

OPINION

**of the member of Jury Professor Ivan Panaiotov
on Dissertation of Prof. Rumen Tsekov,
submitted for the Degree of Doctor of Science
professional field 42, Chemical Sciences (Physical Chemistry)**

I couldn't help but notice that the dissertation of Professor Tsekov "Chemical and Quantum Brownian motion", submitted for Degree of Doctor of Science is one of the most thought - provoking work I have ever reviewed.

The fascinating story of Brownian motion attracted the interest of most significant names in physics over years begins in the Annus mirabilis 1905 with the theoretical approach of the Brownian motion published in Annalen der Physik 17, p.549 by young Einstein. This first attempt for stochastic modelling of random processes and its subsequent development are fundamental to the understanding of many phenomena studied by the natural sciences and mathematics.

An excellent introduction in the dissertation presents the evolution of the main ideas as well as unresolved issues in this fascinating area of the science.

Prof. Tsekov turns his attention to this prestigious subject in the 1990s during his stay in the laboratory of Ruckenstein. Over the next two decades, impressive progress in a series of theoretical results and generalization has been realized. The obtained original results listed in the conclusions are analyzed in the report of the reviewers .Among the developed ideas the following seems more interesting and promising to me - the application on the theory of the Brownian motion to biological systems. As one example in the frames of the classical mechanics the Brownian motion model was applied in [22] to the living cell migration. A new quantity θ , called temperament, proportional to the temperature reflecting the motivity of living cells was introduced. According to non-equilibrium thermodynamic, the cell entropy production related to specific biophysical process could be calculated. For illustration in [22] in the simplest case of spherical cells obeying to Stokes law the values for θ were estimated. It is important to notice that the developed approach could be extended for description of Brownian motion in a micro- and nano- structured medium. It is well known that the all biological processes are organized

in such complex environments. The classical example is the structure of mitochondria where the processes of oxidative phosphorylation coupled with active proton transport are realized by a complex succession of polyenzymatic reactions located on the inner membranes distanced one from other at 500 Å. The question that arises is whether the specificity of enzymatic reactions or active transport of chemical species in the spatially organized structures controls the process. Is it possible to make any estimation using a model taking into account the modulation of friction coefficient and effective periodic potential?

The gas diffusion and drug delivery across the complex respiratory barrier are another important example etc... Wide field for research!

Prof. Tsekov is a researcher and lecturer respected by the Bulgarian physicochemical community. The presented dissertation summarized his thoughts and reflections for years on the mechanical and quantum aspects of the Brownian motion. The presented results are based on 35 publications, 33 of which published in international reputable scientific journals as J. of Chem. Soc. Faraday Trans., Adv. Colloid Interface Sci., J. Chem. Phys., J. Theor. Phys. etc... Prof. Tsekov promoted also his research in a large number of international meetings.

The results obtained by Prof. Tsekov have been noted by the scientific community and cited 180 times in the issues referenced and indexed in Web of Science and Scopus. He is also a leader and participant in an impressive number of scientific projects.

The submitted report shows that the candidate has fulfilled (even exceeded) the criteria in the four groups, required for the degree of Doctor of Science.

In conclusion, my opinion is that Prof. Tsekov's dissertation fully comply with the requirements of law and regulations. I suggest that the Honourable Jury award him the degree of Doctor of Science.

August, 2021

Sofia

Prof. DSc. Ivan Panaiotov