Title: Numerical modeling of a MHD non-linear radiative Maxwell nano fluid with activation energy

Author: Maxwell fluid, Nanofluid, EFD, Activation energy, Non-linear radiation, MHD

Abstract: The present research explores linear as well as nonlinear radiation patterns based on the MHD non-Newtonian (Maxwell) nanofluid flow having Arrhenius activation energy. This study's core focus is MHD properties in non-Newtonian fluid dynamics and boundary layer phenomena analysis. It initiates with time-dependent equations, employing boundary layer approximations. Extensive numerical computations, executed with custom Compact Visual Fortran code and the EFD method, provide profound insights into non-Newtonian fluid behavior, revealing intricate force interactions and fluid patterns. To check the stability of the solution, a convergence and stability analysis is performed. With the values of $\Delta Y = 0.25$, $\Delta\tau = 0.0005$, and $\Delta X = 0.20$; it is found that the model convergence occurs to the Lewis number, $Le > 0.016$ as well as the Prandtl number, $Pr > 0.08$. In this context, investigating non-dimensional results that depend on multiple physical factors. Explanation and visual representations of the effects of different physical characteristics and their resultant temperatures, concentrations, and velocity profiles are provided. As a result of the illustrations, the skin friction coefficient and Sherwood number, which are calculated, as well as Nusselt values, have all come up in discussion. Additionally, detailed representations of isothermal lines and streamlines are implemented, and it is pointed out that the development of these features occurs at the same time as Brownian motion. Furthermore, the temperature field for Maxwell fluid is modified due to the impression of chemical reaction as well as the Dufour number (Kr and Du). Our research demonstrates the superior performance of non-Newtonian solutions, notably in cases involving activation energy and nonlinear radiation. This paradigm shift carries significant implications. In another context, the interplay between Maxwell fluid and nonlinear radiation is notably affected by activation energy, offering promising applications in fields like medicine and industry, particularly in groundbreaking cancer treatment approaches..

Keywords: Maxwell fluid, Nanofluid, EFD, Activation energy, Non-linear radiation, MHD

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