The Ephemeris

Focus and books

New Light on Redshift Periodicities

I. Quantization in the Properties of Quasars and Planets

Redshifts of quasars tend to be distributed in peaks which are separated by (1.23)^n. Jess Artem has pointed out this gives a fair representation of Bode's Law of planetary distance from the sun. Martin Kokus has noted that 1.23 is the fractal kernel for galaxy distribution on the sky. T.F. Lee has noted that this factor is almost the exact ratio of the mass of the Earth to Venus.

The best values of planetary and satellite masses are examined here, and it is concluded that (1.228)^n is a significant representation of the data. The general conclusion which is suggested is that this represents the law of creation of masses from galaxy to elementary particle scales.

1. Introduction

One of the most puzzling properties of quasars is the tendency for their redshifts to occur at preferred values (Burbidge and Burbidge 1967; Karlsson 1971; 1977; Depaquit, Pecker and Vigier 1985; Arp *et al.* 1990). The ratio of adjacent peaks in the distribution of their redshifts is an empirically determined value of 1.23; *i.e.*:

$$\frac{1+z_n}{1+z_o} = (1.23)^n \quad (1)$$

It has been pointed out by Martin Kokus (1993, 1994) that 1.23 ± .04 is the fractal dimension of the universe (Peebles 1980; Mandelbrot 1983).

A few years earlier, however, another numerical coincidence was brought to my attention by Jess Artem (private communication 1990), who pointed out that the Bode-Titius law expressing planetary distances from the sun obeyed quite well a series based on the preferred quasar redshifts. I made some tests of the data at that time and came to the conclusion that while the effect was improbable as a chance occurrence it was not sufficiently improbable to impress a scientific audience who saw no reason why it should be true.

Finally, in 1994 T.F. Lee (a geologist) sent me a copy of his book *The Origin and Development of the Sun and Planets*. On p.31 of that book he notes that the ratio of the mass of the earth to Venus is 1.23 and notes that powers of this factor give "a limited" Bode's law. After a few weeks my curiosity forced me to see whether other planets in the solar system exhibited this same ratio of masses. The following are the results of that investigation.

2. Mass ratios of planets in the solar system

The most modern compilation of Solar System masses I could find was by J. Pasachoff (1991, Appendix 3). They are listed in Table 1, where n is the number of factors of 1.228 that is contained in each mass ratio and ε is the difference between n and the nearest integer. It is immediately clear that the mass ratios fall significantly close to integer values of n.

In order to test the probability of this occurring by chance, we note that if the mass ratios were distributed randomly around their measured values over an interval which yielded $-.5 < \varepsilon < 0.5$, then there should be as many with $|\varepsilon| > .25$ as there are $|\varepsilon| < .25$. This was tested numerically by uniformly varying the mass ratios and ascertaining that they indeed uniformly vary over the ε values. But it is apparent at a glance that all seven points fall in the half of the available domain closest to the integer value. In fact the greatest $|\varepsilon|$ is just 0.18, which yields a probability of .18/.50 = .36 that a point would fall this close to an integer value by chance. But the first seven ε's fall within or closer than this range, which is only a chance probability of $P_{tot} = (.36)^7 = 7.8 \times 10^{-4}$. In reality there is an even smaller chance of this result being accidental because the points are not evenly distributed between $-.18 < \varepsilon < .18$, but are peaked toward $\varepsilon \approx 0$.

It might be objected that the last digit in 1.228 can be adjusted at high n to give an optimally small ε. But we will see in section 7 that the satellites of Jupiter and Saturn at very much higher n give 1.2282, so for the planets we can take 1.228 as a given value.

Although the further discussion will strengthen this result we will assume at this point that the 0.999 significance establishes the result as proven.

3. Venus

At closely the same mass value as the earth, it is impressive that Venus comes out to differ by one factor of 1.228 to an accuracy of 4 parts in 1000. This alone, without the other planets, would be strong numerical evidence that the factor had a significant relation to the previously found value in quasars. This leads us to ask immediately: how accurately is the factor known from quasar redshifts?

4. Accuracy of redshift factor in quasar redshifts

In the usual expression for quasar redshifts, $\Delta \ln(1+z) = .206$, certain subsets of quasars can show period spacings which vary from .20 to .25. But the overall average of brighter quasars is clearly .206 and not .205 or .207 (Arp *et al.* 1990). Therefore, the factor is 1.2288 ± .0006 as measured from the quasars. The overall factor which fits the planets best in Table 1 is 1.228 and the factor from Venus alone is 1.227. All three of these numbers agree to within two parts in a thousand.

