



CZECH TECHNICAL UNIVERSITY IN PRAGUE

FACULTY OF NUCLEAR SCIENCES
AND PHYSICAL ENGINEERING

Academician B.N. Chetverushkin
Chair, dissertation committee
Miuskaya pl. 4, 125047 Moscow, Russia

Prague, October 7, 2013

Dear Academician Chetverushkin,

I would like to inform you that works by Miss Alexandra Ivanovna Lebo, devoted to numerical modeling of physical processes in laser-produced plasmas, are well known in our group at the Czech Technical University (CTU) in Prague.

Physical-mathematical model and simulation results presented in articles A.I. Lebo *et al.* "Simulations of shock generation and propagation in laser-plasmas" (*Laser and Particle Beams* **26** (2008), 179-188) and Lebo A.I. *et al.* "Dependence of pressure in compressed condensed matter on parameters of high-power pulses" (*Quantum Electronics* **38** (2008), 747-754) facilitated interpretation of the experimental data at the PALS laser of the Academy of Sciences of the Czech Republic in Prague. Comparison of the experimental data with the presented simulation results enabled determining the thermodynamic parameters behind the strong shock wave front. Namely, a scaling of parameters behind the shock wave front was derived on the basis of the simulation results and their comparison with the experimental data.

Theoretical model describing the energy propagation in the turbulent plasma generated during interactions of intense laser pulses with low-density porous matter was developed in the articles Lebo A.I., Lebo I.G. "A model of the energy transport in turbulent laser plasma of porous targets" (*Physica Scripta*, **T142** (2010), 014024), and A.I. Lebo, I.G. Lebo "Interaction of high-power laser pulses with low-density targets in experiments with the PALS installation" (*Mathematical Models and Computer Simulations* **1** (2009), 724-738). This model was used as the basis of the developed code "Atlant_C_turb" that allowed suitable description of the experiments at PALS laser system.

Generation of superstrong magnetic fields in turbulent plasmas formed in laser interaction with low-density foams was demonstrated in the articles A.I. Lebo, I.G. Lebo "Possibility of eddy currents and spontaneous magnetic fields observations in plasma formed through the interaction of high-power laser pulses with porous targets (*Mathematical Models and Computer Simulations* **2** (2010), 359-361) and A.I. Lebo *et al.* "Laser foam targets for production of magnetized thermonuclear plasma" (*Turbulent Mixing and Beyond*, 3-rd International conference and Advanced School, 21-28 August, 2001, p.49). Construction of a target with a porous matter layer was proposed and the simulation results obtained with the code "Atlant_C_turb" predict generation of magnetic fields up to 10^4 T during compression of such targets. These magnetic fields may influence the transport of α -particles significantly and thus the fusion yield in the laser-induced inertial confinement fusion may be vastly enhanced.

On the basis of numerical simulations, physical model was developed by Yu.V. Korobkin, A.I. Lebo, I.G. Lebo "Investigation of the foreplasma parameters of a laser-plasma diode" (*Quantum Electronics* **40** (2009), 811-816) that allowed to determine the parameters of



CZECH TECHNICAL UNIVERSITY IN PRAGUE

FACULTY OF NUCLEAR SCIENCES
AND PHYSICAL ENGINEERING

plasma near the cathode irradiated by a laser pulse of duration in range 10-100 ps and intensity of 10^{11} - 10^{13} W/cm². The formation of such plasma is necessary condition for an efficient high-current discharge that can be applied as a compact source of fast ions and X-rays.

Miss A. I. Lebo was invited for a short visit to the Czech Technical University in Prague during the year 2010. She presented her results on seminars at the Faculty of Nuclear Sciences and Physical Engineering of the CTU and at the Institute of Physics of the Academy of Sciences of the Czech Republic. The results of Miss Lebo were discussed in details and their significance for our research was acknowledged.

I have acquainted myself with the thesis statement of Miss A. I. Lebo «Анализ лазер-плазменных экспериментов с помощью методов математического моделирования.» The results of the thesis are novel, topical and credible. I would like to recommend the dissertation thesis of Miss Alexandra Ivanovna Lebo for defence and I am of the opinion that after successful defence she deserves to be awarded the degree of the candidate of physical-mathematic sciences in the branch 05.13.18 – Mathematical modelling, numerical methods and programme code complexes.

prof. Ing. Jiří Limpouch, CSc.
full professor of applied physics
Czech Technical University in Prague
Faculty of Nuclear Sciences & Physical Engineering
Břehová 7, 115 19 Praha 9, Czech Republic
jiri.limpouch@fjfi.cvut.cz
<http://kfe.fjfi.cvut.cz/kfe/home/limpouch/en/index.html>