REFUTATION OF THE OLD QUANTUM THEORY AND INTENSITY THEORIES OF THE EVANS / MORRIS EFFECTS.

by

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ABSTRACT

The Rayleigh Jeans distribution and Stefan Boltzmann law from the Planck distribution are corrected for the omission by Rayleigh of higher order infinitesimals. The correction is small at angular frequencies above about one radian per second, but at the same time it entirely refutes the explanation of black body radiation in the old quantum theory. An intensity theory is developed for the Evans Morris effects, and it is shown that the old quantum theory does not conserve momentum on the one photon level in reflection and refraction because the one photon theory is incompatible with Snell's experimental laws. An averaging procedure must be used to conserve energy and momentum in reflection and refraction.

Keywords: ECE theory, Evans Morris Effects, Rayleigh Jeans distribution, Stefan Boltzmann law, old quantum theory.

UFT 290

1. INTRODUCTION

Recently in this series of two hundred and ninety papers to date {1 - 10} theories have been developed of the Evans / Morris effects, which reveal novel colour changes in reflection and refraction (many experimental results posted on the blog or diary of www.aias.us). Several theories of the effects have been developed and the old dogmatic approach rejected. The dogma insisted that frequencies of the incident, reflected and refracted beams be the same under all conditions. This dogma has been refuted using simple geometrical considerations. In general, both experimentally and theoretically, both frequency and wavelength change in reflection and refraction. In Section 2, the Evans Morris effects are considered as conservation of beam intensity or power density in watts per square metre, directly related to the energy density (energy per volume of radiation) in joules per cubic metre. The theory is developed initially for one incident frequency (monochromatic theory) and then developed into a polychromatic theory. In so doing, corrections are developed for the Rayleigh Jeans distribution and the Stefan Boltzman law as developed in the old quantum theory from the Planck distribution. These corrections originate in the omission by Rayleigh in 1900 of higher order infinitesimals. The corrections are small for angular frequencies above about a radian per second, but at the same time they entirely refute the claim that black body radiation can be described by the old quantum theory. It is shown that momentum conservation on the one photon level in the old quantum theory is incompatible with Snell's experimental laws of reflection and refraction. Averaging must be used to make the old quantum theory compatible with Snell's experimental laws.

This Section should be read in conjunction with the ten background notes posted with UFT290 in the UFT section of www.aias.us, and one note by H. Eckardt posted in the diary or blog of www.aias.us. Notes 1 and 2 are summarized in Section 2 and give details of the intensity theory. Notes 3 to 5, 8 and 9 give details of the refutation of the old quantum theory summarized in Section 2. Note 6 develops the intensity theory combined with Snell's laws, and Note 7 refutes the old quantum theory by showing that it is incompatible on the one photon level with Snell's laws.

In Section 3 the theory is analyzed and developed with computer algebra combined with graphics.

2. REFUTATION OF THE OLD QUANTUM THEORY AND INTENSITY THEORY.

The old quantum theory is refuted straightforwardly in two ways to begin this section, and an intensity theory later developed for the Evans / Morris effects. The first refutation is based on elementary considerations of the derivation of the Rayleigh Jeans density of states, (Note 290(3)), which starts with the number of oscillators N per volume V of radiation:

$$\frac{N}{V} = \frac{\omega^3}{6\pi^2 c^3} \qquad -(1)$$

where ω is the angular frequency of the radiation and c the vacuum speed of light. The infinitesimal density of states is calculated with:

$$\frac{dN}{V} = \frac{1}{6\pi^2 c^3}\left((\omega + d\omega)^3 - \omega^3\right) \qquad -(2)$$

and the result is doubled because Rayleigh assumed that each oscillator has two states of polarization. Therefore:

$$\frac{dN}{V} = \frac{\omega^2}{\pi^2 c^3}\, d\omega + \frac{2\omega}{3\pi^2 c^3}(d\omega)^2 + \frac{(d\omega)^3}{3\pi^2 c^3}. \qquad -(3)$$

Rayleigh omitted two terms and claimed that:

$$\frac{dN}{V} = \frac{\omega^2}{\pi^2 c^3} d\omega \quad -(4)$$

a result which is known as the Rayleigh Jeans density of states. Rayleigh in 1900 appears to have given no justification for the omission of higher order infinitesimals.

