

starting point is the conclusion from measurements:

- 1) That the 2 way speed of light is always c and the possibility to have a 1 way speed different from c
- 2) The conclusion that the time it takes for light to start at a point and to come back to that point via an arbitrary route is always equal to the total pathlength divided by c as we can measure.
- 3) the option to have a 1 way speed of light different than c in a certain direction

This gives schematic diagram below with assumed lightspeed to be:

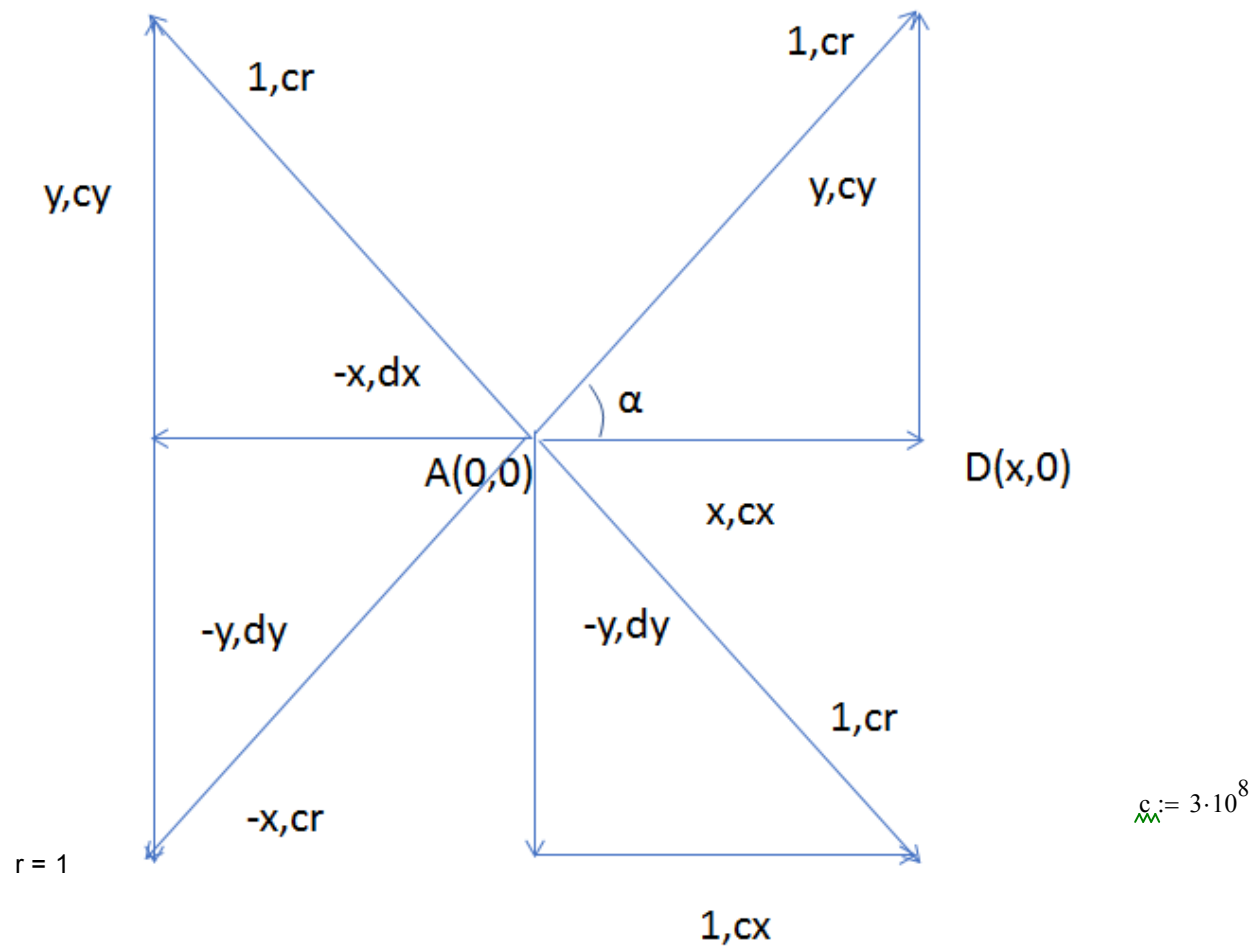
==> c_x in positive x direction

==> d_x in negative x direction

==> c_y in positive y direction

==> d_y in negative y direction

Further we assume a unity vector in a direction with angle α to the positive x axis



