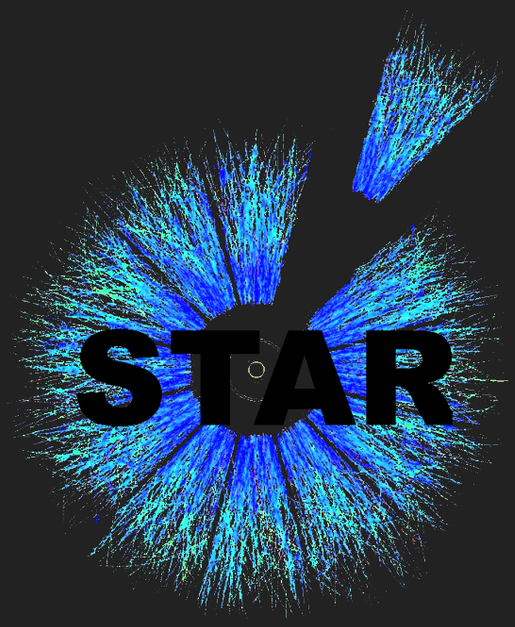


SOFTWARE & COMPUTING

INTEGRATION OF NEW DETECTORS

GENE VAN BUREN - BNL - STAR S&C TEAM

CBM-STAR WORKSHOP AT CCNU - WUHAN

September 23, 2017

BROOKHAVEN NATIONAL LABORATORY
U.S. DEPARTMENT OF ENERGY | Office of Science

SOFTWARE & COMPUTING ORGANIZATION

- Hierarchical organization
  [https://drupal.star.bnl.gov/STAR/comp/org]
  - Modest core team size (10 FTE) for a large, operating experiment mandates distributed efforts across the Collaboration, and a focus on prioritized tasks
- Long history of synergistic efforts with other groups (including CBM)

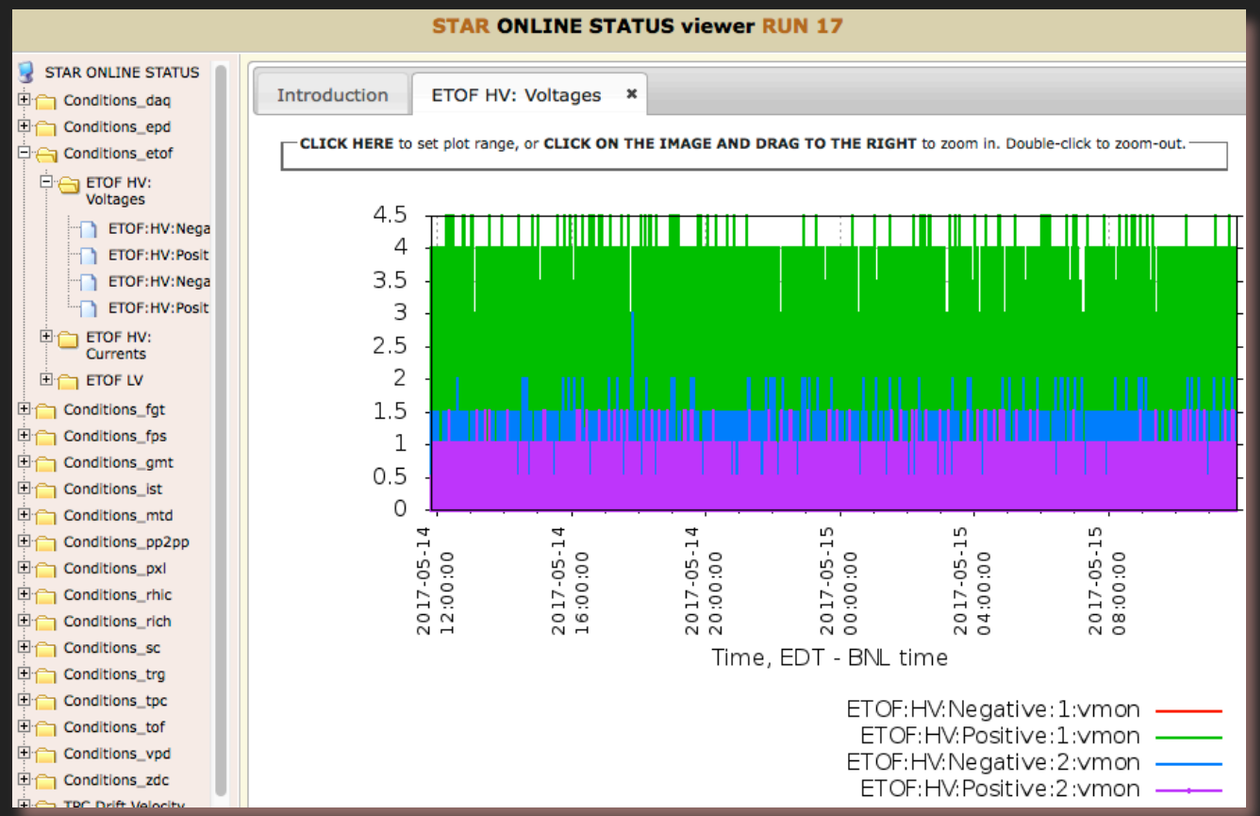
  - Workshops, facilities, software development, etc.

