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Probing nuclear structure with neutron transfer reactions

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One of the essential questions in nuclear structure is how the nucleus reacts to the addition or removal of a nucleon. In standard quantum many-body theory, this single-nucleon response can be described by the single-particle Green's function, which is non local in space, as well as energy dependent. This quantity provides access to a wealth of structure information, such as the spectral function (for each spin and parity), level densities, non-local density matrix, etc. The Green's function is linked to the effective nucleon-nucleus interaction (self-energy) through the Dyson equation, and this interaction can be either calculated microscopically or fitted from experimental data. In order to respect causality and particle conservation, the effective interaction is both non-local and energy dependent. Arguably, the experimental tools of choice to probe the nuclear response to the addition and removal of neutrons are (d,p) and (p,d) reactions, we thus present recent developments towards a unified structure and reactions framework that links cleanly the observed cross sections with the single-particle Green's functions, dealing with the technical difficulty introduced by non-local, energy dependent neutron-nucleus interactions.

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