The K and K' Diagrams

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What happens to non-adjustable rulers and clocks when they are accelerated with identical simultaneous accelerations from an initial reference frame K into a new reference frame K'?

The results are described by the Fitzgerald-Lorentz transformation equations.

The Fitzgerald-Lorentz transformation equations.

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$y' = y$$

$$z' = z$$

$$t' = \frac{t - \frac{v}{c^2} \cdot x}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The Gallilei-Newton transformation equations.

$$x' = x - vt$$

$$y' = y$$

$$z' = z$$

$$t' = t$$

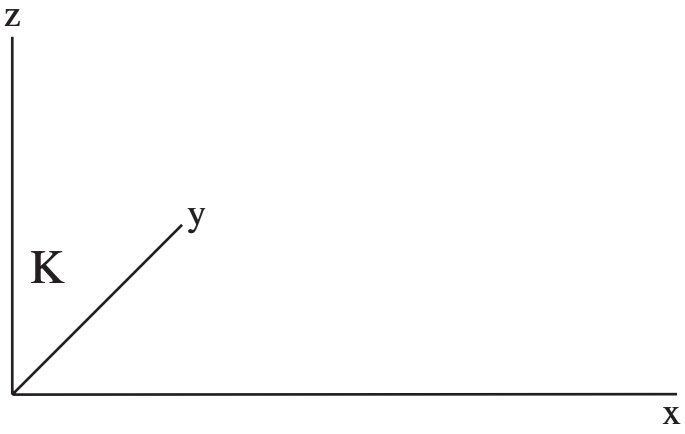
Non-adjustable rulers and clocks are those rulers and clocks whose lengths and rates of ticking vary inversely with accelerations and decelerations. These can be called variable rulers and clocks.

By contrast, adjustable rulers and clocks are those rulers and clocks whose lengths and rates of ticking are adjusted to compensate for the changes of length and rate of ticking normally caused by accelerations and decelerations. These can be called invariable rulers and clocks.

Thus, non-adjustable (variable) rulers and clocks change their lengths and rate of ticking when accelerated or decelerated but adjustable (invariable) rulers and clocks do not change their lengths and rates of ticking when accelerated or decelerated.

For describing what happens when non-adjustable clocks are accelerated with identical simultaneous accelerations we will need to discuss a number of concepts and principles and cases.

We start with reference frame K, which has three axes—the x-axis, the y-axis and the z-axis.

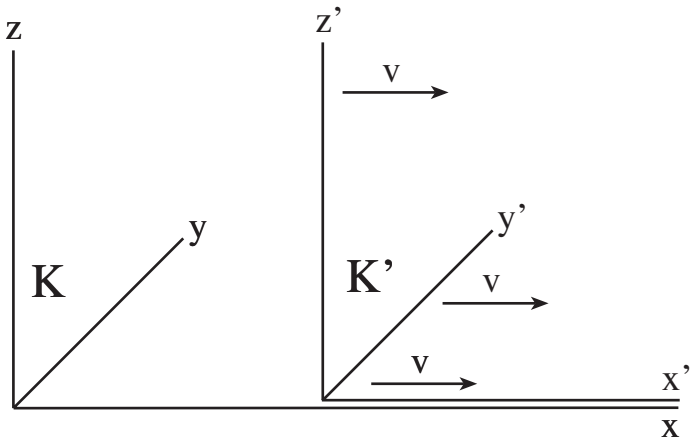


Ka

We will need to observe the x and y axes of the K reference frame from the viewpoint of the z-axis.

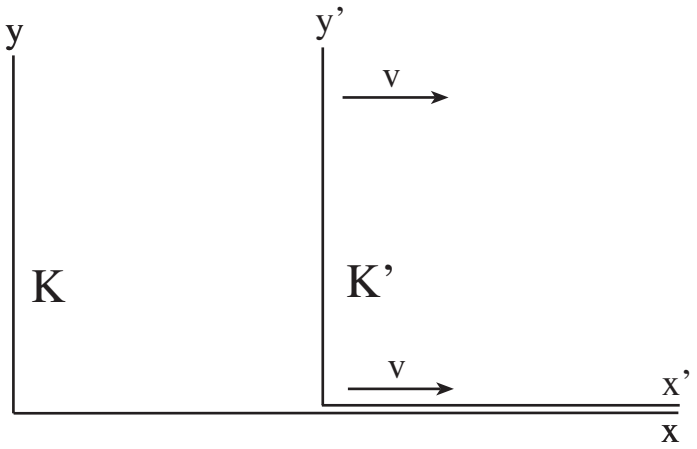
Kb

We will be superimposing reference frame K' onto reference frame K.



KK'a

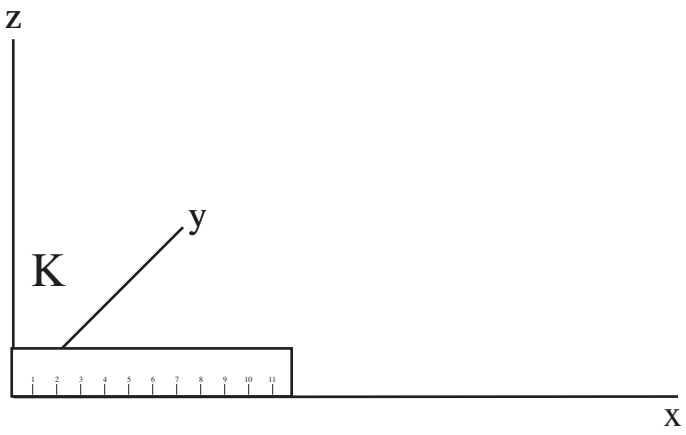
We will need to observe the x and y axes of the K reference frame from the z axis and the x' and y' axes of the K' reference frames from the z' axis.



