

# Valentin Lychagin — A dedication

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This volume is dedicated to the 60<sup>th</sup> anniversary of Valentin Lychagin. It is based on the works of the participants of the International Conference *Geometry and Algebra of PDEs* held in his honor<sup>1</sup> at the University of Tromsø (Norway) in August 12–17, 2007.



Valentin Vasil'evich Lychagin was born on April 1, 1947 in the town Shebekino (the Belgorod Region of the former USSR).

In 1965 he graduated from the celebrated School of Physics and Mathematics (18 Moscow Boarding School) led by A.N. Kolmogorov. Lychagin also graduated from the Department of Mechanics and Mathematics at Moscow State University in 1970 specializing in Differential Geometry and Topology. This area had become the principal area of research in the entire scientific life of Lychagin.

From 1970 to 1973 Valentin Lychagin was a post-graduate student of Department of the Applied Mathematics, Moscow Institute of Electronic Engineering and Applied Mathematics, under formal supervision of V.P. Maslov. In his

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<sup>1</sup>The workshop was organized by B. Kruglikov and P. Jakobsen. It was supported by the Research Council of Norway (project NFR-177526) and the University of Tromsø.

Ph.D. Thesis [1974] Lychagin solved the Sophus Lie problem of local classification for first-order nonlinear differential equations near singularities, i.e. points where the equation, viewed at as a submanifold in the first jets, is tangent to the contact distribution.

From 1974 until 1992 Lychagin worked at the Moscow Institute of Civil Aviation Engineering, the Moscow Institute for Municipal Economy and Civil Engineering as well as in various research centers, including the International Sophus Lie Center, where he became the director of the Moscow Branch.

Lychagin was also one of the main driving forces of the seminar on geometry of differential equations at the Moscow State University, directed by A.M. Vinogradov. There I. Krasil'shchik, V. Lychagin and A. Vinogradov raise the program of putting on rigorous footing ideas of S. Lie and E. Cartan on geometrization of differential equations including into it various aspects of integrability. This activity culminates in the book *Introduction to the Geometry of Nonlinear Differential Equations* [Nauka, Moscow, 1986]. An English translation of an extended version of this book under the title *Geometry of Jet Spaces and Nonlinear Partial Differential Equations* was published by Gordon and Breach Science Publishers [New York, 1986].

In addition to the seminar on the Geometry of PDEs, Lychagin took active part in the seminar by V. Arnold on the Singularity Theory. During this period he writes and defends his Doctor of Science Thesis *Geometrical and Topological Aspects of Non-Linear PDE Theory: Characteristic Classes, Singularities and Normal Forms* [1990], which encompasses various perspectives of the geometric approach to PDEs and solves many important problems in this theory.

In 1992 Valentin visits Norway and works at the Norwegian Academy of Science and Letters. Starting from 1995 until the present time Lychagin is a full professor at the Department of Mathematics and Statistics, University of Tromsø, Norway. He was numerously invited to be a plenary speaker at various conferences. In 1996 Lychagin was elected to be a Corresponding Member of the Russian Academy of Natural Sciences.

His field of research embraces nonlinear partial differential equations, contact geometry and geometry of Monge–Ampère differential equations, differential geometry and mathematical physics, stochastic differential equations, topology and logic, mathematical theory of measurement and information, quantum mathematics as quantizations of differential equations and quantizations of monoidal categories.

Lychagin's scientific activity is incredibly wide. Let us briefly mention some milestones. In latest Soviet years he writes, in collaboration with D.V. Alekssevskii and A.M. Vinogradov, a comprehensive introduction to the Modern Geometry *Basic ideas and concepts of differential geometry. Geometry I*, English translation: [Encyclopaedia Math. Sci., 28, Springer, Berlin, 1991]. This is an excellent scientific work which shows unity of the Differential Geometry and beautifully illustrates interplay between Differential Geometry and Differential Equations.

In recent years, V. Lychagin jointly with V. Goldberg studied planar webs and solved a number of longstanding classical problems in this theory posed by

W. Blaschke. They found a criterion for linearizability of a planar 3-web and of  $d$ -webs with  $d > 3$  (the latter in collaboration with M. Akivis). They also characterized planar webs with a given number of Abelian relations by means of the web invariants.

A series of papers with B. Kruglikov is devoted to construction of an efficient tool to check formal integrability of a system of PDEs. The criteria of compatibility are formulated in terms of multi-brackets, which are related to non-commutative determinants and are based on delicate homological algebra tools. They also investigated algebra of scalar differential invariants and proved a generalized Lie–Tresse finiteness theorem for pseudogroup actions on differential equations.

We cannot reflect here all aspects of scientific activity of V. Lychagin, including his important works on the mathematical foundations of quantization theories, joint works with L. Zilbergleit on Spencer cohomology and symmetry algebras, long collaboration with P. Jakobsen on categorical theory of relations and quantizations as well as many others.

Recently, one of the long-lasting scientific project of Lychagin on geometric treatment of Monge–Ampère equations has been realized. In collaboration with A. Kushner and V. Rubtsov they have written the book *Contact Geometry and Non-linear Differential Equations* [**Cambridge University Press, 2007**].

Along with this activity, Valentin Lychagin is one of the organizers of the Sophus Lie Seminar in Tromsø. This promoted Tromsø in research and made possible visits to the University of Tromsø of many highest rank scientists and experts in various areas of mathematics.

In the last years V. Lychagin was involved in organization of many mathematical meetings devoted to differential equations and differential geometry. He, with the help of V. Kuzakon and A. Kushner, annually organizes the conference *Geometry in Odessa*, which unites the researchers from the disintegrated post-Soviet mathematical community and scientists from abroad. He was one of the organizers of a workshop in Finland and a satellite conference of the *International Congress of Mathematicians* in 2006. In 2008 he will co-organize the prestigious *Abel Symposium*.

Valentin Lychagin has many students, more than 20 co-authors and plenty of friends in science and life. We all, the Authors of the current volume and many others, wish him good health, happiness and joy of new discoveries.