SOFTWARE & COMPUTING ORGANIZATION II

- Core team:
  - Infrastructure & scalable frameworks
  - Reconstruction libraries and data productions
  - Leadership for Collaboration's operation + R&D software & computing efforts: *expertise* x *workforce*
  - Tight cooperation with physics working groups on embedded simulations (e.g. efficiency studies)
- Subsystem software coordinators communicate regularly with core team, providing Collaboration workforce and potentially bringing in additional expertise (e.g. calibrations), while drawing from core team's experience
  - e.g. EMC, BTOF, MTD, HFT, TPC, DAQ, HLT, ... ETOF

DURING DATA ACQUISITION

- Data format & integration into STAR DAQ (and trigger?)
- Metadata (conditions databases)
- Monitoring / data validity
  - Real-time tools
  - Quality Assurance packages (QA histograms)
    - Raw signals
    - Reconstructed information (e.g. tracking, correlations)



Broadening use of Message Queues (possible area of further collaboration)

HIGHLY-ORGANIZED CODING ENVIRONMENT

- Driven by requirement to (re)produce on demand any existing dataset despite limited compute power & workforce
- Documented coding standards to promote reproducibility (and backward compatibility as possible), maintainability, flexibility & robustness to advancing hardware (e.g. HPC‡) & software environments (e.g. OS upgrades, C++ standards)
  - Rely on code reviews, an extensive & expandable regression test suite, and physics working group validation and/or formal review of major projects
- Capable ROOT-based framework
  - Past & current efforts to explore optimization (vectorization, parallelization, etc.)
  - Investigating architecture advances (e.g. component-based framework of the future)
  - Open to collaborative development

