# INTRODUCTION

V.A. Malyshev

**Harmonic chain with deterministic dynamics** First four papers consider infinite chain of point particles $\{x_j(t), v_i(t), i \in Z\}$ on the real axis. In papers [1,2,3] the dynamics is purely deterministic with standard quadratic translation invariant nearest-neighbor interaction Hamiltonian. The problem is how this system behaves for different initial conditions. This type of models do not fit completely to our axioms (see Issue 1) because the particles are allowed to move through each other. However, very many physical qualitative phenomena in non-equilibrium statistical physics can be demonstrated in the framework of this model.

Paper [1] considers initial conditions from $l_2(Z)$. In the papers [2,3] the initial conditions are from $l_\infty(Z)$. They are not translation invariant but uniformly bounded and can be classified by degree of smoothness or chaotic behaviour. Depending on this degree, the maximum of coordinates and velocities can be either uniformly bounded for all $t$ or grow to infinity. Examples of what means smooth and chaotic are given. It could be very interesting to know whether there exist general definitions of these two notions.

In paper [4] random time-dependent external force (white noise), acting on one particle only, is appended to internal deterministic dynamics. The rate of energy growth for large time is investigated.

**Asymptotically solid particle systems** Paper [5] is a starting point for derivation of classical solid state dynamics from $N$-particle dynamics. We define solid $N$-particle systems (where distances between any two particles remain fixed) and prove that in some cases there is convergence (in some scaling) of standard point particle dynamics to the dynamics of solid particle systems.

**Dissipative force as result of particle micro interaction** In macro mechanics the friction (dissipative) force $-\alpha v$, $\alpha > 0$, is often used, where $v$ is the velocity. Here is the attempt to deduce this force from micro models. For example, when the particle collides with external particles with deterministic or random velocities, masses and time moments. In paper [6] some examples of such deduction are presented. The main problem here is to extend such point of view to systems with many interacting particles and subjected to external dissipation forces. Such models could have some qualitative behaviour similar to important phenomena in physics and biophysics. It is important to avoid randomness in such models.

**Coulomb networks** Papers [7,8] consider problems, which can be attributed to subproject called Coulomb networks. Paper [7] was written in 2019 by very talented student of Faculty of Mechanics and Mathematics of Moscow State University Oleg Nikolaevich Khripunov. He had everything to become a perspective mathematician. But tragically died soon after writing this note. Besides sincere condolences to relatives, this should force us even more to understand mathematically why human life span is so short.

In Issue 1 of our journal we presented (project 4) Drude model for electric current on the circle. However, even for this school level model (no interaction between particles) is not clear how to generalize it for any oriented graph. One of the central point here is the rule how the particle chooses the direction at crossroads (vertices) of the graph. This rule is immediate if the interaction between particles is nearest-neighbor Coulomb as it was explained in the same project. This rule produced immediately many questions. One of these questions (for one vertex graphs) was investigated in detail in paper [8]. Next problem – the Drude model for any graph with edges of finite length.

**Quantum walks** Paper [9] is a continuation of corresponding research in Issue 1, 2018.