**Fusion enhancement/suppression and irreversibility in reactions induced by weakly bound nuclei.**

P.R. S. Gomes[1], L.F. Canto[2], J. Lubian[1], E. Crema[3], L.C. Chamon[3], M.S. Hussein[3]
*[1] Instituto de Física, Universidade Federal Fluminense, Niterói, 24210-340 Brazil.*
*[2] Instituto de Física, Universidade Federal do Rio de Janeiro,Rio de Janeiro, Brazil.*
*[3] Instituto de Física, Universidade de São Paulo, São Paulo, Brazil.*

The effect of breakup of weakly bound nuclei, especially halo nuclei, on the fusion cross section has been widely investigated [1] but not yet fully understood. One can distinguish effects of two kinds. First, there are the static effects associated with the longer tail of the nuclear density, arising from the halo nucleons. This tail gives rise to a more diffuse potential, with a lower barrier. We will show strong sub-barrier fusion enhancements for the $^{6}$He + $^{209}$Bi and $^{238}$U systems, owing to the static halo properties of $^{6}$He, in opposition to what was claimed by Raabe et al. [2], who compared data with calculations using realistic double folding potential and therefore were not able to observe static halo effects. Secondly, there are dynamical effects associated with the strong coupling between the elastic and the breakup channels. The consequences of this coupling are more difficult to assess. To investigate the role of weak binding in the fusion process, it is important to compare fusion cross sections for different systems and to have a benchmark to which the data have to be compared. Recently we have developed a new method [3] to investigate systematical trends in the fusion of weakly bound nuclei, through dimensionless fusion functions and energy variable quantity, and we were able to disentangle static from dynamic effects of the breakup on fusion. By comparing data with a benchmark curve, called Universal Fusion Function [3] we observe a general trend of fusion suppression above the barrier. This fusion suppression is clearly observed when, performing CDCC calculations, continuum-continuum couplings (CCC) are considered. We will present results of CDCC calculations for complete fusion, breakup and elastic scattering, and comparisons with data, in order to investigate the role of breakup and the feeding of continuum states in reaction mechanisms [4]. We will show that the suppression of complete fusion does not come from some kind of irreversibility of the transition to the continuum, but rather the inclusion of CCC makes the real part of the polarization potential more repulsive, so that the incident current has to cross a higher barrier to produce fusion.

[1] L.F. Canto, P.R.S. Gomes, R. Donangelo, M.S. Hussein; Phys. Rep. **424**, 1 (2006).
[2]- R. Raabe *et a.l*, Nature **431**, 823 (2004)
[3] L.F. Canto, P.R.S. Gomes, J. Lubian, L.C. Chamon, E. Crema; J. Phys. G **36,** 015109 (2009); Nucl. Phys. A **821**, 51 (2009).
[4] L.F. Canto, J. Lubian, P.R.S. Gomes, M.S. Hussein, Phys. Rev. C **80**, 047601 (2009)