These considerations emphasize the need to investigate further the propagating properties of the nonlinear gravitational field equation at high intensities before interpretations are given to the detection of gravitational waves.

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Evaluation of 15th-order Harmonics in the Geopotential

AN Earth satellite with initial orbital period greater than about 96 minutes will, as its orbit decays under the influence of air drag, pass through the condition of 15th-order resonance, when successive equatorial crossings are exactly 24° apart, so that the satellite follows a fixed set of 15 ground tracks each day. If the decay is slow enough, the inclination of the orbit to the equator changes appreciably^{1,2} as the satellite passes through resonance, because of the build-up of perturbations caused by tesseral harmonics in the geopotential of order 15 and degree 15, 17, 19, ... By observing a particular satellite, determining its orbit and analysing the change in inclination, it is possible to derive linear equations between the coefficients of these 15th-order harmonics; and the equations can be solved for individual coefficients when results have been obtained for a number of satellites at different orbital inclinations.

Equations between the 15th-order coefficients were obtained by Gooding³ from Ariel 3 (1967-42A) at inclination 80°, and by King-Hele and Hiller⁴ from Transit 1B (1960 γ2) at inclination 51°. Several satellites about to experience resonance are now being specially observed⁵ to evaluate 15th-order coefficients. A preliminary analysis has been made⁶ of the results from the first of these satellites, Cosmos 387 (1970-111A) at inclination 74°, resonant in November 1971, and from Cosmos 373 (1970-87A) at inclination 63°, which passed through resonance in November 1970.

The equations obtained from these satellites, together with those from Ariel 3 and from Transit 1B, can be solved for the coefficients of order 15 and degree 15, 17, 19 and 21. The values obtained are as follows, using the standard notation⁷ for the expansion of the geopotential in terms of normalized harmonic coefficients. All the numerical values are to be multiplied by 10⁻⁹.

$$\begin{array}{ll} \bar{c}_{15,15} = -18.3 \pm 1.7 & \bar{s}_{15,15} = -8.9 \pm 1.6 \\ \bar{c}_{17,15} = 5.3 \pm 2.1 & \bar{s}_{17,15} = 10.1 \pm 2.1 \\ \bar{c}_{19,15} = -13.5 \pm 2.8 & \bar{s}_{19,15} = -21.8 \pm 3.5 \\ \bar{c}_{21,15} = 26.5 \pm 3.0 & \bar{s}_{21,15} = 10.2 \pm 3.7 \end{array}$$

The "errors" quoted here represent an attempt to make realistic estimates of the standard deviations, and are obtained by compounding, first, the errors in analysing the change in inclination, resulting from observational errors, and, second, the errors due to neglecting terms of order 15 and degree 23, evaluated on the assumption that the (23,15) coefficients have the value 10×10^{-9} . This method of evaluating the likely errors tacitly assumes that other errors are likely to be less than

that due to neglecting the (23,15) coefficients and that the numerical values of the coefficients of degree l fall off as $1/l^2$ in accordance with the findings of Gaposhkin and Lambeck⁷. It is just possible, but *prima facie* unlikely, that there are larger contributions to the errors from terms of higher degree, for example (25,15), or higher order (30 or 45). Terms involving the orbital eccentricity e are neglected, but these should not be important except for Transit 1B ($e=0.025$), for which, however, the assigned errors⁴ are already large (about 15%); for the other three satellites the eccentricity is 0.007 or less.

It should soon be possible to improve the values, and extend the evaluation to higher-degree coefficients, utilizing the satellites now being observed for this purpose.

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Effect of Fluidization on the Polarization of Reflected Light from Lunar Dust Layers

STUDIES of the degree of polarization of moonlight were made by Dollfus¹⁻³ many years before dust samples were available for similar studies in the laboratory. Since then extensive studies of sample layers⁴⁻⁶ have shown that layers roughened to simulate the lunar surface show almost identical polarization characteristics. Following our discovery of the marked rise

Fig. 1 Effect of fluidization of lunar dust samples on the degree of polarization of reflected light from dust layers as a function of phase angle V (light incident at 40° to plane of surface). (a) Curves for static, roughened layers. (b) Curves for "fluidized" layers. (The first two figures of the sample numbers shown are the Apollo mission numbers.)