PARALLELIZATION OF THE MULTILEVEL FAST MULTIPole ALGORITHM (MLFMA) ON HETEROGENEOUS CPU-GPU ARCHITECTURES

Research Challenge
The goal of the experiment was to increase the speed of the Multilevel Fast Multipole Algorithm (MLFMA) across multiple Blue Water nodes, and to utilize GPUs.
The nature of the algorithm was not easily spread across multiple CPU/GPU to increase speed for computations.
The complexity of calculations could not be easily run on GPUs

Methods & Codes
The available memory on Blue Waters enabled much larger simulations to be performed.
A different compute mechanism was deployed to better utilize Blue Water resources to lower idle time.
Code was developed (Fortran, C++, and CUDA) specifically for this purpose.

Results & Impact
By using GPUs effectively, researchers were able to obtain a 3.97 times speedup compared to using only CPUs, while also achieving a 96% parallelization efficiency.
Using parallelization, the compute time dropped from 11.5 hours (sequential execution) to 7 seconds using 128 GPU nodes.
This allowed near-real-time image viewing.

Why Blue Waters
The available amount of RAM and GPUs on Blue Waters allowed for research to be performed at a much larger scale than had previously been achieved.
Blue Waters staff also provided expertise that enabled researchers to solve many of the issues developing the code base.