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NO LONGER BIZARRE: THE HINDU EDITORIAL ON THE 2022 NOBEL PRIZE FOR PHYSICS

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The quantum revolution ushered in a new phase of science and technology, with transistors changing electronics forever and lasers providing the foundational cornerstones in fields from communication to medicine. This year's Nobel prize for physics awards yet another milestone in quantum physics. This has been dubbed a revolution in the making, with many possibilities for applications in quantum computation, quantum cryptography and quantum networks. Alain Aspect (France), John F. Clauser (the U.S.) and Anton Zeilinger (Austria) have been awarded for experimental work 'on entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science'. The common concept in their work is quantum entanglement. This is a quirk of quantum mechanics which allows two or more particles to exist in an 'entangled state' such that what happens to one particle affects the others immediately, irrespective of how far they may be. This is what Einstein called 'spooky action at a distance' and prompted him, along with Boris Podolsky and Nathan Rosen to come up with the thought experiment (1935)— the case of Schrodinger's cat which can be alive and dead at the same instant. The idea that challenged the very foundations of quantum mechanics was that there could be 'hidden variables' that decide the state of the particles that were separated in space, and there was no real quirk in quantum mechanics that caused them to be entangled.

John Stewart Bell, in 1964, came up with a mathematical way of testing whether quantum mechanics was compatible with the local hidden variable theory. After further improvisations, these inequalities were named Bell's inequalities. John Clauser and Alain Aspect have been awarded for showing experimentally the violation of Bell's inequalities. This implies that entanglement is indeed intrinsic to quantum mechanics, and there are no local hidden variables dictating the correlation between the properties of the entangled particles. This led to further development of the field. Anton Zeilinger and his team took up the challenge of establishing 'quantum teleportation'. Though this phrase sounds magical, physical particles are not teleported; however, information about their quantum states is moved through a distance — helping in new forms of communication and cryptography. Today, entangled quantum states between photons have been demonstrated when the photons have traversed tens of kilometres of optical fibres. Also, entangled states have been demonstrated between photons on earth and those on a satellite. It is likely that researchers will find ways of using this property which is both exotic and promising.

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