The Ten Body Problem
of
Celestial Mechanics

by Bill H. Clark II, P.E.

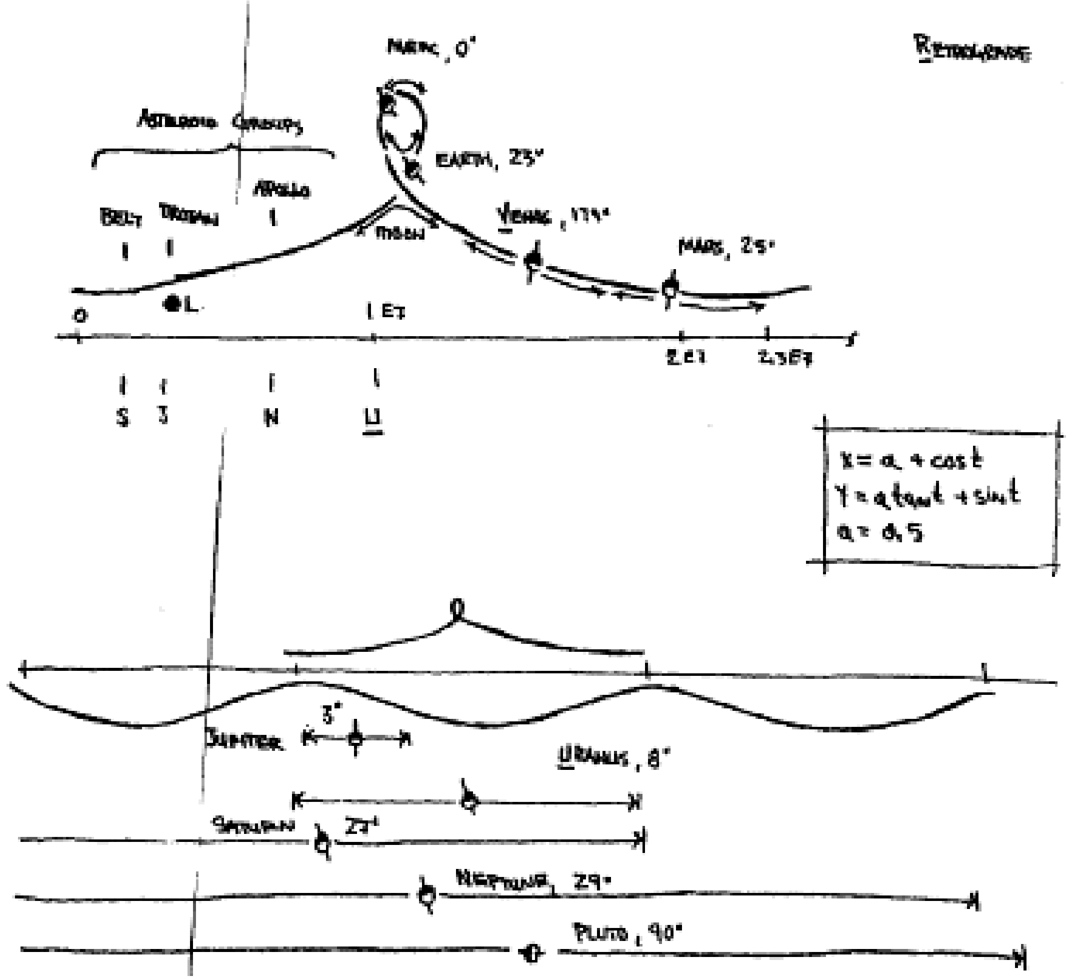
ABSTRACT

A graphical solution to the Ten Body Problem - the sun + nine planets - is found. A mathematical proof is also found that generates the imaginary number "j" as the solution, which in complex numbers implies rotation. This solution is of the so-called Szebeheley Equation, of the Regularized Three Body Problem. The paper developes the idea that on a macroscopic scale the solar system behaves as a three bodies. This is substantiated by a study of the data on the planets as an "inverse problem," which shows the inner and outer planets in different regimes; thus, with the sun, the ten bodies in this regularized problem act as just three. It is postulated that some of the recent planet systems that have been discovered to be massive Jupiter-sized planets are actually groups of planets that from a distance behave as large cumulative bodies.

PART I: CELESTIAL MECHANICS

The Ten Body Problem (the sun + nine planets) is also known as the Inverse Problem of Celestial Mechanics. That is, studing the raw data of planet positions, and attempting to devise a theory explaining these data. My solution, derived in full in another paper, is reproduced in Figure 1.

FIGURE 12



This is how I was able to explain several aspects of the Solar System, showing that this "system wave" is fit for all the nine planets to match, the (1) ellipticity of the orbit; (2) the axis of rotation of each planet; (3) that this axis of rotation has a constant orientation in the celestial sphere; (4) the inclination of the orbit to the ecliptic; and (5) also explaining the retrograde rotation of two of the planets.

The formal name for this curve is a prolate cycloid. This kind of curve is formed by fixing a line to one point on a circle, and rotating that circle around its center. In two dimensions the resultant curve looks sinusoidal, in three it is similar to a helix. Both are common patterns in nature. In fact, Fourier Series of sine and cosine functions are known to be able to represent any natural pattern by summing a combination of sinusoidal functions.

To put this in context, a little history is helpful. Many years ago Fourier Series were used in celestial mechanics to describe the motion of the planets. They went out of vogue because Poincare showed that Fourier Series solutions imply a system that is not stable long term. This was upsetting to astronomers, so other methods were developed. Generally, my approach is a return to the original trends in CM, the system wave I have found being in that context, the fundamental frequency of the solar system.

