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Exploring a superradiant laser of Ginzburg phonons

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Building on the analogy with superradiant amplification of waves scattered from a rotating black hole, this investigation considers the problem of a rotating detector embedded into a weakly interacting Bose gas. We observe a qualitative transition in the amplification of the ground state excitation rate of the detector at supersonic speeds. This results from the scattering of co-rotating cylindrical Bogoliubov waves impinging upon the detector, and it resides in a mechanism similar to Ginzburg radiation. In our exploration, we also show that the mechanism can be employed to manufacture a laser of Ginzburg phonons: by confining the system inside a cylindrical mirror, we show that population inversion can be realized for broad intervals of supersonic speeds. This effect has root in the amplification of the quantized Bogolyubov modes of the cavity, and it is therefore absent in the simpler case of a rotating quantum emitter in free space.

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