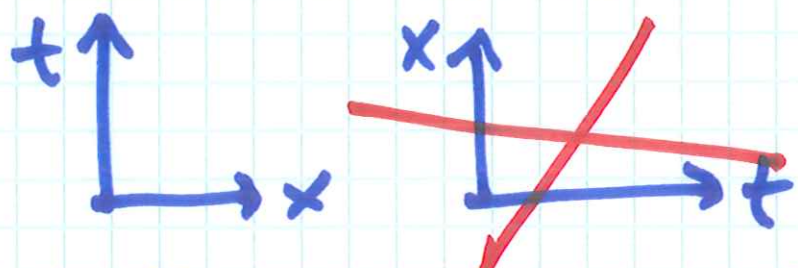
NYU Physics I — 2016-12-01

Agenda: - Reading: Ch 2, Ch 3 of.
http://cosmo.nyu.edu/hogg/sr/

- Light-clock & twins.

- conventions of S.R.:

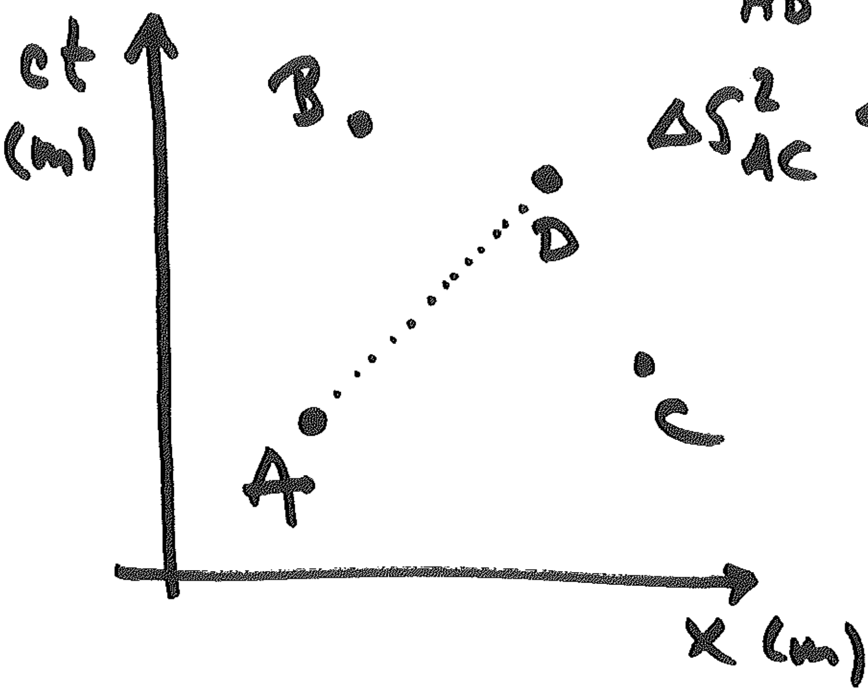
~~imaginary numbers~~



"signature" $(ct)^2 - x^2 - y^2 - z^2$ $\cancel{-(ct)^2 + x^2 + y^2 + z^2}$

$$\underbrace{\begin{bmatrix} c\Delta t & \Delta x & \Delta y & \Delta z \end{bmatrix}}_{\text{4-vector}} \underbrace{\begin{bmatrix} 1 & & & 0 \\ & -1 & & \\ & & -1 & \\ 0 & & & -1 \end{bmatrix}}_{\text{metric}} \begin{bmatrix} c\Delta t \\ \Delta x \\ \Delta y \\ \Delta z \end{bmatrix} \text{ 4-vector.}$$