The dogmatic theory proceeds by asserting that the infinitesimal of energy density is:

$$\frac{dU}{V} = \langle E \rangle \frac{dN}{V} \quad -(5)$$

where $\langle E \rangle$ is the average energy of the Planck oscillator:

$$\langle E \rangle = \left(\frac{x}{1-x}\right)\hbar\omega \quad -(6)$$

where

$$x = \exp\left(-\frac{\hbar\omega}{kT}\right) \quad -(7)$$

Here $\hbar$ is the reduced Planck constant, k the Boltzmann constant and T the temperature. Eq. (6) is true if and only if:

$$\hbar\omega < kT. \quad -(8)$$

Therefore the usual Planck distribution is:

$$\frac{dU}{V} = \frac{\hbar\omega^3}{\pi^2 c^3}\left(\frac{x}{1-x}\right) d\omega \quad -(9)$$

The Stefan Boltzmann law is claimed to be:

$$\frac{U}{V} = \int_0^\infty \frac{\hbar\omega^3}{\pi^2 c^3}\left(\frac{x}{1-x}\right) d\omega = \left(\frac{\pi^2 k^4}{15 c^3 \hbar^3}\right) T^4 \quad -(10)$$

It is claimed in this dogmatic approach that Eq. (10) has been tested experimentally with precision.

However, the correct infinitesimal of energy density for a monochromatic beam is:

$$\frac{dU}{V} = \langle E \rangle \left(\frac{\omega^2}{\pi^2 c^3} d\omega + \frac{2\omega}{3\pi^2 c^3} (d\omega)^2 + \frac{(d\omega)^3}{3\pi^2 c^3} \right) \quad -(11)$$

Express Eq. (3) as:

$$\frac{dN}{V} = \frac{1}{V} \left(dN_1 + dN_2 + dN_3 \right) \quad -(12)$$

then:

$$\frac{dN_1}{V} = \frac{\omega^2}{\pi^2 c^3} d\omega \quad -(13)$$

$$\frac{dN_2}{V} = \frac{2\omega (d\omega)^2}{3\pi^2 c^3} \quad -(14)$$

$$\frac{dN_3}{V} = \frac{(d\omega)^3}{6\pi^2 c^3} \quad -(15)$$

It follows that:

$$\frac{dN_2}{dN_1} = \left(\frac{2\pi^2 c^3}{3\omega^3} \right) \frac{dN_1}{V} \quad -(16)$$

and

$$\frac{dN_3}{dN_1} = \frac{1}{12} \frac{(d\omega)^2}{\omega^2} \quad -(17)$$

so:

$$\frac{dN}{dN_1} = 1 + \frac{2}{3\omega} d\omega + \frac{1}{12\omega^2} (d\omega)^2 \quad -(18)$$

To first order assume that:

$$\frac{dN}{dN_1} = 1 + \frac{2}{3\omega} d\omega \quad -(19)$$

so to first order:

$$dN = \left(1 + \frac{2}{3\omega} d\omega\right) dN_1 . \quad -(20)$$

By definition:

$$\frac{dN}{dN_1} = \lim_{\delta N_1 \to 0} \left(\frac{f(N_1 + \delta N_1) - f(N_1)}{\delta N_1} \right) \quad -(21)$$

where:

$$N = f(N_1). \quad -(22)$$

Now let:

$$N = \left(1 + \frac{2}{3\omega} d\omega\right) N_1 \quad -(23)$$

and Eq. (20) follows.

