

## **Encomium**

**Nikolai Chernov, PhD, 1956 -- 2014**

### **His Mathematical Life**

Nikolai Chernov's mathematical career started in his youth. He actively participated in Math Olympiads in the former Soviet Union and was a winner of several of them. He then competed in the International Mathematics Olympiad in Erfurt, 1974, and won one of the medals there. From that point on, the arrow of his career has always flown straight and true. In 1978, shortly before the time of his receiving his diploma (equivalent of master's degree) from Moscow State University (1980) Yakov Sinai (now a professor at Princeton University) became his mentor and advisor. That association had a strong impact on Nikolai's scientific life.

Nikolai received his PhD from Moscow State University in 1984 with Sinai as his advisor. He worked on dynamical systems, more precisely, mathematical models of gases and fluids where particles (molecules) collide elastically with each other and/or bounce off the walls of the vessel containing them by the law of specular reflection. These mathematical models are often called "billiards", and they play a major role in statistical mechanics, optics, and other areas of physics and the natural sciences.

Nikolai, under the direction of Sinai, has studied the so-called Boltzmann Ergodic Hypothesis, which goes back to Ludwig Boltzmann (circa 1870). It claims that the dynamics of gases and fluids modeled with hard (rigid) molecules is chaotic (ergodic) and thus can (and should) be described in probabilistic terms. In mathematics and physics "ergodic" means that the system in question, over long periods of time, spends as much time in one area of its "phase space" of possible states as any other: that is, all accessible states are equiprobable over long time. This hypothesis is at the heart of the mathematical foundation of statistical mechanics.

Even before receiving his PhD, Nikolai (jointly with Sinai) proved a fundamental theorem on what later was called “local ergodicity”, which was instrumental for many subsequent proofs of ergodicity in various physical models.

Shortly after receiving his PhD, he obtained other important general results for chaotic billiard systems, including gases with hard (rigid) molecules and the so called Lorentz gases modeling electrical current in metals (which has been studied since 1905). In a recent paper (2010, joint with Dolgopyat), he derived Ohm’s Law from a billiard model under more realistic assumptions than had previously accomplished.

Since 1991, Nikolai resided and worked in the United States, and for the past 20 years, at the University of Alabama at Birmingham. He has been a professor at UCLA, Georgia Tech, and Princeton University. He was a visiting member of the Institute for Advanced Studies (Princeton) in 2002, a prestigious appointment for any mathematician. Throughout this time, he continued his research in dynamical systems and statistical mechanics and became one of the major players in the field.

Nikolai published over 100 papers in refereed journals and several books and book chapters. The most significant of his publications are

- an article on Markov partitions for hyperbolic flows in the *Annals of Mathematics* (1998, one of the most prestigious mathematics journals in the world),
- an 80-page article on the classical physical model of the moving piston (joint with Joel Lebowitz at Rutgers and Yakov Sinai at Princeton, 2002), and
- a 200-page volume of the *Memoirs of American Mathematical Society* on a novel diffusion model with two moving molecules (joint with Dmitry Dolgopyat at Georgia Tech, 2009),

just to name a few.

Nikolai published several books, including ***Chaotic Billiards*** in the American Mathematical Society series *Mathematical Surveys and Monographs* (2006), as well as several book chapters and survey articles.

Nikolai was an eagerly sought invited speaker at many research conferences and workshops, both national and international. He gave a plenary address at the regional AMS meeting in Memphis in 1997. He gave plenary lectures at mathematics and physics conferences in Germany, Italy, France, England, the Netherlands, Austria, Hungary, Bulgaria, Japan, Brazil, Uruguay, Mexico, Canada, etc. Nikolai was invited to speak at the 2014 International Congress of Mathematics in Seoul (South Korea).

Nikolai also organized several conferences and professional meetings. He was Head of the Organizing Committee for a regional AMS meeting in Birmingham in 2000.

Nikolai has been active as a reviewer and has been a member of the editorial board for

- *the Journal of Statistical Physics*,
- *Annales Henri Poincare*,
- *Chaos*,

and other professional journals.

Nikolai's research has been continuously supported by the National Science Foundation since 1994. He has been the Principle Investigator on eight NSF research grants. His current NSF grant would have supported his research until 2016. He has been an NSF panel member, reviewing the research proposals of his peers, frequently since 1997.

Nikolai's research interests also include probability and statistics, with various applications: nuclear physics, computer vision, archaeology, crystallography, operations research, and others. He has published about 25 articles in applied research journals, as well as a book: ***Circular and Linear Regression*** in the series *Monographs on Statistics and Applied Probability* (2010).

Nikolai maintained several web pages devoted to his research. They contain his publications, visual demonstrations, computer codes, etc. He often collaborated with scientists and engineers, both locally and internationally.

Nikolai mentored seven Ph.D. students at UAB. One of them (Hongkun Zhang) is now supported by a National Science Foundation Career Grant, an honor given to a small number of very promising young researchers each year. Another (Alexey Korepanov) holds a post-doctoral position at Warwick University (England). Yet another (Henry van den Bedem) is employed by Stanford University. Nikolai has served as the designated graduate adviser for all masters level students in our department since 2005. He has had a lasting impact on the many undergraduate students who passed through his courses.

Nikolai made significant contributions to the education enterprise. He developed several new courses here at UAB, including Probability, Statistics, Dynamical Systems, Thermodynamic Formalism, Applied Mathematics, Advanced Probability, and Advanced Statistics. He has also written lecture notes for several pre-existing courses (such as Numerical Linear Algebra and Real Analysis) that are used by other instructors in those courses. The latter two mathematical topics are among those for which graduate students aiming to enter the PhD program in our department must pass “qualifying exams”. He maintained notes for courses and numerous past examinations on his website. Students regularly use Nikolai’s course notes to study for qualifying exams. Students and faculty used his bank of past course

examinations for inspiration and practice.

Nikolai was, and is, tremendously respected by his peers. He was recently nominated by his peers in the mathematical community to become a Fellow of the American Mathematical Society.

It is often said that we live on in the memories of our family, friends, and colleagues. Mathematicians are especially favored in this – because mathematicians like Nikolai discover, create, and prove important and fundamental results, they live on in the intellectual world of mathematics for years, decades, centuries, and even millennia.