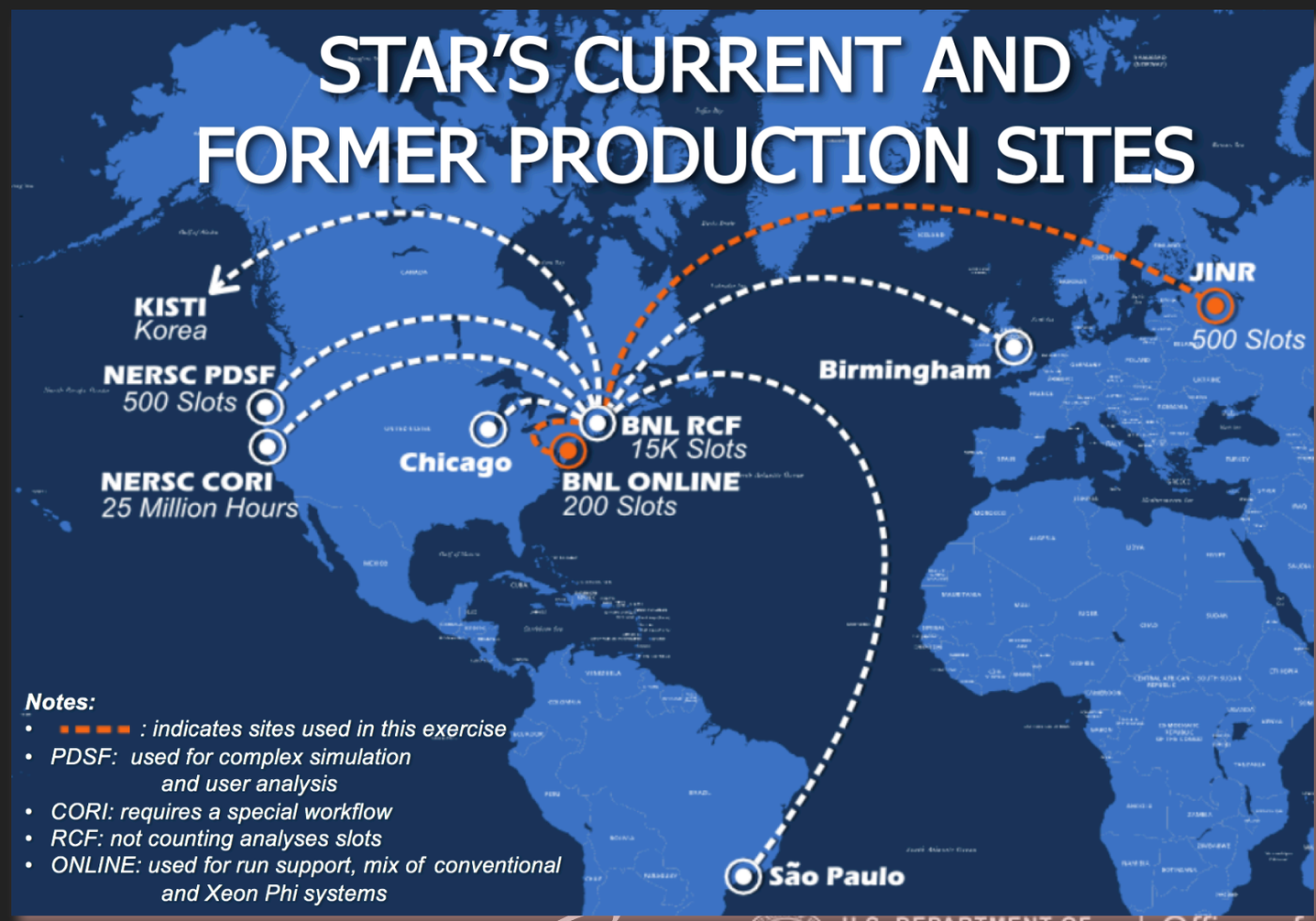
‡ High Performance Computing

PHYSICS MODELING

- Thoroughly established simulation framework
  - Powerful geometry description language (featuring robust verification/QA tools, cross-language support, misalignments... ...see Jason's talk for more details!)
  - Matured for high precision era (i.e. silicon)
- Cohesive union of simulations embedded into real data
  - Subsystems provide simulators, mixers, integration, vetting
- Requirements-driven (again, e.g. on-demand reproducibility), coding standards play a critical role