In the dogmatic approach with higher order infinitesimals missing, the number of photons per volume of radiation of black body radiation is {1 - 10}:

$$\frac{N_1}{V} = \frac{2\zeta(3)}{\pi^2} \left(\frac{kT}{c\hbar}\right)^3 \quad -(24)$$

where the third zeta function is:

$$\zeta(3) = 1.20206 \quad -(25)$$

calculated from the standard integral:

$$\int_0^\infty \left(\frac{x^{2n}}{e^x - 1}\right) dx = (2n)!\,\zeta(2n+1) \quad -(26)$$

Eq (24) is a form of the old Stefan Boltzmann law for the number of photons per unit volume of black body radiation rather than intensity or energy density. The number of photons per volume of radiation should be:

$$\frac{N}{V} \rightarrow \frac{1}{V}\left(N + dN\right) = \frac{2\zeta(3)}{\pi^2}\left(\frac{kT}{c\hbar}\right)^3\left(1 + \frac{2}{3\omega}d\omega\right) \quad -(27)$$

so the first order correction to the Stefan Boltzmann law is:

$$\frac{dN}{d\omega} = \frac{2N}{3\omega} \quad -(28)$$

where:

$$\frac{N}{V} = \frac{2\zeta(3)}{\pi^2}\left(\frac{kT}{c\hbar}\right)^3. \quad -(29)$$

It may be argued that at frequencies greater than about one radian per second the correction is small, but the Stefan Boltzmann law must be calculated for all frequencies down to zero. Below about a radian per second the correction goes to infinity and the old dogmatic approach is refuted completely foe black body radiation. For a high frequency monochromatic beam it is still acceptable provided that it is corrected as argued.

The second refutation of the old quantum theory is given in detail in Note 290(7) by considering the fundamental geometry of the incident ($\underline{k}$), refracted ($\underline{k}_1$) and reflected ($\underline{k}_2$) wave vectors at a boundary between two materials such as air and glass or air and water :

$$\underline{k} = k\left(\underline{i}\sin\theta + \underline{j}\cos\theta\right) \quad -(30)$$

$$\underline{k}_1 = k_1\left(\underline{i}\sin\theta_1 + \underline{j}\cos\theta_1\right) \quad -(31)$$

$$\underline{k}_2 = k_2\left(\underline{i}\sin\theta_2 - \underline{j}\cos\theta_2\right) \quad -(32)$$

where θ , θ_1 and θ_2 are the incident, refracted and reflected angles. Snell's experimental laws are:

$$\theta = \theta_2 \quad -(33)$$

and

$$n \sin\theta = n_1 \sin\theta_1 \quad -(34)$$

where n and n_1 are the refractive indices of the materials. Let the phase velocities of the incident and refracting materials be v and v_1 respectively, then:

$$n = \frac{c}{v}, \quad n_1 = \frac{c}{v_1}, \quad v = \frac{c}{n}, \quad v_1 = \frac{c}{n_1}. \quad -(35)$$

The Evans Morris effects show that the incident (ω), refracted (ω_1) and reflected (ω_2) angular frequencies are all different in general, so:

$$\kappa = \frac{n\omega}{c}, \quad \kappa_1 = \frac{n_1\omega_1}{c}, \quad \kappa_2 = \frac{n\omega_2}{c}. \quad -(36)$$

Therefore:

$$\underline{\kappa} = \frac{n\omega}{c}\left(\underline{i}\sin\theta + \underline{j}\cos\theta\right) \quad -(37)$$

$$\underline{\kappa}_1 = \frac{n_1\omega_1}{c}\left(\underline{i}\sin\theta_1 + \underline{j}\cos\theta_1\right) \quad -(38)$$

$$\underline{\kappa}_2 = \frac{n\omega_2}{c}\left(\underline{i}\sin\theta - \underline{j}\cos\theta\right). \quad -(39)$$

Conservation of momentum on the one photon level demands that:

$$\underline{\kappa} = \underline{\kappa}_1 + \underline{\kappa}_2 \quad -(40)$$

from which:

$$\omega_1 = \left(\frac{2n\cos\theta}{n_1\cos\theta_1 + n\cos\theta}\right)\omega \quad -(41)$$

and

$$\omega_2 = \left(\frac{n_1 \cos\theta_1 - n\cos\theta}{n_1 \cos\theta_1 + n\cos\theta} \right) \omega \quad -(42)$$

It also follows from Eq. (40) that:

$$\omega = \omega_1 + \omega_2 \quad -(43)$$

which is one photon conservation of energy.

