Development of the data acquisition system for the Triple-GEM detectors for the upgrade of the CMS forward muon spectrometer

G. De Lentdecker, on behalf of the CMS Collaboration
Université Libre de Bruxelles (ULB)

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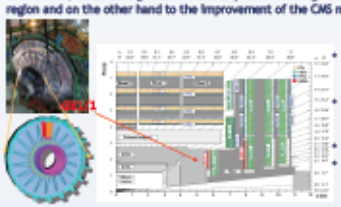

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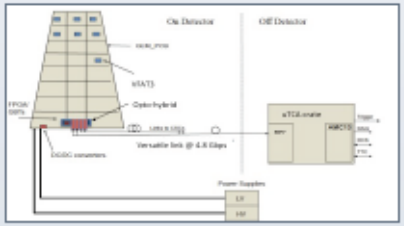
The challenges for the GEM readout system are numerous: the time resolution should be as good as 5 ns, to unambiguously identify each LHC bunch crossing, the best spatial resolution, ~100 μm, should be ensured at the first level of the CMS trigger system which has a latency of 3.2 μs and the data acquisition should sustain a very high data throughput, of the order of 100 MB/s of trigger data (zero-suppressed) per detector at high LHC luminosity (HL-LHC).

DAQ system architecture

The CMS GEM Collaboration has launched a complete R&D program to develop a new Front-End chip, which should be flexible enough to be used with various Micro Pattern Gaseous Detectors (MPGD), as well as a trigger and data acquisition system based on the most recent developments from the telecommunication industry (μTCA), in line with the other CMS upgrade projects. In this contribution we will report on the design and the expected performance of the CMS GEM readout system, including preliminary results obtained with the first electronics prototypes.



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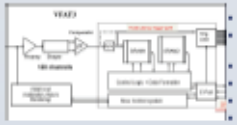
VFAT3 features



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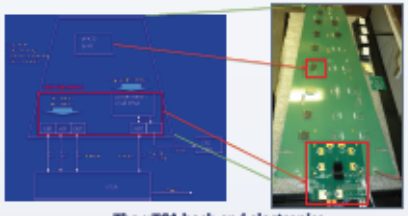

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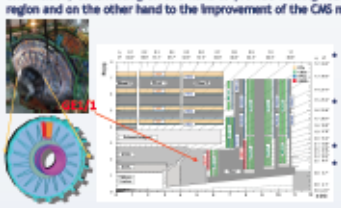

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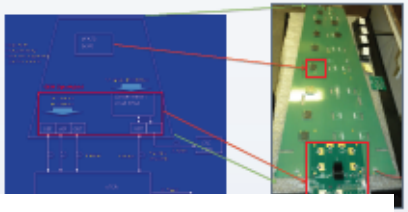

