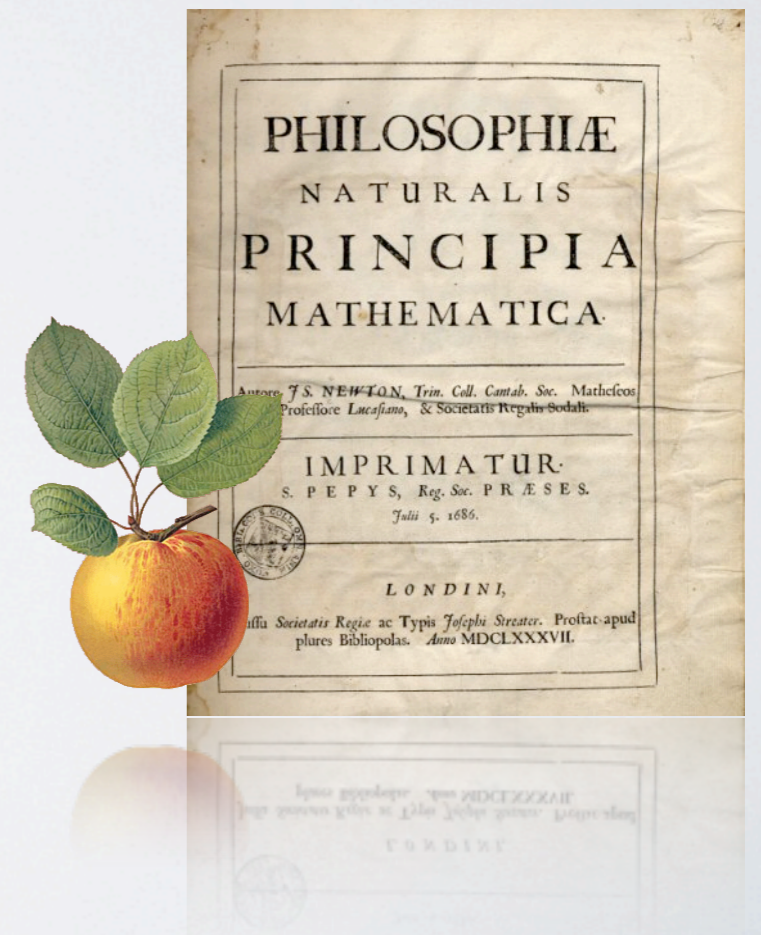


# GENERAL RELATIVITY

A New View of Spacetime

“...Thus, I have explained the phenomena of the heavens and of our sea by the force of gravity, but I have not yet assigned a cause to gravity...I have not as yet been able to deduce from phenomena the reason for these properties of gravity, and I do not feign hypotheses.”



# HIS HAPPIEST THOUGHT

–Albert Einstein, 1907



# PRINCIPLE OF EQUIVALENCE

The effects of gravitation are indistinguishable from accelerated motion.

