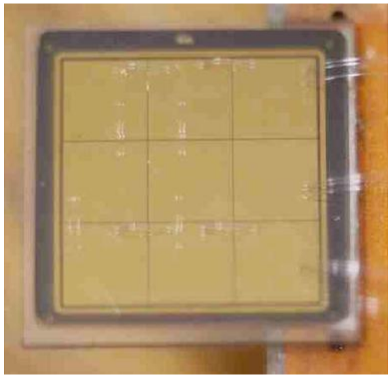
Particle Detection System for MERIT

Detector types

- Main: Diamond detectors
  - Same principle as a PIN-diode, with reverse bias voltage and separation of electron-hole pairs, created by traversing MIPs.
  - Previously tested in conditions similar to what a MERIT-detector will experience, with comforting results.
  - 5 pcs (being delivered)



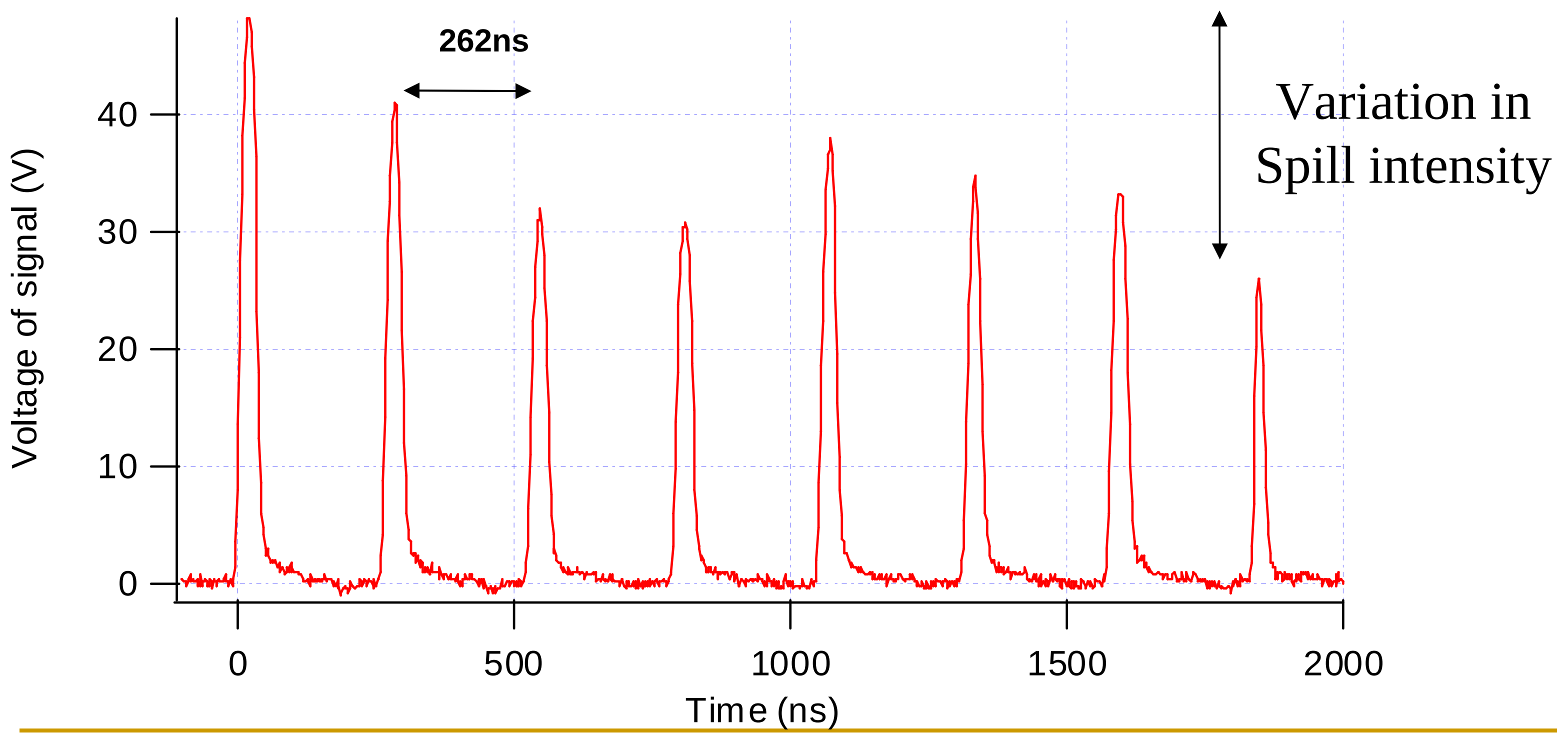
Diamond sample

- Backup: ACEM
