The Solar System: A Graphical Model

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Purpose:

To create a tool for teaching young students about the Solar System that exceeds the current mechanical models.

Areas of Study

- The Solar System
  - in general
  - in depth research about the planets
- Gravitational Physics
- 3D Programming
  - lighting
  - animation
  - texture

Intended Results

- Main goal: Educational Product
- Secondary Goal
  - Physical Accuracy
    - compare the revolution periods, inclinations, and eccentricities of the planets firsthand

Previous Work

- Numerical Models (statistical and dynamic)
  - used to study both astronomy and the atmosphere
- Indiana University
  - creating models as a method of learning astronomy

Timeline

First Quarter – getting acquainted with 3D programming in OpenGL and Processing

Second Quarter – computational physics component

Third Quarter – expansion and user interaction

Fourth Quarter – educational value, extras if time

Gravitational Physics

Newton's Universal Law of Gravitation

$F = (G*m_1*m_2) / d^2$

Newton's Second Law:

$F = ma$

Planetary inclination: movement occurs along all three axes

Leapfrog Algorithm

$$r\left(t + \delta t\right) = r(t) + \delta t \cdot v\left(t + \frac{1}{2}\delta t\right)$$

$$v\left(t + \frac{1}{2}\delta t\right) = v\left(t - \frac{1}{2}\delta t\right) + \delta t \cdot a(t)$$

Testing

Visual: how does it look?
Can the user tell what's going on?
Is everything clear?

Numerical: Is the computational physics side of this working correctly?

Testing (Cont.)

User testing: Does the user interaction work properly?
camera motion

original camera positioning and lighting adjustments for it

IS IT EDUCATIONAL?

