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Structural Composite Design, Simulation, and Testing of the HL-CMS Inner and Outer Tracker Support Tubes

Wednesday 29 May 2024 16:00 (30 minutes)

The Composites Manufacturing and Simulation Center at Purdue University is responsible for the delivery of final CMS Barrel Timing Layer Tracker Support Tube (BTST) and inner tracker support tube (ITST) for the LHC Phase II high luminosity upgrade. Challenges and lessons learned while prototyping, re-designing for manufacturing in composites, simulation, and testing will be presented for both.
BTST is nearly complete, including metrology and validation. It is an outwardly simple, but actually complex, 2.4m diameter, 5.3m long composite sandwich structure that will provide primary support to BTL, Outer Tracker, and Inner Tracker CMS components. Topics covered will include 1m long prototype validation, FEA simulation predictions of deflection during final integration loading, as-manufactured metrology, tracker rail placement and bonding, and simulated deflection validation via partial loading of the final structure. Many fabrication steps performed by Rock West Composites in San Diego are intended to be covered in a separate presentation.
Following a successful prototyping and testing phase, the production of center and end sections of ITST has commenced. A major achievement in January 2024 was the successful integration test of the TBPX and TFPX, involving the insertion of a mock service cylinder into the ITST center section prototype. This test provided valuable insights into metrology methods and the software and hardware requirements for tracker alignment in TFPX and TBPX. Additionally, track manufacturing and bonding for both center and end section ITST provided crucial design insights. The presentation will also cover the results from silicone seal fabrication between the inner and outer tracker volume and composite processing lessons learned about the degradation of Aires R82.80 when co-cured with cyanate ester resin systems.

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