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THE RELATIVISTIC MASS RATIO IN ULTRARELATIVISTIC PHOTON ROCKETS

Abstract

In this paper we take a closer look at the initial mass relative to the relativistic mass of the payload for an ideal photon rocket travelling at its maximum velocity. Haug has recently suggested that for all known subatomic particles, a minimum of two Planck masses of fuel are needed to accelerate the fundamental particle to its suggested maximum velocity (see [1]).

Here we will show how this view is consistent with insight given by Tipler in the NASA Breakthrough Propulsion Physics Workshop Proceedings in 1999 (see [2]). Tipler suggested that the mass ratio of the initial rest-mass of an ultrarelativistic rocket relative to the relativistic mass of the payload is likely "just" two. An ultrarelativistic rocket is one travelling at a velocity very close to the speed of light. We will here show that the Tipler factor is consistent with results derived from Haug's suggested maximum velocity for any known observed subatomic particle.

However, we will show that the Tipler factor of two is unlikely to hold for ultra-heavy subatomic particle payloads. With ultra-heavy particles, we think of subatomic particles with mass close to that of the Planck mass. Our analysis indicates that the initial mass relative to the relativistic mass of the payload for any type of subatomic particle rocket must be between one and two and that it is a non-linear function. Remarkably, the mass ratio is only one for a Planck mass particle. This at first sounds absurd until we understand that the Planck mass particle is probably the very collision point between two photons. Even if a photon's speed "is always" considered to be the speed of light, we can think of it as standing still at the instant it collides with another photon (backscattering). The mass ratio to accelerate a particle that only exists at velocity zero is naturally one. This is true since no fuel is needed to go from zero to zero velocity. Remarkably this indicates that the Planck mass particle and the Planck length likely are invariant. This can only happen if the Planck mass particle only lasts for an instant before it bursts into energy, which is what we could expect for the collision between two photons.