Gravity's Effects on Planer Orbit Within a Solar System

New Mexico

Supercomputing Challenge

Final Report

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Team #92

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Executive Summary

Over recent years, there have been hundreds of planetary bodies found orbiting suns in the Milky Way Galaxy (and even some that have no orbit and are only floating through space). The method to find these planets are being perfected, but scientists still know very little about these other solar systems.

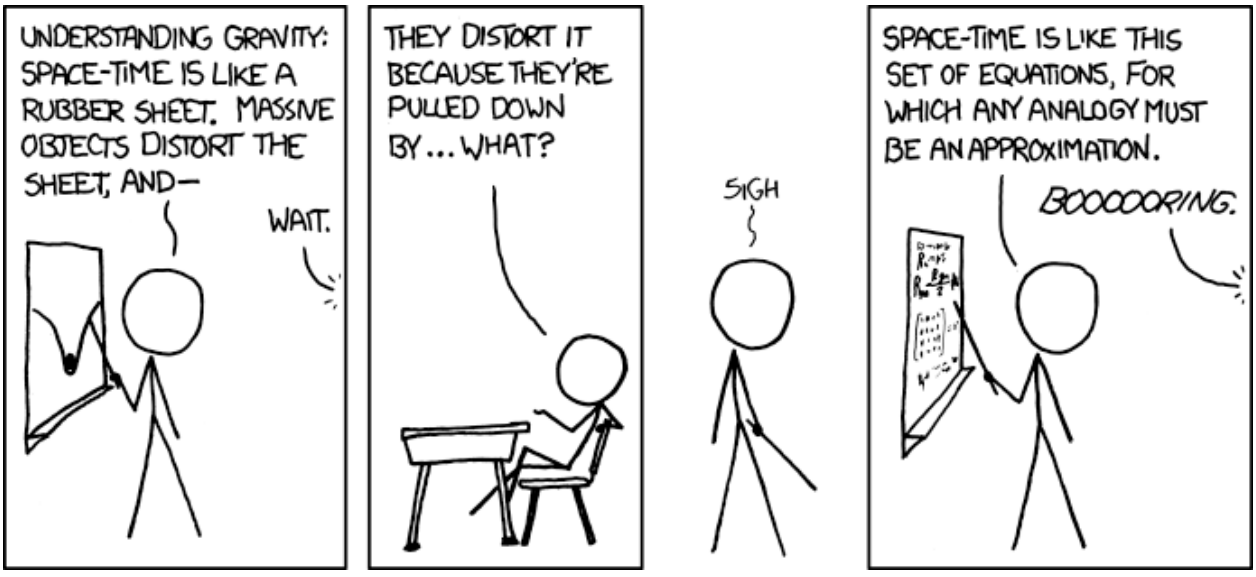
One thing that scientists have not yet seen is a solar system that has planets off a central plane of orbit. There are many inferences about this phenomenon, one of which has to do with gravity's effects on planetary orbit. The original hypothesis of this group was that the planetary bodies of this Solar System interact with each other through gravity.