5. Pluto

Pluto is an interesting story because it used to be thought to have a mass comparable to the earth. With the recent discovery of a satellite, however, its mass is now around 1/500th of the earth's, too small to have caused supposed perturbations of Neptune's orbit which led to its much publicized discovery (Pasachoff 1991).

McKinnon and Mueller (1988) estimate the mass of Pluto as 1.25×10^{25} g, and this gives the mass ratio of .00209 as listed in Table 1. If their last digit on the mass of Pluto is significant, then we have a mass ratio of .00209 ± .00001, which gives an $\varepsilon = .04^{+.03}_{-.02}$. In this case Pluto would give a strong confirmation of the (1.228) ratio at the highest planetary n value.

In a private communication, Tom van Flandern, who kindly supplied me with the pertinent references, however, expressed the concern that the Pluto-Charon orbit scale might be uncertain by about 10%, and therefore the mass uncertain by about 30%. In that case the n value computed in Table 1 would have no significance. The value in Table 1 is taken from Lang (1992) which has the note

Table 1 - Mass Ratios in Solar System in Terms of $(1.228)^n$

Planet	Mass	*n*	ε
Mercury	.0553	–14.10	.10
Venus	.8150	– .996	– .004
Earth	1.0000	——	——
Mars	.1074	–10.86	– .14
Jupiter	317.89	28.05	.05
Saturn	95.17	22.18	.18
Uranus	14.56	13.04	.04
Neptune	17.15	13.84	– .16
Pluto	(.00209)	–30.04	.04
Sun	3.95×10^5	61.91	–.09

"adapted from McKinnon and Mueller (1988)". It would be worthwhile to verify that this value is more accurate than about 4% in order to furnish another meaningful confirmation of the 1.228 factor in the planetary system.

6. The sun

Because the mass of the sun is known to many significant figures, it is possible to ratio it with the earth rather accurately. As Table 1 shows this leads to $n = 61.91$, $\varepsilon = -.09$. Therefore, the sun is within the average tolerance of the planets of $(1.228)^n$, even after 62 powers of the factor. On the conservative estimate of the improbability of chance occurrence we gave in section 2: $(.36)^8 = 2.8\times10^{-4}$. Therefore, the major bodies in the solar system are shown to have their masses in integer factors of $(1.228)^n$ up to 62 powers of *n*.

7. The satellites

Table 2 lists those moons in the solar system where the ratio of the moon mass to the mass of the host planet is accurately enough known to compute a meaningful *n* and ε. Surprisingly, it is seen in Table 2 that two satellite masses fall at integer values, but the rest at half-integer values. The first reaction to this is skepticism, because the factors for the planets generally avoided half integer values and now they favor $\varepsilon = 0.5$. But when one considers how close these satellite mass ratios fall to whole and half integer values, it is difficult to believe this is a chance occurrence. For example, the average absolute deviation from $\varepsilon = 0$ for the seven planets in Table 1 is 0.096 (*vs.* 0.25 expected for a random distribution). But in Table 2 the eight satellites of Jupiter and Saturn show an average deviation from 0.5 and 0 of only 0.0325! The value expected from a random distribution is 0.125, so these satellites show an even more significant periodicity than the planets.

Because the computation goes over 80 powers of *n*, it is now possible to improve the fit by using (1.2282) instead of $(1.228)^n$. It also should be remarked that the Satellites of Jupiter and Saturn give particularly accurate results. The earth's moon and Uranus's two moons give about as accurate a fit to the half integer values as the planets to the full integer values in Table 1. I have no explanation for the half integer values except that the factor 1.2282 may be like a spin with whole and half integer values..

8. Discussion

The only suggestion that has been advanced for the discreteness of the quasar redshifts is that the particle masses of the matter in the quasars which comprise each peak have discretely different values. That means the electrons which transition between atomic orbits are discretized in masses with ratio 1.23, and therefore, the photons which are emitted are redshifted in energy by this factor.

This interpretation would mean that the masses of electrons in different quasars vary as $m_e \propto (1.23)^n$. Since this same ratio seems to apply to masses of planets, satellites and the sun, it would imply that masses on all scales, in at least our local universe, are formed in the same ratio. This would suggest a rather audacious test: namely, are terrestrial electrons in a ratio of $(1.23)^n$ to the mass of the earth?

