When Anderson localization makes quantum particles move backward

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We unveil a novel and unexpected manifestation of Anderson localization of matter wave packets that carry a finite average velocity: after an initial ballistic motion, the packet center-of-mass experiences a retroreflection and slowly returns to its initial position. We describe this effect both numerically and analytically in dimension 1, and show that it is destroyed by weak particle interactions which act as a decoherence process. The retroreflection is also present in higher dimensions, provided the dynamics is Anderson localized.