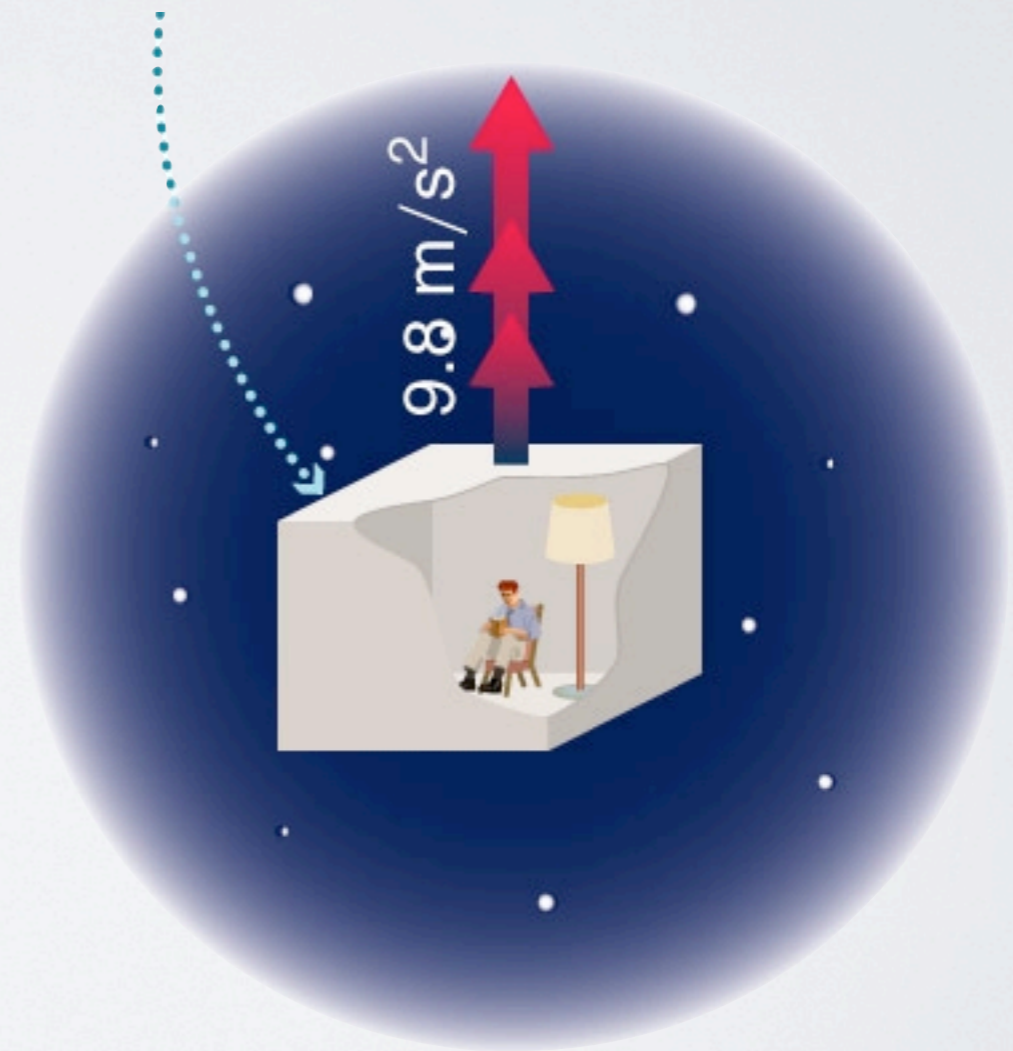


# EXAMPLE

You can't tell the difference between a closed room on Earth...

