Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Hyperbolic cooling of graphene Zener-Klein transistors WEI YANG, SIMON BERTHOU, LPA-CNRS, XIAOBO LU, IOP-CAS, EMMANUEL BAUDIN, QUENTIN WILMART, ANNE DENIS, MICHAEL ROSTICHER, LPA-CNRS, TAKASHI TANIGUCHI, KENJI WATANABE, NIMS, GWENDAL FEVE, JEAN-MARC BERROIR, LPA-CNRS, GUANGYU ZHANG, IOP-CAS, CHRISTOPHE VOISIN, BERNARD PLACAIS, LPA-CNRS — Engineering of cooling mechanisms is a bottleneck in nanoelectroniscs. In graphene/hBN transistors, Wiedemann-Frantz cooling and supercollision-cooling prevails, and the latter is suppressed in high mobility graphene/hBN samples and substituted by the super-Planckian radiation of hyperbolic phonon-polaritons (HPPs) in the hBN substrate. Using electrical Joule heating and sensitive noise thermometry in several GHz range we report on prevailing HPP cooling in the upper Reststrahlen-band of hBN at high bias. We predict and observe its activation threshold, along with interband Zener-Klein tunneling. HPP cooling is able to evacuate at least several GW/m2 to the bottom gate, resulting in an unusual clipping of electronic temperature. As a scattering counterpart, HPPs of the lower Reststrahlen-band control current saturation at high doping. The combination of both mechanisms promotes graphene/hBN as a valuable nanotechnology for applications in the high power devices and radio frequency electronics.

Wei Yang
CNRS Paris

Date submitted: 24 Oct 2016 Electronic form version 1.4