These scripts are part of the lecture materials for my courses on reactor physics at Technical University of Munich. 2011 – 2016. The software comes as is, only for educational purposes and no warranties. © Dr.Sdl

The free gas scattering kernel of neutrons can be derived analytically directly from quantum mechanics. See for example: <https://mcnp.lanl.gov/pdf_files/la-ur-11-06503.pdf> or <http://iopscience.iop.org/article/10.1088/0953-8984/15/19/204/meta> or

<http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/23/081/23081271.pdf> .

One major contribution to the field of neutron scattering is the so called Van Hove framework: Correlations in Space and Time and Born Approximation Scattering in Systems of Interacting Particles, Phys. Rev. 95, 249 –1 July 1954:

“A natural time-dependent generalization is given for the well-known pair distribution function g(r) of systems of interacting particles. The pair distribution in space and time thus defined, denoted by G(r, t), gives rise to a very simple and entirely general expression for the angular and energy distribution of Born approximation scattering by the system. This expression is the natural extension of the familiar Zernike-Prins formula to scattering in which the energy transfers are not negligible compared to the energy of the scattered particle. It is therefore of particular interest for scattering of slow neutrons by general systems of interacting particles: G is then the proper function in terms of which to analyze the scattering data.

After defining the G function and expressing the Born approximation scattering formula in terms of it, the paper studies its general properties and indicates its role for neutron scattering. The qualitative behavior of G for liquids and dense gases is then described and the long-range part exhibited by the function near the critical point is calculated. The explicit expression of G for crystals and for ideal quantum gases is briefly derived and discussed.”