The mass of the earth is taken as $5.977 \pm .004 \times 10^{27}$ *g.*
The mass of the electron is taken as $9.109558 \pm .000054 \times 10^{-28}$ *g.*

Because of the large power of the factor we take 1.2282, the most accurate value as obtained from Table 2. The result is:

$$\frac{M_{sol}}{m_e} = 6.561\times10^{54} \qquad n = 614.06, \qquad \varepsilon = .06 \qquad (2)$$

This could be used to derive the most accurate possible value of the factor as $1.2282265 \pm .0000015$. Of course, this latter calculation assumes that since the mass of the earth was created, it has not lost an appreciable amount of mass through radiation processes or ejection, or gained a significant amount through accretion. The same could be remarked of the sun and the remaining planets, and would be a reasonable explanation of why all ε's are not exactly zero.

Among the elementary particles, the ratio of proton to electron mass gives $n = 36.59$ and neutron to electron mass gives $n = 36.60$. The most interesting ratio is the mass of the electron to the m-meson ratio:

$$\frac{m_e}{m_m} = 2.06.9 \pm .2 \qquad (3)$$

which yields

$$n = 25.96 \pm .004 \qquad \varepsilon = .04 \qquad (4)$$

It may be significant that in these two members of the lepton family, the muon is considered very similar to the electron, in fact being sometimes referred to as "the heavy electron".

9. The Titius-Bode law of planetary distances

In 1766 Johann Titius von Wittenberg pointed out that the radii of planetary orbits obeyed a law involving 2^n. With the discovery of Neptune and Pluto, however, the law failed badly and had to be modified to one involving $(1.7275)^n$ with complicated corrections for each planet. This so-called Blagg-Richardson law fitted the planetary, and also lunar distance, to a very high degree of accuracy (Nieto 1972). But the correction could never be understood in terms of planetary formation theory, and so the so-called Bode's law has subsequently been neglected.

In Table 3 we investigate the simplest possible application of the $(1.228)^n$ factor as a representation of the spacing of the planets. It is immediately apparent that this is a very good fit to whole- and half-integer values of *n*. If we use the fact that the probability is 0.5 that a

Table 2 - Mass Ratios of Satellites in Terms of $(1.2282)^n$

Planet	Satellite	Mass Ratio	n	ε*
Earth	Moon	.01230002	21.40	–.10
Jupiter	Ganymede	7.80×10^{-5}	46.02	.02
	Callisto	5.66×10^{-5}	47.58	.08
	Io	4.68×10^{-5}	48.50	.00
	Europa	2.52×10^{-5}	51.51	.01
Saturn	Mimas	8.0×10^{-8}	79.50	.00
	Rhea	4.4×10^{-6}	60.00	.00
	Iapetus	3.3×10^{-6}	61.40	–.10
	Titan	2.4×10^{-4}	40.55	.05
Uranus	Oberon	6.9×10^{-5}	46.65	.15
	Titania	6.8×10^{-5}	46.72	.22

*ε measured from closest integer or half integer.

random n will fall less than 0.125 from a whole- or half-integer value, then we see from column 4 of Table 3 that all nine planets (re earth) have $|\varepsilon| \le 0.12$. Therefore we have a probability of ${}^9P_9(0.5) = 2 \times 10^{-3}$ of an accidental result.

It should be also emphasized that using the 1.228 factor gives a significantly better fit than the more approximate 1.23 factor. This is the same result obtained in Tables 1 and 2 for the masses of the planets and appears to be a strong confirmation of the significance of the 1.228 factor for the planetary system.

Other comments are that T.F. Lee (1994, p31) noted the approximate orbital ratios of 1.23 of the major planets beyond earth. In fact Table 3 shows that for the four major bodies outward from the earth the fit to whole integers is exceptionally good, these four alone giving a chance of $< 7 \times 10^{-3}$ for accidental occurrence in a sample of 9.

Another comment is suggested by the test of the Blagg-Richardson form of Bode's law in the final column of Table 3. There we see the factor 1.7275 gives a very bad fit to the spacing of the planets, 5 greater than $|\varepsilon| = 0.125$ and four less, just what would be expected from a random distribution. This result shows that a) the goodness of the Blagg-Richardson fit comes entirely from the correction terms applied and b) that using an arbitrary number other than 1.228 does not give a significant fit to the data.

