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R&D Activities in Electronics for future HEP Experiments

Future HEP experiments will require better impact parameter resolution, higher channel count, better hermeticity, lower tracker mass, better timing resolution, higher trigger and data readout rates, more flexible data processing together with very harsh environmental running conditions, including high magnetic and radiation fields.

In the last 25 years microelectronics technologies have been key enabling technologies for designing and building detectors with increasing capabilities and performance. Today, very deep-submicron technologies (65 nm and below) open new possibilities for meeting the future experiments requirements. However these technologies are both complex and expensive and their qualification for our environment (radiation) and their effective use in the community will require a very substantial investment in money and manpower.

Emerging hybrid and interconnect technologies (small pitch bump bonding, Through Silicon Via and 3D assembly for instance) can enable the construction of new low mass high-density detectors. Although our requirements in terms of density and performance are not very different from those of commercial applications (as typically found in portable devices), the access to these technologies and the adaptation to our specific needs (reliability and radiation hardness, size, etc.) require a solid development program.

Powering the front-end electronics of the new detectors requires the development of innovative techniques because of our specific environmental conditions. The on-going R&D effort on the subject is to be continued.

The need of low power, low mass, high speed and radiation hard optical links for reading out and controlling the detectors calls for a robust R&D effort to break the limits of existing concepts and to explore emerging technologies, such as silicon photonics.

Maintaining and increasing the support and services for key activities such as radiation hardness (key issue for both the experiments and the accelerators), high reliability design and access to microelectronics technologies is essential for guaranteeing good engineering practices and efficient use of resources. Collaborative efforts with other scientific and industrial partners in very deep sub micron CMOS design help to maintain and enhance the ability of the HEP community to harness the technology for future physics experiments and such activities should be encouraged.

The cost of the readout and control electronics of current HEP experiments represents about 25% of the total experiment cost. This is not going to decrease in the future and such a level of funding deserves a corresponding substantial investment in R&D activities.

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