Contribution ID: **47** Type: **Oral**

Elementary atoms in spaces of constant curvature by the Nikiforov-Uvarov method

Wednesday 2 July 2025 15:30 (20 minutes)

Spaces of constant curvature provide the simplest curved background against which to study theoretical problems and questions related to quantum mechanics in curved spaces, and therefore such studies are of considerable theoretical interest. However, they are not only of academic interest. Effective curvature of space arises in a number of real physical situations from the physics of atoms and nanotubes to the chiral and deconfinement phase transition in the Nambu-Jona-Lasinio model, symmetries of the W algebra of string theory and quasi-exactly solvable models, as well as superintegrability in the framework of supersymmetry (see, for example [1-3]).

The Nikiforov-Uvarov method is a simple, yet elegant and powerful method for solving second-order differential equations of generalized hypergeometric type [4]. In the past, it has been used to solve many problems in quantum mechanics [5,6,7]. We apply this method to the classical problem of hydrogen-like atoms in spaces of constant curvature. Both the spectra of these atoms and their wave functions, including normalization, are easily obtained.

References

[1] Carinena J.F., Ranada M.F., Santander M. The quantum free particle on spherical and hyperbolic spaces: A curvature dependent approach. J. Math. Phys., 2011, vol. 52, pp. 072104.
[2] Kirchbach M., Compean C.B. Baryons from quarks in color gauge space of constant positive curvature and deconfinement. Preprint arXiv:0805.2404, 2008.
[3] Quesne C. Quasi-exactly solvable extensions of the kepler–coulomb potential on the sphere. Ann. Phys., 2023, vol. 451, pp. 169265.
[4] Nikiforov A., Uvarov V. Special Functions of Mathematical Physics: A Unified Introduction with Applications, Springer, Basel, 1988.
[5] Ellis L., Ellis I., Koutschan C., Suslov S.K., On Potentials Integrated by the Nikiforov-Uvarov Method. Preprint arXiv: 2303.02560, 2023.
[6] Tezcan C., Sever R., A general approach for the exact solution of the schrodinger equation. Int. J. Theor. Phys., 2009, vol. 48, no. 2, pp. 337–350.
[7] Suslov S.K, Vega-Guzman J.M, Barley K., An introduction to special functions with some applications to quantum mechanics, in: Foupouagnigni M., Koepf W. (Eds.), Orthogonal Polynomials, Springer International Publishing, Cham, 2020, pp. 517–628.

Primary authors: Dr ALIZZI, Abdaljalel (Budker Institute of Nuclear Physics and Novosibirsk State University); Dr SAGAYDAK, Alina (Novosibirsk State University); SILAGADZE, Zurab (Budker Institute of Nuclear Physics and Novosibirsk State University)

Presenter: SILAGADZE, Zurab (Budker Institute of Nuclear Physics and Novosibirsk State University)

Session Classification: 4. Relativistic nuclear physics, high-energy and elementary particle physics: Theory

Track Classification: Section 4. Relativistic nuclear physics, high-energy and elementary particle physics.