

## **The Corona Effect**

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### **Abstract:**

It can be shown that the extreme temperatures in the corona could be due to the genesis of nucleons within the corona and that all heavier elements present in the planetary system could be indigenous to our system and could have been produced in the corona by nucleosynthesis.

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### **1- Summary description of the corona**

The most remarkable feature of the corona is its extreme temperature which far exceeds that of the Solar surface (the photosphere) and its atmosphere (the chromosphere) located just below it.

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While the temperatures of both photosphere and chromosphere remain fairly constant at ~5800 Kelvin up to an altitude of ~2400 km, it then starts steeply climbing towards the 11000 K mark<sup>1</sup> in a rather narrow transition region, to abruptly jump over the 1 million K mark at an altitude of ~2500 km, which marks the lower edge of the corona.

From this point outwards, temperatures of 2 to 3 million K are often observed with frequent way higher peaks. On average, the temperature in the corona is about 200 times that of the solar surface and chromosphere. This quite abrupt increase in temperature at the chromosphere-corona boundary is accompanied by an equally abrupt density decrease by many orders of magnitude.

On an 11 years cycle, the shape of the corona oscillates from a wide crown about the Sun's equator to a completely closed envelope surrounding the Sun.

It is assumed quite logically that the only possible cause for this million+ K heat has to be some process involving the Sun itself. But since none of the satisfactorily demonstrated heating models in the score that are currently being examined ([1], p. 360, Table 9.2) can account for more than about 10% of the observed coronal heat, the whole issue remains essentially unresolved.

The reason is that it is impossible in view of the 2<sup>nd</sup> principle of thermodynamics that the 5800 K heat coming from the photosphere and chromosphere could explain the sudden 200 fold raise in temperature observed at the chromosphere-corona boundary. This would be like expecting water to start boiling by laying a pot full on dry ice at sea level.

Quoting Markus Aschwanden in his excellent textbook **Physics of the Solar Corona**: "*The physical understanding of this high temperature in the solar corona is still a fundamental problem in astrophysics, because it seems to violate the second thermodynamics law, given the much cooler photospheric boundary, which has an average temperature of  $T = 5785 K$ " ([1], p.26).*

In relation with these extreme temperatures, all atoms present in the corona are ionized, contrary to the chromosphere, which means that all hydrogen atoms are fully ionized in the corona considering that each of them has only one electron to be shed. The energy of the free moving electrons in the corona is so great that permanent capture by positive ions becomes practically impossible.

The corona is a highly fluctuating and inhomogeneous medium, constantly being stirred up by important upflow and downflow exchanges with the chromosphere, intense closed magnetic fluxes originating mainly from the equatorial belt of the sun that constantly reconfigure it and open magnetic fluxes from the poles, cause of the solar winds, constantly expelling hundreds of millions of tons of ionized material from its outer edges away to migrate into the whole solar system.

### 2- Overabundance of elements in the corona

The variety of elements that can be found in atomic state in the corona is largely similar to that of the photosphere and general cosmic distribution as confirmed by meteorite analysis.

One fact of particular interest to us here is that most detected metals, particularly sodium, magnesium, aluminum, iron and nickel, seem to be about **3 times more abundant in the corona and solar winds** than in the photosphere ([1], p. 31, Table 1.2)! Current instrument sensitivity

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<sup>1</sup> 11000 K is the temperature of total ionization of hydrogen.

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prevents being as affirmative for elements more massive than nickel, so we do not really know the abundance status of those others with respect to the photosphere.

Elements with atomic number 31 and more cannot currently be detected in the corona with current instruments. But there is no doubt that all elements of the periodic table can be found in the corona since they all are detected up to and including uranium in the photosphere with which it has constant exchanges.

### 3- Coronas about other stars

Elsewhere in the Universe it was also found that all stars that have been examined with x-ray telescopes also have a corona, some belonging to young stars being much more active than Sun's. So corona activity seems to be a universal process accompanying each star.

Now that we have put in perspective the main unexplained features of the corona, that is its extreme temperature and confirmed overabundance of practically half the elements that can be detected in it (we are missing sufficient data about the other elements), let us explore how these issues can integrate in the context of the present model.

### 4- Possible source of heat within the corona

No current theory hints at the possibility that the unaccounted for excess heat of the corona could be generated within the corona itself, so this avenue has of course never been explored.

The reason is an axiomatic strict adherence to the *Principle of conservation of energy*. Any matter present in the corona is thus deemed as having been ejected from the only conceivable source from this perspective, which is the Sun, just like its extreme heat. So all currently theories being examined are attempts to explain the corona characteristics only from this perspective.

