

## Initialization & Library Loading

### Defining Constant Speed Motion Worldline

```
In[*]:= SetAttributes[v, Constant];
$Assumptions = v > 0 && v < 1;

ConstantSpeedMotion[v_] := t  $\mapsto$  mkFourVector[t, v t];

Worldlines are parametrized by local time:
```

```
In[*]:= ConstantSpeedMotion[v]
Out[*]= Function[t$, mkFourVector[t$, v t$]]

In[*]:= ConstantSpeedMotion[v][t]
Out[*]= FourVector[t, t v, 0, 0]
```

### Proper Time

```
In[*]:= Dtau[ConstantSpeedMotion[v]][λ]
Out[*]=  $\sqrt{1-v^2} \, Dt[\lambda]$ 

In[*]:= ProperTime[ConstantSpeedMotion[v]][λ]
Out[*]=  $\sqrt{1-v^2} \, \lambda$ 

In[*]:= ProperTimeParametrization[ConstantSpeedMotion[v]][τ] // Simplify
Out[*]=  $\left\{ \text{FourVector}\left[ \frac{\tau}{\sqrt{1-v^2}}, \frac{v \tau}{\sqrt{1-v^2}}, 0, 0 \right] \right\}$ 

In[*]:= ProperTimeToFrameTime[ConstantSpeedMotion[v]][τ] // Simplify
Out[*]=  $\left\{ \frac{\tau}{\sqrt{1-v^2}} \right\}$ 

In[*]:= FrameTimeToProperTime[ConstantSpeedMotion[v]][t] // Simplify
Out[*]=  $\left\{ t \sqrt{1-v^2} \right\}$ 
```

### Local Frame Properties

```
In[*]:= FrameVelocity[ConstantSpeedMotion[v]][λ]
Out[*]= {v, 0, 0}
```

```
In[*]:= FrameAcceleration[ConstantSpeedMotion[v]][λ]
```

```
Out[*]= {0, 0, 0}
```

## Velocity and Acceleration

```
In[*]:= FourVelocity[ConstantSpeedMotion[v]][λ]
```

```
Out[*]= FourVector[ $\frac{1}{\sqrt{1-v^2}}$ ,  $\frac{v}{\sqrt{1-v^2}}$ , 0, 0]
```

```
In[*]:= ProperVelocity[ConstantSpeedMotion[v]][λ] // Simplify
```

```
Out[*]= 1
```

```
In[*]:= FourAcceleration[ConstantSpeedMotion[v]][λ]
```

```
Out[*]= FourVector[0, 0, 0, 0]
```

```
In[*]:= ProperAcceleration[ConstantSpeedMotion[v]][λ]
```

```
Out[*]= 0
```