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EM form factors of purely relativistic systems

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In the Wick-Cutkosky model [1,2] (two scalar particles interacting by massless exchange), for enough large coupling constant ($\alpha > \frac{\pi}{4}$), there exist two different types of solutions of the Bethe-Salpeter equation [3]. Some solutions turn, in the non-relativistic limit, into the well-known Coulombien ones; other solutions, on the contrary, disappear in the non-relativistic limit (pushed out from the discrete spectrum). The latter ones have purely relativistic origin and are called "abnormal". We have shown [4] that similar abnormal solutions of the Bethe-Salpeter equation exist also for the massive exchange (for which the strong coupling constant is more realistic), that makes probable their existence in the nature.

In the present talk, we report some results of our study of the properties of these new states. Still in the Wick-Cutkosky model, in particular, for the coupling constant $\alpha = 5$, we found that the ground state (which is normal) is accompanied by two excited abnormal states. We calculated the elastic EM form factors for all these states and also the transition form factors between all of them. We found that the form factors for the abnormal states vs. momentum transfer Q^2 decrease much more faster than for the normal one. In this model, the ground state form factor has no nodes, whereas the form factor for the first abnormal state has one node, the form factor for the second abnormal state (next excited state) has two nodes.

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