

```
(%i1) kill(all);
(%o0) done

(%i1) assume(c>0, v>0);
(%o1) [c>0, v>0]
```

1 Self-consistent determination of gamma factor

```
(%i2) E0: gamma = (1-p^2/(m^2*c^2))^(1/2);
```

```
(E0) 
$$\Gamma = \frac{1}{\sqrt{1 - \frac{p^2}{c^2 m^2}}}$$

```

```
(%i3) p: gamma*m*v;
```

```
(p) 
$$m v \Gamma$$

```

```
(%i4) E1: ev(E0);
```

```
(E1) 
$$\Gamma = \frac{1}{\sqrt{1 - \frac{v^2 \Gamma^2}{c^2}}}$$

```

```
(%i5) E2: 1/E1^2;
```

```
(E2) 
$$\frac{1}{\Gamma^2} = 1 - \frac{v^2 \Gamma^2}{c^2}$$

```

```
(%i6) E3: E2*gamma^2;
```

```
(E3) 
$$1 = \Gamma^2 \left( 1 - \frac{v^2 \Gamma^2}{c^2} \right)$$

```

```
(%i7) E4: subst(Gamma_2, gamma^2, E3);
```

```
(E4) 
$$1 = \Gamma_2 \left( 1 - \frac{\Gamma_2 v^2}{c^2} \right)$$

```

```
(%i8) E5: solve(E4, Gamma_2);
```

```
(E5) 
$$\left[ \Gamma_2 = -\frac{c \sqrt{c^2 - 4 v^2 - c^2}}{2 v^2}, \Gamma_2 = \frac{c \sqrt{c^2 - 4 v^2 + c^2}}{2 v^2} \right]$$

```

2 First solution for gamma^2

```
(%i9) G1: rhs(first(E5));
```

```
(G1) 
$$-\frac{c \sqrt{c^2 - 4 v^2 - c^2}}{2 v^2}$$

```

```
(%i10) G2: 1/2*c^2/v^2*(1-sqrt(1-4*v^2/c^2));
```

```
(G2) 
$$\frac{c^2 \left( 1 - \sqrt{1 - \frac{4 v^2}{c^2}} \right)}{2 v^2}$$

```

```
(%i11) ratsimp(G1-G2);
```

```
(%o11) 0
```

```
(%i12) Ga: sqrt(ev(G2, [c=1]));
```

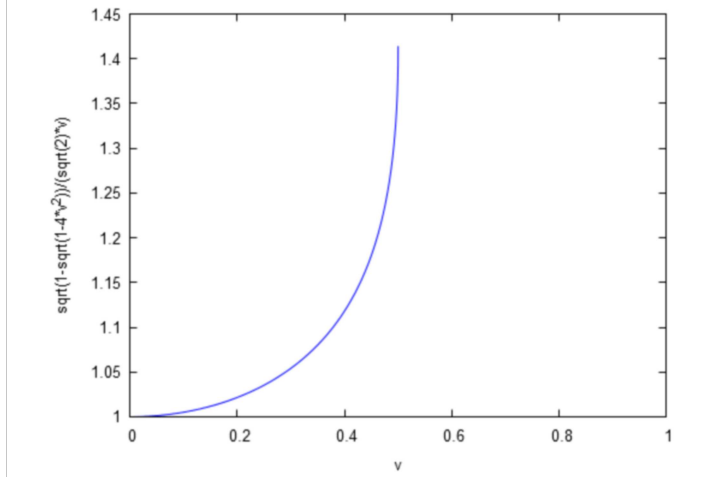
```
(Ga) 
$$\frac{\sqrt{1 - \sqrt{1 - 4 v^2}}}{\sqrt{2} v}$$

```

```
(%i13) wxplot2d([Ga], [v,0,1])$
```

plot2d: expression evaluates to non-numeric value somewhere in plotting range.

```
(%t13)
```



3 Second solution for gamma^2

```
(%i14) G1: rhs(second(E5));
```

$$(G1) \quad \frac{c\sqrt{c^2-4v^2+c^2}}{2v^2}$$

```
(%i15) G2: 1/2*c^2/v^2*(1+sqrt(1-4*v^2/c^2));
```

$$(G2) \quad \frac{c^2\left(\sqrt{1-\frac{4v^2}{c^2}}+1\right)}{2v^2}$$

```
(%i16) ratsimp(G1-G2);
```

```
(%o16) 0
```

```
(%i17) Gb: sqrt(ev(G2, [c=1]));
```

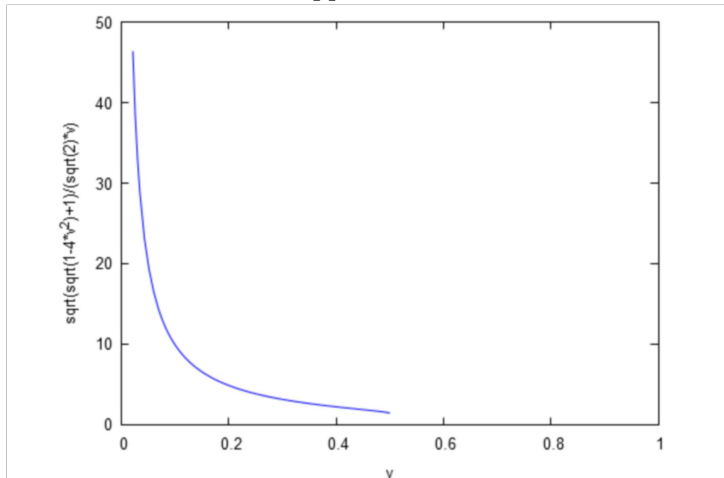
$$(Gb) \quad \frac{\sqrt{\sqrt{1-4v^2}+1}}{\sqrt{2}v}$$

```
(%i18) wxplot2d([Gb], [v,0,1], [y,0,50])$
```

```
plot
```

2d: expression evaluates to non-numeric value somewhere in plotting range.
plot2d: some values were clipped.

```
(%t18)
```



4 Comparison with gamma of Photons

```
(%i19) G4: (1-v^2/(2*c^2))^(1/2);
```

$$(G4) \quad \frac{1}{\sqrt{1-\frac{v^2}{2c^2}}}$$

```
(%i20) Gc: ev(G4, [c=1]);
```

(Gc)

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

```
(%i21) wxplot2d([Ga, Gc], [v,0,1])$
```

plot2d: expression evaluates to non-numeric value somewhere in plotting range.

(%t21)

