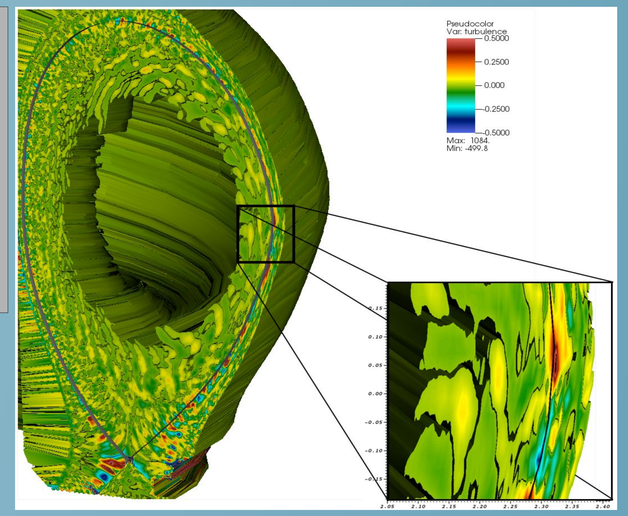
HBPS
High-fidelity Boundary Plasma Simulation

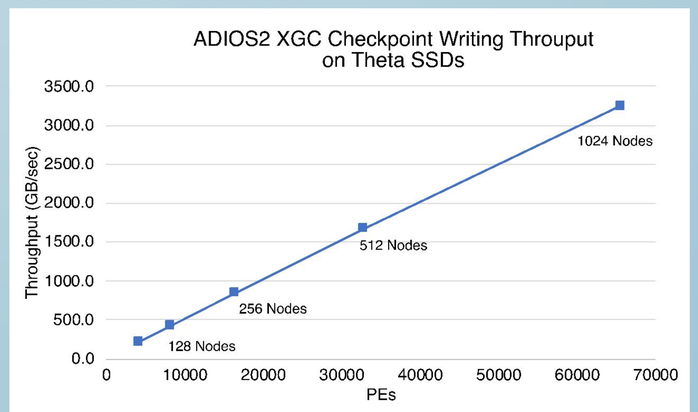
Data Management Challenges in HBPS

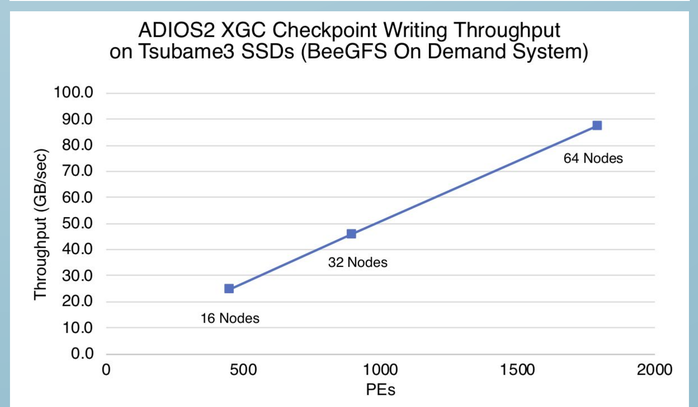
Jong Youl Choi[1], Michael Churchill[2], Robert Hager[2], Seung-Hoe Ku[2], E. D'Azevedo[1], Bill Hoffman[3], David Pugmire[1], Scott Klasky[1], C. S. Chang[3]
[1]ORNL, [2]PPPL, [3]Kitware



XGC I/O Performance

We maintain cutting edge I/O performance for XGC on various file systems, including SSDs and NVMe, on Theta, Cori, and Summit. We also tested on Tusbame3.



