Lecture 18) Accelerating point charge - intuitive approach

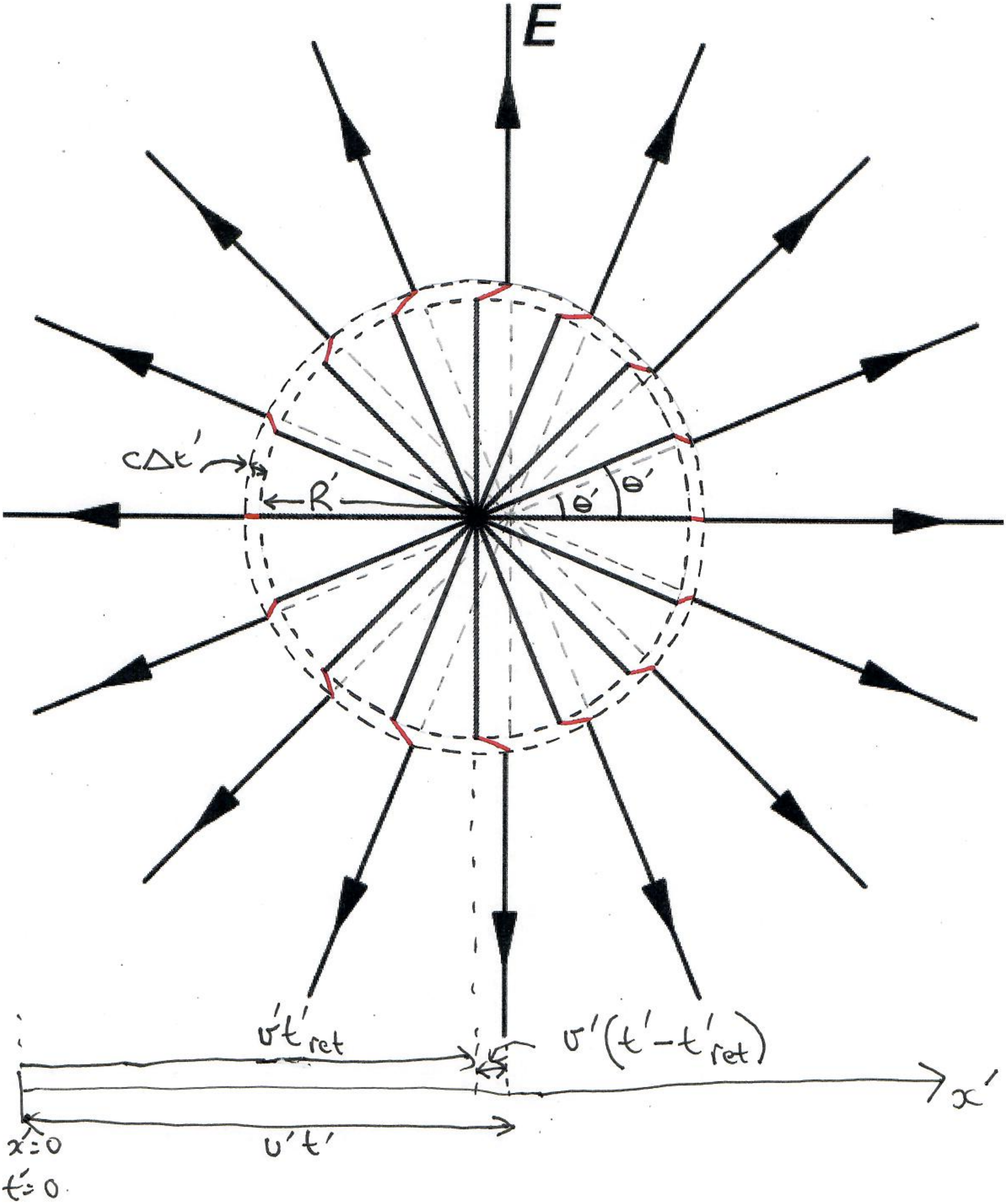
Point charge q travelling initially with a constant speed $v' \ll c$ in frame S'

At time t'_{ret} : q rapidly decelerates to be at rest over an interval $\Delta t'$

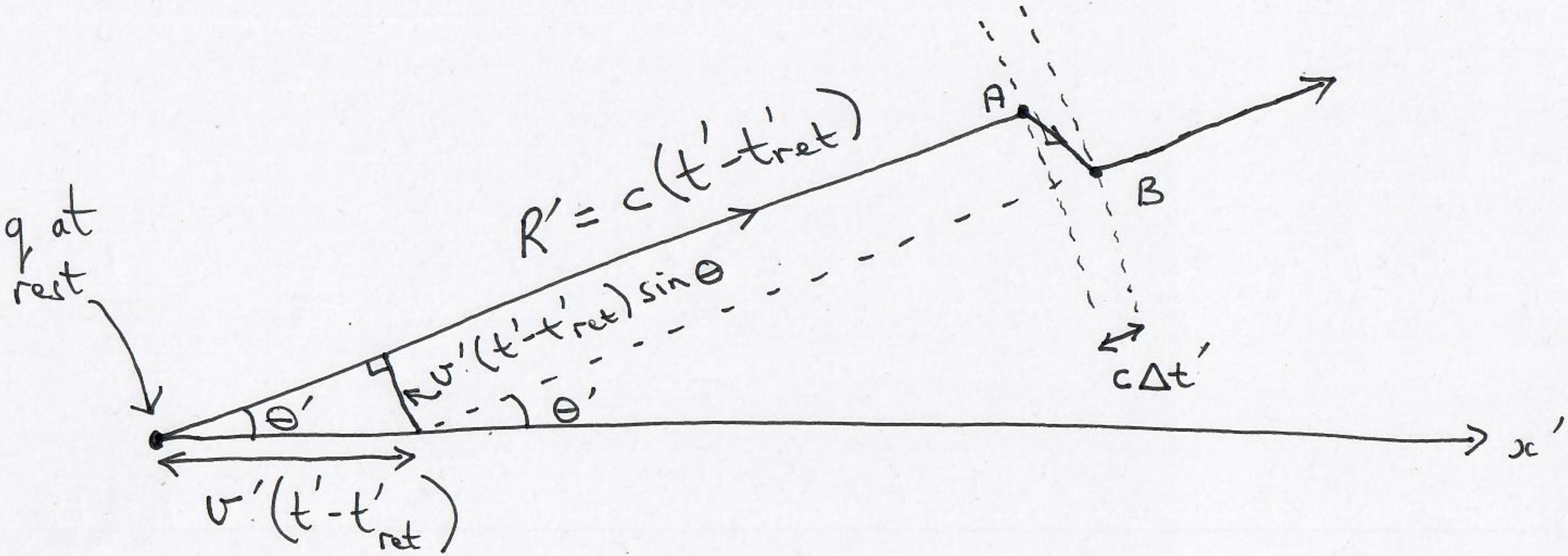
$$\dot{\beta}' = \frac{v'}{c\Delta t'}$$

At time $t' > t'_{ret}$:

- Region within $R' = c(t' - t'_{ret})$ sees field of stationary q at $x' = v't'_{ret}$
- Region outside $R' + c\Delta t'$ still sees field of moving charge at $x' = v't'$



E
$c\Delta t'$
R'
θ'
θ'
$v't'_{ret}$
$v'(t'-t'_{ret})$
x'
$x=0$
$t=0$
$v't'$



Radial field at A: $\quad E'_R = \dfrac{1}{4\pi\varepsilon_0} \dfrac{q}{(R')^2}$

Tangential component E'_T given by $\quad \dfrac{E'_T}{E'_R} = \dfrac{v'(t' - t'_{ret}) \sin\theta}{c\,\Delta t'}$

$$\therefore \; E'_T = \frac{q}{4\pi\varepsilon_0} \frac{c(t' - t'_{ret})}{(R')^2 c} \frac{v'}{c\Delta t'} \sin\theta' = \frac{q}{4\pi\varepsilon_0 c} \frac{\dot{\beta}'}{R'} \sin\theta'$$

Notes

- Accleration has produced a tangential component of $\underline{E}$
- Associated with this will be a field $\underline{B}$
- Both $\underline{E}$ and $\underline{B}$ fall off with $\frac{1}{R'}$

  * Compare this with $\underline{E}$ and $\underline{B}$ produced by charge moving with constant velocity $\propto \frac{1}{(R')^2}$

- $E \propto \sin\theta'$ dependence makes intuitive sense from the diagram.