



B09: Path to CD-2

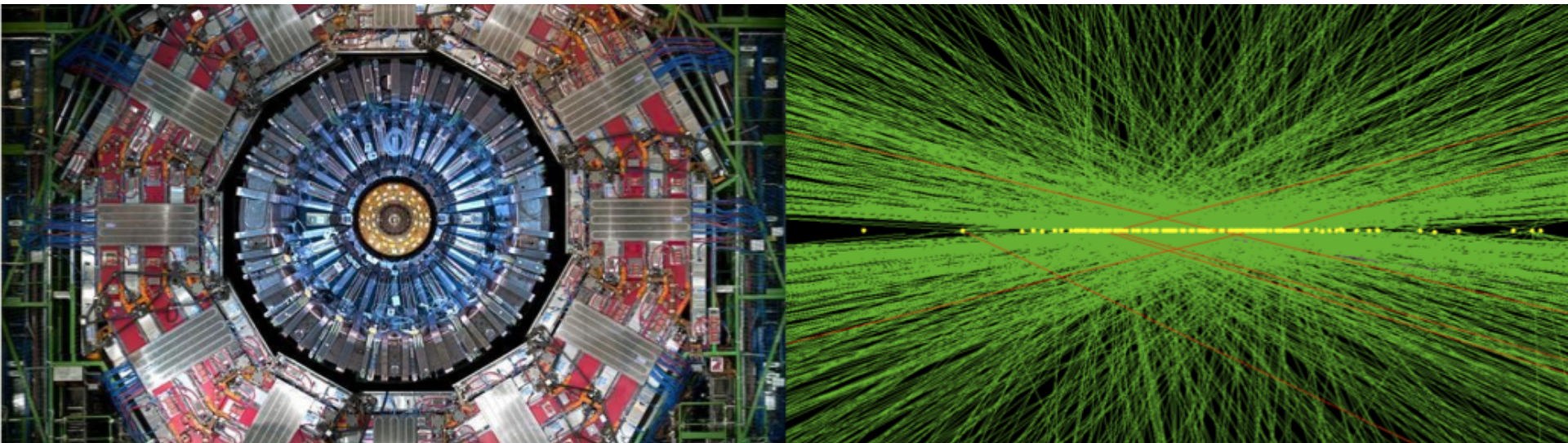
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Univ. of Calif. Santa Barbara

HL-LHC CMS CD-1 Review

23 October 2019





Biographical Sketch

David Stuart, Prof. at U. Calif. Santa Barbara

- Serving as ETL Technical Coordinator in MTD
- Serving as deputy L2 in US-MTD
- Related experience:
 - Searches for new phenomena at CDF and CMS
 - Convener of CDF exotics and CMS SUSY groups
 - Design, construction, & operation of tracking detectors at AMY, CDF, CMS
 - Track reconstruction and b-tag development
 - Fast timing R&D for SSC with Charpak group



Overview and outline

- We are preparing for:
 - CD-3a in April 2020 for LYSO purchase.
 - CD-2 baseline & CD-3 final design by end of 2020 or early 2021
- We now have a well-defined scope, which is being formalized in MOUs after the LHCC and UCG review.
- By late 2020 we will be ready for CD-2 baseline.
- By end 2020 / early 2021, all design decisions will have been made and component performance validated. Only design/assembly optimization and validation of assemblies using final prototypes will remain.
- I will cover the
 - early purchase of LYSO for CD-3a.
 - remaining R&D and milestones for CD-2/3.



Early Purchases

- BTL schedule necessitates placing orders for production era LYSO ahead of the CD-2/3 review:
 - LYSO order is to be placed in October 2020
- The US is planning to make a significant contribution to this commodity:
 - 18% of the required LYSO, at a direct cost of \$500k
- By April, 2020 we will be ready with the final design specification for LYSO crystals, with design review planned for May 2020.
- We are planning to participate in a CD-3a review in April 2020 to accommodate early purchases



BTL R&D and milestones to CD-2/3

- **LYSO:** Remaining R&D limited to production details for commercially available solutions such as choice of optical **glue** and reflective **wrappings**.
 - By CD-2/3, pre-production LYSO crystal matrices will have been evaluated, production-era crystal specification finalized, vendors chosen and **orders placed**;
 - TL9610 BTL - Contribution to CMS production LYSO matrices [CORE] Jun-2020
- **SiPM:** Testing of SiPMs from HPK and FBK with optimized QE, S/N, and power consumption at optimal $V-V_b$.
 - By CD-2/3, pre-production SiPMs and packaging will have been ordered and assessed.
 - TL001640 BTL - POs for SiPM preproduction and packaging issued Jan-2020
- **SiPM Packaging:** prototype ceramic package and optimize thermal properties.
 - By CD-2/3 the package will have been developed; thermal properties may require optimization.
- **Sensor boards:** studying two options for connection of SiPMs to TOFHIR boards.
 - By CD-2/3 decision will be made between these options.



BTL R&D and milestones to CD-2/3

- **Concentrator Card:** Testing of full functionality prototypes in Q1 2020. Decisions on 2 vs 3 lpGBT/VTRx+ and integration of PCC to be made in early 2020.
 - By CD-2/3, prototype CCs with prototype components (lpGBT, VL+, DCDC) will be **complete and assessed**;
 - TL00942 BTL - T5 - CC - Concentrator Card prototype complete Jan-2020
- **Assembly:** Module and tray design transitioning from conceptual to engineering design.
 - By CD-2/3, BTL **system testing completed with prototypes**.
 - TL1001909 BTL – B.T.1 - System test using RU Proto1 Mar 2020
 - TL1001919 BTL – B.T.2 - TOFHIR2 DCR circuit test with irradiated sensors May 2020
- This allows development of **assembly procedures** and mockups. Industry outsourcing options to be explored.
 - By CD-2/3, the BTL assembly procedure will have been **defined and tested and mechanical mockups will have been built**;
 - TL00932 BTL - T4 - Module R&D and prototyping complete -- assembly process validated Sep-2020

ETL R&D and milestones to CD-2/3



- **ETROC ASIC:** Evaluating ETROC0 (preamp+discriminator) and producing ETROC1 (4x4 w/ preamp + discriminator + TDC), designing full functionality ETROC2 (8x8), and will scale to ETROC3 (full 16x16)
 - By CD-2/3, we will have the ETROC1 testing results and simulated performance of the full-functionality ETROC2 design.
 - EM165 ETL - T4 - ETROC1 testing results available Jun-2020
- **Assembly:** Constructing modules of increasing size and complexity, first mechanical and thermal mockups, then prototype modules with electrical functionality. Will verify the full end-to-end module assembly procedure, first with mechanicals and then functional parts.
 - By CD-2/3, the ETL module design will have been validated and tested with ETROC1 based mini-modules and the assembly procedures tested.
 - TL1001120 ETL - T4 - Module mechanical design validated Mar-2020
 - TL1001140 ETL - T4 - Module thermal performance validated Jun-2020
 - TL1003180 ETL - T4 - Tested ETROC1 based modules Aug-2020



CD-2/3 Readiness summary

- The cost, schedule, and risks are already well developed and the design is beyond conceptual.
- The US-MTD scope is defined and will now be formalized in the MOU process following the UCG review.
- The project will be ready to baseline for CD-2 and have all design decisions completed and component performance verified for CD-3.
- We are on track for CD-2/3.