

Abstract Submitted
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Validity criteria for scattering rates obtained with Fermi's golden rule in semi-classical transport KRISTOF MOORS, KU Leuven, imec, BART SORE, imec, KU Leuven, U Antwerpen, WIM MAGNUS, imec, U Antwerpen — Fermi's golden rule is often invoked to obtain scattering rates due to imperfections for semi-classical transport in different condensed matter systems. As it is an estimate for relatively small perturbations, its validity depends on the system and imperfection properties under consideration. We present a formal way to obtain easy to handle validity criteria, based on general system parameters, e.g. system size and momentum of the electron states, and the statistical properties of the imperfections. The criteria can also be obtained with a simple set of Feynman rules and corresponding diagrams. We show concrete examples of validity criteria for electron transport in metallic nanowires with several elastic scattering mechanisms, e.g. point defect or grain boundary scattering. We observe realistic nanowire examples where the scattering rate appears to be valid but also cases where the criteria are clearly violated. The latter indicates that higher order effects come into play, such as electrons being trapped between grain boundaries or at a rough surface, which cannot be described using Fermi's golden rule. The presented validity criteria are therefore very useful to check whether or not the transport properties predicted by a semi-classical transport simulation can be trusted.

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