3. *The structure of levels of rest-motion energy*

In physics, we can select two very extensive kinds of time and space differentials of rest-motion state and exchange:

$$d\hat{Z} = \hat{R}dt \text{ and } d\hat{E} = \hat{U}\, d\hat{\psi} ,$$

where $\hat{Z},\ \hat{R},\ \hat{E},\ \hat{U},\ \hat{\psi}$ are arbitrary parameters of rest-motion; *dt* are time differentials.

In the first differential equality, parameter $\hat{R}$ is generalized power or velocity of exchange by rest-motion at $\hat{Z}$-parameter level. It expresses simultaneously non-separable relation of exchange and rest-motion state with time. In the second one, arbitrary parameter $\hat{E}$ expresses non-separable relation of exchange parameter $\hat{U}$ and rest-motion state with arbitrary space $\hat{\psi}$, where relevant phenomena are occurring.

Oppositi $\hat{Z}$ form a set of parameters which we will call by a common name a set of time energies. According to this notion, such parameters as momentum $\hat{P} = m\hat{\upsilon}$, kinema $\hat{F} = m\hat{w}$ and other are time energies of different levels of exchange.

Accordingly, oppositi $\hat{E}$ form a set of parameters, which we will call a set of space energies. By this definition, kinetic and potential energies are space energies of the definite level of exchange.

We will define now longitudinal, transverse, longitudinal-transverse, and total energies of any rest-motion level by the formula

$$\hat{E} = \int_{\hat{\psi}_0}^{\hat{\psi}} (\hat{U}d\hat{\psi})_k + \hat{E}_0 , \tag{2.40}$$

where $k \in (\tau, n, \tau n\ , tot)$ is an indicator of the type of the scalar product; $\hat{Q} \in (\hat{S}, \hat{P}, \hat{F}, \hat{D}, ...)$ and $\hat{\psi} \in (\hat{o},\ \hat{\phi},\ \hat{\psi})$ are types of the parameters.

By definition (2.40), potential-kinetic energies of the levels $\hat{S}$, $\hat{P}$, $\hat{F}$, and $\hat{D}$ in the space of harmonic displacements $\hat{\psi}$ are

$$\hat{E}_s = \frac{m\hat{\psi}^2}{2} = \frac{\hat{S}^2}{2m}, \quad \hat{E}_p = \frac{m\hat{\psi}\hat{\upsilon}}{2}, \quad \hat{E}_f = \frac{\hat{P}^2}{2m}, \quad \hat{E}_d = \frac{\hat{P}\hat{F}}{2m}. \tag{2.41}$$

Classical physics, including modern physics, operates explicitly with the $\hat{F}$-level of energy and implicitly with the $\hat{P}$-level in the form of action. However, these levels are not described completely and the notions of other energy levels are absent at all.

We will consider now the structure of the F-level energy:

$$\hat{E}_f = \frac{m\upsilon_k^2}{2} + \frac{m\upsilon_p^2}{2} + \frac{m\upsilon_k\upsilon_p}{2} + \frac{m\upsilon_p\upsilon_k}{2} \quad \text{or} \quad \hat{E}_f = -\frac{ky^2}{2} - \frac{kx^2}{2} - \frac{kyx}{2} - \frac{kxy}{2} \tag{2.42}$$

Every energy level, including the F-level, has four sublevels:

a) a Yes-Yes sublevel, a kinetic energy sublevel

$$E = \frac{m\upsilon_k^2}{2} = -\frac{ky^2}{2}$$

defined by a kinetic velocity or a kinetic displacement;

b) a No-No sublevel, a potential energy sublevel

$$E = \frac{m\upsilon_p^2}{2} = -\frac{kx^2}{2}$$

defined by a potential velocity or a potential displacement;

c) a Yes-No sublevel, a kinetic-potential energy sublevel

$$E = \frac{m\upsilon_k\upsilon_p}{2} = -\frac{kyx}{2};$$

defined by kinetic and potential velocities or kinetic and potential displacements;

d) a No-Yes sublevel, a potential-kinetic energy sublevel

$$E = \frac{m\upsilon_p\upsilon_k}{2} = -\frac{kxy}{2}.$$

defined by the same velocities and displacements.

The Yes-Yes and No-No sublevels are symmetrically opposite. The opposition is expressed by signs, namely, the Yes-Yes energy is positive and the No-No energy is negative. The Yes-No and No-Yes sublevels are equal here.

The first time derivatives of energy are powers of exchange, for the underlying levels, and parameters of state for the overlying levels. They are

$$\hat{N}_s = m\hat{\psi}\hat{\upsilon} \quad \text{and} \quad \hat{N}_p = \frac{1}{2}(\hat{P}\hat{\upsilon} + \hat{F}\hat{\psi}), \tag{2.43}$$

$$N_f = \hat{F}\hat{v} \quad \text{and} \quad N_d = \frac{1}{2}(\hat{P}\hat{z} + \hat{F}\hat{w}),$$

respectively.