At the middle of the 20th century - before Fourier Series solutions in CM were rejected, and as Relativity gained dominance - the prevailing understanding of the solar system was epitomized by the notions of classical CM. They are best exemplified by the work of Dicke and Goldsetein, who have shown that the precession of Mercury's orbit is not due to a Relativistic distortion of space and time, but to a variation in the sun's gravity that acts similar to Earth's equatorial bulge. The plane which I formed as part of my geometric analysis implies such a strong gravitational anomaly within the sun. Coincidentally, it is slightly distorted very near to the Sun, just as is predicted in Relativity. Thus, I have a formal theory of which the two competing theories at the time are both special cases.

I have recently been able to show that the equation of the "system curve" I found is a solution to the so-called Szebehely Equation (for the regularized Elliptical Three Body Problem). The formal derivation is simple enough. It's reproduced in a more formal paper called "The Inverse Problem of Celestial Mechanics."

I presented these results in 1997 in a graduate class at UT Austin taught by Dr. Szebehely on the Theory of Orbits. Neither of us were able to apply the solution. The following presentation explores my current understanding of this function.

The meaning of the result, "j" the imaginary number, is what makes this understanding so difficult, and is the basis for this entire theorem. The imaginary number is an integral part of Fourier Analysis, which comforms to my general approach of using sinusoidal functions to model the motion of the planets under the influence of the sun's gravity. The problem is in quantifying the effects mathematically; or, at least, in understanding what the solution I have found means.

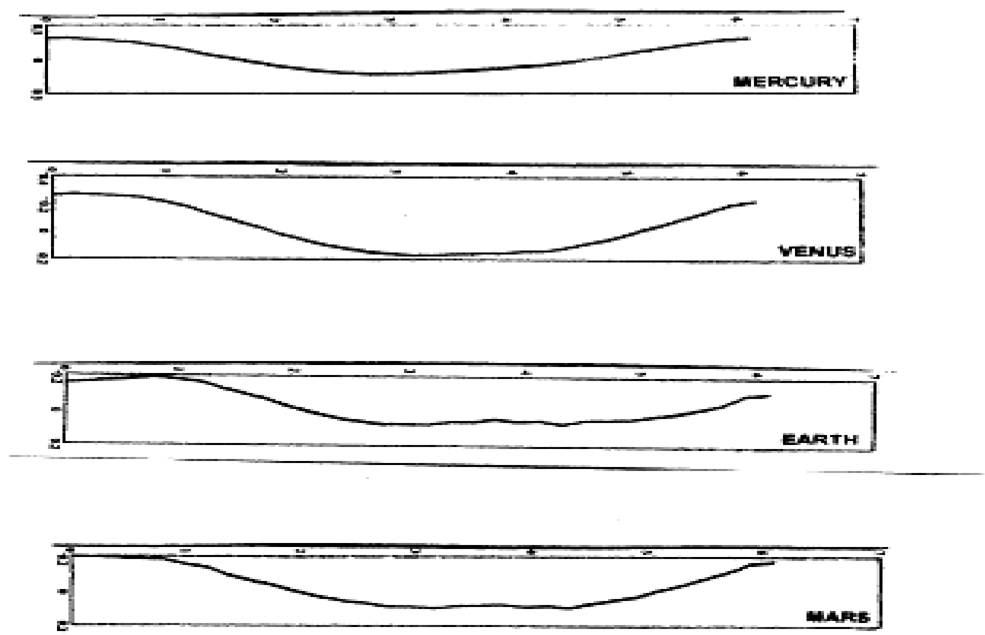
The Invariant Plane

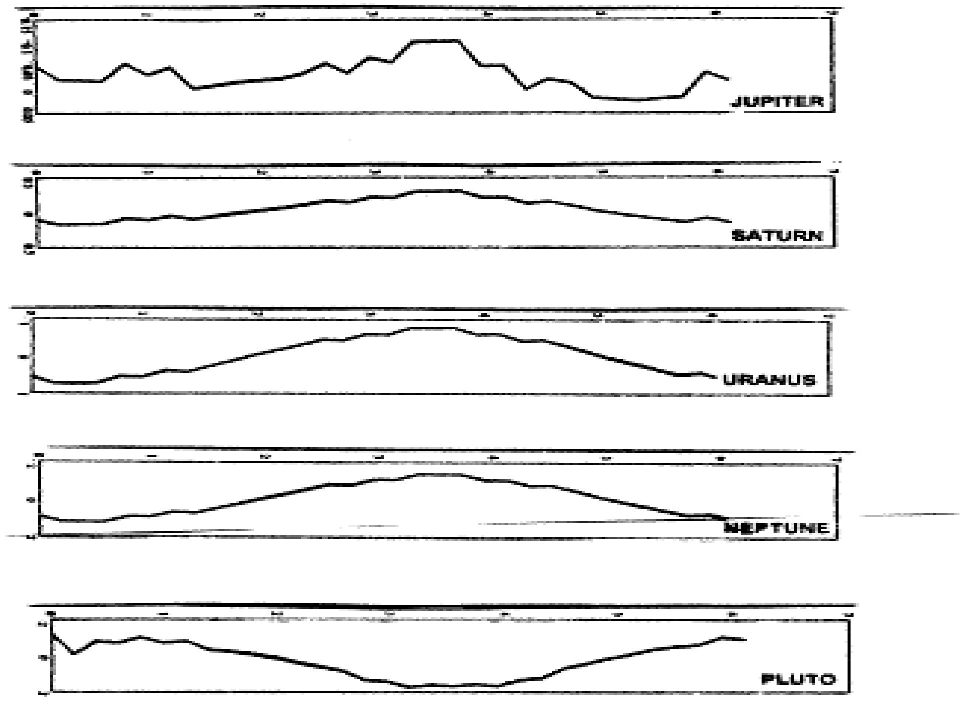
It is important to get the geometry straight on how the analysis was done. The position of each planet was calculated at ten degree increments in celestial longitude. A line was fit, using a least squares model, to each set of these positions. The masses were neglected because, pretending to be Kepler in solving the Inverse Problem (ie. given a set of data, fit a theory to explain it - in this case, the positions of the planets), the masses are not known.

