

Fig. 1. Electromagnetic Nature of Thermo-Mechanical Mass-Energy Transfer Due to Photon Diffusive Re-Emission and Propagation: Based on atomic electron-shell interactions and the Einstein mass-energy equivalence, during “believed-massless” heat conduction or mechanical work transfer there has to be electromagnetic, photonic mass-energy propagation through involved material structures from a mass-energy source to a sink system. Steady-state, mass-energy transfer is depicted through heat conduction plate (above) and rotating shaft (below). Energy transfer (i.e., Einstein’s mass-energy equivalency transfer, $\dot{E}_{tran} = \dot{m}_{tran}c^2$) has to be electromagnetic by photon transfer, either as photon electromagnetic waves on-long range through space/vacuum ($\dot{Q}_{rad} = \dot{m}_{rad}c^2$), or photon “on-contact” transfer within material structures, e.g., through heat conduction plate (above) and turbine shaft work (below), since it is neither gravitational nor nuclear (strong or weak) interaction. Otherwise, Einstein’s mass-energy equivalency and the fundamental force/interactions will be violated. Thermal conduction is due to chaotic thermal electron-shell collisions and may be enhanced by free-electrons or crystal-lattice structure vibration (phonons), both phenomena due to underlining photon propagation (similar to electro-chemical phenomena). The mechanical work transfer is due to electron-shell directional pushing/twisting as the most efficient (“focused”) energy transfer (i.e., mechanical super conductor). If it is fully investigated and understood, it has potential for development of hybrid synthetic-materials with superior thermal conductivity like diamond, for critical and new application.

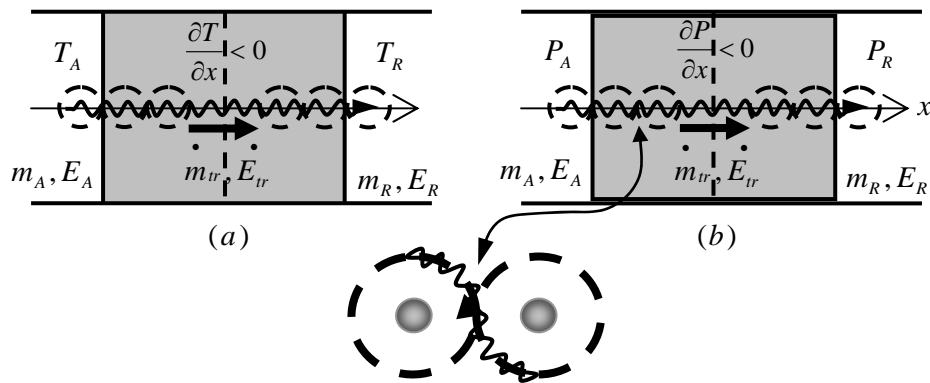


Fig. 2. Thermo-mechanical energy transfer by photon “on-contact propagation.” (a) Heat transfer by propagating photons (due to chaotic thermal electron-shell collisions), in direction of decreasing temperature (opposite direction of temperature gradient), and (b) work transfer by propagating photons (due to electron-shell directional pushing/twisting as the most efficient “focused” energy transfer), in direction of decreasing “collective stress” (opposite direction of collective stress gradient); from Acting-source (*A*) to Reacting-resisting-sink (*R*) systems.

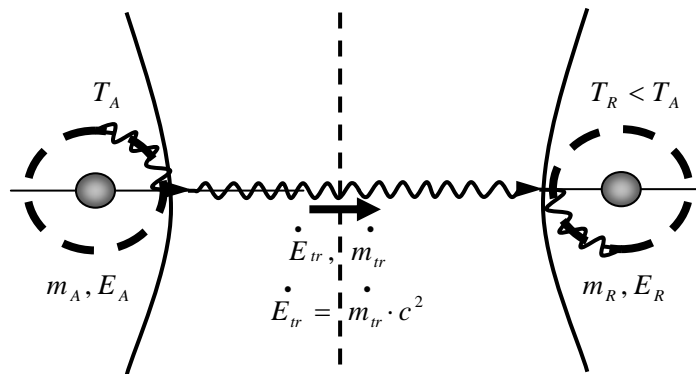


Fig. 3. Photon mass-energy transfer. Any energy transfer (other than gravity and nuclear interactions) must be photonic, accompanied by photon transfer either as electromagnetic waves on-long range through space, or “on-contact propagation” within material structures, or as diffusion or motion of material structures (including electrons), accompanied with underlining photon mass-energy exchange, thus unifying the mass and energy concepts and a notion of “massless photon” rest-mass *transfer* (as from the Sun to Earth).