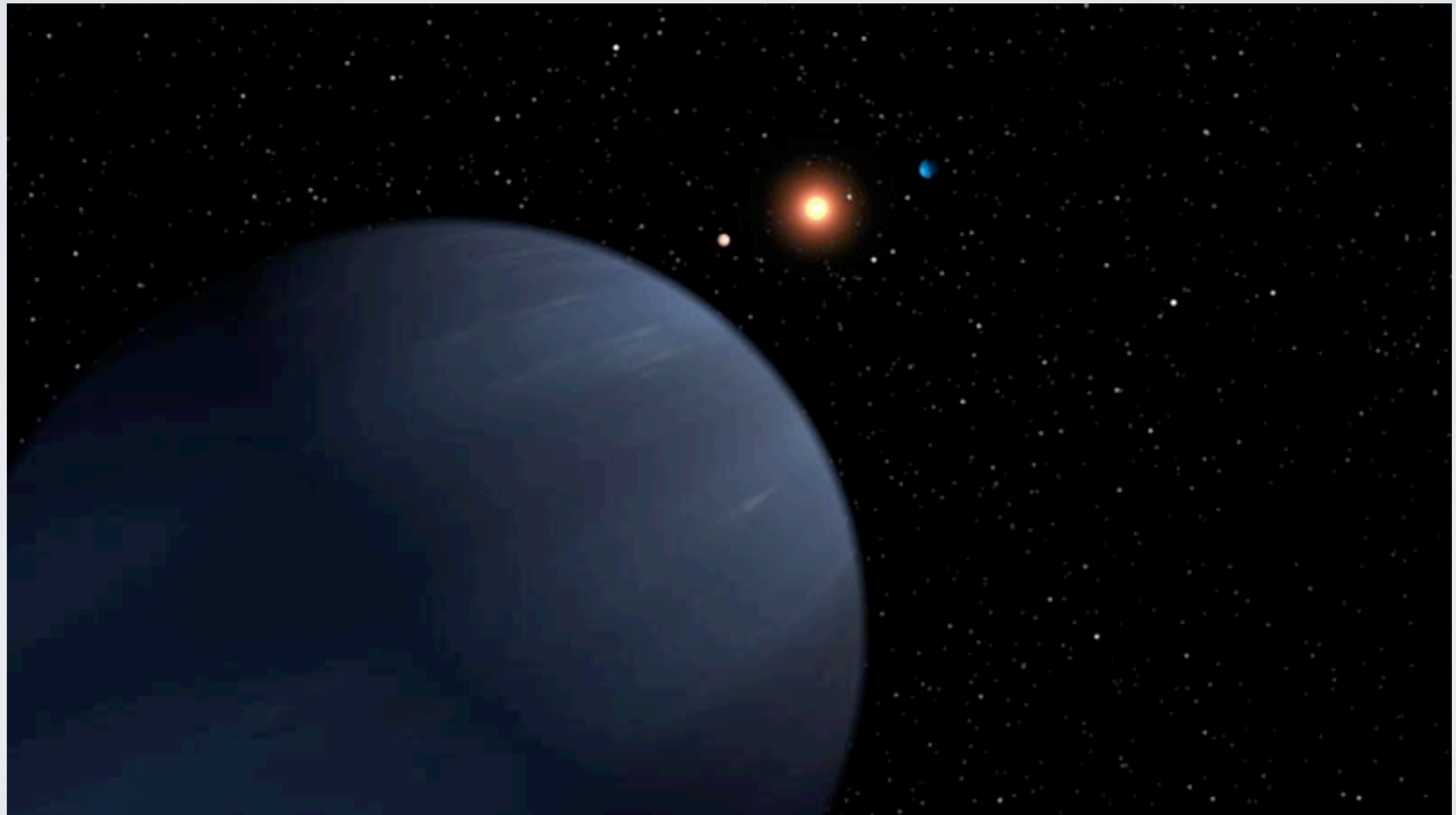


...and a closed room accelerating in space at  $1g$ .

