How Special Relativity is incorporated into BOXEL.C

In Newtonian dynamics, the Force and Acceleration vectors are related as follows:

$$\vec{F} = m\vec{a}$$

But when velocities become a significant faction of the speed of light, this relationship becomes more complex. In short, this is because no amount of force is capable of accelerating an object above the speed of light. The component of the force that is parallel to the direction of motion is governed by this equation:

$$\overrightarrow{F_{=}} = m\vec{a}_{=}\gamma^{3}$$

Where:

$$\gamma = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^{2}}}$$

And the Force that is perpendicular to motion is governed by this equation:

$$\overrightarrow{F_{\perp}} = m\vec{a}_{\perp}\gamma$$

The first order of business in the simulation is to determine the component of force that is parallel to the direction of motion. This is accomplished via the following:

$$\overrightarrow{F_{=}} = \vec{F} \cdot \frac{\vec{V}}{\left|\vec{V}\right|}$$

Once the parallel force is in hand the simplest way to compute the perpendicular force is with:

$$\overrightarrow{F_{\perp}} = \vec{F} - \overrightarrow{F_{=}}$$

Note that in the computer model that the velocity is already scaled to 1=c, so no division by c is required and the calculations are simplified by not dividing by gamma but simply multiplying by its inverse.