Amending Celestial Mechanics

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Abstract

Celestial Mechanics needs to be amended.
First step:
Kepler's Third Law of Planetary Motion has an equation which apparently mixes units (AU and year). This paper explains how this equation actually works with those values.
Second step: Explain how this change affects the broader scope of celestial mechanics.

Contents

1 Introduction

Celestial Mechanics explains the motions of the planets in our solar system. This scope should include the motions of moons around planets and of exoplanets around other stars.

Kepler's 3 laws of planetary motion are an essential part of celestial mechanics. These laws describe elliptical orbits. These orbits exist beyond the scope of planets in our solar system.
Kepler's Third Law of Planetary Motion has an equation which equates different units (astronomical unit and year).
This paper explains how this equation in the 3rd law works.
Some od Celestial mechanics is reconsidered after an extensive analysis of orbits of celestial bodies.

2 Celestial Mechanics

Wikipedia has a basic description:
Celestial mechanics is the branch of astronomy that deals with the motions of objects in outer space. Historically, celestial mechanics applies principles of physics (classical mechanics) to astronomical objects, such as stars and planets, to produce ephemeris data.
This paper is about planets (both around our Sun and around other stars), asteroids, and moons but not stars. Stars in spiral galaxies do not have an elliptical motion around the galaxy center with increasing distances and times for their individual orbits where all are roughly concentric. Stars in elliptical galaxies (or globular clusters) have radial orbits totally unlike a spiral galaxy.
Kepler's laws of planetary motion do not apply to stars. Stellar motion is not relevant to this paper.

3 Kepler's Third Law

Kepler's Third Law is the focus of this paper.

3.1 Its Description

excerpt from Wikipedia as a reference:

[Third Law:] The square of the orbital period of a planet is directly proportional to the cube of the semi-major axis of its orbit.

reference

web-link: Kepler's laws of planetary mption

3.2 Its Equation

This law can be expressed by the formula: $\mathrm{T}^2 = \mathrm{R}^3$ where T is the time or period in years and R is the radius in AU.

For examples:

a) Mercury T=0.2409 year and R= 0.3871 AU

b) Venus T=0.6152 year and R= 0.5352 AU

c) Earth T=1 year and R= 1 AU

These values conform to the equation.

The formula can be represented also as a a ratio, like:

$X = T^2 / R^3$

so X should equal 1.0
if X is >1.0 then T is too high for R or if <then the opposite, so one or both are mismatched for a valid ellipse. In other words, the pair of values are not the correct proportions of radius to time.
Because published values are usually specified (or estimated) with a certain number of significant digits, the range of X is often from 0.998 to 1.002, or the two values (from squared and cubed) are very close to equality.

All the planets in the solar system conform to this equation.

3.3 Its Problem with units

The units in this equation cannot be $\text{year}^2 = \text{AU}^3$ because mixing these inconsistent units is invalid.

The current description lacks an explanation for the units.

3.4 Solving the problem with units

The values in the equation are actually ratios with respect to Earth, so as a ratio each value has no units. The description omits this detail. The equation simply demonstrates the orbits in the system are proportional to each other by using ratios.

3.5 New Equation

This new simple equation has unit-less values from ratios using the ratio of the planet's orbit to Earth's orbit.

This equation can be expressed in a slightly different format:

$TF^2 = RF^3$

where TF is the Time Factor and RF is the Radius Factor.

TF is the scalar factor relative to the baseline time, or orbital period, with the ratio of two values in whatever units are used to describe the period. The values from each planet could be years, days, hours, or anything consistent. This is a ratio where its common units are critical.

The ratios require unit consistency but, as a result, the equation uses values with no units.
RF is the scalar factor relative to the baseline radius from a ratio in whatever units are used to describe the radius. The values from each planet could be AU, km, or anything consistent. This factor is from a ratio.

Currently these factors are the ratio for each planet's orbit to Earth's orbit as the baseline.
That is why the numbers of years and of AU work.This equation can also use ratio values from a different planet as the basis than Earth.

The simple change: Instead of entering a planet's orbit values their proportional values are entered.

3.6 Confirming the solution

All of the planets could have their factor based on their ratio to another planet because all their ellipses are proportionally consistent. This equation is based on the ratios between the respective elliptical orbits.

Each factor is a ratio from a body's value divided by a baseline value. Currently we use Earth for the baseline for planets simply for its convenience.

