

# Simultaneous Enhancement of Electrical and Thermal Conductivity in Graphene through Excitation of the Etheric Longitudinal Mode

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Within the framework of the *Quarkbase Cosmology*, electromagnetic and transport phenomena arise from longitudinal pressure waves in an etheric medium described by the scalar field  $\Psi(\mathbf{x}, t)$ . When an excitation in the terahertz or mid-infrared range (10–60 THz) couples resonantly to the longitudinal mode of this field, the coherence of both charge and heat carriers in graphene increases simultaneously. The predicted result is a reversible and correlated enhancement of the electrical conductivity  $\sigma$  and the thermal conductivity  $\kappa$ , a distinctive signature of the etheric longitudinal mode acting as a unifying coupling channel.

## THEORETICAL FRAMEWORK

The etheric field  $\Psi$  obeys the stationary equation of the Quarkbase theory [1]:

$$(\nabla^2 - \lambda^{-2})\Psi = -\alpha \sum_i \delta(\mathbf{x} - \mathbf{x}_i), \quad (1)$$

where  $\lambda$  is the characteristic pressure screening length and  $c_\Psi = \sqrt{\beta/\rho_p}$  the propagation velocity of longitudinal disturbances. In planar systems such as graphene, periodic strain patterns of period  $L$  define a confined cavity mode with frequency

$$\omega_\Psi \simeq \frac{\pi c_\Psi}{L}. \quad (2)$$

The coupling between the etheric field and the charge or heat currents is described by

$$\mathcal{L}_{\text{int}} = -g_e \Psi \nabla \cdot \mathbf{J}_e - g_q \Psi \nabla \cdot \mathbf{q}, \quad (3)$$

where  $\mathbf{J}_e$  and  $\mathbf{q}$  are the electric and heat flux densities. Near resonance ( $\omega \approx \omega_\Psi$ ), the field susceptibility is

$$\chi_\Psi(\omega) = \frac{A}{\omega_\Psi^2 - \omega^2 - i\Gamma_\Psi \omega}, \quad (4)$$

with  $A$  the mode strength and  $\Gamma_\Psi$  its damping.

## RENORMALIZATION OF SCATTERING RATES

The coupling to  $\Psi$  modifies the carrier scattering rates as

$$\gamma_e(\omega) = \gamma_{e0} - g_e^2 \Im \chi_\Psi(\omega), \quad \gamma_q(\omega) = \gamma_{q0} - g_q^2 \Im \chi_\Psi(\omega), \quad (5)$$

increasing the relaxation times  $\tau_{e,q} = 1/\gamma_{e,q}$ . Hence,

$$\frac{\Delta \tau_{e,q}}{\tau_{e,q}} \propto \Im \chi_\Psi(\omega) = \frac{A \Gamma_\Psi \omega}{(\omega_\Psi^2 - \omega^2)^2 + \Gamma_\Psi^2 \omega^2}. \quad (6)$$

In the linear response regime,

$$\frac{\Delta \sigma}{\sigma} \approx \frac{\Delta \tau_e}{\tau_e}, \quad \frac{\Delta \kappa}{\kappa} \approx \frac{\Delta \tau_q}{\tau_q}, \quad (7)$$

and both enhancements share the same Lorentzian dependence on frequency:

$$\frac{\Delta \sigma}{\sigma}, \frac{\Delta \kappa}{\kappa} \propto \frac{\Gamma_\Psi^2}{(\omega - \omega_\Psi)^2 + \Gamma_\Psi^2}. \quad (8)$$

## PREDICTED CORRELATED RESPONSE

This relation implies a simultaneous and spectrally narrow increase in  $\sigma$  and  $\kappa$ , centered at  $\omega_\Psi$ . The correlation  $r(\Delta\sigma, \Delta\kappa)$  approaches unity since both follow the same  $\Im \chi_\Psi$  profile. The resonance frequency scales inversely with the resonator period:

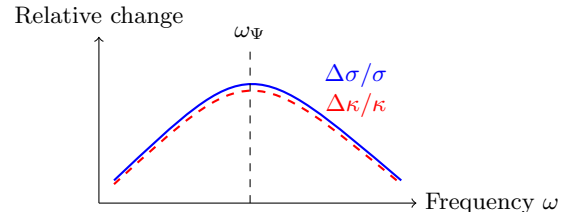
$$\omega_\Psi(L) \propto \frac{1}{L}. \quad (9)$$

## EXPECTED MAGNITUDE

For realistic parameters  $Q = \omega_\Psi/\Gamma_\Psi \sim 10$ , coupling strengths  $g_{e,q} \sim 10^{-2}$  and moderate pump fluences, the expected variations are

$$\Delta\sigma/\sigma \simeq 0.5\text{--}3\%, \quad \Delta\kappa/\kappa \simeq 0.5\text{--}2\%. \quad (10)$$

These changes exceed the noise level of standard four-probe and time-domain thermoreflectance measurements, enabling direct experimental verification.



**FIG. 1.** Common Lorentzian peak of  $\Delta\sigma/\sigma$  and  $\Delta\kappa/\kappa$ .

## CONCLUSION

Excitation of the etheric longitudinal mode in graphene is predicted to simultaneously enhance electrical and thermal conductivities by increasing the coherence of charge and heat transport through a common pressure-field mechanism. The effect is resonant, reversible, and characterized by a unique correlation between  $\sigma$  and  $\kappa$ . Its observation would constitute direct

evidence for the Quarkbase description of the etheric plasma as the physical substrate underlying electronic and thermal conduction.

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- [1] C. Omeñaca Prado, “Genesis Quarkbase: Field Foundations of Etheric Cosmology” (2025).