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Neutron to proton mass difference, parton distribution functions and baryon 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 absolute neutral-flavour singlets 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 neutrino. The presence of such strange 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 certain dynamical mixing angles and phases as projections from u(3) which we then call allopairs.

The allospatial hypothesis

The Laplacian in (1) contains off-diagonal derivatives which are represented by the off-diagonal Gell-Mann matrices. We diagonalize three of these to represent spin and group them into \( \lambda = (\lambda_1, \lambda_2, \lambda_3) \). This interpretation is supported by their commutation relations as body fixed angular momentum. The relation between space and allopaity is like the relation in numerous physics between dynamic systems and reals body fixed coordinate systems for the definition of rotational degrees of freedom. The remaining three are grouped into \( \mu = (\mu_1, \mu_2, \mu_3) \), which is related to hypercharge and isospin. They comply the algebras by commuting into the subspace of \( \lambda \). The fully parametrized Laplacian in polar decomposition reads

\[
\Delta = \sum_{ik} \sum_{j} \frac{\partial^2}{\partial x_j^2} \left( \frac{1}{\rho} \frac{\partial}{\partial \rho} \right) + \sum_{i<k} \sum_{j} \frac{\partial^2}{\partial x_j^2} \left( \lambda_i \lambda_k \right)
\]

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

The theory unfolded

The potential is half the squared geodetic distance from the 'point'

\[ V = \frac{1}{2} \left( x^2 + y^2 + z^2 \right) \]

The potential is half the squared euclidean distance from the 'point'

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Approximate energy levels for baryonic states are found by combinations of three parameters: eigenstates of the three tuning angles. These eigenstates originate from the same periodicity as the present theory. However a coupled periodical doubling can decrease the total energy.

The potential can be written as

\[ V = \frac{1}{2} \left( x^2 + y^2 + z^2 \right) \]

We interpret the period doublings as related to the creation of the proton from the reaction decay. Similar states all the states may contribute to neutral states with one even label give the N resonances.

For three even labels the complex phases factorize out and the proton charge in the reaction decay. Similar states all the states may contribute to neutral states.

The allospatial Hamiltonian in (1) or (3) may be seen as an effective phenomenology or interpreted more radically in a conceptual interpretation where we see

\[ \Delta \equiv \sum_{ik} \sum_{j} \frac{\partial^2}{\partial x_j^2} \left( \frac{1}{\rho} \frac{\partial}{\partial \rho} \right) + \sum_{i<k} \sum_{j} \frac{\partial^2}{\partial x_j^2} \left( \lambda_i \lambda_k \right) \]

two even labels give possibilities of double charges which we interpret as \( \Delta \) resonances.

\[ \Delta \equiv \sum_{ik} \sum_{j} \frac{\partial^2}{\partial x_j^2} \left( \frac{1}{\rho} \frac{\partial}{\partial \rho} \right) + \sum_{i<k} \sum_{j} \frac{\partial^2}{\partial x_j^2} \left( \lambda_i \lambda_k \right) \]

\[ \Delta \equiv \sum_{ik} \sum_{j} \frac{\partial^2}{\partial x_j^2} \left( \frac{1}{\rho} \frac{\partial}{\partial \rho} \right) + \sum_{i<k} \sum_{j} \frac{\partial^2}{\partial x_j^2} \left( \lambda_i \lambda_k \right) \]

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References

Acknowledgments

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