XGC Fusion Code

XGC is a modern first-principles gyrokinetic code using particle-in-cell (PIC) technology for modeling the plasma in a tokamak fusion device, emphasizing the boundary region. XGC can handle complex geometry including the X-point and the scrape-off edge region. A field-following unstructured mesh is used in each poloidal plane.

Performance Results

- **Electron push** is the most expensive computational kernel and optimized for GPU using CUDA Fortran to take advantage of texture memory.
- **Multi-species collision** is another expensive kernel and optimized using OpenACC for GPU.
- XGC uses ADIOS to achieve high performance in parallel I/O to NVRAM and parallel file system (300 GB/s on 32 nodes).
- XGC uses OpenMP over multiple cores and uses 1 MPI rank per GPU

**CONCLUSIONS**

- Near linear strong scaling to 2048 nodes (over 40%) of Summit
- Weak scaling is also near linear
- About 11X speedup at 2,048 nodes using GPU (and CPU simultaneously) acceleration over CPU-only version
- 2048 nodes on Summit is about 3.8X faster over 12288 nodes on Titan
- Further scaling studies will be performed when a larger fraction of Summit will be available.

**Acknowledgments**: Work supported by the 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.
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Performance Results

- Near linear strong scaling to 1024 nodes (over 20%) of Summit
- About 11X speedup using GPU acceleration over CPU-only version
- 1024 nodes on Summit is about 3.4X faster over 6144 nodes on Titan
- Further scaling studies will be performed when a larger fraction of Summit will be available.

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