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A Unified Description of the Electrical Properties of Low-Density Polyethylene via the Dispersion Parameter ZACHARY GIBSON, MEGAN LOVELAND, JR DENNISON, Utah State University — Low-density polyethylene is a prototypical highly disordered insulating material. This ubiquitous polymer has a variety of applications from spacecraft charging to high voltage DC power cable insulation. Therefore, the electrical properties are of great interest. The dispersion parameter, which originally appeared in a semi-empirical model to describe anomalies in permittivity data, is central to an understanding of these electrical properties. This parameter depends linearly on either temperature (low field regime) or on electric field (high field regime) and is scaled by the reciprocal of a characteristic energy. When the dispersion parameter reaches one, a transition from dispersive to non-dispersive transport occurs. Scher and Montroll spurred an "anomalous to obvious phase transition" by describing the anomalous transit times in dispersive materials with use of long-tailed hopping-time distribution functions characterized by the dispersion parameter. Direct measurements of the evolution of embedded charge distributions via pulsed electroacoustic measurements show a dispersive to non-dispersive transport transition occurs at an electric field strength of ~10^8 V/m. Measurements of the temperature transition in constant voltage conductivity data measured by our group and extensive data from the literature are presented and described in terms of the dispersion parameter. Other models and measurements—including those for AC and DC conductivity, radiation induced conductivity, charge decay, and electrostatic breakdown—also depend on the dispersion parameter.

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