It is a well established fact that the **Principle of conservation of energy** definitely applies to any transformation involving both energy and matter. But it is also a well established fact that natural electrostatic acceleration at the level of elementary particles does create energy, and that although the **Principle of conservation of energy** definitely applies to any transformation involving both energy and matter, it seems that when natural acceleration is involved, new energy really is created.

But before we can put in perspective how acceleration induced energy can be related to the extreme heat observed in the corona we must first establish or refresh memories on how exactly acceleration can really create energy at the fundamental particles level.

### 5- Defining acceleration

In other words, let's mathematically describe energy induction as elementary particles accelerate in free fall.

What better way to clarify such an issue but to give a practical example, which also applies to all possible cases of freefall acceleration, electrostatic attraction between elementary particles being known to induce this type of acceleration.

Let's consider a free moving electron being captured by a proton to eventually form a hydrogen atom. It is well documented that a photon of energy 13.6 eV is emitted as the electron settles to the ground state (let's consider the Bohr atom for practical reasons), a mean orbit whose average radius corresponds besides, to a constantly induced energy of 27.2 eV, which is twice the energy of the escaping photon.

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$$E = \frac{1}{4\pi\epsilon_0} \frac{e^2}{a_0} = 4.359743805 \text{ E} - 18 \text{ J} \quad (1)$$

which is the well known energy in Joules corresponding to the Bohr ground state or rest orbital of Quantum Mechanics in a hydrogen atom. Dividing this value by conversion factor  $1.602176462\text{E}-19$  will of course give us this value in electron-Volts, that is  $27.21138344 \text{ eV}$

Note that this amount of  $13.6 \text{ eV}$  is the energy liberated as a photon when a “free” electron has presumably accelerated from an infinite distance to stop at a distance  $a_0 = 5.291772083 \text{ E}-11 \text{ m}$  from a proton. This energy can thus be calculated by integrating all of the kinetic energy that accumulates as the electron closes in towards the proton as it accelerates when driven by the electrostatic force. The general formula for this relation is, in agreement with Leibnitz:

$$\int_{r)0}^{\infty} F \cdot dr, \quad \text{the Coulomb force equation being} \quad F = k \frac{e^2}{r^2} \quad (2)$$

Let us apply this general equation to the Coulomb equation for electrostatic force and calculate the quantity of energy that the electron accumulates before finally arriving at the Bohr orbit.

$$E = \int_{a_0}^{\infty} \frac{1}{4\pi\epsilon_0} \frac{e^2}{r^2} \cdot dr = 0 - \frac{1}{4\pi\epsilon_0} \frac{e^2}{a_0} = -4.359743805 \text{ E} - 18 \text{ J} \quad (3)$$

We note here that  $4.359743805 \text{ E}-18 \text{ Joules}$  corresponds to  $27.2 \text{ eV}$ , and not to  $13.6 \text{ eV}$ , that is, double the energy that is freed as a bremsstrahlung photon escaping in physical reality as the electron stabilizes on its mean rest orbital about the proton. Why? Why is there this difference?

It is well established that half the energy that a massive particle accumulates in excess of the energy of its rest mass systematically converts to additional relativistic mass, an additional electromagnetic mass that depends entirely on the total additional amount of energy that the particles momentarily has and that in turn depends uniquely on the instantaneous local electromagnetic equilibrium.

It is also well established that whatever the distance between 2 charged particles, the electrostatic force induces, in other words « adds » by a mechanism not yet understood, an amount of directed kinetic energy specific to this distance between the particles, which depends on the total electromagnetic mass of the particle at this distance, that is, its rest mass plus its added instantaneous relativistic mass, and this, independently of the amount of directed kinetic energy already accumulated, as was conclusively demonstrated when attempts made to accelerate electrons to relativistic velocities in the first cyclotrons failed, since cyclotrons require that the mass of the moving particles remain stable at all velocities for proper operation. This is why cyclotrons can be useful only when velocities clearly below the relativistic range are required.

