PIMS APPLIED MATHEMATICS SEMINAR SERIES

Pacific Institute *for the* Mathematical Sciences

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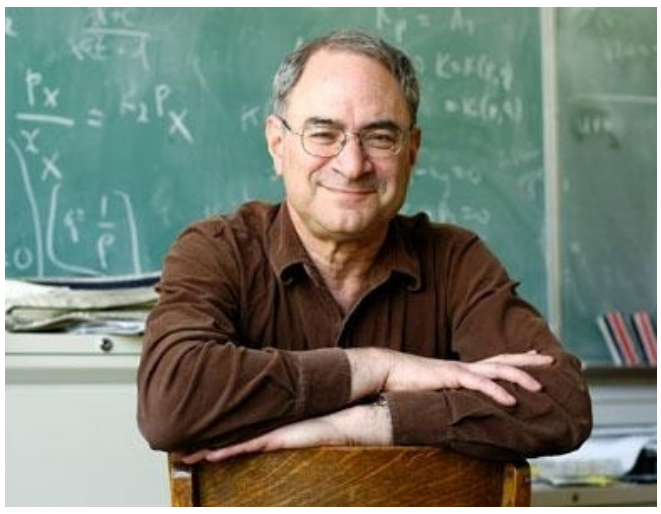

Friday, March 23, 2012
3:30 p.m. Arts 263
University of Saskatchewan

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.

In the classical Lie method, one seeks symmetries that are point transformations leaving invariant the solution manifold of a given partial differential equation (PDE) system, i.e, symmetries that map any solution of a given PDE system to another solution of the same system, and then seeks corresponding solutions that are themselves invariant. In the nonclassical method, one seeks "symmetries" that are transformations leaving invariant a solution submanifold of a given PDE system, i.e., "symmetries" that are transformations mapping some solutions of a given PDE system into solutions of the same system but map other solutions of the given PDE system map to solutions of a different PDE system, and then seeks corresponding solutions that are invariant. Consequently, all solutions obtainable by Lie's classical method can be obtained by the nonclassical method.

This is joint work with PhD students Zhengzheng Yang (UBC) and Shou-fu Tian (Dalian University of Technology).

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