Harmonic Oscillators and Hadrons

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Two dynamical systems with same symmetries should have features in common, and as far as their shared symmetry is concerned, one may represent the other. The three light quark constituents of the hadrons, a) have an approximate flavor-SU(3) symmetry, b) have an exact color-SU(3) symmetry, and c) as spin 1 2 particles, have a Lorentz SO(3,1) symmetry. So does a 3D harmonic oscillator. a) Its Hamiltonian has the SU(3) symmetry, breakable if the 3 fundamental modes of oscillation are not identical. b) The 3 directions of oscillation have the permutation symmetry. This enables one to create three copies of unbreakable SU(3) symmetry for each mode of the oscillation, and to mimic the color scheme of the elementary particles. And c) The Lagrangian of the 3D oscillator has the SO(3,1) symmetry. This can be employed to accommodate the spin of the particles. In this paper we are able to draw up a one-to-one correspondence between the eigen modes of the Poisson bracket operator of the 3D oscillator and the flavor multiplets of the particles, and between the permuted modes of the oscillator and the color and anticolor multiplets of the particles. Gluons are represented by the generators of the color-SU(3) symmetry of the oscillator. Harmonic oscillators are common place objects and wherever encountered, are analytically solvable. Elementary particles, on the other hand, are abstract entities far from one's reach. Understanding of one may help a better appreciation of the other.

Key words: SU(3) symmetry, harmonic oscillators, elementary particles

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