  - Aluminum Cathode Electron Multiplier – Built like a photo multiplier, but with an aluminum foil functioning as a secondary electron emitter as cathode. See [1].
  - 4 pcs

ACEM

Diamond performance

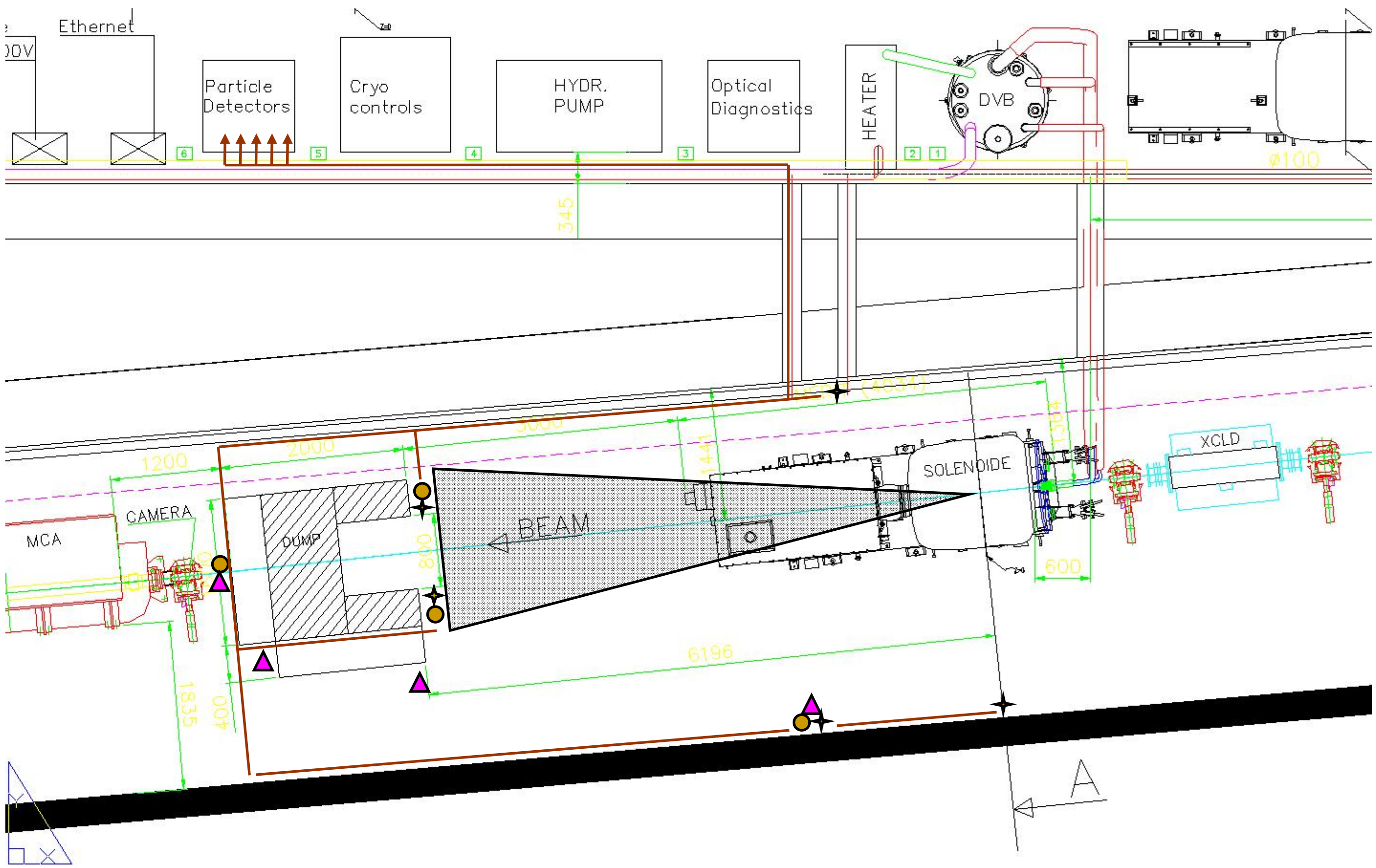
- Earlier test of a pCVD-type detector [2].
  - Diamond response in a proton beam (~$3*10^8$ p/cm^2), simulating an unsynchronized beam abort in LHC.
  - A reservoir capacitor maintains the bias voltage over the detector.



