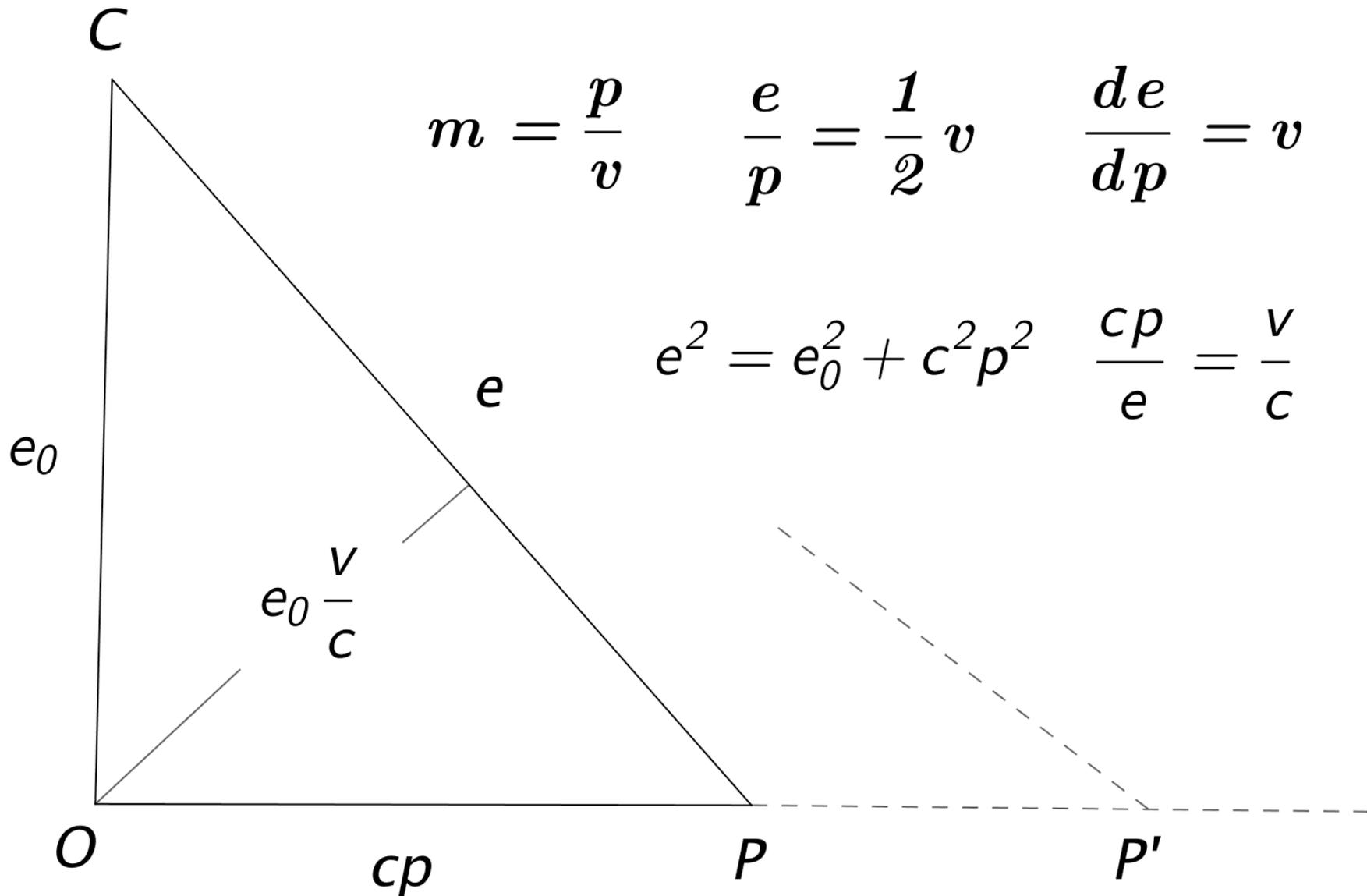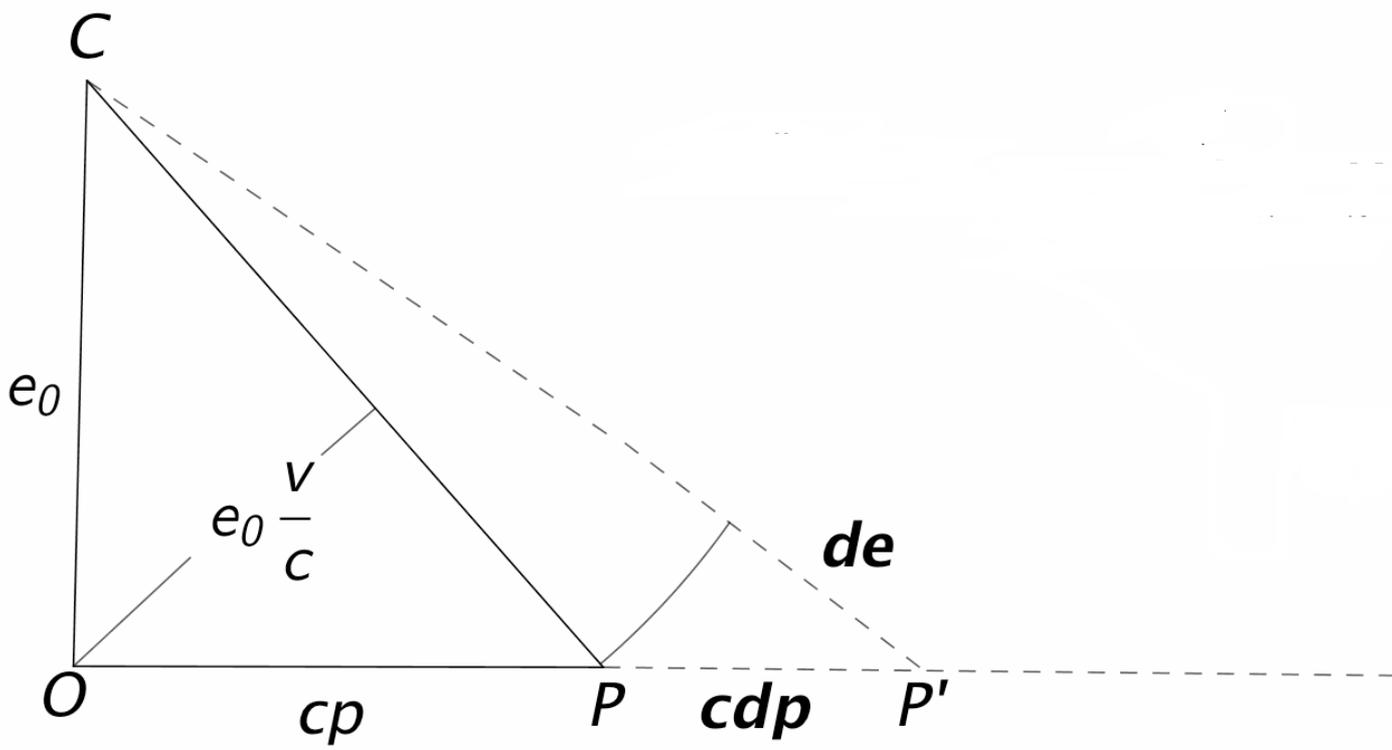# Dimostrazioni di Fisica

