The center of mass of an isolated relativistic system and its motion

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In Classical Mechanics, isolated systems are most easily analyzed by first computing their center of mass and determining its motion, and then, as a second step, expressing the motion of the full system relative to the center of mass. Mathematically, this works because the underlying partial differential equation, the Poisson equation, is linear and hence allows for superposition of solutions. This is in stark contrast to General Relativity, which is a nonlinear theory. Yet, near infinity, isolated relativistic systems are almost non-gravitating so that one can hope to effectively work with a linearized version of the nonlinear geometric partial differential equations of General Relativity.

After a rather extensive introduction of the central concepts and ideas, I will describe a new approach to defining the center of mass of an isolated relativistic system at a given time and explain the law of motion it is subject to. I will explain why this definition can be considered satisfactory from both mathematical and physical viewpoints and illustrate how it fixes deficiencies of previous definitions. This is joint work with Anna Sakovich.