Detector positions

ACEM	pCVD
Dump (0°)	-
-8°	-8°
+8°	+8°
-	-45°
+45°	+45°
-	+90°

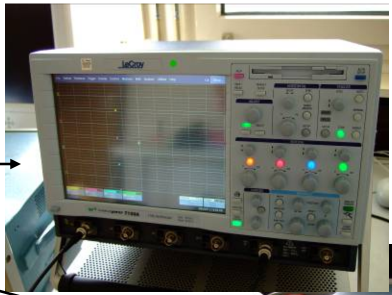
- ✦ pCVD
- ● ACEM
- ▲ Simulated spots (Striganov)



The 8°-detectors have "open view" into the solenoid.

Equipment specifications

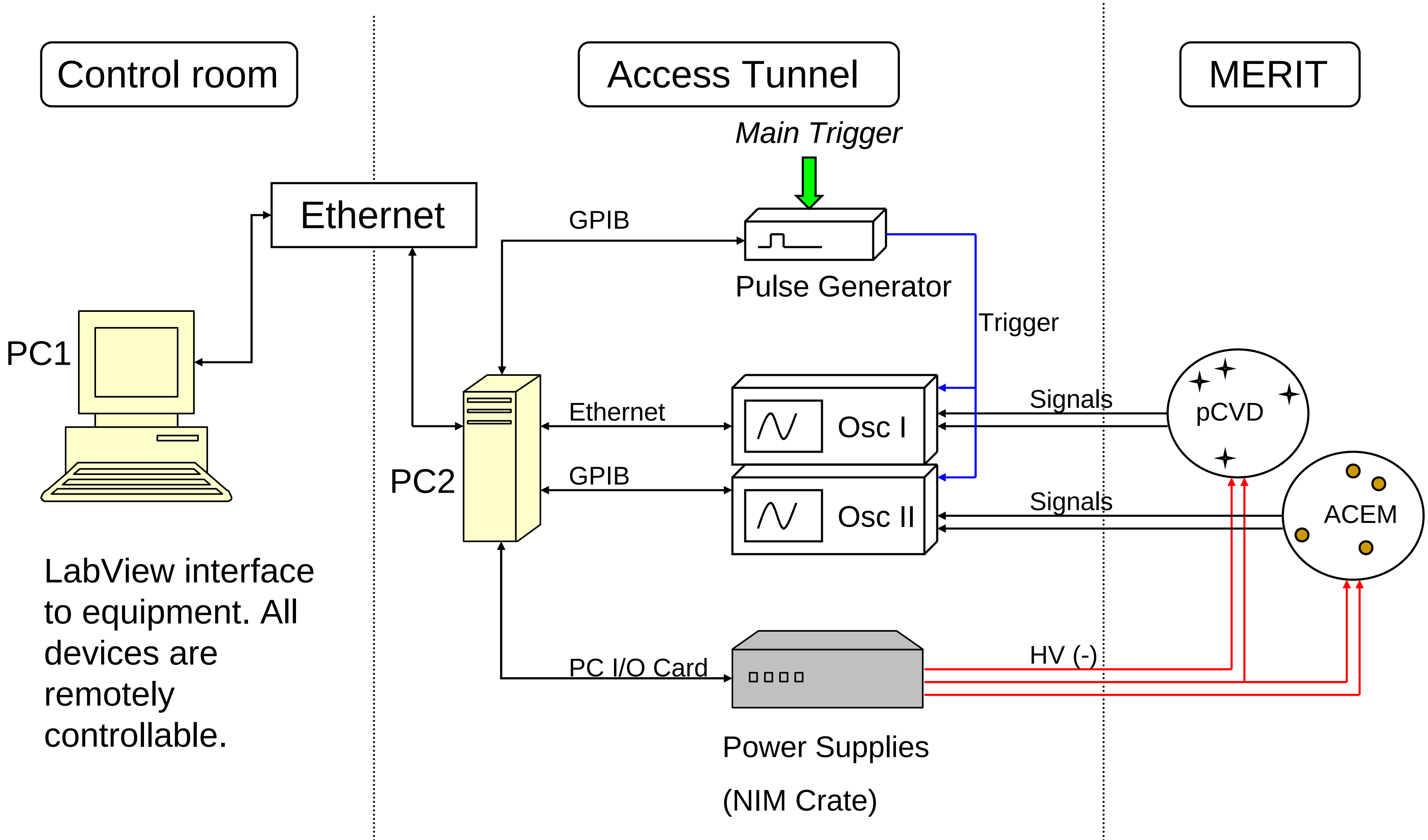
- Oscilloscopes (2)
  - LeCroy WavePro 7100A: 4 CH, 2.5 GS/s, Ethernet
  - Tektronix 744A: 4 CH, 500 MS/s, GPIB



