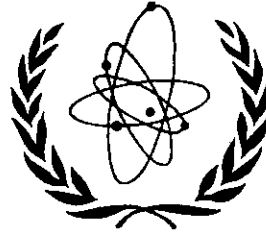


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RELATIVISTIC CORRECTIONS TO A VERTEX
FOR COMPOSITE SYSTEMS

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The purpose of this talk is to discuss the connection between the covariant vertex which can be deduced from a Majorana-type equation representing a composite system, with non-relativistic internal motion, and the vertex which can be deduced for the same system with standard field-theoretical methods.

First, the covariant Bethe-Salpeter equation with a ladder kernel and no retardation is taken as the zeroth-order approximation for the covariant description* of a system with slow (non-relativistic) relative motion^{1), 2)}:

$$(P^2 - H_1 - H_2)\varphi(p^T) = -\hat{P}^{(1)}\hat{P}^{(2)} \int G(p^T - q)\varphi(q)\delta(q \cdot P)d^4q \quad (1)$$

where

$$\hat{P}^{(1)} = \gamma_1 \cdot P$$

$$H_1 = m_1 \hat{P}^{(1)} - i P \cdot \sigma^{(1)} \cdot p$$

$$p^T \cdot P = 0$$

$$H_2 = m_2 \hat{P}^{(2)} + i P \cdot \sigma^{(2)} \cdot p$$

$$P = \sqrt{P_\mu P^\mu}$$

then the equation for the Coulomb interaction and slow relative motion is algebrized and brought to the Majorana form (with no space-like solution):

*) A similar formalism has been used by Brodsky and Primack to discuss relativistic correction to an electromagnetic vertex; see also Matveev et al. (Ref.3).

$$\left[P \Gamma_{\mu}^{\mu} \left(\frac{\partial^2}{2\mu} + M - P \right) + P \Gamma_4 \left(\frac{\partial^2}{2\mu} + P - M \right) + e^2 a P \right] \psi_P = 0 \quad (2)$$

and a vertex can be constructed from this point of view. (Eq. (2) can be brought to the relativistic form used by Fronsdal⁴⁾ and is deducible from a Lagrangian formalism by dropping terms of the order $(P-M)/M$.)

Then a scalar vertex in terms of $\varphi(p^T)$ is deduced starting from the covariant Mandelstam vertex⁵⁾. It is shown that for not too high momentum transfer the integrations on the relative energy can be performed and the vertex takes a particularly simple form:

$$J(q) \sim \int \varphi_{P'}^*(p^{T'}) \varphi_P(p^T) W(\beta) d^3 p^T . \quad (3)$$

Here $W(\beta)$ is a known function connected with the contraction of the element of integration and $p^{T'}$ is a given function of p^T and q , which reduces to that of the Schrödinger theory:

$$p_{T'}' = p_T - \frac{m_2}{M} q \quad \text{for } q^2/P^2 \ll 1 .$$

Expression (3) can be brought to the algebraic form^{2), 6)} provided one is able to define the $SO(4, 1)$ transformation among the Γ 's properly, which brings p^T to $p^{T'}$ and express $W(\beta)$ in terms of functions of Γ 's .

For high q values the retardation effects in the kernel become important and one has to use the integral equation with the correct four-dimensional kernel⁷⁾. Even an approximate treatment of these effects, through a finite iteration of the integral equation, does not appear to come out straightforwardly from the algebraic vertex.

The conclusion is that, at low momentum transfer q , computation of relativistic corrections to the composite system vertex can relatively easily be taken into account by an appropriate dependence of the internal momentum on q . At high momentum transfer, dynamical corrections due to retardations in the binding forces become important and do not appear to be a straightforward generalization of the algebraic description.

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The detailed calculations concerning the present talk will be published elsewhere.