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Magnetohydrodynamic Two-Phase Slip Flow and Heat Transfer of Dusty Tangent Hyperbolic Fluid over an Expansive Porous Sheet

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The relevance of flow dynamics and heat transfer in complex fluid-solid systems is essential in many manufacturing and engineering processes, such as chemical processing, thermal cooling systems, heat exchangers, etc. The current study, therefore, delves into the analysis of dusty tangent hyperbolic fluid flow mechanism and heat transfer characterized by the MHD two-phase flow phenomenon over a porous expansive sheet. A mathematical model is developed in partial derivatives to capture the physical description of the problem for both phases in the presence of thermal radiation, Joule heating, exponentially decaying heat source, Navier slip and convective heating boundary situations. A numerical technique via shooting with the Runge-Kutta Fehlberg method is employed to solve the controlling model equations. The results are presented graphically and tabularly with relevant discussion to comprehend the critical engineering parameters on the dimensionless profiles of velocity, temperature, and heat transfer phenomena. The computational results expose a decline in the hydrodynamic boundary layer but an expanded thermal boundary layer due to magnetic field influence. Improvements in the heat source and surface convection terms raise thermal distribution across the system surface.

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