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A powerful new scenario for forming the Sun's planetary system, with good links to exoplanet findings, arising from new physical insight on the gravitational process

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It was shown by Jeans, and successively endorsed by Lyttleton and Gold [1], that a single contracting solar nebula (SCSN) is dynamically incapable of forming both the Sun and the planets, primarily because of their huge (x 137,000) mean specific angular momentum (a.m.) relative to the Sun's. Yet the SCSN model is still pursued by cosmochemists and astronomers, believing them to have been formed in a single event, from a common body of material, the close match of the solar spectrum to planetary compositions being regarded as definitive. We need a physical scenario which at least can accommodate both.

The author's ongoing work in fundamental physics [2, 3] has been based on two things: (i) an apparently unprecedented physical implementation of the elastic aether specified by Maxwell's equations [4], the existence of which has been ignored for over a century but without which transverse electromagnetic waves cannot exist; (ii) the suggestion of Maxwell [5] and his contemporaries that mass-bearing particles are dynamical constructs of vortical aether motion. We will show briefly that this leads to a fundamental insight on the nature of gravitational interaction, carrying the expectation that a gravitation-related radial electric field (the gravity-electric or G-E Field) exists around gravitationally retained assemblages such as the Sun, and probably drives stellar winds generally, supervening radiation pressure, mass loss rates for high-mass stars being up to 10^{-4} solar mass/yr.

As a test of this result we apply it here to the further development of a **two-stage scenario** for building the solar planetary system [6 - 8]. In this the protoSun is formed as a star (possibly in an SCSN mode) in one nebular dust cloud, subsequently traversing a second, from which the Sun, an unmixed star, acquires a 'coating' of fresh material and establishes a disk in which the planets are formed. In this basic scenario, cloud transit-time replaces canonical nebular collapse time, with receipt of short-life nuclides from a near-by stellar event at any time along the traverse. It also provides for the possible input of the enhanced metallicity [Fe/H] that characterizes both the solar spectrum and those of more than 60% of known exoplanet-harbouring stars.

G-E field action, moderated by dust opacity inhibiting the ionization of the incoming material, is seen to have dominated the acquisition dynamics of this second-cloud material. There resulted an in-near-the-pole(s), out-near-the-equator flow, within which CAIs were formed and then took up to 2 m.y. to spiral outward to the asteroid belt, where chondrules were being formed. The outer part of that flow, shielded by dust from solar radiation, preserved the CI composition. The innermost part of the flow 'contaminated' the supra-tachocline zone of the Sun, so its composition compares well with the planets. Protoplanets were gravitationally nucleated successively close to the Sun, where disk density was high, magnetic coupling provided their systematically prograde spins and dust shielded them from solar radiation. They were then pushed outward by the G-E field in the form of a plasma-driven Protoplanetary Disk Wind (PDW), with smaller material moving past them as feedstock. To preserve their spin directions that feedstock must have been acquired as a balanced population of tidal captures, not by random impact, though the feedstock bodies may have grown in that way.

If 5-fold allowance is made for the magnetic slowing of solar rotation - it's a slow rotator (26d *vs*. 5d or less) - this purely radial force offers a unique (and quantitatively accurate) resolution of the planetary a.m. problem - the a.m. grew as radius from the centre increased, and none of it came from the Sun. To achieve an individual planet's a.m. both the protoplanet and its feedstock must have acquired similar a.m., so planetary growth must be largely completed while the PDW is present. Tidal capture greatly increases the capture cross-section, so would provide this accelerated growth, which would, in turn, help to maintain the necessary high temperature rheology of the central body. The continuity of feedstock provision and outward motion means the protracted 'late giant impact' stage is absent in this scenario, Mercury being the only sufferer in this regard and maybe much later. The lunar event cannot have been a giant impact because the Earth's orbit has retained its prior circularity and conformity, but a suitable alternative is available. The asteroid belt is not a failed planet but, together with most of the Giant Planets' satellites, may show the nature of those feedstock bodies at the moment of nebular departure.

Rapid, nebula-present, formation of iron cores needs to have been by the Ringwood-favoured mechanism (1960-1978), not by iron percolation, which takes too long. This, by nebular reaction with erupted FeO, resolves another extant problem of the system - the provision of its abundant water [7].

Prograde orbits predominate in the satellite populations of the Giant Planets (GPs). This tells us their 8-18M_E silicate 'cores' were completed by tidal capture of the retrograde counterparts [9], and that their massive gas envelopes, plus some of the ices around the satellites, were final acquisitions as the nebula and water were expelled from the inner solar system by the G-E field, accelerating the GP rotations correspondingly. This reduces the former 'building a Jupiter' problem to that of constructing the GP silicate interiors.

Viewed overall, with allowance for the inwards-decreasing growth time provided, the spacing and silicate core masses of the solar planets crudely profile the cloud density during the traverse.

This 2-stage scenario for the solar system bears close comparison with several exoplanet features. Of the 347 discovered (as at mid-May 2009), 99 of them have semi-major axes that lie within 20 solar radii (and most within 10) of their star's centre, far too close to have been there long, and certainly much less than the age of their star. (*cf*. the figure for Mercury's orbit is 83 solar radii.) We must be seeing them soon after leaving their second cloud and now deprived of the shielding by its dust. In that case, with no PDW now to drive them outward, one must infer that they will eventually vanish by evaporation, with G-E field expulsion of the ions, and not join their companions further out. Was that also the fate of any protoplanets interior to Mercury?

Contrasting with the solar system, the exoplanet database (*exoplanet.eu*) shows both that substantial eccentricity is widespread, and that it seems to grow with orbit radius. In our scenario this could arise from an infall column that was far from polar, making the (near-equatorial) PDW much stronger in one direction, which would 'puff' protoplanets additionally as they passed, building up their eccentricity. A further contrast is the super-Jupiter masses of many of these close-in planets, one even attaining 23 Mj. This must confirm that very high mass-input rates from the second cloud do occur; factors here are cloud density, the mass of the star and its velocity through it. Evidently the scenario has potential for building brown dwarfs and perhaps even disparate binaries.

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