this we can apply the usual perturbation theory.

Energy Levels of a Deformed Nucleus

Suppose that the stationary energy levels for a "spherical box" are known and that it is necessary to find them for an ellipsoidal box (the walls are to be considered as infinitely high). The equation for the surface S_0 has the form

$$\Phi_0(x_j) = 0 : \sum_{j=1}^{3} \frac{x_j^2}{R^2} - 1 = 0,$$

and the equation for the surface S is

$$\Phi(x_j) = 0 : \sum_{j=1}^{3} \frac{x_j^2}{a_j^2} - 1 = 0 .$$

Let us introduce the new variables:

$$x_j = \frac{a_j x_j'}{R} .$$

Then $\Phi(f_i(x_j')) = \Phi_0(x_j')$. In this case the operator for the kinetic energy of the particle is changed:

$$T(x_i) = -\frac{1}{2M}\sum_{i=1}^{3} \frac{\partial^2}{\partial x_i^2} = -\frac{R^2}{2M}\sum_{i=1}^{3} \frac{1}{a_i^2}\frac{\partial^2}{\partial x_i'^2} .$$

Consequently, the perturbation has the form

$$H'(x_i') = -\frac{1}{2M}\sum_{i=1}^{3}\left(\frac{R^2}{a_i^2} - 1\right)\frac{\partial^2}{\partial x_i'^2} .$$

It is small if all the a_i are close to R.

Let us consider a deformation of a nucleus in which its shape is that of an ellipsoid of revolution (with half-axes a and b). The quantity

$$\beta = 2\,\frac{a-b}{a+b}$$

is called the deformation parameter. We shall assume that the volume of the nucleus is unchanged in the deformation, that is, $ab^2 = R^3$. If we write $b = R(1-\delta_1)$, $a = R(1+\delta)$, where $\delta, \delta_1 \ll 1$, then, in the first approximation, from $ab^2 = R^3$, we get $\delta - 2\delta_1 = 0$, that is,