CS 475

Intro to Parallel Programming

Instructor: Matthew Meyn

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Project 7

1. **Computer I ran my program on**

   I ran developed and ran my program in Computer Graphics Education Lab (CGEL)
   Processor: Intel Xeon CPU E3-1230 v5 @ 3.40 GHz (8 CPUs)
   Memory: 16384 MB
   Operating System: Windows 10
   GPU: NVIDIA GTX 1080 Ti
   GPU memory: 19286 MB

2. **What dynamic thing did you do with the particle colors**

   The color of a particle is determined by the sum of its current position and its current velocity, with respective to each components. Specifically, the formula is:

```
        c.x = vp.x + pp.x;
        c.y = vp.y + pp.y;
        c.z = vp.z + pp.z;
        c.w = 1.;
```

   When the particle bounce off the yellow sphere, its color is changed to briefly to **blue**.

```
if( IsInsideSphere( pp, Sphere1 ) ) {
                vp = BounceSphere( p, v, Sphere1 );
                pp = p + vp*DT + (float4)(.5*DT*DT)*G;
                c.x = 0.0f;
                c.y = 0.0f;
                c.z = 0.9f;
                c.w = 1.;
        }
```

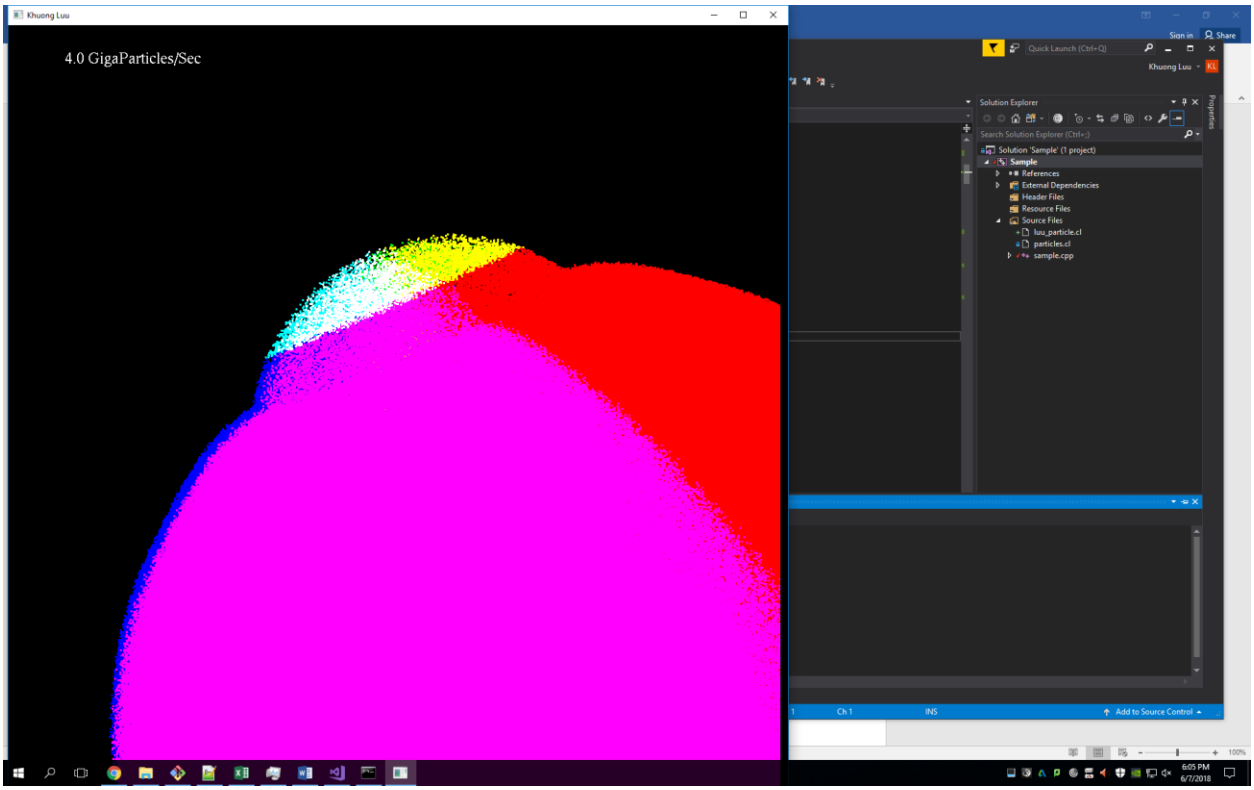
   Then the particle bounce off the white sphere, its color is changed briefly to **red**

