

PH 354: hw 3, problem 14

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At $z = 0$, The force is zero as can be seen from the following expression except for the singularity at origin:

$$F_z = G\sigma \int_{-\frac{L}{2}}^{\frac{L}{2}} dx \int_{-\frac{L}{2}}^{\frac{L}{2}} dy \frac{z}{[x^2 + y^2 + z^2]^{\frac{3}{2}}}$$

Because F_z has a discontinuity at $z = 0$, F_z increases for smaller and smaller values of z but suddenly drops off to zero giving a fake impression that the force F_z has a falling trend for small enough z values.

A way to get around this is by decreasing the spacing between consecutive z values. If the spacing is smaller than the desired smallest z scales, this numerical artifact can be avoided upto the desired z resolution. However, accurate evaluation of the integral for smaller z values require higher number of Quadrature points.