Title: **Comparative simulation of nonlinear radiative nano casson and maxwell fluids with periodic magnetic force and sensitivity analysis**

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Abstract: This study investigated cyclic magneto-hydrodynamic radiative effects in Casson and Maxwell fluids, including nonlinear radiation and Arrhenius activation energy. It promotes non-Newtonian fluid use in diverse fields like industry, manufacturing, sciences, medicine, and engineering. Using boundary layer approximations, non-dimensional equations are formulated. For numerical solutions, widely recognized explicit finite difference method (EFDM) has been utilized. To ensure the robustness of EFDM results, stability and convergence tests are performed. Exploration involve a detailed sensitivity analysis by using RSM, offering a thorough understanding of influential parameters. These analyses explore complex interactions among physical parameters, affecting Nusselt number, skin friction, and Sherwood number. Maxwell fluid's velocity is more affected by periodic magnetic force than Casson fluid, during the presence of nonlinear radiation. Additionally, nonlinear thermal radiation has a greater impact on temperature and concentration profiles compared to linear radiation for both fluids. Moreover, Casson fluid has a stronger influence on the average heat transfer rate compared to Maxwell fluid with nonlinear thermal radiation which is 8.6 % greater than the Maxwell fluid. On the other hand, at constant thermal radiation (*Ra*), due to decrease of Brownian motion (*Nb*), the rate of heat transfer is reduced by 1.2 % and 0.3 % respectively for Maxwell and Casson fluid. Also, for thermophoresis parameter (*Nt*), this rate is reduced by 2 % and 1.6 % respectively. The investigation also revealed that the *Ra* exhibits a positive sensitivity towards average Nusselt number, while *Nb* and *Nt* are displayed a negative sensitivity.

Key words: Nanofluid Maxwell fluid Casson fluid Arrhenius activation energy Periodic MHD Non-linear radiation Sensitivity analysis

https://www.sciencedirect.com/science/article/pii/S2405844024053374