EFFECTS OF RESONANCES IN LOW-ENERGY NUCLEON SCATTERING WITH WEAKLY-BOUND NUCLEI

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Many nuclei are known to be weakly bound, and often to have low excitation spectra involving resonance states. 6He is a case of current interest. Studies of such nuclei are more common now with the advent of radioactive ion beams (RIB). We consider how those resonance properties influence spectra of clusters, and scattering, of nucleons with those nuclei using a multi-channel algebraic scattering (MCAS) theory to solve the relevant coupled-channel Lippmann-Schwinger equations.

Treating `target' nucleus resonances as Lorentzians leads to non-physical asymptotic behaviour of reaction cross sections near the scattering threshold since they are non-zero at and below the threshold. Also some otherwise bound states in the spectrum of the compound system have spurious widths. A remedy is to use a scaling function on those Lorentzians. Causality also mandates an energy-dependent addition to the value of the target state centroid energies in the Green's function; found by solution of relevant dispersion relations.

Our choice for the scaling function U(E), which modifies energy-dependent target-state widths, is based upon a Wigner distribution with the following physical specifications: it is vanishing together with its energy derivative at E = 0, it vanishes as E $\rightarrow$ infinity, and, at the resonance centroid energy, the function U(E) = 1. Including these resonance corrections influences the spectral properties of compound systems and causality restoration affects the shape of cross sections, eliminating otherwise spurious threshold predictions.