These thirty six straight lines form elements of a single plane. The changes in slope and intercept of all these lines can be fit to a simple mechanism: A straight line attached at one point of the circumference of two circles, one centered at the sun and one centered at a radius from the sun equal to Mars' orbit. Each circle makes one full rotation as you go through 360 degrees of celestial longitude. The line attached to the circumference of these two circles as they rotate forms the invariant plane.

This plane has a distortion at the sun: the Relativistic warping of space and time.

A confirmation of the theoretical significance of this plane is that all of the planets exhibit uniform sinusoidal motion with respect to it.





In the course of their revolution around the sun, they move the same distance above this plane as they move below it, in a sine or cosine type of motion. The fit is not exact, but quite consistent, which is all that is necessary at this point: we seek only the basic, fundamental frequency that can be modified later by additional sinusoidal functions, summing them all up in a Fourier Series to arrive at the exact solution.

It should be noted that the ephemerides of the planets were not used to the high accuracy known today; again, the visual observations of Kepler are the standard for this Inverse Problem study. The idea is to find a formula that fits the nominal motions, assuming variations from it are due to perturbations from other planets or other sources, as later represented by other sinusiodal functions.

I have recently done this same analysis with the exact ephemerides, and arrived at an entirely new theory! I was able to show an affect that might explain the seasonal variation in the Earth's rate of rotation (that part which is yet unexplained, at least). This is not an unexpected result, since ultimately the Fourier Series should be able to explain all aspects of planetary motion.

Be that as it may, the system wave works like this: each planet is fixed to this wave form. If you move a planet the distance between its aphelion and perihelion (most distant and closest point to the sun in the elliptical orbit), then the motion up and down on this curve matches its motion above and below the invariant plane as determined above. Also, the axis of rotation of the planet is perpendicular to the wave, so that in one complete revolution around the sun it remains perpendicular to this wave; thus the rotation axis points to the same point in the celestial sphere at all times.

There are other correlations. You will also notice Earth is at the big loop near where it crosses; perhaps this is why we have such a big satellite, the Moon. The Trojan Asteroids, which will play a prominent role later, are at the intersection of the two regimes: short wave for the inner planets, long wave for the outer planets. The retrograde rotation of Venus and Uranus is shown. Finally, Pluto behaves as though it were an inner planet, or perhaps an asteroid as many have proposed.

The Planetary Gear

Getting back to the solution I have formed for the Inverse Problem, the plots of the planets versus the invariant plane shows two distinctive gravitational regimes for the inner and outer planets.

These plots are made versus the Invariant Plane, and they show that the motion of the planets is uniformly above and below this plane, in sinusoidal patterns. Furthermore, the inner and outer planets are in sequence, and the two sets are pi radians apart. Clearly, there are two separate but similar gravitational forces at work here.

So, it is logical to designate the region of space occupied by the asteroids as a boundary type regime between the inner and outer planets. In a rotating system if two distinctive regimes are shown to exist, there must be some formal relationship between them. In the complex plane the notion of "j" as generated from my solution to the Szebehely Equation signifies a uniform rate of rotation. This is what you would expect to happen betweeen these two regimes, so the result I achieved is not unreasonable.

Furthermore, you will recall that the Szebehely Equation is a solution of the Three Body Problem. In this case, it is implied that the inner planets act collectively as one body, the outer planets as another, and the sun as the third. These are confirmed by the above plots, so the solution I have derived continues to be a valid and applicable one.

So that is the theory, and it is shown to be logical. Now to test this theory by a more detailed investigation of the boundary region. The best way to do this is to study the Earth to Mars trajectory, which brings a spacecraft from the inner planet regime into the boundary region that borders Mars. If the theory derived here is valid, then there will be evident a distinctive difference between these regions.

I have created a computer program that optimizes this trajectory as a Four Body Problem. It is accurate to 16 significant digits, sufficient to show any global characterists as should exist because of the above theory.

This computer study shows that the most efficient trajectory of the spacecraft from Earth to conjunction (about half way to Mars) is identical to the Hohmann Transfer, which is a solution of the problem in two bodies. The trajectory from conjunction to Mars is extremely complicated, however. Both of these results fit in with the notion of the spacecraft entering a sort of gravitational boundary layer. Furthermore, it is quite unexpected that the first half of the flight path is a two body problem; although, if the inner planets were to behave as a single body on the macroscopic scale as implied by the solution to the Szebehely Equation, then it is logical that if a spacecraft is within the bounds of the inner planet regime, it would not experience the effects of the inner planets, only of the sun. That is precisely what the computer study shows.

