FR8402779

Université Scientifique et Médicale de Grenoble

INSTITUT DES SCIENCES NUCLÉAIRES DE GRENOBLE

53, avenue des Martyrs — GRENOBLE

ISN 83.42
July 1983

NON RELATIVISTIC 3-QUARK DYNAMICAL SOLUTION OF FADDEEV EQUATION AND THE S-WAVE NUCLEON-NUCLEON SCATTERING

B. SILVESTRE-BRAC, A.K. JAIN, C. GIGNOUX

10th International Conference on Few-Body Problems in Physics, Karlsruhe, 21-27 August 1983.

Laboratoire associé à l'Institut National de Physique Nucléaire et de Physique des Particules.

NON RELATIVISTIC 3-QUARK DYNAMICAL SOLUTION OF FADDEEV EQUATION AND THE S-WAVE NCLEON-NUCLEON SCATTERING

B. SILVESTRE-BRAC, A.K. JAIN*, C. GIGNOUX

INSTITUT DES SCIENCES NUCLEAIRES, 53 avenue des Martyrs

38026 GRENOBLE-CEDEX, France.

The phenomenological non relativistic q-$\bar{q}$ and q-q potentials have been found to generate the spectra of mesons and baryons in reasonable agreement with observations. These results thus indicate that non relativistic dynamics may provide reasonable structure for lighter baryons[1]. The general form of the q-q potential contains predominantly a central part V_{qq}^{c} and a hyperfine spin-dependent potential V_{qq}^{σ}. In perturbative calculations the radial form used for the hyperfine term is a delta function[2]. As these zero range forms for the hyperfine term lead to a collapse in a dynamical calculation one is obliged to replace it by a more realistic finite range form. The resulting 3-q wave function one obtains has a different form than one gets in perturbative calculations. The central part of the potential also contains an energy shift to reproduce the ground state mass, this shift if not incorporated leads to change of other parameters in the central part in order to reproduce the ground state mass. However this potential shift does not change N-N phase shifts. As the nucleon-nucleon (N-N) scattering phase shifts derived by the q-q interactions depend strengly on the size parameter of the nucleon a more realistic q-q potential will lead to a unified approach for the internal structure of nucleon and for the contribution of the quark-exchange terms to the N-N scattering.

We used the potential due to Bhaduri et al.[1]

$$V_{qq} = V_{qq}^{c} + V_{qq}^{\sigma}$$

$$V_{qq}^{\sigma} = \frac{\hbar^2 K_\sigma}{2 m_q^2 c^2} \exp(-r/r_0)/(r_0^2 r) \cdot \underset{\sim}{\sigma}_i \cdot \underset{\sim}{\sigma}_j$$

$$V_{qq}^{c} = \frac{-K_c}{2r} + \frac{r}{2a^2} - \frac{\Delta}{2}$$

The parameters of this potential are claimed to reproduce the spectra of charmomium. The quark mass $m_u (= m_d)$ is not a free parameter for calculating spectra of light mesons and baryons but chosen from magnetic moment considerations. The various parameters are $K_c = K_\sigma = 102.67$ MeV fm, $a = 0.0326\ (\mathrm{MeV}^{-1}\ \mathrm{fm})^{1/2}$, $\quad = 913.5$ MeV, $r_0^{-1} = 2.2\ \mathrm{fm}^{-1}$, $m_u = m_d = 337$ MeV. We found that the excited states of nucleon produced by this q-q interaction are in reasonable agreement with experiment.

This potential is used to generate the 3-q nucleon wavefunction and this then is utilized to calculate the $^1S_0$ phase shifts in the single channel resonating group approximation. Our preliminary results when compared with experimental values indicate that there is a shift in our calculations towards positive phase shifts indicating increased attraction between nucleons and a smaller hard core size. The present preliminary results also indicate that inclusion of single and double π-meson contributions will not improve the agreement with experiment contrary to the results obtained by Faessler and Fernandez [3] and one has to look elsewhere for the explanation of this discrepancy.

*On leave of absence from Bhabha Atomic Research Centre, Bombay, India.

1) R.K. Bhaduri, L.E. Cohler, Y. Nogami
Preprint

2) A. Faessler, F. Fernandez, G. Lubeck & K. Shimizu, Phys. Lett. 112B, (1982), 201

3) A. Faessler & F. Fernandez, Phys. Lett. 124B, (1983) 145