KK'b

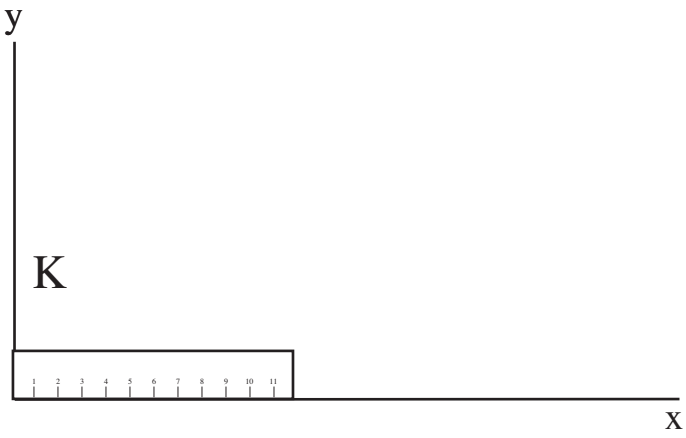
According to Einstein/relativity, accelerated rulers do not shorten along any axis other than the x-axis.

Let's add a ruler to the x-axis of the K reference frame.



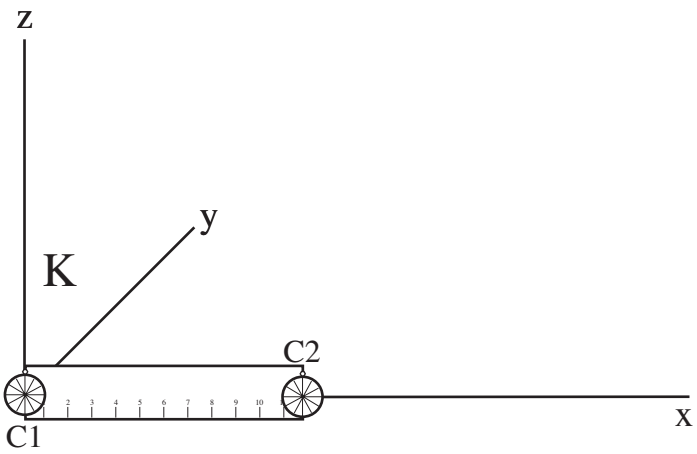
KRa

Here is the z-axis view of the of the x and y axes of the K reference frame and the ruler lying lengthwise along the x-axis.

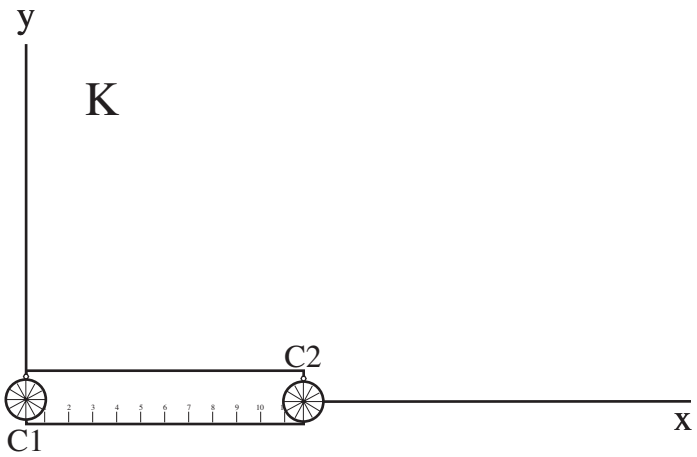


KRb

Let's add the clocks C1 and C2 to the ends of the ruler.



