FIXED POINTS OF THE SIMILARITY RENORMALIZATION GROUP AND THE NUCLEAR MANY BODY PROBLEM

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The Nuclear Many Body Problem has always been plagued with difficulties and ambiguities. An outstanding problem is the incorporation of 3 and 4-body forces whose very definition is linked to the 2-body problem. Nonetheless, within a meson exchange picture n-body forces have decreasing range as they require at least n-1 mesons to be exchanged. This leads to a scenario where few body forces are suppressed as compared to two body forces, so that for light nuclei their effect on the total binding energy becomes perturbative.

Actually, there is much freedom in making unitary transformations keeping the two body bound and continuum spectrum while generating a wide range of three and four body properties. A practical way which has been intensively pursued during the last years of generating these unitary transformations is by means of the similarty renormalization group (SRG). However, heavy calculations display exceedingly simple regularities, such as the Tjon line, a linear correlation between the triton and the alpha particle binding energies within a relatively large range. This suggests the onset of some scale invariance and the understanding of this correlation should also provide a credible value for the slope of the Tjon line. We discuss how this and other regularities can be understood and possibly be extended to heavier nuclei within a SRG context by analysing its infrared fixed points. The proposed scenario is free of ambiguites but indicates a predominant role played by few body forces even in triton and alpha nuclei. Our constructon also sheds some light on the inverse scattering problem as it needs the notion of a distance between different Hamiltonians.

[1] S. Szpigel, V. S. Timoteo and E. R. Arriola, AIP Conf. Proc. **1520** (2012) 346.

[2] E. R. Arriola, V. S. Timoteo and S. Szpigel, arXiv:1302.3978 [nucl-th].

[3] V. S. Timoteo, S. Szpigel and E. Ruiz Arriola, Phys. Rev. C **86** (2012) 034002 [arXiv:1108.1162 [nucl-th]].

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