

Dear members of the Admissions Committee,

It is my pleasure to support Filipp Uskov's application to the PhD program at Skoltech. I know Filipp from 2016. At that time I was seeking for a collaborator skillful in computer algebra systems. I needed to automatize otherwise unmanageable algebraic manipulations with bulky expressions constructed of scalar and vector products of sigma matrices, which emerged in the studies of spin (or qubit) systems with a global $SU(2)$ symmetry. Filipp was recommended by V. P. Gerdt as a person capable of doing this job. Filipp accomplished the task with excellence. He first wrote a code in the FORM computer algebra system, and then rewrote the same code in Mathematica to make it accessible to myself and other collaborators. While doing so, Filipp independently derived a number of useful analytical relations. His code and analytical results were used in our joint paper

N. Il'in, E. Shpagina, F. Uskov, O. Lychkovskiy, A parametrization of constrained and unconstrained sets of quantum states, J. Phys. A: Math. Theor. 51, 085301 (2018).

They can be further used in the studies of spin systems. In particular, Filipp has applied his results to enhance an unconventional variational principle which produces a lower (not an upper) bound on the ground state energy. This is described in Filipp's Master thesis which has been officially distinguished among the best thesis of the year by the Department of Physics of the Moscow State University. The paper reporting this development is in preparation.

Currently Filipp participates in my project "Quantum adiabaticity in many-body systems" supported by the Russian Science Foundation (grant № 17-71-20158). Recently we have initiated a research on the adiabatic quantum algorithms. I expect a very fruitful future collaboration with Filipp.

The experience of collaboration with Filipp convinces me that he is an outstanding, highly motivated student with a strong background in physics, mathematics and computer science. Filipp is particularly passionate about application of computer science methods to physical problems. I anticipate he will be extremely successful in a research of this kind. I highly recommend Filipp for admission to the Skoltech PhD program.

Yours Sincerely,

Oleg Lychkovskiy,

Senior Research Scientist,

Center for Photonics and Quantum Materials,

Skolkovo Institute for Science and Technology.