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Graphene based superconducting circuits platform

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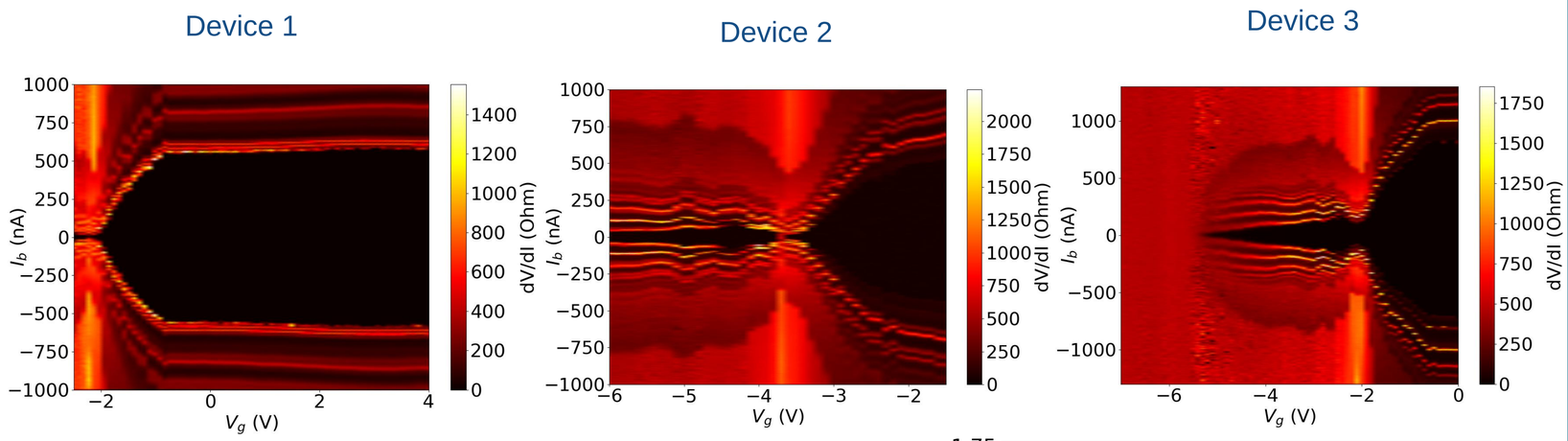
Motivation

- Gate tunable material
- A lot of junction regimes accessible
- Interplay between superconductivity and relativistic quantum mechanics
- Easy to integrate in RF circuits

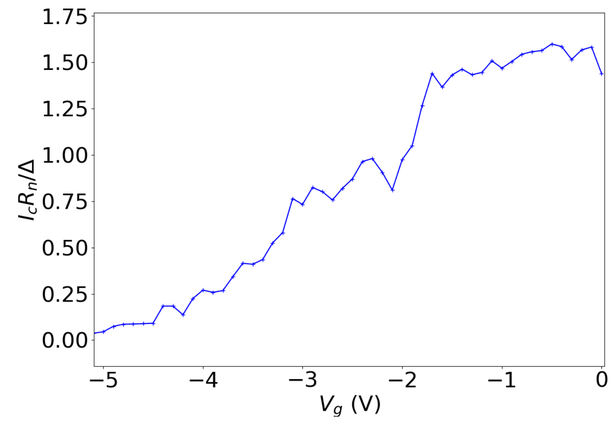
Ti/Al junctions critical current



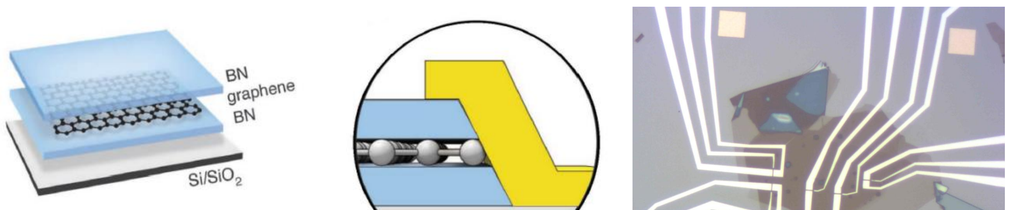
Fabrication and measurement setup

- Encapsulated graphene [1]
- Junction size: W = 2µm, L = 300nm
- Superconducting contact: Ti/Al or MoGe
- Intrinsic Si substrate
- Side gate control of the carrier density
- Standard 2 probes current bias lockin measurement technique at a base temperature of 100mK

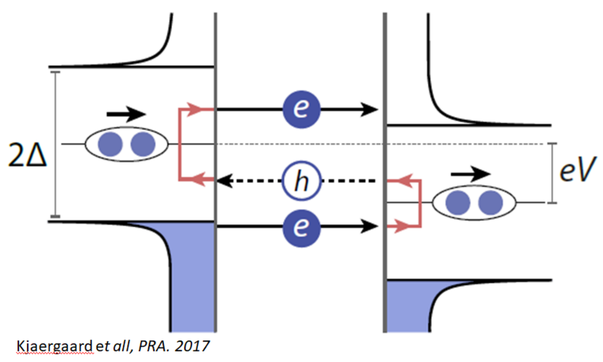
- Extracted induced gap: Δ = 140µeV
- Critical current close to the tunnel junction limit $2\Delta/R_N e$
- Critical current effectively tunable with a side gate