In order to consider reflection the refracted frequency is eliminated using:

$$\omega_1 = \omega - \omega_2 \quad -(44)$$

but this results as in Note 290(7) in the unphysical result:

$$\omega \stackrel{?}{=} 0. \quad -(45)$$

It is concluded that the old quantum theory is incompatible with Snell's experimental laws on the one photon level and the old quantum theory is refuted in a second way. In immediately preceding papers this failure of the old quantum theory was remedied with averaging, and all the main features of the Evans Morris effects described qualitatively.

In a monochromatic beam the errors made by Rayleigh in omitting higher order infinitesimals do not affect the theory, because only one frequency is considered. Therefore consider the intensity I in watts per square metre of a beam incident on a boundary in reflection and refraction. It is assumed that the sum of the intensities of the refracted and reflected beams, I1 and I2 respectively, is the same as the intensity of the incident beam. So

$$I = I_1 + I_2 \quad (46)$$

For one frequency, the intensity of the beam is:

$$I = \left(\frac{x}{1-x}\right)\frac{\hbar\omega^4}{6\pi^2 c^2} \quad (47)$$

so it follows from Eq. (46) and (47) that:

$$\left(\frac{x}{1-x}\right)\omega^4 = \left(\frac{x_1}{1-x_1}\right)\omega_1^4 + \left(\frac{x_2}{1-x_2}\right)\omega_2^4 \quad (48)$$

At thermodynamic equilibrium the temperature of the three beams is the same, so in general:

$$I \neq I_1 \neq I_2 \quad (49)$$

In order to derive ω_1 and ω_2 in terms of ω , a second equation is needed. Some suggestions for a second equation are made in Notes 290(1), 290(2) and 290(6). For example it may be assumed as in immediately preceding papers that the average momentum of a Planck oscillator is conserved:

$$\langle \underline{\kappa} \rangle = \langle \underline{\kappa}_1 \rangle + \langle \underline{\kappa}_2 \rangle \quad (50)$$

As in Note 290(1) this leads to the equation:

$$\frac{\omega^2}{c^2}\left(\frac{x}{1-x}\right)^2 = \frac{\omega_1^2}{v^2}\left(\frac{x_1}{1-x_1}\right)^2 + \frac{\omega_2^2}{c^2}\left(\frac{x_2}{1-x_2}\right)^2 + \frac{2\omega_1\omega_2}{cv}\left(\frac{x_1}{1-x_1}\right)\left(\frac{x_2}{1-x_2}\right)\cos\theta_3 \quad (51)$$

where it has been assumed that the incident medium is air, with phase velocity c. The phase velocity in the refacting medium is v. Here θ_3 is the angle between the refracted and reflected wave vectors.

So Eqs. (48) and (51) can be solved simultaneously using numerical methods, but this appears to be a highly non trivial problem needing careful programming

In the refracting medium the Beer Lambert law applies:

$$I_1 = I \exp(-\alpha Z) \quad - (52)$$

where α is the power absorption coefficient and where Z is the distance through which the refracted beam has propagated. So the Beer Lambert law can be used to relate I and I_1 and the incident and refracted angular frequencies as follows:

$$\left(\frac{x_1}{1-x_1}\right)\omega_1^4 = \left(\frac{x}{1-x}\right)\omega^4 \exp(-\alpha Z) \quad - (53)$$

If

$$\hbar\omega_1 \ll kT \quad - (54)$$

and

$$\hbar\omega \ll kT \quad - (55)$$

then:

$$\left(\frac{\omega_1}{\omega}\right)^3 = \exp(-\alpha Z) \quad - (56)$$

where we have used:

$$\exp\left(\frac{\hbar\omega}{kT}\right) \sim 1 + \frac{\hbar\omega}{kT} \quad - (57)$$

Eq. (56) confirms qualitatively the colour changes observed by Evans and Morris (blog of www.aias.us) as a beam propagates through a sample. These effects are reproducible and repeatable and are new to science. Eq. (56) also explains the cosmological red shift straightforwardly as discussed in UFT49 on www.aias.us. ECE theory has refuted big bang in several ways, it neglects torsion so is mathematically incorrect, so big bang can have nothing to do with the cosmological red shift or with any experimental data.

