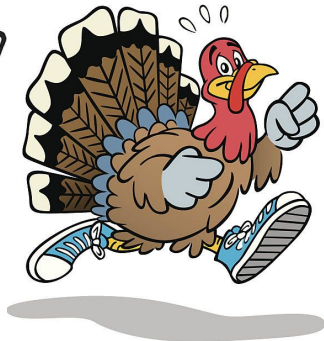


EPIC Simulation Update

Wouter Deconinck, for EPIC SimQA and CompSW
December 14, 2022



1 Slide Summary

- Latest reconstructed simulations exist on S3 at:
 - S3/eicctest/EPIC/RECO/22.11.2
 - S3/eicctest/EPIC/RECO/22.11.3 (no geometry difference, just lower memory use)
- Physics jobs have been running for two weeks now, ~125k jobs
 - Primary platform for running simulations has been Open Science Grid
 - No significant operational issues due to software stability or performance
 - Reducing memory use below 2 GB allows for more than factor 2 increase in throughput
 - Interruption during Thanksgiving weekend due to S3 storage issues (impact of multiple days)
- Remaining jobs to be run:
 - fill the 'holes' in the production samples due to the S3 outage
 - currently working through exclusive data sets (TCS, DVCS) and pythia6 SIDIS jobs
 - djangoh DIS jobs: export to hepmc3 not possible, regenerating with djangoh 4.6.20
 - several sets exclusive events for which no hepmc3 files are available
- All brycecanyon will be rerun with working imaging calorimeter clustering

What is available? Number of files as of Dec 8, 2022

```
S3/eicctest/EPIC/RECO/22.11.3
├── epic_arches
│   ├── DIS
│   │   ├── NC
│   │   │   └── 5x41
│   │   │       └── minQ2=100 1094
│   │   └── EXCLUSIVE
│   │       ├── DIFFRACTIVE_JPSI_ABCONV
│   │       │   └── Sartre
│   │       │       ├── Coherent 2478
│   │       │       └── Incoherent 1511
│   │       ├── DIFFRACTIVE_PHI_ABCONV
│   │       │   └── Sartre
│   │       │       ├── Coherent 2305
│   │       │       └── Incoherent 1587
│   │       └── UPSILON_ABCONV 34
│   └── SIDIS
│       ├── Lambda_ABCONV 4488
│       └── epic_brycecanyon
│           ├── DIS
│           │   ├── NC
│           │   │   └── 5x41
│           │   │       └── minQ2=100 1064
│           └── SIDIS
│               └── Lambda_ABCONV 4489
```

```
S3/eicctest/EPIC/RECO/22.11.2
├── epic_arches
│   ├── DIS
│   │   ├── CC
│   │   │   ├── 10x100
│   │   │   │   ├── minQ2=100 1900
│   │   │   │   └── minQ2=1000 1767
│   │   │   ├── 18x275
│   │   │   │   ├── minQ2=100 6166
│   │   │   │   └── minQ2=1000 5663
│   │   │   └── 5x41
│   │   │       └── minQ2=100 884
│   │   └── NC
│   │       ├── 10x100
│   │       │   ├── minQ2=1 2675
│   │       │   ├── minQ2=10 1162
│   │       │   ├── minQ2=100 545
│   │       │   └── minQ2=1000 833
│   │       ├── 18x275
│   │       │   ├── minQ2=1 6969
│   │       │   ├── minQ2=10 6792
│   │       │   ├── minQ2=100 6628
│   │       │   └── minQ2=1000 6602
│   │       └── 5x41
│   │           ├── minQ2=1 1259
│   │           ├── minQ2=10 1105
│   │           └── minQ2=100 1160
```

```
└── epic_brycecanyon
    ├── DIS
    │   ├── CC
    │   │   ├── 10x100
    │   │   │   ├── minQ2=100 1917
    │   │   │   └── minQ2=1000 1727
    │   │   ├── 18x275
    │   │   │   ├── minQ2=100 6169
    │   │   │   └── minQ2=1000 5664
    │   │   └── 5x41
    │   │       └── minQ2=100 875
    │   └── NC
    │       ├── 10x100
    │       │   ├── minQ2=1 2545
    │       │   └── minQ2=10 1214
    │       ├── 18x275
    │       │   ├── minQ2=1 7019
    │       │   ├── minQ2=10 6795
    │       │   ├── minQ2=100 6634
    │       │   └── minQ2=1000 6614
    │       └── 5x41
    │           ├── minQ2=1 1260
    │           ├── minQ2=10 978
    │           └── minQ2=100 1154
```

Operational details for this and future productions

Condor job scheduling:

- Using input events on JLab xrootd server:
 - HepMC3 WriterRootTree conversion
 - Read-only public access at dtn-eic.jlab.org
 - Used for up to ~10k simultaneously active TCP connections without any issues
- Using built-in S3 transfer output files
 - Jobs themselves unaware of S3
 - Single TCP connection at end of job
 - Reconstructed output at 25 kB/event; about 80 MB/s for 10k jobs at at 3 s/event
 - Working with OSG and Condor on S3 transfer resiliency to dtn01 and now eics3
 - Currently treating S3 output resiliency as operational limitation
- Load leveling settings:
 - `max_jobs = 500`, `max_idle = 100`

