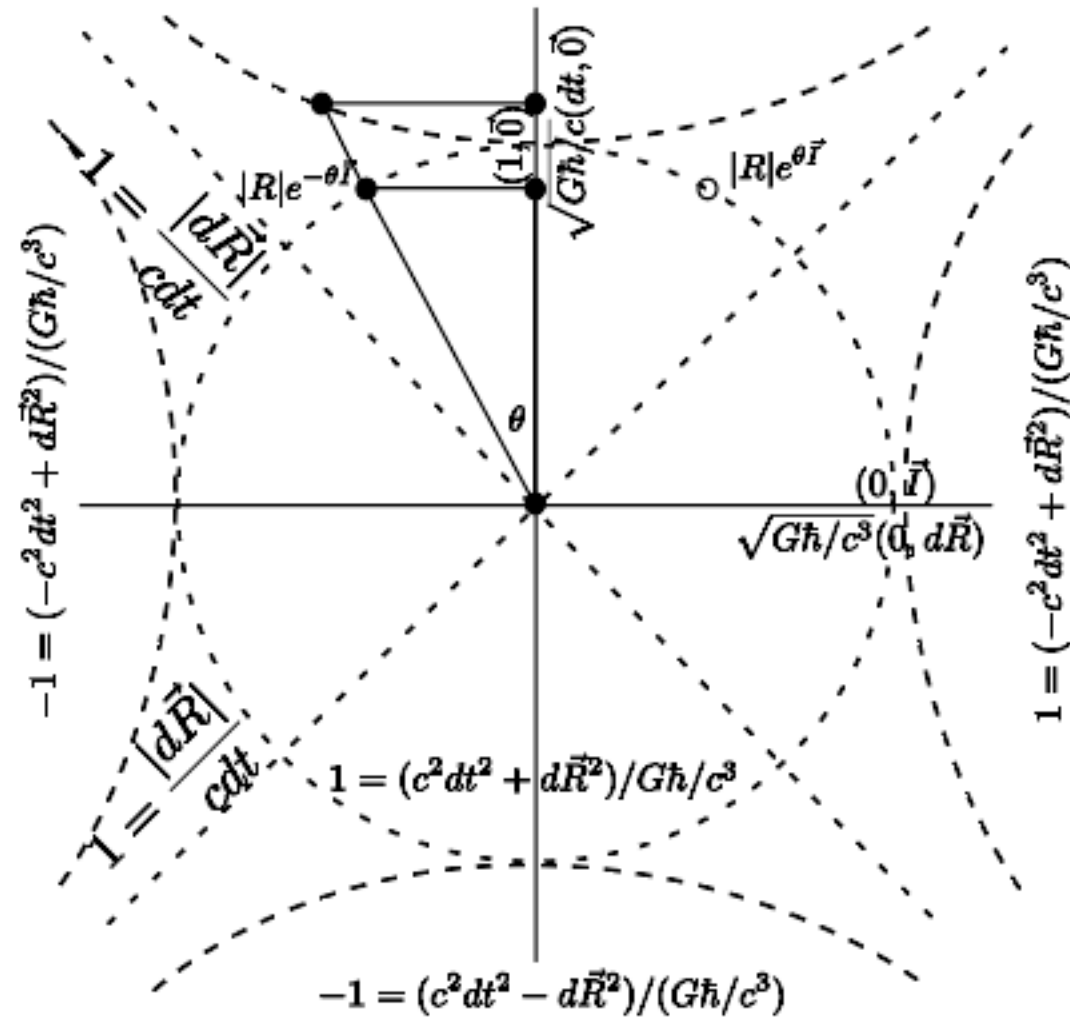


# Spacetime Trig Functions



## Distance & Velocities

$$\begin{array}{l} d = |dR| \\ s = \frac{1}{c} \frac{d\vec{R}}{dt} = \infty \end{array}$$

$$\begin{array}{l} d = \sinh(\theta) \\ = \gamma\beta = \frac{\beta}{\sqrt{1-\beta^2}} \end{array}$$

$$\begin{array}{l} d = c|dt| \\ s = \frac{1}{c} \frac{d\vec{R}}{dt} = \vec{0} \end{array}$$

$$\begin{array}{l} d = \cosh(\theta) \\ = \gamma = \frac{1}{\sqrt{1-\beta^2}} \end{array}$$

$$\begin{array}{l} d = \sqrt{c^2 dt^2 + dR^2} \\ s = \frac{1}{c} \frac{d\vec{R}}{dt} = \vec{\beta} \end{array}$$

$$\begin{array}{l} d = \sqrt{\cosh(2\theta)} \\ = \frac{\sqrt{1+\beta^2}}{\sqrt{1-\beta^2}} \end{array}$$

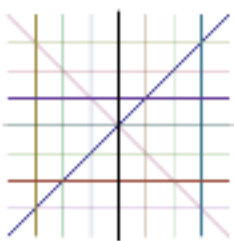
## Ratios

$$\begin{array}{l} \sin(\theta) = \frac{dR}{\sqrt{c^2 dt^2 + dR^2}} \\ = \frac{1}{\sqrt{\beta^{-2} + 1}} \end{array}$$

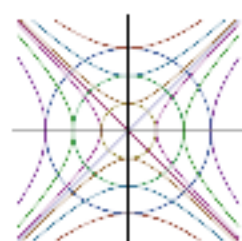
$$\begin{array}{l} \cos(\theta) = \frac{c dt}{\sqrt{c^2 dt^2 + dR^2}} \\ = \frac{1}{\sqrt{1 + \beta^2}} \end{array}$$

$$\begin{array}{l} \tan(\theta) = \frac{1}{c} \frac{d\vec{R}}{dt} = \vec{\beta} \end{array}$$

A unit circle, parabola, & lightcone



Euclidean



Polar Coordinates

## Hyperbolic

$$\text{Sine } \frac{(e^{(dt, \vec{0})/\sqrt{G\hbar/c}} - e^{(-dt, \vec{0})/\sqrt{G\hbar/c}})/2}$$

$$\text{Cosine } \frac{(e^{(dt, \vec{0})/\sqrt{G\hbar/c}} + e^{(-dt, \vec{0})/\sqrt{G\hbar/c}})/2}$$

## Trigonometric

$$\frac{(e^{(0, \vec{R})/\sqrt{G\hbar/c^3}} - e^{(0, \vec{R})^*/\sqrt{G\hbar/c^3}})/2}$$

$$\frac{(e^{(0, \vec{R})/\sqrt{G\hbar/c^3}} + e^{(0, \vec{R})^*/\sqrt{G\hbar/c^3}})/2}$$