8.3 Nuclear Fission with Mean-field Instantons

by J.Skalski

We consider [1] a variational search for instantons - imaginary-time mean fields, describing spontaneous fission, and generally quantum tunneling, within the mean-field theory. The specific nature of imaginary-time mean-field equations requires that each fission path consists of two, necessarily different, branches. For each mean-field state of one branch, there is an associated state of the second branch and together they serve as bra and ket in the calculation of observables.

A formula for the decay exponent is given in terms of trial Hartree-Fock states. Though exact for an instanton, it requires additional conditions to be imposed on trial paths (momentum-velocity relations) to provide an upper bound for the instanton action. A simple implementation of those conditions is necessary to make a variational approach feasible.

[1] Proceedings of the Int. Workshop on "New Developments in Nuclear Self-Consistent Mean-Field Theories (MF05)", p. B62, Yukawa Institute for Theoretical Physics reports series (2005): (http://www.nucl.ph.tsukuba.ac.jp/MF05/proceedings.html)

8.4 Σ Hiperons in Nuclear Matter

by J.Dąbrowski

Our work on the interaction of Σ hiperons with nuclei was continued. We applied previously derived expressions for the single particle potential V of the Σ hiperon in nuclear matter [1] to investigate the dependence of V on the nuclear matter density and on the Σ momentum. We obtained results [2] for V - in particular for the isospin and spin dependent parts of V - for the Nijmegen models of the baryon-baryon interaction. These results, discussed in [3], are important in the description of Σ production reactions, for Σ atoms, and also for the properties of neutron stars.

[1] J.Dąbrowski, Phys. Rev. C 60 (1999) 025205
[2] J.Dąbrowski, Acta Phys. Pol. B 36 (2005) 3063
[3] J.Dąbrowski, J.Rożynek, Acta Phys. Pol. B 37 (2006) 87

8.5 Σ Atoms and Nucleon Density Distributions

by J.Dąbrowski

The analyses of measured cross sections for Σ production reactions, of observed properties of Σ atoms, and of the two-body hiperon-nucleon data indicate that the ΣN interaction V is well described by model F of the Nijmegen baryon-baryon interaction. We have shown - on the example of the $\Sigma^- \otimes {}^{208}Pb$ atom - that we may exploit the sensitivity of the calculated energy shifts and widths of Σ atoms to the nucleon density distributions in these atoms to gain information on these distributions, especially at the nuclear periphery. The procedure requires the knowledge of V for which we assume the Nijmegen model F [1, 2].

[1] J.Dąbrowski, J.Rożynek, Eur. Phys. J. A 25 (2005)137
[2] J.Dąbrowski, Int. J. Mod. Phys. E, *in press*

8.6 Cross Sections Calculated for Cold Fusion Reactions with Emission of Only One Neutron for Producing the Heaviest Elements

by R.Smolańczuk

Entrance-channel effects in cold fusion reactions that lead to heavy and superheavy nuclei are discussed in the framework of the coupled-channels theory [1]. Dynamical deformation besides collective excitations is taken into account in the entrance channel. The exit channel is described by using the modified statistical model that takes into account the difference between the level density in the equilibrium configuration and that in the saddle-point configuration Comparison of the calculated fusion cross sections with experimental data is given.

[1] R.Smolańczuk, Int. J. Mod. Phys. E 14 No.3 (2005)373