For the opposite speed d_1 with respect to c_1 in a certain direction with length a , the relation between c_1 and d_1 can be calculated using the fact that 2 way speed of light is always c and using $t_1=a/c_1$ in 1 direction and $t_2=a/d_1$ in the opposite direction giving :

$$\frac{a}{c_1} + \frac{a}{d_1} = \frac{2a}{c} \quad \Leftrightarrow \quad d_1(c_1) := \frac{c_1}{2 \cdot \frac{c_1}{c} - 1} \quad \text{eq [1]}$$

next step is to send different lightbeams via mirrors in the direction of the unity vector and the x and y direction for all 4 quadrants of x and y direction

for example for the positive x and y direction with c_r is the lightspeed in the direciton of the unity vector this gives:

$$\frac{r}{c_r} = \frac{x}{c_x} + \frac{y}{c_y} \quad \text{with} \quad |r| = 1 \quad \text{we get}$$

$$x = \cos(\alpha)$$

$$y = \sin(\alpha)$$

as time duration must be positive, while \cos and \sin can become negative it is easiest to define dx and dy such that time remains positive sign. for the first quadrant this gives for example:

$$\frac{1}{c_r} = \frac{\cos(\alpha)}{c_x} + \frac{\sin(\alpha)}{c_y} \quad \text{giving}$$

$$c_r = \frac{1}{\left(\frac{\cos(\alpha)}{c_x} + \frac{\sin(\alpha)}{c_y} \right)}$$

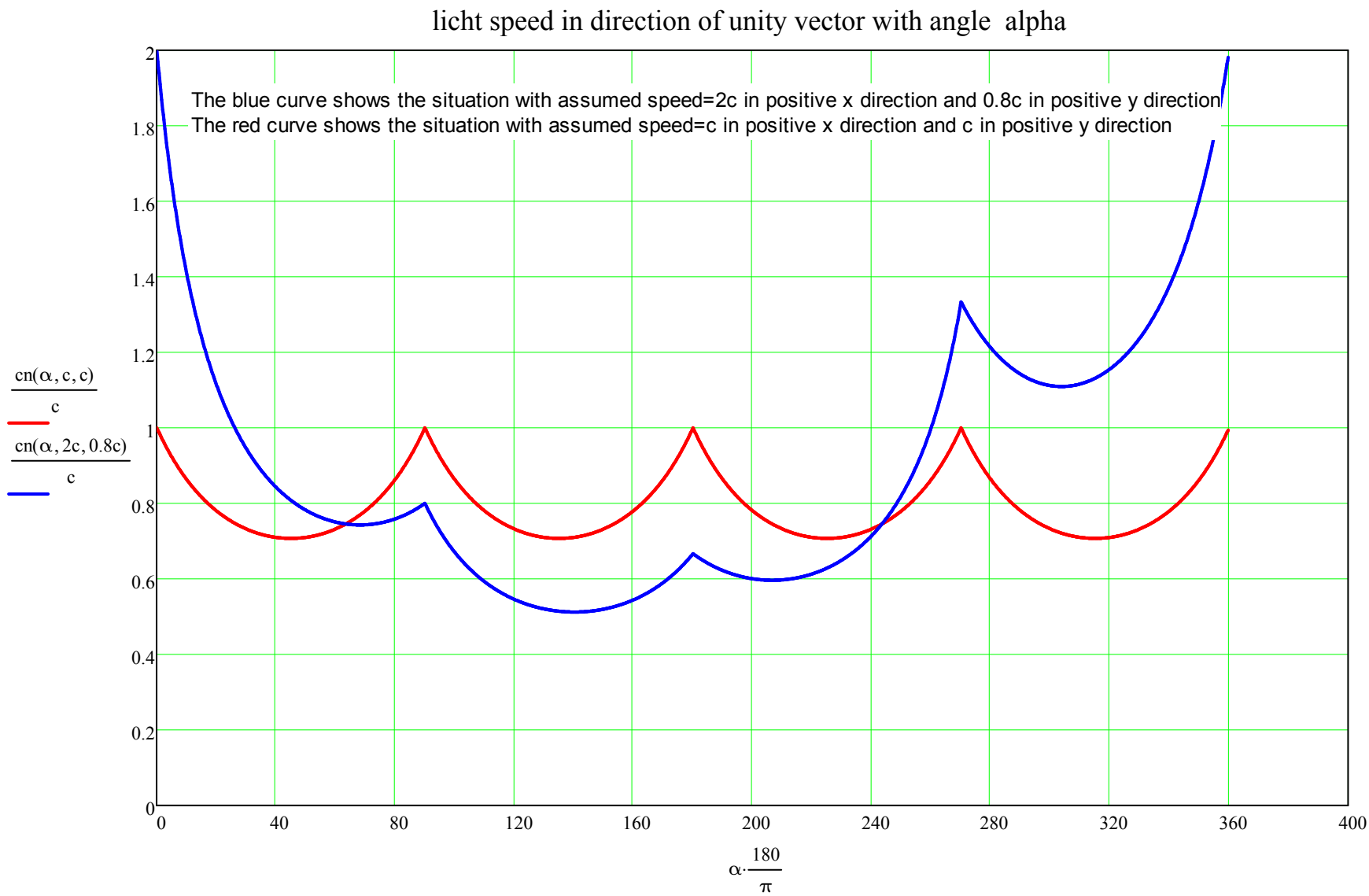
$$\text{cn}(\alpha, \text{cx}, \text{cy}) :=$$

