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## 75 years of entanglement

By Alexandra Witze

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Though it has been confirmed numerous times since 1935, entanglement is as spooky as ever.

**1935:** Physicists Albert Einstein, Boris Podolsky and Nathan Rosen publish a paper in *Physical Review* asking "Can quantum-mechanical description of physical reality be considered complete?" Their answer: no.

The same year, in the journal *Naturwissenschaften*, Erwin Schrödinger coins the term *Verschränkung*, meaning "entanglement," and develops his famous thought experiment of a cat that exists simultaneously in a state of being alive and dead.

**1952:** Building on earlier work by French physicist Louis de Broglie, theoretical physicist David Bohm suggests a deterministic interpretation of quantum theory that incorporates "hidden variables." He claims that the initial state of a system, like a particle's position, can determine its future evolution.

**1964:** Irish physicist John Bell proposes his inequality, which lays out math that would allow researchers to experimentally rule out any hidden variables operating locally to determine quantum entanglement outcomes. If the inequality holds, then entanglement could be explained through purely local effects. If violated, some amount of nonlocality must be occurring, as standard quantum mechanics would predict.

**1972:** Berkeley researchers Stuart Freedman and John Clauser experimentally test Bell's theorem by measuring the polarizations of a pair of photons. Though the team found that the inequality is indeed violated, some loopholes exist in the experiment.

**1982:** French physicist Alain Aspect performs an even stronger test of entanglement, confirming that nonlocal effects do exist.

**1984:** Charles Bennett and Gilles Brassard propose a theoretical system for quantum cryptography, which would use photons in a superposition of states to create a secure key.

**1990:** Bennett and colleagues report the first experimental quantum key distribution.

**1993:** Bennett and collaborators propose that entanglement can, in principle, be used to teleport a particle's quantum information from one place to another.

**1997:** Austrian quantum physicist Anton Zeilinger and colleagues report in *Nature* the first experimental verification of quantum teleportation.

**2007:** Zeilinger and colleagues set a distance record by sending entangled photons across 144 kilometers, between two of the Canary Islands. Chao-Yang Lu and colleagues also entangle six photons, a record number.

**2010:** Researchers observe new kinds of entanglement when linking multiple objects quantumly, quantum information is teleported a record 16 kilometers and teams find better ways to create and control entangled objects.