3. NUMERICAL ANALYSIS AND DISCUSSION.

Section by Dr. Horst Eckardt

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3 Numerical analysis and discussion

Calculations of refracted and reflected frequencies from the intesity eqaution (48) is a numerical challenge because the fourth orders of frequencies occur. If we make the linear approximation for low-frequencies as in previous papers (UFT279), Eq.(48) takes the form

$$A_0\,\omega_0^4 = A_1\,\omega_1^4 + A_2\,\omega_2^4 \tag{58}$$

with

$$y_i = \frac{\hbar\omega_i}{kT}, \tag{59}$$

$$A_i = \frac{1-y_i}{y_i}. \tag{60}$$

This means that the equation remains of forth order. As proposed in section 2 we can try using the momentum conservation as a second condition to find a dependencies between incident frequency and refracted and reflected frequencies. Replacing the phase velocities in Eq.(51) in the usual way by the refractive indices, $n_i = c/v_i$, leads to the equation

$$n_0^2\,\omega_0^2\,A_0^2 = n_1^2\,\omega_1^2\,A_1^2 + n_0^2\,\omega_2^2\,A_2^2 + 2\,n_0\,n_1\,\omega_1\,A_1\,\omega_2\,A_2\cos(\theta_3) \tag{61}$$

where θ_3 is the angle between refraced and reflected vectors $\boldsymbol{\kappa}_1$ and $\boldsymbol{\kappa}_2$ and can be replaced by the angle of incidence θ as in previous papers:

$$\theta_3 = \pi - \arcsin\left(\frac{n_0}{n_1}\sin(\theta)\right) - \theta. \tag{62}$$

Simultaneous Evaluation of Eqs.(58) and (61) is difficult because ω_i and A_i appear with different exponents each in both equations. This leads to polynomials

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of at least the order 16. To get an impression of the solutions we make some rough approximations. first we rewrite (58) to a single-photon equation:

$$\omega_0^4 = \omega_1^4 + \omega_2^4. \tag{63}$$

Then we restrict statistics in the momentum equation (61) to that of the incident beam, setting

$$A_1 = A_2 = 1. \tag{64}$$

When ω_2 is replaced in (61), this leads to the equation

$$\frac{n_0^2\,(1-\omega_0\,\hbar\,f_T)^2}{\hbar^2\,f_T^2} - n_0^2\,\sqrt{\omega_0^4-\omega_1^4} - n_1^2\,\omega_1^2 = 2\,n_0\,n_1\,\omega_1\,\left(\omega_0^4-\omega_1^4\right)^{\frac{1}{4}}\cos(\theta_3) \tag{65}$$

which has to be raised to the power of 4 due to the appearing power factor 1/4. Alone further removing of the first two terms leads to a solution of the equation. In this radical method, all statistical effects have been lost and only the fourth power of the intensity has remained in some form. The remaining equation of eighth order for ω_1 has five solutions from which exactly one is real valued and positive. The same procedure can be applied to obtain a solution for ω_2. We have evalueted both solutions for ordinary refraction ($n_0 = 1$, $n_1 = 1.5$) and total reflection ($n_0 = 1$, $n_1 = 1.5$). The results are graphed inf Figs. 1 and 2. for reasons of plausibility we have only chosen the refraction frequency in the first case and the reflection frequency in the second. The zero crossings are certainly artifact of the crude approximations but the frequencies remain in a range of $\pm 10^{-12}$/s which was taken for ω_0. Temperature was $T = 293$K. The ending of the reflection at the angle of total reflection is present in Fig. 2. The results show a red shift as to be expected from the Evans/Morris effects.

