

# OOKAMI PROJECT APPLICATION

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**Date:** March 23rd 2022

**Project Title:** Performance Portable Vector Particle-In-Cell (VPIC)

**Usage:**

Testbed

Production

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**Usage Description:**

Vector Particle-In-Cell (VPIC) is a 3D relativistic, electromagnetic particle-in-cell code plasma simulation code. VPIC was recently updated to VPIC 2.0 which uses the Kokkos performance portability framework for GPU acceleration on modern and future systems. The move to Kokkos

came with some inherent portability drawbacks that we are investigating. Vectorization performance in particular degraded significantly. Earlier versions of VPIC (VPIC 1.2) use hand tuned vector intrinsics to vectorize important kernels. Tuning and adding vector intrinsics for new platforms is not ideal. We are studying methods to enhance the vectorization capabilities provided by Kokkos such that VPIC can vectorize properly.

The A64FX chips in Oookami present an ideal testing platform for analyzing and addressing challenges introduced by performance portability frameworks. The A64FX is a new architecture that VPIC 1.2 is not tuned for. Vectorizing on the A64FX will not only improve overall performance but also presents an opportunity to explore the process of optimizing VPIC 2.0 for new architectures while remaining portable.

### **Computational Resources:**

Total node hours per year:

5,000

Size (nodes) and duration (hours) for a typical batch job:

3 nodes, 30 minutes

Disk space (home, project, scratch):

(30GB, 1TB, 1TB)

### **Personnel Resources** (assistance in porting/tuning, or training for your users):

Documentation on A64FX chip and compilers.

### **Required software:**

C/C++ compiler, MPI implementation, cmake

### **If your research is supported by US federal agencies:**

Agency: DoE through Los Alamos National Laboratory contract; NSF

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