Relativistic (3-)momentum: Most fundamental object, conserved. New: scale factor Gamma multiplies rest mass $m$.

Example: two equal “putty” masses thrown sideways from platform and train stick together
Mass is NOT conserved. But Gamma*Mass is! Example: exploding firecracker in S', one fragment at rest in S
\[ \Gamma \cdot mc^2 = \text{Energy} \]
\[ \Gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = 1 - \frac{1}{2} \left( -\frac{v^2}{c^2} \right) - \frac{3}{8} \left( -\frac{v^2}{c^2} \right)^2 \]
\[ \Gamma mc^2 = mc^2 + \frac{1}{2} mv^2 + \ldots \]
\[ \text{Energy} = \Gamma mc^2 \]
\[ \text{Momentum} = \Gamma m \frac{v}{\sqrt{1 - \frac{v^2}{c^2}}} \]