In a second, more elaborate approach, we derived a numerical solution of the simultaneous equations (58,61). Solution of (61) according to ω_2 gives

$$\begin{aligned}\omega_2 = \pm\frac{1}{n_0\,\hbar\,f_T}\Bigg(\bigg(&\left(n_1^2\,\omega_1^2\cos(\theta_3)^2 - n_1^2\,\omega_1^2 + n_0^2\,\omega_0^2\right)\hbar^2\,f_T^2\\ &+\left(-2\,n_1^2\,\omega_1\cos(\theta_3)^2 + 2\,n_1^2\,\omega_1 - 2\,n_0^2\,\omega_0\right)\hbar\,f_T + n_1^2\cos(\theta_3)^2 - n_1^2 + n_0^2\bigg)^{1/2}\\ &- n_1\,\omega_1\cos(\theta_3)\,\hbar\,f_T + n_1\cos(\theta_3) + n_0\Bigg).\end{aligned} \tag{66}$$

This expression is inserted into (58) which gives quite a complicated equation which cannot be solved by Maxima analytically. Since we have only one variable (ω_1) left, we can apply a numerical root finding procedure. The results of $\omega_1(\theta)$ for both signs of Eq.(66) are graphed in Fig. 3. The result looks quite chaotic. The frequency is constant in certain ranges but jumps to quite low values in sharp kinks. The functions are differentiable, the kinks are artifacts of the discrete θ lattice of the calculation. The values never exceed the thermal energy mean value of about $6.1 \cdot 10^{12}$/s.

The analogues procedure can be applied for the reflected frequency ω_2. We have applied this to the case of total reflection as in the analytical calculation. There are sharp edges at the angle of total reflection for both solutions (Fig.

4). However the first solution pertains with the single-photon frequency in the forbidden θ range. The second solution seems more plausible. We cannot exclude that numerical instabilities (for example limit of accuracy) are a reason for the nearly unsteady behaviour. However control calculations with a doubled mantissa (32 digits) gave the same results. The functions are strongly oscillating. One can question the appropriateness of using statistical momentum conservation. In addition, it was shown in section 2 that the one-photon theory is incompatible with Snell's laws. Both facts should be given consideration in future work.

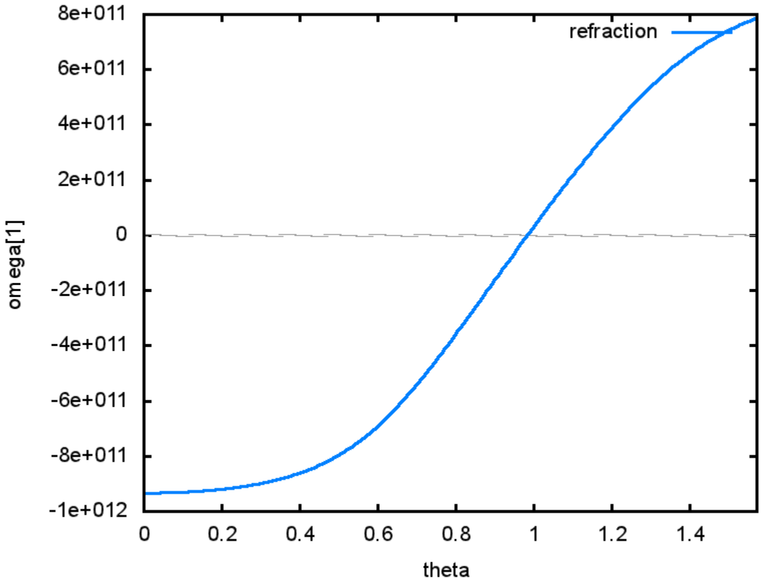

Figure 1: Angle dependence of refraction frequency, analytical model.

