Integrable multidimensional PDEs of hydrodynamic type: method of solution and multidimensional wave breaking

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Integrable PDEs of hydrodynamic type, including physically relevant examples like the dispersionless Kadomtsev - Petviashvili, the Boyer - Finley and the heavenly equations, arise from the commutation of vector fields and can be studied using a novel Inverse Spectral Transform [1, 2]. In particular, the nonlinear Riemann - Hilbert inverse problem is a powerful tool i) to study the longtime behavior of localized solutions, ii) to establish if such solutions break, due to the lack of dispersion and dissipation, and, if they do, to extract the analytic features of such a breaking in a surprisingly explicit way; iii) to construct distinguished examples of exact implicit solutions [3]. A summary of the above theory is presented, together with some recent results on the rigorous aspects of such a theory, obtained in collaboration with P. G. Grinevich and D. Wu. This presentation is dedicated to Manakov's memory.

References

[1] S. V. Manakov and P. M. Santini, *Inverse scattering problem for vector fields and the heavenly equation* http://arXiv:nlin.SI/0512043

[2] S. V. Manakov and P. M. Santini, *Inverse scattering problem for vector fields and the Cauchy problem for the heavenly equation*, Phys. Lett. A 359 (2006), pp. 613–619.

[3] S. V. Manakov and P. M. Santini, *On the solutions of the dKP equation: nonlinear Riemann Hilbert problem, longtime behaviour, implicit solutions and wave breaking*, J.Phys.A: Math.Theor. 41 (2008), 055204.