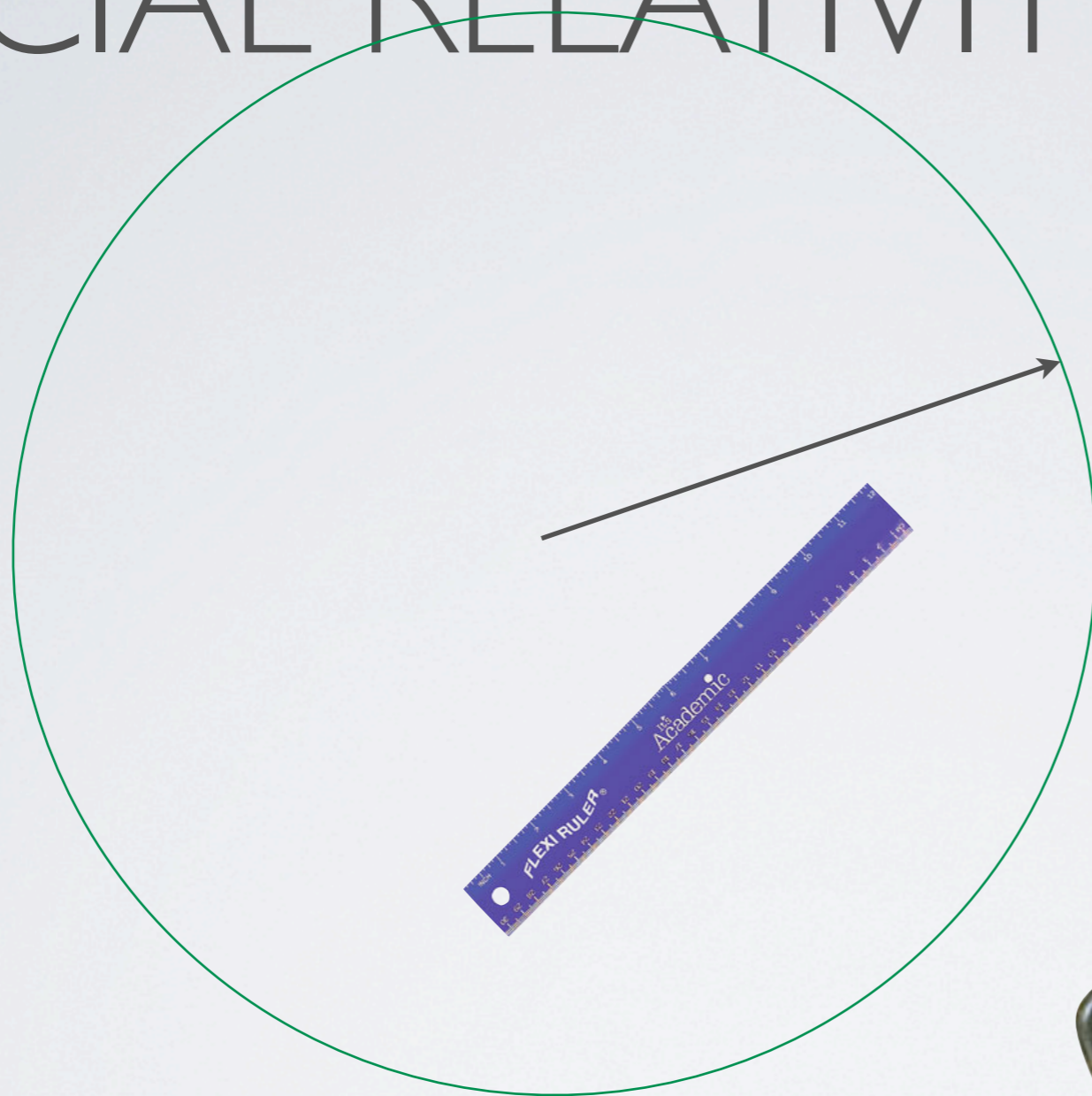


No experiment can be performed that would reveal whether one is at rest in a gravitational field or moving with constant acceleration.

