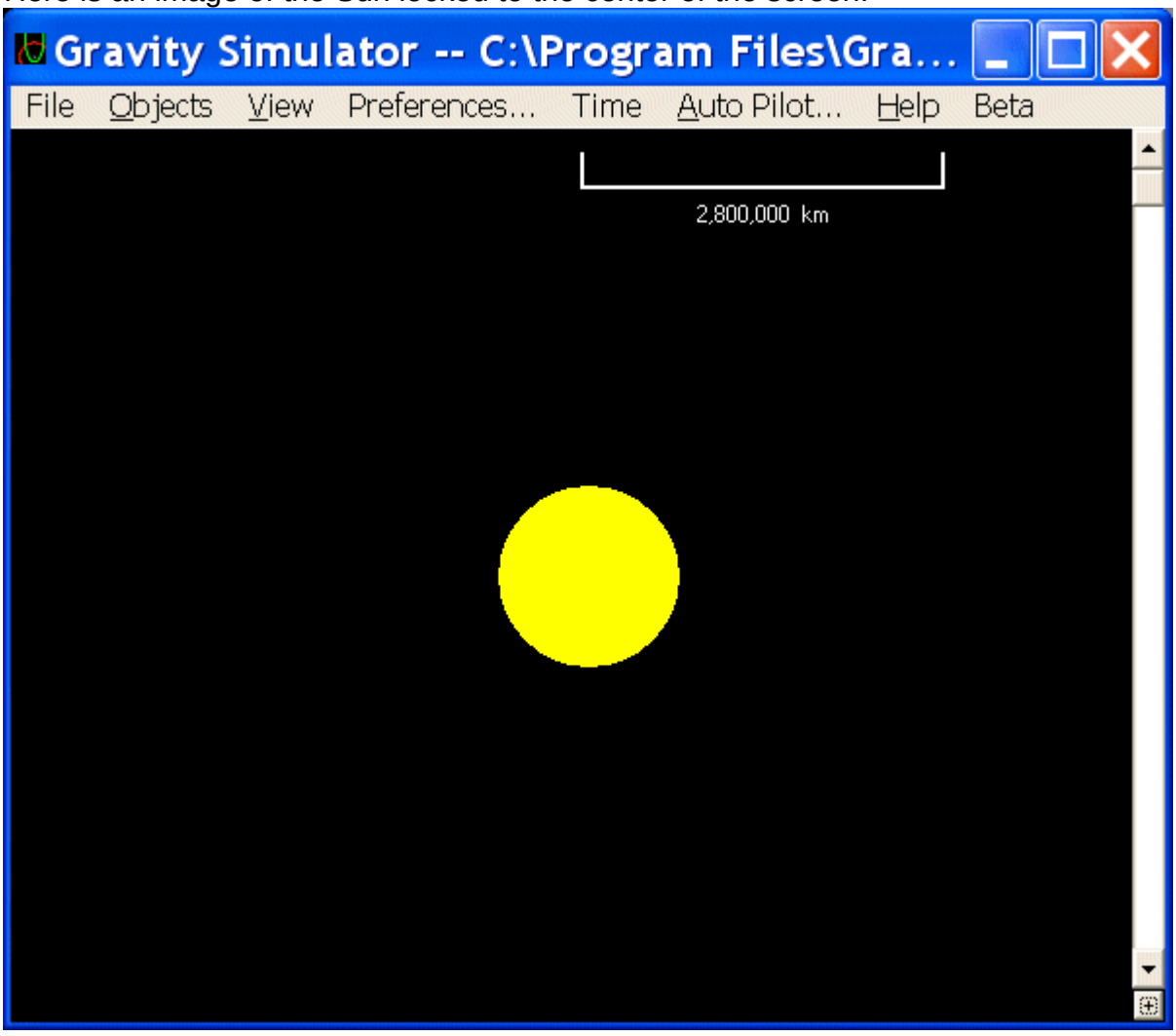
The Solar System Barycenter

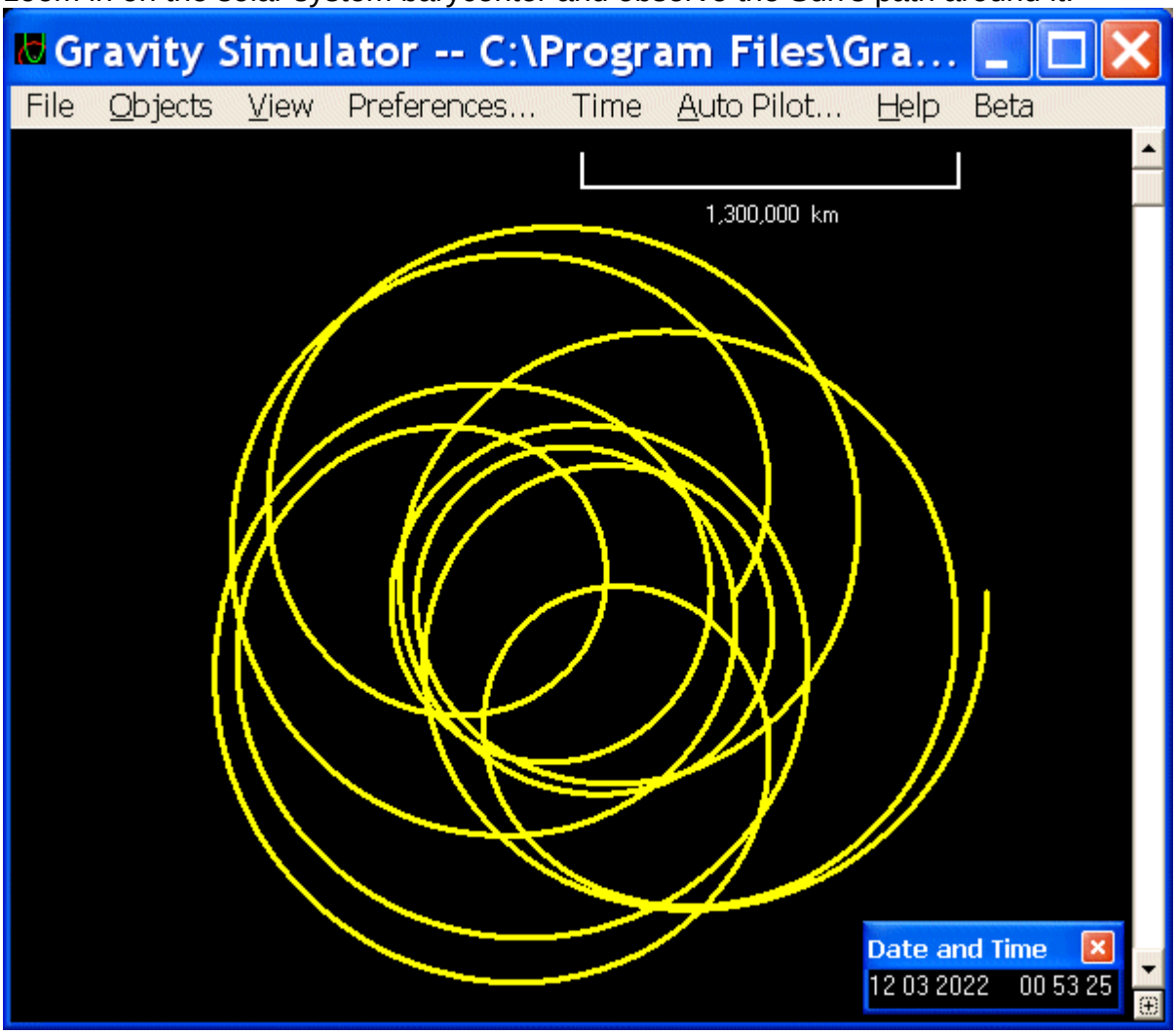
Although it is convenient to think of the Sun as the stationary anchor of our solar system, it actually moves as the planets tug on it, causing it to orbit the solar system's barycenter. The Sun never strays too far from the solar system barycenter. The barycenter is often outside the photosphere of the Sun, but never outside the Sun's corona. The simulation ssbarycenter.gsim allows you to watch the Sun orbit the barycenter of the solar system. By deleting the planets one-by-one, you can observe the effect each one has on the solar system barycenter.

