WP9 : Detector R&D Infrastructure

WP 9.1 - Gaseous detector R&D

Potential Participants: Athens, DESY, CERN, Saclay, Bonn, NIKHEF, Lund, Mainz, Prague

R&D on gaseous detection is at present concentrated on micropattern detectors (MPGDs) and is federated at the world-wide level (with a strong European contribution) with the CERN-based RD51 collaboration. This collaboration however has no funding except from the laboratories. The field would thus benefit very much from a funding for common infrastructures. Major applications of MPGDs in future large collider experiments are:

- Large surface trackers for SLHC muon detection, with an increase by a factor of 10 of the rate compared to previous detectors and large surface detectors for neutrino experiments
- Gaseous vertex (Gossip) and planar tracking (GridPix) detectors, with the potential for high radiation tolerance and fast directional sensitivity in a single layer
- A large TPC with MPGD readout for the Linear e^+e^- Collider.

To enable advanced R&D on these detectors two infrastructural measures are proposed within WP9.1 (in addition required electronics infrastructure is proposed in WP3).

9.1.1: A facility for a large TPC and Gridpix/Gossip characterization at DESY

Within the EUDET project an infrastructure to develop proof-of-principle detectors for a large TPC, the “large prototype” (LP) was built and is in operation. We propose to extend and improve this facility to enable the development of an advanced (engineering) TPC endplate which should address the important engineering aspects of such a TPC: low-material, cooling, alignment, power-pulsing, realistic operation gas mixture. The same facility can also be used to characterize readout structures (InGrids, GEMGrids etc) to be developed for Gossip and/or GridPix detector for an sLHC upgrade.

A large user community is expected to use this facility. The users will provide different prototype for readout modules and possibly endplate mechanics. The main focus of this proposal is provide the infrastructure necessary for **integration and operation** of the components.

- Provision of the LP facility including 1T solenoid (DESY)
- Mechanical + electrical integration of endplate+module systems (DESY)
- Development of an FPGA-based programmable cosmic trigger (Saclay)
- TPC diagnostics: gas purification and analysis, high-precision current monitoring, laser alignment system(?) (DESY, Saclay, Bonn)

- The effect of the time and space structure of the ionization in the TPC ('ion disk') could be experimentally studied with UV light from a lamp shade on the cathode with the beam time structure.

- Power pulsing tests in a strong magnetic field will also necessitate an infrastructure. A 5T magnet from DESY, 240 mm bore diameter, could be used for this, but needs to be refurbished and connected to a new liquid helium line. The users might be Bonn, Saclay, in collaboration with non-European countries: Canada and Japan. DESY would be the most obvious candidate, but help from other laboratories with cryogenic capabilities (Saclay, KEK,…) could be required.

The facility should be constructed in a way that it will be possible to move the main components to a test beam with high-energy muons and hadrons, e.g. CERN when the state of the project calls for it. Since the best time for this movement depends on outcome of the R&D pursued at this facility, it is not part of this proposal.

9.1.2 Infrastructure for the production of large area MPGDs

SLHC muon chambers will need R&D connected to large surface. To avoid inconveniences of large capacitance detectors (high charge stored and sensitivity to noise), the GEM foils and Micromeshes will probably have to be segmented. Resistive anodes have to be developed to limit the number of electronic channels, and provide protection to the readout electronics. These put constraints on the CERN workshop, or calls for an adapted, upgraded facility.

(to be further defined by CERN)

9.1.3 Electronics for gaseous detectors (should go into WP3, but listed here for completeness)

Pixel readout of MPGDs (Ingrids, GEMs): it is likely that the next development step for pixelized readout of MPGDs, the Timepix-2 chip will be realized in 2010 (probably in the context of the Medipix-3 collaboration). In order to make this chip usable for gaseous detectors common electronics infrastructure has to be developed:

- A multi-chip (64/128?) readout system for Timepix-2 suited for high energy physics needs (interested: Bonn?, NIKHEF?, Mainz?, Prague?)

- Tools for large area module construction, cooling, mechanics, maybe 3D integration (interested: Bonn, NIKHEF?, Saclay?)

Further development of conventional electronics for pad-based readout? ***(to be further defined by Lund)***