

Role of Dinuclear Collective Excitations and Nucleon States in Fusion Dynamics

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Two-center vibrational [1,2] and rotational states [2] of the closely located nuclei and two-center nucleon states [1,3] in the coupled channel approach are used to study fusion dynamics, cross sections and fine structure of the so-called barrier distributions. For example, the probability flow across multidimensional barrier for $^{40}\text{Ca} + ^{90}\text{Zr}$ fusion shows that peaks of the barrier distribution $D(E_{c.m.})$ [4] correspond to the most populated two-surface vibrational states in vicinity of the barrier. The dynamics of the outer neutron clouds in the time-dependent approach [5, 6] demonstrate that the formation of the two-center nucleon states take place at sub- and near-barrier energies. The transitions between the two-center levels with positive Q -values and relatively large probabilities may be a microscopic validation of the empirical coupled channel (ECC) model [7] and the quantum coupled-channels + empirical neutron rearrangement (QCC + ENR) model [8].

References

- [1] V. Samarin, *EPJ Web Conf.* **86**, 00039 (2015).
- [2] V. V. Samarin, *Phys. Atom. Nucl.* **74**, 1682-1694 (2009).
- [3] V. V. Samarin, *Phys. Atom. Nucl.* **78**, 861-872 (2015).
- [4] H. Timmers et al., *Nucl. Phys. A* **633**, 421-445 (1998).
- [5] V. Samarin, *EPJ Web Conf.* **86**, 00040 (2015).
- [6] V. V. Samarin, *EPJ Web Conf.* **118**, 08018 (2016).
- [7] V. I. Zagrebaev, *Phys. Rev. C* **67**, 061601 (2003).
- [8] A. V. Karpov, V. A. Rachkov, V. V. Samarin, *Phys. Rev. C* **92**, 064603 (2015).