interval



$\Delta s^2_{AB} > 0$: "timelike" –

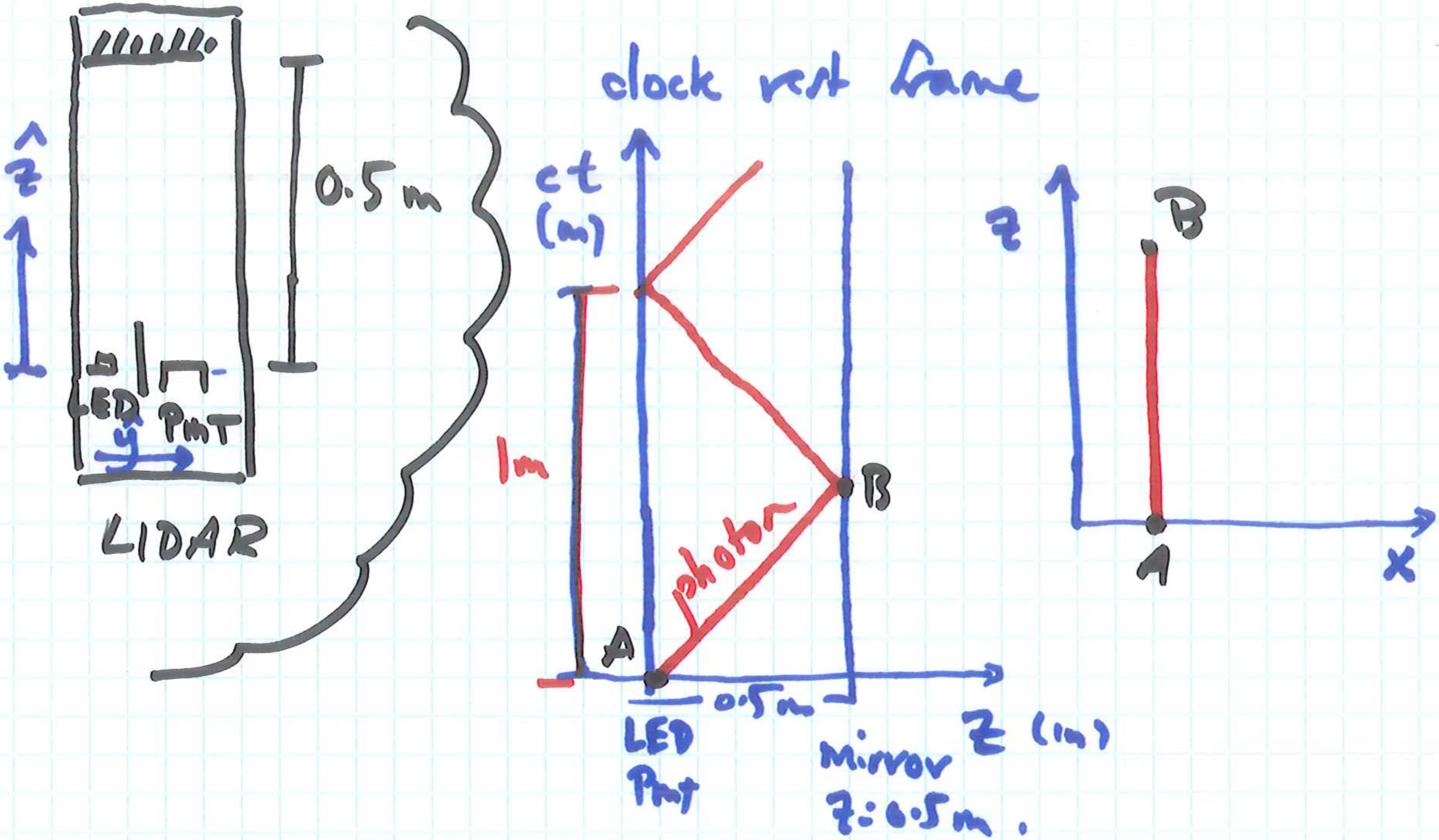
$\Delta s^2_{AC} < 0$: "spacelike"

A, C – simultaneity issues

$\Delta s^2_{AD} = 0$: "null"