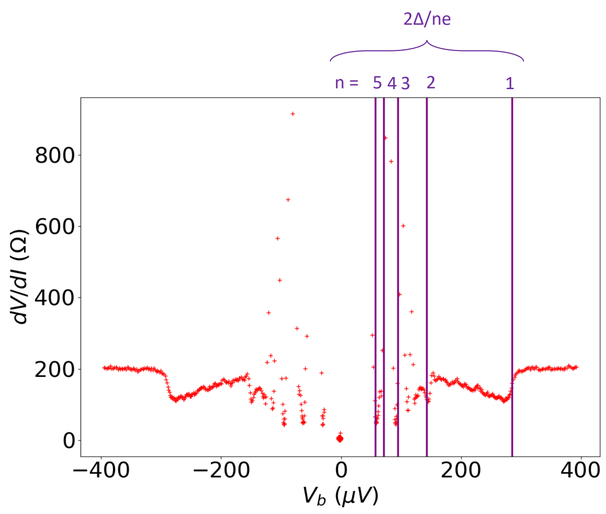
Ti/Al junctions multiple Andreev reflections (MAR)



Wang et al, Science (2013)

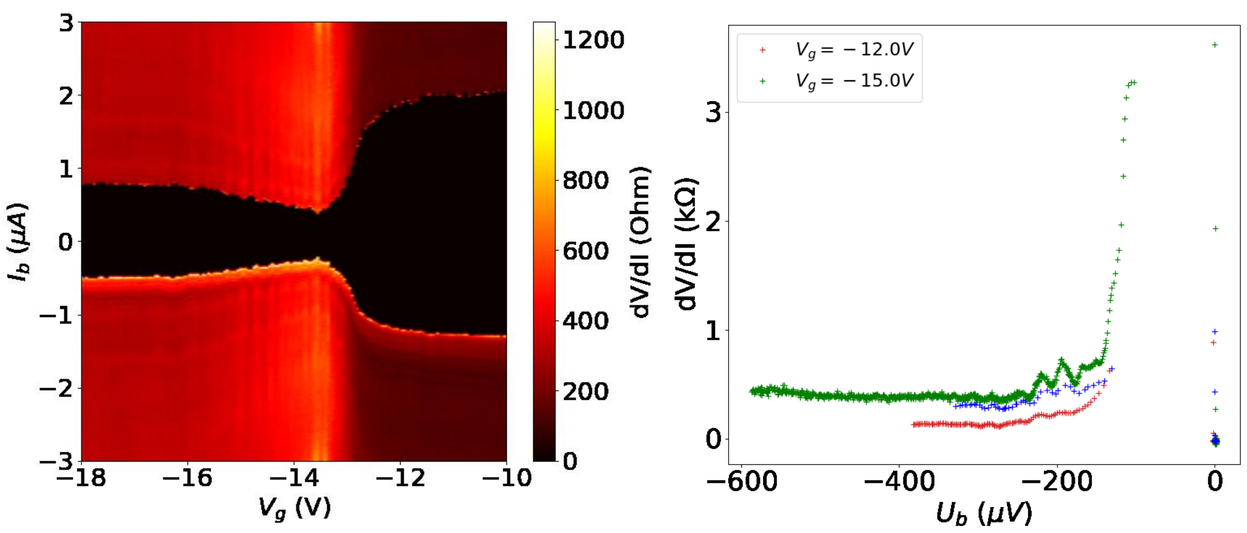


Kiaergaard et all, PRA. 2017



- MAR should manifest themselves as peaks in conductance for Vb = 2Δ/ne with n an integer
- Sharp peaks in resistance are observed whereas only peaks in the conductance are expected
- Some peaks in conductance do not correspond to the 2Δ/ne formula

MoGe junctions



- Critical current up to 2µA despite local gating
- MAR have a more standard behavior in contrast with the Ti/Al devices where sharp peaks in resistance are measured

Conclusion

- The side gate technology offers a ‘non invasive’ way of tuning the parameters of the junction
- Therefore, encapsulated graphene on intrinsic Silicon with side gate control is a good candidate for RF applications such as qubits [2] and bolometers [3,4]
- MAR features in short ballistic graphene Josephson junctions are not entirely understood

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REFERENCES

[1] L. Wang et al. *Science* **342**, 2013
[2] J. Wang et al. *Nature Nanotechnology* **14**, 2019
[3] R. Kokkoniemi et al. *Nature* **586**, 2020
[4] G-H. Lee et al. *Nature* **586**, 2020

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