Scalar Electrodynamics – the Core of EED (Extended Electrodynamics) - A New Challenge to the Science of Classical Electrodynamics

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ABSTRACT. Extended Electrodynamics (EED) predicts the scalar-longitudinal wave (SLW) via a complete and consistent model, including irrotational components of electrical current density, vector potential, and electric field. The transverse formulation under classical electrodynamics (CED) is preserved under EED. Recent experiments provide preliminary evidence for the SLW, also known as the electro-scalar wave. These tests show evidence for five of the eight validation criteria: no constraint by the skin effect for propagation in linearly conductive media, $1/r^2$ free-space attenuation, an isotropic radiation pattern from a monopole antenna, power level comparable to transverse electromagnetic waves, and an irrotational current as the source. Irrotational (gradient-driven) field components are not yet recognized as such in CED but are well-known experimentally (e.g., lightning and electrostatic arcs, electrostatic plasma oscillations, concentration-gradient-driven ion currents across living cell membranes, triboelectric effect). EED is a gauge-free with a dynamical, scalar field (C), where C = 0 is the Lorenz gauge under CED. The gradient-driven current in EED leads to novel SLW antennas, as disclosed in Lee Hively's 2016 US Patent #9,306,527. EED gives physical significance to the vector- and scalar-potentials which are then independent quantities. EED also predicts a propagating scalar field without an electric or magnetic field. EED further predicts four (three) new terms in the energy (momentum) balance equations. EED is therefore a harbinger of disruptive technologies and a forerunner of paradigm revolutions for many astronomical and geophysical phenomena whose origins are presently poorly understood.

Keywords: scalar electrodynamic wave, electroscalar wave, gradient-driven current.