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Asymmetry in the Ultrafast Dynamics of Excited Electrons and Holes in Gallium Nitride[1] VATSAL JHALANI, JIN-JIAN ZHOU, MARCO BERNARDI, Caltech — Wurtzite GaN is the primary material for efficient light emission technology. The radiative processes in GaN are regulated by the dynamics of excited (or so-called hot) carriers, through microscopic processes not yet completely understood due to the ultrafast (fs ps) timescales involved. We present ab initio calculations of hot carrier dynamics in GaN. We compute the electron-phonon (e-ph) interaction from first principles, and include the ab initio Fröhlich correction due to the polar phonon modes. Using a novel numerical approach[2], we converge the e-ph relaxation times within 5 eV of the band edges, and find a significant asymmetry in the time scale for the electron and hole relaxation near the band edge. The dynamics of hot electrons and holes injected with up to 1 eV excess energy is investigated by solving the electronic Boltzmann equation, revealing the significant difference in the sub-ps relaxation times of electrons and holes in GaN.[3] The talk will discuss the technological implications of our findings, as well as highlight the novel parallel algorithms that made these calculations possible.

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[2]J.J. Zhou and Marco Bernardi (2016). arXiv:1608.03514.
[3]V. Jhalani, J.J. Zhou, and M. Bernardi. Submitted for publication.

Vatsal Jhalani
Caltech

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