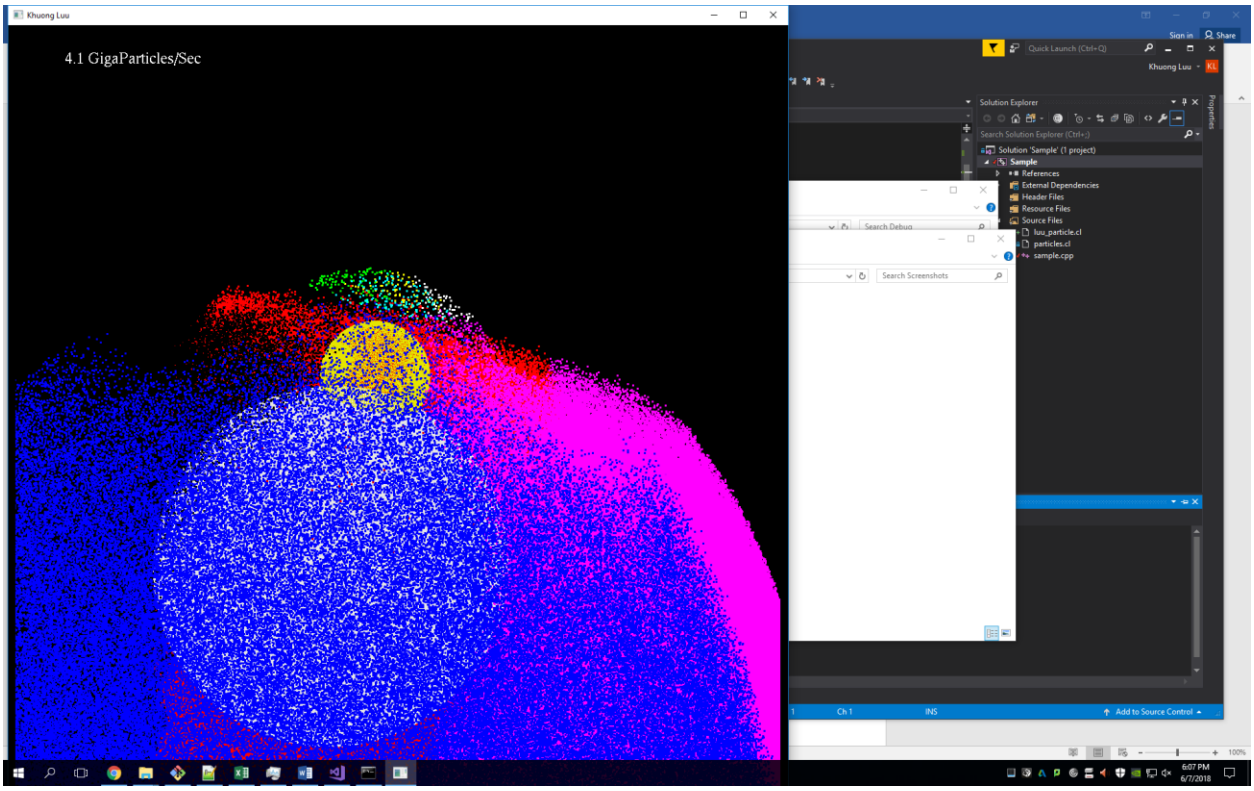
```
if (IsInsideSphere(pp, Sphere2)) {
                vp = BounceSphere(p, v, Sphere2);
                pp = p + vp * DT + (float4)(.5*DT*DT)*G;
                c.x = 0.9f;
                c.y = 0.0f;
                c.z = 0.0f;
                c.w = 1.;
        }
```

