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Can Ball Lightning Exist in a Vacuum?

BLAIR¹ has suggested that ball lightning is associated with a strong magnetic field which extends far beyond the confines of the ball.

I have been within 50 cm of ball lightning in its smooth and unerring passage through an aircraft^{2,3}. I carried a penknife in my trouser pocket, a steel tobacco tin in my left jacket pocket and a steel screwdriver in my right jacket pocket. No motion of these objects was detected although they were known to be satisfactory detectors of magnetization and would have been greatly moved by a field of 150 gauss whether centred on the ball or otherwise directed through the aircraft. Noting also the ethereal quality of ball lightning, it is surprising that, if it is strongly coupled to a magnetic field as Blair suggests, the balls did not dance to the bells¹.

In recent years I have received several first hand reports on ball lightning. These include an event where the ball appeared some seconds before a nearby building was struck with lightning. The ball had the classical diameter of \sim 20 cm and maintained a flight path about 50 cm above the local surface (a staircase and subsequently the flex of a vacuum cleaner held in the mouth by the transfixed observer). A further important observation was of a 20 cm ball which appeared at a height of about 50 cm over the trailing edge of the mainplane of an aircraft in flight. It moved parallel to the line of the mainplane at a speed of about 1 m s⁻¹ before being cast off the end and was not blown off in spite of the considerable air speed. There are other reports where the velocity of a ball external to an aircraft is quoted as comparable to that of the aircraft and not that of the air through which it is moving.

As I pointed out in my review of Singer's book4, if one rejects sightings which are contradictory or highly questionable as scientific observations, the same salient features of ball lightning recur in all reliable reports. In particular, the diameter of the ball, the velocity relative to the local surface, the distance from the surface and the lifetime of the ball are remarkably consistent. On the whole the reports of benign ball lightning tend to be more reliable than those of the explosive variety which may be confused with meteorites and other energetic phenomena.

I suggest that ball lightning is dependent not on the vaporization of a surface but on the formation of a phaselocked loop of electromagnetic radiation in the intense field associated with lightning activity. I further suggest that there is, in these circumstances, a particular wavelength of electromagnetic radiation which can form a stable standing wave which externally exhibits a spherical configuration and which excites the ambient gas to produce the glow by which it is seen. As the energy is dissipated in this manner the lifetime of the ball is limited but the locking of the wavelength maintains its configuration and its dimensions. It follows that the typical clearance of the ball from conducting surfaces may be associated with the maintenance of equilibrium between the ball and its image in the conductor.

Although the scale and degree of quantization of the phenomena are quite different, the occurrence of electromagnetic radiation in phase-locked loops at a precise frequency also occurs in the process of pair production.

There are at present a few reliable reports, but it will be very interesting to accumulate further reliable data with which to show that the size of a ball is, to a first order, independent of the pressure of the air. In particular, it may be possible for ball lightning to exist in regions of very low pressure where it may not be recognized by the luminosity of excited gas.

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BIOLOGICAL SCIENCES

Ribosomal DNA Connectives between Human Acrocentric Chromosomes

Association of satellite regions of the human acrocentric chromosomes 13, 14, 15, 21 and 22 has received much attention because of its possible relation to nondisjunction, translocation and lesser structural variations, to which these chromosomes seem unusually prone. (A list of references relevant to this subject is available from the authors.) The overall frequency of associations in metaphase varies with techniques of cell culture and preparation as well as with the individual¹⁻⁴. The participation of different acrocentric chromosomes is random in some people, but nonrandom in others³⁻¹³. As individual variation may account, in part, for contradictory reports concerning correlation of association characteristics with age14,15, sex4,14,17,18 and chromosomal abnormalities^{12-14,18-22} it is an important feature to explain.

Threads connecting satellites are occasionally visible; for example, Zang and Back⁴ noted that about 10% of their associations were fixed in this manner. By electron microscopy, Lampert et al.23 showed that intersatellite fibres-in common with other connectives-consist of type B nucleoprotein, the usual structural component of condensed chromosomes. A large bundle of such fibres would be required to produce a visible thread; from this it can be surmised that connectives are more often present than seen. In the course of experiments on hybridization of tritiumlabelled rRNA (3H-rRNA) to human metaphase chromosomes²⁴ we found grains arranged between separate satellites, indicating the presence of subvisible labelled strands. Thus intersatellite connectives are indeed more frequent than they seem to be, and their nucleic acid is identified as DNA complementary to rRNA (rDNA). This identification suggests a hypothesis to explain individual variation in human satellite associations.

We used a modification of the in situ hybridization technique of Gall and Pardue25. Human 3H-rRNA of specific activity 4×10^6 d.p.m. μ g⁻¹, at a concentration of 2 μ g ml⁻¹ in 4×SSC, 50% formamide, was applied to slides on which the DNA of human lymphocyte chromosomes had been denatured in 95% formamide. The slides were held for 18 h at 38° C, washed, treated with RNase, dried, coated with Kodak NTB 2 emulsion and exposed for 1 month. The ³H-rRNA was accompanied by excess unlabelled bacterial RNA to compete for nonspecific binding. After development, the slides were stained with Giemsa. Details of

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