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Nonclassical analysis of the nonlinear Kompaneets equation

The nonlinear Kompaneets (NLK) equation describes the spectra of photons interacting with a rarefied electron gas. We exhibit five previously unknown classes of explicit time-dependent solutions (each class depending on initial conditions with two parameters) of the NLK equation. It is shown that these solutions cannot be found as invariant solutions using the classical Lie method (solutions obtained by Ibragimov (2010)) but are found using the nonclassical method. Interestingly, each of these new solutions can be expressed in terms of elementary functions. Three of these solution classes exhibit quiescent behaviour and the other two solution classes exhibit blow-up behaviour in finite time. As a consequence, it is shown that corresponding nontrivial stationary solutions are all unstable. This is joint work with Zhengzheng Yang and Shou-fu Tian. For details, see our paper with the same title in J. Eng. Math 84: 87-97 (2014)