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Review

Helium-3 spin-echo: Principles and application to dynamics at surfaces

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ABSTRACT

In this review we give a detailed description of the recently developed helium-3 spin-echo technique and its application to several classes of surface dynamic measurements. We review existing surface dynamical probes briefly and illustrate the need for new experimental tools that measure on nanoscale distances and over picosecond timescales. We then describe the helium-3 spin-echo method, which is one such tool, together with the approaches used to describe such measurements and the instrumentation developed to realise its application. The main application of helium-3 spin-echo is the study of surface dynamics, hence we review the approaches which have been established to interpret dynamical data and the signatures for various forms of motion, before going on to summarise the experimental studies to date. We also describe Fourier transform atom spectroscopy, a new method for measuring elastic and resonant scattering that is facilitated by the availability of spin-echo instruments. Finally, we look towards future scientific challenges for the technique.

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