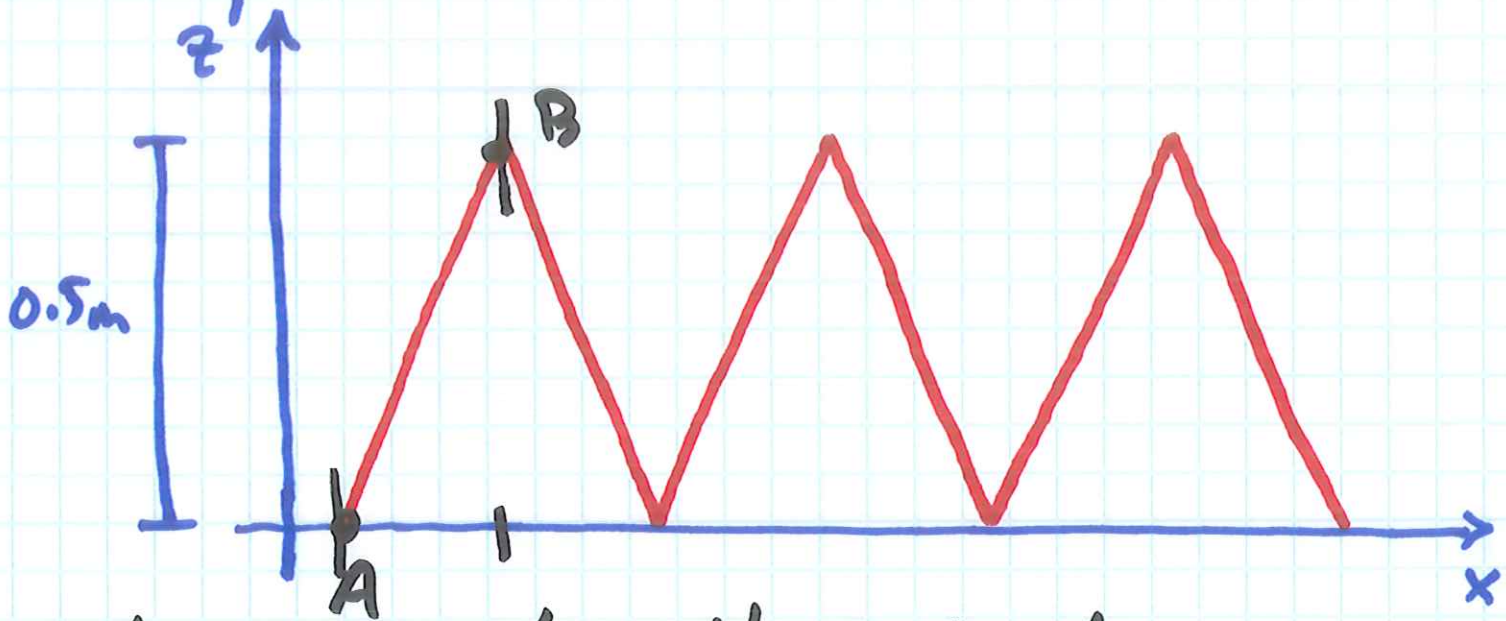
photon trajectory

clock rest frame



$$c\Delta t = \Delta z = 0.5\,m$$

boosted frame – primed



$c\Delta t'_{AB}$ $\Delta z'_{AB} = 0.5\,m$ $\Delta x'_{AB} = v\cdot\Delta t' = \beta\cdot(c\Delta t')$

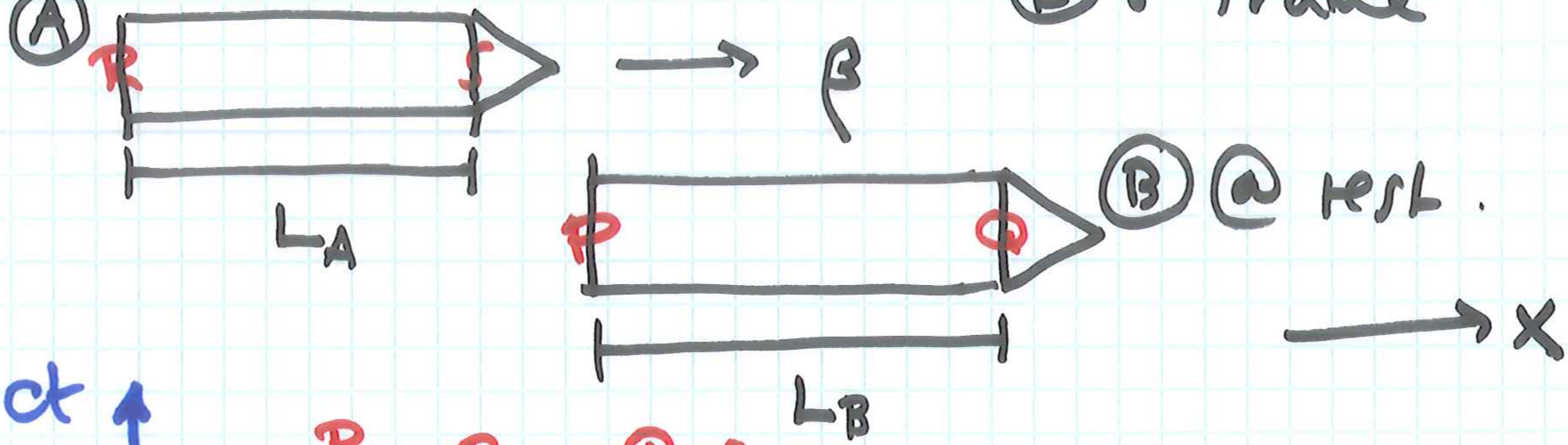
$$(\Delta z')^2 + (\beta c\Delta t')^2 = (c\Delta t')^2$$