Lagrange Points

At this point it is important to know exactly how CM studies the Three Body Problem. Take as an example the Sun-Jupiter system. These are the two major bodies, or primaries. The classical problem is to investigate how a much, much smaller third body behaves in their presence.

The analysis is set up with the center of the coordinates at the Sun and Jupiter on the x-axis. (Well, technically, the origin is at the center of mass of the Sun-Jupiter system, but since the sun is 10,000 more massive, for understanding this problem, you can assume the origin is at the center of the sun.) The coordinate system rotates so that Jupiter always stays right on the x-axis.

There are two points in this system that are stable equilibrium points. They are called the L4 and L5 Lagrange Points. If you put a tiny body at either of them it will remain there indefinetly. If you put it in a small elliptical orbit about this point, it will likewise remain in that stable orbit, indefinetly.

The location of these two points is simplicity itself. Form an equilateral triangle with the base as the sun-Jupiter axis; there are two such triangles, mirrored on this axis. The apex of each of these triangles are the L4 and L5 Lagrange Points. The Trojan Asteroids are located at one of these points. They are a small collection of asteroids in stable orbits around the Lagrange Points. A group of asteroids is also in orbit around the other stable point.

The other three Lagrange Points are on the x-axis, in this rotating coordinate system. The L2 point is between the sun and Jupiter, closer to Jupiter, and it is where the gravity from the sun and Jupiter exactly cancel each other. The L1 point is on the far side of the sun from Jupiter at about Jupiter's orbit radius; the L2 is on the far side of Jupiter from the sun. They are all equilibrium points, but they are unstable. An object placed at one of these points will not remain there if it is acted upon by an external force, however small.

The only rule used to create this analysis is Newton's law of gravitation. It says the force between two bodies is inversely proportional to the distance between them. This is an important concept because it means that any force that acts this way can be studied using the methods of CM. Electrostatic forces act by such an equation, Coulomb's Law. Thus, it is possible to model atomic forces, electromagnetic forces, and even chemical bonding forces using CM. As such, there is a 3BP of subatomic physics and one of quantum chemistry.

In this context, it should be a little easier to accept the notion of a "galactic atom," or of finding a similar pattern to the statistical electron positions around the atom as shown by the Schrodinger Electron Cloud Plots. Fundamentally, the same forces are acting; the only difference is in scale.

The Semiconductor Junction

Believe it or not, everything - and I mean EVERYTHING - we know about transistors is based on statistics. It's not hard to realize that statistics has its limitations. The base region of transistors is on the order of ten atoms thick now, and our theory is beginning to break down. Aircraft systems have random errors, as do all computer based systems; and the only remedy is to have duplicate systems. Even that has its limits, though.

Solid state physics isn't the only field that is statistical. All the cutting edge research being done now is statistical - quantum mechanics, chemistry, astronomy, physics, and even psychology.

One of the most exciting projects I have been working on is to build a discrete - not statistical - model of the semiconductor junction diode. I have made a very promising start, in using my Earth to Mars trajectory optimization program. You will recall that gravity and electrostatics are both governed by an inverse squared law. So fundamentally it's not such a bad idea to use celestial mechanics to model the transistor.

Otherwise, the structure of junction diodes is equivalent to an electron going from a stable orbit in one material across a uniformly charged region to a stable orbit in a second material. Historically, transistors have been optimized by having a small forward bias in three places: across the emitter, the base, and at the collector. This is exactly analagous to the optimum trajectory I have found: a thrust from the initial Earth parking orbit, one at midpoint in the "base" region, and another at the final Mars parking orbit. The electronic model for the junction, as embodied in the Ebers-Moll equations is exacly analagous to this. I have even found what act like Lagrange Points in the more advanced transistors, the BJT and Mosfet. The advances in solid state physics have followed exactly the same lines as those in celestial mechanics.

The bonus in this kind of investigation would not just be a better transistor, or a confirmation of the Chaos Theory in finding another level of the repeating body of theory. The bonus would be in finding a discrete analogy to statistics. It would put some physical significance to all the abstract statistical methods that have been developed. This would allow many fields to be better understood, as statistical processes were given some physical significance.

One example already developed is the Schrodinger Electron Cloud Plots. These are statistical probabilities of the location of electrons in orbit around a central positively charged nucleus. Finding an anaytical equivalent in the principles of celestial mechanics would help us to go beyond Relativity and its immutable law that the exact state of any subatomic object cannot ever be known with certainty.

As an application of this constraint consider the Bohr atom - one electron orbiting a nucleus. Physics cannot say where that electron is, it can only say where it is likely to be. Celestial mechanics, on the other hand, can say exactly where it is. Furthermore, CM can do so with two electrons, and a more complex nucleus; and even in some cases, with four discrete bodies. We are already far beyond where physics is now, and it's time to back up a few paces and see what that means.

NOTE: This begins speculative ideas to be developed further at some future date into one or more papers. Comments are welcomed!

PART II: TEMPORAL MECHANICS

The Scientific Method

There are a few things to be clarified at this point, primarily the notion of long term stabiity in the solar system. Metaphysically, I think nothing can ever be long term stable. Any theory that so proves should automatically be suspect (whatever happened to the Hiesenberg Uncertainty Principle?); not the other way around. To seek stability in all theory is a cowardly way; it takes a brave person, for example, to accept the Big Bang theory that the Universe is expanding indefinitely. The fact that modern science has "proven" this theory wrong says more about the moral fiber of those massaging the facts to suit their fears, than it does about the true nature of reality.

