Progress of few-body calculational methods stimulated by muCF

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Purpose of this talk is to emphasize that one of the important contributions of "muCF" is that development of some few-body calculational methods have particularly been stimulated and accelerated by difficult three-body problems appearing in the muCF cycles. Examples of such problems are calculations of

i) ε_{11} of $dt\mu$ and $dd\mu$ molecules,
ii) reaction rate of the muon transfer reaction $(d\mu)_{1s} + t \to d + (t\mu)_{1s} + 48\text{eV}$,
iii) nuclear fusion rate in $(dt\mu)$ molecule,
iv) muon sticking probability in $(dt\mu) \to {}^4\text{He} + n + \mu, ({}^4\text{He}\mu)_{nl} + n$,
v) competition between particle-decay and radiative-decay of $(d^{3,4}\text{He}\mu)$ molecule.

One of the few-body methods so developed is Gaussian Expansion Method [2, 1] that taking all the possible Jacobi coordinates explicitly. The method has a wide applicability to various types of three-body problems for both bound states and scattering states. For each subject above, Kino and the author were able to provide with one of the best calculations.

Since then, the method has been further developed by Kino and Hiyama for more complicated three-body and four-body problems (reviewed in [3]), and successfully been applied to problems in various fields, for example,

i) antiprotonic helium atoms (determination of antiproton mass) (reviwed in [3]),
ii) three- and four-body structure of hypernuclei (reviwed in [3]),
iii) ground and excited states of four-nucleon systems with realistic NN forces [4],
iv) bound and scattering states of multi-quark systems [5],
v) breakup reactions induced by three-body exotic beams (unstable nuclear projectiles such as ^{6}He) with proposing the method of four-body CDCC (continuum-discretized coupled channels) [6].

In this talk, this type contribution of "muCF" to few-body physics will be reviewed shortly.

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