc)
- This should be re-verified as each stave is installed

# Power Sub-System Integration Infrastructure

- Thermal load test fixture
  - Accepts power connector assembly for 3 backplanes
    - PEPI board loads
    - Hybrid loads
  - Test points to verify voltage drops
  - Loads are air cooled
  - SMCU sensor stimulus to verify PEPI control and sense cable
- Need power source(s) for testing subassemblies
  - Stand-alone PEPI chassis
  - Hybrids in final stave configuration + PEPI chassis
  - May need separate power source for clean room system integration?
  - May be able to 'borrow' production power boards, but need to coordinate with in-situ power tests in the cavern

# Summary

- Decisions we make today will impact the system maintainability for many years to come!
- Final integration and test flow must build in sub-system tests to minimize damage risks to labor intensive integrated stave assemblies
- Power sub-system needs to be installed, integrated, and tested under load before being integrated with PEPI and Staves
- Likewise, system failsafes need intentional verification test plan