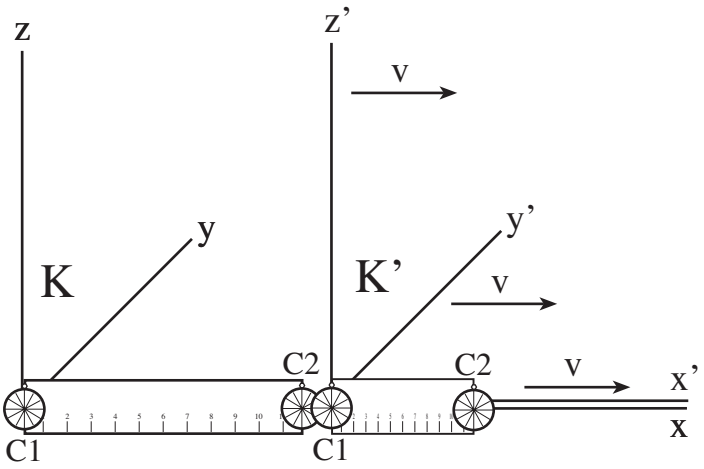
KRC1.1



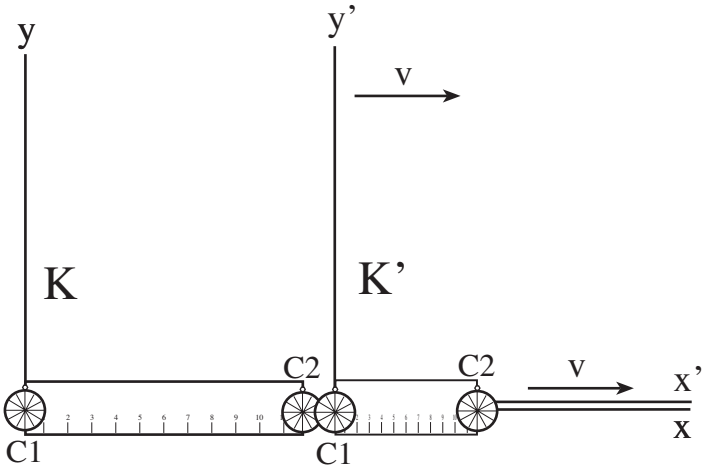
KRC1.1b

When the ruler & clocks are accelerated from K into K' with a difference velocity of v, then the ruler shortens along the x-axis, the clocks move along the x-axis, the distance C1 moves (the distance traveled by C1 from its position in K to its position in K') is greater then the distance C2 moves (the distance traveled by C2 from its position in K into to its position in K'), and therefore there is a difference between the time-intervals, rates of ticking, timepoints, timelines, and time-counts of C1 and C2 in K'.

NOTE: The ruler is shown both inre its original position and length in K and inre its new position and length in K'.



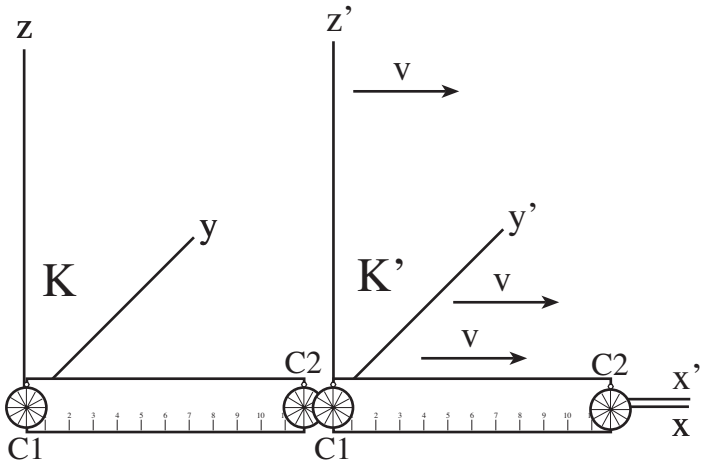
KRCK'RC1.1a



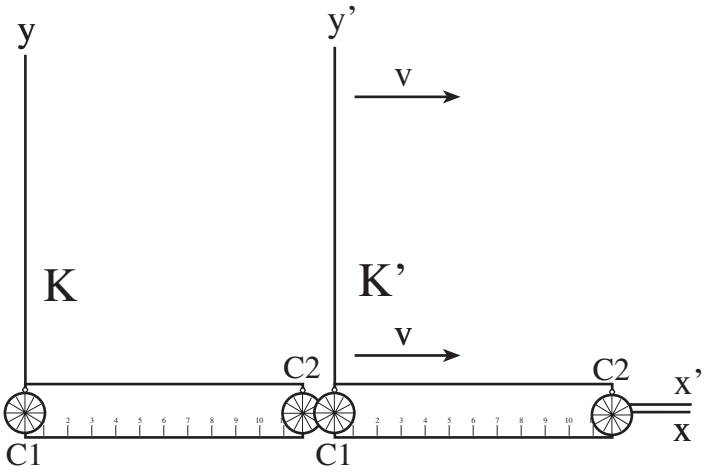
KRCK'RC1.1b

What if the ruler was an adjustable/adjusted ruler and it did not contract?

Then we would have the case wherein the clocks would move identical distances under identical simultaneous acceleerations and therefore their time–intervals, rates of ticking, timepoints, timelines, and timecounts would be identical.

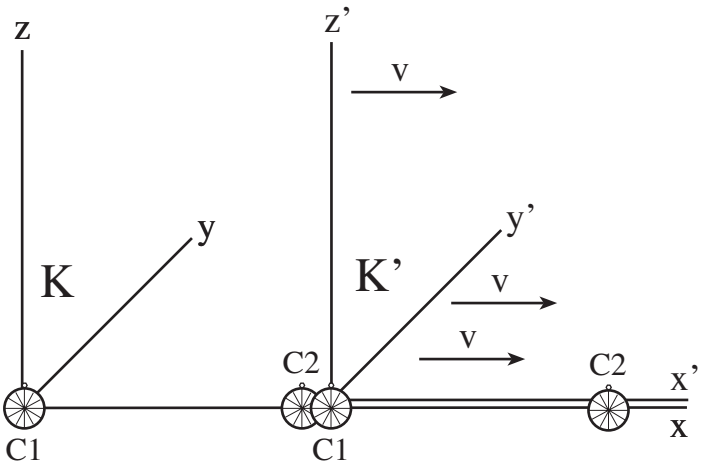


KRCK'RC1.2a

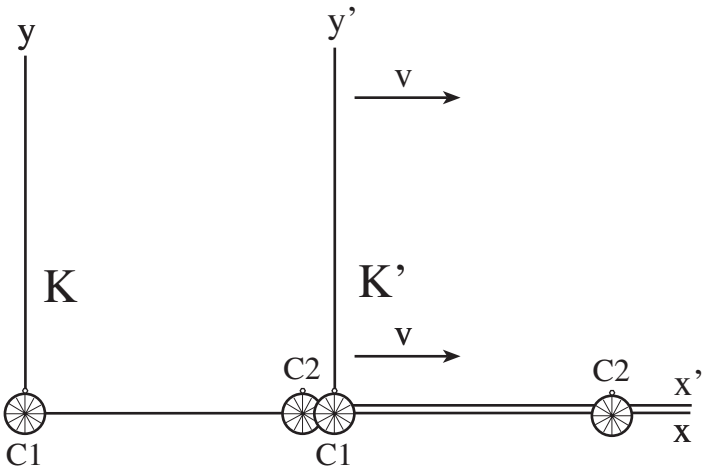


KRCK'RC1.2b

Let's create the case wherein the clocks are not attached to a ruler in K but are separated by a distance equivalent to the ruler's length in K; when the clocks are accelerated, then the distance between the clocks does not shorten and therefore the clocks travel the same distance under identical simultaneous accelerations and therefore, according to the F–L transforms, after the accelerations the clocks have identical time–intervals, rates of ticking, timepoints, timelines, and timecounts.

