Dynamical Algebras from Nuclear Structure to Planetary Motion

J. Cseh

HUN-REN Institute for Nuclear Research, 4026 Debrecen P. O. Box 51, Hungary

Symmetry considerations, i.e. the applications of group theory are extremely useful in many branches of physics. Some of them are simple and well-known, e.g. the spherical symmetry of the oscillator or Kepler problem. They are examples of the geometrical symmetry. Dynamical symmetries are usually more hidden, but they can be equally illuminative, c.f. the rich variety of the U(3) in nuclear physics, or the role of O(4) in the hydrogen atom.

Dynamical algebras (DA) describe the whole spectrum within a single representation, thus in addition to the subalgebras of the degenerecies, they contain spectrum generating parts, too. They were introduced in quantum mechanics [1], and one of the best known example is the U(6) dynamical algebra of the quadrupole nuclear collective model [2]. In this presentation I plan to discuss some less frequently cited DA's of other models of the nuclear structure [3].

For a long time it was not even clear if the concept of DA makes sense in classical mechanics. Then a uniform interpretation for classical and quantum physics was found [4]. Some studies indicate that they may have an important role even in celestial mechanics [5–7].

References

[1] S. Goshen, H.J. Lipkin, *Ann. Phys.* **6** (1959) 301.

[2] F. Iachello, A. Arima, "The Interacting Boson Model", Cambridge University Press: Cambridge, MA, USA (1987).

[3] J. Cseh, *EPJ Web Conf.* **311** (2024) 00029.

[4] C. Quesne, In "Symmetries in Physics"; Frank, A., Wolf, K., Eds.; Springer: Berlin/Heidelberg, Germany, p. 325 (1992).

[5] A.O. Barut, In "Symmetries in Science II"; Plenum Press: New York, NY, USA, p. 37 (1989).

[6] J. Cseh, *Symmetry* **12** (2020) 2109.

[7] J. Cseh, P. Dang, S. Szilágyi, G. Lévai, *Symmetry* **15** (2023) 2114.