Table 3 - Orbital Sizes in Solar System

Planetary distance (semi Major Axis in AU)		factor 1.228 n	$\lvert\varepsilon\rvert$	factor 1.7275 n	$\lvert\varepsilon\rvert$
Mercury	.387	–4.62	(.12)	–1.74	(.24)
Venus	.723	–1.58	(.08)	–.59	(.09)
Earth	1.0				
Mars	1.524	2.05	.05	.77	.23
Asteroids	2.8	5.01	.01	1.88	.12
Jupiter	5.203	8.03	.03	3.02	.02
Saturn	9.539	10.98	.02	4.13	.13
Uranus	19.191	14.38	(.12)	5.40	(.10)
Neptune	30.061	16.57	(.07)	6.23	.23
Pluto	39.529	17.90	.10	6.73	(.23)

ε values in parentheses are deviations from half-integer values.

10. Summary

It was mentioned in the introduction that $1.23 \pm .04$ was the fractal dimension of the distribution of galaxies on the sky. If this represents a self-similar spacing in nature which is invariant to transformations in scale, then we would be seeing an empirical connection between the hierarchical spatial distribution of galaxies and planets in the solar system. This would then be exactly confirmed by quantitatively the same hierarchical distribution of masses, from electrons to planetary systems, as seen in the first sections of this paper. This could seem to be rather direct evidence in favor of a self-similar cosmos, from macroscopic to microscopic, as speculated by many people in the past, but as developed in rigorous scientific terms by Robert Oldershaw (1989 and references therein).

Of course, there are many problems to be solved. For example: Why are just the planetary distances quantized? Cursory attempts to find a 1.228 geometric progression in period, angular momentum and kinetic energy of the planets were not successful, but a systematic analysis should be made. What is the relation between mass and orbital location? It cannot be single-valued because masses first increase outward and then decrease. Is mass the fundamental quantity which is quantized? Why are whole integer values of 1.228 realized in some cases and half integer values in other cases? The latter property is reminiscent of elementary particle spins which can assume whole or half integer values. In the following paper (II) some possible connections to spin properties are explained.

I would like to gratefully acknowledge helpful comments during preparation of this paper from: Horace Drew, Tom van Flandern, Martin Kokus, Thomas Phipps and Milo Wolff.

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II. Astronomical Quantization and Spin

If particle masses are viewed as a function of electromagnetic frequency, then quantization of masses from large to small can be better understood. In particular, the mysterious 72 km s^{-1} quantization of galaxy redshifts can be quantitatively calculated. The basic usefulness of extragalactic redshifts would then be to explore the general, non-local relation between frequency and cosmological (x,t) coordinates.

1. Introduction

In the previous paper (I) it was shown that quasar redshifts and planetary masses were both quantized in numerical factors of 1.23. In the case of the quasars the redshift quantization was attributed to a quantized mass of the electron making the transition between atomic orbits. In the case of the planets it was shown that masses in the solar system, including the sun, were all high, but close multiples of 1.23 times the mass of the electron.

2. The relation between mass and frequency

In order to attempt to understand why masses should be quantized I tried to start with the question of what, fundamentally, mass was. Two recent theoretical developments were considered: One was the general solution of the relativistic field equations (Narlikar 1970; Narlikar and Arp 1993) which yields the mass of fundamental particles proportional to time ($m \propto t^2$). The second was the space resonance theory of the electron by Milo Wolff (1993). In both cases the masses depend on exchanging signals within the age horizons of the particles, a necessarily Machian, and time-dependent mass. Considered in this way, the interesting question then becomes: what is the operational definition of time? I would suggest that time depends on the regular repetition of a configuration, like the rotation of the earth or its revolution around the sun. The most fundamental definition of time is then suggested to be the rotation, or spin, of the electron. (For the present purpose it does not seem to matter if the electron is some unspecified distribution of charge spinning about an internal axis or a loop of circulating current, as some have modeled it.)