Problems

Circular Motion is *not* Projectile Motion

Ellipses are not Circles

I HATE ellipses

Results

Planets orbiting the Sun
in a circles, not ellipses

Planets are lit as if light is emanating from the Sun

No texture =(

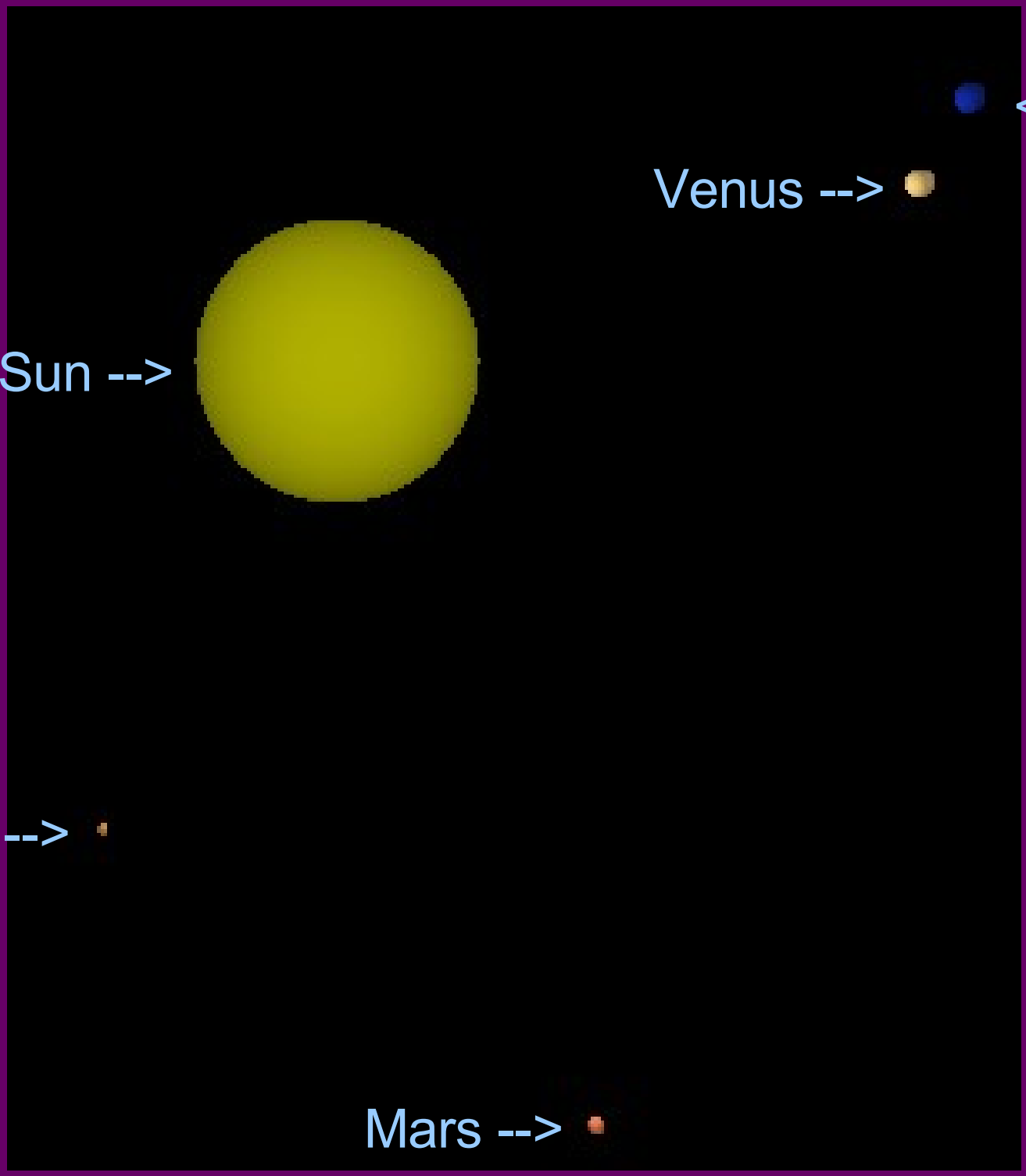
Interaction trouble

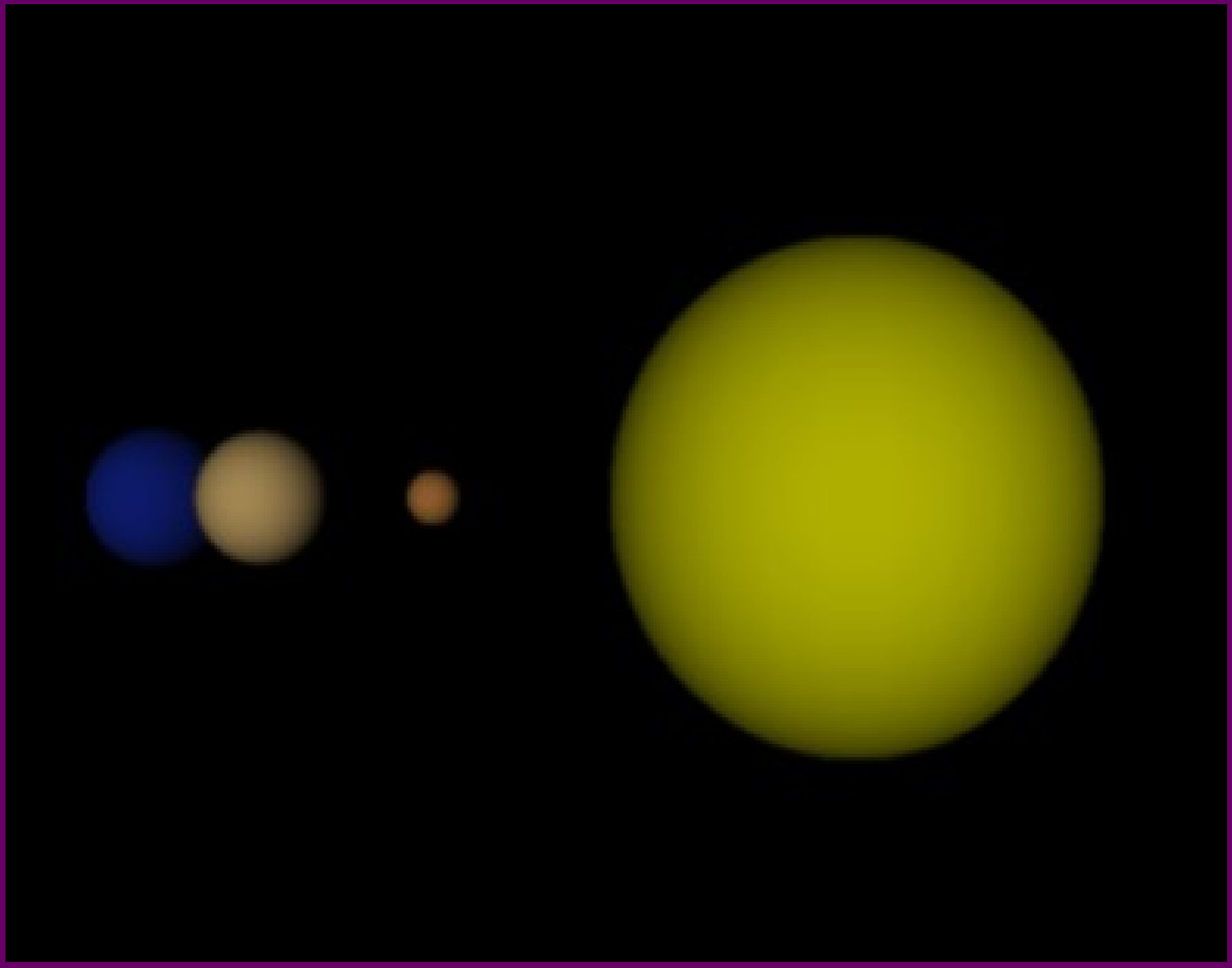
