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Infrared Problem in a Hybrid System: Ultracold Atoms Coupled to a Vibrating Membrane SANGHITA SENGUPTA, DENNIS CLOUGHERTY, Univ of Vermont — We study the dynamics of a hybrid system consisting of ultracold atoms coupled to the mechanical oscillations of a suspended membrane at zero temperature. The system suffers from an infrared problem that is analogous with radiative processes in quantum electrodynamics where terms in the perturbation series diverge as a result of massless particles in the model (photons in QED and flexural phonons of the membrane in our case). We treat this infrared problem to obtain finite results by explicitly summing the most divergent diagrams. We derive a new formula for the adsorption rate of atoms on the membrane that is nonperturbative in the atom-membrane coupling. We compare and contrast this result with rates obtained by a variety of perturbative and nonperturbative methods, including the non-crossing approximation and the independent boson approximation. In particular, we apply these methods to the case of adsorption of atomic hydrogen on suspended graphene, providing numerical results.

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