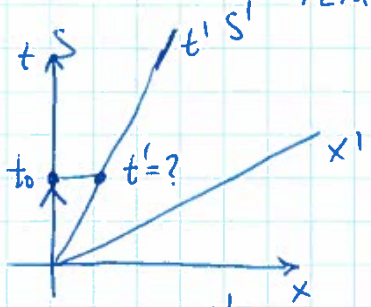
L29 Time dilation again.



S & S' clocks sync at t=0

S clock advanced from 0 → t_0

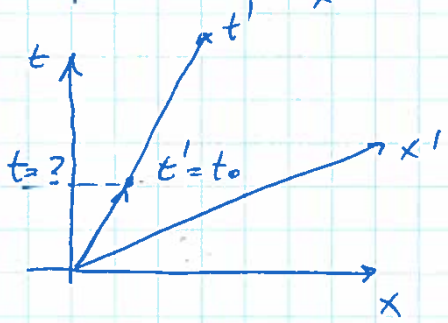
What is time on S' clock?

for S observer

$x = (x' + vt')\gamma = 0 \quad x = vt$

$t_0 = (t' + \frac{x'v}{c^2})\gamma = t'(1 - v^2/c^2)\gamma = t'/\gamma$

t_0 – proper time. → $t' = \gamma t_0$



S' clock advanced from t'=0 to $t' = t_0$

What is time on S clock?

for S' observer

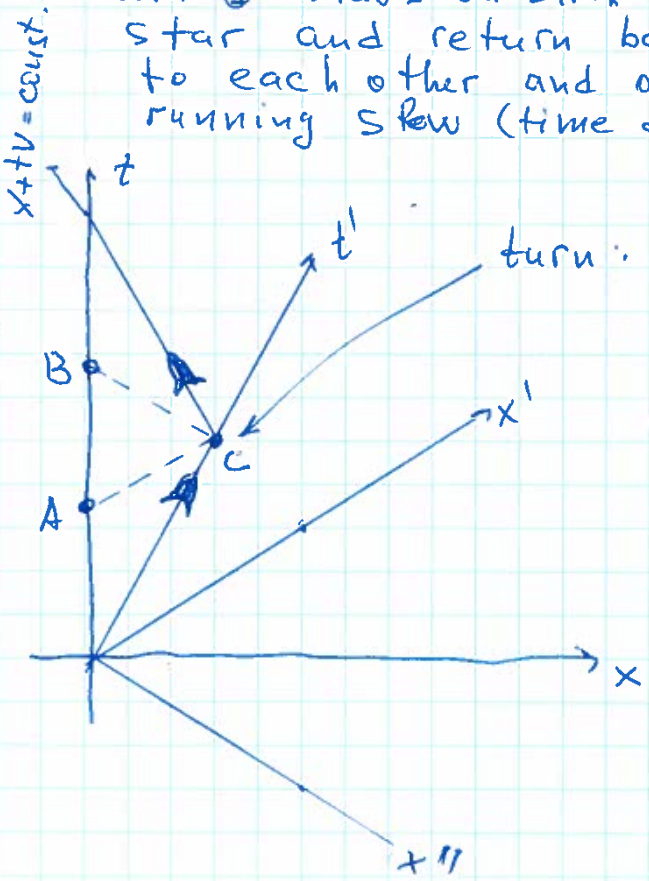
$x' = (x - vt)\gamma = 0 \quad x = vt$

$t_0 = t' = (t - xv/c^2)\gamma = t(1 - v^2/c^2)\gamma = t/\gamma$

t_0 – proper time. $t = \gamma t_0$

Twin paradox.

Twin ① stays on Earth, Twin ② travels to a distant star and return back. They both move relative to each other and observe the opposite clock running slow (time dilation) → Why Twin 2 is younger?



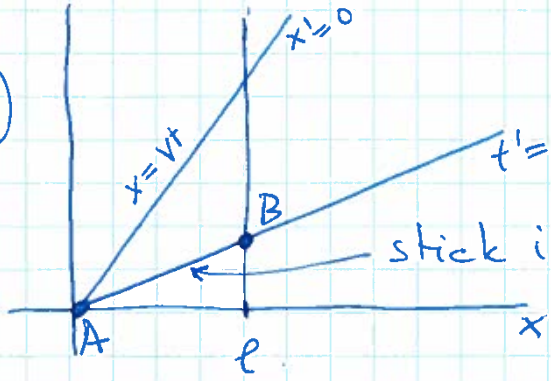
turn: during the turn @ C, time on Earth advances from A to B

acceleration during the turn brokes the symmetry between the Twins.

Twin 2 trip involves 2 frames. S' & S''

L29 Length Contraction again

(a)



stick in S' frame. $A \Rightarrow x'_A = 0$
$B \Rightarrow x'_B = ?$

ℓ_0 – length of a stick in S

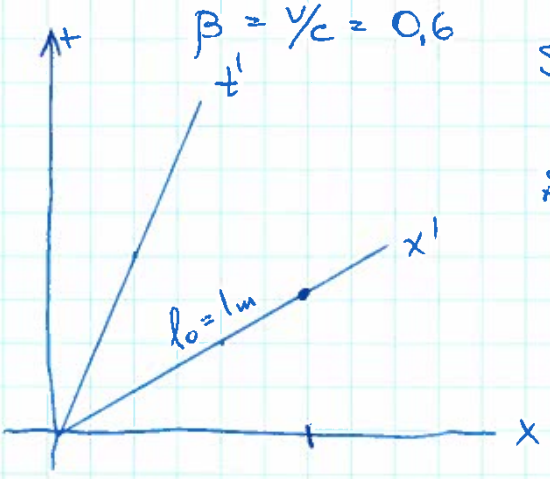
$t' = \left(t - \frac{\ell_0 v}{c^2}\right)\gamma = 0 \qquad t = \frac{\ell_0 v}{c^2}$

$\ell' = (\ell_0 - vt)\gamma = \ell_0\left(1 - \frac{v^2}{c^2}\right)\gamma = \ell_0/\gamma$

observer in S' frame is measuring.
stick length $\ell' = \ell_0/\gamma$ ℓ_0 – proper length.

Relativistic Snake (see Textbook P 613-614)

$\beta = v/c = 0.6$



S: 0.8m; $T_L = 0$ ← 1m → $T_R = 0$

S': distance between cleavers is 0.8m < length of snake in S

resolving paradox;

$T'_R < 0 \qquad T'_R = \left(T_R - x_R\frac{v}{c^2}\right)\gamma = \frac{x_R}{c}\beta\gamma$

$T'_R = -2.25\,ns \qquad \gamma = 1.25 \quad \beta = 0.6$

$x'_L = (x_R - T_R v)\gamma = x_R\gamma$

both cleavers in S fall at $t = T_L = T_R = 0$