of the non-dipole part of the geomagnetic field —corresponding to the 'ideal auroral curve' (the I-curve) of Alfvén[2] was plotted and is shown in Fig. 2 together with Alfvén's theoretical I-curve. The entire experimental curve is situated outside the circle, with which it coincides at 1800, in contrast to the theoretical curve, which is inside the circle. The difference is attributable to the fact that the azimuth values of the experimental curve are 7–9° greater than the values of the theoretical curve even after correction for the effects of the non-dipole components of the geomagnetic field. Hence, the theoretical curve is situated outside the standard deviation 'region' of the observational material. The difference, therefore, is probably a real one, which is not surprising since the theoretical curve is based on a highly idealized model.

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ASTROPHYSICS

Lunar Dust and the Gegenschein

OF the four possible explanations of the gegenschein which have been proposed, not one so far has explained satisfactorily the meagre observational data concerning this phenomenon. The Glyden–Moulton hypothesis[1], which suggests a concentration of meteoric material at a libration point of the Sun–Earth system, seems incapable of explaining all the luminosity of the gegenschein. The zodiacal light hypothesis[2], which claims that the glow opposite the Sun results from a phase-function for the interplanetary dust layer which produces such a brightening, fails to explain the fact that the gegenschein usually lies approximately 3° west of the anti-solar point[3]. The gaseous tail hypothesis[4,5], in explaining the light as the result of excitation of Earth-escaped gases by the interplanetary plasma, does not account for the fact that the colour of the gegenschein is slightly redder than that of the Sun[6]. Finally, the dust tail hypothesis[7], although explaining the facts in a qualitative way, at least, requires a large and continuous source of dust particles in Earth's neighbourhood.

Before the satellite measures of interplanetary dust concentration became available, there was little reason to suggest such a source of dust in the immediate vicinity of Earth. However, the remarkable fact that Earth is surrounded by a concentrated dust layer[8] seems to be explained in no other way. Whipple has found that the Moon might be the source of Earth's dust layer, for under certain conditions, the velocities of fragments thrown up from the lunar surface as a result of meteorite impact will exceed the lunar escape velocity. Many of these particles will be captured in quasi-stable orbits about Earth, forming just the sort of layer of dust found by the satellite experiments. Smaller particles will be blown out by radiation pressure before they can orbit Earth.

It seems reasonable to suggest that this localized source of dust in the immediate vicinity of Earth is sufficient to maintain a dust tail for Earth acted on probably by radiation pressure analogously with type II comet tails. If such is the case, then Earth has a dust tail as well as a gas tail[9], and we would be in the position of looking down the axis of the tail. To test such a hypothesis it will be necessary to work out theoretically the mechanism of supply of the dust layer and of its depletion. It will also be helpful to have further observations of the gegenschein to confirm its colour, spectrum, location, surface brightness, and variations in these quantities. Especially interesting would be systematic studies of the motions of the gegenschein and any relations these might have with other events. Measures of the parallax of the gegenschein should be attempted from an orbiting vehicle.

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PHYSICS

Mode Characteristics and Coherence in Optical Ruby Masers

AN optical maser, using a good-quality ruby crystal with plane-parallel reflectors, oscillates in modes corresponding to Fabry–Perot resonances. Oscillations are shown to occur at several different wave-lengths corresponding to various numbers of half-wave-lengths between reflecting ends. For each wave-length, there are many angular modes which are coupled so that they oscillate coherently. This implies that a set of angular modes may be considered a single modified mode and that light from the entire set may be focused to a point of minimum size allowed by the wave-length of the light.

There have already been various discussions of the modes in an optical cavity[1–4] and experimental demonstration of a ring structure[5] in light emitted by ruby masers. The photograph shown in Fig. 1 was taken by passing a pulse from a ruby maser through a 410-mm. lens, with the photographic plate in the focal plane (far-field pattern). The series of rings observed corresponds within the accuracy of measurement with the pattern of a Fabry–Perot interferometer. Separations between successive sets of rings follow the interferometer equation:

$$D_n^2 - D_{n-1}^2 = \frac{4f^2\lambda\mu}{L}$$

where D_n is the diameter of the n^{th} ring on the film, f the focal length of the lens, λ the wave-length, μ the refractive index, and L the geometrical length of the ruby. The value of L obtained from this expression, on substitution of other quantities and measured values of D_n, agrees with the measured length of the crystal to within a few per cent. This was found to be the case for crystal samples of differing lengths, a fact which rules out interpretations of the rings on the basis of diffraction by some unidentified aperture.