

Macroscopic quantum phenomena and related matters: A brief history and the Nobel Prize in Physics 2025

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It is my intention in this talk to present a chronological overview of the development of the basic ideas of what is nowadays called *macroscopic quantum phenomena*, show where to find and study them.

I shall approach the problem by introducing a few quantum mechanical phenomena through very simple examples accessible to a lay audience. Next I will extend them to mesoscopic superconducting devices - the SQUIDs and CBJJs - which act as “giant atoms”, where effects such as the quantization of energy, and quantum mechanical tunneling of a macroscopic variable take place. I shall further discuss the implications of these quantum phenomena, and the unavoidable influences to which they are subject such as, for example, the presence of dissipative effects. Actually, these systems have become the paradigm of the area of quantum dissipation.

Then, I shall present the experimental results which indisputably prove the existence of macroscopic quantum phenomena in superconducting devices, namely the pioneering measurements of J. Clarke, M. Devoret, and J. Martinis in the mid 1980s for which they were awarded the Nobel Prize in Physics in 2025.

Finally, I shall mention other possible examples of these phenomena in condensed matter physics, their potential applications, and even impact on the foundations of quantum mechanics.