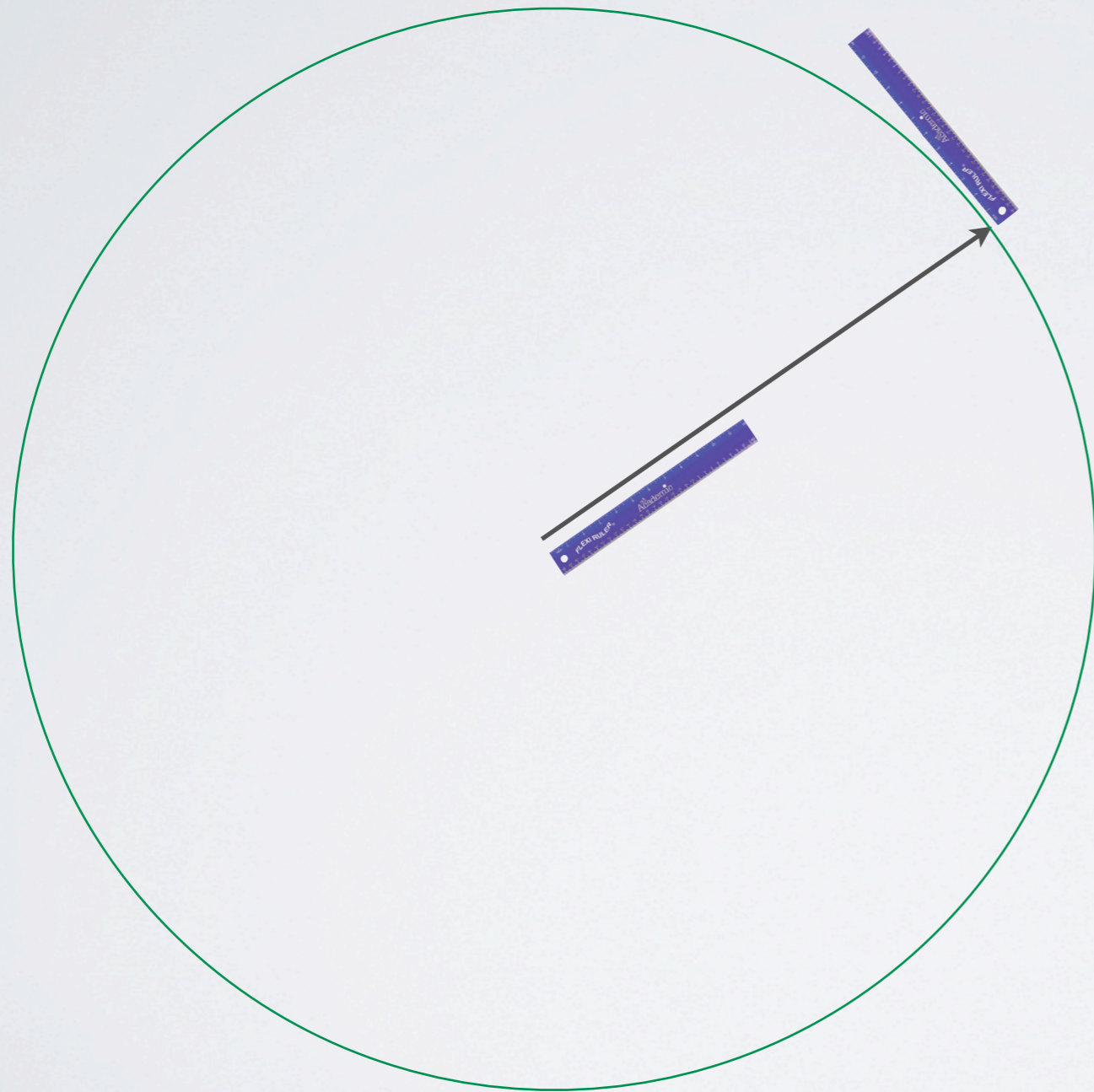
# GRAVITY'S PARADOX



# SPECIAL RELATIVITY'S ROLE



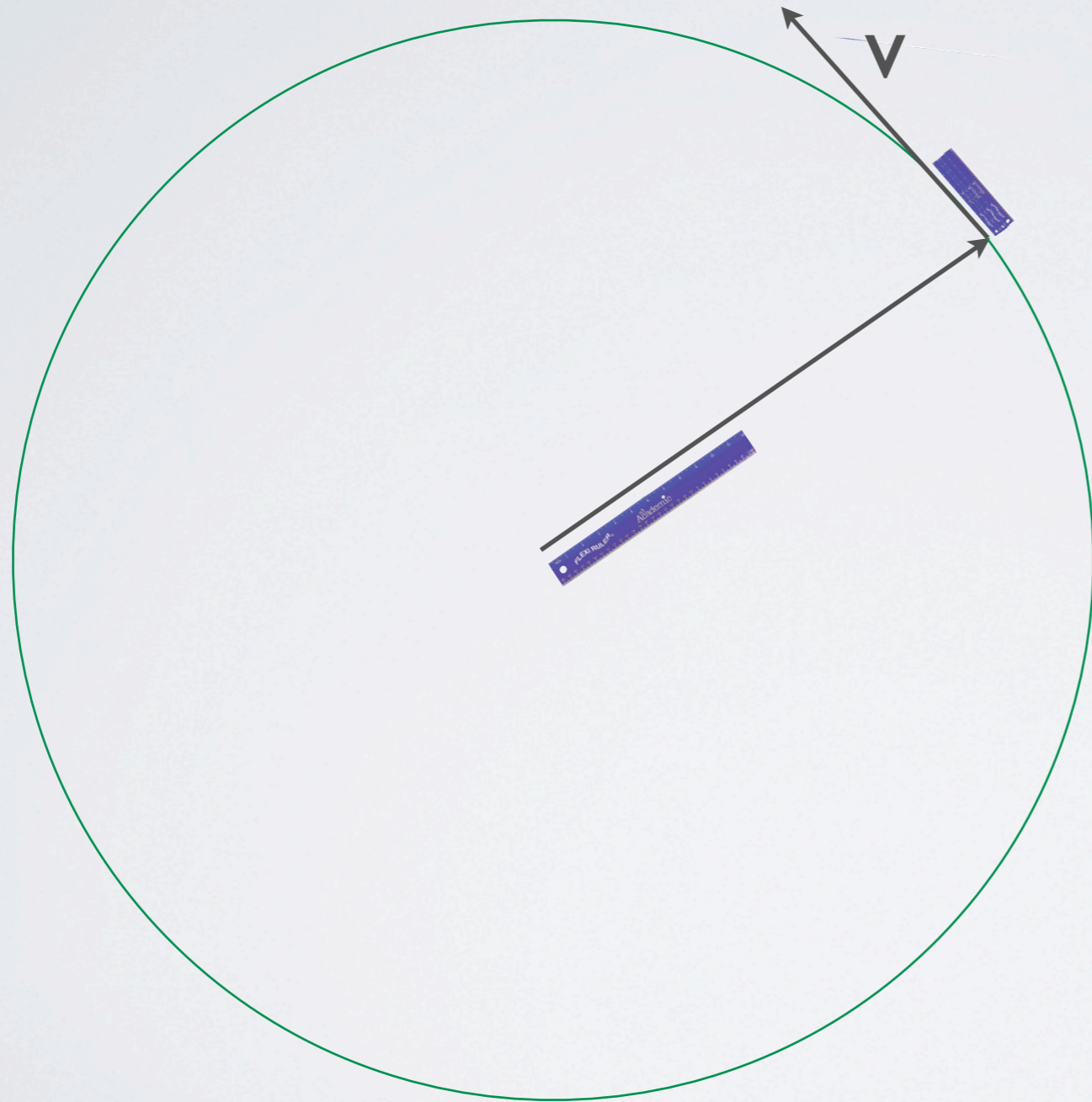
# STATIONARY



$$C = 2\pi r$$

Calculated is  
the same as  
measured.