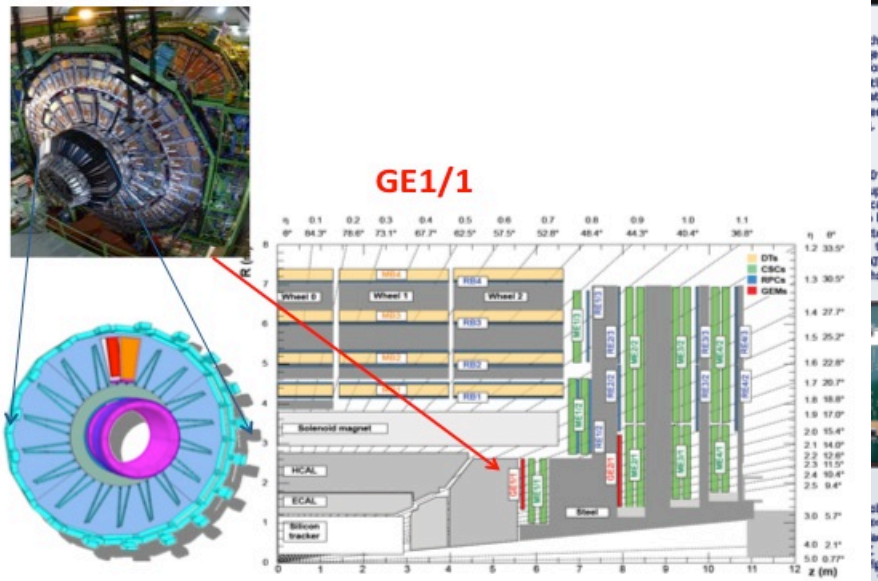

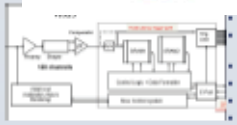

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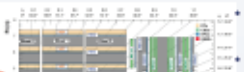

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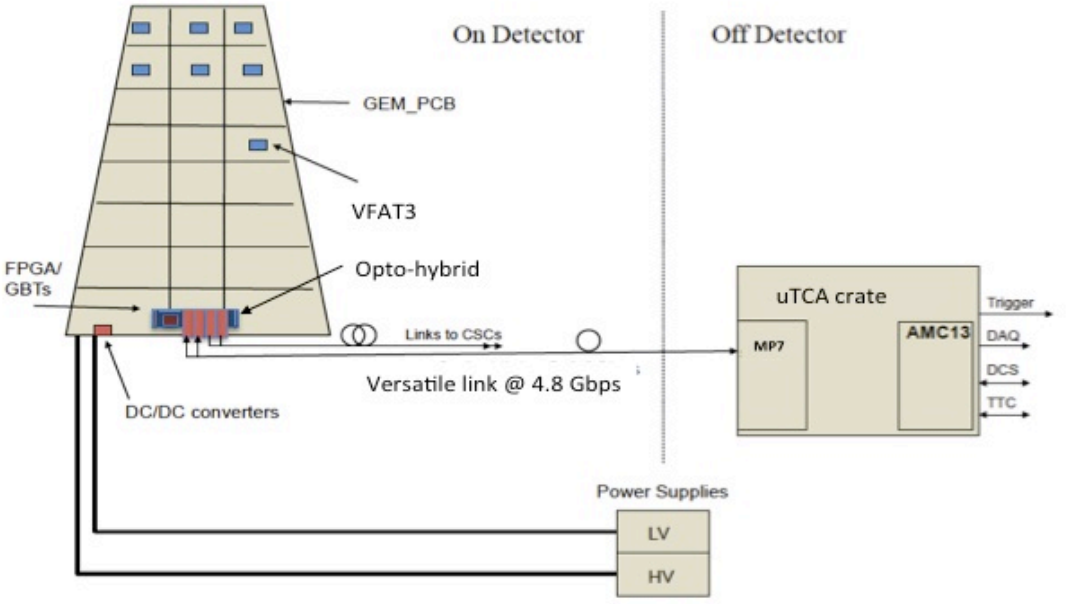

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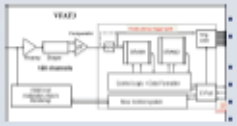