So let's see what amount of energy will have to be induced when the electron finally reaches the Bohr orbit. Given that the amount of kinetic energy required by the force for the electron to remain at this distance of the proton is determined by the total electromagnetic mass that the electron will have at this distance, and that this total electromagnetic mass was, at an infinitesimal distance before arriving at this orbit:

$$m = m_0 + \frac{E_{(a_0-dr)}}{2c^2} \quad (4)$$

it will be at distance  $a_0$  :

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$$m = m_0 + \frac{E_{(a_0 - dr)}}{2c^2} + \frac{E_{(dr)}}{2c^2} \quad (5)$$

the total electromagnetic mass of the electron will thus increase by induction by the infinitesimal quantity

$$\frac{E_{(dr)}}{2c^2} \quad (6)$$

which will render  $E/2$  (that is, the total amount of induced energy that will have converted to relativistic mass since the beginning of the acceleration) exactly equal to 13.6 eV, which means that the amount of directed kinetic energy (not converted to relativistic mass) that will have been accumulated by acceleration at the moment of arrival at the Bohr orbit will of course be:

$$K = \frac{1}{4\pi\epsilon_0} \frac{e^2}{2a_0} = 2.179871903 \text{ E-18 J} \quad (7)$$

which corresponds very precisely to 13.6 eV of directed kinetic energy added by acceleration.

It can easily be verified that the mass calculated with equation (5) is exactly equal to the relativistic mass of an electron moving at relativistic velocity 2187647.561 m/s which is the classical relativistic velocity associated with the moving electron in the hydrogen ground state.

So let's summarize. Equation (5) reveals that half the energy of 27.2 eV calculated with equation (3), that integrates all of the energy induced from an infinite distance down to the Bohr orbit, is in reality converted to added relativistic mass, which is why only half of this energy accumulated by acceleration remains in the form of directed kinetic energy sustaining the motion of the associated mass.

So, at the precise moment of arrival of the electron at the Bohr ground orbit, we now have a total of 13.6 eV converted into relativistic mass, plus 27.2 eV of added directed kinetic energy, the latter quantity being made up of the remaining 13.6 eV not converted to mass coming from the acceleration down to the Bohr orbit and an additional 13.6 eV directly induced at the moment of arrival at the Bohr orbit to complement the 13.6 eV already converted to relativistic mass.

Given that the energy allowed by the electrostatic force at the Bohr orbit can under no circumstance exceed 27.2 eV if the electron is to remain at this distance (13.6 eV as added relativistic mass and 13.6 eV as directed kinetic energy), we now obviously have an excess of directed kinetic energy of 13.6 eV that must separate from the electron when it reaches the Bohr orbit, or else the electron would remain way too excited and would have no choice but to rebound to escape from the proton. This is the reason why a bremsstrahlung photon of 13.6 eV has to escape when a free electron is captured by a proton, which involves an abrupt slowing down to stabilize at a mean distance  $a_0$  from the hydrogen nucleus.

Now before we can relate acceleration to the extreme temperatures observed in the corona, we need to put one more item into clear perspective. It is the fact that the only known existing elementary stable massive charged and verifiably scatterable particles that can move freely in the universe can easily be manufactured, so to speak, from pure energy.

## 6- Converting energy to mass

Numerous experimentalists, among whom Blackett and Occhiolini, Anderson, Irène Curie, Joliot, Chadwick, etc, have experimentally confirmed that a photon possessing an energy of 1.022 MeV or higher can convert into a pair of electron and positron if it passes close to an atom's nucleus ([8], p.17), a process that was named materialization.

It was also exhaustively demonstrated that positrons and electrons are totally identical, except for the sign of their charge, both particles having the exact same invariant rest mass of  $9.10938188E-31$  kg, or  $0.511$  MeV/c<sup>2</sup>, which is exactly half the energy of the lowest energy photon that can convert to a pair of these particles.

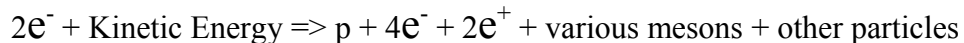
It is well established that if a photon being converted possesses more the 1.022 MeV, the energy in excess directly determines the relative velocities in opposite directions of both particles in normal space after materialization ([2], p. 174).

It was also experimentally confirmed in 1997 by a team led by Kirk McDonald, at the Stanford Linear Accelerator (SLAC) that it is possible to produce electron/positron pairs by simply converging sufficiently concentrated beams of sufficiently energetic photons towards a single point in space, which means that photons can succeed in mutually destabilizing each other under the right conditions, when they are forced close enough to each other, just like they destabilize by passing close to a heavy nucleus.

## 7- Hypothesis of nucleon genesis from accelerating triplets of electrons and positrons

M. Haïssinsky, then Director of Research at the C.N.R.S. in Paris, reveals in his book «**La chimie nucléaire et ses applications**», that it had been theoretically demonstrated that combinations of 2 positrons + 1 electron, or alternately 2 electrons + 1 positron show some stability, but that it is much less than that of positronium, and that no experimental verification had been carried out at the date of publication (1957) ([8] , p. 33).

