Does God Play Dice?

"God does not play dice with the Universe," was Einstein's famous retort to the uncertainty principle – nowadays one of the basic tenets of modern physics. Certain aspects of material existence do seem truly random; they lack order and can never be completely predicted. Scientists in the Faculty of Mathematics and Computer Science investigate various aspects of randomness and use their findings to develop sophisticated research tools and information security protocols.

Randomness has always been seen as an impartial, unpredictable method of decision making. But is there such a thing as true randomness? According to Prof. Oded Goldreich, the question shouldn't be whether a phenomenon is truly random, but whether it appears to us to be random, and whether we are capable of generating phenomena that appear random even though they are

Diagram of a hyperbolic surface with infinite genus, from the research of Prof. Omri Sarig

(l-r) Profs. Omri Sarig, Gideon Schechtman and Oded Goldreich

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not. Such pseudo-random systems are used to preserve privacy and protect digital information, as well as providing research tools for scientists in many fields.

Prof. Omri Sarig researches chaotic systems. Due to their inherent instability, even simple laws (e.g., the laws of motion or Newton's laws) can produce unexpected behavior. The evolution of such systems over time cannot be predicted, even though they act according to deterministic laws, and thus their behavior appears to be arbitrary and unpredictable.

Prof. Gideon Schechtman uses randomness to prove the existence of simple, multidimensional structures that are hidden as substructures within larger, complex formations. The basic example of such an application of randomness was discovered by Prof. Aryeh Dvoretzky, seventh president of the Weizmann Institute, some fifty years ago.