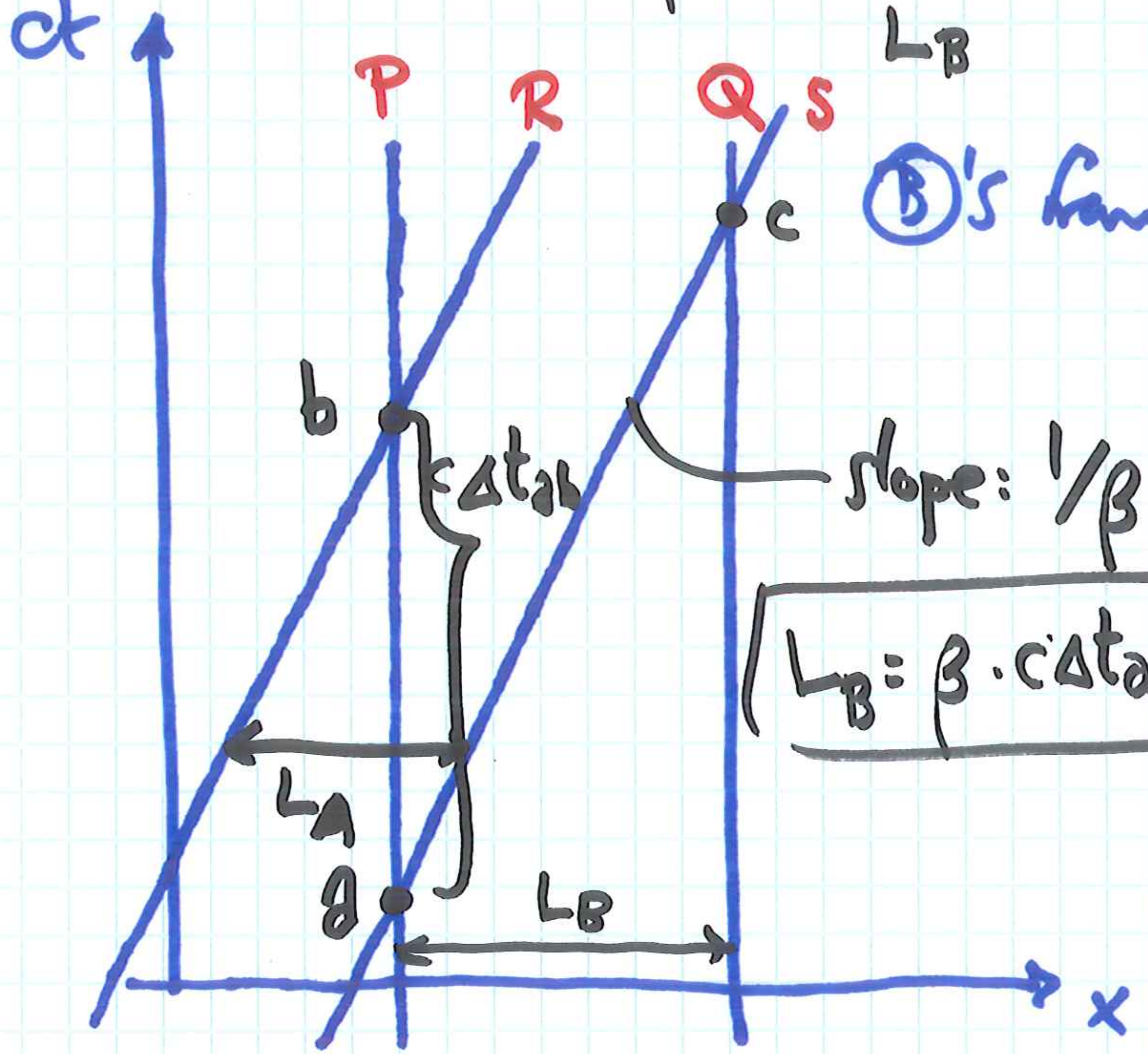
$$(c\Delta t')^2 = \frac{(\Delta z')^2}{1-\beta^2}$$

$$c\Delta t' = \frac{\Delta z'}{\sqrt{1-\beta^2}} = \gamma\,\Delta z' = \gamma\cdot 0.5\,m.$$

