Introduction to parallel computing for the simulation of the many-body system dynamics in the Heterogeneous cluster HybriLIT

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The simulation of the many-body system dynamics is a simulation of the physical movements of particles under the influence of physical interactions. It is a method which studies the evolution of a dynamical system and it has a lot of applications to physics: dynamics of charged particles in accelerators, interaction of high-energy heavy ions with condensed matter, evolution of a planetary systems and etc.
Usually, the simulation of the many-body system requires computational power. Hence the key problem is the development of parallel algorithms with an effective use of modern computational architectures and technologies. Note, that fast simulation equals fast progress in science.

Students will develop their own code for particular problem using one or more parallel computation technologies installed in heterogeneous computing cluster HybriLIT.

The project is meant to provide students with the basic knowledge about:
- Numerical methods of simulation of the many-body system dynamics, such as molecular dynamics methods (e.g. the Verlet method and other symplectic methods),
- Means of parallelization of computations, such as MPI, OpenMP, OpenCL and/or CUDA technologies;
- How to work on the heterogeneous cluster HybriLIT (e.g. structure of the cluster, running tasks on a variety of computing architectures, and services provided to enhance the efficiency work on the cluster).

Easy-going, diligent and inquiring students with good sense of humor are wanted, loafer students are not banned☺

Useful references:
1. W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, Numerical Recipes 3rd Edition: The Art of Scientific Computing, Cambridge University Press, Cambridge, England, 2007
2. Harvey Gould, Jan Tobochnik, Wolfgang Christian. An Introduction to Computer Simulation Methods, 3rd Edition, http://www.opensourcephysics.org/items/detail.cfm?ID=7375
3. Heterogeneous cluster HybriLIT, http://hybrilit.jinr.ru/en, Links to different technologies of parallel computing could be find here http://hybrilit.jinr.ru/en/users/links