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Neutron to proton mass difference, parton distribution functions and baryonic resonances from dynamics on the Lie group $u(3)$

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Abstract

We present a hamiltonian structure on the Lie group $u(3)$ to describe the baryon spectrum. The ground state is identified with the proton. From this single fit we calculate approximately the relative neutron to proton mass shift to within half a percentage of the experimental value. From the same fit we calculate the nucleon and delta resonance spectrum. For specific spin eigenfunctions we calculate the delta to nucleon mass ratio to within one percent.

We derive parton distribution functions. The distributions are generated by projecting the parton state to space via the exterior derivative on $u(3)$. We predict accurate neutron-flavour angule which should be visible in neutrino diffusion dissipation experiments or in invariant mass spectra of proton and negative pions in B-decays and in photoproduction on neutron. The presence of such singlet states distinguishes experimentally the present model from the standard model as does the prediction of the neutron to proton mass splitting. Conceptually the Hamiltonian may describe an effective phenomenology or more radically describe interior dynamics implying quarks and gluons as projections from $u(3)$ which we then call allospace.

The theory unfolded

The Lapplacian in (1) contains off-diagonal derivatives which are represented by the off-diagonal Gell-Mann matrices. We choose three of these to represent spin and group them into $\lambda_{1}, \lambda_{2}, \lambda_{3}$. This interpretation is supported by their commutation relations as body fixed angular momentum. The relation between space and allospace is like the relation in number theory between linear and cyclic systems and relieves body fixed coordinate systems for the description of rotational degrees of freedom. The remaining three are grouped into $\mu_{1}, \mu_{2}, \mu_{3}$ which is related to hypercharge and isospin. They add the algebra by commuting into the subspace of $K$. The fully parametrized Lapplacian in polar decomposition reads

$$\frac{1}{2m} \left( \frac{\partial}{\partial x} \right)^{2} + \frac{1}{2m} \left( \frac{\partial}{\partial r} \right)^{2}$$

The constant term is interpreted as a curvature potential and the off-diagonal term is analogous to the centrifugal term in the usual treatment of the radial wave function for the hydrogen atom.

With the periodic potential in (2) our complete Schrödinger equation reads with $E = E/\Lambda$ and $\lambda = \lambda/\hbar^{2}/m = 210 \text{MeV}$

$$-\frac{1}{2m} \left( \frac{\partial}{\partial x} \right)^{2} + \frac{1}{2m} \left( \frac{\partial}{\partial r} \right)^{2} + \frac{1}{2m} \left( \frac{\partial}{\partial \lambda} \right)^{2} + V(r) + E_{\lambda}(\theta, \phi, \lambda) = \psi_{\lambda}(x, r, \lambda, \theta, \phi)$$

And a similar factorization of $\theta_{\lambda_{1}}(x_{1}, x_{2}, x_{3}, \lambda_{1}, \lambda_{2}, \lambda_{3})$ results in $\psi_{\lambda}(x, r, \lambda, \theta, \phi)$

The algebraic representation for periodic spin reduced the total energy by impacting upon it a massless four-vector.

$$\Delta_{\lambda_{1}} + E_{\lambda_{1}} = 2E_{\lambda_{1}}(\theta_{1}, \theta_{2}, \theta_{3})$$

The figure shows parametric eigenvalues with periodicity 2h to the left and periodicity 4h for threshold states in the right column. We can couple a diminishing period doubling in level two with an augmenting period doubling in level one. We interpret these coupled period doublings as representing the transformation from a neutral state (e.g. the reaction) to a charged state (e.g. the particle).