KINEMATICS OF NONEXTENSIVE STATISTICAL SYSTEMS

Olemskoi A.I., *professor*; Yushchenko O.V., *associate professor*;
Badalyan A.Yu., *post-graduate student*

A field theory is developed for nonextensive statistical systems on the basis of the generating functional

$$Z_q\{u(\mathbf{r},t)\} = \int Z_q\{x\} e_q\left[\int ux(Z\{x\})^{q-1} d\mathbf{r}dt\right] Dx$$

Here, $q\in(0, \infty)$ is deformation parameter; $x(\boldsymbol{r},t)$ and $u(\boldsymbol{r},t)$ are fluctuating order parameter and its conjugate field, respectively; $e_q(x):=[1+(1-q)x]^{1/1-q}$ is the Tsallis exponential related to $1+(1-q)x\geq 0$. The generating functional represents a generalized Fourier-Laplace transform of the partition functional

$$Z_q\{u(\mathbf{r},t)\} = {2\pi}/{2-q}\int e_q\left[-Sx\{x(\mathbf{r},t), p(\mathbf{r},t)\}\right] Dp$$

being integral over generalized momentum $p(\boldsymbol{r},t)$ conjugated to the generalized coordinate $x(\boldsymbol{r},t)$. Here, the effective action $S = \int \mathcal{L} dt$ is defined by the Lagrangian

$$\mathcal{L} = \mathrm{p}(\dot{\mathrm{x}} - \nabla^2 \mathrm{x} + \frac{\partial \mathrm{F}}{\partial \mathrm{x}}) - \frac{\mathrm{p}^2}{2}$$

Equations of the system evolution within phase space is shown to be non-dependent of the deformation parameter, whose value determines only the probability to realize phase trajectories

$$P_q\{x(\boldsymbol{r}, t),p(\boldsymbol{r}, t)\}\propto e_q[- Sx\{x(\boldsymbol{r}, t),p(\boldsymbol{r}, t)\}].$$

Within the harmonic approach, deformed partition function and moments of the order parameter of lower powers are found. A set of equations for the generating functional is obtained to take into account constraints and symmetry of the statistical system.