Diffusive Mechanics

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QUANTUM MECHANICS AS DIFFUSION AND GRAVITATION AS THERMODIFFUSION IN THE VACUUM

The problem of physical interpretation of QM

1. The problem is not in the probabilistic nature of quantum mechanics, but in the energy and momentum non-conservation at quantum fluctuations of an isolated particle in the classical euclidean space.

2. Stochastic mechanics was an attempt how this problem can be solved by introducing the physical vacuum as a sourse of quantum fluctuations of classical particles with the diffusion coefficient inversely proportional to the mass of the particle.

3. The Diffusive Mechanics preserves this idea of Stoch. Mech., but is free on its formal inconsistencies, directly starting from the Fick law as a definition of any diffusion, including the conservative diffusion required by the principle of relativity.

Conservative diffusion

1. Any classical particle possesses to quantum fluctuatons caused by the interaction with the physical vacuum and the diffusion coefficient of such transport process is inversely proportional to the mass of the particle.

$$m\mathbf{v} = \nabla S. \qquad \mathbf{u} = -D\frac{\nabla\rho}{\rho}. \qquad \Gamma_D = 2mD, \qquad D = \frac{\Gamma_D}{2m},$$

2. Quantum fluctuatons do not depend on the choosing of inertial frames.

$$\int \rho(x,t)\, d^3x = 1, \qquad \bar{\mathbf{u}} = \int \mathbf{u}\,\rho\, d^3x = 0, \qquad \int \mathbf{u}^2 \rho\, d^3x \neq 0.$$

$$\bar{H}_{tot} = \int \left(E_{(0)} + \frac{\mathbf{p}_v^2}{2m} + \frac{\mathbf{p}_u^2}{2m} + V \right) \rho\, d^3x. \qquad \bar{H}_{tot} = \bar{E}_{(0)} + \bar{H}$$

$$\bar{H} = \int \left(\frac{1}{2m}(\nabla S)^2 + \frac{\Gamma_D^2}{8m}\left(\frac{\nabla\rho}{\rho}\right)^2 + V \right) \rho\, d^3x.$$

Diffusive Mechanics

$$\bar{H} = \int \left(\frac{1}{2m}(\nabla S)^2 + \frac{\Gamma_D^2}{8m}\left(\frac{\nabla\rho}{\rho}\right)^2 + V \right) \rho \, d^3x.$$

$$\frac{\partial S}{\partial t} + \left(\frac{(\nabla S)^2}{2m} + V \right) - \frac{\Gamma_D^2}{8m} \frac{\Delta\sqrt{\rho}}{\sqrt{\rho}} = 0,$$

$$\frac{\partial \rho}{\partial t} + \nabla(\rho \nabla S / m) = 0.$$

$$\rho_{12} \neq \rho_1 + \rho_2$$

$$\psi_1 = \sqrt{\rho}\cos(S/\Gamma_D), \quad \psi_2 = \sqrt{\rho}\sin(S/\Gamma_D),$$

$$\rho = \psi^* \psi$$

$$\psi = \psi_1 + i\psi_2 = \sqrt{\rho}\exp(iS/\Gamma_D).$$

$S(x,t) \qquad \rho(x,t)$

$$\{A,B\} = \int \left(\frac{\delta A}{\delta\rho}\frac{\delta B}{\delta S} - \frac{\delta B}{\delta\rho}\frac{\delta A}{\delta S} \right) d^3x,$$

$$\{\rho(x,t), S(x',t)\} = \delta(x - x').$$

$$\frac{\partial S}{\partial t} = \{S, H\} = -\frac{\delta H}{\delta\rho}, \quad \frac{\partial\rho}{\partial t} = \{\rho, H\} = \frac{\delta H}{\delta S};$$

ψ_1, ψ_2

$$\{A,B\} = \int \left(\frac{\delta A}{\delta\psi}\frac{\delta B}{\delta\psi^*} - \frac{\delta B}{\delta\psi}\frac{\delta A}{\delta\psi^*} \right) d^3x,$$

$$\{\psi(x,t), \psi^*(x',t)\} = \delta(x - x').$$

$$\boxed{i\Gamma_D \frac{\partial\psi}{\partial t} = \left(-\frac{\Gamma_D^2}{2m}\Delta + V \right)\psi.}$$

