

## Application for a short visit MISGAM grant

**Applicant:** Alexander Its  
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**Host:** Boris Dubrovin  
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## **Project Description :**

### **The asymptotic analysis of random matrices and related aspects of the theory of integrable systems**

The goal of the visit is to analyse the recent advances in the theory of random matrices based on the Riemann-Hilbert method and relate them to the general aspects of the theory of integrable systems, particularly to the ones concerning with the universal critical behavior of integrable PDEs. The concrete topics to be discussed during Dr. Its' visit include the following problems.

- The uniqueness and the global asymptotic properties of the special solution to the  $P_I^2$  equation which was introduced by B. Dubrovin in his studies of the universalities in the Hamiltonian perturbations of hyperbolic systems of conservation laws. Relation to the universalities in matrix models.
- The asymptotic analysis of the block Toeplitz determinants appearing in random matrix theory and in the theory of quantum spin chains.
- The pole structure of the tritronquee solution to the Painlevé I equation which plays a central role in several aspects of modern theory of integrable systems including the 2D quantum gravity and the critical behavior in the focusing nonlinear Schrödinger equation.

In addition, Dr. Its will give a short course (2-3 lectures) on the asymptotic analysis of random matrices and orthogonal polynomials via the Riemann-Hilbert method.

## Curriculum Vitae :

**Name:** ALEXANDER R. ITS

**Degrees:** PhD in Mathematics, Leningrad University, Leningrad USSR, 1977; Habilitation, Mathematics, Steklov Mathematical Institute, Leningrad, USSR, 1987

**Present employment:** Brunel University, West London & Imperial College, London, UK; on leave of absence from Indiana University-Purdue University at Indianapolis, USA

**Awards:** The Prize of the Moscow Mathematical Society (1976); The Prize of the Leningrad Mathematical Society (1981); 2002 Hardy Fellow of the London Mathematical Society;

**Honorable lecturships:** Invited Address to the AMS - MAA - SIAM Joint Mathematical Meetings, January 22, 2000; Hardy lectures to the London (June 21.02) and to the Edinburgh (May 24.02) Mathematical Societies. Series of Hardy lectures in several universities in the UK ( March 12 - June 28, 2002 )

### Selected Monography

1. E.D. Belokolos, A.I. Bobenko, V.Z. Enolskii, A.R. Its, V.B. Matveev, *Algebro-Geometric Approach to Nonlinear Evolution Equations*, 337 p., Springer-Verlag (1994)
2. Athanassios S. Fokas, Alexander R. Its, Andrei A. Kapaev, Victor Y. Novokshenov, Painleve Transcendents: The Riemann-Hilbert Approach, AMS Series: Mathematical Surveys and Monographs, v. 128, 563p. (2006)

### Selected Publications

1. A.S. Fokas, A.R. Its and A.V. Kitaev, The Isomonodromy Approach to Matrix Models in 2D Quantum Gravity, *Comm. Math. Phys.* 147, 395-430 (1992).
2. P. Bleher, A. Its, *Semiclassical Asymptotics of Orthogonal Polynomials, Riemann-Hilbert Problem, and Universality in the Matrix Model*, *Ann. of Math.*, 150 (1999), 185 - 266.
3. P. A. Deift, A. R. Its, X. Zhou, A Riemann-Hilbert Approach to Asymptotic Problems Arising in the Theory of Random Matrix Models, and Also in the Theory of Integrable Statistical Mechanics, *Ann. of Math.* **146**, 149-235 (1997).
4. A. R. Its, *The Riemann-Hilbert Problem and Integrable Systems*, A Feature Article, *Notices of the AMS*, Vol. **50**, Number 11 (2003) 1389 - 1400
5. A. Its, B.-Q. Jin, V. Korepin, *Entanglement in XY spin chain*, *Journal Phys. A: Math. Gen.* 38, 2975, (2005)
6. P. Deift, A. Its, I. Krasovsky, Asymptotics of the Airy-kernel determinant, arXiv: math/0609451 accepted to *Commun. Math. Phys.*