$$\begin{aligned} &\text{dx} \leftarrow \text{dl}(\text{cx}) \\ &\text{dy} \leftarrow \text{dl}(\text{cy}) \\ &\text{cn} \leftarrow \frac{1}{\frac{\cos(\alpha)}{\text{cx}} + \frac{\sin(\alpha)}{\text{cy}}} \quad \text{if } \left(0 \leq \alpha \wedge \alpha < \frac{\pi}{2}\right) \\ &\text{cn} \leftarrow \frac{1}{\frac{\cos(\alpha)}{-\text{dx}} + \frac{\sin(\alpha)}{\text{cy}}} \quad \text{if } \left(\frac{\pi}{2} \leq \alpha \wedge \alpha < \pi\right) \\ &\text{cn} \leftarrow \frac{1}{\frac{\cos(\alpha)}{-\text{dx}} + \frac{\sin(\alpha)}{-\text{dy}}} \quad \text{if } \pi \leq \alpha \wedge \alpha < \pi \cdot 1.5 \\ &\text{cn} \leftarrow \frac{1}{\frac{\cos(\alpha)}{\text{cx}} + \frac{\sin(\alpha)}{-\text{dy}}} \quad \text{if } 1.5\pi \leq \alpha \wedge (\alpha) < 2 \cdot \pi \\ &\text{cn} \end{aligned}$$

this function defines the 1 way light speed in the direction of the unity vector with angle α to the positive x axis and splits it up in 4 parts valied for each quadrant of the x,y plane.
 the one way light speed is defined for the positive x direction and positive y direction. The 1 way lightseed is calculated according to the rules as mentioned at the top