- Pulse generatorm (1)
  - Agilent 81110A, GPIB
    - Receives a main trigger signal and distributes it to the oscilloscopes.
    - The original purpose of this was to easily generate single or double triggers to the oscilloscopes, depending on the pump/probe time interval. At longer intervals, the oscilloscope sampling has to be divided in 2 segments due to memory restrictions.
    - At the moment, the long (~ms) time separations are not accelerator feasible so a single trigger will most likely do in all scenarios. Nevertheless, the pulse generator is kept as a safety net for revival of the ms intervals.

- Power Supplies (2)
  - CAEN N470: 4 HV channels, 0-3 kV, NIM crate. Daisy connected using LEMO cables and PC communication with a PCI CAENET A1303 card.

Communication

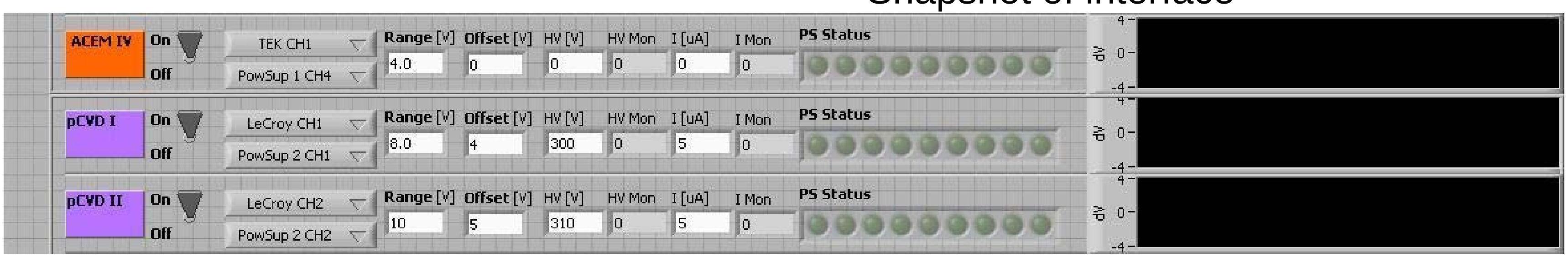


LabView interface to equipment. All devices are remotely controllable.

LabView interface

- As a certain level of uncertainty regarding the particle flux at each detector position is unavoidable, the first couple of runs will be dedicated to fine tuning of the detection system. This may include:
  - Finding proper bias voltage on each detector. Too high voltage might destroy the detectors as well as the oscilloscopes.
  - Finding highest possible oscilloscope resolution, without losing signal peaks.
  - (Adjust trigger timing and delay time on oscilloscope – the time between received trigger and start of acquisition. Very important parameter, but can be predefined to a high degree of accuracy.)

