



ID de Contribution: 29

Type: Non spécifié

## Universality in Four-Boson Systems

*lundi 10 octobre 2011 09:20 (40 minutes)*

The rich nature of quantum few-body systems interacting with short-ranged forces is not shaped only by three-body properties. Weakly-bound tetramers composed by identical bosons and their excited states have a characteristic scale, which is independent of the trimer one, for resonant pairwise interaction in the unitary limit (zero two-body binding or infinite scattering length. Such property can be revealed if one considers the general case, not constrained by some specific strong short-range interaction. The existence of an unsuspected new limit cycle is shown through calculations with Faddeev-Yakubovsky (FY) for a renormalized zero-range two-body interaction. The new limit cycle is expressed by an universal function relating the binding energies of two consecutive tetramer states,  $B_4^{(N)}$  and  $B_4^{(N+1)}$  (where for  $N = 0$  we have the ground-state) and the corresponding three-body subsystem binding energy  $B_3$  of an Efimov state [1].

We further derive that the  $N + 1$  tetramer emerges from the  $3+1$  threshold for a universal ratio  $B_4^{(N)} = 4.6 B_3$ , which does not depend on  $N$ . The tetramers move as the short-range four-body scale is changed. The existence of the new scale can be also revealed by a resonant atom-trimer relaxation. The resonant behavior arises when a tetramer becomes bound at the atom-trimer scattering threshold. Furthermore, the independent four-body scale implies in a family of Tjon lines in the general case. These findings give further support in favor of the independent role of a four-body scale near a Feshbach resonance and its implications for coldatoms.

Furthermore, we will present to some extend the momentum-space structure of the FY components of weakly-bound tetramers at the unitary limit [2]. We show that both channels of the FY decomposition [trimer plus atom (T+A), or  $K$ -type and dimer plus dimer (D+D), or  $H$ -type] present high momentum tails, which reflects the short-range four-body scale. We also found that the  $H$ -channel is favored over  $K$ -channel at low momentum when the four-body momentum scale largely overcomes the three-body one.

[1] M. R. Hadizadeh, M. T. Yamashita, Lauro Tomio, A. Delfino, T. Frederico, Phys. Rev. Lett. (2011); arXiv:1101.0378v1 [physics.atm-clus]

[2] M. R. Hadizadeh, M. T. Yamashita, Lauro Tomio, A. Delfino, T. Frederico, in preparation.

**Auteur:** Prof. FREDERICO, Tobias (Instituto Tecnológico de Aeronáutica)

**Co-auteurs:** Prof. DELFINO, A. (Instituto de Fisica Univ Federal Fluminense); Prof. TOMIO, L. (Instituto de Fisica Teorica-UNESP); Dr HADIZADEH, M. (Instituto de Fisica Teorica-UNESP); Prof. YAMASHITA, M. T. (Instituto de Fisica Teorica-UNESP)

**Orateur:** Prof. FREDERICO, Tobias (Instituto Tecnológico de Aeronautica)