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A Theory of General Particle Transfer Potential from Atom-Molecule to Quark-Gluon Systems

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A Theory of General Particle Transfer Potential from Atom-Molecule to Quark-Gluon Systems
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A structure of a general particle transfer (GPT) potential based on the quasi two-body equation in the three-body system is investigated. It was found that the quasi two-body threshold with one particle creation has a 1/r-type singularity
for the electromagnetic interactions, hadronic interactions and quark-quark interactions. Although the theory was developed in a framework of non-relativistic three-body AGS equation, however it could be automatically generalized into the relativistic three-body equation. The GPT potential generates not only the short range Yukawa-type potential but also the long range 1/r^n-type potential. A relation between the index number n and the transferred particle mass was found where the fundamental particle of the atom-molecular system is an electron (and/or a positron), while a pion is the fundamental particle in the hadronic systems. On the other hand, the negative index number represents the quark-gluon system which is illustrated in the unphysical Riemann sheet. Therefore, one could imagine that they could not be observed in the usual experiments. The potential structure illustrates a fundamental and a unique property in the dispersion theoretical framework. The many-body effects in the three-hadronic Faddeev equation reveal a non-linearity which are integrated into a three-body short range force (3BSF) and a three-body long range force (3BLF). The 3BSF has been discussed in a strongly coupled nuclear systems, while the 3BLF has not been investigated yet, however it represents the loosely coupled three-body system such as the nuclear halo and/or the Borromean systems, while the Efimov potential belongs to the 3BLF which is connected with the 3BSF by the GPT theoretical framework. \\
Finally, it should be emphasized that the GPT potential could represent from the atom-molecule system to the quark-gluon system by a unique potential with the relevant particle exchange, where pico-meter physics would be highlighted anyhow in the future. \\
Some applications for historical few-body problems in physics will be summarized.\\
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Experimental study on nuclear physics

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