

- Light = Electromagnetic wave
— a disturbance propagating in the ether with velocity c
- Ether:
 - Penetrates “ponderable” matter but does not interact with it
 - Is devoid of all physical properties (i.e., mass, density, etc.) except that it defines a frame of reference in which light propagates with c in all directions

Two Scenarios

(1) Ether-drag

- The velocity of light must depend on the velocity of the light source
- Is not confirmed by observations

(2) All matter moves through “ether-sea”

- Galilean relativity breaks down
- All light sources, whether moving or at rest in the calm “ether-sea,” propagate light with the same velocity
- The velocity of light will be different in different directions: this can be tested, has been tested, and has *not* been confirmed

- (Classical) mechanics is Galilean-invariant
 - Electrodynamics is not (Why? One (but not the only) reason is that the speed of light is *not* preserved under Galilean transformations)
- (1) Make electrodynamics “effectively” Galilean-invariant by introducing ether-drag contradiction with observations
 - (2) Leave it non-invariant contradiction with observations
 - (3) Save the invariance of *both* mechanics and electrodynamics by revising the underlying assumption that the transition from one reference frame to another is effected by Galilean transformations
- New type of coordinate transformation (Lorentz-transformation):
 - Do *not* leave times of events intact (hence, relativity of simultaneity)
 - Do *not* preserve distances between even “simultaneous” events (hence, length contraction)
 - BUT: *do* preserve the velocity of light
 - (New versions of) both mechanics and electrodynamics *are* Lorentz-invariant.