con il Triangolo Rettangolo

Corrado Agnes, già Politecnico di Torino;
corrado.agnes@polito.it
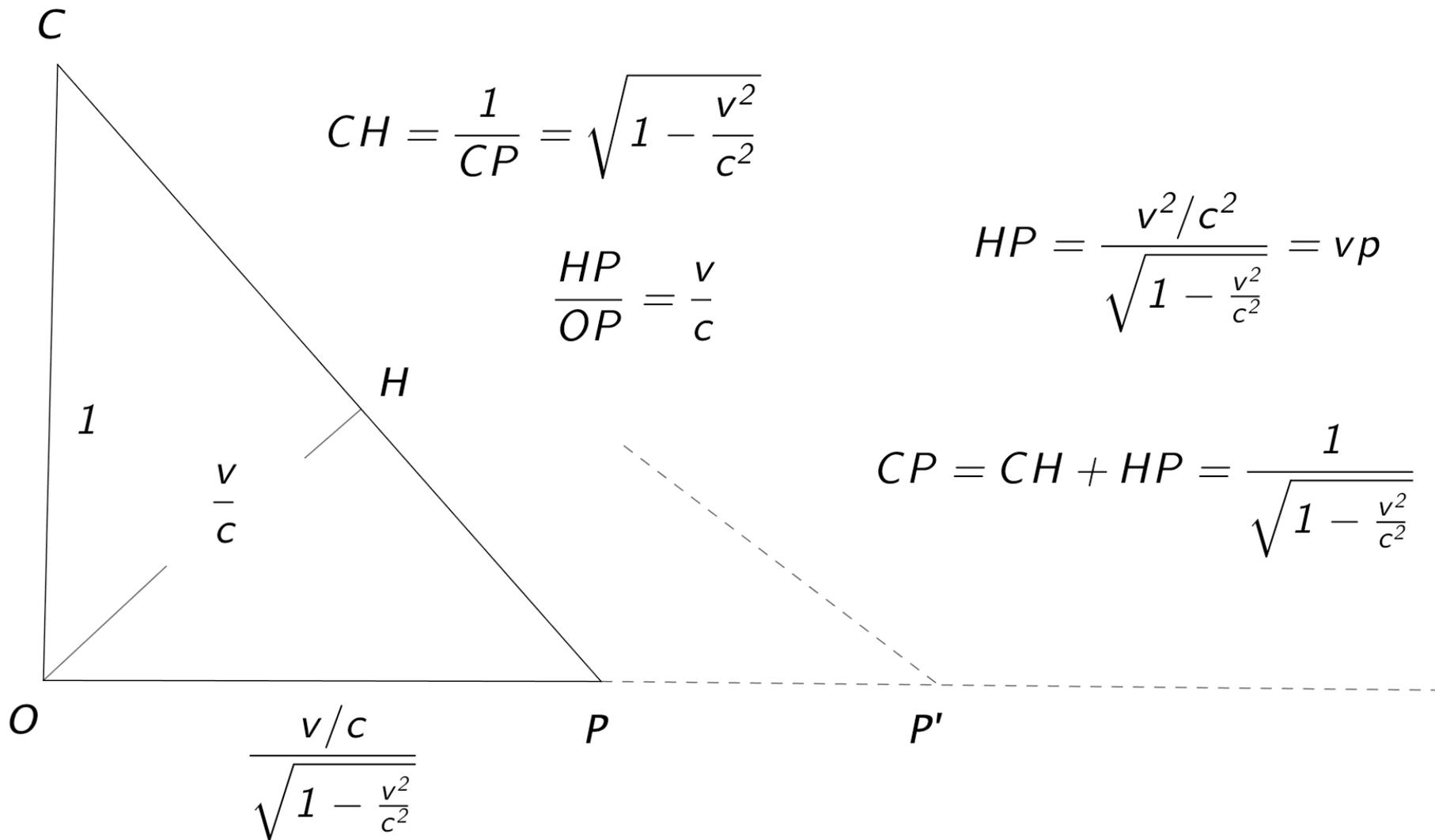
Angelo Merletti, Liceo Scientifico Maria Curie di Pinerolo;
merletti@curiepinerolo.gov.it