The problem then suggests itself: can the mass of the electron be expressed in units of time? Formally, this is simply achieved by using the Compton wavelength of the electron l_c in terms of the Planck constant *h* and the velocity of light, *c*.

$$l_c = \frac{h}{m_e c} \tag{1}$$

which gives

$$m_e = \frac{h}{c^2} n_c \tag{2}$$

where the Compton frequency, using the terrestrial value of the Compton wavelength gives

$$n_c = \frac{c}{l_c} = 1.2356 \times 10^{20}\ \ \mathrm{s}^{-1} \tag{3}$$

and finally

$$m_e = \frac{h}{c^2} \times 10^{20} (1.2356) \tag{4}$$

This expresses the mass of the electron in terms of some fundamental constants and its spin frequency—and that spin frequency. It is tempting to relate the 1.2356×10^{20} s^{-1} to the 1.23 ratio of masses found in paper I. The latter quantity, however, is not a ratio and is in arbitrary (*cgs*) units. To clarify this we can write

$$\frac{1.2356 \times 10^{20} - n\Delta}{1.2356 \times 10^{10} - (n+1)\Delta} = 1.23 = \frac{n_n}{n_{n+1}} = \frac{m_n}{m_{n+1}} \tag{4a}$$

if Δ is a small quantum of frequency, and $\Delta \approx 10^{17}\ \mathrm{s}^{-1}$, $n \approx 1000$. Then the addition or subtraction of one quantum will cause a frequency change by a factor of 1.23. This would be fore a limited range in *n*, and what we observe as adjacent states would have to be far from the fundamental frequency. Leaving that investigation for the future, the general point is that what we have called the Compton frequency of the electron, n_C, is simply what other authors have called *w*, the circular frequency in the wave equations of the electron, $\Psi(t) = Ae^{iwt}$. For example, Wolff (1993) calls *w* the mass frequency of the space resonance electron. Marquardt and Galeczki (1995) remark that this is de Broglie's mysterious frequency which, in 1925, he called the "periodic phenomenon" or particle internal frequency. We adopt here the view that elementary particle masses are frequency determined (agreeing with Haisch, Rueda and Puthoff, 1994). In that case the mass ratios are given by n_n / n_{n+1}, and the observations require that frequencies are only permitted in discrete factors of 1.23.

3. The 72 km s^{-1} redshift periodicity for galaxies

We apply this idea now to an astronomical calculation which has heretofore resisted interpretation in terms of quantized electron mass. The quantization is the mysterious 72 km s^{-1} periodicity in galaxy redshifts which was originally found by William Tifft and later confirmed by others (*e.g.*, Arp and Sulentic 1985; Arp 1986). The problem with the 72 km s^{-1} quantization is that it cannot be derived from the regular 1.23 factor of quasar redshift peaks. These peaks, as observed, are:

$$\begin{array}{ll} z_1 = .06 & z_5 = 1.41 \\ z_2 = .30 & z_6 = 1.96 \\ z3 = .60 & z_7 = 2.64 \\ z_4 = .96 & z_8 = (3.47) \end{array} \tag{5}$$

But $(1+z_1)/1.23$ yields a large negative redshift, not 72 km s^{-1} = .00024. Simply out of curiosity I calculated what the power of 1.23 should be in order to give a redshift of 72 km s^{-1}:

$$1 + \frac{72}{c} = 1.00024 = (1.23)^a \tag{6}$$

it turned out that

$$a = .0011592. \tag{7}$$

Because I had been exploring the spin of the electron as a possible basic time unit, I was in a position to notice the extraordinary coincidence of this power, *a*, with the numbers in the value measured for the magnetic moment of the electron (which is ½ the Landé *g* splitting factor):

$$\frac{g}{2} = m_e = 1.00115965 \tag{8}$$

What this amounts to is that

$$\frac{1.23^{m_e}}{1.23} = 1.000240 = 1 + \frac{\mathrm{km\ s^{-1}}}{c} \tag{9}$$

So the spin of the electron seems to have something to do with the mysterious 72 km s^{-1} periodicity found in galaxy spectra. But what?

If we return to equation (4) and designate the electron with its spin in the magnetically split, fine structure energy state as m_e^n, then:

$$\frac{m_e}{m_e^n} = 1.23^{n(m_e - 1)} = \frac{1+z^n}{1+z_o} \to z = 72,\ 144,\ 216,\ 288\ \mathrm{km\ s^{-1}} \ldots \text{as} \quad n = 1, 2, 3, 4 \ldots \tag{10}$$

(note the redshift, 1 + *z* varies inversely with the Rydberg constant which varies directly with m_e)

The three or four first values of *n* give the peaks most strongly observed in differential redshifts within groups of galaxies.

