Researchers 'rewrite the book' in quantum statistical physics

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An important part of the decades-old assumption thought to be essential for quantum statistical physics is being challenged by researchers at Rutgers, The State University of New Jersey, and colleagues in Germany and Italy.

In a journal article to be published in *Physical Review Letters* and now available online, the researchers show that it is not necessary to assume that large collections of atomic particles are in a random state in order to derive a mathematical formula that conveys that smaller collections of those particles are indeed random. While their proof is unlikely to change any of today's high-tech products and processes, it could nonetheless lead to rewrites of tomorrow's physics textbooks.

For decades, physicists believed that an assumption of randomness accounts for the canonical distribution formula at the heart of statistical mechanics, a field that helps scientists understand the structure and properties of materials. Randomness remains a necessary foundation to derive this formula for systems governed by the principles of classical mechanics. But the basic constituents of materials reside at the atomic and subatomic levels, where the principles of quantum mechanics take hold. The researchers have found that for quantum systems the situation is quite different than physicists had believed.

"What we have found is so simple that it is surprising that it was not discovered long ago," said Sheldon Goldstein, professor of mathematics and physics at Rutgers and one of the paper's four authors. "More

surprising still is the fact that Erwin Schroedinger, one of the founders of quantum mechanics, had the essential idea more than fifty years ago, and this was entirely unappreciated."

The other authors of the journal article, titled "Canonical Typicality," are Joel Lebowitz, professor of mathematics and physics at Rutgers; Roderich Tumulka, assistant professor of mathematics at the University of Tuebingen in Germany; and Nino Zanghi, professor of physics at the University of Genoa in Italy.

Source: Rutgers, the State University of New Jersey