# ROTATING AT 0.87C



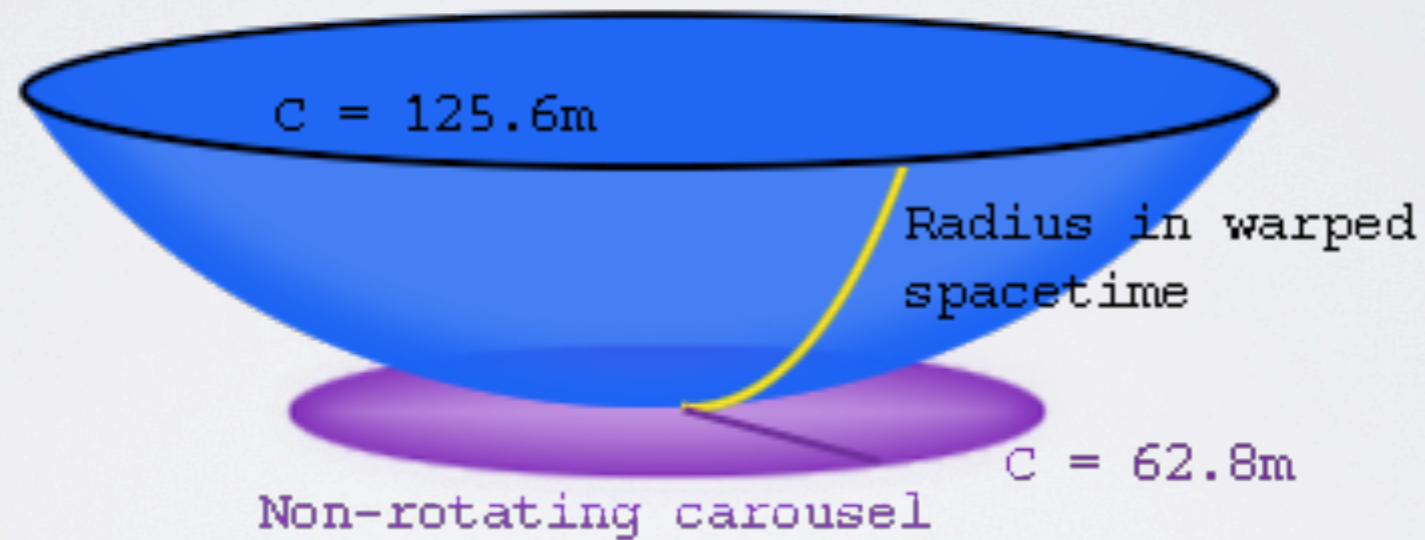
$$C = 2\pi r$$

Calculated is **half** measured value.

# REALIZATION

Acceleration warps spacetime!

