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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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## Outline, to guide you around this poster

Two of the most explicit, but hitherto unresolved, problems of the solar planetary system in the context of a single contracting solar nebula (SCSN) have been (a) the huge (x 137,000) mean specific angular momentum (a.m.) of the planet material relative to the Sun's and (b) the origin of its water, not readily provided within the hot SCSN picture. Jeans, successively endorsed by Lyttleton and Gold [1], considered that SCSN is dynamically incapable of forming both the Sun and the planets. Yet the near-parity of the solar spectrum and the planetary compositions has seemed to support SCSN.

It has been suggested [2-6], however, that a 2-stage scenario offers hope of resolving these issues in a well-integrated manner. In this scenario (Panel A) the protoSun is formed as a star in one nebular dust cloud, subsequently (even several 100Ma later) traversing a second, from which it acquires an external addition 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.

In this poster we show that the new scenario not only offers to resolve several other solar system issues but also illuminates several increasingly evident features of the exoplanet scene.

Our new scenario derives from the author's ongoing work in fundamental physics [6, 7] but begun in 1959. This has been based on two things: (i) an apparently unprecedented physical implementation of the elastic aether specified by Maxwell's equations [8], the existence of which has been ignored for over a century but without which transverse electromagnetic waves cannot exist; (ii) the suggestion of Maxwell [9] and his contemporaries that mass-bearing particles are dynamical constructs of vortical aether motion.

We show briefly <u>(Panel 1)</u> that the resulting Continuum Theory (CT) leads to a fundamental insight on the <u>nature of mass and the mechanism of gravitational interaction</u> - not previously understood. This yields the expectation that a <u>gravitation-related radial electric field (the gravity-electric or G-E Field</u>) exists around all gravitationally retained assemblages such as the Sun (and, of course, the Earth) and probably drives stellar winds generally, supervening radiation pressure, mass loss rates for high-mass stars being up to $10^{-4} M_{Sun}$/yr. In the solar environment many phenomena appear qualitatively consistent with the presence of the G-E field (Panel 3).

Surprisingly, CT also offers understanding of phenomena hitherto seen as the exclusive domain of Relativity. Panel 2 samples three of these.

Presence of the G-E field means that the second-cloud material will converge towards the solar poles (Panel A), passing to low latitude where it will form a dense and powerful outward-propelled Protoplanetary Disk Wind (PDW), aerodynamically laden with solids. Crucial properties of this material would have been (i) its high dust-opacity, and (ii) its low temperature, the source cloud being typically at 10K or even lower.

Consequently only that part of the flow very close to the solar surface would get heated enough to generate CAIs, the outer part staying cool enough to preserve CI composition. Planets would nucleate, successively, in the root of the disk, very close to the Sun (where opacity shielded them from the Sun) and be pushed outward aerodynamically in the PDW, fed by capturing smaller material passing them. The asteroids, together with the 63 prograde inner satellites of the Giant Planets, are likely representative of that smaller material, so the asteroids were not a 'failed planet'.

The radial displacements due to PDW action offer the growth of a.m. that we seek (Panel 4). <u>So the high a.m. requirement of individual planets (Panel 5) can only be met if both protoplanet and its feedstock had reached that radial position by PDW action, so post-nebula accretion is largely ruled out.</u> Moreover the low mean temperature of the disk would, if <600K, have meant that construction was mainly of oxidized, not reduced, materials.

This reinstates the rapid core-formation process (Panel 6) long favoured (1960-1978) by A.E. Ringwood. FeO erupted by the growing protoplanet would get reduced to Fe by its H-rich nebular atmosphere, and then 'subducted', thus also generating the solar system water (totalling about 1000 Earth-ocean volumes for the four terrestrial planets). The process would cease at the moment of nebular departure. Disk opacity rendered solar distance unimportant, each body needing to raise its own temperature (accretion, gravitation, radiogenic heat) for convective overturn to begin. But the size of Europa (with a core) may be near the lower limit for overturn, implying that meteoritic irons, reduced as in the Ringwood model, come from 'unsubducted' positions on asteroids, not from cores. The >60 Fe-Ni compositions of meteoritic irons would imply too many separate cores [10], but volcanism during nebular presence is still required.

The systematically prograde spins of the planets support that they were gravitationally nucleated in close-in positions, the only place where prograde vorticity would have been present, and grew by tidal capture, thus preserving their spin directions (Panel 7). The retained circularity of their orbits (bar Mercury) confirms they grew in the presence of nebular gas-drag and were not the victims of late giant impacts (such as that hypothesized as the origin of the Moon (Panel 8). But Mercury certainly was and provided a source for the lunar material (Panel 8).

That tidal capture was the dominant mode of protoplanetary growth is supported by the predominance of prograde orbits among the satellite populations of the Giant Planets (GPs) which tells us their 8-18$M_E$ silicate 'cores' were completed by tidal capture of the retrograde counterparts [11].

So their massive gas envelopes were final acquisitions as the nebula and water were progressively expelled from the inner solar system by the G-E field, accelerating the GP spins proportionately. The resulting interior melting removed the viscosity upon which tidal action had depended and halted the inward progress of retrograde Triton.

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.

Exoplanets. 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 (Panel 9), 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 (Panel 9) both that substantial eccentricity is widespread, and 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 22 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.

The scenario presented here would have been impossible to envisage were it not for the author's recognition of two primary Relativistic fallacies (Panel 10), combined with the CERN demonstration that fundamental particles do have finite size (Panel 1). This has made it legitimate to consider such a particle as a stable entity, independent of velocity, and hence to enquire into its internal nature, responsible for its external properties and behaviour (e.g. charge, mass and gravitation), hitherto a taboo topic.

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**Note**: Refs [6] and [7] can be accessed within the PIRT IX and PIRT X proceedings volumes at the following website:-
http://www.physicsfoundations.org/