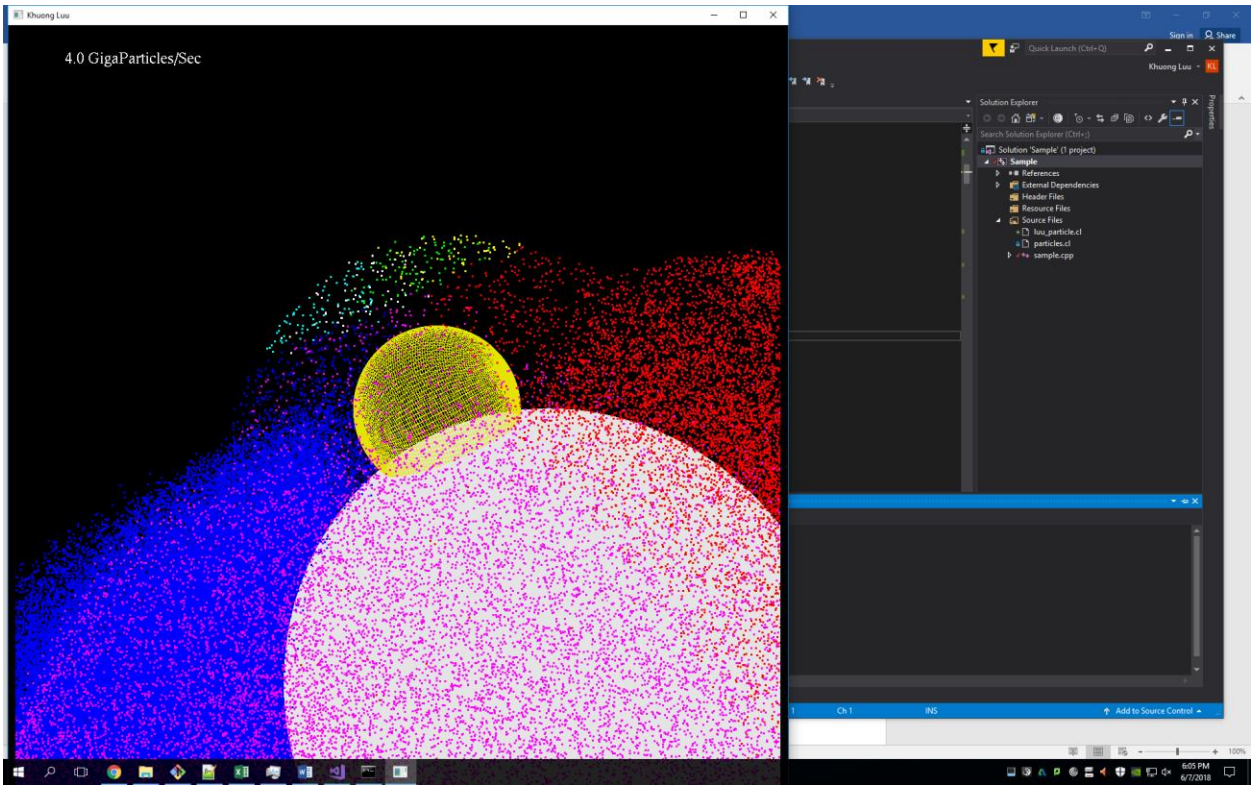
My kernel code is below:

```
3.  Kernel
4.  void
5.  Particle( global point *dPobj, global vector *dVel, global color *dCobj )
6.  {
7.          const float4 G       = (float4) ( 0., -9.8, 0., 0. );
8.          const float  DT      = 0.1;
9.          const sphere Sphere1 = (sphere)( -100., -800., 0.,  600. );
10.         const sphere Sphere2 = (sphere)(-100., -3000., 0., 2000);
11.         int gid = get_global_id( 0 );
12.
13.         point  p = dPobj[gid];
14.         vector v = dVel[gid];
15.         color c = dCobj[gid];
16.
17.         point  pp = p + v*DT + (float4)(.5*DT*DT)*G;
18.         vector vp = v + G*DT;
19.
20.         c.x = vp.x + pp.x;
21.         c.y = vp.y + pp.y;
22.         c.z = vp.z + pp.z;
23.         c.w = 1.;
24.
25.         pp.w = 1.;
26.         vp.w = 0.;
27.
28.         if( IsInsideSphere( pp, Sphere1 ) ) {
29.                 vp = BounceSphere( p, v, Sphere1 );
30.                 pp = p + vp*DT + (float4)(.5*DT*DT)*G;
31.                 c.x = 0.0f;
32.                 c.y = 0.0f;
33.                 c.z = 0.9f;
34.                 c.w = 1.;
35.         }
36.         if (IsInsideSphere(pp, Sphere2)) {
37.                 vp = BounceSphere(p, v, Sphere2);
38.                 pp = p + vp * DT + (float4)(.5*DT*DT)*G;
39.                 c.x = 0.9f;
40.                 c.y = 0.0f;
41.                 c.z = 0.0f;
42.                 c.w = 1.;
43.         }
44.
45.         dPobj[gid] = pp;
46.         dVel[gid]  = vp;
47.         dCobj[gid] = c;
48. }
```