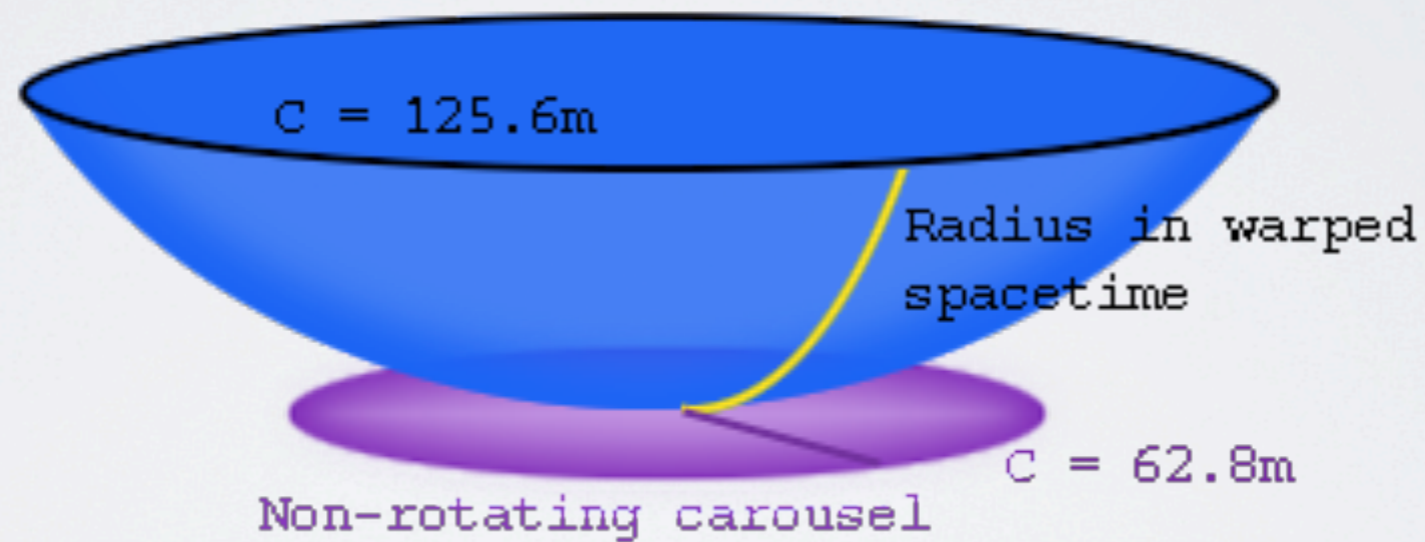
Rotating carousel



# REALIZATION

...and so does Gravity

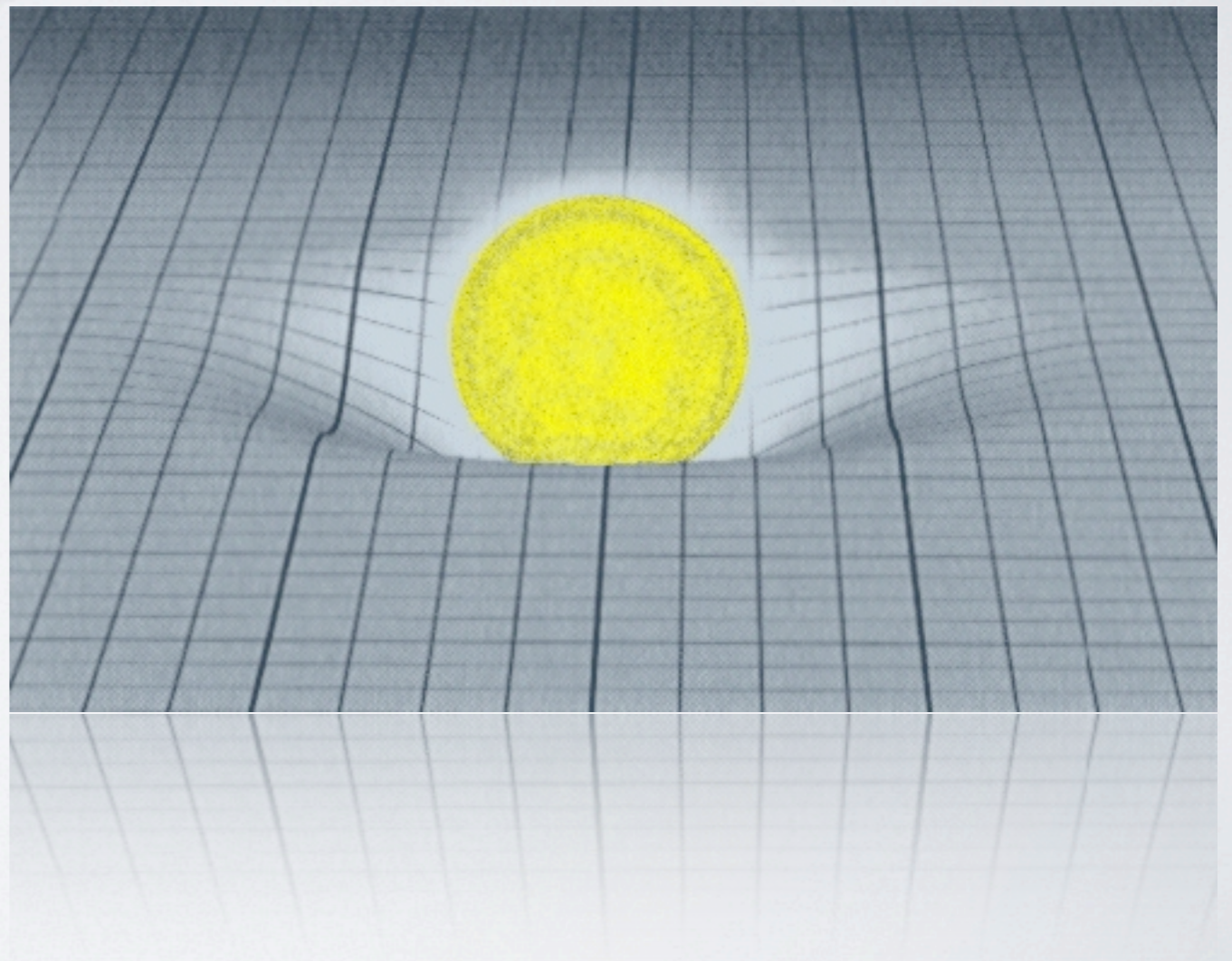
Rotating carousel



# THE ILLUSION OF GRAVITY

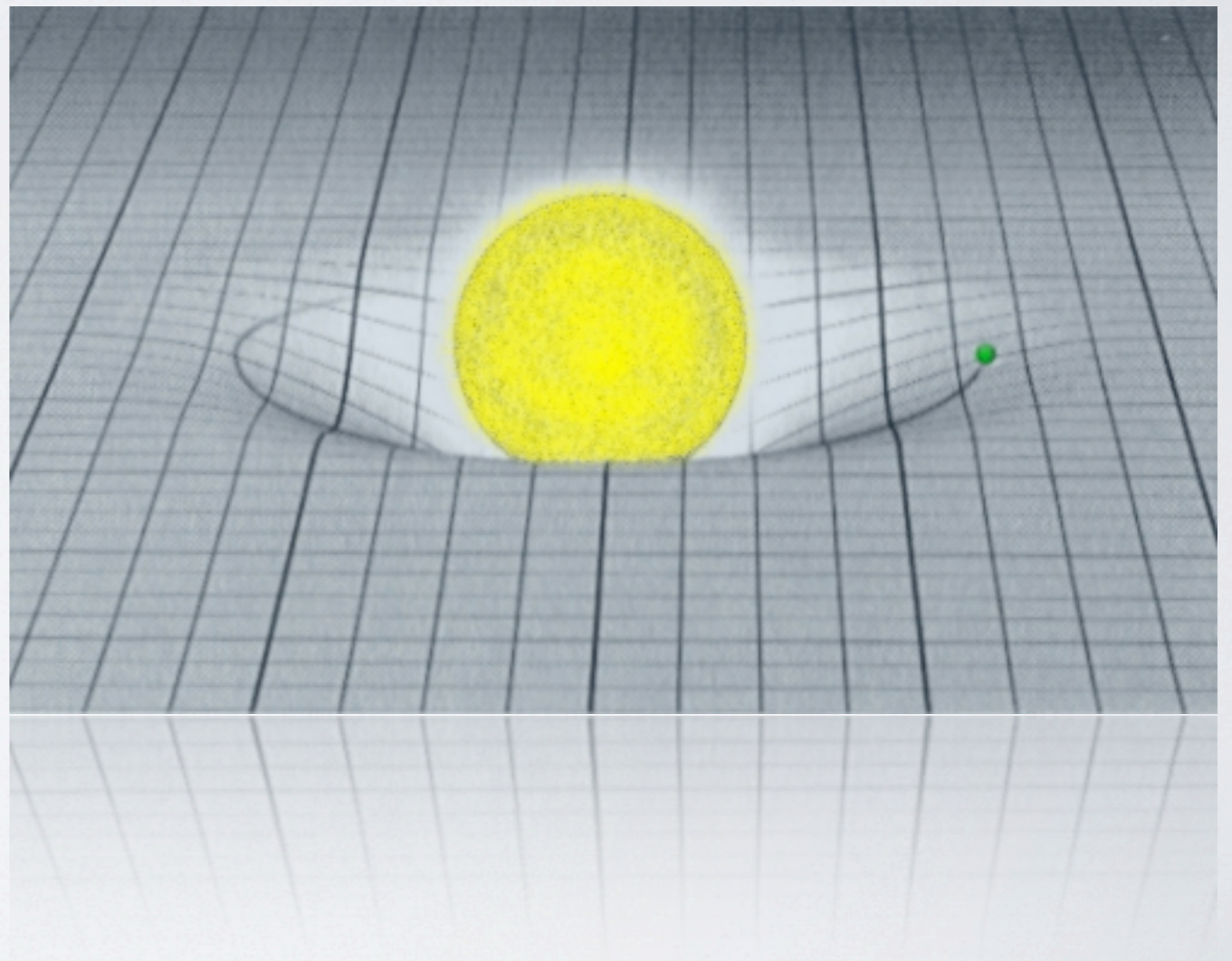
Curved spacetime is the result of mass

$$R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R = T_{\mu\nu}$$



# THE ILLUSION OF GRAVITY

Orbits result from moving through curved spacetime



Space tells matter how to move;  
matter tells space how to curve.

—John Archibald Wheeler

# TIME DILATION

Clocks in curved spacetime run slower than clocks far away from mass.