For Mercury based on Earth, TF= 0.2409 yr / 1 yr or 0.2409 and RF = 0.3871 (from 0.3871 AU / 1 AU).
For Mercury based on Venus, TF = 0.3916 (from 0.2409 yr / 0.6152 yr). RF= 0.5352 (from 0.3871 AU / 0.7233 AU)

These proportional values based on Venus for Mercury conform to the $TF^2 = RF^3$ expectation.
As required, there are no units with the ratio values being entered in the equation.
The useful application of this new definition of Kepler's 3rd Law is its application to systems of moons.

3.7 Applying the solution to moons

Nearly every planet in our solar system has one or more moons, as well as dwarf planet Pluto; only Mercury and Venus have none.

As an initial test, Jupiter's set of moons can be verified with this new description. All have their orbits described in km and in either days or hours.

Jupiter has a number of large moons: 1 Io, 2 Europa, 3 Ganymede, 4 Callisto, 5 Amalthea, 6 Himalia, 7 Elara

If the moons other than Europa have their TF and RF based on the orbit of Europa. this squared=cubed equation applies to all these moons. Europa can have its ratios based on Io.

The new description applies to Jupiter's moons. They conform to the equation.

This description change allows verification of orbit values of moons as well as exoplanets.

4 Applying this solution

The orbit parameters were entered into an Excel spreadsheet for all bodies in the solar system which could be found with this data (radius and time per orbit).

This included all planets, all their moons, most identified asteroids, and several periodic comets. Only about 7000 of the (estimated) billions of asteroids have been identified but not all have their data published in a public archive like Wikipedia.

All the planets and asteroids and several comets in orbit around the Sun and all the moons were checked. The result verifies his equation's use of an appropriate baseline orbit for every body in orbit around a primary.

Earth has only 1 Moon but its orbit is roughly proportional to the International Space Station or the Hubble Telescope.

Mars has 2 moons. Each can be the baseline for the other; both conform.

Jupiter has over 50 moons. Wikipedia notes some moons get lost and found again; 2 were found in 2004 and 2007 but both (unnamed) remain lost at the time of this paper.

Europa can serve as the baseline for most of the moons. Only a few were not closely proportional to Europa. Carme has one of the longest periods among Jupiter's moons. Harpalike provides a baseline. Both Megaclite and Chaldene have high eccentricities and Ananke provides a baseline.

The numbering of Saturn's moons is different in Brittanica or Wikipedia. This paper uses the Brittanica numbering.

Brittanica reference:

web-link: Brittanica list of Saturn's moons

Wikipedia reference:

web-link: Wikipedia list of Saturn's moons

In the case of Saturn's moons, the orbit of Janus can be the baseline for most moons. Janus can use Mimas for its baseline.

An issue with Saturn's moon collection is after the main moons there are more moons with higher eccentricites. As Wikipedia describes: Saturn has 24 regular satellites in prograde orbits not inclined. The remaining 58 are irregular satellites with a mix of prograde and retrograde. An unnamed moon found in 2004 is not closely proportional to Janus. This one is proportional to another unnamed one found in 2004.

In the case of moons around Uranus, the orbit of Miranda can be the baseline for most moons. Miranda can use Ophelia for its baseline. Uranus also has irregular satellites. Only 3 long period moons, Caliban, Sycorax, and Margaret are not closely proportional to Miranda. these 3 are proportional to similar long period moons like Trincolo.

In the case of moons around Neptune, the orbit of Naiad can be the baseline for most moons. Naiad can use Thalassa for its baseline. Only 2 high eccentricity moons Nereid and Psamathe are not closely proportional to Naiad. Both can use Halimede which also has high eccentricity for their baseline.

In the case of 5 moons around Pluto, the orbit of Styx can be the baseline for Charon. Styx can use Charon for its baseline. Nix, Kerberos and Hydra are more closely proportional to any in this set of 3 than to Styx.

2 of the high eccentricity moons (Nereid and Psamathe) are not closely proportional to Styx. Nereid is closely proportional to Halimede, while Psamthe is closely proportional to Nereid. Apparently there are about 50 Nereids in a group around Pluto but only 3 (these 2 and Neso) have a name and data.

reference for this spreadsheet of orbit data:

pdf-link: Solar System Data with check of Kepler's 3rd law as updated here

The table shows the orbit data, in units ranging from AU, km, year. day, hour. With the 3rd law equation based on ratios not on the measured values, the orbits are confirmed to conform with the elliptical baseline for the groups of moons around planets.