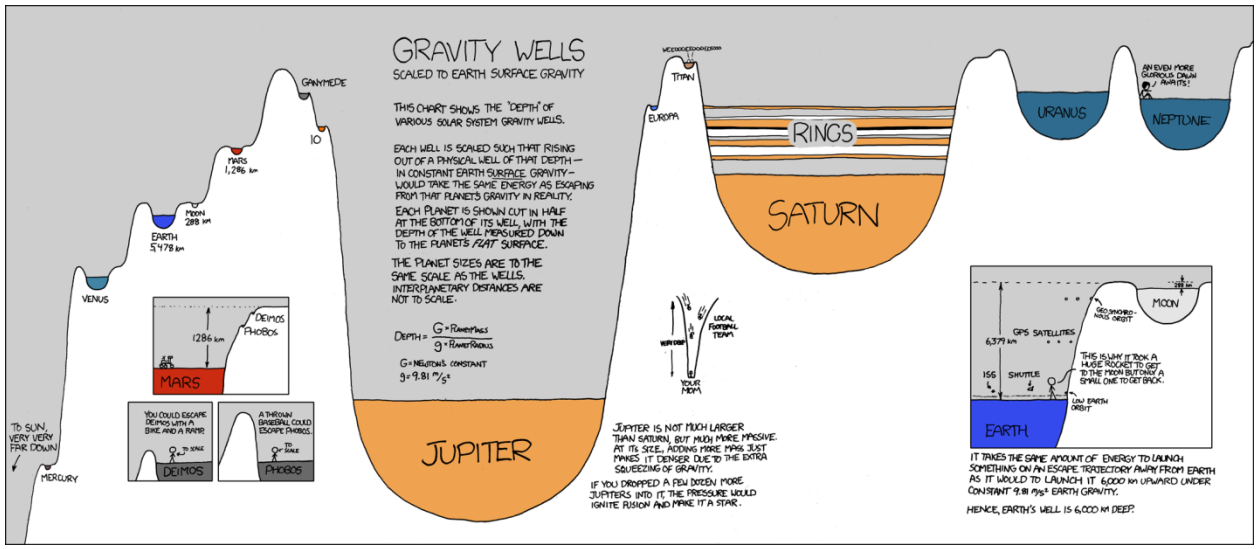
It is already known that gravity of planets in the Solar System affect each other. For example, Neptune was found through mathematical evidence instead of sight; the already-discovered Uranus appeared to be off its orbit, and scientists correctly predicted that another, unknown planet's gravitational pull was acting on it. The planet Neptune was discovered to be this "Planet X" shortly thereafter.

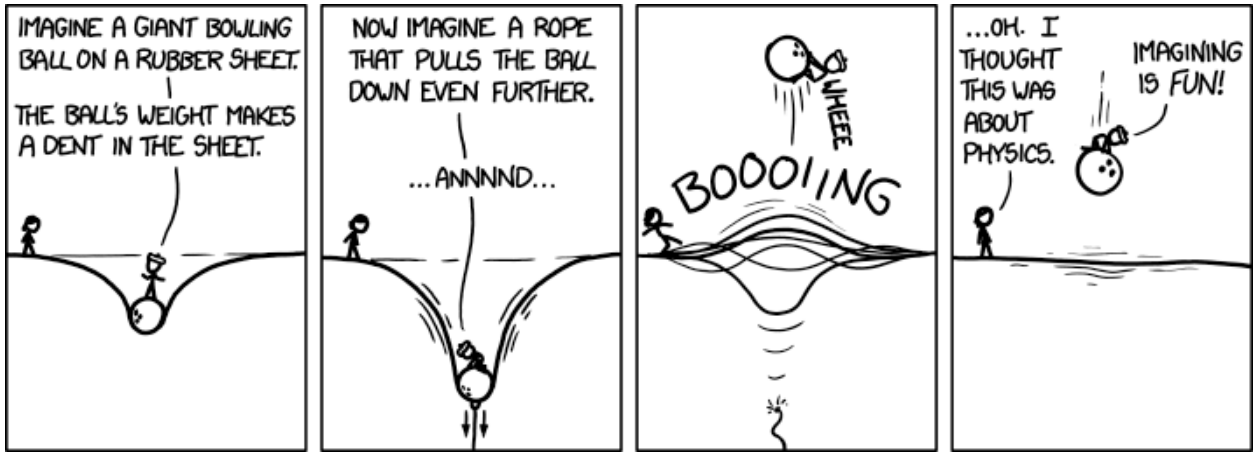
The use of space-time has also reflected back on this group's hypothesis. According to this theory, gravity acts as a giant sheet. Heavier objects, such as the Sun, pull down the sheet, allowing lighter objects to "roll" towards the heavier object.

The project uses Newton's Law of Universal gravitation. $F = G\frac{m_1 m_2}{r^2}$ During the runtime of the program each body interacts with each other using this formula. This using the formula a=f/m the new acceleration is found, through vector analysis this is separated into x, y and z components. From here every hour it updates the position by adding it's velocity to it's position. After this period(one hour) the program runs once again and recalculates this data. The data is stored every twenty four hours.

The data for the project is yet to be finalized. We have huge quantities of raw data that is yet to be formalized. Without this formalization no conclusions can be drawn easily. We plan to find a data base that can handle the data we're putting into it. With daily data from each body(at least 9) the simulation has over three thousand data points per year. This data is then translated into two values of degree's the first in terms of high away from a central axis. The second computed value is degrees in the circle with central point at the sun. This data will then give us the deviation from average planar degree.


UNDERSTANDING GRAVITY: SPACE-TIME IS LIKE A RUBBER SHEET. MASSIVE OBJECTS DISTORT THE SHEET, AND—
WAIT.
THEY DISTORT IT BECAUSE THEY'RE PULLED DOWN BY... WHAT?
SIGH
SPACE-TIME IS LIKE THIS SET OF EQUATIONS, FOR WHICH ANY ANALOGY MUST BE AN APPROXIMATION.
BOOOOORING.


GRAVITY WELLS
SCALED TO EARTH SURFACE GRAVITY
THIS CHART SHOWS THE "DEPTH" OF VARIOUS SOLAR SYSTEM GRAVITY WELLS.
EACH WELL IS SCALED SUCH THAT RISING OUT OF A PHYSICAL WELL OF THAT DEPTH — IN CONSTANT EARTH SURFACE GRAVITY — WOULD TAKE THE SAME ENERGY AS ESCAPING FROM THAT PLANET'S GRAVITY IN REALITY.
EACH PLANET IS SHOWN CUT IN HALF AT THE BOTTOM OF ITS WELL, WITH THE DEPTH OF THE WELL MEASURED DOWN TO THE PLANET'S /ZOT SURFACE.
THE PLANET SIZES ARE TO THE SAME SCALE AS THE WELLS. INTERPLANETARY DISTANCES ARE NOT TO SCALE.
DEPTH = G * PLANET MASS / g * PLANET RADIUS²
G = NEWTON'S CONSTANT
g = 9.81 m/s²
TO SUN, VERY VERY FAR DOWN
MERCURY
VENUS
EARTH 5,478 km
MOON 288 km
MARS 1,286 km
GANYMEDE
IO
1286 km
DEIMOS
PHOBOS
MARS
YOU COULD ESCAPE DEIMOS WITH A BIKE AND A RAMP.
TO SCALE
DEIMOS
A THROWN BASEBALL COULD ESCAPE PHOBOS.
TO SCALE
PHOBOS
JUPITER
TITAN
EUROPA
RINGS
SATURN
URANUS
NEPTUNE
AN EVEN MORE SURREAL DAWN AWAITS!
LOCAL FOOTBALL TEAM
YOUR MOM
JUPITER IS NOT MUCH LARGER THAN SATURN, BUT MUCH MORE MASSIVE. AT ITS SIZE, ADDING MORE MASS JUST MAKES IT DENSER DUE TO THE EXTRA SQUEEZING OF GRAVITY.
IF YOU DROPPED A FEW DOZEN MORE JUPITERS INTO IT, THE PRESSURE WOULD IGNITE FUSION AND MAKE IT A STAR.
MOON
GEOSYNCHRONOUS ORBIT
GPS SATELLITES
6,379 km
THIS IS WHY IT TOOK A HUGE ROCKET TO GET TO THE MOON BUT ONLY A SMALL ONE TO GET BACK.
156
SHUTTLE
LOW EARTH ORBIT
EARTH
IT TAKES THE SAME AMOUNT OF ENERGY TO LAUNCH SOMETHING ON AN ESCAPE TRAJECTORY AWAY FROM EARTH AS IT WOULD TO LAUNCH IT 6,000 km UPWARD UNDER CONSTANT 9.81 m/s² EARTH GRAVITY.
HENCE, EARTH'S WELL IS 6,000 km DEEP.


IMAGINE A GIANT BOWLING BALL ON A RUBBER SHEET.
THE BALL'S WEIGHT MAKES A DENT IN THE SHEET.
NOW IMAGINE A ROPE THAT PULLS THE BALL DOWN EVEN FURTHER.
...ANNNND...
WHEEE
BOOOIING
...OH. I THOUGHT THIS WAS ABOUT PHYSICS.
IMAGINING IS FUN!