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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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