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Gravitational tidal forces and the equivalence principle

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Gravitational tidal forces conceal very interesting effects when combined with the extended nature of the wavefunction of a freely-falling quantum particle. The reason being that inertial properties of the particle get then mixed with the gravitational effects in such a way that, as in classical mechanics, the ratio between the gravitational mass and the inertial mass emerges. The equivalence principle in quantum mechanics then takes on a novel meaning thanks to the emergence of mass-independent dynamics during the free fall of the quantum particle.

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