time dilation —— $\gamma \equiv \dfrac{1}{\sqrt{1-\beta^2}}$

B's frame



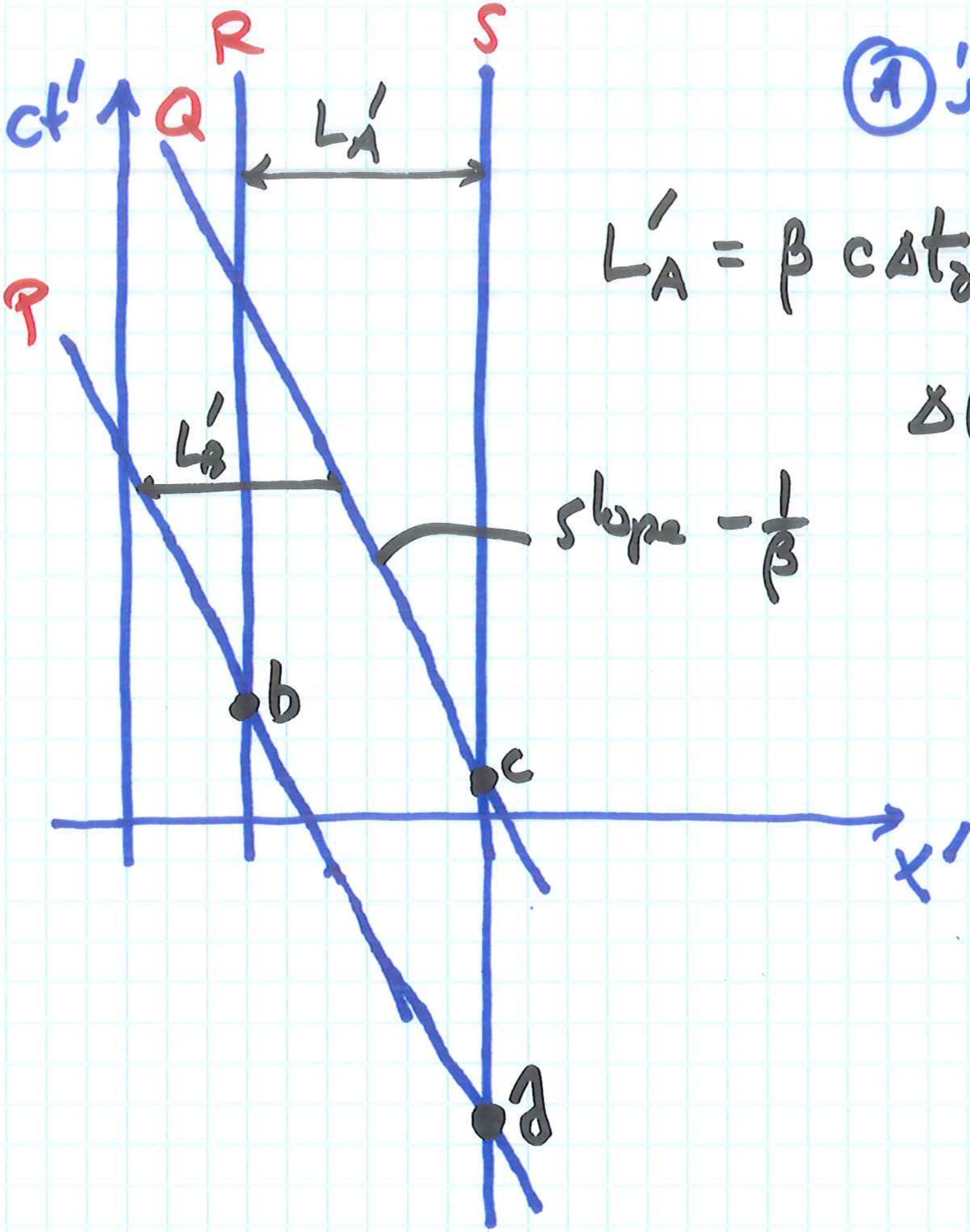


B's frame.

$$\boxed{L_B = \beta \cdot c\Delta t_{ac}}$$

B says:
"length of A's ship is β times the time interval between a, b."

$$\boxed{L_A = \beta c\Delta t_{ab}}$$



Ⓐ's frame.

$L'_A = \beta c \Delta t'_{ab}$ — but

$\Delta t'_{ab} > \Delta t_{ab}$

so $L'_A > L_A$

"length contraction"