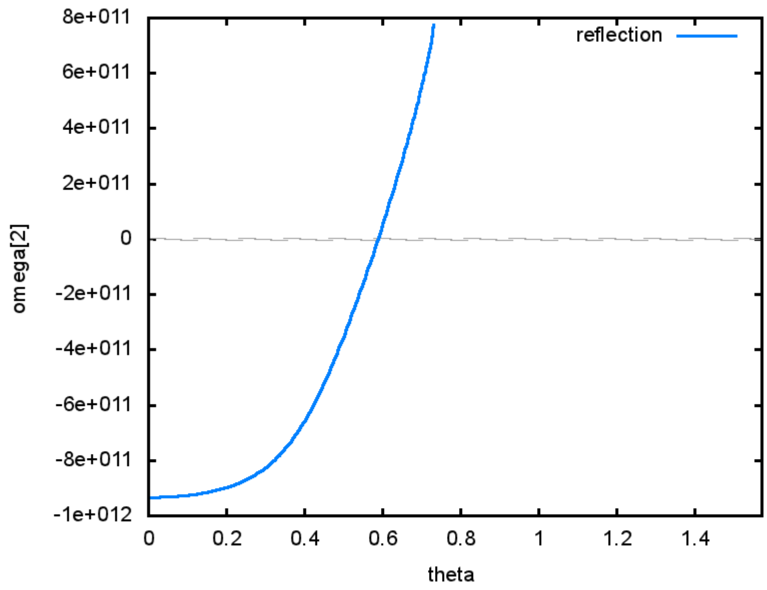

Figure 2: Angle dependence of reflection frequency, analytical model (total reflection).

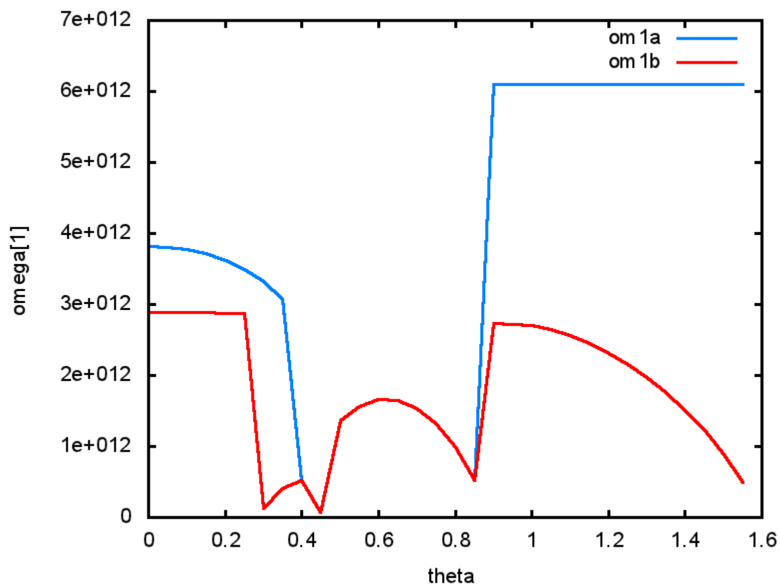

Figure 3: Angle dependence of refraction frequency, numerical solution.

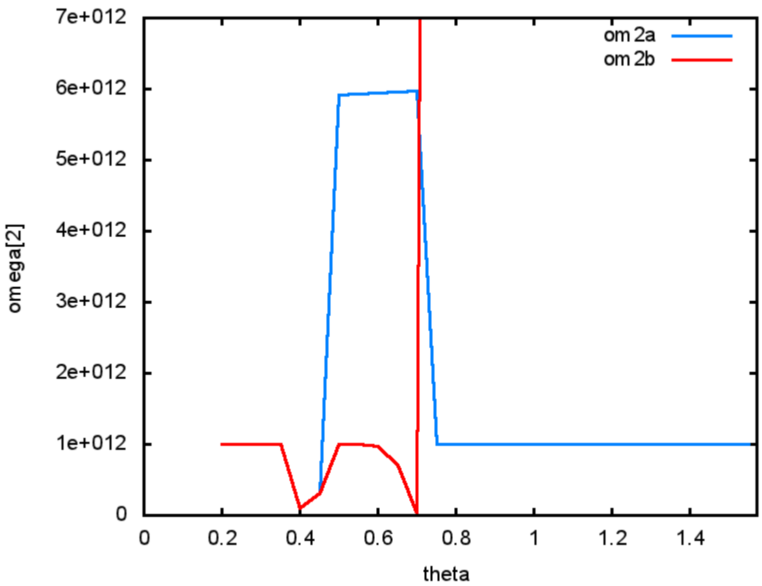

Figure 4: Angle dependence of reflection frequency, numerical solution (total reflection).

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