LEARN-BY-DOING RESEARCH & TEACHING SYSTEM

We work in the Joint Institute for High Temperatures of Russian Academy of Sciences (JIHT) and teach part-time in the Moscow Institute of Physics and Technology (State University) (MIPT). The research work is related to the diverse applications of molecular (atomistic) modeling & simulation

1. Students selection and their start in research.

We look for talented advanced students and select 1-3 students each year (some years the number is zero). It happens mostly at Norman's lectures in MIPT on the classical molecular dynamics and Monte Carlo methods, which Norman deliver for the second and third year students, or now at Stegailov's and Morozov's lectures as well. The opposite situation occurs sometimes when a student finds us and asks for a work. When Norman, Stegailov or Morozov select a person we invite each individually to start his/her scientific career under our supervision. If he/she agrees, we proceed with a particular learn-by-doing process. It means that despite they are very young, a second or even a first year student receives from the very beginning an original problem to solve. It is a challenge to stay within the scope of classical physics only: mechanics and molecular physics, which are in the program of the first year university curriculum. However the problem is a scientific one. Molecular modeling & simulation allow it (that is why our "quantum" colleagues envy us). Quantum problems are added at the proper time.

Study of the curriculum is the first priority at the first, second, third years. Both bachelor and master diplomas with honors are strongly desirable. However solving an original problem at the same time helps students to consolidate and extend their educational background. There is a particular concern for the education in Computer Science and Information Science and Technology needed, since the university curriculum is barely satisfactory in this area. Now we have senior PhD pupils who deliver special lectures in parallel computing technologies in MIPT.

2. Training in the technology of the scientific life.

The next stage starts when a young student obtains a first scientific result. We teach him/her how to write a paper, how to prepare a presentation and deliver a report at his/her first scientific conference, first in Russian, then in English.

Collective discussions take place besides individual teaching. For example 14 students were at the 5-day conference in the Near-Elbrus region in March 2012, each with an oral talk: a third year student, two forth year students, three fifth year students, two post graduate students and six PhD senior researchers. The conference is traditionally organized by JIHT and active participation of our group is also a tradition. The appreciation of our department by our colleagues is partially created at the series of these annual conferences. During the conference we got together almost each evening to discuss strong and weak points of the past talks.

The other very important issue is how to convert scientific results or even plans of them into financial support. We teach young colleagues from the early studentship how to earn money writing proposals for youth grants, applications for stipends or prizes etc. They succeed in this art. We attract our students to collective grants, projects and contracts as well.

3. Bachelor, master, postgraduate study, promotion and doctoral candidacy

It is evident that now Norman is not able to supervise each new member of the team. He shares the supervision with his first PhDs Morozov (2004) and Stegailov (2005) who are already the heads of laboratories in the JIHT division and assistant professors in MIPT. Besides, a special flexible hierarchy is organized when senior people help juniors.

For their bachelor, master and PhD works, all students are working on original new applications of molecular modeling & simulation in the diverse areas from plasma physics to condense matter and biochemistry. They start with classical and proceed with quantum problems. They are able to reduce their post graduate study from three to one year because of the early start of their research. Certainly not each of them uses the possibility.

The scientific activity of the best collaborators is acknowledged by 6 medals of Russian Academy of Sciences for advanced students and scientists, by 6 grants of the President of Russian Federation for advanced young PhDs, and other awards.

Students of first-third years start their work in JIHT as laboratory assistants. Bachelors are promoted to the probationer-researcher position. It is the initial scientific position. He/she is promoted to the junior research worker after publication of an article in the peer-reviewed journal. The promotion to the research worker occurs after 3 articles. PhD thesis is defended usually after 5-10 articles. It allows the promotion to senior research worker just after the PhD defense. Moreover 5 PhDs became MIPT doctoral candidacies. Stegailov is the first who already defended his Dr. Habilitus thesis in 2012. The table of personal promotions in our department is attached.

Each postgraduate student undergoes practical training in teaching. It is obligatory in MIPT. According to Norman's recommendation they continue their teacher's carrier after PhD thesis defense. It becomes possible because they do their best to prove themselves to be good teachers during their practical training and are invited on the part-time regular basis in MIPT.

4. PhD work and transformation of our group

All Norman's 10 former PhD students make many short-stay visits to US, Germany, UK, France, Japan and other developed countries and travel to conferences throughout the world. They enjoy travelling and receive invitations for positions in many top-level universities and laboratories abroad. Most of my pupils are not Moscow residents originally. However their choice is to have permanent position in Moscow. It is a very important result of the research & teaching system.

Initially we all worked in JIHT. Besides, most of us teach in MIPT. Now our advanced group becomes more and more well known and demanded. The new process of expansion started in 2012 according to the requests of directorship of some institutions.

Yanilkin changed his position to start a new section in Dukhov VNIIA, remaining in JIHT at part-time. Two our post graduate students and a student are already with him. Another JIHT PhD has a part-time position there. We are invited to delegate people to Nuclear Safety Institute RAS, Keldysh Institute of Applied Mathematics RAS and to Moscow Institute of Electronics and Mathematics (at Higher School of Economics). A group of us is invited to join a certain MIT (Boston, US) team to participate in a Center for research, education and innovations in SkTech (Skolkovo, Moscow). Our group is transforming into an inter-institute one.

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