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Some Comments on the DWBA, its History, Applications and Possible Future Applications (remotely)

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We now take it for granted that scattering a powerful enough X-ray beam from an object can in principle reveal the complete structure of the object, although we know that in practice this is not quite true, as our beams are not quite powerful enough. If the object or objects are deposited on a smooth reflecting featureless substrate, or if they are part of the fluctuations of the substrate itself (e.g. roughness) the DWBA often provides a reasonable approximation to describe the scattering, which is why it has featured so prominently in so many SXNS meetings. In the early days it gave researchers a method to obtain quantitative information from the diffuse scattering people saw from thin films and multilayers, instead of throwing all that data away. It helped to lead to quantitative characterization of film growth, concepts such as correlated roughness from multilayer films, etc. Apart from roughness, it was soon applied to arrays of particles on solid and liquid surfaces to obtain detailed quantitative analyses of GISAXS experiments on a variety of systems such as quantum dots, magnetic nanoparticles, etc. and became an essential part of GISAXS analysis. This also led to several successful commercial codes such as BORN AGAIN to carry out such analyses.
Finally, when iterative methods for phase retrieval came along with the use of coherent X-ray beams, particles could be directly imaged in 3 dimensions, and the DWBA was also extended to this case so that particles on substrates could be imaged, by reconstructing the speckle patterns produced. However, in all the above methods it is either the average structure of the roughness, nanoparticles, or nano-objects being imaged that is dominant. The scattering from small details such as defects are actually dispersed in the (weak) diffuse scattering between Bragg reflections or the strong speckle in the case of coherent beams. However, many real-life applications (e.g. computer chips) depend on understanding these defects and where they reside in the system.
We shall explore how the DWBA can throw light on these defects.

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Instrumentation and methods

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