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Comment on the paper: “Thermal radiation and chemical reaction effects on boundary layer slip flow and melting heat transfer of nanofluid induced by a nonlinear stretching sheet, M.R. Krishnamurthy, B.J. Gireesha, B.C. Prasannakumara, and Rama Subba Reddy Gorla, Nonlinear Engineering 2016, 5(3), 147-159”

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Abstract: The present comment concerns some doubtful results included in the above paper.

In the above paper the concentration equation is as follows (equation 4 in [1])

$$u \frac{\partial C}{\partial x} + v \frac{\partial C}{\partial y} = D_B \frac{\partial^2 C}{\partial y^2} + \frac{D_T}{T_\infty} \frac{\partial^2 T}{\partial y^2} - k_0(C - C_\infty) \quad (1)$$

In the above equation the units of each term are $\text{sec}^{-1}C$. Therefore the units of k_0 must be sec^{-1} in order that the term $k_0(C - C_\infty)$ is compatible with the other terms in equation (1).

The non-dimensional chemical reaction parameter is defined as (equation 15 in [1])

$$y(y) = \frac{k_0 Le}{a} \quad (2)$$

Taking into account that the symbol used in figures is y it is clear that in equation (2) the correct symbol is y and y is a misprint. In equation (2) $Le = \frac{\nu_f}{D_B}$ is the dimensionless Lewis number and a is a constant which appears in the following equation

$$u_w(x) = ax^n \quad (3)$$

From equation (3) it is found that the units of a are

$$[a] = m^{1-n}(\text{length})^{1-n}\text{sec}^{-1}(\text{time})^{-1}$$

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Therefore the units of chemical reaction parameter are

$$[y] = m^{n-1}(\text{length})^{n-1}$$

This means that the chemical reaction parameter is dimensional, not dimensionless, as the authors claim. The chemical reaction parameter is dimensionless and correct only for the case $n = 1$. However, there are many results with $n \neq 1$ in [1]. It is reminded here that the physical phenomena are treated with universal dimensionless numbers, not dimensional. See for example the view of Paul Dirac (Nobel Prize in Physics 1933) about dimensionless numbers in Buckley and Peat [2].

"Now, there is another dimensionless number which is of importance. If you have an electron and a proton, the electric force between them is inversely proportional to the square of the distance; the gravitational force is also inversely proportional to the square of the distance; the ratio of those two forces does not depend on the distance. The ratio gives you a dimensionless number. Of course it doesn't depend on what units you're using. It's a number provided by nature and we should expect that a theory will some day provide a reason for it."

In conclusion the results in Krishnamurthy et al. [1] for $n \neq 1$ are not correct.

References

- [1] M.R. Krishnamurthy, B.J. Gireesha, B.C. Prasannakumara, and Rama Subba Reddy Gorla, "Thermal radiation and chemical reaction effects on boundary layer slip flow and melting heat transfer of nanofluid induced by a nonlinear stretching sheet", Nonlinear Engineering, 5(3) (2016) 147-159.
- [2] P. Buckley(ed.), F.D. Peat(ed.) (1996) Glimpsing Reality: Ideas in Physics and Link to Biology, University of Toronto Press.