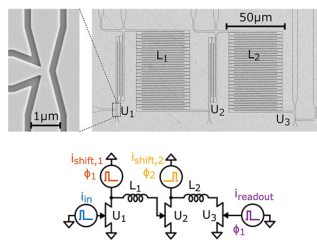


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Scaling up superconducting nanowire-based electronics

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Nanocryotrons produce a shift register capable of coupling with compatible photon detectors and withstanding strong magnetic fields.



Superconducting nanowires produce devices that store data in persistent supercurrents while operating in harsh environments. This makes them ideal for cryogenic electronics, especially state-of-the-art photon detectors.

Foster et al. designed and fabricated a shift register made of superconducting loops connected with nanocryotrons, or superconducting nanowire electrothermal switches. Whereas existing superconducting technology is sensitive to magnetic flux noise, they found this nanocryotron-based shift register can operate in high magnetic fields up to 6 millitesla.

The authors simulated readout of superconducting nanowire single photon detector (SNSPD) arrays with this shift register. The shared technology platform should allow it to integrate with SNSPDs more easily than other superconducting techniques. The digital nature of the shift register also simplifies readout compared to existing analog approaches that require time-to-digital converters.

The researchers believe these attributes will streamline the process of scaling up nanocryotron-based electronics to larger SNSPD arrays.

“One advantage of doing digital readout as opposed to an analog readout is that you can greatly simplify the room-temperature electronics that are needed to read out large scale detector arrays,” said author Reed Foster. “This shift register is yet another tool to add to a collection of useful circuits for scaling up this technology.”

The authors plan to use the shift register to demonstrate the readout of an SNSPD array in experiments. This technology may also find use in quantum computing and other cryogenic applications.

“Having a whole new family of electronics based on these nanocryotrons that are tolerant to magnetic fields and relatively easy to fabricate is attractive for cryogenic systems,” said author Karl Berggren.

Source: “A superconducting nanowire binary shift register,” by Reed A. Foster, Matteo Castellani, Alessandro Buzzi, Owen Medeiros, Marco Colangelo, and Karl K. Berggren, *Applied Physics Letters* (2023). The article can be accessed at <https://doi.org/10.1063/5.0144685>.

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