$$m = \frac{p}{v} \qquad \frac{e}{p} = \frac{1}{2}v \qquad \frac{de}{dp} = v$$

$$e^2 = e_0^2 + c^2 p^2 \qquad \frac{cp}{e} = \frac{v}{c}$$

C

e_0

e
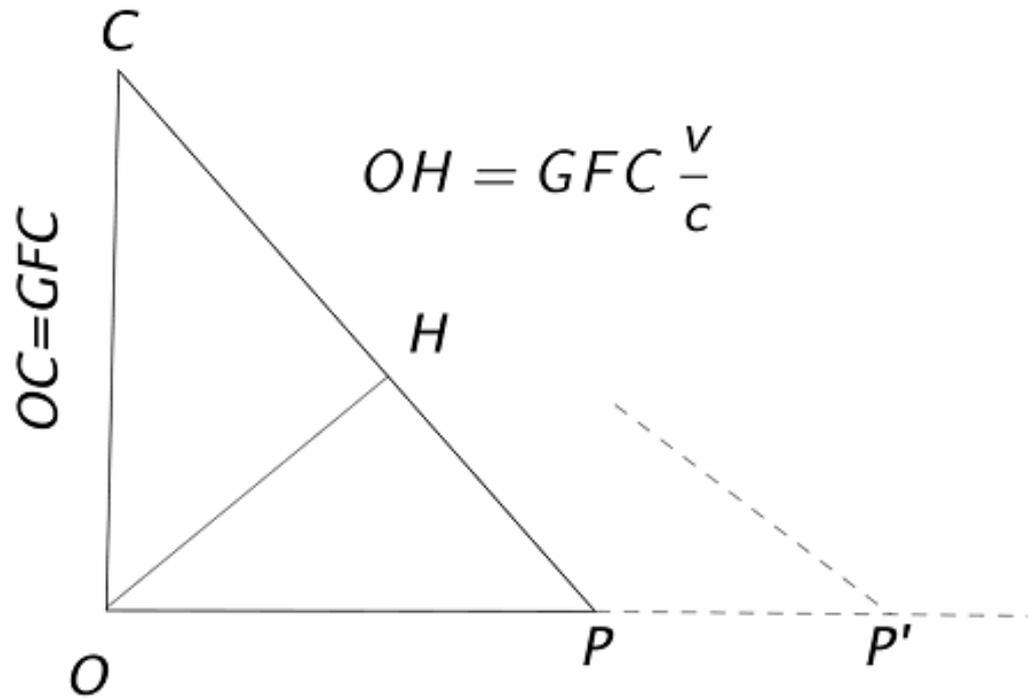
$e_0 \dfrac{v}{c}$

O

cp

P

P′

$$OH = e_0 \frac{cp}{\sqrt{e_0^2 + c^2 p^2}} = e_0 \frac{d\sqrt{e_0^2 + c^2 p^2}}{d(cp)} = e_0 \frac{de}{cdp} = e_0 \frac{v}{c}$$

$$e_0 cp = e_0 \frac{v}{c} e \qquad e = \frac{c^2 p}{v} = c^2 m$$

C

H

O

P

P'

$$CH = \frac{1}{CP} = \sqrt{1 - \frac{v^2}{c^2}}$$

$$HP = \frac{v^2/c^2}{\sqrt{1 - \frac{v^2}{c^2}}} = vp$$

$$\frac{HP}{OP} = \frac{v}{c}$$

$$CP = CH + HP = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

1

$\dfrac{v}{c}$

$$\frac{v/c}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$OC = GFC$

$OH = GFC\,\dfrac{v}{c}$

$CP = \dfrac{GFC}{\sqrt{1 - v^2/c^2}}$

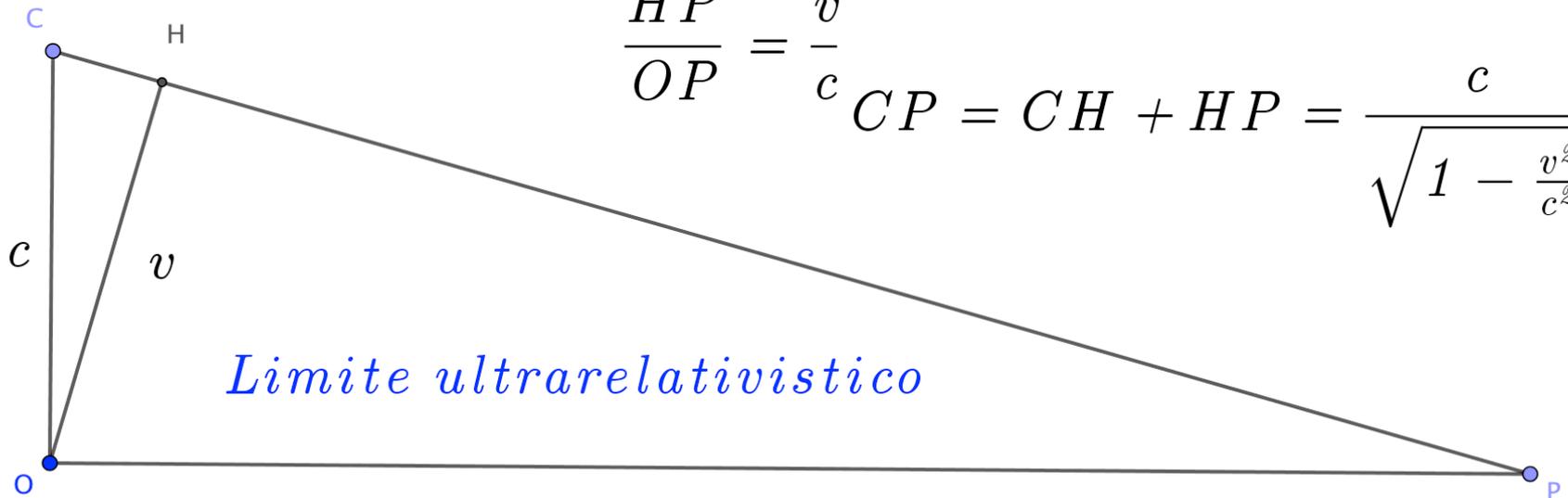$OP = \dfrac{GFC\ v/c}{\sqrt{1 - \frac{v^2}{c^2}}}$

$CH = GFC\sqrt{1 - v^2/c^2}$

$HP = \dfrac{GFC\ v^2/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$

$$\frac{CH}{c} = \frac{c}{CP} = \sqrt{1 - \frac{v^2}{c^2}} \qquad HP = \frac{v^2/c}{\sqrt{1 - \frac{v^2}{c^2}}}$$
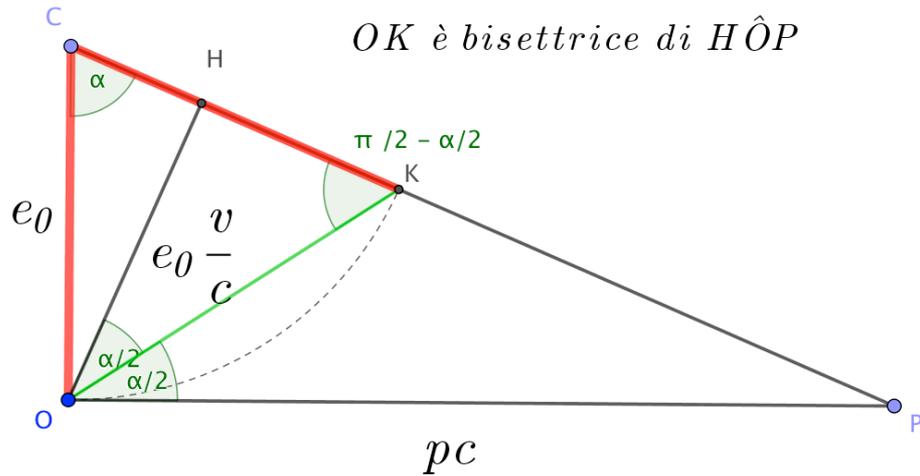
$$\frac{HP}{OP} = \frac{v}{c} \qquad CP = CH + HP = \frac{c}{\sqrt{1 - \frac{v^2}{c^2}}}$$

C

H

c

v

Limite ultrarelativistico

O

P

$$OP = \frac{v}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$OP = \frac{e_0 v/c}{\sqrt{1 - \frac{v^2}{c^2}}} = pc$$

$$PH = pv$$

$$CP = e = e_0 \sqrt{1 - \frac{v^2}{c^2}} + e_0 \frac{v^2/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$OH : HK = OP : PK$$

$$(teorema\ della\ bisettrice)$$

OK è bisettrice di $H\hat{O}P$

C

H

α

π/2 − α/2

K

e_0

$e_0 \dfrac{v}{c}$
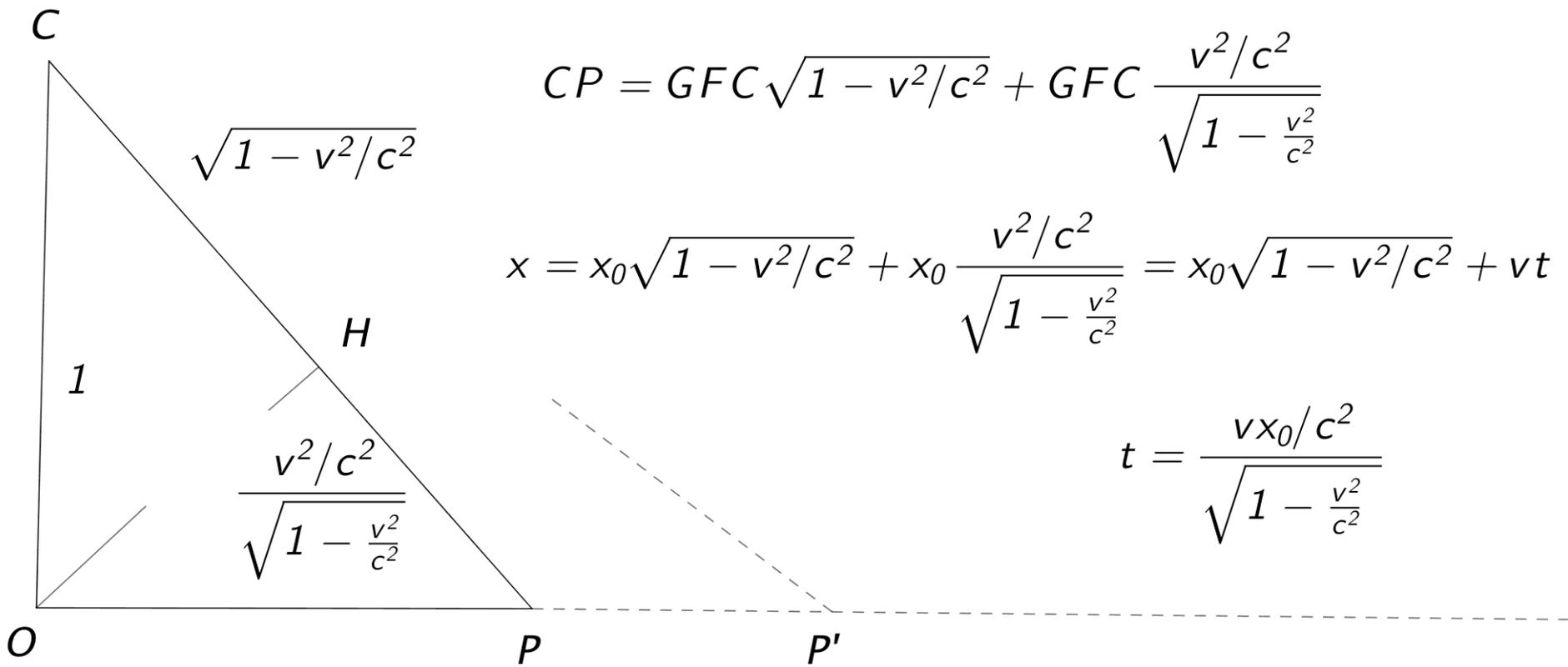
α/2
α/2

O

P

pc

Limite per basse velocità.

