GTC Gaussian Radial Boundary Mitigation

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Particles getting lost to the boundary is a problem that needs to be addressed by all PIC codes. In GTC, when a particle exits the simulation boundary, all of its parameters (position, velocity, etc.) are reset to the values they had at the previous time step, except θ. Now, an artificial boundary condition necessarily yields a larger or lesser degree of unphysical effects into a simulation. Thus, mitigating these effects is important. Here, a gaussian function is used to significantly reduce the magnitude of any radial mesh defined quantity.

Let *A*(i) be any radial mesh defined quantity, where i ranges from 0 to mpsi-1, and let nbound be the number of radial points where *A*'s magnitude will be suppressed inside of the left and right radial boundaries. Then, on the radial points where there is radial suppression,

$$A(j) = A(j) \cdot exp[-\tfrac{1}{2}(\tfrac{j-(nbound-1)}{\sigma})^2],$$

for the left boundary, and

$$A(mpsi-j) = A(mpsi-j) \cdot exp[-\tfrac{1}{2}(\tfrac{j-(nbound-1)}{\sigma})^2],$$

for the right boundary, where,

$$\sigma = \frac{(nbound-1)/2}{2\sqrt{2ln2}},$$

and $j = [0,\ nbound-1]$.

Now, when $i = \tfrac{3}{4}(nbound-1),\ A(i) = \tfrac{1}{2}A(i)$, that is, the magnitude of *A*(i) is halved in (nbound-1)/4 points.