In a more practical sense, the standard way used in CM to prove the solar system is stable is to integrate the motion of the planets forward in time a couple million years; then back to time zero, and when you end up with the same initial conditions, stability is proven. Then you look at the fine print. Many untoward assumptions are made here: among them that all the forces are central forces - they aren't! Solar radiation pressure isn't that kind of force, and to neglect it in any study (we don't even neglect it in predicting the orbits of satellites over their five year lifetime!) of that longetiviy is not too smart. Since forces that aren't central forces cannot be integrated back in time, this approach is totally incorrect and its conclusions wrong. Why not face the facts, and accept that there is presently no way to prove long term stability; and accept the contrary, until proven otherwise.

So, if stability is not a problem, there is no longer an issue with using Fourier Series methods to study the solar system as a Ten Body Problem. However, it's still not that easy. To use such an outdated method requires much, much more. You must show a fundamental flaw to the present methods, making it necessary to seek solutions under other paradigms. Galileo had a nice idea in his heliocentric system, but spent the last 8 years of his life under house arrest by the Church because there was no fundamental support for his work. Indeed, Kepler found such support a few years later, but still refused to publish his work during his lifetime. We aren't any better in the modern day - believe you me.

The fundamental flaw is, with all due respect, in our proof of Kepler's 2nd Law - that the planets sweep out equal areas (ie the line from the sun to the planet) in equal times in their elliptical orbits. The standard proof of this uses a function that is for a circular orbit; it doesn't work for an elliptical orbit. (That is, when Newton proved the equal areas in equal times in The Principia, he took the limiting case as the area goes to zero. At which time the sides become equal. This is the limiting case, but it is a circular orbit; it cannot be applied to an ellipse of any appreciable eccentricity.) As a result, Kepler's 3rd law is also invalid. Then there are issues with the angular momentum of orbits, which is derived from these two laws; if it isn't constant, then one by one all the derivations we have done in the modern day are flawed.

It is appropriate to spend a paragraph developing this notion more formally. When proving Kepler's 2nd law, the limiting case is taken. However the idea is not valid in the limit because as the angle - 0 and the area - 0 the time also - 0. So it is necessary to go something LESS than the limit so there is a measurable area to be compared to a measurable time. At this point it is necessary for the eccentricity e - 0 for the law of equal areas to be valid. This implies that this Law is sufficient only for orbits near e = 0. Whereas it is typically assumed that Kepler's 2nd Law is good for all orbits - including hyperbolic orbits, with e 1. This is not supported by the analytical or the geometrical basis of the formula.

This does not introduce a major error in calculations; perhaps not until you reach the twentieth significant digit (after which time we usually attribute errors to computer round off). I'd guess that Relativity makes up the difference and after factoring it into our analyses, the science works just fine. However, all technological applications suffer under another constraint: even if the theory they use is inaccurate, the machines still must work! So, just to be safe; well, you've noticed that 95% of all satellites are in circular orbits. That's because orbital mechanics becomes increasingly inaccurate as the ellipticity of the orbits increases. Let's call it the Kepler Effect.

So, there IS a fundamental flaw in the present scientific context. Consequently, there IS motivation to consider other schemes. If these schemes are to have any hope of being successful, they must be more complex in their view of gravity.

A Galactic Atom

My "Journal of 21st Century Technology" had one other important concept. I was able to take the "system wave" and rotate it and resize it and form a set of fractal patterns that fit very nicely the Schrodinger Electron Cloud Plot solution of quantum mechanics. It was more than that, because it showed the Cloud Plots to be several nested sequences of a Chaos Theory - i.e. similar patterns repeating at subsequent levels of magnitude.

This remained a curiosity until I attended a seminar at the Aerospace Engineering Department here at UT Austin a couple of years ago. Dr. Roger Broucke presented his analysis of all the comets' paths as they move in the vicinity of Jupiter.

Dr. Broucke, now a Professor Emeritus, showed his analysis in the form of a series of graphs. In two dimensions on an overhead projector, they were interesting enough. I saw them in three, and it astonished me. Assuming that the orbit of Jupiter was at the edge of one of the Cloud Plots, which I had generated using the "system curve" as 2D sections of these 3D plots (eg barbells, toruses, etc. from your basic chemistry book), if you were to extend them slightly above and below this 2D section and sprinkle the outer shell with powder, you would get exactly the plots Dr. Broucke had created.

Well, it's not Dr. Broucke who created these patterns, but the comets, through their trajectories, have traced the patterns of 3D forms that, at Jupiter's orbit, are barbell shaped. Thus, my original theory went immediately from being an interesting curiosity like Bode's Law, to being a possibility; if not a probability. This latter jump in stature, may very well be achieved by the next paragraphs.

The logical progression of these hypotheses is that the pattern of electrons orbiting an atom is repeated at successive levels, up to the level of being represented on the scale of our Solar System. There should, by Chaos Theory, be some intermediate level. The sun is big enough; why not there? We assume it is one huge ball of uniformly distributed gas - what if it is not?

A strong case has been made historically that the sun is, in fact, not of uniform density. One anomaly has been proposed that would explain the precession in Mercury's orbit. That would still leave the precession in all the other planet's orbits, which are unexplained. If there were an anomaly that caused Mercury's precession, there would by extension be similar anomalies affecting the other planets. Where would all these variations in density come from? How could any theory possible explain their nature?