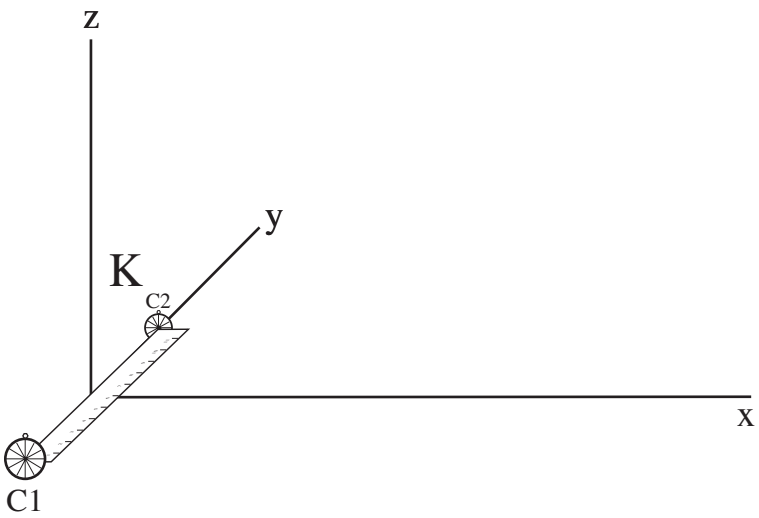


KRCK'RC1.3a

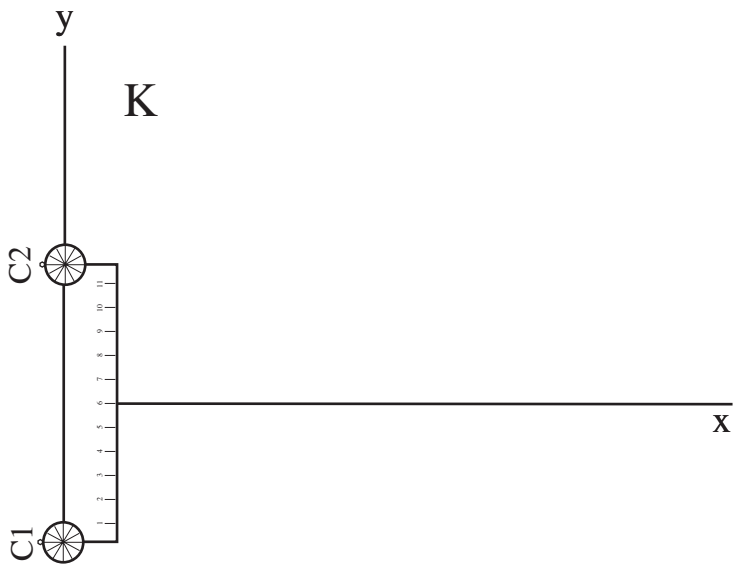


KRCK'RC1.3b

Let's rotate the ruler in K so that the ruler's length is parallel to the y-axis and perpendicular to the x-axis, and the ruler's midpoint, space-interval 6, is located on the x-axis; then we place two clocks, C1 and C2 on the ends of the ruler in K; the clocks are separated by the distance of the ruler, 12 space-intervals.



