CS 6230: HIGH PERFORMANCE PARALLEL COMPUTING
ASSIGNMENT #3: CHARGED PARTICLES SIMULATION

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Figure 1: FLOAT – OpenMP vs. OpenACC

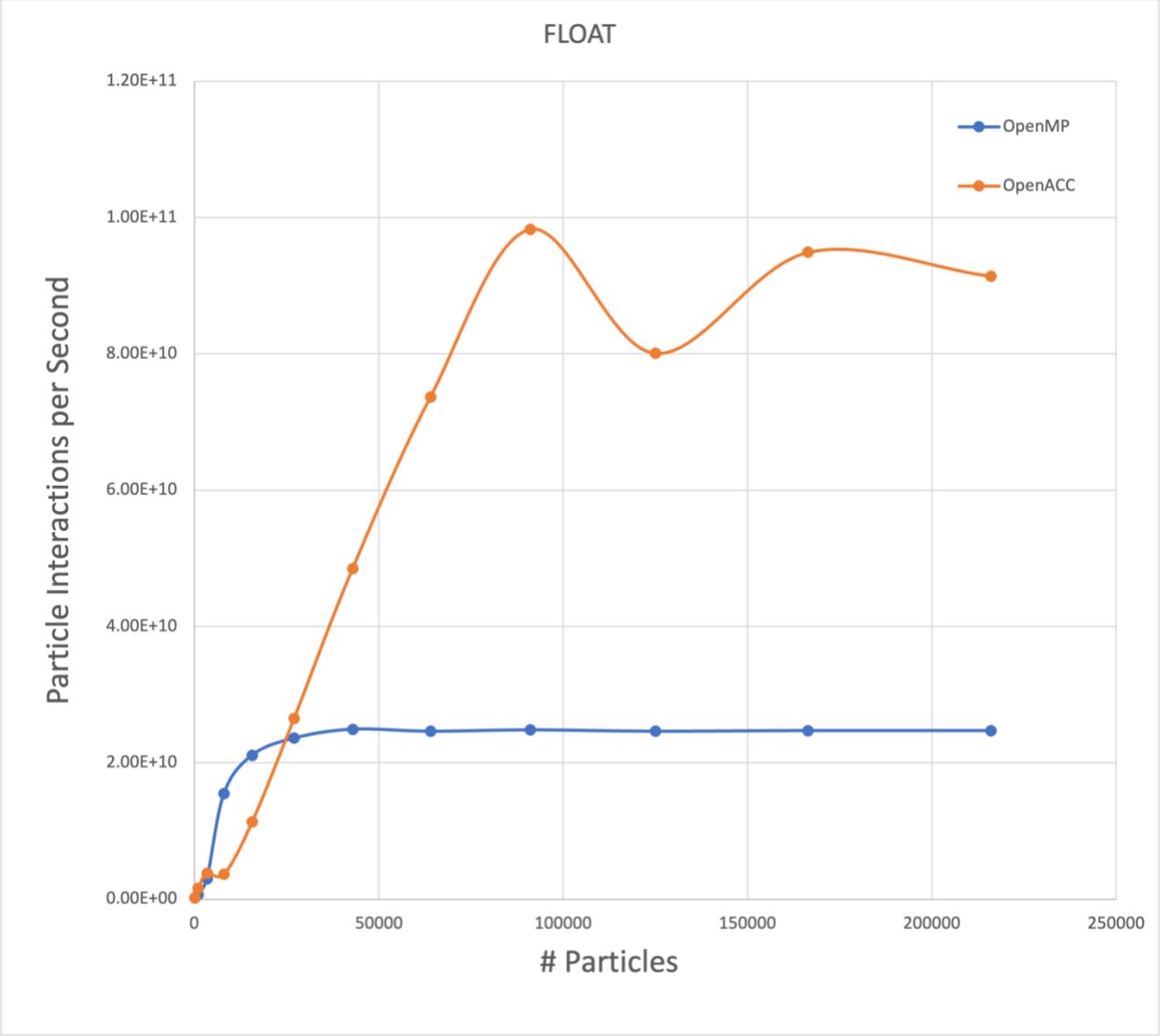
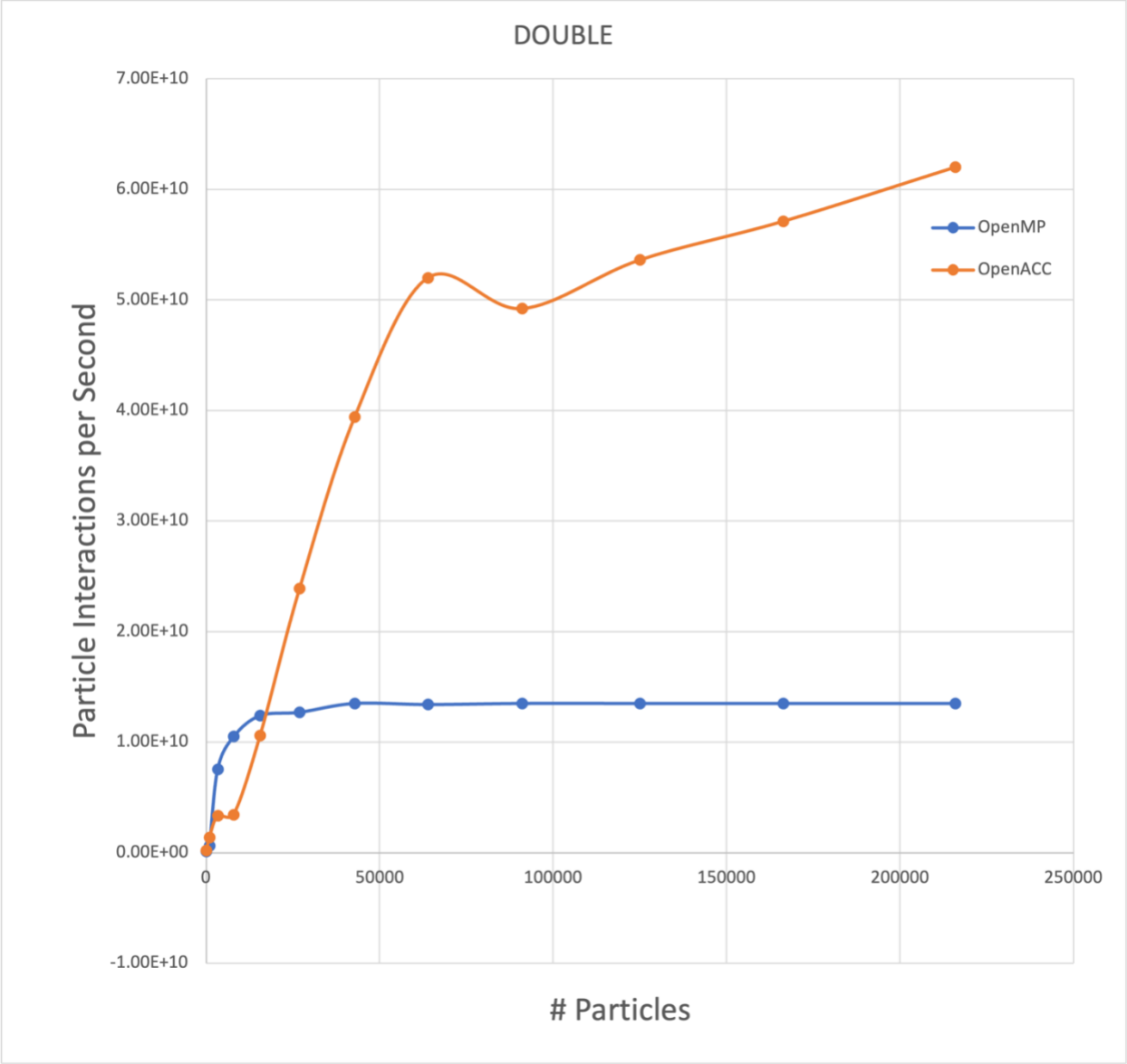


Figure 2: DOUBLE – OpenMP vs. OpenACC



In both cases, OpenACC is less efficient when compared to OpenMP for a small number of particles: <25,000 particles being simulated. As the number of particles grows, the performance of OpenMP plateaus whereas the performance of OpenACC keeps increasing even till 216,000 particles.

GPUs have a higher flop rate than CPUs (~4TF/s vs ~500GF/s), which is why see the above performance and behavior when using a bunch of cores vs. a GPU for our computations. Moreover, the Bandwidth of Main Memory → CPUs is also much lower than Global Memory → GPU (~50GB/s vs ~250GB/s), which also explains the above behavior.

Coming to the nature of the problem where each particle is affected by the remaining n-1 particles, GPUs perform better since their hardware are optimized for Fused Multiplication

Arithmetic, which is what most of the computation is in our problem here. This is why, using GPUs for these types of problems yields higher performance than running it in a multicore environment.