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Gravitational tidal forces bring Newton's equivalence principle to life in quantum mechanics

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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 of the gravitational mass to the inertial mass of the particle emerges in an isolated form. 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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