Perhaps the interior of the sun is organized like a great big atom. An equatorial bulge would be a donut shaped orbital, sufficient to explain Mercury's orbital precession. What about all the other barbells and other shapes? Perhaps one barbell rotates at the same rate as Jupiter, say, causing its orbital precession, while having only a tiny affect on all the other planets? If Chaos Theory tells us anything, it is that if several sequences can be proven, then subsequent ones must exist even if they cannot be directly observed.

Separate but Equal

It's known that some of the comets have Jupiter at the focus of their orbits, rather than the sun. This implies a discontinuity between our solar system and milky way galaxy at that order of magnitude, or level of Chaos Theory. This is confirmed by the Schrodinger Plots mentioned in the previous page.

This discontinuity is evident in the Inverse Problem as I have formulated it. The one plot shown so far hints of separate gravitational regimes for the inner and outer planets. Two more series of plots show this distinction even better, when the two sets of planets are looked at separately. These are the same plots as presented earlier; this time look at their phase relationship - all the inner planets start at the same phase angle (Pluto included, for some unknown reason); ditto for the outer planets.

These plots are made versus the Invariant Plane, and they show that the motion of the planets is uniformly above and below this plane, in sinusoidal patterns. Furthermore, the inner and outer planets are in sequence, and the two sets are pi radians apart. Clearly, there are two separate but similar gravitational forces at work here.

So, it is logical to designate the region of space occupied by the asteroids as a boundary type regime between the inner and outer planets. On the inner side, the gravity of the sun is able to hold very small planets. On the other side the planets must be four orders of magnitude larger for the sun's gravity to hold them in stable orbit. Something is acting to greatly dampen the force of gravity between these two levels of planets; perhaps the mass of the asteroids spread in the boundary layer behaves as a kind of lubricant to absorb the gravity or to concentrate in in the inner planets.

Be that as it may, in a rotating system if two distinctive regimes are shown to exist, there must be some formal relationship between them. In the complex plane the notion of "j" as generated from my solution to the Szebehely Equation signifies a uniform rate of rotation. This is what you would expect to happen betweeen these two regimes, so the result I achieved is not unreasonable.

Furthermore, you will recall that the Szebehely Equation is a solution of the Three Body Problem. In this case, it is implied that the inner planets act collectively as one body, the outer planets as another, and the sun as the third. These are confirmed by the above plots, so the solution I have derived continues to be a valid and applicable one.

Carrier Wave

In the spring of 1984 I gave a formal presentation of the results of my work to Major General Niles Fulwyler, the Post Commander, and Dr. Davies, the Chief Scientist. This was no small accomplishment because White Sands was at the time where the High Energy Laser used in the Strategic Ballistic Missile Defense system that was being built and tested. The letter from NASA opened the door to that high office for me.

I had been working hard on a computer verification of the system wave, previously illustrated. I generated some solid numbers, and fine tuned the theory (this is how I found the mechanical specifications of the invariant plane - ie the location and size of the circles). The wave form itself was confirmed, and I was further able to show the existence of a carrier wave, a small sinusoidal pattern superimposed on the much larger system wave. This small pattern had a direct correlation in the only aspect of the planets' motion I had not yet fit in my theory: the rate of rotation. (before I had only total energy, which was composed of energy of rotation on the axis and energy of revolution around the sun.) It was an exact fit.

At the time, all of this was just a geometric curiosity shown to fit a complex system. It was historically correct, conceptually reasonable, and mathematically accurate, but there was no fundamental basis. Fifteen years later, I can now postulate that the large wave I found is gravitational, and the smaller one is electromagnetic. I suspect they have the same frequency, having a common origin in the sun; which would make the larger one travel much, much faster - as we now know gravity does. It's also reasonable that the smaller wave is electromagnetic in nature, having its subtle effect because of the magnetic core of the planets; acting like a magneto to induce rotation as implied in my paper proposing a cause for the seasonal variation in the Earth's rate of rotation.

The troubling part is that the carrier wave I found was not of constant magnitude; it had a slowling increasing magnitude. This implies that light waves do not travel unchanged through space, especially space in the vicinity of a solar system, but is quite noticeably altered by it. This, in turn, implies that the distances we compute to nearby stars are not nearly as far away as they calculate to be.

This is equivalent to what was postulated in the spatial investigation in the "Planetary Gear" page, where the great divergence between the gravity fields extant in the inner and our planets does not jive with a uniform gravitational flux from the sun. Consequently, the evidence cited then applies here as well: the plots of the two sets of planets versus the invariant plane, the great difference in the mass of the planets, and so forth.

The inevitable conclusion is that this boundary regime would have an effect upon electromagnetic radiation as well as gravity. Conseqently, light reaching Earth from beyond the asteroid belt would exhibit this shift. Any spacecraft going beyond this zone and transmitting radio signals back would have this property as well, however small.

Time and Tide

I got a suggestion a few years ago from Dr. Broucke, and that is to organize my Mars trajectory analysis computer program (available free on this web site) with regards to the conjunction. It has turned into a very sage piece of advice. But first a little bit about the politics of Mars.

One of the main reasons for our probes to Mars is to search for water. There have been sporadic announcements by scientists claiming to have proof of major water deposits there, etc. I say they are all completely wrong, and I have good reason to say so. Were we ever to establish a manned presence on Mars, and create an atmosphere, it's an established fact that we would have to constantly replinish it to make up for what is lost to space because of Mars' very low gravity. Mars is too small to have ever had an atmosphere! It's too hot in the day to have ever had any surface water, which would immediately evaporate and be gone with the atmosphere.