$$fisica : PK = e - e_0$$

$$v << c \rightarrow e_0 \frac{v}{c} \approx pc$$

$$HK \approx PK \rightarrow PK = \frac{1}{2} PH$$

$$\rightarrow e = e_0 + \frac{1}{2} pv = e_0 + \frac{1}{2} \frac{e_0}{c^2} v^2$$
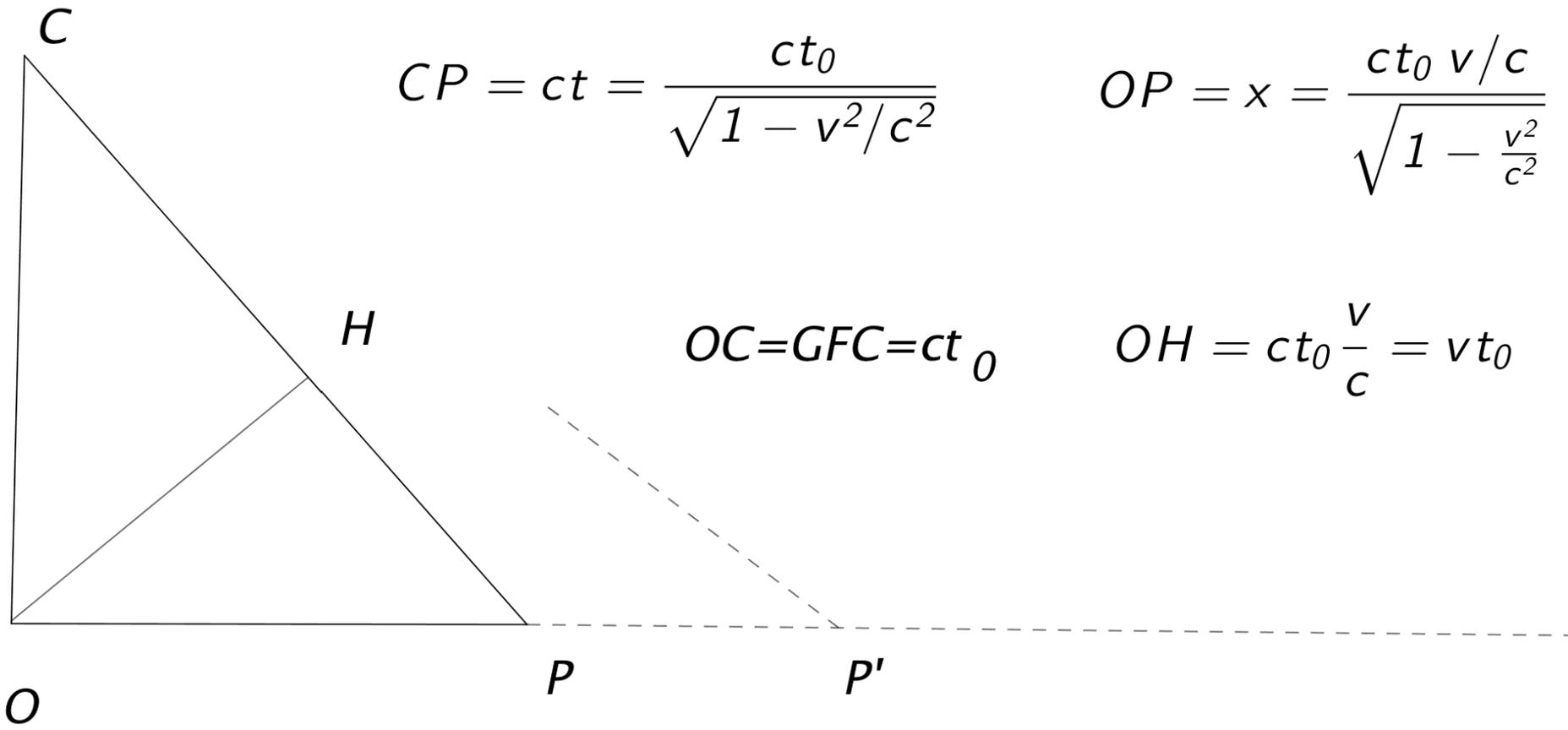
$$= e_0 + \frac{1}{2} m_0 v^2$$

$$CP = GFC\sqrt{1 - v^2/c^2} + GFC\,\frac{v^2/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$x = x_0\sqrt{1 - v^2/c^2} + x_0\,\frac{v^2/c^2}{\sqrt{1 - \frac{v^2}{c^2}}} = x_0\sqrt{1 - v^2/c^2} + vt$$

