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"Hot" Schrodinger cat states created

Quantum states can only be prepared and observed under highly controlled conditions. A research team from Innsbruck, Austria, has now succeeded in creating so-called hot Schrodinger cat states in a superconducting microwave resonator. The study, recently published in Science Advances, shows that quantum phenomena can also be observed and used in less perfect, warmer conditions.

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Schrodinger cat states are a fascinating phenomenon in quantum physics in which a quantum object exists simultaneously in two different states. In Erwin Schrodinger's thought experiment, it is a cat that is alive and dead at the same time. Previous experiments have focused on creating such states by cooling a quantum object to its ground state, the state with the lowest possible energy. Quantum superpositions are usually created from this well-defined state. Now, researchers led by Gerhard Kirchmair and Oriol Romero-Isart have demonstrated for the first time that it is indeed possible to create quantum superpositions from thermally excited states. i¿½Schrodinger also assumed a living, i.e. ?hot' cat in h s thought experiment,i¿½ remarks Gerhard Kirchmair from the Department of Experime tal Physics at the University of Innsbruck and the Institute of Quantum Optics and Qua tum Information (IQOQI) of the Austrian Academy of Sciences (OAW). i¿½We wanted t know whether these quantum effects can also be generated if we don't start from the cold' ground state,i¿½ says Ki chmair. In their study published in the Science Advances, the researchers used a transmon qubit in a microwave resonator to generate the cat states. They succeeded in creating the quantum superpositions at temperatures of up to 1.8 Kelvin - which is sixty times hotter than the ambient temperature in the cavity. i¿½Our results show that it is possible to generate high y mixed quantum states with distinct quantum properties,i¿½ explains Ian Yang, the first au hor of the st dy. The researchers used two special protocols to create the hot Schrodinger cat states. T ese protocols were previously used to produce cat states starting from the ground state of the system. i¿½It turned out that adapted protocols also work at higher temperatures, gene ating distinct quantum interferences,i¿½ says Oriol Romero-Isart, until recently Prof ssor of Theoretical Physics at the University of Innsbruck and research group leader t IQOQI Innsbruck and since 2024 Director of ICFO - the Institute of Photonic Sciences, in Ba

celona. i¿½This opens up new opportunities for the creation and use of quantum superposi
ions, for example in nanomechanical oscillators, for which achieving the ground st
te can be technically chall
nging.i¿½ The states created in the experiment were characterized by measurements o
the Wigner function, which makes the quantum interference visible. i¿½Our measurement
confirm that the states exhibit clear quantum features despite the high temperature,i
?½ adds Thomas Agrenius, who was also involv
d in the study. These research findings could benefit the development of quantum tech
ologies. i¿½Our work reveals that it is possible to observe and use quantum phenomena e
en in less ideal, warmer environments,i¿½ emphasizes Gerhard Kirchmair. i¿½If we ca
create the necessary interactions in a system, the temperature ultimat

y doesn't matter.i¿½ The study was funded by the Austrian Research Fund FWF and t
e Europ

Reference:

Hot Schrodinger Cat States. Ian Yang, Thomas Agrenius, Vasilisa Usova, Oriol Romero-Isart, Gerhard Kirchmair. Science Advances 2025 DOI: 10.1126/sciadv.adr4492

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Researchers generated highly mixed quantum states with distinct quantum properties. Credit: IQQOI Innsbruck.