So, now there is the mystery of the strange patterns on Mars that are reminiscent - and there is no debate over this - of water washing across the surface, for aeons on end. I contend it was not water at all, but gravity waves. My Inverse Problem analysis shows clearly a strong discontinuity or vortex at Mars. It's like the beach on a huge ocean; the waves on one sidea are short and strong; on the other they are long and lazy.

This kind of strange and unpredictable gravitational field in the vicinity of Mars is borne out by more facts. The Russians have tried six times to land on Mars; and have failed all six times. We have failed two out of the last three; and the one satellite that did make it was severely damaged, having lost half its solar panels in transit.

Mars is right in the middle, it seems, of the inner to outer planet transition. This was shown in my Inverse Problem study, which in generating the invariant plane, did so with a line fixed at the sun and pivoting on a circle at Mars. That's how a prolate cycloid is formed geometrically, and it fits the pattern I derived. So, there is physical as well as theoretical basis for postulating this phenomenon.

Where there is such a boundary region, there must be some strong discontinuity. I have built a full computer model of the Earth to Mars trajectory (available on this web site for free download), hoping to plumb the true nature of this transition region. I have formed a separate theory, and it is available on my website at inviticus.com

What I found, in my so far very superficial study, is that it is possible to get to Mars 30 days faster and using 25% less fuel by following a simple ballistic trajectory with a single thrust at conjunction. You can get some background on this from a magazine style article, also on my website.

The idea is to find the seam between these two gravitational regimes, and to use it to use gravity to better advantage, perhaps in a manner like the Babylon 5 jump gate.

The Limiting Case

A common topic of study in CM is the n-body problem, which is a heuristic investigation of many bodies interacting. It is well known that in the limit, the equations of motion reduce to those of incompressible flow in fluid dynamics. You could think of CM as describing the totality of forces between molecules in a fluid. Does this have any real significance?

In the classical sense, CM is the study of large massive bodies such as planets or moons or stars. The only context in which there are n such bodies is something with a nearly infinite number of masses in an finite space. One such example is looking at many thousands of stars and their planets. It is in such a context that the equations of motion reduce to that of a fluid. This implies that forces exist that go far beyond the speed of light, in which such a context is possible.

It doesn't stop there, either. Incompressible flow is actually a very small part of what we know about fluid dynamics; it's almost an insignificant part of the whole, compared to compressible flow regimes.

Another way to look at the many body problem is a little more fruitful. A popular way to present the Three Body Problem many years ago was the study of periodic orbits. Put the little third body in motion around the primaries, then let the system run for thousands if not millions of loops. Eventually the path repeats. The graphical solution to these studies are called Poincare Plots.

One very interesting such Plot shows a triangular shape within the circular shell that is the limit - i.e. the little third body does not ever have enough energy to pass beyond this circular outer line. This shape is a collection of nested periodic orbits wound like twine around a ball, so that collectively they create this overall pattern. Hypothetically, this could also represent many small bodies in periodic orbits, so that overall they form a shape that is a solid by comparison to the whole.

When I first saw this particular Poncare Plot it struck me how very similar the pattern is to that of the rotating piston in the old rotary Wankel engines. The natural extension of this is that it should be possible to form such a device as a way to generate power.

Event Horizon

The theoretical development to this point builds a case for (1) a separate gravitational regime for the inner and outer planets, (2) a boundary region between them as distinguished by a different rotation, and (3) a different fundamental relationship to the sun. The latter is shown directly by virtue of the different masses of the sets of planets and other fundamental aspects of their orbits.

This abrupt change is surmised to be caused by the asteroids, which act as sand in a planetary gear to reduce the efficiency by which gravity is transmitted to the outer planets. The equilibrium points probably play an important role in this mechanism. They may be where the greatest stress between the gravitational plates exists, so more mass collects there at the hinges to exacerbate the effect. (Remember the photos of Eros the asteroid last Valentines Day - the asteroid had a very uniform surface; as though it had been worn smoothe in such a mechanism.) This process is so efficient that bodies not native to our solar system such as comets see the entire inner solar system as a single body and have Jupiter as the focus of their hyperbolic orbits.

What this means is that these comets do not even see the gravity of the inner planets. It is masked from them, at least until they are quite close to the sun. Hypothetically, it should (by Chaos Theory) be possible to create a machine that does this same thing for a flying machine - mask gravity. Without gravity it's easy to make 90 degree turns and other abrupt course changes, and to go at very high speeds. (There was a place in California, Chico, where for years little round rocks fell right from the middle of the sky - from pebble size to fist size; maybe a UFO was broken down and was leaking "grease" from its drive mechanicm.

Without having another model to go by, the exact nature of this mechanism will be elusive. However, perhaps cosmology gives a clue in the inner structure of black holes. Theoretically, a critical amount of mass at the Lagrange Points will mask the solar system completely, making it seem like a black hole. This would be a probable stage in the evolution of a solar system, and may explain why astronomers have found many, many more black holes in the cosmos than theory predicts. Another probable stage of the solar system would be an intermittent one with the system acting as a pulsar, the Lagrange Point mass being borderline so the system fluctuates between on and off.

The Continuum

One of the classical problems of CM is the study of periodic orbits around the equilibrium points L4 and L5. This is a three body problem in rotating coordinates: two primaries, and a small third body orbiting L4, say. This is quite an amazing thing, if you think about it. The whole system is rotating, and there is a tiny little body in its comfortable little orbit around some remote point, in perfect equilibrium. Subtle, but amazing nonetheness.

