European Funds
Knowledge Education Development

Republic of Poland

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CERTIFICATE

Mrs/Mr

Marcin Klaczak

participated in the

Quantum and Molecules I Summer School
(QUEUE I)

from 26/09/2022 to 30/09/2022

organized by Gdańsk University of Technology

Maciej Bobrowski, Ph.D., D.Sc, university professor, Gdańsk, 30 September 2022
Chair of the Quantum and Molecules I Summer School 2022

GDAŃSK UNIVERSITY OF TECHNOLOGY
FACULTY OF APPLIED PHYSICS AND MATHEMATICS

Description of the learning outcomes[1]:

Knowledge (knows and understands quantum-chemical theories, practical methods and applications in investigations in chemistry, materials science and nanotechnology)[2]

The Quantum and Molecules I Summer School graduate knows basics and the advances in quantum methods and their applications for atomic and molecular systems. Students know on how to represent electronic structures and both on how to manage analytically with quantum calculations for smaller n-electron systems and numerically, by means of advanced quantum-methods software by using super-computer. Students know how to effectively and professionally use the "quantum" software, orientate in capabilities as well as in limitations of available methods in applications in chemistry, material science and nanotechnology.

Skills *(can practically apply quantum methods analytically for particular electronic configurations and practically for chemical reactions and excited states of the systems)* [3]

The Quantum and Molecules I Summer School's graduate understands and knows basic and more sophisticated methods widely used for electronic-structure systems and can apply the methods both analytically for smaller electronic structures and practically, by means of advanced quantum software running the dedicated jobs in a supercomputer. Graduates can investigate chemical reactions pathways with and without change of the system's spin within the reaction and can practically investigate influence of various factors on the reactivity of reactants. Graduates understand complexity of the electronic structures, can draw ground-state and excited-state configurations, compare ad hoc their energies and do the computations for real electronic systems using various systems of coordinates. Graduates have experience in working under professional computer systems in network including work with a supercomputer, in configuration of the user shell and in usage of more advanced tools like: batch programs, large amount of data's buffering and non-trivial commands for data's analysis.

Social competence *(is ready to start working in collaboration with international academic community on real projects)*[4]

The Quantum and Molecules I Summer School graduate is able to communicate and collaborate with the international academic community. Is ready to work individually on short term projects to shape own development. He/she is aware of the societal, and cultural challenges faced by the Polish and European societies nowadays, and in the recent decades. Knows the ethical context of his/hers professional activity.

The Quantum and Molecules I Summer School was organized within the ScienceApp Project run within the frame of the 'SPINNAKER – Intensive International Curricula' program, organized by the National Agency for Academic Exchange (NAWA), financed by the European Union under the Knowledge Education Development Operational Program (Action 3.3. Internationalization of Higher Education). The budget of the project is PLN 726,900.00.

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[1] The learning outcome is what the learner knows, understands and can do as a result of learning, expressed in terms of knowledge, skills and social competence.

[2] **Knowledge** – a collection of descriptions of objects and facts, principles, theories and practices acquired in the learning process and relating to the field of learning or professional activity.

[3] **Skills** – the ability, assimilated in the learning process, to perform tasks and solve problems specific to the field of learning or professional activity.

[4] **Social competence** – the ability to participate autonomously and responsibly in the professional and social life and to shape own development, taking into account the ethical context of own behaviour.