Comment on "Estimate of the vibrational frequencies of spherical virus particles"

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This Comment corrects some errors which appeared in the calculation of an elastic sphere eigenenergies. As a result, the symmetry of the mode having the lowest frequency is changed. Also a direction for calculating the damping of these modes for embedded elastic spheres is given.

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In a recent article [1], Ford discusses the normal modes of vibration of spherical virus particles using a liquid drop model and an elastic sphere model.

However the analysis errs in calculating the energy of the $n=0$ spheroidal mode with the elastic sphere model. This same error is recurrent in the literature [2–5]. Some authors have since corrected them [6]. The original Lamb paper [7] was correct and an explanation is available elsewhere [8]. This error results in additional energies which do not correspond to any vibration eigenmode. It gives a wrong energy for the lowest $n=0$ spheroidal mode comparable to the one of the lowest $n=2$ spheroidal mode. For materials with positive Poisson ratio, it is impossible to have the energy for the fundamental $n=0$ mode smaller than the energy for the fundamental $n=2$ one.

Equation (3) in the paper is valid for n different from zero. For n equal to zero, $S_{rp}(0,x,y)=0$ should be used instead [see Eq. (4)]. Moreover, expressions given in Eqs. (4) and (7) are invalid: there is no square dependence and the sign of S_{ts} is wrong. With correct calculations, the lowest frequencies for the elastic sphere model are reached with $n=2$ modes and frequencies are a bit lower (9.2, 9.4, and 4.6 GHz for nylon, polystyrene, and polyethylene, respectively).

We also would like to point out that these normal modes are damped when the virus particle is embedded inside a liquid. Estimations of damping can be made using the "complex frequency" approach described elsewhere [9,10]. When the virus is inside water, for example, there is not much acoustic impedance mismatch at the surface. For this reason the normal modes will be broad and have short lifetimes. Therefore, the objective of killing viruses by sending out sound waves that resonate and destroy them is probably unworkable in such a configuration.

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