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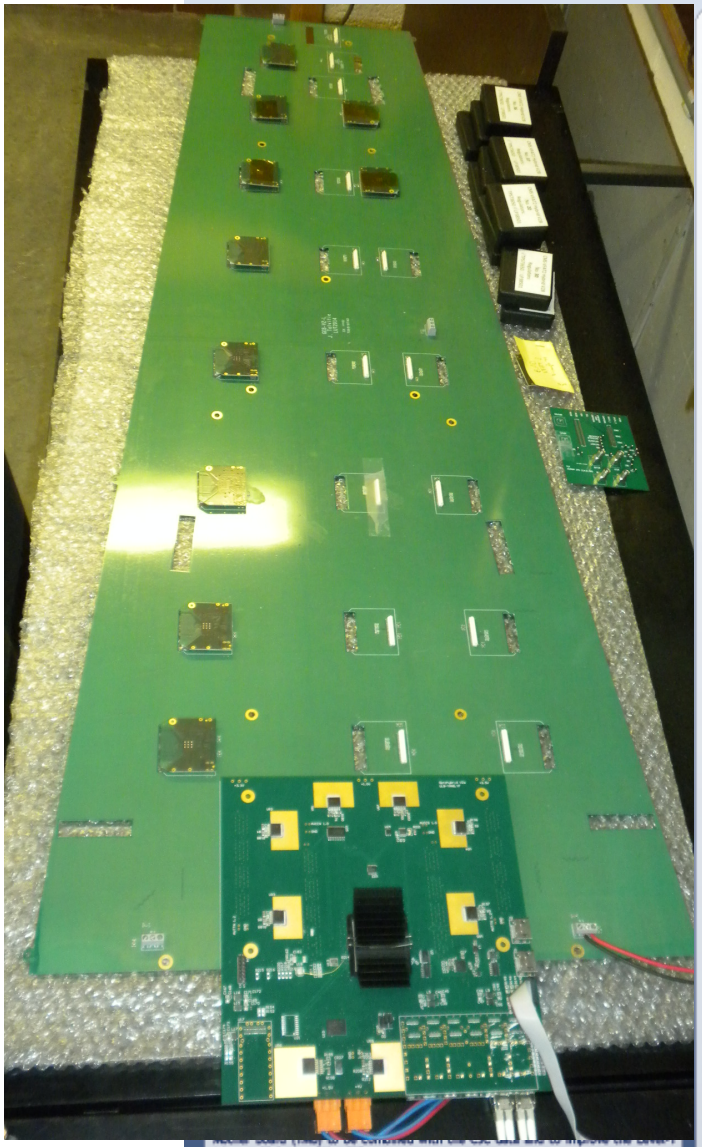

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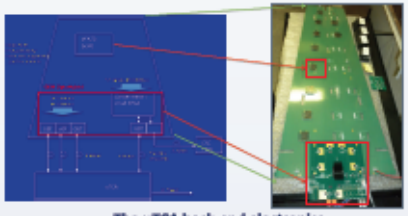

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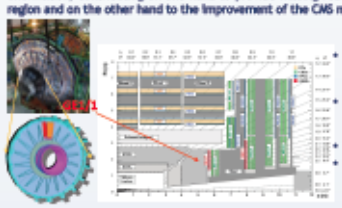

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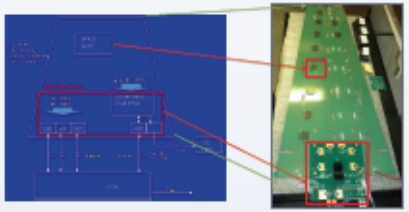

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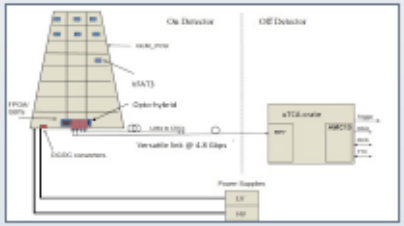

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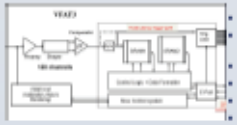

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The 2nd version of the GE1/1 DAQ system has been tested with beam in October 2015. The GEB reads-out the 24 VFAT2 chips and the OH is equipped with a Virtex-6 FPGA. The DAQ software is the CMS XDAQ. In addition a GEM-CSC integration facility has been set-up at CERN. Synchronization of the GEM electronics with the CSC has been achieved using the AMC13 and the CMS TTC system as source of clock and trigger. GEM trigger data are now transmitted to the CSC TMB and to the AMC13. We have demonstrated the LHC clock recovery from the optical link using a QPLL or a CDCE on the OH. In the latest version of the OH, a GBTX chipset has been added on the OH to improve the clock recovery process. Developments are now focused on the use of the VFAT3 chip which will become available end of 2016.

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