Title: Unsteady boundary layer flow and heat transfer over an exponentially shrinking sheet with suction in a copper-water nanofluid

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Abstract: An analysis of unsteady boundary layer flow and heat transfer over an exponentially shrinking porous sheet filled with a copper-water nanofluid is presented. Water is treated as a base fluid. In the investigation, non-uniform mass suction through the porous sheet is considered. Using Keller-box method the transformed equations are solved numerically. The results of skin friction coefficient, the local Nusselt number as well as the velocity and temperature profiles are presented for different flow parameters. The results showed that the dual non-similar solutions exist only when certain amount of mass suction is applied through the porous sheet for various unsteady parameters and nanoparticle volume fractions. The ranges of suction where dual non-similar solution exists, become larger when values of unsteady parameter as well as nanoparticle volume fraction increase. So, due to unsteadiness of flow dynamics and the presence of nanoparticles in flow field, the requirement of mass suction for existence of solution of boundary layer flow past an exponentially shrinking sheet is less. Furthermore, the velocity boundary layer thickness decreases and thermal boundary layer thickness increases with increasing of nanoparticle volume fraction in both non-similar solutions. Whereas, for stronger mass suction, the velocity boundary layer thickness becomes thinner for the first solution and the effect is opposite in the case of second solution. The temperature inside the boundary layer increases with nanoparticle volume fraction and decreases with mass suction. So, for the unsteadiness and for the presence of nanoparticles, the flow separation is delayed to some extent.