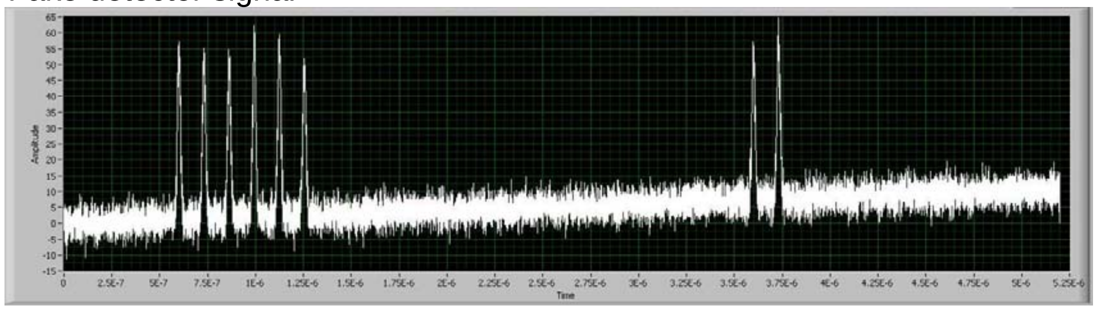
Snapshot of interface



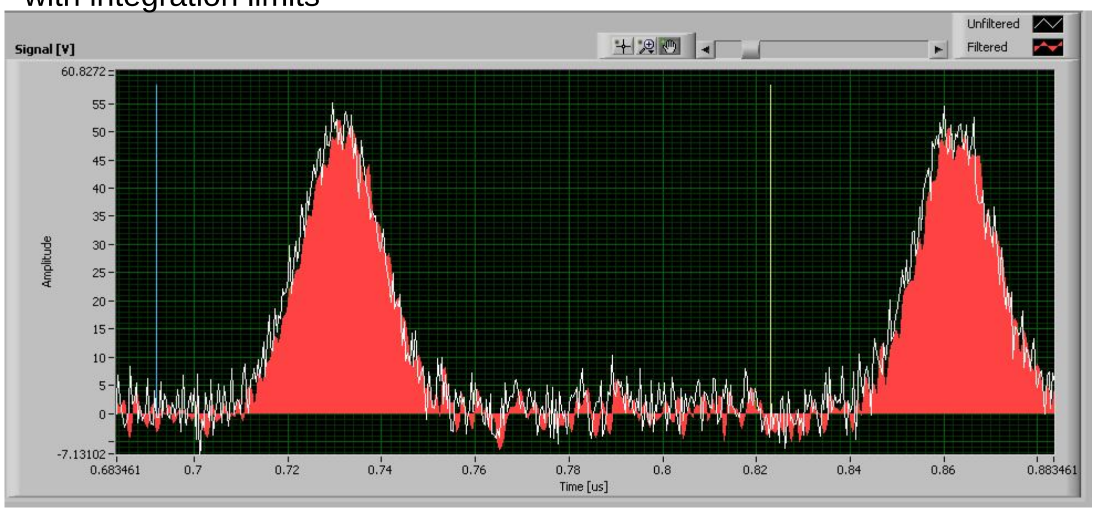
Signal analysis

- What we want to do:
  - A relative measurement of the total number of secondary particles from target on detector. ("Does 7th pulse yield less particles than the 3rd?")
- How:
  - (LP-filter detector signal, and - if necessary - correct for voltage drifting)
  - Identify what parts of the signal corresponds to each pulse.
  - Define integration intervals.
  - Integrate.

Fake detector signal



Filtered and drift corrected signal with integration limits



Upcoming activities

- ACEM and pCVD testing in beam with MERIT equivalent intensity.
  - Main purpose: Find proper HV for the ACEMs
  - At PS startup, spring 2007

- Testing of performance deterioration in magnetic field
  - ACEMs already tested and passed[1].
  - Diamonds not as sensitive to magnetic fields, but this will be properly experimentally verified.

References

- 1 Previous presentation, http://proj-hiptarget.web.cern.ch/proj-hiptarget/doc/ACEM_slides.ppt
- 2 Thesis: *Development of a Beam Condition Monitor System for the Experimental Areas of the LHC Using CVD Diamond*, Juan Luis Fernández-Hernando
  - Chapter 9 - *Simulation of the worst accident scenario with a test beam*