Note: an extra row is provided for the planets Mercury, Venus, Earth, and Mars. This row has the orbit data as km and days; these values do not conform to Kepler's 3rd law equating an orbit's radius and period. The description for using the equation must be clear. The equation is using ratios and is sensitive to the units of the original values.

5 Solar System Stability

The bodies in orbit around a primary apparently maintain the proportional orbits even through disturbances.

The gas giants have captured moons over time. Their systems of moons maintain the proportions in radius to time.
Cosmologists have proposed Jupiter and Saturn have changed their orbits in the past, including the era of widespread cratering in the solar system.
reference:

web-link: Late Heavy Bombardment
The giant planet Jupiter is found to disturb parts of the main asteroid belt.
These are called Kirkwood Gaps, named after the person explaining them.
At the radius from the Sun where there is a periodic resonance with Jupiter there are few asteroids.
The description mentions the resonances of Jupiter suggesting either Saturn or Neptune could increase the disturbance. These giant planets have electric fields. At these distances, an electromagnetic force could cause the disturbance rather than gravity.
reference:
web-link: Kirkwood Gap

6 Exoplanets

Using new technology in recent decades, astronomers were able to detect planets in orbit around distant stars; these are called exoplanets.

The orbit parameters were entered into an Excel spreadsheet for many of the systems with several exoplanets which had this data (radius and time per orbit).

reference for this spreadsheet of orbit data:

pdf-link: Exoplanet Data with check of Kepler's 3rd law as updated here

The table shows the orbit data, with units of AU and either day or year. With the 3rd law equation based on ratios not on the measured values, the orbits are confirmed to conform with the elliptical baseline for the groups of exoplanets around each distant star. Stars with their exoplanets measured in hours or in years have different proportions for their sets.

7 Conclusion drawn from the spreadsheets

Kepler's 3rd law uses a planet's semimajor axis and its period.
IFor other bodies, those values cannot be used directly. Each must be converted to a value (with no units) for the equation from a ratio to a baseline.

After converting to a proportional factor as required, the squared-cubed relationship can be confirmed for every orbit in each system.

. This new description has been confirmed for all planets, moons, asteroids, and several periodic comets in our solar system and for many exoplanet systems (not all exoplanets have data).
These proportional orbits probably cannot be attributed to gravity because the mass of every body in the system is NOT involved in this proportional configuation. This observed behavior cannot be driven by gravity alone when a body's mass has no effect on the proportional orbit behavior.
The observed pattern in the set of bodies having a proportional orbit radius and period must be driven by forces which are not restricted to only attraction.

8 Kepler's Problem

Kepler's problem is also one of celestial mechancis as the inability to explain planetary motion only by gravity. reference:

pdf-link: Kepler's Problem
excerpt:
The Kepler problem arises in many contexts, some beyond the physics studied by Kepler himself. The Kepler problem is important in celestial mechanics, since Newtonian gravity obeys an inverse square law. Examples include a satellite moving about a planet, a planet about its sun, or two binary stars about each other. The Kepler problem is also important in the motion of two charged particles, since Coulomb's law of electrostatics also obeys an inverse square law. Examples include the hydrogen atom, positronium and muonium, which have all played important roles as model systems for testing physical theories and measuring constants of nature.

The Kepler problem and the simple harmonic oscillator problem are the two most fundamental problems in classical mechanics. They are the only two problems that have closed orbits for every possible set of initial conditions, i.e., return to their starting point with the same velocity (Bertrand's theorem). The Kepler problem has often been used to develop new methods in classical mechanics, such as Lagrangian mechanics, Hamiltonian mechanics, the Hamilton–Jacobi equation, and action-angle coordinates. The Kepler problem also conserves the Laplace–Runge–Lenz vector, which has since been generalized to include other interactions. The solution of the Kepler problem allowed scientists to show that planetary motion could be explained entirely by classical mechanics and Newton's law of gravity; the scientific explanation of planetary motion played an important role in ushering in the Enlightenment.
(excerpt end)
Observation:
The hydrogen atom is an example of Kepler's problem. Its context explicitly involves the Coulomb's electrical force between two charged bodies, not gravity.

9 Updated Model for Orbits

In the Electric Universe cosmology, there are interesting similarities and differences to the atomic model.

