```
(%i15) kill(all);
(%o0) done
```

```
(%i1) assume(v0>0, c>0, gamma>0);
(%o1) [v0>0,c>0,gamma>0]
```

1 Vacuum mass velocity

```
(%i2) E22: gamma^2=1/(1-v0^2/c^2);
```

$$(\%o2)\quad gamma^2=\frac{1}{1-\frac{v0^2}{c^2}}$$

```
(%i3) E22a: expand(solve(E22, v0^2));
```

$$(\%o3)\quad [v0^2=c^2-\frac{c^2}{gamma^2}]$$

```
(%i4) E22b: sqrt(first(E22a));
```

$$(\%o4)\quad v0=\sqrt{c^2-\frac{c^2}{gamma^2}}$$

```
(%i5) v0 = c*sqrt(1-1/gamma^2);
```

$$(\%o5)\quad v0=c\sqrt{1-\frac{1}{gamma^2}}$$

```
(%i6) ratsimp(E22b^2-%^2);
(%o6) 0=0
```

```
(%i7) g: 2.00231930436182;
      gamma: g-1;
(%o7) 2.00231930436182
(%o8) 1.00231930436182
```

```
(%i9) c: 2.99792458e8;
(%o9) 2.99792458 10^8
```

```
(%i10) E22c: ev(E22b);
(%o10) v0=2.0382626563005663 10^7
```

```
(%i11) %/c;
(%o11) 3.3356409519815204 10^-9 v0=0.067989123872508
```

```
(%i12) v[vac]: rhs(E22c);
(%o12) 2.0382626563005663 10^7
```

2 Hubble constant and universal absorption coeffic

(%i13) H: 7.2e6/3.0857e22;

(%o13) $2.3333441358524806\,10^{-16}$

(%i14) alpha[univ] = H/v[vac];

(%o14) $\alpha_{univ}=1.1447710767990447\,10^{-23}$