Here are some screen shots describing how to do this:

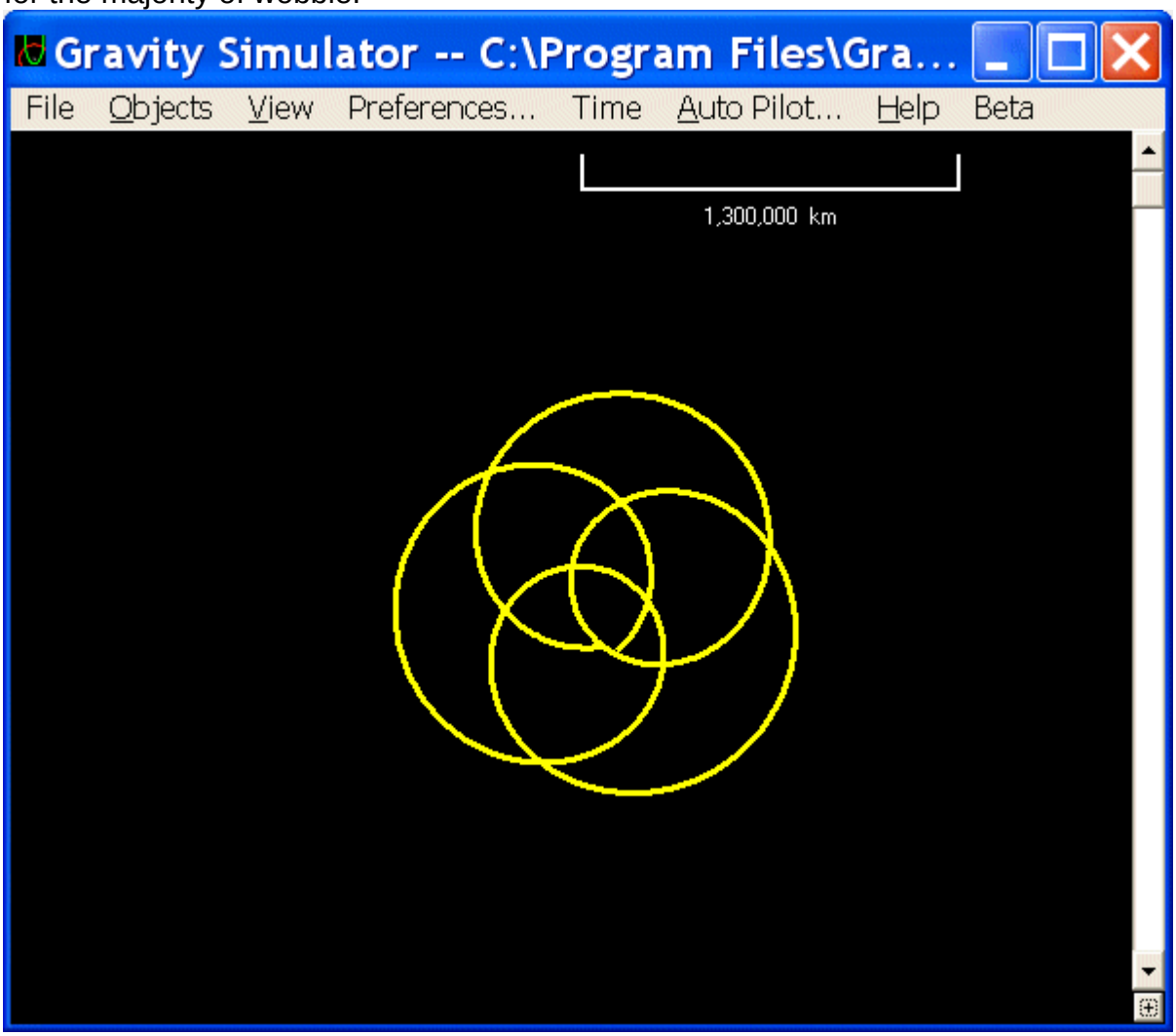
Here is an image of the Sun locked to the center of the screen:



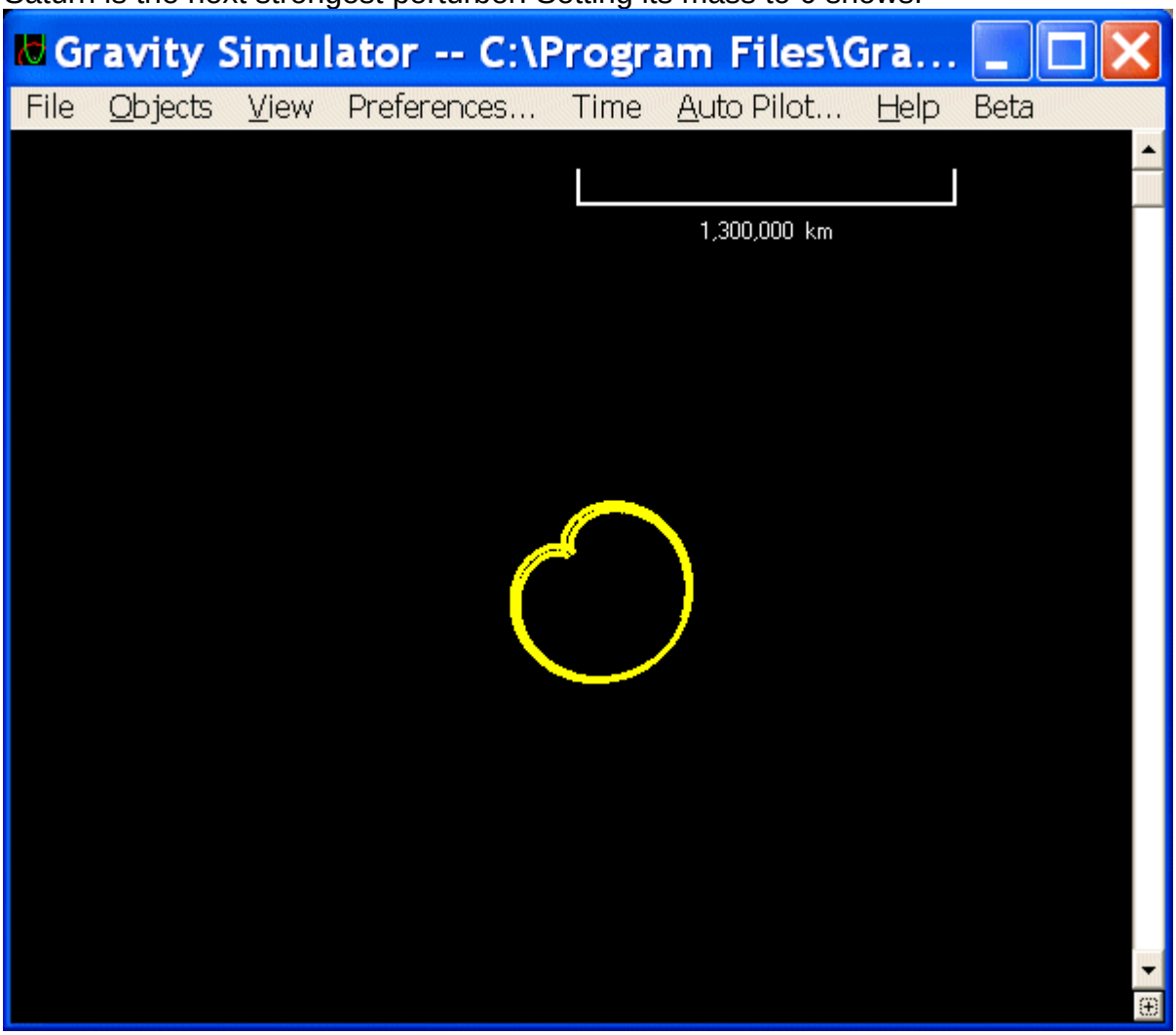
Editing the Sun and setting its size to 0 while retaining its mass allows me to zoom in on the solar system barycenter and observe the Sun's path around it:



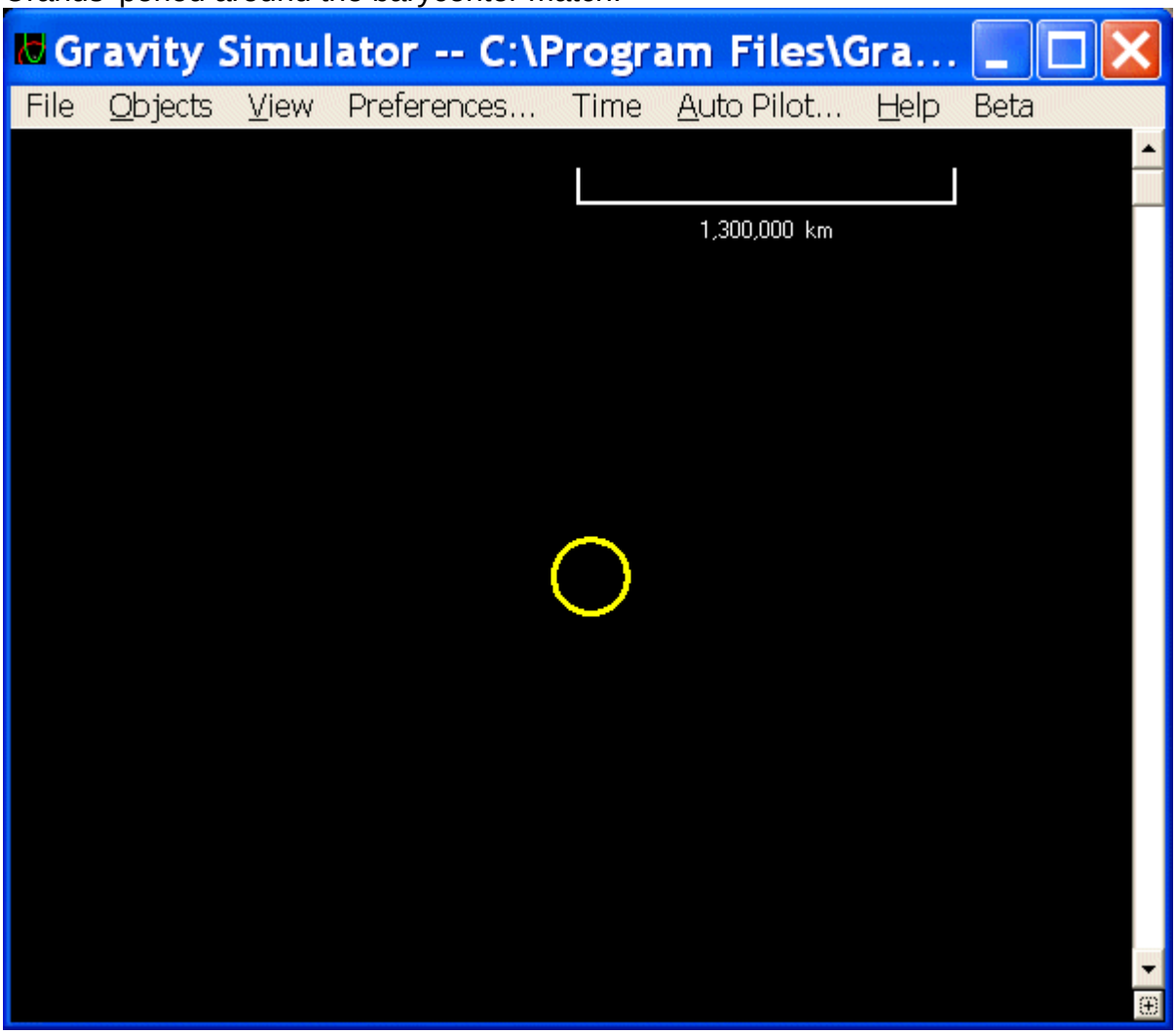
Editing Jupiter, and setting its mass to 0 demonstrates that Jupiter is responsible for the majority of wobble:



