Time Dilation

What Time Dilation is NOT

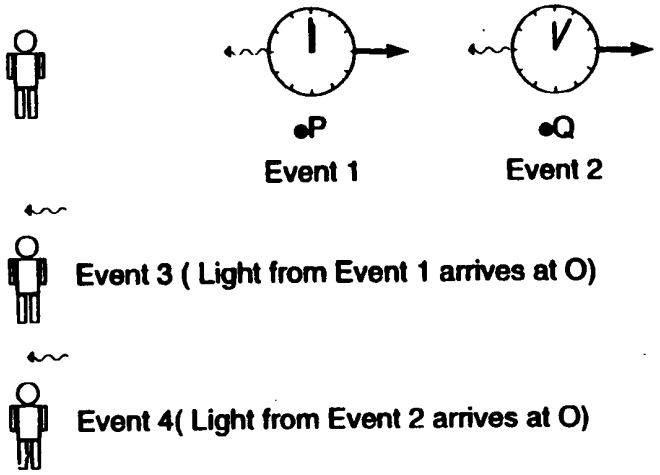
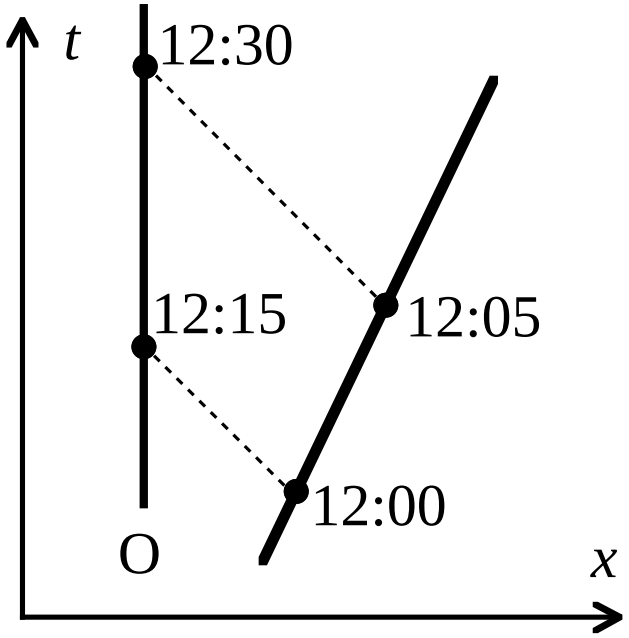
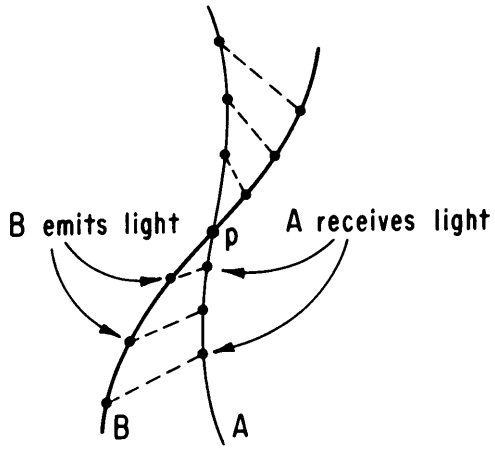
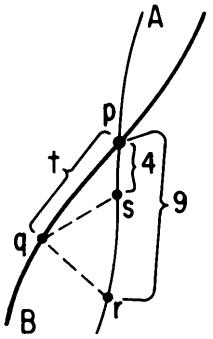


Fig. 3.9. Moving clock viewed by a single observer. When the clock is at *P*, it reads 12:00; when it is at *Q*, it reads 12:05. To observer *O*, the clock appears to be running slow. This is *not* a relativistic effect.

[Sartori, p. 73]



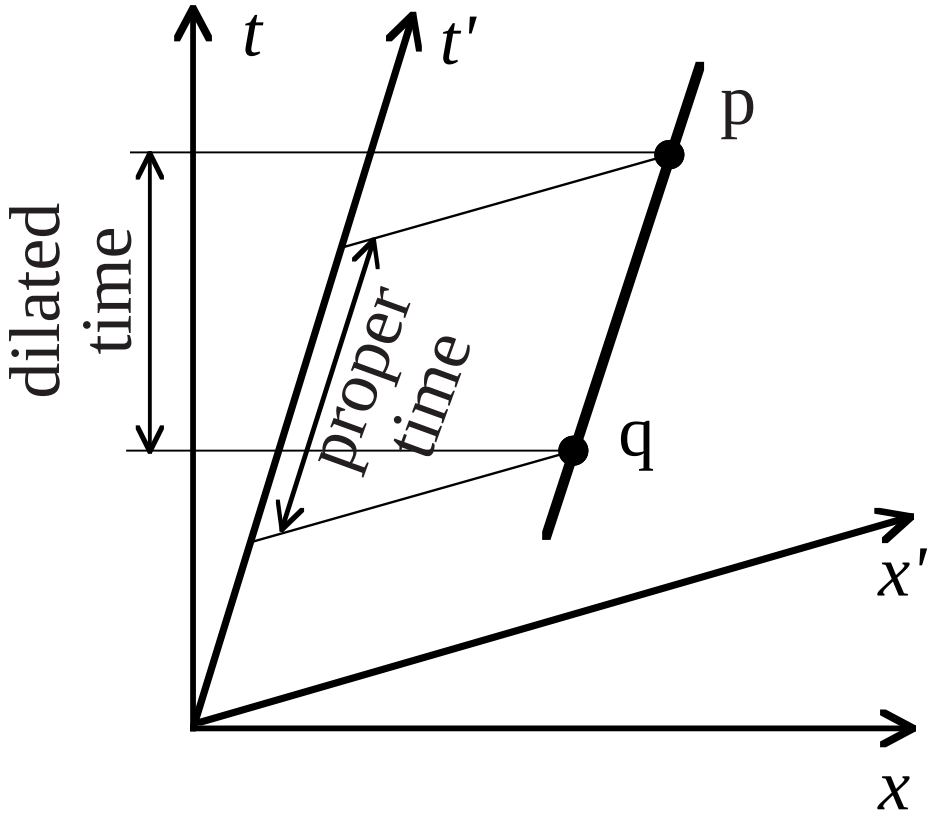




[Geroch, pp. 125–126]

What Time Dilation IS

- The time elapsed between two events is shortest when measured in the frame in which the events occur at the same place (*proper* time, $\Delta\tau$). In any other frame, the time elapsed between the events is longer by the factor $\gamma = \dfrac{1}{\sqrt{1-\dfrac{v^2}{c^2}}} > 1$: $\Delta t = \gamma\Delta\tau$
- In the frame in which a certain clock is *at rest*, it measures proper time between events it passes through.
- If that clock is monitored from a moving frame (i.e., moving with respect to that clock), it is found to run slow by factor γ in comparison with clocks that are stationary in the moving frame.


t
t′
p
dilated
time
proper
time
q
x′
x