MAPPING PROTON QUARK STRUCTURE – LOOKING INSIDE THE PROTON: HOW DO QUARKS SPIN?

Research Challenge
• COmmon Muon Proton Apparatus for Structure and Spectroscopy (COMPASS) is a high-energy physics experiment that probes proton substructure by scattering high-energy pion and muon beams off of nuclear targets at CERN in Geneva, Switzerland.
• The experiment explores the momentum and coordinate phase space of quarks inside the proton to shed light on the quark dynamics and provide a critical test of fundamental predictions derived from Quantum Chromo Dynamics (QCD), the quantum field theory describing the nuclear force.

Methods & Codes
• Each triggered event is recorded by the Data AcQuisition system. The COMPASS Reconstruction Analysis Library (CORAL) software performs the transition from raw data information to physical quantities.
• CORAL’s function is to reconstruct particle trajectories and momenta as well as the position of vertices.

Why Blue Waters
• Experimental and Monte Carlo data can be processed 10 to 25 times faster compared to other computing resources available to the COMPASS collaboration.
• Blue Waters enables novel explorations; for example, detector resolutions in kinematic binnings and two-dimensional detector efficiency maps.
• Blue Waters staff provide essential guidance in terms of job flow, load distribution, data transfer, and BW-specific technical features.

Results & Impact
• 3 PB of data has been transferred to Blue Waters for data production and analysis
• Blue Waters enables processing an annual COMPASS data set on Blue Waters within five days rather than 50 days on the CERN primary computing clusters
• In addition to raw data processing and physics-level analysis, Blue Waters allows for the detailed simulation of COMPASS detector properties and environmental effects.