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Special Lecture

**How Does God Throw Dice? Speculations About  
Quantum Mechanics at the Planck Scale.**

of Nobel Laureate

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in honor of

**Hagen Kleinert**

on the occasion of his 60th birthday on June 15th, 2001  
at the Freie Universität Berlin

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Attempts to arrive at consistent theories combining quantum mechanics with general relativity not only require new concepts of space, time, and matter, such as the ideas that lead to superstring theory, D-brane theory, and M-theory, but they may also require a reconsideration of what quantum mechanics itself really is about. Although completely deterministic scenarios appear to be ruled out by the Bell inequalities, it is nevertheless worth-while to investigate a set-up where we start with a deterministic theory and add to this the notion of information loss. Models proposed so-far all show deficiencies of some sort which make them unrealistic for describing the real world, but they do show how chaotic phenomena in a deterministic theory might be found to lie at the basis of the quantum nature of our world.

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