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The dependence of energy and momentum on fiducial 4-vector fields

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1 Momentum in "static" electromagnetic configurations

(a) Why is internal energy invariant under a change of Newtonian reference frame, whereas kinetic energy is not?

(b) Consider a car accelerating on a street, say in the positive-x direction. In the frame of reference where the street is at rest, there is a flow of positive x-momentum – that is, force – from the street to the car, or equivalently a flow of negative x-momentum from the car to the street. In the frame of reference where the car is at rest, the *flow* of momentum is the same.

Not so with energy flow. In the frame of reference where the street is at rest, there is no flow of energy between street and car: the contact forces involved act on matter that has momentarily zero velocity, so their work is zero. In the reference frame where the car is at rest, there is a flow of positive energy from the car to the street: the contact forces do work on the latter.

Why do the flows of momentum and of energy behave differently under this change of frame?

(c)