

Projects for Computational Physics

Breakup observables of 2+1 scattering

Preparation(**), Implementation(**), Analysis(*)

Project Description

Probably, most rich source of information on interactions of two- and three-body systems are breakup observables in 2+1 scattering [1]. By choosing very different kinematical configurations, e.g. two particles leaving the collision collinearly or one remaining almost at rest, the observable can be sensitive to very specific parts of the interaction. In this project, we formulate a representation of cross sections that allows the comparison to data in the laboratory frame. We then identify some example for special configurations with a focus on the so-called final state interaction configuration. It is then studied how cross sections for this observable depend on the properties of two-body interactions and how this can be used to pin down properties of nuclear interactions for systems that are not directly experimentally accessible [2].

Tasks / hints / interesting problems¹

- Formulate and implement the breakup cross section for the 2+1 scattering problem.
- Identify the so called *S*-curve of the 3-body kinematics to define cross sections in the laboratory frame.
- Identify configurations that include quasi-free scattering (QFS) of two particles or final state interaction (FSI) configurations.
- Solve the Faddeev equations and extract these cross sections for a series of interactions that predict slightly different slightly two-body observables and compare their predictions for the QFS and FSI configurations.

References

- [1] W. Glöckle, H. Witala, D. Hüber, H. Kamada, and J. Golak, “The Three nucleon continuum: Achievements, challenges and applications,” *Phys. Rept.* **274** (1996) 107–285.
- [2] D. Gonzalez Trotter *et al.*, “Neutron-deuteron breakup experiment at $E(n) = 13$ -MeV: Determination of the (1)S(0) neutron-neutron scattering length ann,” *Phys. Rev. C* **73** (2006) 034001.

¹These tasks should rather be considered a general guideline than a strict requirement. Besides, the list is by no means complete and could easily be extended