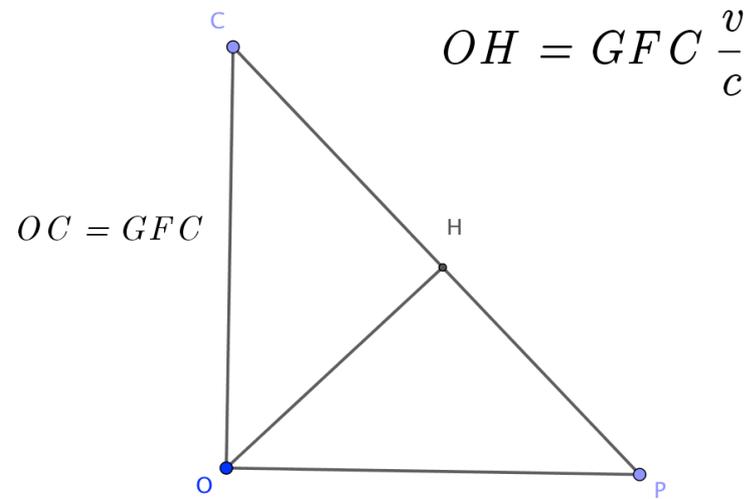$$t = \frac{vx_0/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$CP = ct = \frac{ct_0}{\sqrt{1 - v^2/c^2}}$$

$$OP = x = \frac{ct_0\, v/c}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$OC = GFC = ct_0$$

$$OH = ct_0\frac{v}{c} = vt_0$$
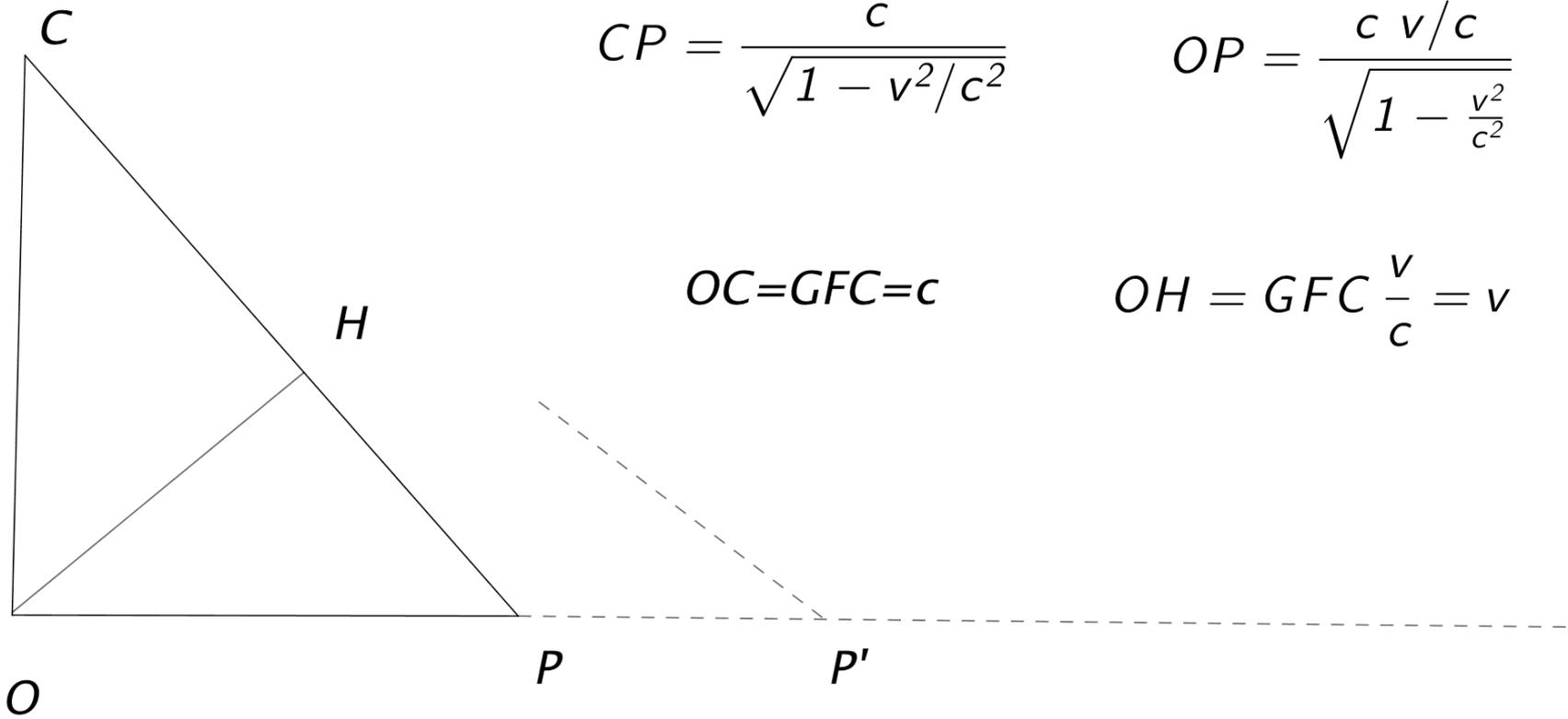
C

H

O

P

P'

