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Distribution of semi-major axes and eccentricities of exoplanets in scale relativity

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To date, more the 130 candidate planets have been found around stars of the main sequence. The characteristic parameters of these planets (in particular their orbital elements) present a wide variety which could make the comparison between the planetary systems difficult. However, the theory of scale relativity allows one to display the existence of a hierarchical structuring which is common to all planetary systems including our own solar system. In fact in the framework of scale relativity, we describe the motion of bodies in the protoplanetary nebula in terms of a fractal and irreversible process. As a consequence the equation of dynamics can be transformed to take a Schrödinger-like form. Its solutions yield a matter distribution showing peaks of probability for particular values of conservative quantities such as the energy and the Runge-Lenz vector. After accretion, this results in expected probability peaks of the semi-major axis distribution at $a_n = (GM/w^2)n^2$, and of the eccentricity distribution at $e = k/n$, where k and n are integer numbers, M is the star mass and w is a constant having the dimension of a velocity. The current observational data in our solar system and extrasolar planetary systems support these predictions in a statistically significant way: we show that these systems are hierarchically organized in terms of a sequence of constants which are multiples and submultiples of $w = 144.7 \pm 0.5$ km/s.