The “Radiation Tolerant DDL” project

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The main results of the project

The Detector Building Section of the KFKI Research Institute for Particle and Nuclear Physics, together with CERN and other Hungarian partners, has developed a high-speed optical link called DDL for the ALICE detector of the new LHC accelerator facility at CERN. A DDL link consists of 3 parts: a destination interface unit that is connected to the data receiving computers; duplex optical cable of a length of 300 m, max.; and a Source Interface Unit (SIU) connected to the data source (e.g. a particle detector in our case). The SIU cards are located in radiation environment. The “brain” of a SIU card is a programmable logical device, an FPGA, which can loose its programmed “knowledge” if exposed to radiation. It may also produce single transmission errors that can result in erroneous, unpredictable behavior. Developing such data transmission devices that do not loose its programmed configuration under radiation; and correct or detect the incidental data errors is very much needed not only in the field of experimental particle physics but also in several industrial and scientific field (nuclear reactors, experimental fusion plants, space research, etc).
During the present project we examined, developed and tested several electronic and logical design methods, which are able to assure the errorless functionality under small or moderate radiation level. At the same time we made the DDL links developed for the ALICE experiment radiation tolerant for the radiation level of that experiment. We proved with measurements that using our solutions there is no configuration loss and we can detect the single event errors produced by the radiation.

The exploitation of the results

The DDL link and as its part, the radiation tolerant SIU will be used in bigger quantity first in the data acquisition system of one of the four big experiments planned on the new LHC accelerator at CERN, the ALICE experiment. During the last year Hungarian industrial firms have started the production of SIU cards. Till the end of the year of 2007 more than 500 SIU cards have been delivered to the detectors of the ALICE experiment. During the ongoing cosmic test runs the DDL links are producing good test results.

The DDL link has been successfully introduced in the space science as well. The Institut de RadioAstronomie Millimétrique (IRAM) successfully tested and uses DDL.
Another user of the DDL is the CERN experiment NA61. This is a fixed target experiment using the high-energy particle beam of the Super Proton-Synchrotron of CERN. We made test measurements in simulated and real working environment. The data acquisition system for this experiment will collect detector data through 6 to 10 DDL links exposed to a lower radiation level than of the ALICE experiment.
There are promising negotiations with the STAR experiment at the Brookhaven National Laboratory (BNL, Brookhaven, USA). The upgrade of the data acquisition system of the STAR experiment running on the Relativistic Heavy Ion Collider (RIC) have been based on the DDL links developed for CERN. Tests of a subsystem with 6 to 8 links have been carried out. The building of the full system containing 160 radiation tolerant DDL links will be started in the first half of 2008.