WBS-8 GEM

Requirements:
1. <100 um position resolution (giving better than 1mr angular resolution with 3 GEMs). Achieved 75 um at OLYMPUS.
2. At least 95% efficiency (has been established with OLYMPUS, investigations are ongoing). Can use any-2-of-3 to define track for higher efficiency.
3. No time information; GEMs require external trigger
4. GEM track to provide reference direction for scattering angle measurement
5. Readout speed of 2 kHz at 20% deadtime, corresponding to 200 usec readout time per event

Steps to achieve fast readout:

Currently 400 Hz readout rate has been established for two telescopes, where the readout time per event has been 1.8ms. For the goal of 2 kHz at 20% deadtime, it is needed to achieve 200 microsec readout per event. One can gain a factor 2 by implementing block transfer of 32-bit words, and another factor 2 by using only one telescope, i.e. 500 microsec. However, another factor 2.5 is needed.

With the existing system design, one can gain another factor 3 by using three VME crates with three CPUs and MPD FPGA boards, respectively, i.e. by adding another 2. Hampton has one spare VME crate with CPU and MPD from OLYMPUS still available. Reading out with one VME crate per GEM will require a slight reconfiguration of the telescope cabling. The cost for this approach is included in this WBS.

Alternatively, it has been discussed to avoid the VME bus limitation by employing a UDP protocol via PCI bus. This option will be explored further but requires R&D and hence involves certain risks.

It would be desirable to establish the required readout speed with the GEM telescope as soon as possible, therefore the funds are requested in the first year.

One telescope along with one MPD is now on its way from PSI back to Hampton, where one set of VME crate and CPU is available. The additional two sets of VME crate with CPU and MPD will be set up and tested at Hampton University in fall 2014 before the new electronics are shipped to PSI.