The Data Acquisition System of the SuperB-SVT Beam Test

INFN Istituto Nazionale di Fisica Nucleare

C. Sbarra on behalf of the SuperB-SVT Collaboration

Requirements for the layer0 of the SuperB-SVT:

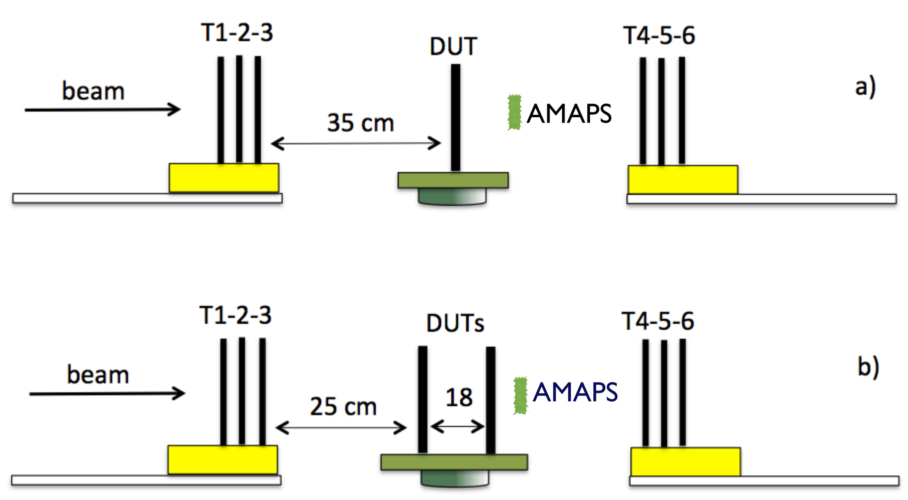
- excellent position resolution
- low material budget
- limited occupancy
- high radiation tolerance
- high-speed readout
- good time resolution

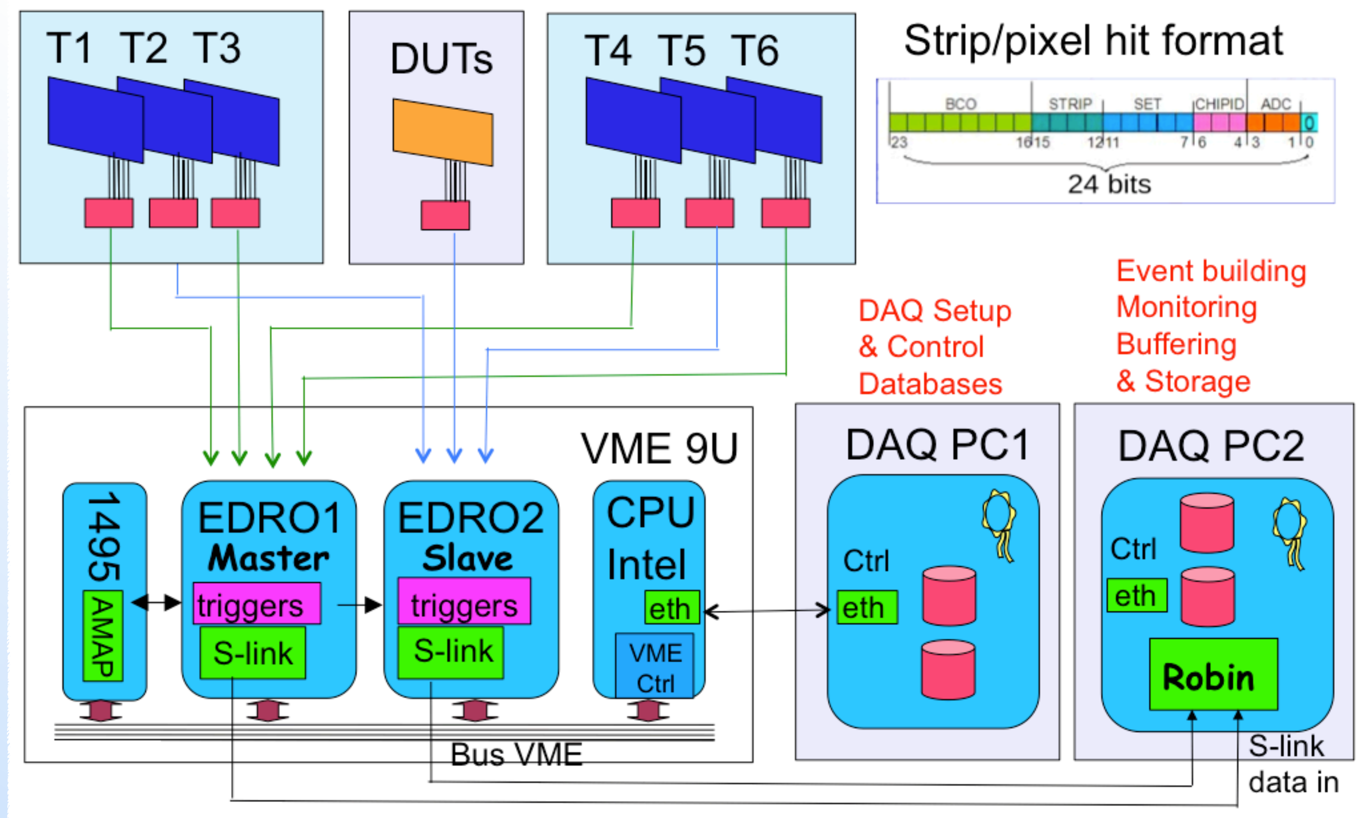
Striplets in layer0 for the first years; detector upgrade at high luminosity to cope with higher rate

