Predictions of Discrete Scale Relativity

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Abstract: Fourteen definitive predictions of Discrete Scale Relativity are listed and some general comments are included at the end. Four of the predictions have been vindicated or are strongly supported by observational evidence.

1. Discrete Scale Relativity definitively predicts the dark matter mass spectrum: main peaks are at 8 x 10^{-5} $M_\odot$, 0.145 $M_\odot$ and 0.580 $M_\odot$. The objects are ultracompact Kerr-Newman systems (stable solutions of the Einstein-Maxwell equations). The dark matter is definitely not composed of subatomic particles. [arXiv:astro-ph/0002363v1].

2. This new self-similar cosmological paradigm has already successfully predicted [*Astrophysical Journal* **322**, 34-36, 1987] the existence of vast numbers of unbound planetary-mass objects. A new and unexpected population of unbound planetary-mass objects was recently discovered by Sumi *et al* [*Nature*, 19 May 2011].

3. Discrete Scale Relativity predicts an unusually low exoplanet abundance for the lowest mass red dwarfs, i.e., with masses of 0.1 $M_\odot$ to 0.25 $M_\odot$. [arXiv:astro-ph/0102285v3]. This definitive prediction appears to have been verified by Bonfils et al, *Astronomy and Astrophysics*, 2012 [available at http://arxiv.org/abs/1111.5019].

4. Isolated neutron stars in low energy states are predicted to have radii on the order of 0.5 - 5 km, instead of the conventional 10 - 20 km.

5. When we can observe them with adequate resolution, stellar plasma envelopes will strongly resemble atomic wavefunctions, i.e., $|\Psi|^2$ shapes. Planetary nebulae give us a preview of this in their *ejected* envelopes [spherical, toroidal, bipolar, crossed double-"propellers", "butterfly" shapes, symmetric caps, etc.; the same shapes as Schrodinger wavefunctions] .

6. In 1989 the self-similar cosmological paradigm (aka Discrete Scale Relativity in the case of exact cosmological self-similarity) predicted pulsar-planet systems. No other theory made this prediction, and conventional astrophysics is still unable to give a convincing explanation of how these systems form. The first pulsar-planet system was discovered in

1994, and subsequently 3 more have been found. Black hole-planet systems are also predicted by Discrete Scale Relativity.

7. The general properties of the Solar System, which is a discrete self-similar analogue of a highly excited Rydberg atom, will be reproduced to good approximation by the Schrodinger equation solution for a Li atom with $n_1 = 1$, $n_2 = 5$ ($l_2 = 0$) and $n_3 = 168$ ($l_3 = 160$). [See http://www3.amherst.edu/rloldershaw , Selected Papers #1 and #2]

8. The stellar mass spectrum will be found to have *preferred* peaks at multiples of 0.145 $M_\odot$. The discrete mass distributions will be most readily seen in the total system masses for eclipsing binary and multiple star systems having *all* components identified and included in mass determinations that are accurate to +/- 0.02 $M_\odot$. The dark matter mass spectrum will have highly *discrete* peaks at these same multiples of 0.145 $M_\odot$.

9. Every star, planetary nebula and supernova will be found to have a massive ultracompact nucleus, since they are exactly self-similar to atoms in various states of excitation and ionization. The linear log-log ($1/R^2$) relation between the average global magnetic field strengths of Stellar Scale systems possessing global dipole fields and their average radii [e.g., neutron stars, magnetic white dwarfs, red dwarfs, giant stars and supergiant stars] is consistent with very strongly magnetized ultracompact nuclei within magnetic stars.

10. The electron (virtually a horizonless singularity) will eventually be found to have a very low density envelope with a radius of about 4 x 10^{-17} cm, composed of Subquantum Scale systems.

11. Subquantum Scale systems with radii on the order of 10^{-31} cm [individual particles], 10^{-30} cm to 10^{-29} cm [high energy clusters of particles], and 10^{-26} cm [Subquantum Scale atom analogues] should eventually be observed in ultra-fine scale fluctuation experiments. These predicted values are 100 to 10,000,000 times larger than the putative conventional Planck length. Observational hints of such Subquantum Scale gravitational signatures in the 10^{-31} cm to 10^{-26} cm range have been seen in experiments at HERA (2.57 +/- 0.71 x 10^{-26} cm) and at SLC (3.50 +/- 0.04 x 10^{-28} cm), as reported by V. Gharibyan, *Physical Review Lett*., **109**, 141103, 2012. [http://arxiv.org/abs/1207.7297].

12. The observable physical properties of exoplanet systems and highly excited atoms (with states between n = 4 and n = 300, but primarily ranging from about n = 4 to n = 15) are predicted to be indistinguishable except for discrete self-similar scaling of their mass, length and time parameters.

13. Discrete Scale Relativity predicts that the exoplanet mass function will have a primary peak at 8 x 10^{-5} solar masses, or about the mass of Neptune. There are not yet quite enough representative exoplanet mass data to fully test this prediction, but the Kepler mission has found that the thousands of candidate exoplanets it has identified have a radius function that is strongly peaked in the Neptune range. Also, the inferred mass spectrum for exoplanets with periods less than 100 days is strongly peaked at roughly the mass of Neptune [M. Mayor and D. Queloz, *New Astronomy Reviews*, **56**(1), 19-24, 2012; Figure 7].

14. Discrete Scale Relativity has predicted a deep valley in stellar mass distributions at about 0.73 $M_{\odot}$, which corresponds to a deep valley in atomic mass distributions that is due to the instability of atomic nuclei with masses of 5 atomic mass units. Mass distributions for white dwarf stars have provided some tentative support for this prediction. [arXiv:astro-ph/0011480v2]

These are a few of the many definitive predictions made by ***Discrete Scale Relativity*** (which applies in the special case of exact cosmological self-similarity) and the ***Discrete Self-Similar Cosmological Paradigm*** (which applies in the case of strong, but not exact, self-similarity).

Given the definitive scaling equations for mass, length and time, and the fundamental principle of discrete cosmological self-similarity, there are potentially a very large number of definitive predictions generated by this new paradigm. They are only limited by our current observational capacity to test them.

Finally, the self-similar scaling equations of Discrete Scale Relativity have not been modified or "adjusted" in any way since they were first derived in 1985. Over the last 35 years they have successfully retrodicted scores of fundamental properties for particles, atoms, stars and galaxies. [http://www3.amherst.edu/~rloldershaw]

Discrete Scale Relativity and the Self-Similar Cosmological Paradigm are thoroughly discussed at: http://www3.amherst.edu/~rloldershaw , where one can find lists of publications and successful retrodictions/predictions, as well as selected papers, new developments and technical notes.