Quantum Mechanics as the theory of conservative diffusion in the physical vacuum

$$i\Gamma_D \frac{\partial \psi}{\partial t} = \left(-\frac{\Gamma_D^2}{2m}\Delta + V \right)\psi .$$

$$\Gamma_D = \hbar$$

$$D = \hbar / 2m$$

$$\psi = c_1\psi_{(1)} + c_2\psi_{(2)} + \ldots$$

$$\overline{\mathbf{p}_u^2} \cdot \overline{\mathbf{x}^2} \geq \left| \overline{\mathbf{p}_u \cdot \mathbf{x}} \right|^2 = m^2 \left| \int \mathbf{u} \cdot \mathbf{x}\, \rho\, d^3x \right|^2 =$$

$$= (mD)^2 \left| \int \nabla \rho \cdot \mathbf{x}\, d^3x \right|^2 = \frac{\Gamma_D^2}{4}.$$

$$\overline{L}_{tot} = \int \left(E_{(0)} + \frac{m\mathbf{v}^2}{2} - \frac{m\mathbf{u}^2}{2} - V \right) \rho\, d^3x.$$

The "quantum potential" as the localization energy

$$S(\mathbf{x},t) = \mathbf{px} - Et \qquad \bar{H} = \int \left(\frac{1}{2m}(\nabla S)^2 + \frac{\Gamma_D^2}{8m}\left(\frac{\nabla \rho}{\rho}\right)^2 + V \right) \rho \, d^3x.$$

$$\psi = const \cdot \mathrm{e}^{i(\mathbf{px}-Et)/2mD}$$

$$\rho^{1/2} = const. \qquad \mathbf{p}_u = 0$$

$$E_u = 0$$

The rest energy of the particle as its thermal energy in the fluctuating vacuum

$$\bar{L}_{tot} = \int \left(E_{(0)} + \frac{m\mathbf{v}^2}{2} - \frac{m\mathbf{u}^2}{2} - V \right) \rho \, d^3 x.$$

$$\bar{E}_{(0)} \sim kT_V \qquad U_0 = m\varphi_0 .$$

$$U_0 = m\varphi_0 = mc^2 .$$

Quantum statistics in classical systems

$$n = n_0 e^{-E_n/kT} \quad .$$

$$n = \frac{n_0}{e^{E_n/kT} - 1} . \qquad E = \sum_n N_n E_n \, .$$

Conservative thermodiffusion and concentration in a cold region

$$\nabla n_l \qquad \nabla T \qquad \nabla T \sim -\nabla n_l .$$

$$a_D(x) \sim -\nabla \overline{\mathbf{v}^2} \sim -\nabla \overline{\mathbf{V}^2} . \qquad \rho \mathbf{u}_T \sim -\nabla T \sim \nabla n_l .$$

$$\frac{\overline{\mathbf{v}_1^2(x)}}{\overline{\mathbf{v}_2^2(x)}} \sim \frac{\overline{\mathbf{V}^2(x)}}{\overline{\mathbf{V}^2(x)}} = 1, \qquad \frac{a_1(x)}{a_2(x)} \simeq 1 . \qquad a_D(x) \sim -\nabla T .$$

$$\frac{\overline{\mathbf{v}_1^2(x)}}{\overline{\mathbf{v}_2^2(x)}} \sim \frac{m_2}{m_1}, \qquad \frac{\mathbf{u}_{T1}(x)}{\mathbf{u}_{T2}(x)} \sim \frac{m_2}{m_1} .$$

Gravitation as a conservative thermodiffusion in the vacuum

$$U_0 = mc^2 \qquad Nmc^2$$

$$a_0 = \frac{dv}{dt} = \frac{dx}{dt}\frac{dv}{dx} = v\frac{dv}{dx} = \frac{1}{2}\frac{d(v^2)}{dx} = \text{const.},$$

$$a_0 \equiv -\frac{d\varphi_h}{dx}, \quad \varphi_h(x) = -a_0 x.$$