

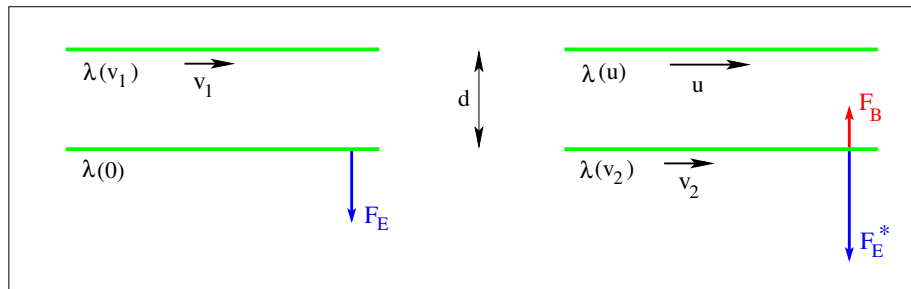
### [lex91] Velocity addition rule from principle of relativity

Consider two parallel rails a distance  $d$  apart, both electrically charged with uniform charge density.

Observer 1, who sees the lower rail at rest and the upper rail move with velocity  $v_1$  predicts that the two rails only exert a repulsive electric force  $F_E$  on each other.

Observer 2, who sees the lower rail move with velocity  $v_2$  and the upper rail with velocity  $u$  to be determined, predicts that the two rails exert on each other an attractive magnetic force  $F_B$  in addition to the (now modified) repulsive electric force  $F_E^*$ .

Note that the modified charge density  $\lambda(v)$  of a moving rail due to length contraction affects both electric and magnetic forces. The principle of relativity asserts that observers must predict the same net force. Show that this is the case if the relativistic addition rule for longitudinal velocities holds.



**Solution:**