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Field-state back-action from pointlike detectors

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Particle detector models are widely used in quantum field theory as local probes of quantum fields. A common simplifying assumption is that the field-detector interaction is sufficiently weak that the detector's back-action on the field can be neglected. However, detectors necessarily perturb the systems they probe. In this talk, we explore the back-action of a pointlike Unruh–DeWitt detector on the state of a real massless scalar field, when the field is prepared in the vacuum or in a thermal state. To characterise this back-action, we calculate an explicit expression for the renormalised expectation value of the field-squared, valid for a detector following an arbitrary timelike worldline and interacting via an arbitrary switching function. We examine how the back-action depends on the detector's motion, the initial state of the field, and the nature of the switching, comparing sudden and gradual coupling. Finally, we also present some numerical results for the renormalised stress-energy tensor and compare them with the field-squared.

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