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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 neutron 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 of the Schrödinger equation. 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 interpreted more radically in a conceptual interpretation where we see the fields possibly being electrically charged. This points to a configuration space and assume the following Hamiltonian

$$\theta \pi = + + - \leq \leq$$

It is the hypothesis of the present work, that the eigenstates of the above Schrödinger equation describe the baryon spectrum with degrees of freedom to mimic both spin, hypercharge and isospin.

$$\theta \pi = + + - \leq \leq$$

The theory unfolded

The Laplacian 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 $\chi (\mathbf{i}, \mathbf{j}, \mathbf{k})$. This interpretation is supported by their commutation relations as body fixed angular momentum. The relation between space and allopseudo is like the relation in number physics between dynamical systems and renormal body fixed coordinate systems for the description of rotational degrees of freedom. The remaining three are grouped into $\mu (\mathbf{i}, \mathbf{j}, \mathbf{k}, \mathbf{u})$ which is related to hypercharge and isospin. They commute the allopseudo by commuting into the subspace of $\mathbf{u}$. The fully parameterised Laplacian in polar decomposition reads

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \sum_{i} \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

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 potential in (2) our complete Schrödinger equation reads with $E = \epsilon + \lambda$ and $E = h \omega / i c = 210 \text{ MeV}$

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \sum_{i} \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

And a similar factorization of $\theta \pi = + + - \leq \leq$ gives for $\theta \pi = + + - \leq \leq$ we denote as $\theta \pi = + + - \leq \leq$

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \theta \pi = + + - \leq \leq$$

The figure shows parameter eigenstates with periodicity 2n to the left and periodicity 4n for additional states in the right column.

We can couple a diminishing period doubling in level two with an augmenting period doubling in level one. We have omitted these coupled period doublings as representing the transformation from a neutral state (e.g. the proton) to a charged state (e.g. the neutron)

$$n \rightarrow p$$

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

where

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

Conclusions

The allopseudo Hamiltonian in (1) or (2) may be seen as an effective phenomenology or interpreted more radically in a conceptual interpretation where we see the fields possibly being electrically charged. This points to a configuration space and assume the following Hamiltonian

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

A quite accurate prediction of the relative neutron to proton mass shift 0.138% follows from approximate solutions to the Schrödinger equation. A projection of states to space is given via the exterior derivative. This projection has shown to yield approximate energy eigenstates of the three types. These eigenstates are the object of the present work. 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 neutron and delta resonance spectrum. For specific-spin eigenfunctions we calculate the delta to nucleon mass ratio to within one percent.

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

References


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Parton distributions

We project from a state constructed from trigonometric functions to mimicking the period doubling implied in the decay to the proton state

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

$$\sum_{i} \frac{\partial^{2}}{\partial x_{i}^{2}} + \frac{2}{r} \frac{\partial}{\partial r} \frac{1}{r} \frac{\partial}{\partial r}$$

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