



## Online Conference on Gravitational Physics and Astronomy

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## Superfluids and local gravitational field

Monday, 5 December 2022 17:30 (30 minutes)

We discuss the possible coupling between a superfluid and the local gravitational field. After introducing a quantum-gravity theoretical framework to describe the supercondensate-graviton coupling, we exploit an effective theory for generalized Maxwell-type fields to analyze quantum effects originating from the proposed interplay.

From an experimental point of view, it had been shown that generalized electric-type fields can be induced in (super)conductors by the presence of the Earth's weak gravitational field. These observations led to the theoretical, formal introduction of an effective modified electric-type field, determining detectable corrections to the free fall of charged particles.

The above remarkable experimental results can be combined to the theoretical weak-field gravity formulation, leading to a more general definition of new, generalized electromagnetic fields. The latter feature a component defined in terms of the weak gravitational perturbations, and satisfy a specific set of equations that can be put in a form closely analogous to Maxwell's equations.

The latter symmetry is then exploited to analyse the gravity/supercondensate interplay, the new generalized fields being involved in quantum effects originating from the interaction with the weak gravitational background (in analogy to what happens for gravity-induced electric fields in superconductors).

In particular, the emerging formal symmetry allows to use the Ginzburg–Landau model for the description of the physics, resulting in a mean-field theory for the system's thermodynamics, including the effects of thermal fluctuations. We then quantitatively analyse how the local gravitational field could couple to the superfluid condensate in a superconductor, making use of the time-dependent Ginzburg–Landau equations in the regime of fluctuations.

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