The Physics of hBN-encapsulated Graphene Field Effect Transistors under Large Bias

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A decade ago, hBN encapsulation enabled reaching the intrinsic properties of graphene electronics. In FET geometry, the graphene electron gas becomes mostly decoupled from its host matrix, which allows reaching exotic transport and optoelectronic regimes under large bias where far out-of-equilibrium electronic distributions develop.
In this poster, we review key phenomena observed in high mobility graphene FETs under large bias, starting with transport and the emergence of interband Zener-Klein tunnelling and mesoscopic Schwinger effect.
These peculiar transport regimes are associated to new photoemission and energy transfer regimes revealed by the observation of electroluminescence cooling, as well as mid-infrared near-field and far-field electroluminescence.

References

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Figures

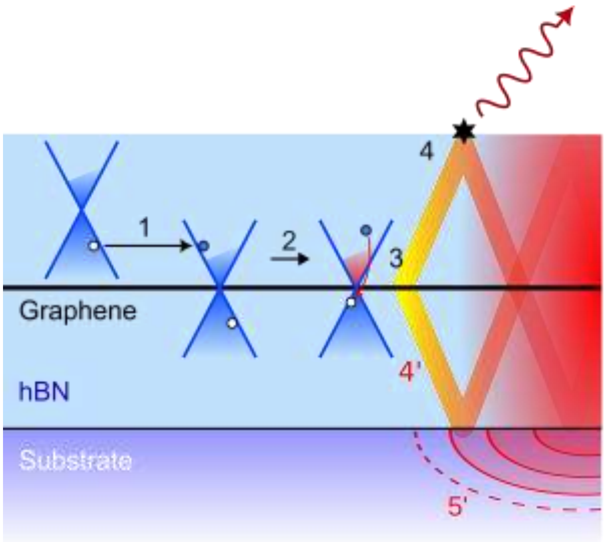

Figure 1: Energy transfer and electroluminescence from graphene under large bias. (Step 1) Electrical Zener-Klein interband pumping under large applied bias. (Step 2) Intraband thermalization. (Step 3) Interband emission of a hyperbolic phonon-polariton (HPhP) from hBN.
(Step 4) HPhPs ballistically propagate through the encapsulating medium, leading to photon emission at a scatterer within or on hBN (Step 4') or dissipates within hBN resulting in (Step 5') a local temperature increase.