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Analogue Hawking radiation in a ring of Bose-Einstein condensate

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Hawking radiation is one of the most fascinating phenomena taking place near the black hole horizon. Featuring both gravitational and quantum properties this effect is extremely hard to observe on the real objects. Surprisingly, it is possible to mimic evaporation of particles on the acoustic analogs, where Bose-Einstein condensate plays a role of background giving birth for Hawking pairs. This area is still a matter of multiple discoveries providing us with the very first convincing observation of Hawking effect analog this year.
We address a model of effectively one-dimensional (1D) Bose-Einstein condensate (BEC) confined in a toroidal trap. This system is attractive to explore since the total flow of quantum liquid is quantized which results in a restriction on possible values of the velocity of the condensate. Moreover, it is impossible to avoid the presence of the so-called white hole (inner) horizon in such toroidal geometry.
Unlike recent works on the acoustic horizon in toroidal BECs, we apply the method previously used for modeling an infinitely long quasi-one-dimensional condensate to our system. It allows to create acoustic horizons in the condensate with uniform density. Remarkably, we managed to see the correlation pattern having the properties of the analog Hawking effect. Obtained correlations turned out to be strongly dependent on the length of the ring and initial noise for the fixed parameters of the horizon. Furthermore, for some particular size of the region Hawking correlations disappear that may be an interesting analogy of the existence of Planck mass limit for real black holes. Also, we considered the influence of the white hole horizon on the correlation pattern and stability of the system for different values of surface gravity.

Primary authors: YATSUTA, Igor (Department of Physics, Taras Shevchenko National University of Kyiv); Dr YAKIMENKO, Alexander (Department of Physics, Taras Shevchenko National University of Kyiv)

Presenter: YATSUTA, Igor (Department of Physics, Taras Shevchenko National University of Kyiv)

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