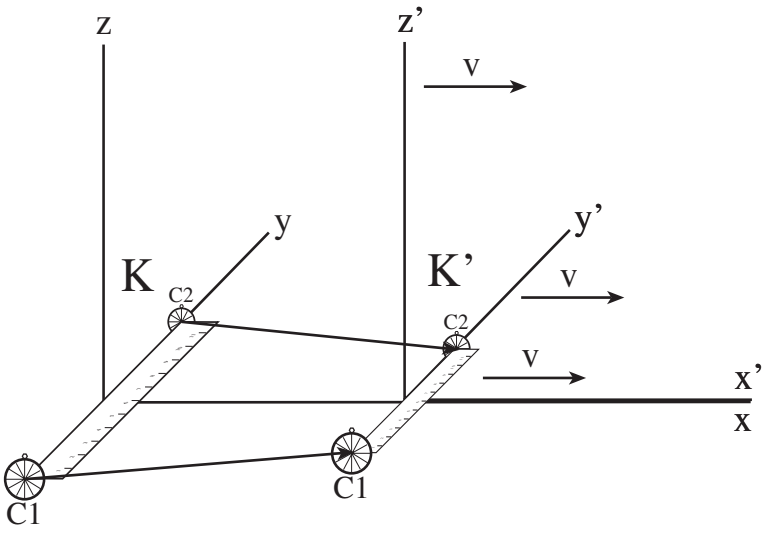
KRC2a



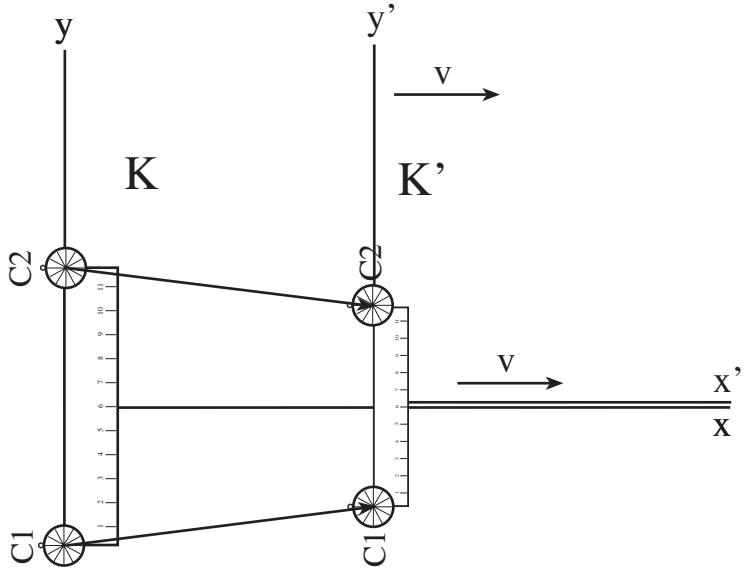
KRC2b

The ruler & clocks are accelerated from K into K' with a difference velocity of v; the clocks C1 and C2 are accelerated simultaneously and identically.

If the ruler shortens, and if it shortens along the y–axis, then the clocks C1 and C2 move the same distance, and their time–intervals, rates of ticking, timepoints, timelines, and timecounts are identical.



KRCK'RC2.1 a

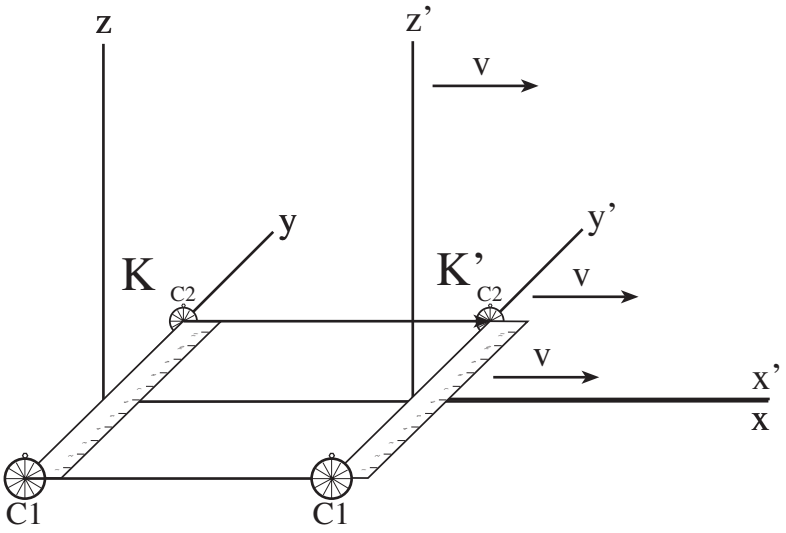


KRCK'RC2.1 b

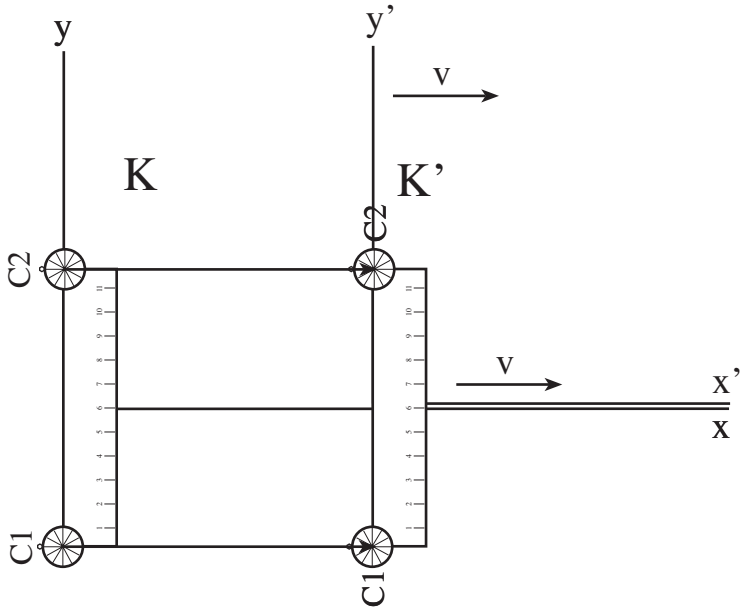
What if the ruler does not shorten along the y–axis?

Then the clocks would travel parallel to each other and in the same direction of motion along the x–axis.

If the distance traveled by C1 is the same as the distance traveled by C2, then C1 and C2 should have the same time–interval, rate of ticking, timepoints, timeline, and timecount.

