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A Digital Front-end and Readout Microsystem for Calorimetry at LHC

Spokespersons: G. Goggi, B. Lofstedt

B. Lofstedt, J.P. Vanuxem
CERN, Geneva, Switzerland

C. Svensson, J. Yuan
Department of Physics and Measurement Technology, University of Linköping, Sweden

H. Hentzell
Center of Technology Transfer, University of Linköping, Sweden

M. Sami, F. Stefanelli
Dipartimento di Elettronica, Politecnico di Milano, Italy

P. Cattaneo, A. Dell'Acqua, G. Fumagalli, G. Goggi
Dipartimento di Fisica Nucleare e Teorica dell' Universita' e Sezione INFN, Pavia, Italy

F. Maloberti, G. Torelli
Dipartimento di Elettronica dell' Universita' e Sezione INFN, Pavia, Italy

P. Carlson, C. Fuglesang, A. Kerek
Manne Siegbahn Institute of Physics, Stockholm, Sweden

G. Appelqvist, S. Berglund, C. Bohm, N. Yamdagni
Fysikum, University of Stockholm, Sweden

The list of institutions and signatures is not yet finalized.

· R&D proposal
subject to approval by the Funding Agencies

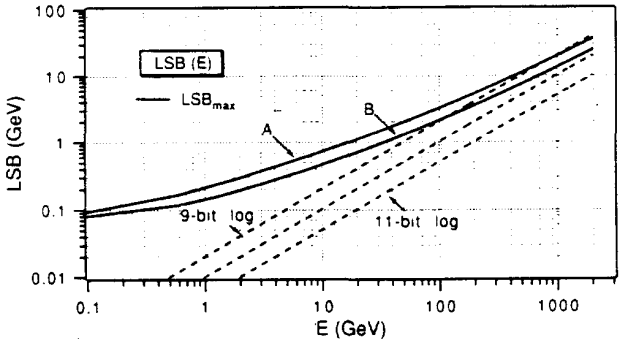
Abstract

Front-end signal processing for calorimetric detectors is essential in order to achieve adequate selectivity in the trigger functions of an LHC experiment. Furthermore, data identification and compaction before read out is required in the harsh, high rate environment of a high luminosity hadron machine. Other crucial considerations are the extremely wide dynamic range and bandwidth requirements for the front-end electronics, as well as the volume of data to be transferred to following stages of the trigger and readout system. These requirements are best met by an early digitalization of the detector information, followed by on-chip digital signal processing and buffering functions at both the first-level and second-level trigger latencies.

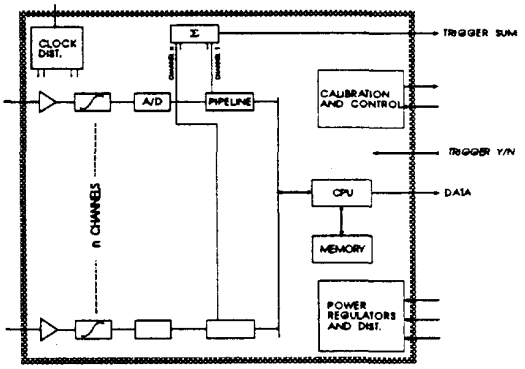
We propose a digital approach to the front-end electronic chain for calorimetric detectors based on high speed A to D converters, a fully programmable pipeline/digital filter chain and local intelligence. Questions of error correction, fault-tolerance and redundancy are also to be considered. The solutions proposed are designed to match the whole range of calorimeter performances in terms of resolution and signal speed.

A system integration of a multichannel device in a multi-chip, Silicon-on-Silicon Microsystem hybrid is proposed. This solution allows a new level of integration of complex analog and digital functions, with an excellent flexibility in mixing technologies for the different functional blocks.

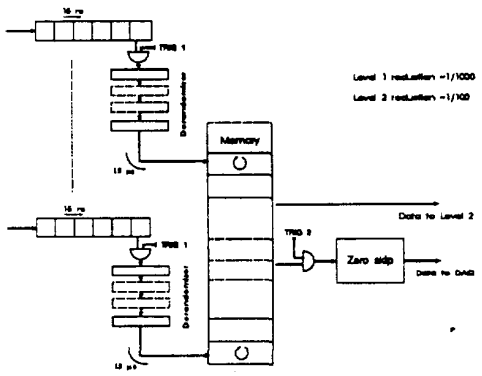
This type of large scale integration offers also the possibility to implement detector-specific functions, as well as a high degree of programmability at both the function and the system level.



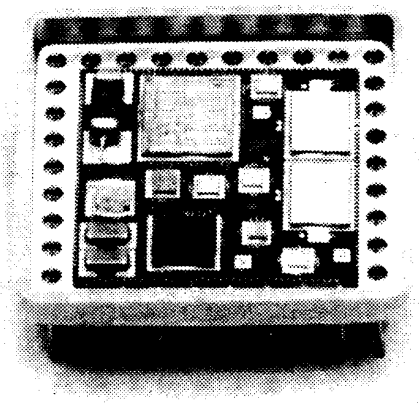
Comparison between possible differential resolutions and upper limits derived from two detector families



Block diagram of a multichannel front-end microsystem hybrid



Block diagram of the buffer and readout functions



A microsystem demonstrator