Prototypes of a new hybrid pixel detector and a high resistivity detector with short strips, developed by the VIPIX collaboration and aimed at equipping the layer0 of the SuperB vertex detector, have been tested in September 2011 with a 120 GeV pion beam at the SPS H6 beam line at CERN. They are placed at the center of a reference telescope consisting of six planes of silicon detector with double-sided strip readout. Both the telescope and the detector under test (DUTs) are supplied with a custom-design, data-push digital readout. The core of the trigger and data acquisition system are two custom-design VME boards (EDRO) organized in a master-slave configuration and responsible for programming the front-end chips of both the telescope and the DUTs. The master distributes synchronization clocks to all devices, as well as triggers to the slave and a small analog-maps detector placed behind the DUTs and equipped with an independent readout. Both EDROs act as event-fragment builders, packing data from the telescope and the DUTs in fragments that are then sent out to a remote PC for event building, buffering and storage.

Beam Test Setup

- 120 GeV/c pion beam;
- beam width at DUT ~8x4 mm rms
- ~9s spill duration;
- 6 planes of double-sided silicon strip detectors with 50 μm readout pitch and 2×2 cm^2 area with data driven digital readout;
- data driven, digital readout DUTs on motorized table with remote control;
- analog maps with independent readout but participating to the trigger