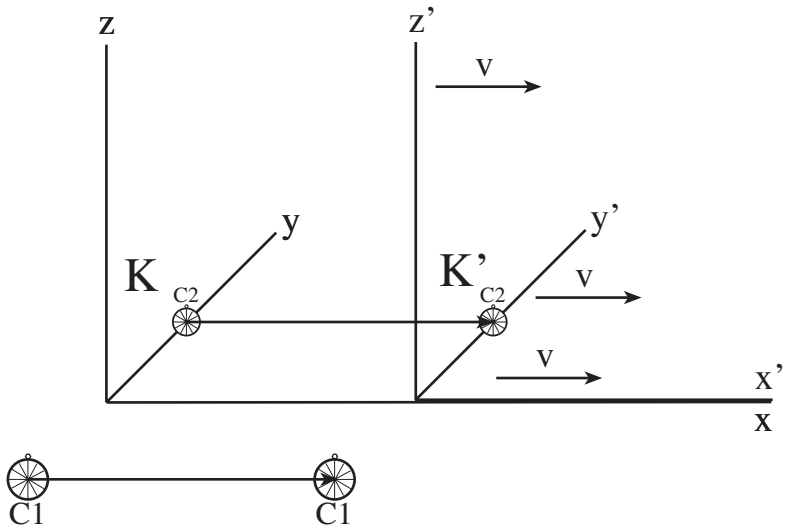


KRCK'RC2.2a

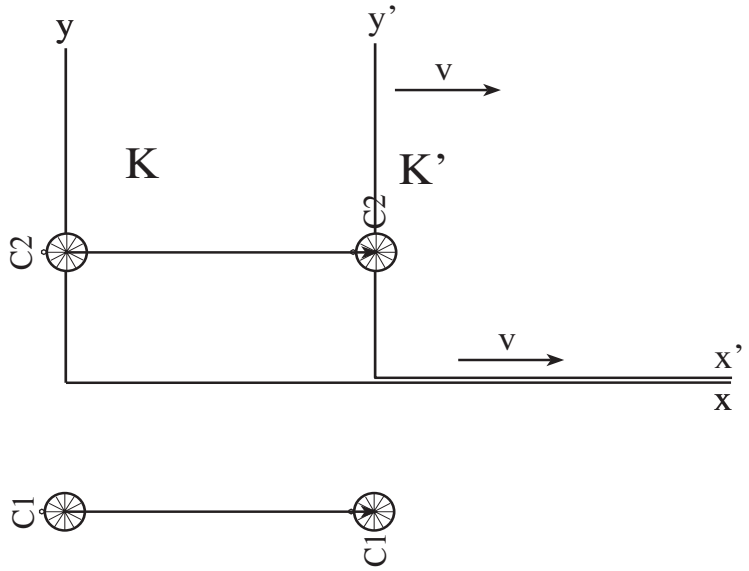


KRCK'RC2.2b

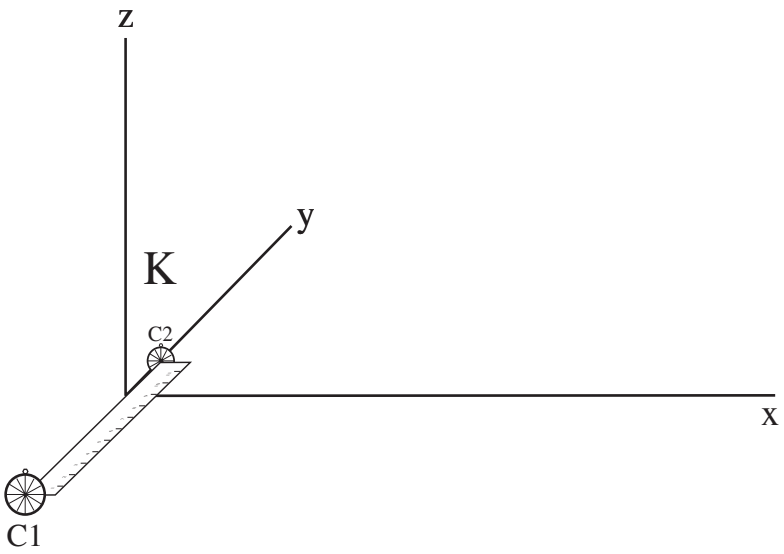
Let's create the case wherein the clocks are not attached to a ruler in K but are separated by a distance equivalent to the ruler's length in K; when the clocks are accelerated, then the distance between the clocks does not shorten and therefore the clocks travel parallel to each other the same distance under identical simultaneous accelerations and, therefore, according to the F–L transforms, after the accelerations the clocks have identical time–intervals, rates of ticking, timepoints, timelines, and timecounts.



