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Phase and critical behavior in hydrocarbon mixtures under external fields

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Some flow assurance solutions in the oil industry are based on the use of control devices that employ electric or magnetic fields that affect the thermodynamic behavior of produced fluids, either in the flowing well or transportation pipeline. Modeling of these flows requires a description of the phase and critical behavior of hydrocarbon mixtures under the influence of such fields, for systems ranging from near-critical gas condensates to heavy oils. In this work, we develop a thermodynamic framework for calculating the phase and critical behavior of hydrocarbon mixtures subjected to applied (static) electric or magnetic fields, using an equation of state. Mathematical expressions for calculating magnetic and electric susceptibilities of mixtures and their respective compositional derivatives are proposed. These susceptibilities (and their compositional derivatives) are necessary to obtain the magneto (or electro)-chemical potentials. Results in modeling gas condensate fluids and heavy oils show the versatility of the proposed framework, and are in concordance with Monte Carlo simulations and other physical theories.