Other operational details

- <1% failure rate for jobs, by frequency:
 - \$ Failed hand shakes when reading xrootd (limited to certain sites: Syracuse U)
 - \$\$ OOM killer when > 2 GB; suspected config issue (limited to certain sites: UNL)
 - \$\$ Geant4 navigation errors in MRICH Fresnel lens
 - \$\$\$ Stalls or 503 of S3 output file transfer
 - \$\$ podio::~MCParticles segfault in eicrecon
 - \$\$\$ Jobs go awol and stop reporting
- Failed jobs resubmitted, complete on 2nd run (except for geant4 navigation error)
- Currently avoiding following OSG sites:
 - GPGGrid, Crane, IU-Jetstream2-Backfill, SU-ITS-CE2, SU-ITS-CE3

Current production requirements

SIDIS: 412512 core-hours
pythia6: 401949 core-hours
10x100: 68942.1 core-hours
noradcor: 68942.1 core-hours
18x275: 299066 core-hours
noradcor: 156833 core-hours
radcor: 142233 core-hours
5x41: 33940.2 core-hours
noradcor: 19286.1 core-hours
radcor: 14654.1 core-hours

EXCLUSIVE: 122426.7 core-hours
DIFFRACTIVE_JPSI: 38154.8 core-hours
DIFFRACTIVE_PHI: 55919.1 core-hours
DVCS: 9731.32 core-hours
TCS: 18555.3 core-hours

SINGLE (1M): 4635.79 core-hours
3to50deg: 2124.77 core-hours
130to177deg: 1301.02 core-hours
45to135deg: 1210 core-hours

DIS: 259859 core-hours
CC: 73743.2 core-hours
10x100: 9246.4 core-hours
minQ2=1000: 4243.85 core-hours
minQ2=100: 5002.55 core-hours

18x275: 29100.3 core-hours
minQ2=1000: 13950.6 core-hours
minQ2=100: 15149.7 core-hours
5x41: 2197.1 core-hours
minQ2=100: 2197.1 core-hours
10x275: 26272.9 core-hours
minQ2=1000: 12784.3 core-hours
minQ2=100: 13488.6 core-hours
5x100: 6926.45 core-hours
minQ2=1000: 2716.51 core-hours
minQ2=100: 4209.94 core-hours
NC: 186116 core-hours
10x100: 24992.8 core-hours
minQ2=1000: 6742.12 core-hours
minQ2=100: 5933.93 core-hours
minQ2=10: 6121.88 core-hours
minQ2=1: 6194.85 core-hours
18x275: 65939.5 core-hours
minQ2=1000: 16678.8 core-hours
minQ2=100: 15881 core-hours
minQ2=10: 16347.8 core-hours
minQ2=1: 17031.9 core-hours

5x41: 8606.16 core-hours
minQ2=100: 2760.59 core-hours
minQ2=10: 2706.75 core-hours
minQ2=1: 3138.82 core-hours
10x275: 63340.1 core-hours
minQ2=1000: 15808.9 core-hours
minQ2=100: 15312.9 core-hours
minQ2=10: 15586 core-hours
minQ2=1: 16632.3 core-hours
5x100: 23237.6 core-hours
minQ2=1000: 5778.19 core-hours
minQ2=100: 5378.98 core-hours
minQ2=10: 5865.21 core-hours
minQ2=1: 6215.25 core-hours

TOTAL: 799434 core-hours = 91 core-years per configuration

Average OSG node running time (wall clock) about 25% longer than our benchmarks -> 114 core-years

Note: Not all data sets included (too many small exclusive datasets to list here); this is the dominant portion of it. A Djangoh EW DIS set of estimated 200k core-hours is the only unbenchmarked large part missing.

Planning for the future

Evolution in Computing, Software, Simulation, QA working group(s)

- Joint development and operations (only joint CompSW and SimQA meetings)
- Conveners: Welcome to Markus Diefenthaler as CompSW conveners
- Discussions about scope and division of work, with goal of teams within the working group and ability for shared leadership roles and responsibilities within those teams
- Discussions about lessons learned about the reconstruction framework: how to combine planning for the future with delivering results now
 - Wednesday November 30: analysis of simulations, discussion with PWGs
[\[https://indico.bnl.gov/event/17807/\]](https://indico.bnl.gov/event/17807/)
 - Wednesday December 7: lessons learned and next steps meeting
[\[https://indico.bnl.gov/event/17858/\]](https://indico.bnl.gov/event/17858/)

Planning for the future

Simulation production campaign schedule for 2023:

- Large scale (full) production campaigns targeted for every quarter
 - Smaller campaigns in between
- Likely no duplication of these requirements for two configurations starting in April 2023
- Adoption of production workflow and scientific data management system in first or second quarter of CY 2023
- Likely increase in computational cost of simulations as fidelity increases

Why running jobs on OSG and not (only) BNL and JLab?

- Both host labs are providing computing resources are the order of 2k jobs slots dedicated to EIC. Why are we running on OSG?
- Until we have a dedicated discussion and decision on a production workflow and scientific data management framework, we decided to use the existing infrastructure with as few changes as possible (for well-defined workflow and to limit risk). For the single software stack that means running on OSG as we did during the proposal phase.
- Running on OSG gives us access to a level of computing that is an order of magnitude above what the host labs provide. In fact, we have to throttle simulation production because otherwise we risk overwhelming xrootd on the input side and S3 on the output side.