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Einstein Prize: Black Hole Entropy - Then and Now

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Forty five year ago black holes were universally regarded as gravitational entities with only mechanical and electrical attributes. There then occurred a shift in thinking and we became accustomed to regard those exotic objects as also subject to thermodynamics. I shall recollect the forerunners of this conceptual change e.g. Hawking's black hole area increase theorem, and some of the steps by which it took place. The transition involved the introduction of black hole entropy and temperature, and the formulation of a generalized version of the second law. This last proved prophetic with the discovery of Hawking's radiance, a phenomenon which transcends the area increase theorem, but upholds the generalized second law. The thermodynamic paradigm for black holes has brought us face to face with subtle issues having to to do with the significance of information in physics, and the seeming collision between gravitational theory and quantum mechanics. Among the concrete fruits of the new way of thinking are various results on the peak information capacity of physical systems, as well as the "holographic" approach by which intricate calculations in quantum field theory (with applications to elementary particles or condensed matter physics) can be traded for tractable ones in classical gravity theory.