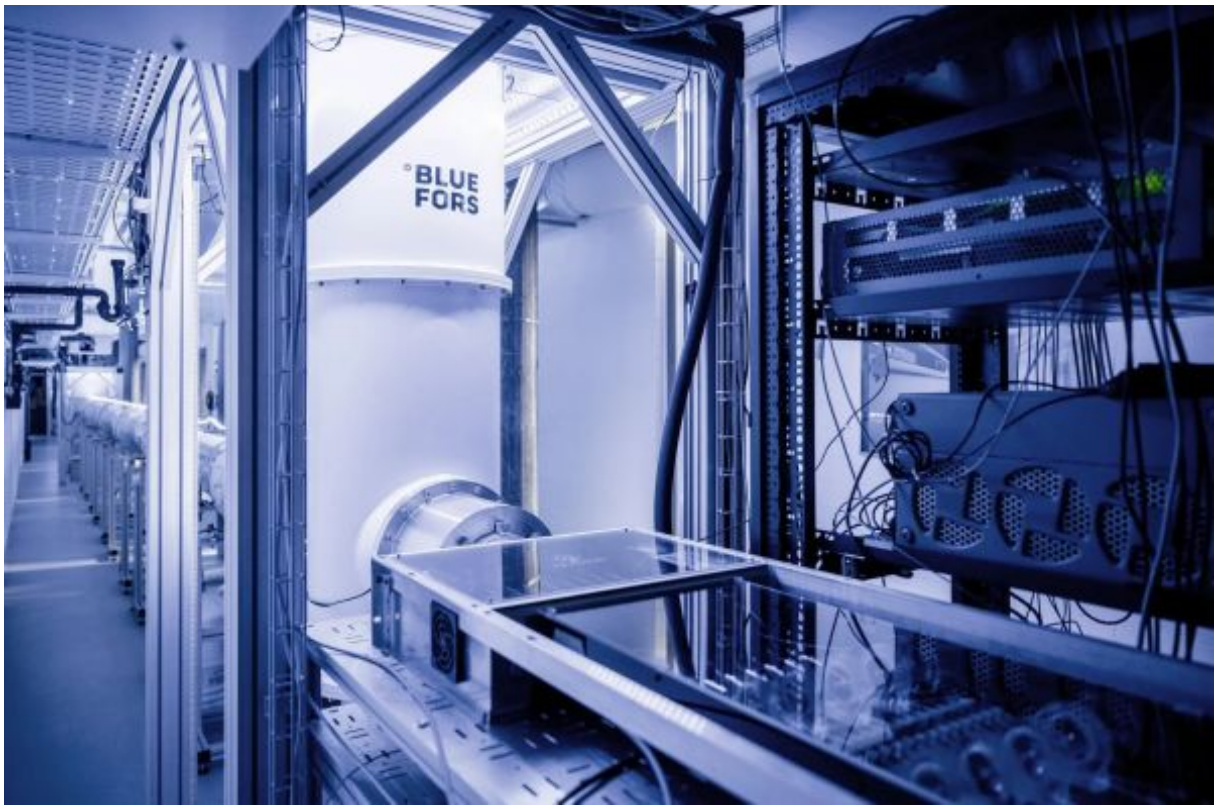

Super quick quantum random number generators enable "spooky action at a distance" between superconducting quantum bits

The study, published recently in Nature, has reported on a i¿½Loophole-free Bell test with Superconducting Circuitsi¿½.

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Random number generators, developed by Quside Technologies in collaboration with ICREA Professor at ICFO Morgan W. Mitchell, made possible a ground-breaking experiment to be published **10 May 2023** in Nature. The experiment, in the laboratories of Andreas Wallraff a ETH Zurich, performed a i¿½loophole-free Bell test,i¿½ similar to experiments that wo the Nobel Prize in Physics last year. For the first time, the ETHZ experiment was able to pe form this kind of experiment with superconducting quantum bits, the basis for today's most advanced quantum computers. The results show i¿½spooky action at a distance,i¿? in which objects in different places behave as if they were a sing e system. As described by the group at ETHZ, the ETHZ experiment first i¿½entangledi¿½

two superconducting qubits at temperatures near absolute zero and separated by 30 meter of distance. The team then measured the state of the qubits simultaneously, and observed that the state of one qubit usually agreed with the state of the other qubit, a coordi ated response consistent with i¿½spooky action at a distance.i¿½ To be sure this coordi ation was not due to ordinary signals traveling from one qubit to the other, the ETHZ eam chose randomly which type of measurements to make on the qubits, and the made the measurements so quickly that not even a signal at the speed of light could reach the other qubi in time. This feat required extremely fast random number generators, and for this the ETHZ team turned to Quside and Prof. Mitchell's research group at ICFO to develop a ran om number generator with unprecedented speed. Quside adapted their patented qua tum random number generation technology, combining a novel parallel architecture with a extremely fast i¿½randomness extractioni¿½ stage. In this way, the QRNG devices delivered pure random bits in 17 nanoseconds, the time it takes light to travel 5 meters. ETHZ teams used i¿½to go beyond the state of the art in random number generation. Never before has a experiment required such good random numbers in such a short time. The Quside team di an amazing job to engineer the solution and integrate it with the ETHZ experimenti¿½ Sa s Carlos Abellan, CEO of Quside and a co-author of the ETHZ stud . The experiment confirms that quantum mechanics allows for non-local correlations, whi h means that superconducting circuits can be entangled over a comparatively large distanc . This may enable new methods of secure communications.

For the Quside/ICFO team, the participation in the ETHZ experiment is not just a chance to contribute to fundamental physics. Says Prof. Mitchell: i¿½This experiment pushed us to develop technologies that we now apply to communications security and high-performance computing, which also require fast, high-quality random numbers.i¿