PHYS-8061 HW3 Discussions

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Find the potential versus the distance r from the point charge, for L=8, 16, 32, 64 respectively.

After calculating Φ using the GPU code, the average error is calculated by:

$$avg\_error = \frac{1}{L^3}\sum_{x=0}^{L-1}\sum_{y=0}^{L-1}\sum_{z=0}^{L-1}\left(\phi(x, y, z) - \frac{1}{\sqrt{(x-\frac{L}{2})^2+(y-\frac{L}{2})^2+(z-\frac{L}{2})^2}}\right)^2$$

And the results are:
L = 8 : 1.016561033034483e-01
L = 16 : 2.774785769861540e-02
L = 32 : 7.218920876384431e-03
L = 64 : 1.839355177037889e-03

As we can observe, the larger the L is, the closer the average error is to 0.
This suggests that with bigger L, the potential for each point in the lattice is closer to 1/r, where r is the distance from the charge, positioned at (L/2, L/2, L/2).

Yes, it does approach Coulomb's Law as L >> 1