Prototype of a data acquisition scheme for the PANDA experiment

Summary
• A prototype of a software based trigger for the PANDA experiment has been developed.
• Semi-realistic event reconstruction algorithms have been implemented and parallelized.
• The developed prototype is highly parallel and scalable.

PANDA experiment
• PANDA is an upcoming particle physics experiment in Darmstadt, Germany.

Method
• Extract physical properties from raw data to filter out irrelevant data (event reconstruction).
• Prototype is written in C++ combining MPI and OpenMP.
• It is based on the master/slave model with added circular topology for inter-process communication.

1. Split data stream and send to available computing nodes (MPI)
2. Perform clustering and event reconstruction on each node (OpenMP)
3. Use circular inter-process communication (MPI)

Event reconstruction
• The prototype includes two parallelized event reconstruction algorithms, particle track fit and displaced vertex detection.

Figure 1. Illustration of the PANDA detector. An anti-proton beam with momenta ranging from 1.5 - 15 GeV/c will impinge on a target of hydrogen or other heavier nuclei.

Figure 2. Schematic diagram of the parallel structure and task order. These three steps are repeated until the data stream is empty.

Figure 3. Visualization of an event reconstruction. The red dots represents the raw data. The blue circle indicates a displaced vertex and the black lines shows a track fit.

Figure 4. Scaling efficiency when varying the number of MPI (left) and OpenMP (right) nodes.

Conclusion
• The general architecture of the prototype shows promising efficiency.
• Software based triggering opens up for smarter and more sensitive data acquisition. The developed prototype shows that it can be feasibly implemented.