Technical Notes, Questions and Speculations

1. Feb 2012 Resolution of an Apparent Solar System Mass Problem

RESOLUTION OF AN APPARENT SOLAR SYSTEM MASS PROBLEM [Feb 2012]

Introduction

Early in the development of the Self-Similar Cosmological Paradigm (which is referred to as Discrete Scale Relativity when the self-similarity between cosmological Scales is exact) a problematic anomaly was identified in the mass distribution of the Solar System. If the Solar System's planetary system corresponds to the wavefunction of a single electron, as required by the SSCP, then why is the mass of the planetary system roughly 17 times larger than the predicted mass of a Stellar Scale electron?

Here is a brief discussion of the problem reprinted from the "Unresolved Issues" section of "Selected Paper" #2 which was published in 1989.

"4.10. Mass of the Planetary System

One of the most worrisome empirical problems confronting the SSCP is the fact that the estimated mass of the Solar System's planetary system is roughly 2.7×10^{30}g, whereas according to the Solar System/Rydberg atom analogy the observed value should be approximately 7.8×10^{-5} $M_\odot$, or about 1.6×10^{29}g. Because this factor of 17 discrepancy appears in such a straightforward test of the SSCP, it is regarded as a serious challenge to the exact self-similarity version of the SSCP."

I am happy to report that an interesting and reasonably compelling resolution of this troublesome problem has finally been found. Moreover, the implications of the proposed resolution are quite surprising – perhaps even revolutionary.

The Resolution

In studying the masses of stars in binary star systems for evidence of discrete multiples of 0.145 $M_\odot$ as predicted by the SSCP, I noticed a very curious thing. While the masses of the *individual* binary stars deviated slightly from the predicted discrete mass spectrum values, the *combined* masses of the total system (including both stars and any massive planets) were much closer to one of the predicted mass peaks at (n)(0.145 $M_\odot$). This unexpected discovery meant that one of the stars tended to have a mass below a predicted mass peak while the other star's mass was above its predicted mass peak by a comparable amount. When the masses were combined the small deviations cancelled themselves out. In cases where high-mass planets or brown dwarfs were present, it was found that their masses played an important role and could not be omitted in careful evaluations of the (n)(0.145 $M_\odot$) prediction.

During the months of September and October of 2011 I collected examples of newly published high accuracy stellar mass estimates for the total masses of multiple stellar systems and exoplanet systems. I found good/excellent agreement with the (n)(0.145 $M_\odot$) expectation values in 20 cases. Another 4 systems were in the fair/inconclusive category, and the fit was poor for 3 systems. Hopefully in the foreseeable future much larger and unbiased samples of low-mass eclipsing binaries and exoplanet systems with high accuracy mass estimates will provide a more rigorous test of the hypothesis discussed here.

At any rate, I quickly realized that this phenomenon might provide a straightforward physical explanation for the factor of 17 mass anomaly relating to the Solar System's planetary system. In fact the calculations shown below were so successful that the planetary mass enigma appears to have been resolved at last. Moreover, the implied mass redistribution within gravitationally **bound** systems represents a radical new idea that would apply to fundamental systems on all cosmological Scales.

Calculations

Multiplying the mass of a singly ionized lithium ion in its ground state by $\Lambda = 1.70 \times 10^{56}$ in order to scale its mass value up to a Stellar Scale mass gives: 1.99169×10^{33} g.

The mass of the Sun (which is actually the self-similar analogue of the low-n core of a neutral Li atom in a high Rydberg state, but is still a very good approximation to a Stellar Scale Li^+ ion) is: 1.98892×10^{33} g.

We find that $(M_{Li\ ion})(\Lambda) - M_\odot = 2.7675 \times 10^{30}$ g (which is quite close to the mass of the planetary system, 2.6563×10^{30} g).

The above calculation shows that the Sun's mass is slightly below the mass predicted by Discrete Scale Relativity, and this small deficit is roughly equivalent to the factor of 17 excess for the planetary system's mass.

From the foregoing discussion of mass distributions in binary star systems and exoplanet systems, we can confidently state that Discrete Scale Relativity definitively predicts that

$$(M_{Li})(\Lambda) = M_\odot + M_{plan\ sys} .$$

The actual the mass values are: $(M_{Li})(\Lambda) = 1.99184 \times 10^{33}$ g and $(M_\odot + M_{plan\ sys}) = 1.99158 \times 10^{33}$ g. The relative agreement of these two mass values is at the 99.987 % level. .

Therefore the predicted mass for a scaled up Li atom and the observed total mass of the Solar System agree at a very reasonable level. There is no factor of 17 mass anomaly for the total mass of the Solar System.

Implications

It has always been assumed that atomic nuclei and electrons retain their canonical masses (which are measured only in the case of single unbound objects) even when they become bound subcomponents of atoms, and when those bound systems undergo energy-state changes.

Discrete Scale Relativity proposes that this is not the case. Rather, a small and limited amount of mass transfer is predicted to occur between the nuclear and orbital systems during the unbound-to-bound transitions, and during energy-state changes. This radical new mass redistribution hypothesis can and will be rigorously tested in the future via high-accuracy mass data for multiple star systems and exoplanet systems. Previously, stellar mass estimates were too crude and uncertain to adequately test the discrete (n)(0.145 $M_{\odot}$) mass spectrum. During the first decade of the 21st century, however, the accuracy of mass estimates for eclipsing binary systems and exoplanet systems has greatly improved and adequate empirical testing of the prediction of quantized stellar masses should become feasible in the near future.

For single unbound stars **(and dark matter objects), we expect the individual masses to obey the discrete (n)(0.145 $M_{\odot}$) mass spectrum.**

For multiple bound systems**, we expect the total system mass to obey the (n)(0.145 $M_{\odot}$) spectrum, but we expect off-setting deviations ($\leq$ 3% for stars) in the masses of individual subcomponents.**

These same expectations are predicted to apply in the case of the Atomic Scale analogues.

One can reasonably infer that the mass transfers among the subcomponents of an excited atom, or its Stellar Scale analogue, are required for stability and are proportional to the excitation level of the bound system. However, additional high accuracy mass data for Stellar Scale systems will need to be collected and analyzed before the detailed mechanism and rationale for the mass transfer phenomena are fully elucidated.