New Book Uses Physical Reasoning to Solve Mathematical Problems

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Mark Levi, professor of mathematics at Penn State, has authored a book titled "The Mathematical Mechanic: Using Physical Reasoning to Solve Problems," soon to be published by Princeton University Press. The book, which is written for a general audience with some knowledge of precalculus and basic geometry, treats readers to a host of entertaining problems and mind-bending puzzles to amuse and inspire their inner physicist.

In his book, Levi reveals how physics can simplify mathematical proofs and lead to quicker solutions and new theorems. He also shows how physical solutions can illustrate why the results of proofs are true. For example, he demonstrates how it is possible to derive the Pythagorean theorem by spinning a fish tank filled with water and how the line of best fit for a dataset can be found using a mechanical contraption made from a rod and springs.

The book has received high pre-publication praise from a number of scholars and book authors, including Louis Nirenberg, a professor of mathematics at New York University and recipient of the National Medal of Science, who said, " This is an absolutely delightful book, full of surprises -- even for mathematicians like myself -- and beautifully written. It can be enjoyed by anyone, from someone just learning calculus to professional mathematicians and physicists." Another endorsement came from Steven Strogatz, author of "Sync: How Order Emerges from Chaos in the Universe, Nature, and Daily Life," who said, "What a fun book! Mark Levi's physical arguments are so clever and

surprising that they made me laugh with pleasure, again and again. The Mathematical Mechanic is downright magical -- a real treat for anyone who loves intuition."

Levi's research focuses on the use of concepts of geometry and analysis to understand physical problems. The analysis of this hidden "geometrical world" gives new insight into concrete problems -- an insight that is not accessible by direct experimental or numerical inspection. In particular, Levi uses mathematical methods to predict and explain the complex motion of various dynamical systems, such as satellites, asteroids, electric circuits, and fluids. Many mechanical problems are geometrical in nature, although in a higher-dimensional space -- the so-called phase space -- than the usual three-dimensional physical space. According to Levi, some fascinating phenomena, such as the stable levitation of charged particles in an oscillating electric field, are much better explained when translated into an equivalent geometrical setting. Levi's combined approach has allowed him to predict a new phenomenon in the motion of a chain of interconnected pendula -- a system that imitates the current in superconducting crystals. This new observation was later rediscovered by experimentalists. "I use mathematics as a tool to explain how things work," he said.

Levi earned his bachelor's degree in mathematics at the Latvian State University at Riga in 1973 and his doctoral degree in mathematics at the Courant Institute of New York University in 1978. He has taught mathematics at a number of universities in the United States and Europe, most recently as professor of mathematics at Rensselar Polytechnic Institute from 1993 to 1998, before joining the Penn State faculty as a professor of mathematics in the fall semester of 1998.

More information about the book is on the Web at: press.princeton.edu/titles/8861.html .