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Trinhammer, Ole

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

Ole L. Trinhammer.
Department of Physics, Technical University of Denmark (DTU)

Abstract

We present a hamiltonian structure on the Lie group u(3) to describe the baryonic spectrum. The ground state is identified with the neutron. 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. The model has no fitting parameters except the scale .

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

Resonances - from space: The impact momentum of strangling operators generalise the maximal torus of u(3).

Conclusion

A quite accurate prediction of the relative neutron to proton mass shift 0.138 % follows from approximate solutions to the Schlögl equation. A projection of states to space is given via the exterior derivative. This has yielded the baryon resonance spectrum that compares rather well with those of the proton-neutron vector distributions already in a first order approximation. A kinematical parameterisation for the projection gives a natural transition between a confornit domain where the dynamics unifies in the spatial group and an asymptotic free domain where the algebra approximates the group. A promising ratio between the A(1232) and N(1535) mass has been calculated based on specific O(3) functions. We expect the allospatial eigenenergies to project to partial wave amplitudes resonances of specific spin and parity via expansions on specific combinations of O(3) functions. Single neutron flavour resonances are predicted above the free chem threshold of .

The allospatial hypothesis

The Laplacian in (1) contains off-diagonal derivatives which are represented by the off-diagonal Gel-Mann matrices. We interpret these three to represent spin and group them into u(3), (u(3),u(3)). This interpretation is supported by their commutation relations as body fixed angular momentum. The relation between space and allospatial is like the relation in number physics between fundamental dynamical systems and remote body coordinate systems for the description of rotational degrees of freedom. The remaining three are grouped into u(3), (u(3),u(3)), which is related to hypercharge and isospin. They combine the allospace to form the subalgebras of K. The fully parameterised Laplacian in polar decomposition reads

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

| \frac{1}{2m}(E - \frac{1}{r}

With the periodic potential in (2) our complete Schlögl equation reads with \( E = E / \lambda \) and \( \lambda = h / c = 210 \text{MeV} \)

And a similar factorization of \( (1-\omega_{12} (1-\omega_{23} (1-\omega_{31} / \omega_{12} \omega_{23} \omega_{31} ) ) ) \) gives for \( \omega_{12} (1-\omega_{23} (1-\omega_{31} / \omega_{12} \omega_{23} \omega_{31} ) ) \).

The figure shows parameter eigenstates with periodicity 2n in the left and 3n in the right column individually. We can couple a diminishing period doubling in level two with an increasing period doubling in level one. We interpret these coupled period doublings as representing the transformation from a neutral state (e.g. the neutron) to a charged state (e.g. the proton).

\[ n \rightarrow p \]

\[ n \rightarrow p \]

The resulting states are found by projecting the proton state to space via the exterior derivative. The result does not depend on the state as long as it is a neutral state. The black dots in the figures show the Bloch wave number on the Fermi surface. For three even labels it is the case that the period doublings increase.

References

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