Algebra preserving metric deformation of a conformal group manifold and degeneracies in hadron spectra

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Several exactly solvable potentials are known to produce spectra that fall into the irreducible representations of certain orthogonal or pseudo-orthogonal group algebras without that the respective Hamiltonians commute with the Casimir invariants of those algebras. An explanation of this phenomenon has been provided by the potential algebra concept, *Y. Alhassid, F. Gürsey, F. Yachello, Phys. Rev. Lett.* **50***, 873 (1983),* which states that the above Hamiltonians can be cast into the form of Casimir invariants of particular algebras, though in representations unitarily inequivalent to those that generate the orthogonal or pseudo-orthogonal groups. Our first point here is that the transition from a canonical to a potential algebra can be viewed as a metric deformation of the initial group manifold towards an isometry copy such that the free geodesic motion on the copy is equivalent to a motion on the undeformed group manifold, perturbed by the potential under consideration. In this fashion, the potential algebra concept opens the intriguing venue towards global group symmetry breaking by mass scales, associated with the potential strengths, and without any local breakdown of the underlying algebras.

We here in particular entertain the possibility that the conformal group symmetry of QCD predicted by the $\mathrm{ADS}_5/\mathrm{CFT}_4$ gauge-gravity correspondence may be globally broken by the dilaton mass in precisely same way.

Specifically, we construct a deformed so(4) isometry copy to the three dimensional sphere, S^3, the SO(4)$\subset$ SO(2,4) group manifold, such that free geodesic motion on the copy is equivalent to motion on S^3 perturbed by the curved Coulomb potential, and identify the potential strength with the dilaton mass. In this fashion we produce conformal group symmetry breaking by the dilaton mass which conserves the conformal degeneracy patterns in both the unflavored baryon and the meson spectra with masses between 1500 MeV and 2500 MeV and in accord with the experimental observations. In the spirit of effective theories and partial dynamical symmetries we discuss the possibility that that the QCD potential beneath the recently reported conformal window in the infrared may have a conformal symmetry algebra.