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Computational Modeling of Radiative Cooling Coupled with Thermoconductivity Using Maple Software: Challenges and Results
ALEXANDER PANIN, Utah Valley University — Maple is a versatile software package which can go as far as solving partial differential equations (PDEs). Many astrophysical problems (as well as many engineering situations) require coupling of thermoconductivity equation with radiative cooling/heating. Using Maple software for such problems results in serious challenge due to the fact that it requires non-linear boundary condition (black body radiation). Turns out that Maple cannot solve linear PDE with non linear boundary condition. However, Maple can solve some non-linear PDEs with non-linear boundary conditions (!). So if to slightly modify thermoconductivity equation by adding some non-linear terms, then Maple accepts non-linear boundary conditions for it too. Decreasing non-linear terms to insignificant values (for the particular problem in hand) allows accurate modeling of radiative cooling/hating, and thus adapting Maple for wide class of problems. As a few examples, we model radiative cooling of a chunk of molten silicate debris in vacuum (as a result of asteroid collision), the dynamics of radiative cooling and heating of lunar soil during lunar nights and days, daily and yearly variations of Earth soil temperature, radiative cooling of a planet, and cooling of a neutron star. The model we used and the computational results are discussed in the presentation.

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