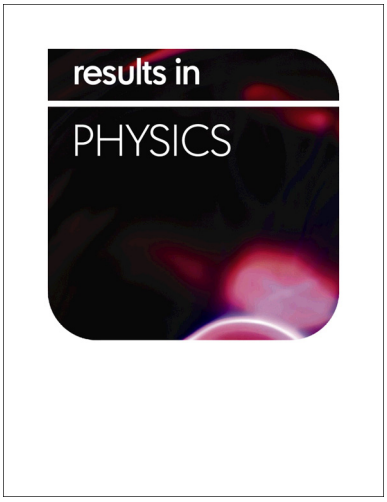


# Heat generation/absorption and nonlinear radiation effects on stagnation point flow of nanofluid along a moving surface

Feroz Ahmed Soomro, Rizwan Ul Haq, Qasem M. Al-Mdallal, Qiang Zhang

PII: S2211-3797(17)32039-9
DOI: https://doi.org/10.1016/j.rinp.2017.12.037
Reference: RINP 1112

To appear in: *Results in Physics*

Received Date: 23 October 2017
Revised Date: 10 December 2017
Accepted Date: 14 December 2017

Please cite this article as: Soomro, F.A., Haq, R.U., Al-Mdallal, Q.M., Zhang, Q., Heat generation/absorption and nonlinear radiation effects on stagnation point flow of nanofluid along a moving surface, *Results in Physics* (2017), doi: https://doi.org/10.1016/j.rinp.2017.12.037

# Heat generation/absorption and nonlinear radiation effects on stagnation point flow of nanofluid along a moving surface

*Feroz Ahmed Soomro*[1], *Rizwan Ul Haq*[2], *Qasem M. Al-Mdallal*[3,*], *Qiang Zhang*[1]

[1]*Department of Mathematics, Nanjing University, Nanjing 210093, China*

[2]*Department of Electrical Engineering, Bahria University, Islamabad, Pakistan*

[3]*Department of Mathematical Sciences, United Arab Emirates University, Al-Ain, UAE*

**Abstract**

In this study, heat generation/absorption effects are deal in the presence of nonlinear thermal radiation along a moving slip surface. Uniform magnetic field and convective condition along the stretching surface are adjusted to deal the slip mechanisms in term of Brownian motion and thermophoresis for nanofluid. The mathematical model is constructed in the form of coupled Partial differential equations. By introducing the suitable similarity transformation, system of coupled nonlinear ordinary differential equations are obtained. Finite difference approach is implemented to obtain the unknown functions of velocity, temperature, nanoparticle concentration. To deduct the effects at the surface, physical quantities of interest are computed under the effects of controlled physical parameters. Present numerical solutions are validated via numerical comparison with existing published work for limiting cases. Present study indicates that due to increase in both Brownian motion and thermophoresis, the Nusselt number decreases while Sherwood number shows the gradual increase.

**Keywords:** Heat generation/absorption; nonlinear thermal radiation; nanofluid; stagnation point; convective boundary; numerical solution.

## 1. Introduction

After the initial concept of boundary layer theory, Sakiadis presented the series of articles [1-3] in 1961, where he mentioned the new class of boundary layer problems that deals the flow on a continuous solid surface. In his study, mathematical model and their solutions were proposed for continuous flat and cylindrical surfaces. The work was further extended by Crane [4] in which he deals the flow past a stretching surface. Study of such kind of flows got motivation from its

[*] *Corresponding author: E-mail: Qasem M. Al-Mdallal (q.almdallal@uaeu.ac.ae)*