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Universality and Kirchhoff's Law of Thermal Emission PIERRE-MARIE ROBITAILLE, The Ohio State University, STEPHEN J. CROTHERS, none — Kirchhoff's law is derived in 'The Theory of Heat Radiation', by Max Planck, but without properly addressing reflection. This is rectified in part by modifying his equation in §25 to $dt \cdot \nu \cdot 8\pi \int_0^\infty (\epsilon_\nu + \rho_\nu \mathbf{K}_\nu)\, d\nu$, and §26 (i.e. Eq. 25) to $dt \cdot \nu \cdot 8\pi \int_0^\infty (\alpha_\nu + \rho_\nu)\, \mathbf{K}_\nu d\nu$, respectively. When these are equated, solutions are either $\mathbf{K}_\nu = \epsilon_\nu/\alpha_\nu$ (Eq. 27), or $\epsilon_\nu = \mathbf{K}_\nu - \rho_\nu \mathbf{K}_\nu$. The former, which leads to Kirchhoff's law, is undefined when $\alpha_\nu = 0$. Planck tries to prove Kirchhoff's law by placing two separate media in contact. Each medium is characterized by its own emission, for which Planck uses the notation (ϵ_ν), absorptivity (α_ν), and reflectivity (ρ_ν). The critical step in the derivation involves Planck's need to set $(1 - \rho_\nu)$=$(1 - \rho'_\nu)$, which he astonishingly achieves by initially deducing that ρ_ν=ρ'_ν=0 and then, in Eq. 40, setting ρ_ν=ρ'_ν (see §37). This is a contradiction of known physics for frequency dependent reflectivities in differing materials. Kirchhoff's law and universality are invalid concepts.

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