3. **Include at least one screen capture image of your project in action**

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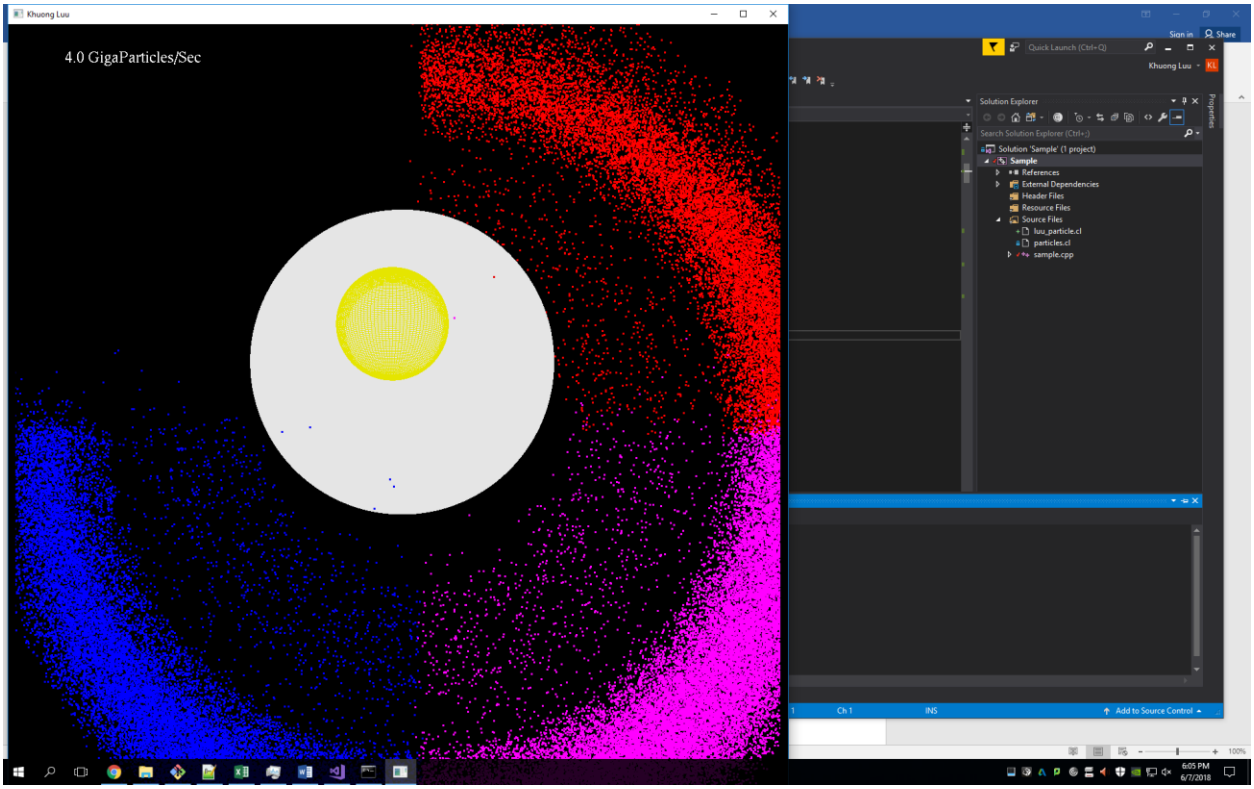
4.0 GigaParticles/Sec
Solution Explorer
Solution 'Sample' (1 project)
Sample
References
External Dependencies
Header Files
Resource Files
Source Files
luu_particle.cl