Nature, as usual, is far more elegant. We struggle to understand this problem mathematically, in the simplest terms - both bodies in circular orbits, no external forces, and so forth. Yet nature has placed dozens if not hundreds of bodies in orbit around the Lagrange equilibrium points: the Trojan asteroids. Despite all the forces between them, they remain in stable orbits around L4 or L5.

That means a lot, if you think about it. In the limit it means you can have many, many bodies in stable equilibrium around that point. Ultimately they will begin to behave like a full Poincare Plot, i.e. the rotary drive postulated earlier. In deep space, you may even achieve propulsion. Put these equilibrium points in the proper orientation to your space ship (ie the center of mass of the main saucer section; with perhaps the energy source in the drive section as the 2nd mass), and you have two warp drives at the end of elegant nacelles, just like the Constellation class star ships.

How to get there from here? Well, CM is not like physics. We do not have a single penultimate theory like the Unified Field Theory, and all fundamental theoretical work stops until that is achieved. Nor do we depend on Chaos Theory; which must, after all, have theories to repeat in their fractal patterns. No, we in CM just add one more body to the problem, put in on the computer, plot out some numbers, and come up with some new ideas. Our ultimate theory is the n-body problem.

So, CM now is quite knowledgeable in the Three Body Problem. We know just about everything about one tiny object orbiting the equilibrium point. Now we just need to study two bodies orbiting this point. The logical thing would be to connect them, like a little barbell, and let it orbit the point. Then see what happens when you change their total mass, their relative masses, the shape of their orbit, the size of their orbit, the size of the primaries, the rotation of the primaries, and so forth. Any one of these studies would get you a doctorate, if you can find somebody to study under. . .

Then you look at all these circumstances with three bodies orbiting the equilibrium point. The simplest problem would be two bodies around L4 and one around L5. Then go through all the same iterations and combinations, learning a little bit more about gravity with each analysis.

Another important Five Body Problem would be to see how one large body external to the whole system would affect the two barbelled bodies at L4. Presumably they would be extremely sensitive to the slightest force; so you have a very nice way to design a gravity sensor. A continuum of these little equilibrium points at different frequences around a circular perimeter would give a full scan. Presumably they would be on the perimter of the main shell of the star ship: the sensor array.

What about lasers? Well, light exists in two forms; as a pure wave, and as a photon which is a discrete electromagnetic particle with measurable mass and momentum. The big problem with lasers is that they dissipate or diverge from a pencil beam over distance. Why not create a laser beam with three photon particles in stable orbit?

What about an energy source? Well, it may be easier to accomplish than you think. Consider the Three Body Problem again; two large, massive primaries. The classical problem is to assume both masses are of uniform density and can be represented as point masses. A nice 3BP would be to make one mass the sun, the second primary the Earth and the small body the mass in the bulge of the Earth. The fourth body would be a tiny satellite orbiting the Earth - how must the two Earth masses be modeled to emulate the affect of the Earth's equatorial bulge on satellites? You can do the same analysis with a bulge in the interior of the sun; causing Mercury's orbital precession. What each of these two systems is really doing is transferring some energy from the dual primary body to the small fourth body. You almost have a controlled fission here.

Another study would be to look at the physical center of mass of the two primaries. Is it possible to put a small mass in a stable orbit around that point? Remember it's a rotating system, so the small body will not only be acted on by the gravity force from the two primaries, but it will also exhibit corriolis and centrifugal forces. It should be possible to balance all these forces in a sixth Lagrange Point. Quite possibly it will have to rotate extremely fast around the center of mass, and at some point you will have a transition from matter to energy because of the speed. But since the whole dynamic system is easily controlled, you can make this process take place at just the rate you desire.

Finally, consider the Szebehely Equation. Applying it to this unique 3BP, it implies that matter can be converted to gravity, in a rotational pattern - eg. actual gravity waves. This would give a direct matter to propulsion process, rather than the extremely inefficient way we do it now: accelerating matter, and using exchange of momentum for thrust.

In all of these cases there are three more Lagrange Points, along the line formed by the primaries in the rotating system. What significance could they have? Perhaps the answer lies in the implications developed earlier, in forming a Fourier Series solution to the many body problem of the solar system. Fourier Series are an important aspect of control theory, so it is logical to suppose that these three unstable points may have some use in controlling the dynamics of the above, and other, problems.

Conclusion

You no doubt think all these wonderful things are impossible, given the current state of the art? Ideas are wonderful, but how to make them work - the current theory can't possible be extrapolated to such complex extremes; and there is no extension of theory in evidence, anywhere.

Wrong. The theory is right before your very eyes! The solution I have derived of the Szebehely Equation shows that the Ten Body Problem can be represented as a Three Body Problem, right? Well, the opposite is also true - everything we now know about the Three Body Problem can now be investigated in light of this much more complex problem. For example, instead of just five stable Lagrange points, the evidence is that there are ten more stable points - add to that all the satellites of the planets; and you have the possibility of close to a hundred Lagrange points. That should be more than enough to develop all the theory for each of the above applications.

Almost. What is really needed are called "energy integrals" in the business. One new energy integral would allow the 3BP to be solved, and the 4BP brought to the level of the 3BP now - a couple of thousand technical papers later. The next integral would generate roughly ten times as many papers, etc at an exponential rate.

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