Conceptually, we visualize an electron with its spin interacting with the magnetic field of the nucleus of its atom. Depending on its spin orientation it can assume a series of quantized, fine structure energy levels. At an earlier time, the electron wants to be at a lower mass (because of $m \propto t^2$). But we hypothesize that it can only change by the least permitted quantum step, so that when it does notch downward, it forms an electron which is less massive by $1.23^{.0011596}$ than at our epoch. Then, any atomic transition, emitting or absorbing a line, *H* beta for example, will be redshifted by 72 km s^{-1} relative to our terrestrial standards. The second notch down will give $+144$ km s^{-1}, then $+216$ etc. as observed in the Local Group companion galaxies, which are on the order of 10^7 yr. younger than our parent galaxy, M31 (Arp 1991).

Returning to the physics of the process, an electron spinning freely would be expected to have the Compton frequency given by (4). But in the presence of the magnetic field inside an atom this frequency would be slightly altered. The alteration is equal to the next permitted value of spin, and its mass is therefore quantized by an amount which gives the observed 72 km s^{-1} periodicity in redshifts.

We should also note that with the introduction of quantum electrodynamics, which takes into account the interaction of the elementary particle with the surrounding electromagnetic field, the lowest order radiative correction to the electron *g* factor became $g/2 = 1 + a/2p$ where a is the fine structure constant. Therefore, equation (10) above can also be expressed as:

$$\frac{m_e}{m_e^n} = 1.23^{\frac{na}{2p}} = \frac{1+z^n}{1+z_o} \to \text{yields 72 km s}^{-1} \text{ periodicity.}$$

4. The constancy of the 1.23 factor

The most accurate value for the 72 km s^{-1} galaxy periodicity is quoted by Tifft (1977) from the Coma Cluster as 72.46 km s^{-1}. In a study of Local Group galaxies, Arp (1987) confirmed the value as 72.4 km s^{-1}. We note that in equation 10) we would need a factor of 1.232 to yield a periodicity of 72.5 km s^{-1}. In Paper I, a factor of 1.229 was obtained from quasar redshifts and a factor 1.2282 from planetary and lunar mass ratios. These values are summarized in Table 1.

The numerical agreement between these independent determinations is remarkable. The total *range* between the largest and smallest values is only 3 parts in 1000! Nevertheless, the differences between some of the values appears to be significant in terms of the observational accuracy of the measured quantities. It is therefore interesting to consider possible reasons for small variations in the numerical value of this factor.

The value of 1.232 which gives the 72 $\mathrm{km\,s^{-1}}$ galaxy periodicity pertains to galaxies in the Local Group at ~ 3×10^{6} yr. look back time and about 10^{7} yr. younger age than our parent galaxy, M31 (Arp 1991). It also applies to the Virgo Cluster at a look back time of ~ 5×10^{7} yr. So this value of 1.232 clearly applies to matter formed between 3×10^{6} and 3×10^{7} yr. earlier than our own matter. On the other hand the next smaller factor of 1.229 comes from quasars of the order of $z = 1$ which we see at about 5×10^{9} years younger age than our own galaxy (Arp 1991). This is a very interesting result if we take it to mean that about 5 billion years ago our own galaxy looked like a $z \approx 1$ quasar. Such a quasar is compact, with high internal energy density and it would not be unreasonable to suppose that many nebulae, stars and planets were at this phase forming, or differentiating out of the evolving material in this young galaxy. If this is the era which is characterized by the factor 1.229, it would then fit with the age of our solar system, which is about 5×10^{9} yr. old and exhibits a factor of 1.228. We might speculate that something like different vacuum permittivity at different epochs and/or different locations produced a slightly different spin quantum than in earth laboratories. Regardless of any theories or models, however, it is suggested here that the fundamental properties of mass, redshift and scale are essentially an expression of the repetition frequency of an elementary charged particle, provisionally the electron. Relative clock rates could then reflect the intrinsic physical properties of any aggregate of coeval matter.

As a comment on the planets and sun forming about 5×10^{9} years ago, it should be noted that their constituent elementary particles must have been created considerably earlier. For any quasar/AGN/galaxy of $z \approx 1$, its elementary particles must have appeared from the $m = 0$ state 10–12$\times10^{9}$ years ago (our, t-time, Arp 1991). At the stage we are suggesting that our planets differentiated themselves from the galaxy medium, the electrons and protons were not so much less massive than their present terrestrial values. Therefore, if their masses are fractal about the 1.23 factor, they must have followed one of two scenarios:

1) aggregated in this fractal pattern from a solar nebula (as Tom Phipps states on p. 623 of his book *Heretical Verities* "there is evidence for molecular aggregation in a hierarchy of fractal, self similar scales"). This would utilize essentially the conventional model of planetary formation.
2) Seed planets and stars were formed in the beginning and grew in mass along with the mass of their constituent particles. Perhaps even virtual atoms, or ensembles of virtual atoms emerged from the $m = 0$ era—a sort of macro matter creation, or aggregate of matter passing through a zero mass surface as suggested by Hoyle (1975).