1) The bodies in orbit have proprtional distances and times, not quantized, as observed in the previous section. 2) these orbits are described as ellipses, not with probabilities. 2) The Sun is a positively charged massive body in the center. 3) The bodies in orbit around this star are electrically charged, not neutral, usually negatively charged. 4) Electromagnetic forces are stronger than gravity.
(3) means there can be a repulsive force available between the bodies in orbit perhaps helping stability when gravity is only attractive.
This paper will not provide a thorough description of the Electric Universe theory. EU has made several confirmed predictions and explanations, a) including the object imaged in M87 galaxy and b) the electrical discharge behavior of comets whose coma is not water vapor, and c) spiral galaxy rotation with no dark matter.
reference for (a):

video-link: M87 Plasmoid

reference for (b): web-link: Electric Comet

reference for (c): pdf-link: Stars moving with no dark matter

In this EU cosmology, stars are positively charged bodies being primarily ionized hydrogen in various states, some planets are negatively charged. The electrical charges on Earth (-) and the Sun (+) have been precisely measured. Plasma physics has a role in the solar system and beyond.

10 Capturing a Moon

Many of the planets have groups of moons with irregular orbits such as long period or inclined or retrograde.
The history of the solar sysystem is unknown.
How Earth's Moon came to be in orbit is still debated. Perhaps the 2 tiny moons of Mars were captured.

For the other planets, their sets of moons have proportional orbits. It is unknown whether the regular prograde moons were collected together so they have their common proportions in radius to time.

These moons were collected in an unknown sequence, but every moon's orbit is proportional to one or more in the set. There are no outliers.

The same lack of history applies to the entire solar system where the same proportion of radius to time applies to all bodies.

We also have no history for exoplanets whose orbits are also proportional in radius to time.

an interesting observation: long ago Jupiter and its moons were called a miniature solar system. That rough description is actually true.

This syatem of orbit proportions seems to be a ‘universal’ behavior.

11 Conclusion

First,
Celestial mechanics should recognize a collection of bodies having elliptical orbits around a primary will have proportional orbits in radius to time. A description of a behavior in astrodynamics usually mentions an individual elliptical orbit behavior but never a relationship among a set of bodies having proportional orbits.
The Kepler problem is the difficulty explaining the return to the orbit starting point with the same velocity. This problem might arise in celestial mechanics when considering orbits only individually rather than as a set which exhibits a proportional behavior.
The primary can be a star with orbiting planets and asteroids, or it can be a planet with orbiting moons.

Second,
Kepler’s Third Law of Planetary Motion has an equation which apparently mixes units. This paper explained how this equation, with a new description, works with all planets (both around our Sun and around other stars), their moons, asteroids, and comets and their motion around their primary.
Instead of entering a planet’s or moon’s orbit values directly (the units for these values vary with the primary), a ratio is required first. This ratio uses a baseline orbit in the system of bodies around a common primary are entered into the equation. Currently Earth’s orbit is the baseline for a ratio for all solar system bodies.

Essentially, a body in rotation with other bodies also in an elliptical orbit around a common primary (either the Sun or a planet) will have its orbit conform with the others in the same proportion of radius to time as demonstrated by the results of Kepler’s 3rd law (with its new description). This revised description applies to everything in an elliptical orbit around a primary.
Kepler’s Laws of Planetary Motion, are currently explicitly limited to planets. Its scope must be extended. The laws are for elliptical orbits. More than just planets have elliptical orbits.
A new name could be 3 Laws of Elliptical Motion.
This revised scope for these Laws applies to all bodies in an elliptical orbit around a primary. Only the 3rd law requires a new description for its use. The equation in the 3rd law is the mathematical representation of the

proportional relationship of radius to time among the elliptical orbits in the system of bodies around the primary.

Kepler's 3 laws of motion apply to bodies whose motion is an ellipse.

There is an interesting analog:
An atom has electron shells or orbits in quantized increments. The normal number of electrons increases with a larger nucleus. An electron has an uncertain position in its orbit which is described as a variety of shapes; its orbit is sometimes described as a cloud.
A change in the atom's energy state can involve multiple electrons changing their orbits. One or more electrons will leave when the atom reaches the highest energy states.

On the cosmological scale, these elliptical orbits around a primary are proportional and have no defined increment for a change in either distance or time. A change in a body's orbit will conform to its group's proportion of radius to time but there are no other defined restrictions for bodies changing orbits. A larger planet has the larger moons.

Each object in an elliptical orbit can have its position measured precisely.

There will always be differences between the subatomic context and above.