$$\alpha := 0, \frac{\pi}{1000} .. 2 \cdot \pi \cdot 0.999$$

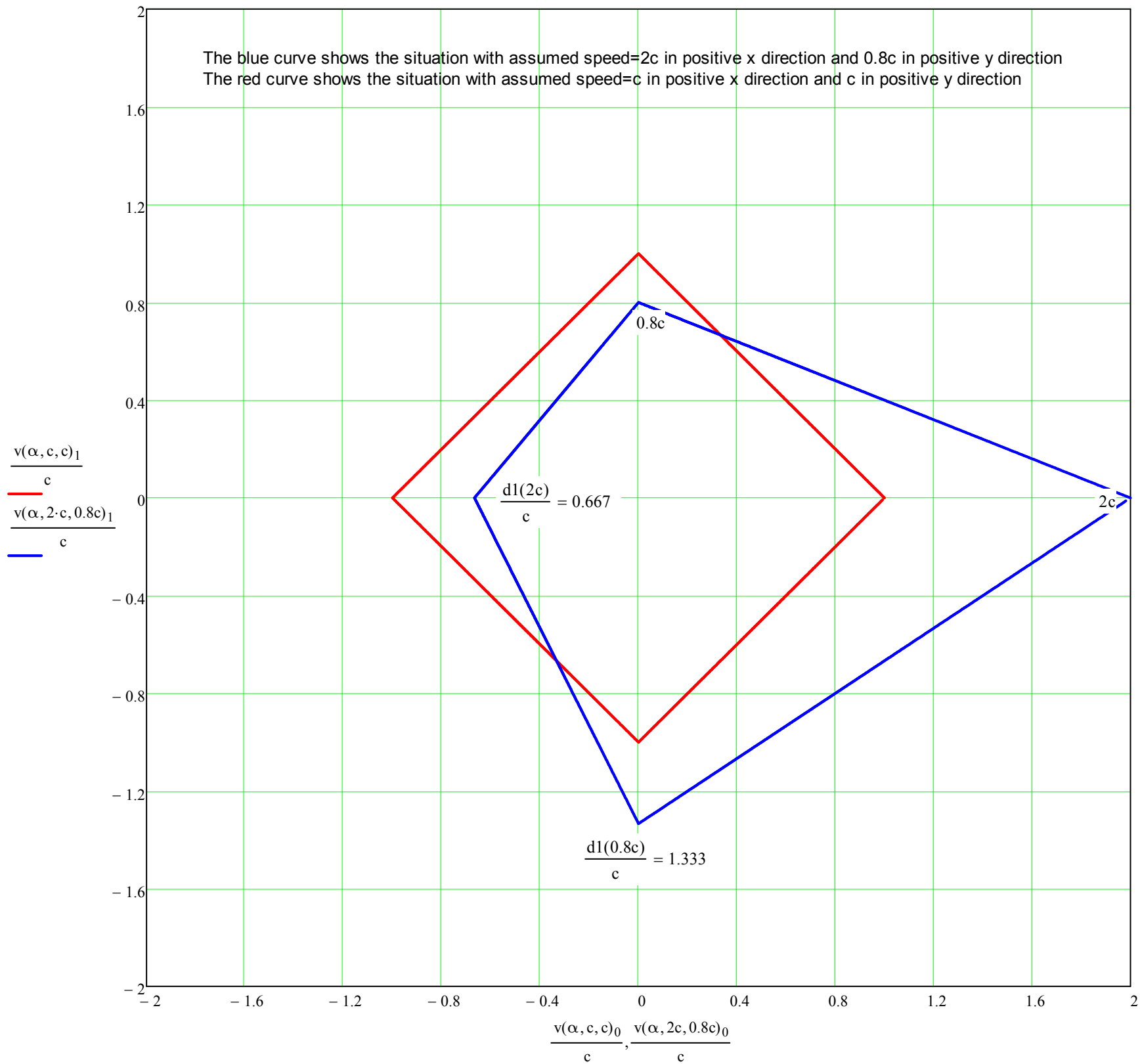
range definition for α



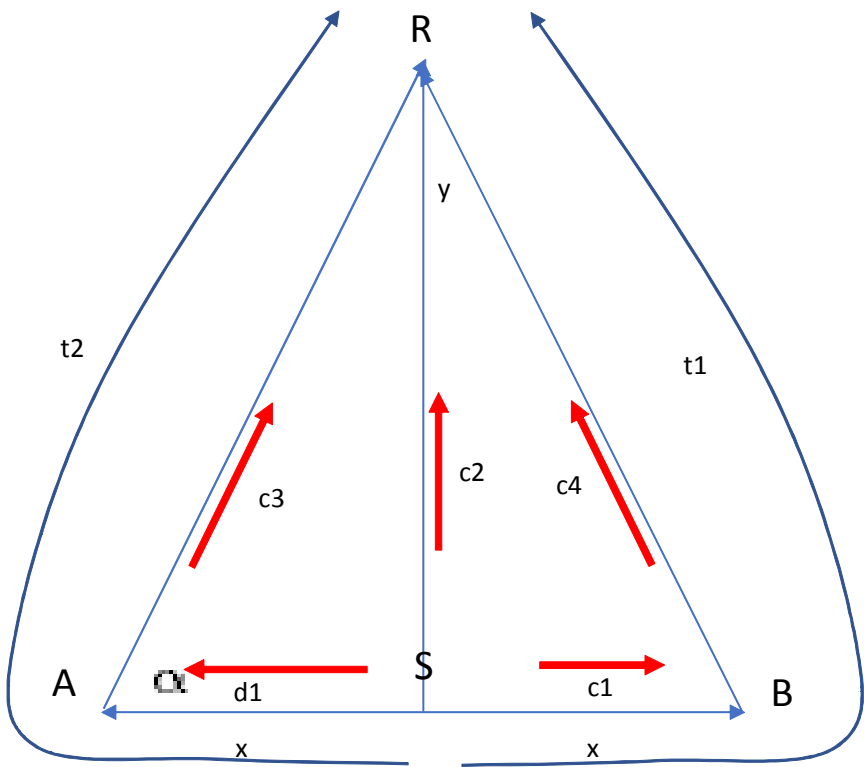
same situation can be plotted in an x,y plane with unity vector pointing from the origin towards the point p(x,y)
 in the plot below the length of the vector with angle α to the x axis represents the lightspeed in that direction.

$$\text{v}(\alpha, \text{cx}, \text{cy}) := \begin{pmatrix} \cos(\alpha) \\ \sin(\alpha) \end{pmatrix} \cdot \text{cn}(\alpha, \text{cx}, \text{cy})$$

lightspeed as function of ane α for a given one way light speed in x and y directions



now we can test the idea for measuring the 1 way light speed by using next proposal:



a lightbeam is sent from sende (S) to receiver (R) via 2 mirrors at point A and B. alternatively we could use 2 clocks at A and B that are synchronized to $t=0$ when receiving a lightpulse from S.