$$OC = GFC$$

$$OH = GFC\ \frac{v}{c}$$

$$CP = \frac{GFC}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$OP = \frac{GFC\ v/c}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$CH = GFC\sqrt{1 - \frac{v^2}{c^2}}$$
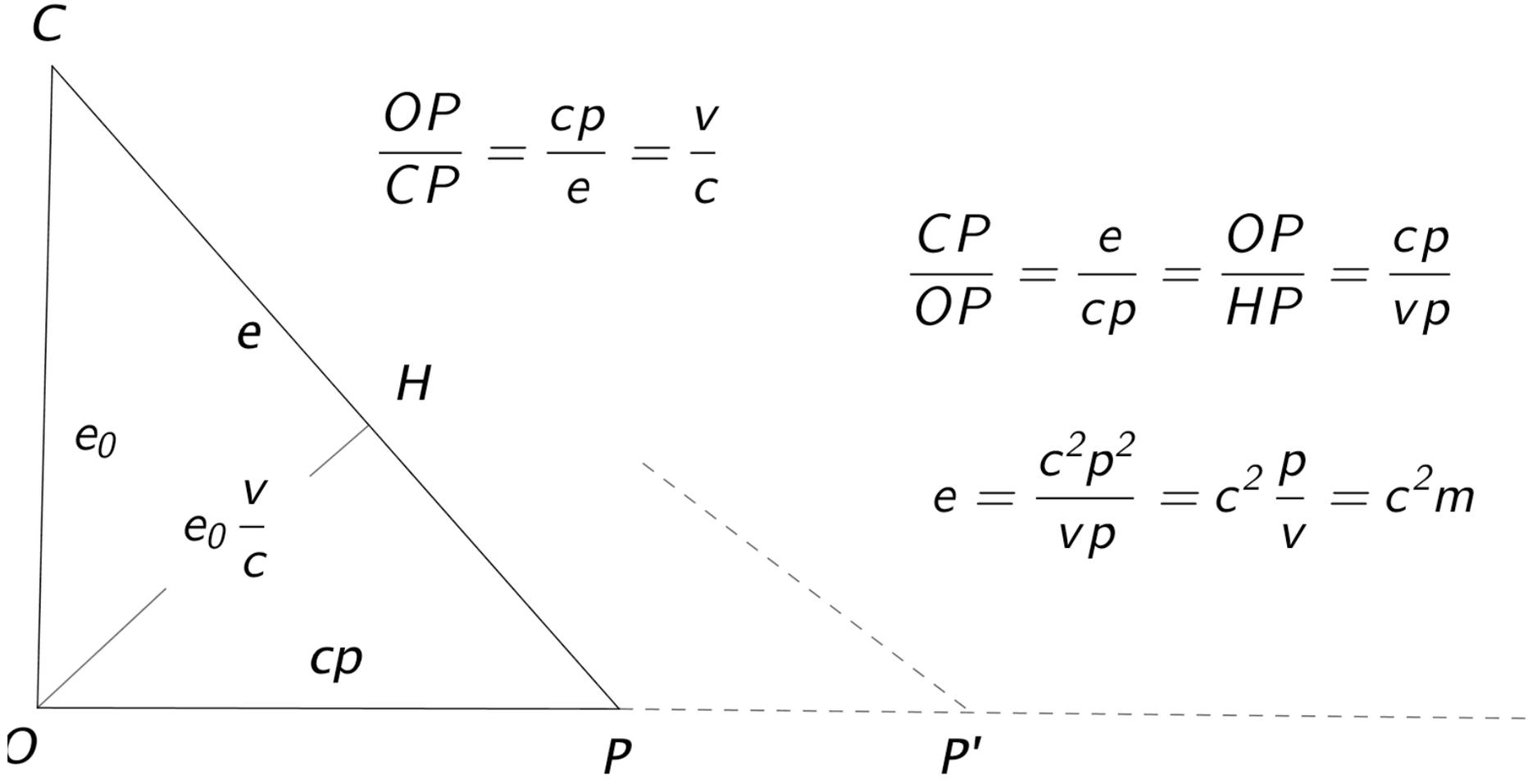
$$HP = \frac{GFC\ v^2/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$CP = \frac{c}{\sqrt{1 - v^2/c^2}} \qquad OP = \frac{c\, v/c}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$OC = GFC = c \qquad OH = GFC\,\frac{v}{c} = v$$

$$\frac{OP}{CP} = \frac{cp}{e} = \frac{v}{c}$$

$$\frac{CP}{OP} = \frac{e}{cp} = \frac{OP}{HP} = \frac{cp}{vp}$$

$$e = \frac{c^2p^2}{vp} = c^2\frac{p}{v} = c^2m$$

$$e = e_0\sqrt{1 - v^2/c^2} + e_0 \frac{v^2/c^2}{\sqrt{1 - \frac{v^2}{c^2}}} = e_0\sqrt{1 - v^2/c^2} + vp$$

$$CP = GFC\sqrt{1 - v^2/c^2} + GFC \frac{v^2/c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$