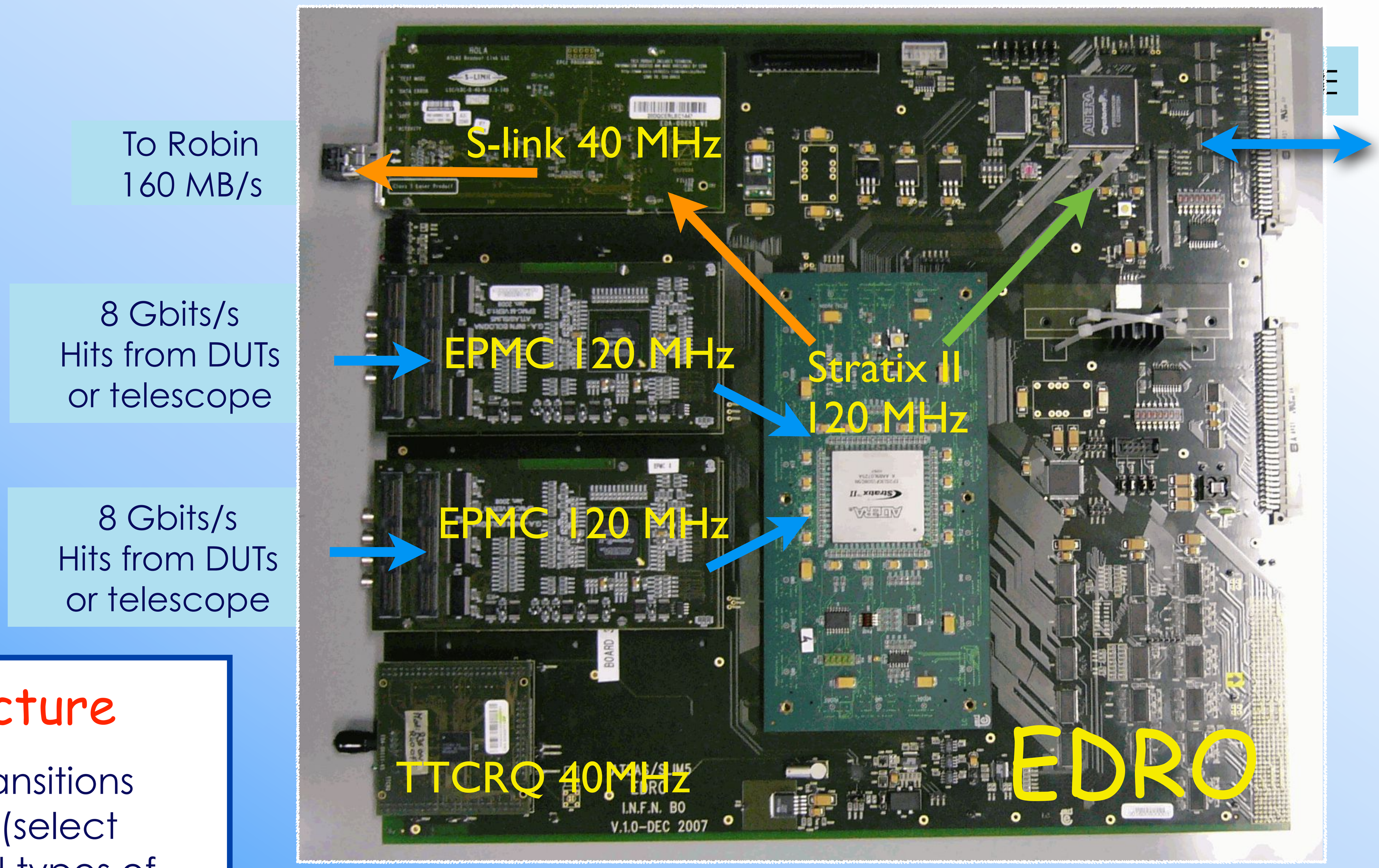


Main Electronics

Two custom VME 9U boards for Event Dispatch and Read-Out (EDRO):

- flexible, fully programmable;
- able to configure the front-end chips of both the telescope and the DUTs (SuperPix0 and Striplets)
- able to collect, format and dispatch data
- organized in master-slave configuration
- the master builds and provides triggers to the slave and the analog maps, and distributes clock and time-stamps to all devices

One Robin PCI card (developed by ATLAS) in a remote PC connected to the EDRO via optical link for fast data reception and buffering



Trigger

Fully configurable logic based on either telescope or analog maps information

Telescope logic

- selectable sub-regions
- selectable number of layers (up to eight in four double-sided planes)
- selectable multiplicity per layer

Analog maps trigger

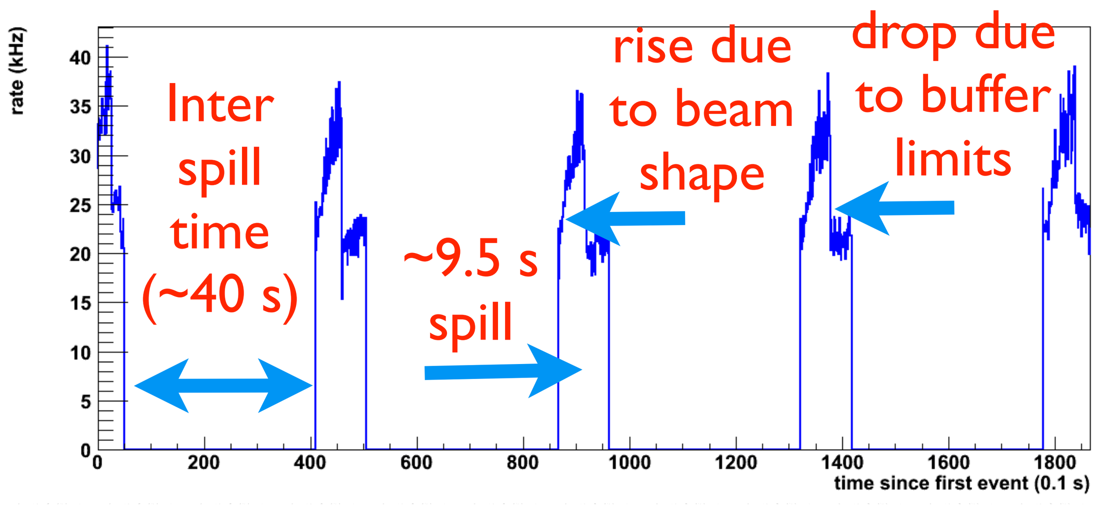
- find the ~150x300 μm^2 analog maps projection on the telescope layers (region-of-interest trigger to be then sent to analog maps)

