Detector development

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CAVEAT: This summary is based on information from collider physics activites only. The reality for all instrumentation activities in Sweden are likely to be very similar hence the conclusions and strategy should reflect the Swedish community.

- Today experiments
- Tomorrow experiments
- Future directions
- Challenges for instrumentation (in SWEDEN)?
- Strategy statement

Today experiments

- The Swedish (collider physics) groups are preparing or in production for LHC.
  - Silicon strip detector modules for ITk
  - PCB boards with elecctronics for TileCal readout
  - PCB boards with readout for Fast Timing Detector
  - Hybridisation of electronics for TPC readout
  - PCB boards with electronics for HTT
- Some activities in generic development in AIDA2020.

Tomorrow experiments

Instrumentation plans for new experiments, upgrade of present experimets, generic technology development.

- Scintillating fibre based luminosity detector for ATLAS
- Si/W sampling calorimeter for ldmx
- TPC electronics for Fair, nnbar,ILC ....
- Fast timing detectors
- Fast low mass readout technologies
- Intelligent on-detector electronics
- Fast data processing HW and methods (for SHiP etc)

Future directions

Common aspects of the Swedish instrumentation developmet for accelerator based experiments are:

- High granularity
  - Position
  - Timing
  - Energy
- Big (real time) Data
  - High speed data readout and processing
  - “Intelligent processing” to make most use of the data -> triggerless readout

Challenges for instrumentation

The list can be made long.Note that the bullet points in the list are highly correlated!

- No national/local platforms for instrumentation
- Lack of funding for long term (generic) developmets
- Funding only directed towards activity in direct connection to major infrastructure projects
- Long cycles between instrumentation projects
- Very small number of technical manpower (engineers, technicians etc)
- Few students working with instrumentation
- Small resources for local infrastructure
- Hard to have continuity in the activity

Problems not solved by European strategy, but can be reduced

Strategy statement

The Swedish groups are focusing on development of technologies for high-granularity detector systems such as semi-conductor trackers, including high resolution timing capabilities, particle-flow calorimetry and TPC for heavy ion physics. A common challenge is the high data rate which requires advanced processing on- and off-detector (hardware, firmware/software algorithms etc) and low power high bandwidth readout and processing technologies to be able to collect and analyse all data produced more and less in realtime. The target is that all future experiments should run trigger-less readout of data to support the broadest possible physics program.

Low power semi-conductor devices will also play an important roles in future astroparticle detectors. + add more text on astroparticle physics

The main technology developments are connected to the construction of major HEP experiments and their upgrades. Because of the long cycles between construction and/or upgrades there are continuous problems to maintain competence in the groups. Instrumentation is often not considred meriting and funding is hard to obtain without a direct connection to (short-term) needs of experiments. To maintain future capability in instrumentation we welcome increased R&D collaboration on instrumentation techniques organized through CERN. Shared instrumentation PhD positions where the student shares time equally between the home institute and CERN could be a catalyser. We also welcome more experiments (fixed target, beam dump) that run alongside LHC which will give more opportunities for instrumentation+ some words on irradiation and test beam facilities.