The Continuum Time-Dependent Hartree-Fock Method

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Time-dependent approaches are useful in tackling dynamic processes in nuclei, such as collective motion of a single nucleus, and collisions between nuclei. The basic mean-field approach is the *time-dependent Hartree-Fock* (TDHF) method. It has been widely applied to giant resonances, fusion, deep-inelastic collisions and transfer reactions [1].

In all or most applications of nuclear TDHF, the processes occur above particle emission threshold. With wave functions represented on a spatial grid, the boundary conditions at the edge of the calculation region become a significant issue as particles are emitted.

The simple conditions of periodic or reflecting boundaries can cause unphysical artefacts in observables. Methods to mitigate unphysical behaviour include the use of extended regions of complex absorbing potentials or masking functions [2]. These methods can be made to work, with some computational cost, by judicious tuning of parameters, but are never exact for arbitrary outgoing flux.

We present an exact method for implementing outgoing wave boundary conditions, based on a Laplace Transformation approach [3]. We apply it to the case of giant monopole resonances in light doubly-magic nuclei, showing that the results agree exactly with computationally-punitive calculations performed in extremely large boxes. We discuss perspectives for application in other resonances, other forms of collective motion, and with more sophisticated interactions.

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References

[1] Cédric Simenel, *Eur. Phys. Jour.* A **48**, 152 (2012).

[2] P.-G. Reinhard, P. D. Stevenson, D. Almehed, J. A. Maruhn and M. R. Strayer, *Phys. Rev.* E **73**, 036709 (2006).

[3] C. I. Pardi and P. D. Stevenson, *Phys. Rev.* C **87**, 014330 (2013).