The one model that does not seem probable is the one suggested many times in the past of the sun being like a proton and the planets like electrons circling around it. In the case where electrons evolve into planets there would be no reason to find any low redshift electrons at the present era. The macro structure of a planet would seem to have to evolved either from the gravitational accretion of co-evolving atoms or the expansion of a compact seed which contained the pattern for the developing discrete body which we now observe.

Table 1 - Independent Determinations of the Factor 1.23

Value	Source
1.232	72 $\mathrm{km\,s^{-1}}$ periodicity of galaxies
1.229	quasar redshift periodicity
1.2282	planetary and satellite mass ratios
1.22823	earth/electron mass ratio

As for the similarity of the 1.23 factor with the distribution scale of the galaxies on the sky and planetary orbit sizes, that connection remains a mystery. Since, in all generality, the mass of the electron is a function of both space and time, *i.e.*, $m = m(x, t)$, there may be a 1.23 factor in the spatial dependence similar to the one we have seen in the time dependence. As for the fractal nature, the complex equations which govern complicated patterns like coast lines may not be applicable here. The self similarity of scales in a 1.23 geometric progression may be only a very simple physical form of fractal mathematics.

5. Summary

The measures which define our physical environment are unambiguous. Examples are: masses of elementary particles, planets and a star in our solar system. At greater distances, the frequency behavior of light emitted from galaxies and quasars (redshifts) can be measured accurately. There is no apparent reason these quantities should bear any particular numerical relation to each other. It is undeniable, however, that the masses involved in all these disparate objects are, in observational fact, in a ratio of close to 1.23 to each other. Therefore one must expect some reason why successive masses in the universe, from electrons to galaxies, occur only in this particular ratio.

The line of reasoning suggested here may be entirely wrong, or only partially right. Nevertheless there should be some explanation for the singular numerical coincidences which are so unavoidable in view of the accuracy of the measured data. A glimpse of this clear pattern beckons us to a more profound understanding of the relation of the smallest to the largest and youngest to oldest entities in the universe.

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Halton Arp
Max-Planck-Institut für Astrophysik
85740 Garching, Germany

Book Review: Progress in New Cosmologies

Review of ***Progress in New Cosmologies: Beyond the Big Bang*** *(edited by Halton C. Arp, C. Roy Keys and Konrad Rudnicki; Plenum Press, New York, 1993, 361 pages)*
This volume is available from Dr. W. Tkaczyk, Institute of Physics, University of Lodz, ul. Pomorska 149/153, 90-236 Lodz, Poland. Internet: wtkaczyk@plunlo51.bitnet.

On September 7, 1992 scientists from around the globe convened in Lodz, Poland for six days to present and listen to new ideas at the Thirteenth Cracow Summer School of Cosmology on Progress in New Cosmology, which was held at the University of Lodz. Papers presented at the conference have been collected into this handsomely bound book which also includes a Dedication to Fritz Zwicky by Konrad Rudnicki, a Foreword on hidden hypotheses of the Big Bang paradigm by Jean-Claude Pecker, and a Preface by the book's editors: Halton C. Arp, C. Roy Keys and Konrad Rudnicki.

When thinking about the purchase and study of a collection of works that challenge orthodox physics, one is always concerned that it not be a hobby horse from which a series of iconoclasts proclaim their mutually exclusive "Theories of Everything." Happily, for the most part, that is not the case for this book. The opening *Dedication* sets the tone by emphasizing Zwicky's commitment to *relying on empirical knowledge* and *treating hypotheses as provisional*. Zwicky's prescription for the 1950's, which unfortunately was increasingly ignored by the majority, is more valid than ever today. For example, in a recent *Scientific American* article (Oct 94) P.J.E. Peebles *et al.* review the standard Big Bang paradigm and make two very remarkable statements.