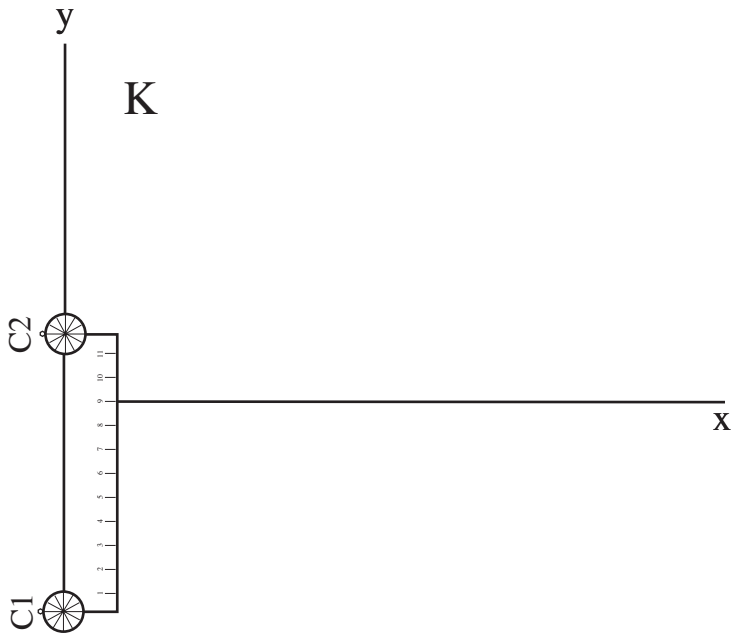
KRCK'RC2.3a



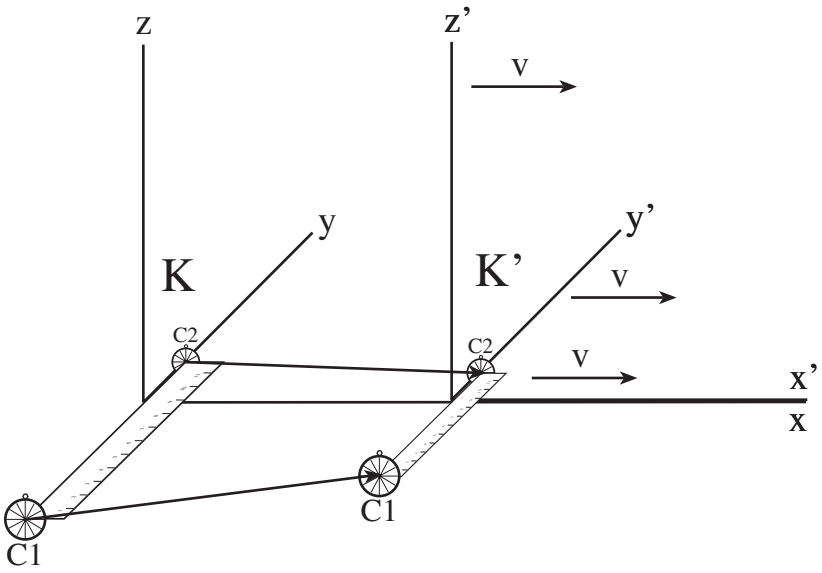
Let's set the ruler's length parallel to the y-axis but offset so the ruler's 9th space-interval rests upon the x-axis, and let's add the clocks C1 and C2 to the ends of the ruler, so they are separated by the distance of the ruler's 12 space-intervals' when accelerated, the ruler and clocks move along the x-axis, and the ruler shortens, and therefore the distance between C1 and C2 shortens, but because neither C1 nor C2 are traveling parallel to the x-axis, then the distance traveled by C1 is longer than the distance traveled by C2, therefore the time-interval, rate of ticking, timepoints, timeline, and timecount of C1 will be different from the time-interval, rate of ticking, timepoints, timeline, and timecount of C2.



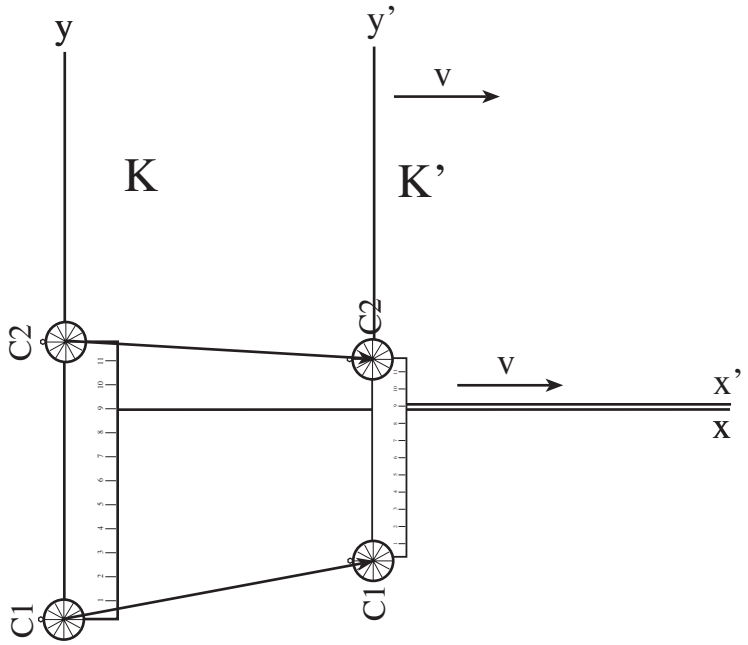
KRC3a



If the ruler shortens, then the clocks will not travel identical distances under acceleration and therefore they will not have identical time–intervals, rates of ticking, timepoints, timelines, and timecounts.

