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Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

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Citation (APA):
Trinhammer, O. (2012). Neutron to proton mass difference, parton distribution functions and baryon resonances from dynamics on the Lie group u(3). Poster session presented at Danish Physical Society Annual Meeting 2012, Nyborg, Denmark.
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 scarce neutral flavour singlets which should be visible in neutron diffraction dissociation experiments at \(10^{13}\) MeV.

The fields possibly being electrically charged. This points to a configuration space containing both \(su(3)\) and \(u(1)\). Thus we choose the Lie group \(u(3)\) as configuration space and assume the following Hamiltonian

\[
E = \int \frac{1}{2m} \sqrt{g} \left( \partial_{\mu} T^{\mu\nu} \right) \partial_{\nu} T^{\mu\nu} - \frac{1}{2} \sum_{j=1}^{3} \left( \partial_{\mu} \xi^{j} \right) \left( \partial_{\nu} \xi^{j} \right) + \frac{1}{2} g \left( 1 \left( \partial_{\mu} \xi^{1} \right) \left( \partial_{\nu} \xi^{1} \right) + 2 \sum_{j=2}^{3} \left( \partial_{\mu} \xi^{j} \right) \left( \partial_{\nu} \xi^{j} \right) \right) + \frac{1}{2} \left( \partial_{\mu} \xi^{1} \right) \left( \partial_{\nu} \xi^{1} \right) + \frac{1}{2} \left( \partial_{\mu} \xi^{2} \right) \left( \partial_{\nu} \xi^{2} \right) + \frac{1}{2} \left( \partial_{\mu} \xi^{3} \right) \left( \partial_{\nu} \xi^{3} \right) + \frac{1}{2} \left( \partial_{\mu} \xi^{j} \right) \left( \partial_{\nu} \xi^{j} \right) \right) + \frac{1}{2} \left( \partial_{\mu} \xi^{1} \right) \left( \partial_{\nu} \xi^{1} \right) + \frac{1}{2} \left( \partial_{\mu} \xi^{2} \right) \left( \partial_{\nu} \xi^{2} \right) + \frac{1}{2} \left( \partial_{\mu} \xi^{3} \right) \left( \partial_{\nu} \xi^{3} \right) + \frac{1}