Accelerated reference frames and fake forces (non-relativistic)

Camera tracks inertial reference frame
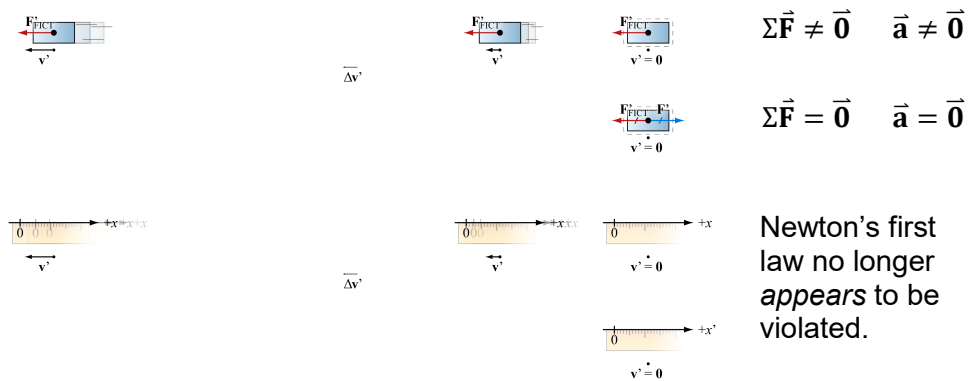
$$\Sigma \vec{F} = \vec{0} \quad \vec{a} = \vec{0}$$

$$\Sigma \vec{F} \neq \vec{0} \quad \vec{a} \neq \vec{0}$$

Newton's first law is not violated.

Camera tracks non-inertial reference frame

$$\Sigma \vec{F} = \vec{0} \quad \vec{a} \neq \vec{0}$$

$$\Sigma \vec{F} \neq \vec{0} \quad \vec{a} = \vec{0}$$
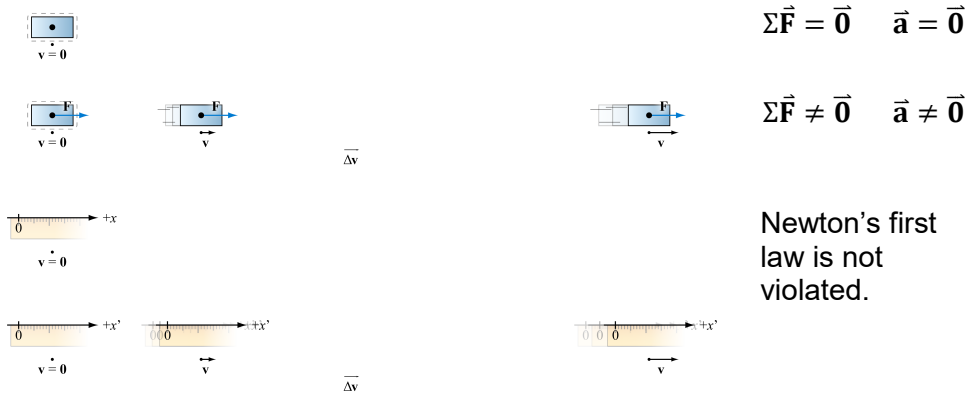
Newton's first law is violated.
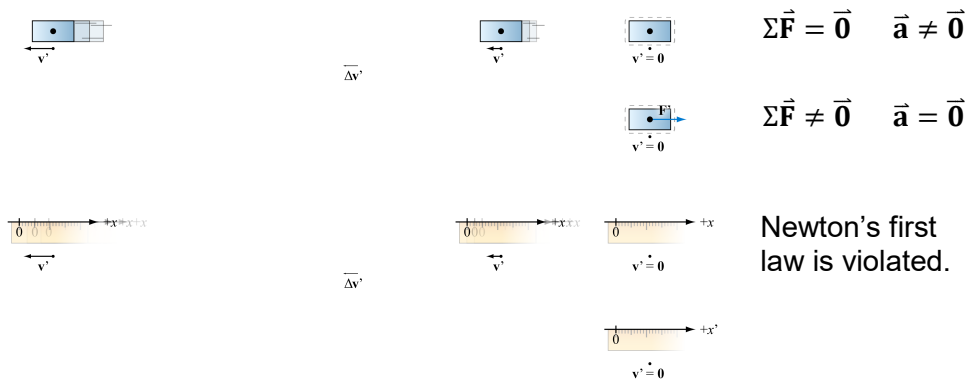
Tell a lie while camera tracks non-inertial reference frame

Add a fictitious force to each mass to make it seem as though Newton's first law is not violated in this frame.

Magnitude: $F_{\text{FICT}} = ma_{\text{NON–INERTIAL}}$
Direction: Opposite acceleration of non-inertial frame relative to inertial frame

$$\Sigma \vec{F} \neq \vec{0} \quad \vec{a} \neq \vec{0}$$

$$\Sigma \vec{F} = \vec{0} \quad \vec{a} = \vec{0}$$

Newton's first law no longer *appears* to be violated.

Vocabulary

Apparent gravitational force:

$$\vec{F}_{\text{G}} + \vec{F}_{\text{FICT}} = \vec{F}_{\text{G EFFECTIVE}}$$