SciDAC Projects

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SCD Projects Meeting

18 August 2022

Scientific Discovery Through Advanced Computing (SciDAC)

- Overall program: https://www.scidac.gov/
  - DOE Program managers are Jeremy Love and Randall Laviolette
  - Combines ASCR and domain science programs
- Five HEP projects
  - **ComPASS4: Accelerator Science and Simulation** (Jim Amundson)
    - Conventional Beam Dynamics, Plasma-based acceleration
  - Accelerating HEP Science - Inference and Machine Learning at Extreme Scales (Salman Habib)
    - Focus areas: Cosmology, Stats/ML at Scale, Accuracy
    - https://press3.mcs.anl.gov/cpac/projects/scidac
  - HEP Data Analytics on HPC (Jim Kowalkowski)
    - Accelerate HEP analysis on HPC platforms with help from ASCR FASTMath and RAPIDS
    - https://computing.fnal.gov/hep-on-hpc/
  - **HEP Event Reconstruction with Cutting Edge Computing Architectures** (Giuseppe Cerati)
    - Accelerate HEP event reconstruction using modern parallel architectures
  - Event Generation on HPC (Stefan Hoeche)
    - Short-distance cross section calculations on HPC

HEP on HPC

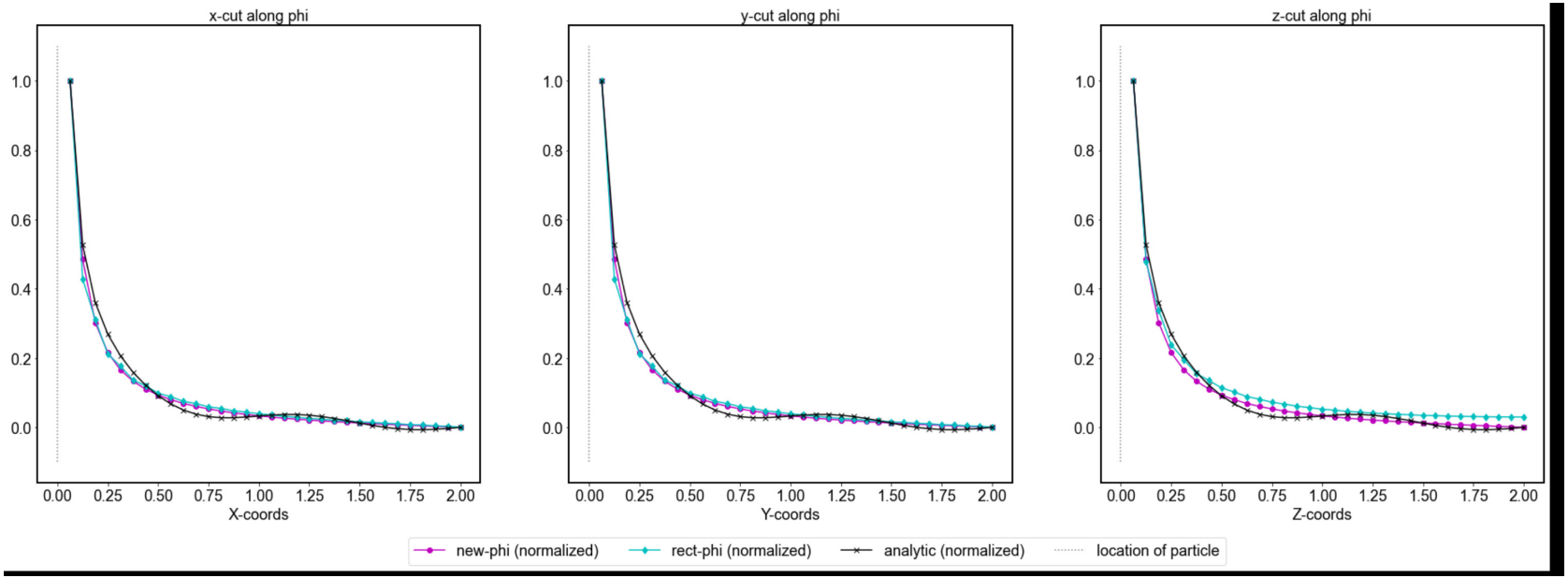
- SBNFit using multivariate functional approximation (MFA)
  - Current version ~30 times faster than grid search technique
  - still being validated
- ROOT-based ICARUS workflow on Theta encountered failures with very large events. Filter module being developed to record IDs of these events for processing elsewhere (and reject them).
- HEPnOS-based ICARUS work has turned up an issue somewhere in the HEPnOS stack, being worked on by both FNAL and ANL. The problem seems to be in over-write (resulting in a claim that a memory buffer to be de-serialized is tens of thousands of terabytes -- the real thing is ~100 MB).
- Request for SSD access on Theta, for jobs to finish testing of HEPnOS (in event selection context) for ongoing paper. (SSD used as backing store for HEPnOS).
- Results from Cori and Perlmutter on sterile neutrino analysis used for Neutrino 22 talk.

HEP on HPC

- PyHEP abstract on parallel data analysis with PandAna accepted.
- SC22 poster “Analyzing NOvA Neutrino Data with the Perlmutter Supercomputer” has been submitted.
- ACAT poster “High Performance Computing Workflow for Liquid Argon Time Project Chamber Neutrino Experiments” accepted for ACAT.
- Papers in progress: all in collaboration with our ASCR partners
  - HEPnOS performance (NOvA candidate selection used as the example)
  - ICARUS workflow (distributed event store HEPnOS used in place of file handling)
  - SBNFit using Multivariate Functional Approximation (MFA)
  - Parallel data analysis conceptual framework
  - Large-scale (MPI-based) tuning of event generators using “trust regions”

Accelerator Modeling developments

- Prototype finite-differences space charge solver in comparison to existing boundary value solver. The finite-difference solver has the capability (in principle) to handle arbitrary boundaries unlike the current solver limited to rectangular boundaries.



Fermilab

HEPReco project

- Deployment of mkFit in offline CMS reconstruction
  - Work ongoing to extend mkFit usage to additional tracking iterations in Run3
    - Especially with low pT iteration. Potential timing benefits 4-6x faster building per iteration
  - Successful “proof of principle” test with HL-LHC tracker geometry
    - still long way to go before having a properly working mkFit tracking at HL-LHC

- Portability studies (p2z and p2r)
  - Summer student project completed: implementation of Alpaka p2z version
  - Consistent timing measurements are in progress, current targets Intel CPU, NVIDIA GPU, AMD GPU
  - Paper writing is in progress

- LArTPC reconstruction and ICARUS HPC workflow
  - Tests on Theta showed failures for large events. A filter module was developed to bypass and keep track of these events.
  - Full processing will start after successful tests of filter module