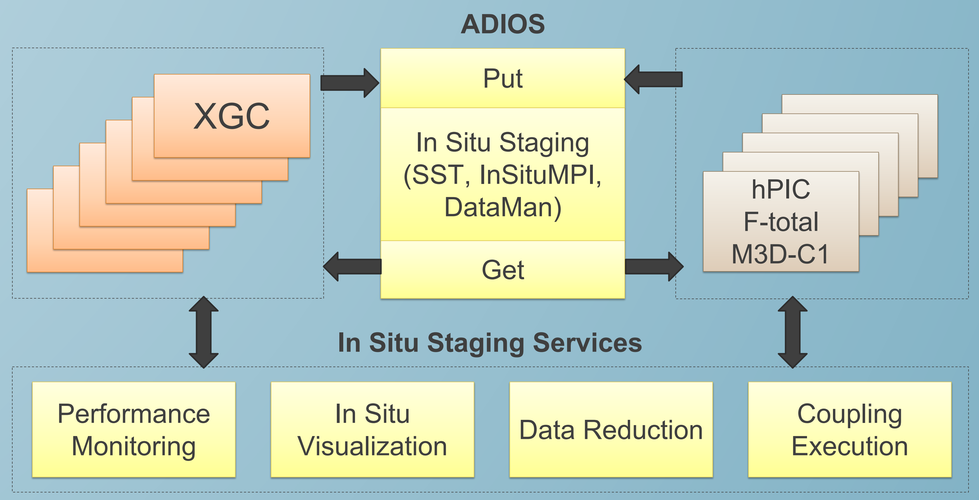


XGC Software Process

Agile XGC development

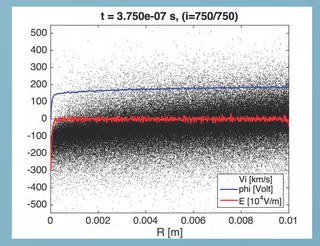
- Incorporate a modern CMake build system
- Continuous Integration testing system
- Git workflow incorporated with CI system
- Integrate CDash into github

Coupling Workflows



We develop 3+ way coupling workflows in HBPS

1) XGC and hPIC
   - Plasma-material-interaction hPIC code coupled into XGC
   - hPIC code has 6D marker particles, while XGC has 5D marker particles
2) XGC and on-memory analysis routines
   - XGC computes 5D f and electromagnetic field
   - Hand-off computational reduction of physics from XGC
3) XGC and M3D-C1
   - M3D-C1 will calculate the nonlinear evolution of the ELM
   - XGC1 will use the MHD-produced non-axisymmetric electromagnetic field and calculate kinetic transport
   - The kinetic information from XGC will be continuously fed back into M3D-C1 for a higher fidelity MHD calculation



Plasma distributions from XGC-hPIC

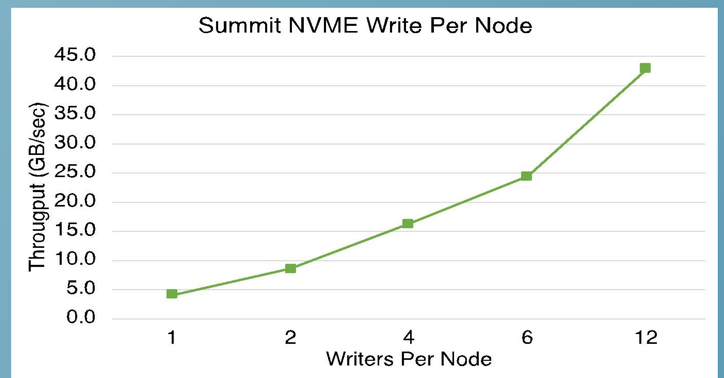
ADIOS coupling technology provides

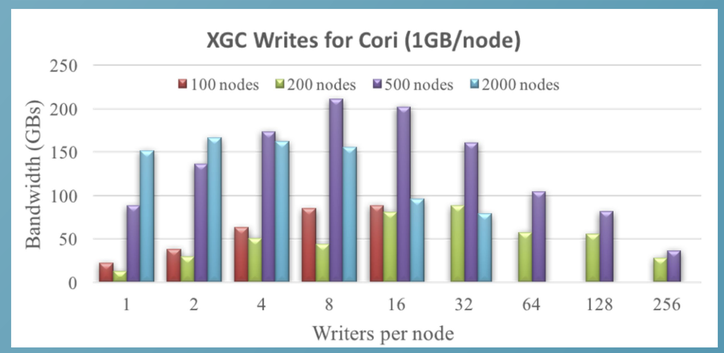
- In Situ/in-memory coupling framework
- Provide easy-monitoring, data compression, and/or visualization services while XGC and coupled application are running

I/O For Next Generation HPCs

The DM team continue to innovate to take full advantage of the new memory and storage technologies, and to provide the highest levels of performance.

I/O System	Summit ORNL	Theta ANL	Cori NERSC
Locality	Node local	Node local	Remote Shared
System	Local filesystem	XFS filesystem	Cray WARP
Capacity	800 GB per node	128 GB per node	288 Server 50 TB limit per job
Parallel Filesystem	GPFS Lustre	Lustre	Lustre





Acknowledgments: Work supported by U.S. DOE Office of Science, ASCR and FES. This research used resources of OLCF, ALCF, and NERSC, which are DOE Office of Science User Facilities.