Change in Intentions

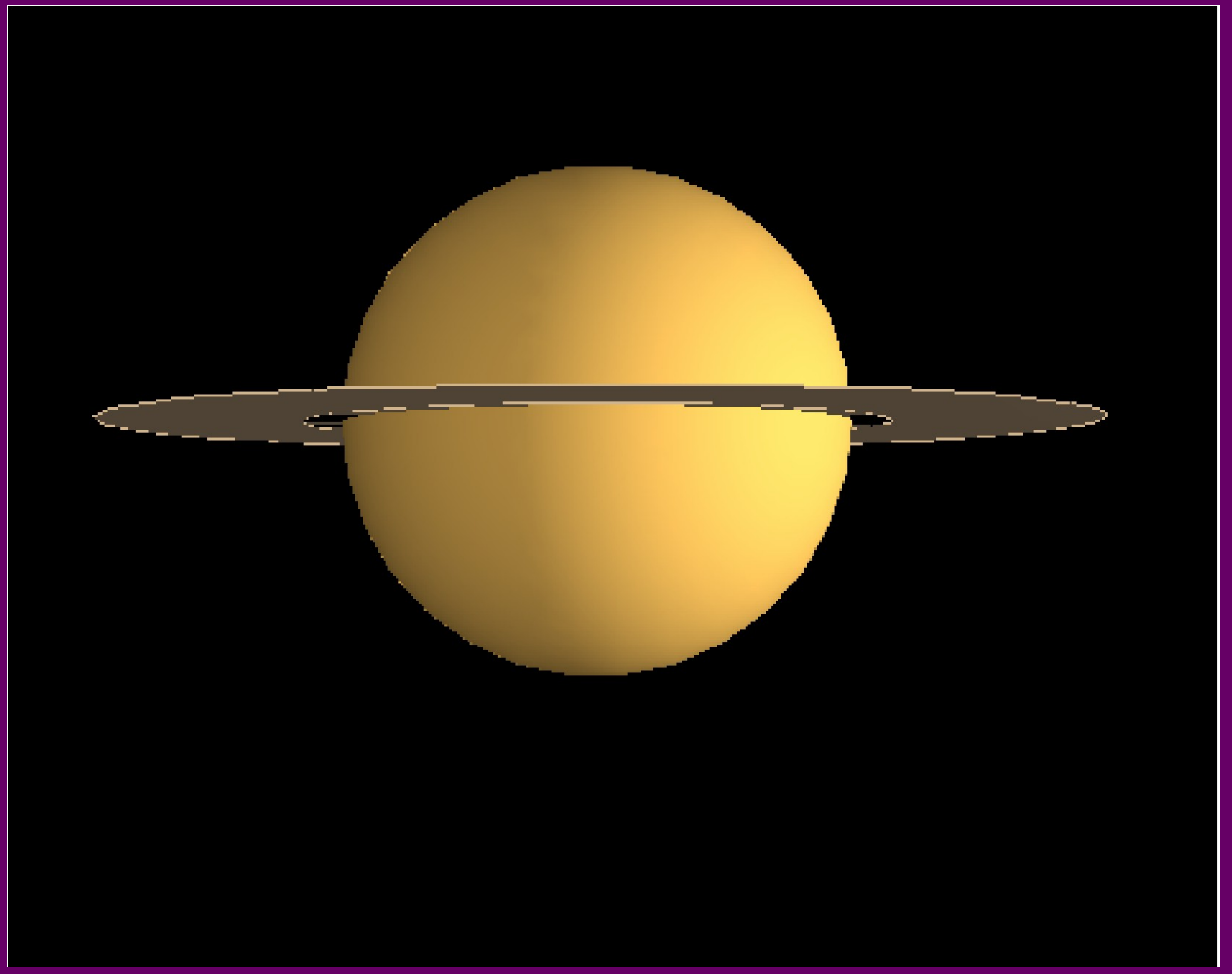
My model is to be different from others in that it is educational, so I need to:

focus more on: user interaction
presentation

and less on: graphics
physical accuracy


<-- Earth
Venus -->
Sun -->
Mercury -->
Mars -->





The End

:-D