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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 which it is calculated 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 resonances spectrum. For specific spin eigenfunctions we calculate the delta to nucleon mass ratio to within one percent.

We derive particle distribution functions. The distributions are generated by projecting the proton-state space via the exterior derivative on $u(3)$. We predict mean square flavour angular momenta which should be visible in neutron diffusion decays and experiments on invariant mass spectra of protons and negative pions in B-decays and in production on neutrino. The presence of such spin 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 as a model of nuclear dynamics (spins and gluons as dynamics from (u(3)) which we then call allospatial.

The allospatial hypothesis

We work to generate appropriate fields transforming under the $u(3)$-algebra with the fields possibly being non-linear. This opens up for configuration space containing both $u(3)$ and $u(1)$. Thus we choose the Lie group $u(3)$ as configuration space and assume the following Hamiltonian

$$H = \sum_{i=1}^{3} p_i^2/2m_i - \sum_{i<j}^{3} C^i_j \phi_i \phi_j - \sum_{i=1}^{3} E_i \phi_i$$

where $\phi_i$ are the eigenvalues of the Schrödinger equation describe the baryon spectrum with a variable of a sole baryonic entity and degrees of freedom to mimic both spin, hypercharge and isospin.

$$\rho(r, \theta, \phi) = \rho_0(r, \theta, \phi) \exp(-i\theta/2)$$

where $\rho_0(r, \theta, \phi)$ is the eigenvalue of $\rho$.

The potential is half the square of the distance between the point $\rho$ to the origin of $\rho$.

Approximate energy levels for baryonic states are found by combinations of three parameters: eigenvalues of the three torus angles. These eigenstates originaly have the same periodicity as the periodic group. However a coupled period doubling can decrease the total energy.

We project from a state $u(3)$ to mimic the period doubling in the decay of the proton charge in the neutron decay. Similar states all the states may contribute to neutral states.

The allospatial Hamiltonian in (1) or (2) may be seen as an effective phenomenology or interpreted more radically in a conceptual interpretation where we see

$$\rho(r, \theta, \phi) = \rho_0(r, \theta, \phi) \exp(-i\theta/2)$$

$$\rho(r, \theta, \phi) = \rho_0(r, \theta, \phi) \exp(-i\theta/2)$$

$$\rho(r, \theta, \phi) = \rho_0(r, \theta, \phi) \exp(-i\theta/2)$$

We interpret the period doublings as related to the creation of the proton charge in the neutron decay. Similar states all the states may contribute to neutral states.

The two-sphere gives possibilities of double charges which we interpret as A-resonance.

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The black dot in the figures show the Bloch wave number choices for the neutron (left) and the proton states (right).

Periodic potential and reduced zone scheme

We boost a proton from rest to energy $E$ by impacting upon it a massless four-vector $p$. After

$$\psi_0 = \psi_0(r, \theta, \phi) \exp(-i\theta/2)$$

$$\psi_0 = \psi_0(r, \theta, \phi) \exp(-i\theta/2)$$

$$\psi_0 = \psi_0(r, \theta, \phi) \exp(-i\theta/2)$$

We project from a state

$$\psi_0 = \psi_0(r, \theta, \phi) \exp(-i\theta/2)$$

$$\psi_0 = \psi_0(r, \theta, \phi) \exp(-i\theta/2)$$

$$\psi_0 = \psi_0(r, \theta, \phi) \exp(-i\theta/2)$$

where $\theta$ is small. The momentum form induces quark an gluon fields.

Parton distributions

References

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