

## **Part I**

# **A First Course in General Relativity<sup>1</sup>**



# Chapter 1

## Special Relativity

### On “Principle of relativity (Galileo)”

#### Galilean invariance

Newton’s laws of motion hold in all frames related to one another by a Galilean transformation. In other words, all frames related to one another by such a transformation are inertial (meaning, Newton’s equation of motion is valid in these frames).<sup>2</sup> The proof has been given by the book on page 2.

### 1.5 - Construction of the coordinates used by another observer

#### Why would the tangent of the angle is the speed in Fig. 1.2?

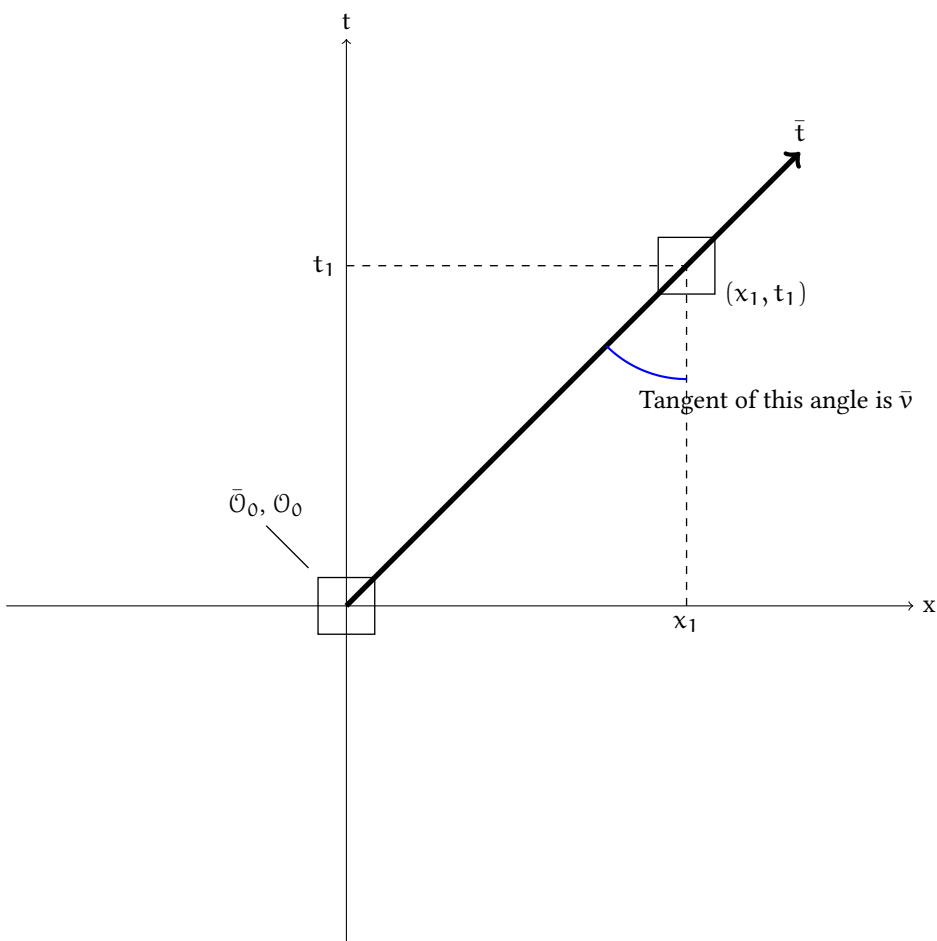
Suppose  $\mathcal{O}$  and  $\bar{\mathcal{O}}$  both start out at the same position where  $\bar{\mathcal{O}}$  moves along the  $x$  at some speed. After  $t_1$ , observer  $\mathcal{O}$  sees  $\bar{\mathcal{O}}$  at position  $x_1$ :

$$\bar{\mathcal{O}}_1 = (x_1, t_1)$$

Observer  $\bar{\mathcal{O}}$ , however, still sees themselves at  $x = 0$ :

$$\bar{\mathcal{O}}_1 = (0, t_1)$$

By definition where “ $\bar{t}$  is the locus of events at constant  $\bar{x} = 0$ ”,  $\bar{t}$  is the straight line that passes the origin and the  $(x_1, t_1)$ :



**1.6 - Why  $(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2 - (\Delta t)^2 = 0$ ?**

# Bibliography

<sup>1</sup> Bernard Schutz. *[A First Course on General Relativity](#)*. 2009.

<sup>2</sup> Wikipedia. [Galilean invariance](#).