Towards measuring the nonlocal Josephson effect in Andreev molecules

QUANTUMatter2022

Mátyás Kocsis
Gergő Fülöp, Zoltán Scherübl, Péter Makk, Szabolcs Csonka

MTA-BME Nanoelectronics Momentum Research Group, Műegyetem rkp. 3, H-1111 Budapest, Hungary

matyaskocsis@edu.bme.hu

Andreev molecules – Josephson junctions positioned closely enough to each other for entangled states to arise – have received much theoretical attention recently as they could have applications in quantum information processing. [1][2] We fabricated devices based on InAs nanowries with epitaxial Al shells, and developed high-frequency experimental methods needed to detect molecular bound states. We also carried out theoretical calculations that highlight the expected experimental signature of entangled states, and help guide the exploration of the rich physics of the parameter space.

References

[1] Kornich et al., *Physical Review B* 101, no. 19 (May 20, 2020)
[2] Pillet et al., *Nano Letters* 19, no. 10 (October 9, 2019): 7138–43.

Figures

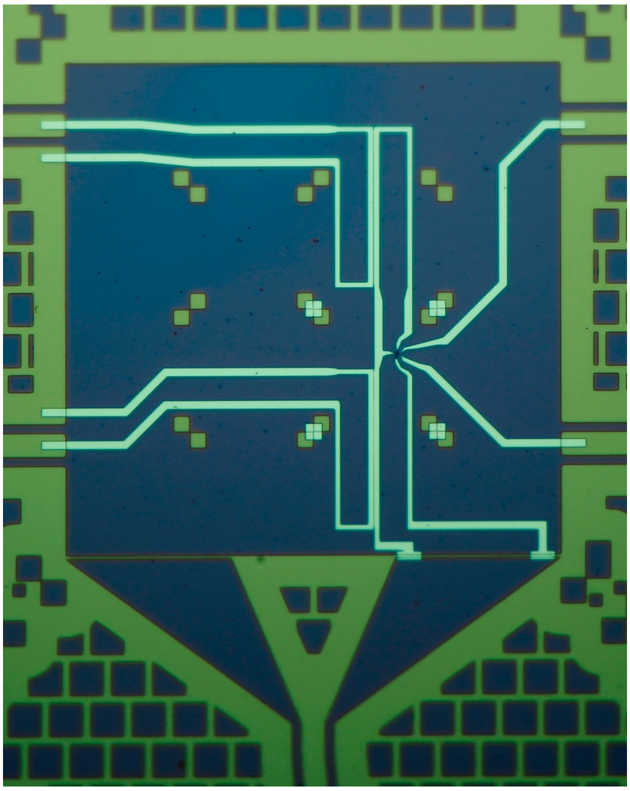

Figure 1: Device with two individually tuneable Josephson junctions coupled to a RF resonator (bottom).

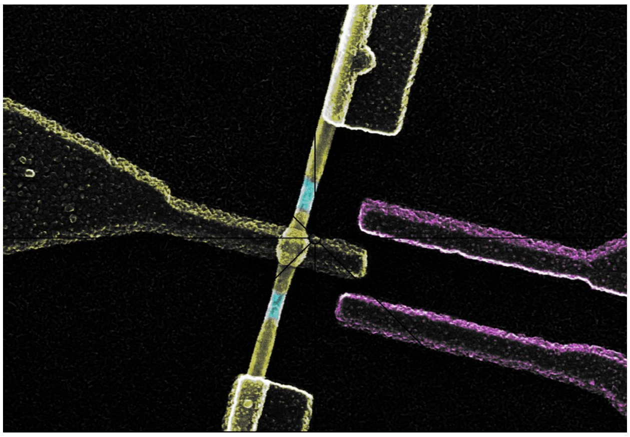

Figure 2: Two Josephson junctions (blue) etched in to the Al shell of a InAs nanowire, close enough for entangled states to arise. The phase of the superconductors (yellow) and the potential on the gates (purple) allows for precise control of the junctions.