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Superconducting Devices Based on Coherent Operation of Josephson Junction Arrays above 77K

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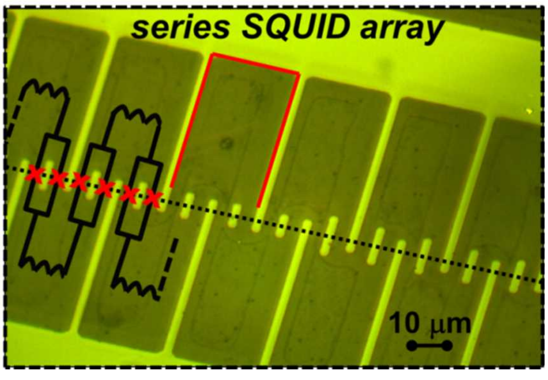
It took a while for Feynman's famous prediction [1] that multiple Josephson junction devices would eventually improve performance of superconducting devices to be confirmed experimentally [2-5]. Such arrays made of low temperature superconductors operate at 4.2K or below and maintaining such low temperatures is both expensive and difficult to handle. This is why high temperature superconductor Josephson junctions operating coherently at 77K are ideal candidates for re-shaping the electronics industry's future. Their advantages over their semiconducting counterparts (higher operating speed, lower power consumption/electronic noise) can be exploited in practice because of their practicality: cooling down to 77K is both cheap and easy to handle. Several promising applications are considerd here. Firstly, when flux coherency is achieved in large SQUID-arrays connected in series magnetic flux sensors or voltage amplifiers can be build having record values for their output voltage and flux noise sensitivities [6] outperforming even single SQUID-based devices operating at 4.2 K. Secondly, when the coherent flux-flow of vortices in parallel asymmetric SQUID-arrays placed in a uniform magnetic field B synchronizes with the collective ac Josephson effect in the array ones can exploit that for the development of B-tunable microwave generators [7]. The coherent flux-flow can be altered by B leading to record values for current amplification [8], highly efficient ratchets with unidirectional vortex motion or integrated nano-magnetic sensors [9].

References

[1] R. Feynman's, *Lectures in Physics, Volume 3, Ch. 21,* 1965.
[2] R.P. Welty and J.M. Martinis, *IEEE Trans. Magn.* **3**, 2924 (1991); *IEEE Trans. Appl. Supercond.*, **3**, 2605 (1993).
[3] K.G. Stawiasz and M.B. Ketchen, *IEEE Trans. Appl. Supercond.* **3**, 1808 (1993).
[4] V. Foglietti, et al. *IEEE Trans. Appl. Supercond.* **3**, 3061 (1993).
[5] K. Li and S. P. Hubbell, *IEEE Trans. Appl. Supercond.* **5**, 3255 (1995); *IEEE Trans. Appl. Supercond.* **7**, 3217 (1997); K. Li, et al, *IEEE Trans. Appl. Supercond.*, **9**, 4420 (1999).
[6] B. Chesca, D. John, C. J. Mellor, *Appl. Phys.Lett.* **107**, 162602 (2015).
[7] B. Chesca, D. John, C.J. Mellor, *Supercond. Sci. Technol.* **27**, 085015 (2014).
[8] B. Chesca, et al, *Appl. Phys. Lett.* **103**, 092601 (2013).
[9] B. Chesca, et al., *Appl. Phys. Lett.* **111**, 062602 (2017).



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