particles.cl
sample.cpp
Add to Source Control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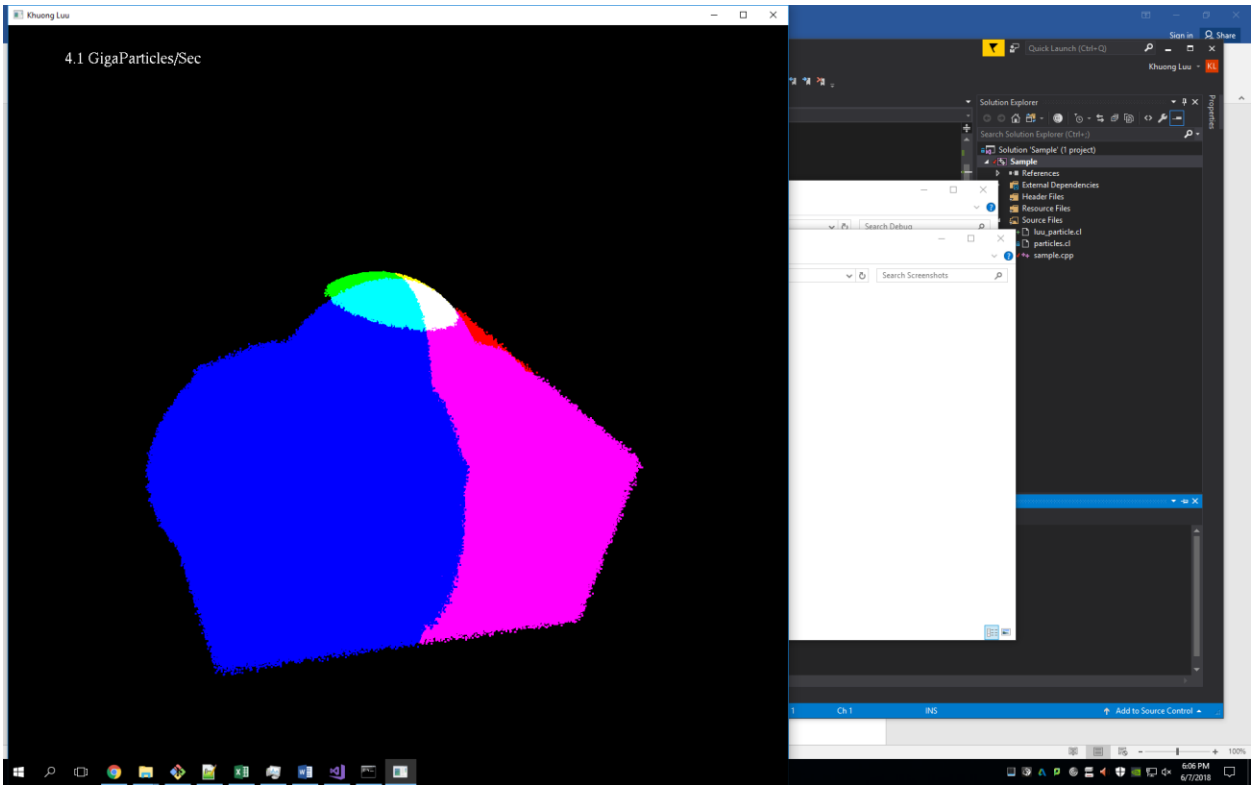
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Search Solution Explorer (Ctrl+;)
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Search Screenshots