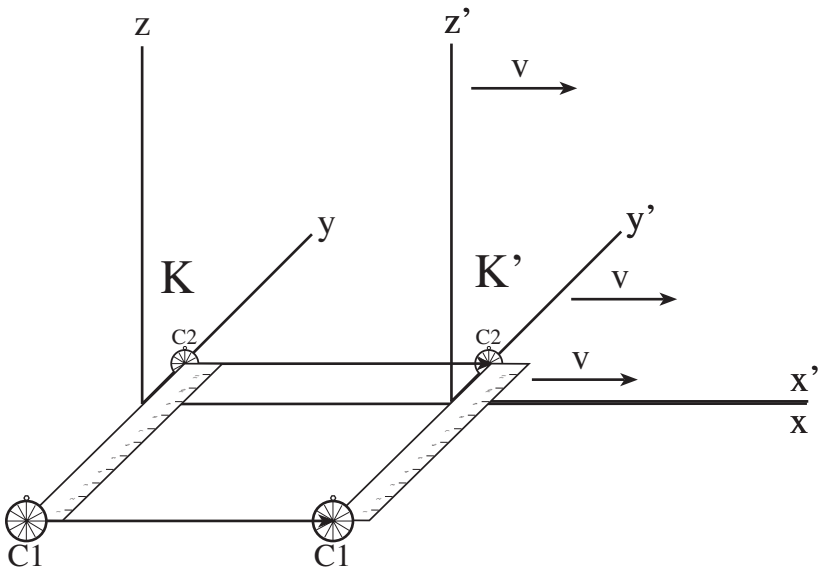


KRCK'RC3.1 a

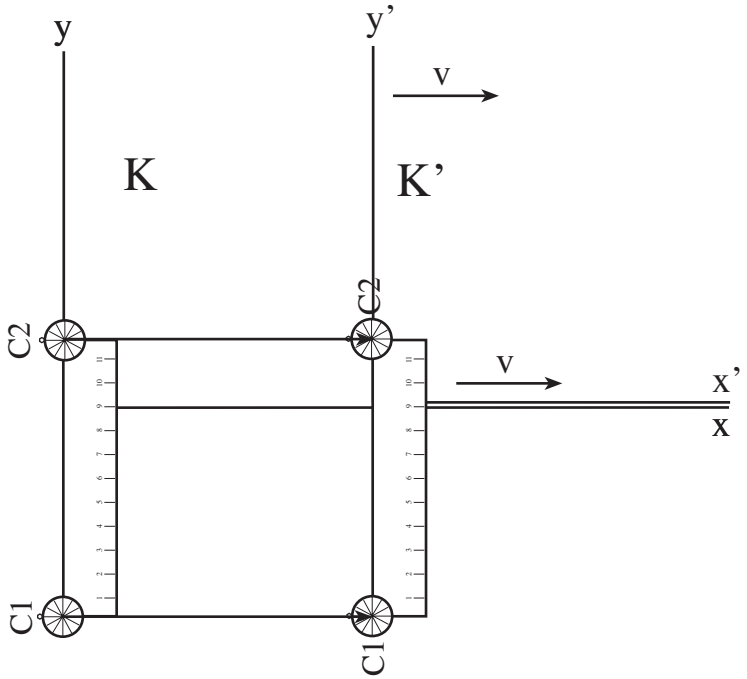


KRCK'RC3.1 b

If the ruler does not shorten, then the clocks will travel identical distances under acceleration and therefore they will have identical time–intervals, rates of ticking, timepoints, timelines, and timecounts.

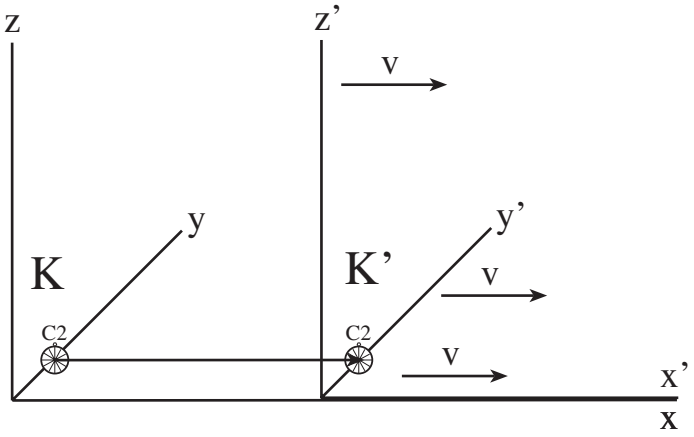


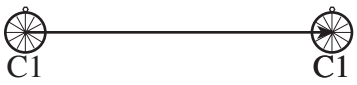
KRCK'RC3.2a



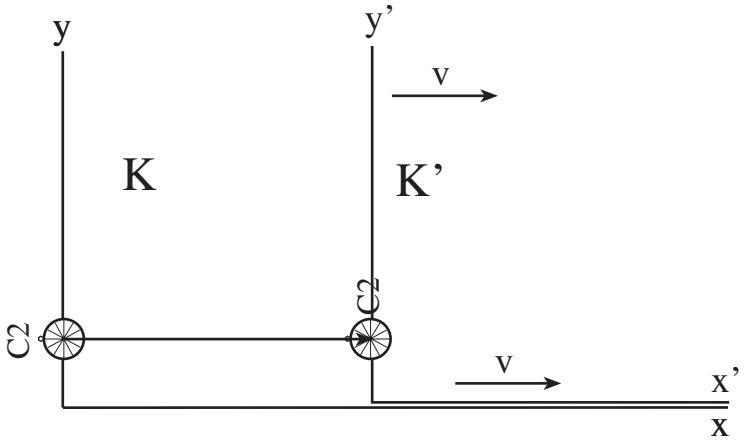
KRCK'RC3.2b

Let's create the case wherein the clocks are not attached to a ruler in K but are separated by a distance equivalent to the ruler's length in K; when the clocks are accelerated, then the distance between the clocks does not shorten and therefore the clocks travel parallel to each other the same distance under identical simultaneous accelerations and, therefore, according to the F–L transforms, after the accelerations the clocks have identical time–intervals, rates of ticking, timepoints, timelines, and timecounts.





KRCK'RC3.3a



KRCK'RC3.3b

Data Summary

Regardless of their locations in the K reference frame, if non-adjustable clocks travel the same distance under identical simultaneous accelerations from an initial reference frame K into a new reference frame K', then they will have identical time-intervals, rates of ticking, timepoints, timelines, and timecounts.

But if the clocks do not travel the same distance from reference frame K into reference frame K', then they will not have had identical simultaneous accelerations and consequently will not have identical time-intervals, rates of ticking, timepoints, timelines, and timecounts.

When non-adjustable clocks are attached to non-adjustable rulers whose lengths are laid out along the x-axis of a reference frame K, then, under simultaneous acceleration along the x-axis, the lengths of the rulers will shorten and although they will travel parallel to each other in the same direction of motion along the axis, the clocks will not travel the same distance and therefore the clocks will not have identical time-intervals, rates of ticking, timepoints, timelines, and timecounts.

There is no reason known to this theorist why the F-L transforms should not describe changes in the lengths of rulers in the y or z axes.