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Metrology and digitization for the highest accuracy class power converters in High Luminosity LHC at CERN

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PART 1
I. Introduction
- What we do at CERN (in general, Electrical Power Converter group, High Precision Measurements section)
- The need for high precision + high dynamic range + stability
- Unique challenges - environment, reliability, maintainability, etc. Differences between a metrology lab and accelererator tunnel. Measurements for closed-loop control and real-time applications
- "The best digitizer"vs "the best trade-off": What is really needed in our case?
- The complete high precision measurement chain: from high current through low voltage to digital code
- Supporting the measurement chain: test and calibration infrastructure

II. Development of high-performance digitizers at CERN

- Development, deployment and use of DS22
- Other digitizers - FGC internal ADCs, PAM, PAMB, etc.
- From LHC to HL-LHC. New requirements and needs
- From DS22 to DS24. Upgrade of dipole circuits
- Evaluation of commercial ADC integrated circuits, comparison of relevant parameters

PART 2
III. HL-LHC Class 0. HPM7177

- The AD7177-2 ADC
- Building a digitizer around an ADC. A system-level view
- The input signal path. Fully differential circuits
- Supporting circuits and sub-systems. Module-level temperature stabilization
- Component level: precision resistors and resistor networks; stable capacitors; voltage references
- Interaction with other systems –connections, communication, EMC
- Sources of measurement error and uncertainty

IV. Proving digitizer performance

- The limits of classical metrology equipment. Performance limitations of buried Zeners
- Voltage calibration infrastructure at CERN
- Going beyond the specs –examples from CDC testing, cross-PSD estimation
- Going straight to the top –PJVS tests at PTB

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