Some thoughts on negative mass.

Jeremy Dunning-Davies,
Departments of Mathematics and Physics (retd),
University of Hull, England;
Institute for Basic Research, Palm Harbor, Florida, USA.
masjd@masjd.karoo.co.uk

Richard Lawrence Norman,
Editor in chief, *Mind* magazine *Journal of Unconscious Psychology*
Scientific Advisor Thunder Energies Corporation
editor@thejournalofunconsciouspsychology.com

Abstract.
Following the appearance of several recent articles on the topic of negative mass, it is possibly of interest to mention some other work associated with this which appeared some years ago and was reviewed in a long article which has just appeared on this site[1].

The topic of negative mass seems to be raising its head yet again after lying dormant for some years. However, an attempt was made to address many of the issues raised by such as Bondi and Forward some years ago[2]. References to the work of Bondi and Forward as well as others may be found in this cited article. In brief, no contradictions were discovered if the idea of negative mass was introduced into Newton's laws of motion and gravitation, although a necessary modification to the principle of least action was proposed. However, when the statistical thermodynamics of a gas composed of particles with negative mass was considered, it appeared that a restriction to such systems being described by negative absolute temperatures was required. This leant support to the already conjectured hypothesis that particles of positive and negative mass cannot coexist. This rules out runaway motion as commented on in earlier papers. Finally, the conclusion reached was that negative mass can exist only at negative absolute temperatures and must be adiabatically isolated from positive mass.

Following on this examination of the issue, the book by Léon Brillouin[3] – *Relativity Reexamined* – was discovered and, apart from comments direct from Brillouin himself introduced the work of Carstoiu[4] to a wider audience. Note though that the main emphasis of Carstoiu's work was to suggest the existence of a set of four equations, analogous to Maxwell's electromagnetic equations, to describe the gravitational field. This involved introducing the idea of a new so-called vortex field but also echoed earlier work by Heaviside during the nineteenth century. The large link up here with notions of negative mass came via Brillouin's ideas where he pointed out that, in order to preserve the well-known mass/energy relation, it was necessary to have both positive and negative masses since both positive and negative energies were possible. Much of this is dealt with in detail in chapter 7 of the above-mentioned book by Brillouin. Note, though, that the negative mass referred to here might well be termed a mass equivalent to account for the mass/energy relationship; it might not refer to actual real negative mass particles and this would allow the considerations of reference 1 to remain valid while still allowing a form of negative mass.

The notion of mass equivalent may also be considered in the case of supposedly zero-mass particles such as photons or neutrinos. In these cases it is customary to write their energy in terms of frequency ν as

$$E = h\nu.$$

However, to ensure consistency with the usual energy/mass equation it is necessary that

$$m = h\nu/c^2,$$

that is, there is a mass equivalent but that does not imply the existence of an actual mass, as we normally know it, for the supposedly zero-mass particle in question.

As is noted in the more recent article mentioned above[1], this entire idea of negative mass has strong implications for any interested in the possibility of the existence of so-called anti-gravity devices. This, however, is yet another point and one which was reviewed extensively in this recent article 1, where further relevant references may be found

References.

1. R. L. Norman & J. Dunning-Davies; *Gravity*, http://viXra.org/abs/1910.0368
2. D. Pollard and J. Dunning-Davies; 1995, *Il Nuovo Cimento*, **110B.** 857-864
3. L. Brillouin; 1970, *Relativity Reexamined*, Academic Press, New York & London
4. J. Carstoiu; 1969, *Compt. Rend.*, **268**, 201-263
   Also note http://viXra.org/abs/1701.0533 where a translation is available.