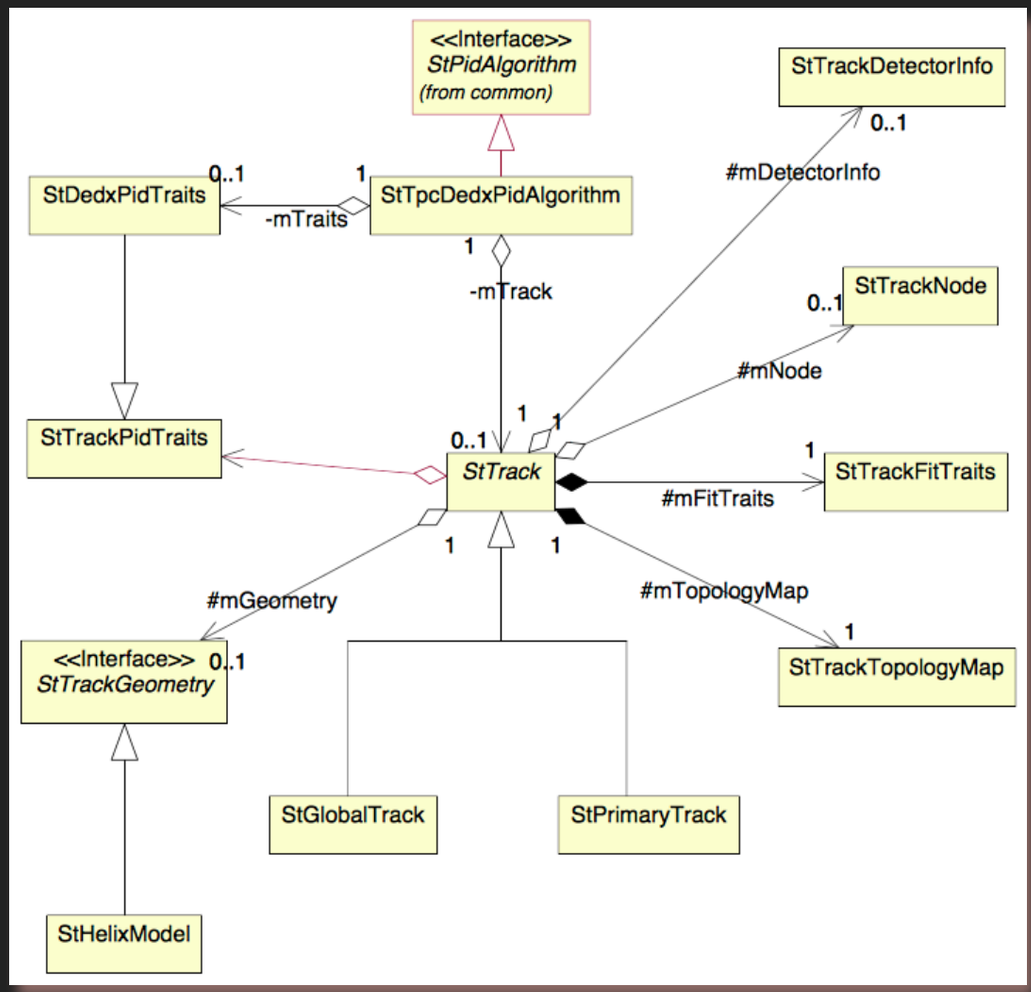
SCALABLE PRODUCTION ENVIRONMENT

- Maximal (highly efficient) use of large computing facilities
  - Resource utilization typically in excess of 97%
- Demonstrated ability to take advantage of a variety of platforms
  - High efficiency real data reconstruction on HPC uniquely demonstrated among NP & HEP
- Additional participation welcome!



PERSISTENT ANALYSIS DATA FORMATS

- Complete reconstructed data model (StEvent)
  - Hierarchical collections with cross-pointers
- Reduced data for general analyses (StMuDst)
  - Flat arrays with some cross-indexing
- Minimal common denominator data (StPicoDst)
  - Focus on storage optimization



SUMMARY

- The STAR Software & Computing Team has worked together with detector groups for over 2 decades of enabling world-class physics for the Collaboration
  - See Jason's presentation for a concrete and current example
- The Team continues to maintain and pursue technologies that keep STAR near the forefront of nuclear physics computing
- The Team fosters an environment of working constructively together and looks forward to opportunities to collaborate with other like-minded groups

Many possible avenues of S&C collaboration: calibrations, forward tracking, optimization strategies, facility utilization, MQ utilization, framework-of-the-future...