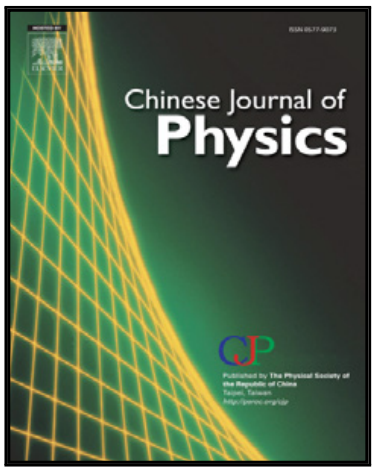

On three-dimensional flow of couple stress fluid with Cattaneo-Christov heat flux

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PII: S0577-9073(17)30130-2
DOI: 10.1016/j.cjph.2017.03.003
Reference: CJPH 197

To appear in: *Chinese Journal of Physics*

Received date: 12 February 2017
Revised date: 2 March 2017
Accepted date: 13 March 2017

Please cite this article as: Tasawar Hayat, Taseer Muhammad, Ahmed Alsaedi, On three-dimensional flow of couple stress fluid with Cattaneo-Christov heat flux, *Chinese Journal of Physics* (2017), doi: 10.1016/j.cjph.2017.03.003

Highlights

- Three-dimensional flow of couple stress fluid is constructed.
- Flow is induced by a bi-directional stretching surface.
- Cattaneo-Christov heat flux expression is accounted.
- Series solutions are developed through homotopy analysis method (HAM).

On three-dimensional flow of couple stress fluid with Cattaneo-Christov heat flux

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Abstract: This communication explores the novel Cattaneo-Christov heat flux model in three-dimensional flow of couple stress material. The flow is caused by a bidirectional stretching surface. This newly proposed model exhibits the properties of thermal relaxation. Mathematical formulation is performed through the boundary layer approach. The governing nonlinear partial differential system is converted to nonlinear ordinary differential system through adequate variables. The resulting nonlinear system has been solved for the series solutions of velocity and temperature distributions. Convergence of the obtained series solutions is verified. The contributions of various physical parameters are studied and discussed. Skin friction coefficients and heat transfer rate at the wall are also computed and analyzed. Our analysis reveals that the temperature and thermal boundary layer thickness are inversely proportional to the thermal relaxation parameter. Moreover the temperature and thermal boundary layer thickness are lower for Cattaneo-Christov heat flux model in comparison to the classical Fourier's law of heat conduction. To our knowledge such analysis even for the two-dimensional flow of couple stress fluid is not addressed yet.

Keywords: Three-dimensional flow; Couple stress fluid; Cattaneo-Christov heat flux; Stretching surface.

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