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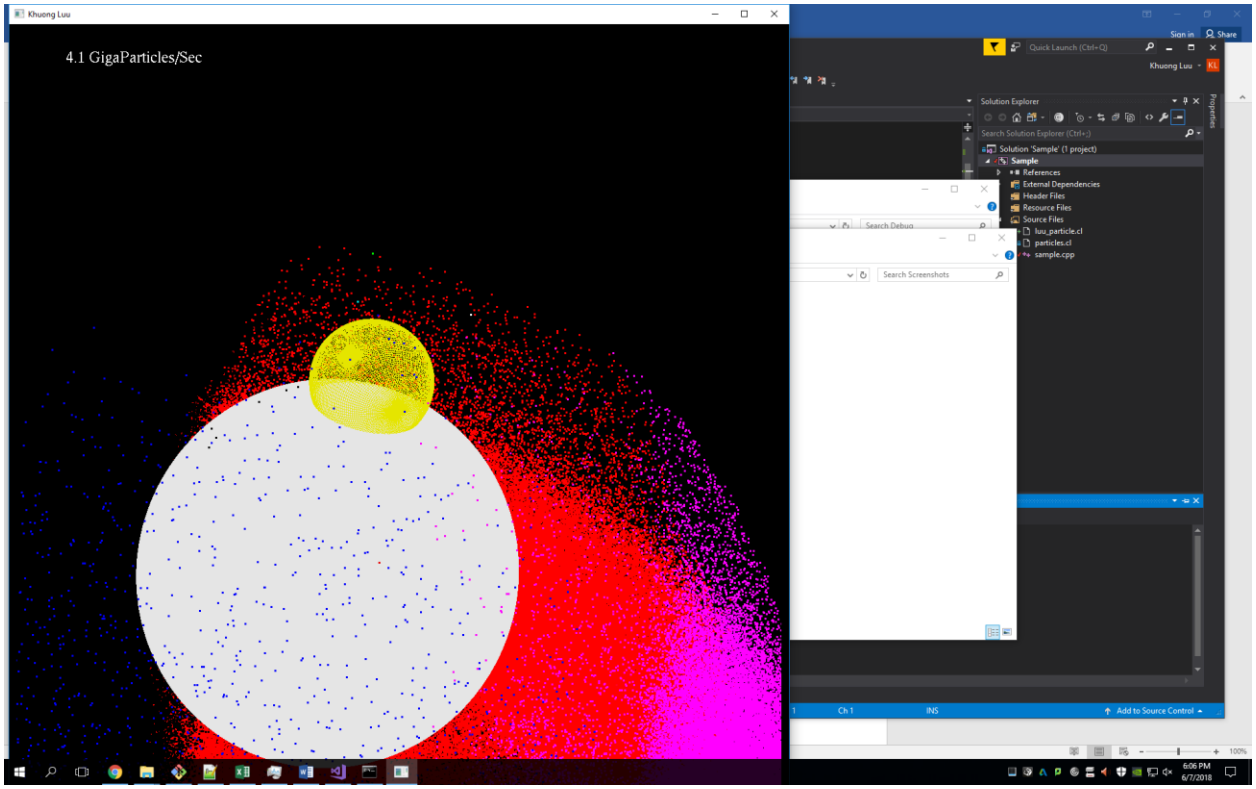
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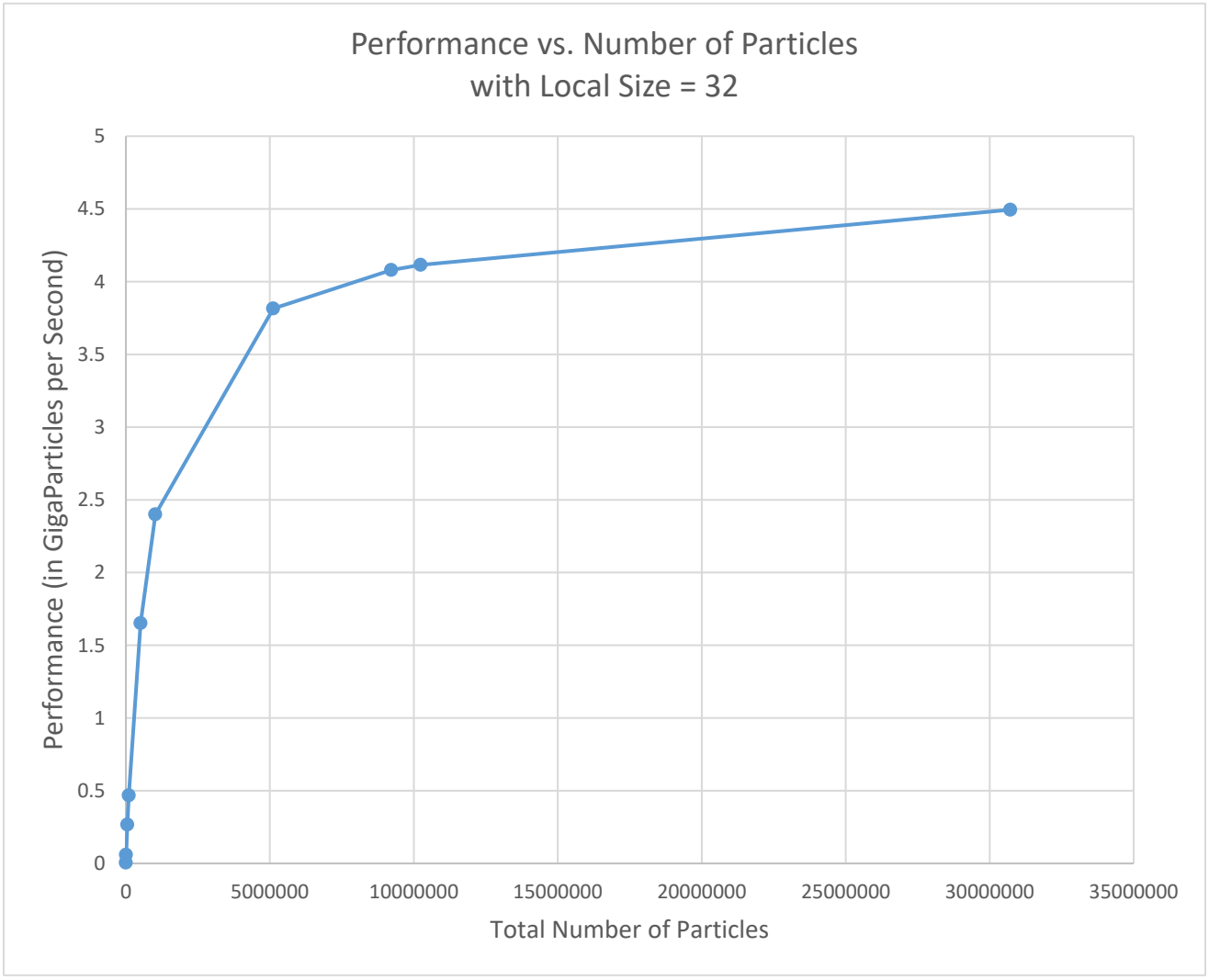
**4. Table**

| Number of Particles | Performance |
|---:|---:|
| 1024 | 0.005742 |
| 10240 | 0.060296 |
| 51200 | 0.267325 |
| 102400 | 0.468611 |
| 512000 | 1.652104 |
| 1024000 | 2.400428 |
| 5120000 | 3.815352 |
| 9216000 | 4.079692 |
| 10240000 | 4.115246 |
| 30720000 | 4.494482 |

5. Graph


Performance vs. Number of Particles
with Local Size = 32
Performance (in GigaParticles per Second)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
5000000
10000000
15000000
20000000
25000000
30000000
35000000
Total Number of Particles