SW Infrastructure

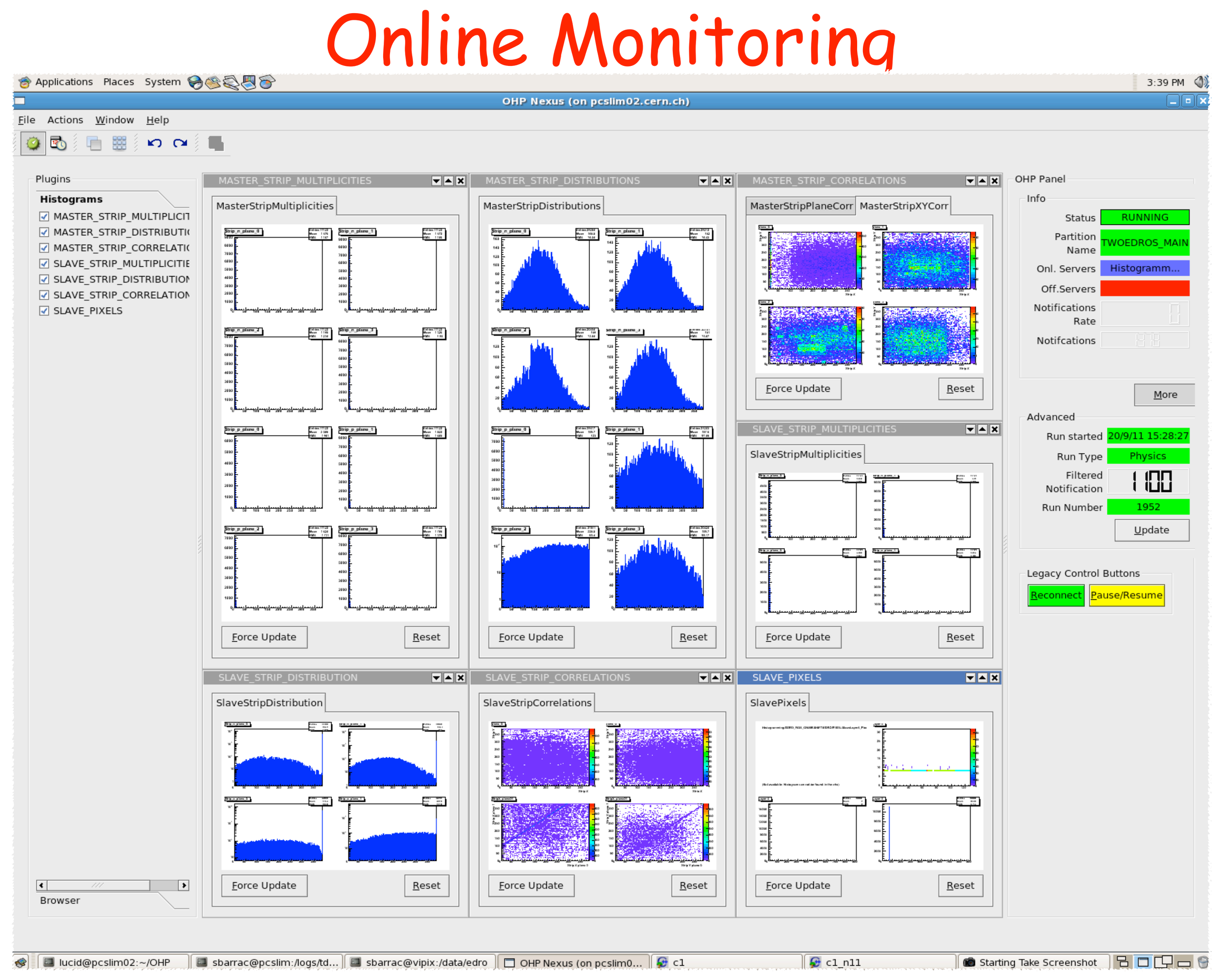
- final state machine transitions
- OKS configuration DB (select different numbers and types of chips to be configured and readout)
- ELOG (run summaries, operators entries)
- online DAQ monitoring/data analysis on event subsample
- Histogram presenter
- MySQL condition DB (store details of each run configuration)

DAQ Rates and Beam Profile

- maximum observed ~40 kHz
- limited by final data writing to disk
- first half of each spill dead-time free (events buffered in Robin)
- second half of spill limited to 20 kHz (Robin buffer full)
- 550 GB stored data (~50 M striplet and ~350 M pixel events)



Online Monitoring



- beam profiles with tescope data
- DUT hit multiplicity
- DUT hit-map
- DUT-telescope spatial correlations