EDITORIAL

Antimatter and relativity

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ABSTRACT

Recent research, published in Nature (Anderson et al, 2023) shows that antimatter, in the form of antihydrogen, falls freely in the presence of a gravitational field. This ought to come as no surprise to any physicist, as it follows, logically, from the Special Theory of Relativity, which proposes that mass and energy are equivalent, and the General Theory of Relativity, which proposes that mass energy produces gravitational fields, and is affected by them.

As antimatter possesses both mass and energy, if the experiment conducted by Anderson and his colleagues had shown any other reaction to the one it did, they would have disproved both of Einstein's theories. 'Exotic matter', rather than antimatter, is the kind that can be expected to evoke an 'anti-gravity' effect.

Key Words: *Antimatter; Gravitational fields; Special and General Theories of Relativity; Mass; Energy; Exotic matter; Anti-gravity.*

INTRODUCTION

Recent research, published in Nature on the 27th September (Anderson et al, 2023), demonstrated that antimatter, in the form of antihydrogen (atoms consisting of positrons orbiting antiprotons), was attracted by a gravitational field, that of the Earth, falling towards it in laboratory conditions [1].

This ought to have come as no surprise to them, or anyone else, for Einstein (1905) had predicted that mass and energy are equivalent, and Einstein (1914; 1915) demonstrated that mass-energy, of necessity, both produced and reacted positively to, gravitational fields, which are curved space-time [2-4].

Antimatter, like matter, has mass and energy – indeed, in most cases (with obvious exceptions, such as antineutrons and antineutrinos) antimatter particles are only differentiated from their matter counterparts by their opposite electric charge (Quinn, 2003) [5].

Exotic matter, on the other hand, otherwise known as 'negative' or 'phantom' matter, unlike antimatter, possesses negative energy (Forward, 1990), and can be expected, if it exists, to react negatively to the presence of any gravitational field, which would repel rather than attract it [6].

See Morris and Thorne (1988); Gibbons (2003, 2018); and Kim (2009) [7-9].

CONFLICT OF INTEREST

The author declares he has no conflict(s) of interest, and that he has received no funding for his research from any source(s), public, private or voluntary sector

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