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Interaction between superconductor and weak static gravitational field

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It is since 1966, with the paper of DeWitt, that there is great interest in the interplay between the theory of gravitation and superconductivity. In the following years, a lot of theoretical papers about this topic have been produced, until Podkletnov and Nieminem declared to have observed a gravitational shielding in a disk of YBaCuO. Of course, after the publication of this paper, other groups tried to repeat the experiment obtaining controversial results so that the question is still open. Many researchers tried to give a theoretical explanation of the phenomenon, but the complexity of the formalism makes it difficult to extract quantitative predictions. Our study provides quantitative calculations in a range of temperatures very close to the critical temperature, in the regime of fluctuations. In particular, we study the behavior of a superconductor in a weak static gravitational field for temperatures slightly greater than its transition temperature (fluctuation regime). Making use of the time-dependent Ginzburg–Landau equations, we find a possible short time alteration of the static gravitational field in the vicinity of the superconductor, providing also a qualitative behavior in the weak field condition. Finally, we compare the behavior of various superconducting materials, investigating which parameters could enhance the gravitational field alteration.

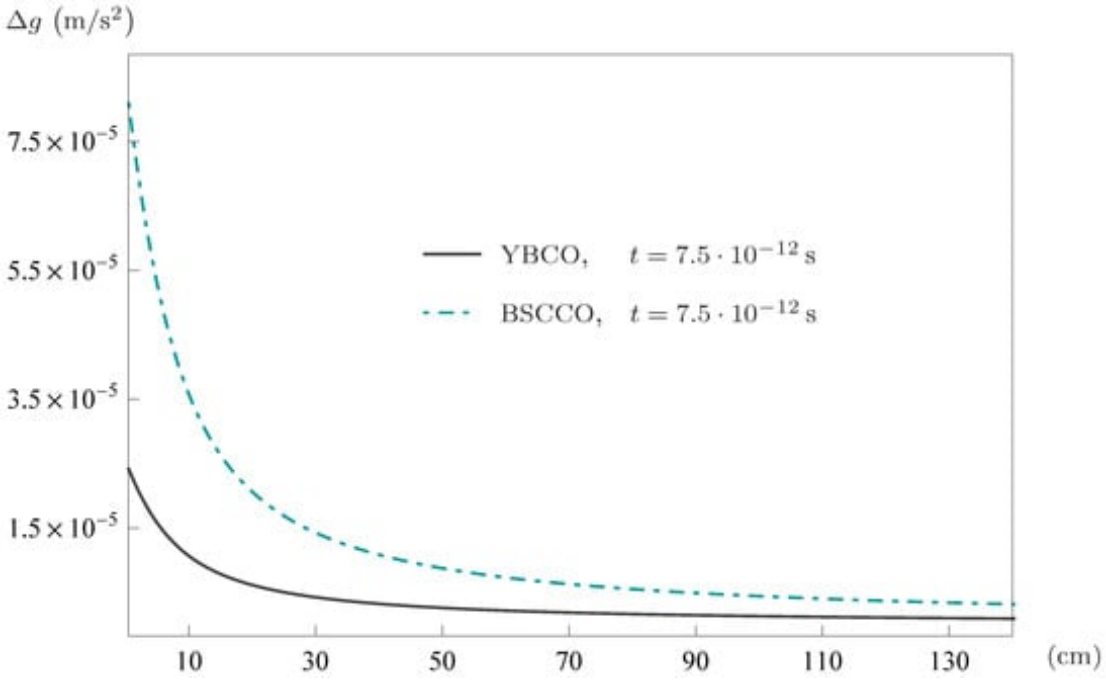

Figure 1: The variation of gravitational field as a function of distance in the vicinity of a superconductive sample of YBCO (grey solid line) and one of BSCCO (light blue dot-dashed line). The field is measured along the axis of the disk, with bases parallel to the ground, at the fixed time that maximizes the variation

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