Now the idea is to have the Receiver very far away from A and B such that both trajectories AR and BR become parallel.

The idea was that in this case one way light speeds $c3$ and $c4$ become equal to $c2$ because they are in parallel so any difference that the receiver sees between both clocks should be because of the difference in 1 way speed between $c1$ and $d1$ because AR and BR are same lengt and same speed.

We can calculate t1 and t2 and the dutation for the light to pass SA and AR and SB and BR path as follows
suppose x is 1 meter

$$\text{ns} := 10^{-9} \quad \text{nano seconds def}$$
$$x := 1 \quad c1 := 10c \quad c2 := 0.6c \quad y := 100$$

$$\alpha := \operatorname{atan}\left(\frac{y}{x}\right)$$
$$\alpha = 1.561 \quad \frac{\alpha}{2 \cdot \pi} = 0.248$$

we can calculate time for the light to travel along SA (as TSA), SB (as TSB), AR (tAR) and BR (tBR) all as function of c1,c2 and α

$$t_{SA} = \frac{x}{d1}$$
$$t_{SB} = \frac{x}{c1}$$
$$t_{AR} = \frac{AR}{c3}$$
$$AR = \frac{x}{\cos(\alpha)} \quad \Leftrightarrow \quad t_{AR} = \frac{x}{\cos(\alpha) \cdot cn(\alpha, cx, cy)}$$

$$t_{BR} = \frac{BR}{c4} \quad \Leftrightarrow \quad t_{BR} = \frac{x}{\cos(\alpha) \cdot cn(\pi - \alpha, cx, cy)} \quad \text{angle of BA with positive X axis} = \pi - \alpha$$
$$BR = AR$$

$$t_{SA}(cx) := \frac{x}{d1(cx)} \quad \text{calcuated time for light to go from S to A} \quad d1(c1) = 1.579 \times 10^8$$
$$t_{SA}(c) = 3.333 \text{ ns}$$
$$t_{SB}(cx) := \frac{x}{cx} \quad t_{SB}(c1) = 0.333 \text{ ns} \quad \text{calcuated time for light to go from S to B}$$

$$t_{AR}(\alpha, cx, cy) := \frac{x}{\cos(\alpha) \cdot cn(\alpha, cx, cy)} \quad \text{actual definition of function with parameter for calculaiton}$$
$$t_{AR}(\alpha, c1, c2) = 555.889 \text{ ns} \quad \text{calculated result with } \alpha \text{ c1, c2 as choosen}$$
$$t_{BR}(\alpha, cx, cy) := \frac{x}{\cos(\alpha) \cdot cn(\pi - \alpha, cx, cy)} \quad \text{actual definition of function with parameter for calculaiton}$$
$$t_{BR}(\alpha, c1, c2) = 561.889 \text{ ns} \quad \text{calculated result with } \alpha \text{ c1, c2 as choosen}$$

$$t_{SA}(c1) + t_{AR}(\alpha, c1, c2) = 562.2222222 \text{ ns} \quad \text{calculaiton of time for light to follow total path S-A-R with } \alpha \text{ c1, c2 as choosen}$$
$$t_{SB}(c1) + t_{BR}(\alpha, c1, c2) = 562.2222222 \text{ ns} \quad \text{calculaiton of time for light to follow total path S-B-R with } \alpha \text{ c1, c2 as choosen}$$

shows that both path are the same while speeds are different

$$t2(\alpha, cx, cy) := t_{SA}(cx) + t_{AR}(\alpha, cx, cy) \quad \text{definition of t1 and t2}$$
$$t1(\alpha, cx, cy) := t_{SB}(cx) + t_{BR}(\alpha, cx, cy)$$
$$t1(\alpha, c1, c2) = 562.222 \text{ ns}$$
$$t2(\alpha, c1, c2) = 562.222 \text{ ns}$$

$$\alpha := 0, \frac{\pi}{100} .. \frac{\pi}{2} \cdot 0.98$$

$$y(\alpha) := x \cdot \tan(\alpha) \quad \text{calculation of y as function of } \alpha \text{ to allow plotting of times agains y}$$