Firstly, they say that "At present, there are no fundamental challenges to the big bang theory...". How can cosmologists say this when they believe that at least 90% of the mass of the universe is in some totally unknown form, and when their Big Bang paradigm has virtually nothing to say about it? That sure sounds like a fundamental challenge to me. Their best guess was that some mythological subatomic particle would come to the rescue of the Big Bang paradigm, but recent microlensing experiments strongly indicate that the galactic dark matter is in the form of compact objects with an average mass of about 0.1 solar masses. Somewhat beyond the subatomic particle mass range!

Secondly they claim that "the predictions of the theory have survived all tests to date." Surely they jest. The just mentioned dark matter problem contradicted original predictions of the Big Bang paradigm and apparently the paradigm cannot even retrodict a plausible solution. The solid evidence for inhomogeneity at scales far beyond that predicted by the Big Bang paradigm is another case in point. Moreover, what about the long-standing enigma of stars and galaxies with ages older than the Big Bang paradigm's prediction for the age of the universe? Nucleosynthesis predictions have repeatedly been contradicted by observations and have required revisions, as have predictions for fluctuations in the microwave background radiation. "No fundamental challenges" and predictions that "have survived all tests to date? Give me a break!

Cosmology is clearly in a state of turmoil as the frayed limits of the Big Bang paradigm appear on many fronts. Yet we cannot confidently construct a more encompassing paradigm until we have a critical mass of empirical information. For example, a denouement on the dark matter problem seems to be a prerequisite for any major progress in cosmology. If we do not know what ≥ 90% of the universe consists of, how can we possibly develop an accurate paradigm for the cosmos?

The authors of the papers reprinted here are serious scholars who are unified in their belief that the Big Bang paradigm needs to be subsumed within a more sophisticated paradigm or discarded altogether. Space does not permit a separate discussion of each paper, but a few papers that particularly impressed me can be highlighted. The book contains two very nice critical reviews of the Big Bang model: Pecker's short *Foreword* and a remarkably thorough and effective attack by Eric Lerner. There are several articles that present provocatively anomalous new observational results. Halton Arp discusses several enigmas involving galactic redshifts, such as a remarkable asymmetry in the distribution of redshifts for companion galaxies, quantization of galactic redshifts and associations between high-z quasars and nearby galaxies. W.M. Napier and B.N.G. Guthrie present convincing evidence for Tifft's original finding that galactic redshifts are quantized. Jack W. Sulentic reports on some surprising properties of compact galaxy groups, including their unexplained stability and unusually large probability for containing a discordant redshift member. A.K.T. Assis presents an interesting discussion of the Steady State paradigm that contains references to pre-Penzias and Wilson predictions of a roughly 3 K temperature for interstellar space by Finlay-Freundlich (1954), Regener (1933) and Eddington (1926); this paper also ends with three clear predictions (something we need more of). The topics covered in the book are very diverse: from comets to gamma-ray bursts to galaxies to universes, and only a few out of 25 discussions are tedious.

The physical quality of the book is good: it is sturdy, has nice cover art and is printed by Plenum Press on good quality paper. The index is rather sparse, with some significant omissions, but that seems endemic to conference reports. I find myself disagreeing with about half of the arguments presented in the book, but that is what an attempt to explore new ideas in cosmology is all about. My main complaint with a couple of authors is that they are just as arrogant and dismissive as their establishment opponents, in whom these same traits are vehemently criticized. Dogmatism, on either side, is not consistent with the open-minded inquiry that Zwicky advocated. In this critical period of transition, cosmologists need to be *sincerely* open to new ideas and willing to drop any assumption or principle that is inconsistent with well-confirmed empirical knowledge.

The bottom line is this: If you like the status quo in cosmology, and think we have a nearly complete understanding of nature, then you need not buy this book. But if you think we still have a lot to learn, then the purchase and study of this book will be a good investment.

Robert L. Oldershaw
Amherst College (Box 2262)
Amherst, MA 01002
USA

The Bookshelf

New Publications on Physics and Astronomy

Fontiers of Fundamental Physics, Proceedings of an international conference on Frontiers of Fundamental Physics, held September 27-30, 1993, in Olympia, Greece (edited by Michele Barone and Franco Selleri; Plenum Press, New York, 1994, 601 pages).

On the Way to the Physics of the XII Century, Philip M. Kanarev (Soviet Kuban Publishers, Krasnodar, 1995, 269 pages). Can be ordered from the author, 11 Pushkin St., Apt. 19, 350063 Krasnodar, Russia, tel./fax: 7(8612)522024, or by E-mail: esin@kccc.kuban.su.