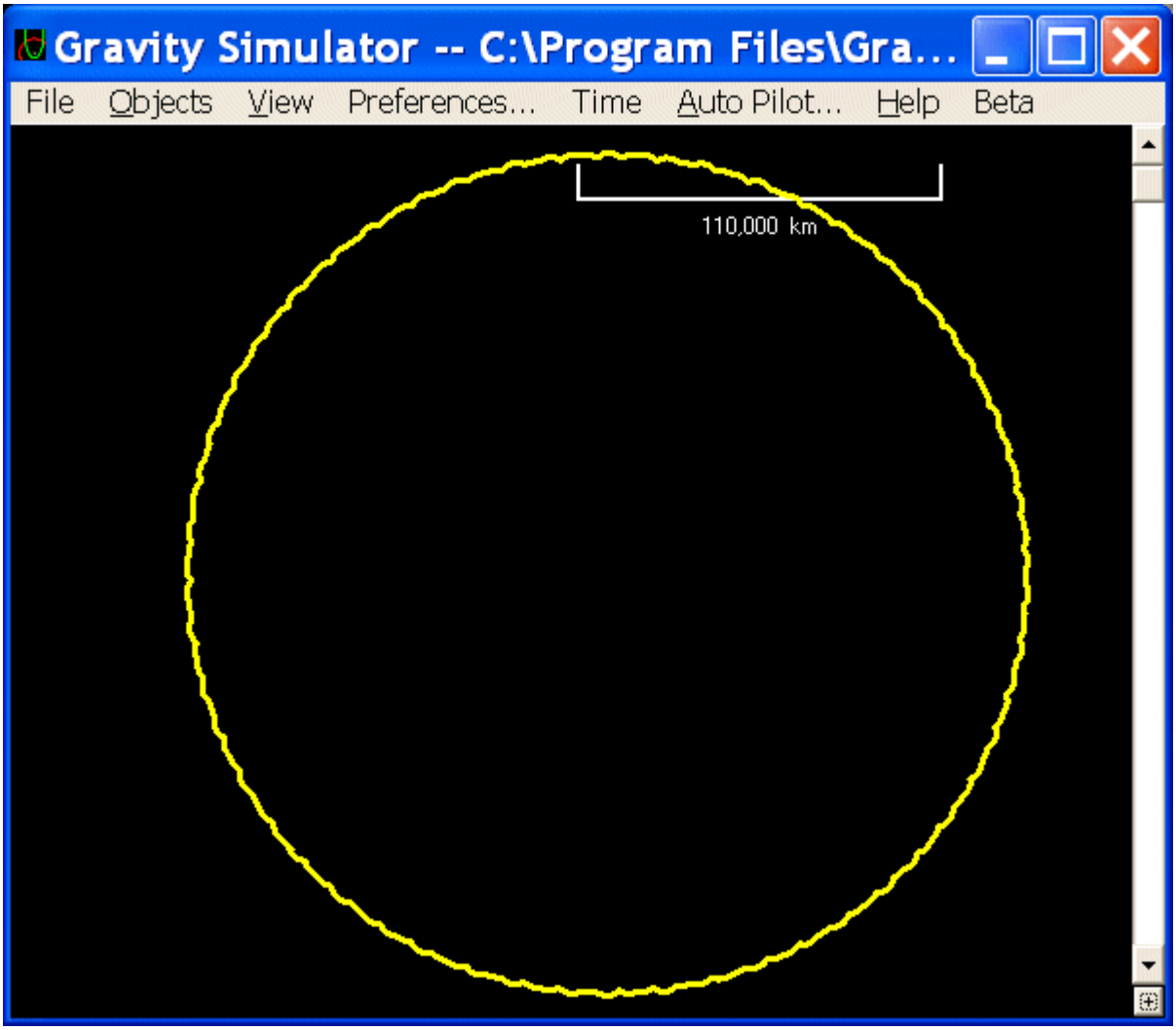
Saturn is the next strongest perturber. Setting its mass to 0 shows:



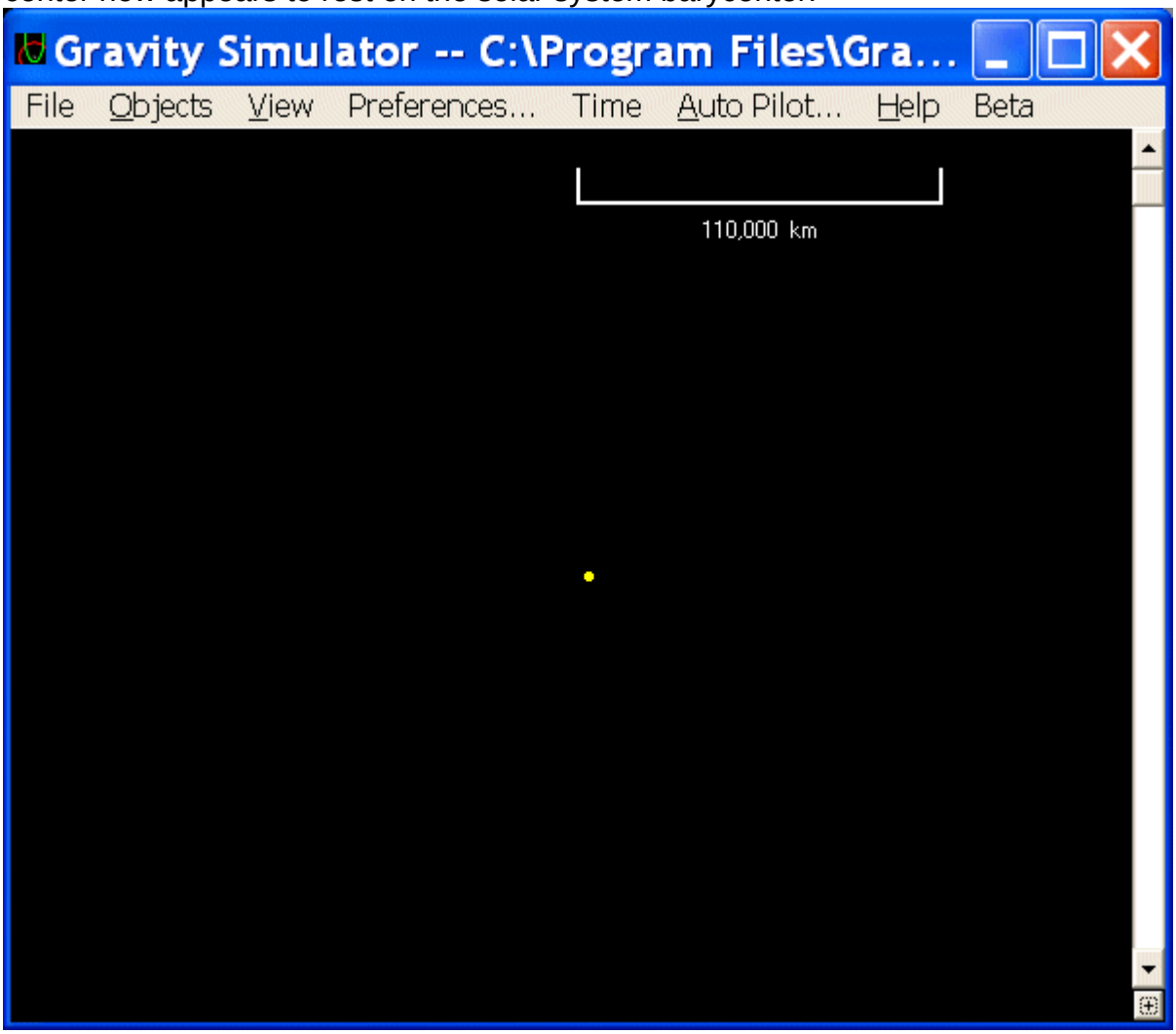
The next strongest perturber is Neptune. Setting its mass to 0 causes the Sun's motion around the solar system barycenter to trace a circle around its barycenter. Uranus is responsible for this circle. The Sun's period around the barycenter and Uranus' period around the barycenter match:



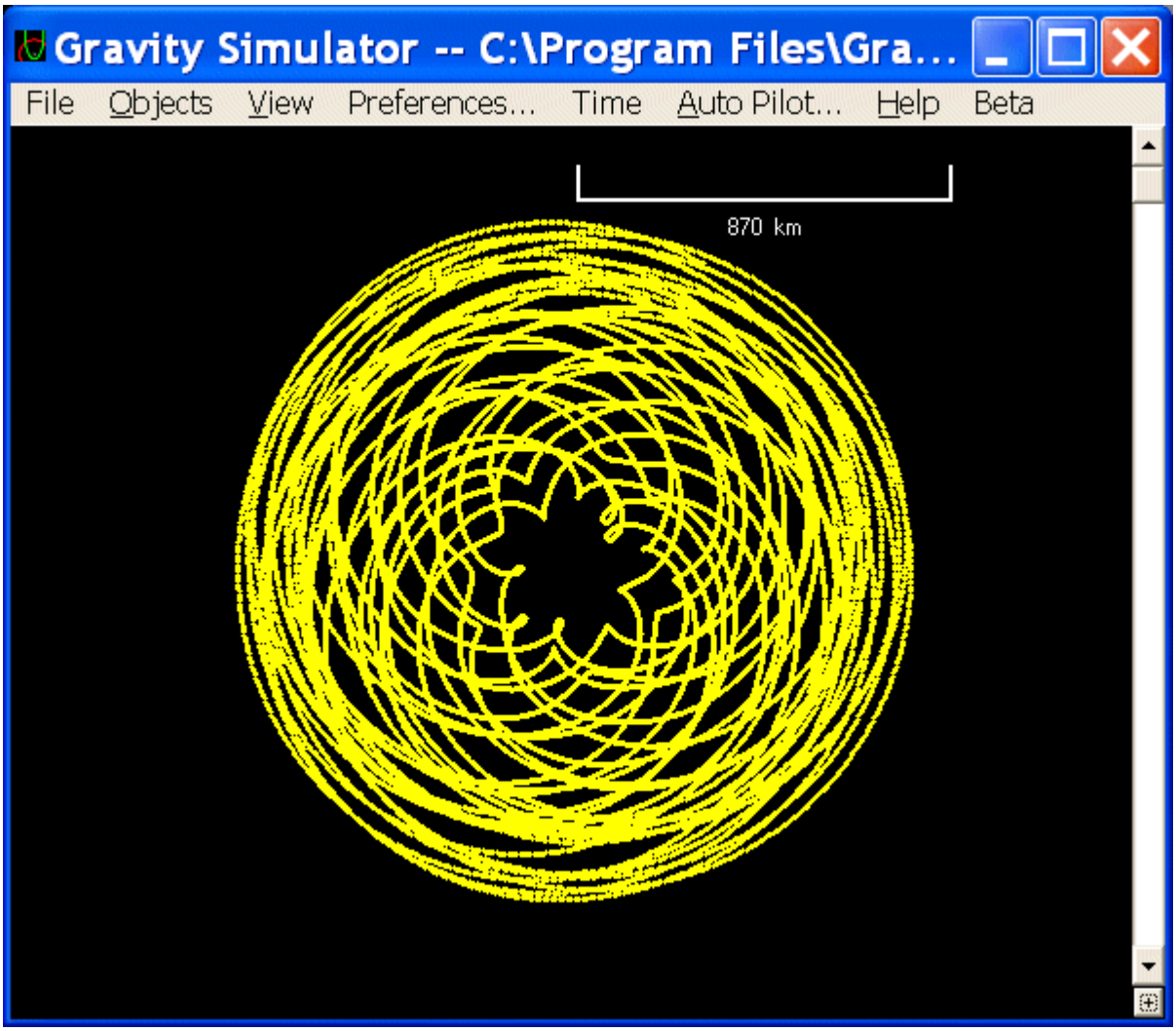
Zooming in exposes the effects of the smaller planets on the Uranus-induced circle:



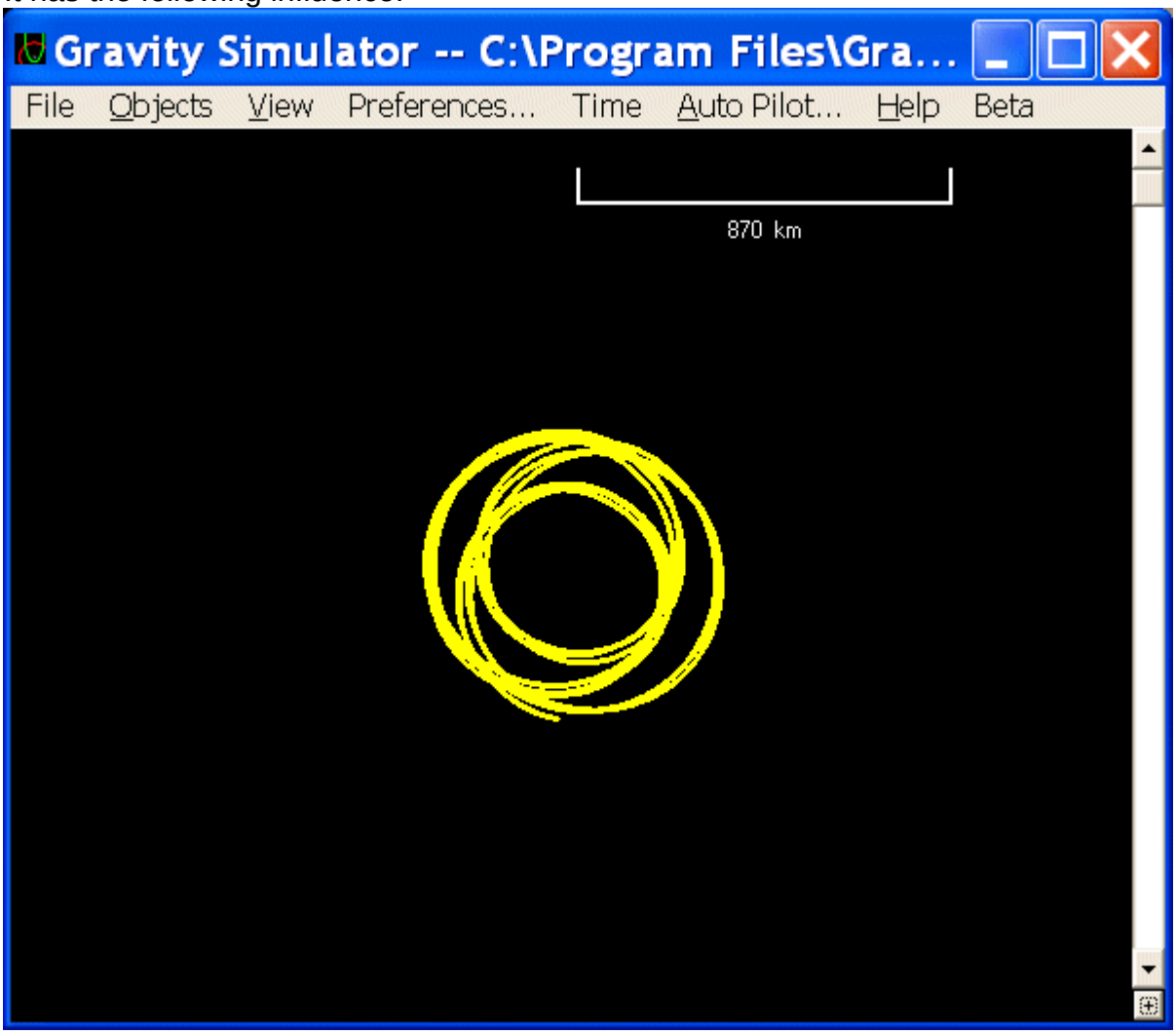
Setting Uranus' mass to 0 eliminates the Uranus-induced wobble. The Sun's center now appears to rest on the solar system barycenter:



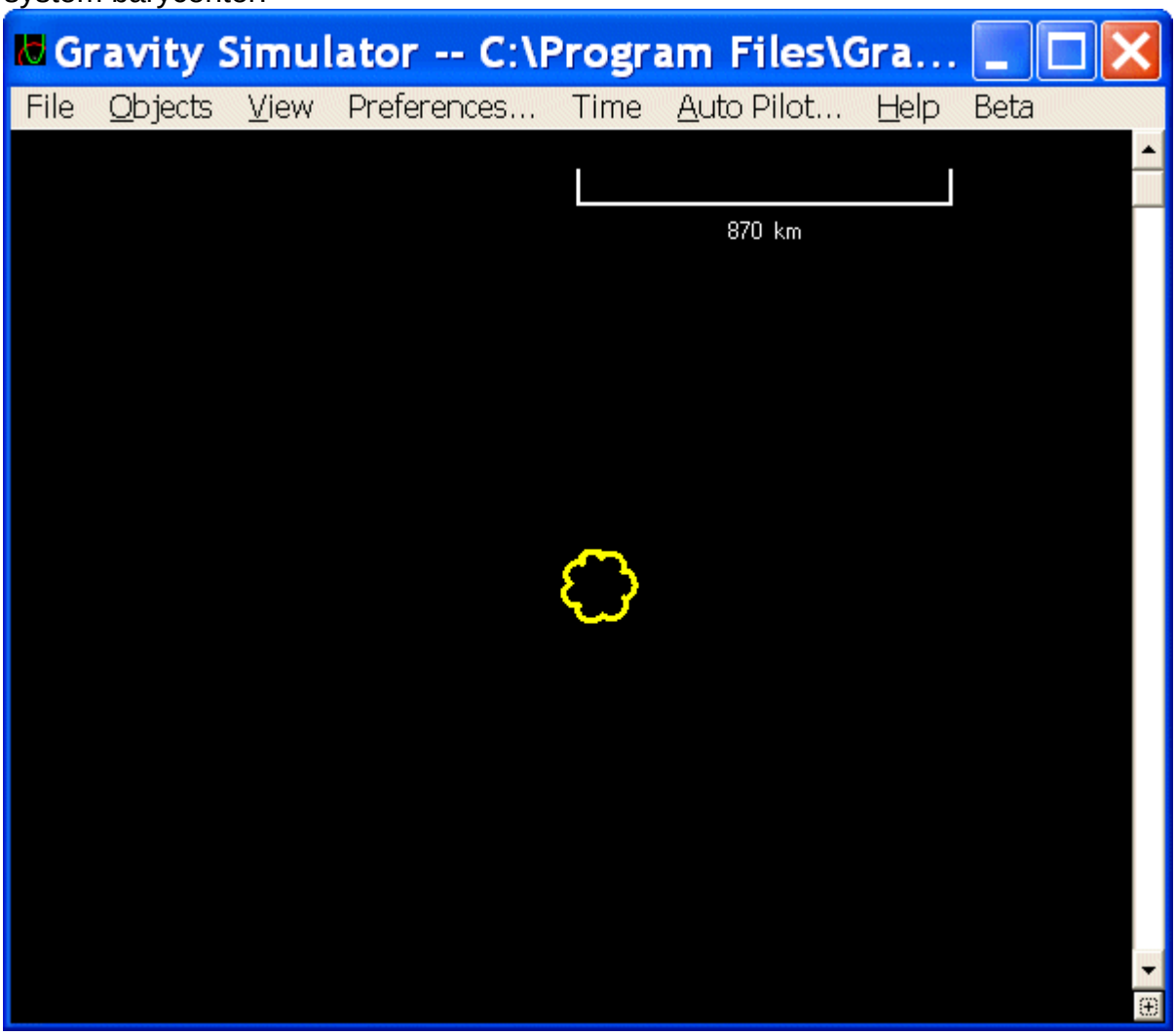
But zooming in further exposes the influences of the remaining planets on the solar system barycenter: The Earth/Moon system is responsible for the majority of the wobble:



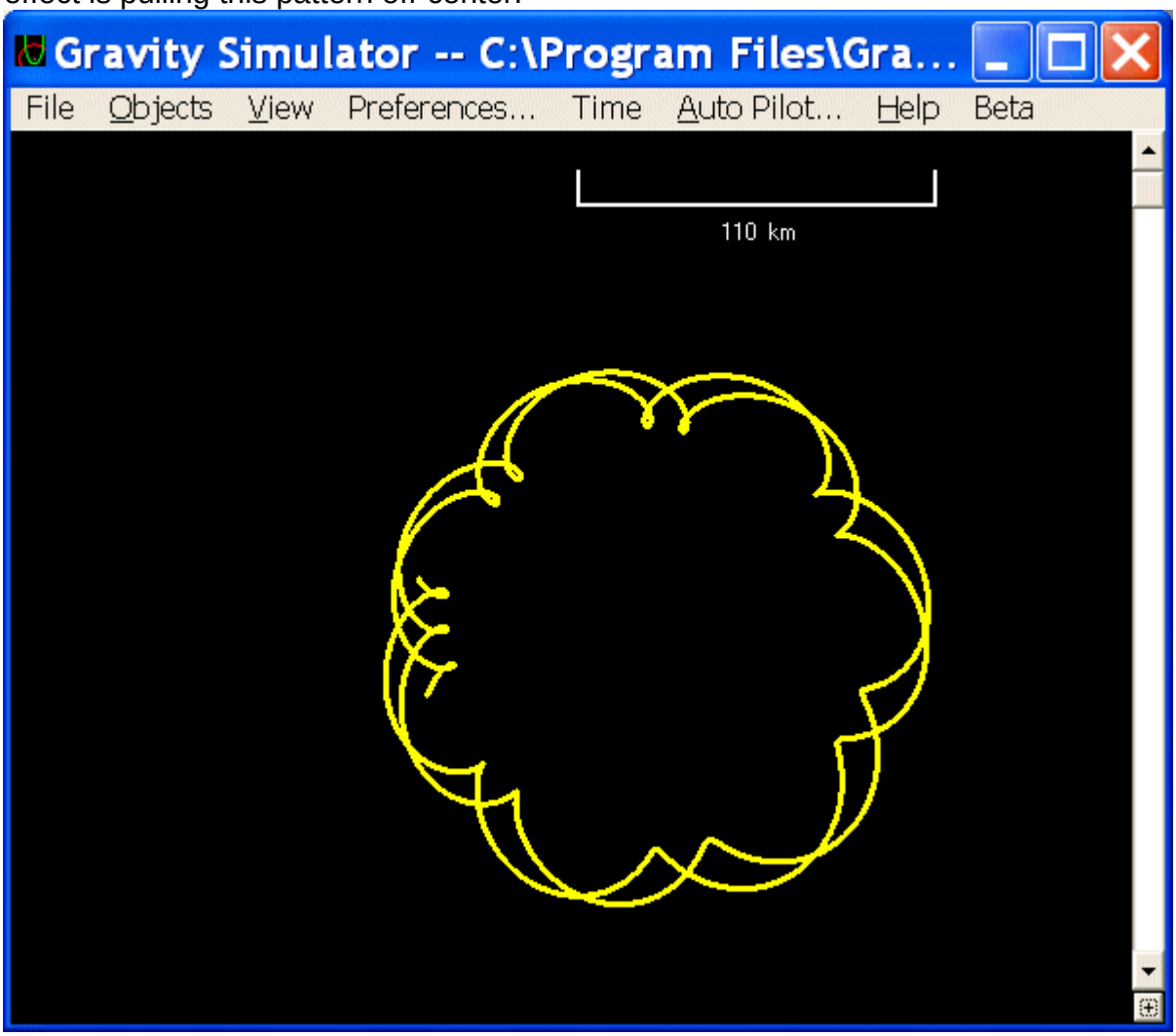
Setting the Earth/Moon mass to 0 leaves Venus as the most significant perturber. It has the following influence:



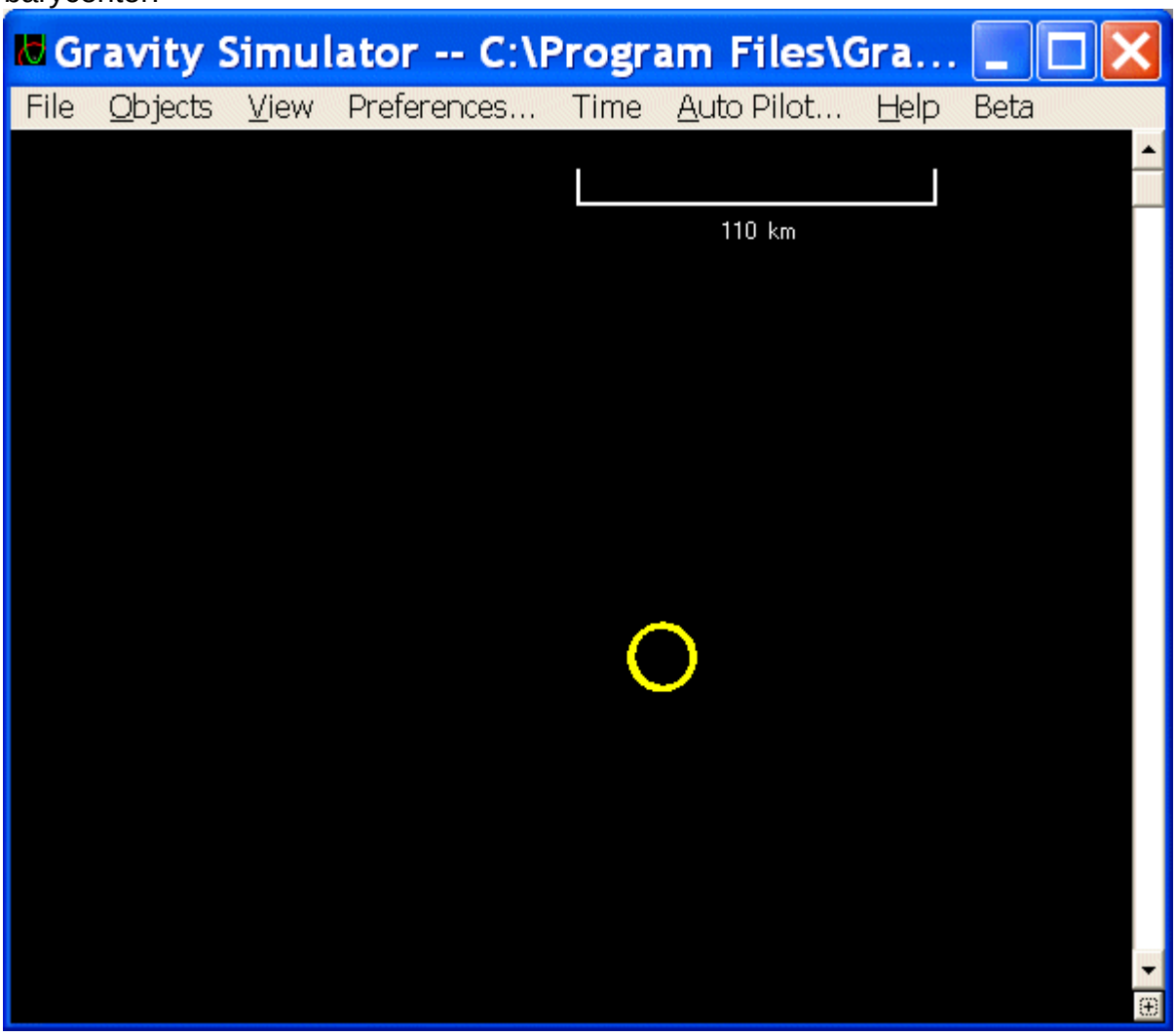
Setting Venus' mass to 0 leaves Mercury, Mars, and Pluto as the sole perturbers. They cause the center of the Sun to trace the following path around the solar system barycenter:



Zooming in for a clearer view, the effects of Mercury and Mars are seen. Pluto's effect is pulling this pattern off-center:



Setting Mars, which is now the most significant perturber, to 0 shows Mercury's influence causing the center of the Sun to trace circles around the solar system barycenter:



Letting this simulation run for half of a Pluto orbit exposes Pluto's influence on the solar system barycenter: