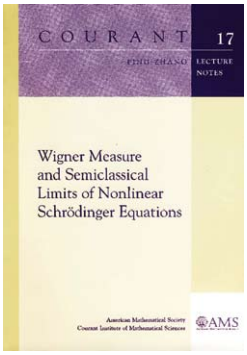
Mathematician Prof. ZHANG Ping

Awarded for Several Studies on Equations from Fluid and Quantum Mechanics

Prof. ZHANG Ping with the CAS Academy of Mathematics and Systems Science and Prof. JIANG Song with the Beijing Institute of Applied Physics and Computational Mathematics are awarded a Second-Prize from the 2011 State Natural Science Award for their contributions to the field of partial differential equations from mathematical physics. Applying analytic tools of weak convergence method and micro-local analysis, they systematically studied several partial differential equation problems from fluid and quantum mechanics.

In the field of **Multi-dimensional isentropic compressible Navier-Stokes system**, JIANG and ZHANG improved previous results given by P. L. Lions, who proved in 1998 the global existence of weak solutions to this system under the assumption that the adiabatic exponent of gas $\gamma>3/2$ when $n=2$ and $\gamma>9/5$ when $n=3$. Through developing new techniques on the singular behavior and finding new properties to the approximate solutions, they improved Lions' existence result to the case $\gamma>1$ when the initial data are spherically symmetric or axisymmetric. Based on Lions and ZHANG and JIANG's results, E. Feireisl generalized the work of Lions to $\gamma>n/2$. So far, ZHANG and JIANG's result is recognized as the only existence result when the adiabatic exponent of gas $1<\gamma\leq n/2$ (and of course with certain symmetry assumption on the initial data).

ZHANG also made contributions to the field of **semi-classical limit to the nonlinear Schrödinger equation**,



The cover of a monograph by Prof. ZHANG Ping. ZHANG at the CAS Academy of Mathematics and Systems Science and his cooperator JIANG Song from the Beijing Institute of Applied Physics and Computational Mathematics are awarded a Second-Prize from the State Natural Science Award for their contributions to the field of partial differential equations from mathematical physics.

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Prof. JIANG Song, ZHANG's cooperator at the Beijing Institute of Applied Physics and Computational Mathematics.

a mathematical branch that makes Bohr's correspondence principle mathematically rigorous, *i.e*. Newtonian mechanics is the limit of quantum mechanics when Planck's constant goes to zero. In the one-dimensional case, they completely solved the limit from the semi-classical Schrödinger-Poisson equations to the Vlasov-Poisson equations; and in the multi-dimensional case, they first introduced the so-called "Modulated Energy Functional" and solved the semi-classical limit before the formation of singularities to the limit system, and globally solved the semi-classical limit of one-dimensional Schrödinger-Poisson equations. This result is so far the only case when the Wigner measure was succeeded in the application to the semi-classical limit of nonlinear problems. Furthermore, they proved the semi-classical limit of Gross-Pitaevskii equation in exterior domains to the Euler system with natural boundary conditions.

In the field of **shallow water equation and related variational wave equation**, ZHANG and his collaborators proved the global existence of weak solutions in the energy space to the shallow water equation (Camassa-Holm equation), by using Young measure method. This work has led to many subsequent works, and has so far been cited by others for 108 times. Through the application of Young measures and micro-local defect measures, they also proved the global existence of weak solutions to a related variational wave equation from liquid crystals. Furthermore, they studied the solution structure and proved the global well-posedness to its general asymptotic equations.

On **incompressible visco-elastic equations**, as mentioned by P. Constantin and C. Fefferman *etc*. in their paper, the mathematical theory to them is still at a developing stage. However, based on the works of P. L. Lions, J. Y. Chemin and E. Weinan, ZHANG and his collaborators systematically studied the global well-posedness to the Oldroyd model in two, three spatial dimensions and with small initial data.

The awardees have so far published 41 papers in the above-mentioned fields, including five in *Comm. Pure Appl. Math*., four in *Arch. Ration. Mech. Anal*., and five in *Comm. Math. Phys*. Moreover, they published a monograph (in English) and wrote two chapters for the book series *Handbook of Differential Equations, Evolutionary Equations*, which was edited by C. Dafermos and E. Feireisl. Their papers have been cited by peers including C. Fefferman, P. L. Lions, G. Papanicolaou, H. P. Mckean, C. Dafermos, and A. Bressan for 584 times in total. In particular, the eight representative papers have been cited by others for 228 times, and the paper on global weak solutions to the shallow water equation cited by others for 108 times.