It is well established experimentally that mesons (made up of quarks up and down) can routinely be created from head on collisions of electron beams ([10]), but it was also mentioned by physicists on **sci.physics** that a similar phenomenon also involving the creation of protons was being observed in accelerators (for which I could not locate a formal paper however) when beams of electrons are collided head-on with sufficient energy. A variety of particles materialize as a function of the quantity of energy liberated during such scattering events, but with the following set being mentioned as apparently more specifically observed:



We will discuss later experimental observations.

Considering the presence of 2 electrons plus 1 positron thermal enough and close enough together to metastabilize into a closed system before inevitably decaying, we observe that we are dealing with two electrons that repel each other while both are simultaneously being attracted to the same single positron.

For such metastable triplets to form, the particles have to be in very low thermal state, implying that they would not have enough energy to escape from each other after initial mutual metastable capture, a metastable system that is deemed to decay even faster than positronium.

But we are faced with a very special problem when 2 thermal electrons and 1 thermal positron are captured in such a common system. We are dealing here with 3 particles instead of 2 Dirac-complementary particles, none of which can be split or be forced to convert to energy at such a

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low energy level.

Of course, as decay proceeds and the particles accelerate as they start translating about their common center of mass, the two electrons will obviously repel each other more and more strongly as they get closer to each other while simultaneously being more and more strongly attracted by the positron.

The actual mechanics of the theoretical complete process of metastable triplets acceleration exceeds the scope of the present paper but is exposed in a separate text ([3]), but summarily put, it is demonstrated that the three particles must end up translating about two axes normal to each other, one named the co-planar axis, which is parallel to the plane determined by the three accelerating particles and the other simply named the normal axis.

As a final step of this acceleration process, a final stable state is reached, at which the three particles display slightly increased mass and diminished charges (we will address this issue a little further on) and where it becomes impossible for the particles (2 electrons « now quarks down » and 1 positron « now quark up ») to approach any closer due to the magnetic repulsion between the various components in motion ending up exactly counterbalancing the electrostatic attraction. This equilibrium state is described in a separate paper ([4], starting at Section II).

The model shows that as the three particles stabilize at a translation radius of the order of  $1.2E-15$  m, an energy of about 310 MeV is continuously being induced for each of the quarks of the triad. This means that when that final state of the shrinking triad formation is reached, three extremely energetic bremsstrahlung photons of about 155 MeV each will have to be emitted to evacuate the excess energy induced during the acceleration process, leaving behind only the maintenance energy perpetually induced at this distance.

It is shown that the rest mass of protons and neutrons is mostly relativistic with the actual masses of quarks up and down being only marginally higher than that of the electron (see below), being made up mostly of the kinetic energy induced at the minute translation radii that determine the actual volumes of protons and neutrons and that cause the quarks to circle at near light speed.

### 8- The issue of fractional charges

Of course, this logic implies that up and down quarks would simply be hyper-accelerated positrons and electrons. So, how could this be reconciled with the fact that up quarks have a charge of only  $2/3$  that of a positron, and down quarks have a charge of only  $1/3$  that of an electron ?

It must be said here that the charge of particles is probably the deepest mystery of fundamental physics. Despite a century of experimentation and reflection, we are still down to the level of pure speculation as to its nature.

What is known with certainty is that the only possible charge for a charged particle moving freely is that of the electron, or of its converse, that of the positron. As to fractional charges, they cannot be dissociated from quarks and can be observed only within the confines of complex particles made up of quarks since all attempts made to scatter them out of nucleons have seemingly failed.

Or have they? If quarks up fundamentally were just hyper-accelerated positrons, and quarks down hyper-accelerated electrons, as we hypothesize here, maybe they very simply re-manifest the unitary charge of the electron or positron at the very moment of their liberation from the confines of nucleons.

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There is an apparently unrelated fact, well understood in high energy accelerator circles that may really apply here. It is the fact that to force a charged particle to move on a closed orbit, which really is the case for quarks up and down within nucleons, it is mandatory that a local magnetic field be established that will be more energetic than the related electric field ([5]). It is entirely conceivable that when charged particles are forced by natural forces to move on closed orbits that their local magnetic field will have to become more energetic than their electric field, some energy from their electric field migrating to reinforce the local magnetic field thus weakening the electric field.

So it is entirely possible that the fractional charges of quarks could be caused by some stress that the particles' energy fields would impose on each other due to the high intensity force imposed on them as the triplet closes in until it stabilizes into its final geometry. The presence of this local stress could cleanly explain why fractional charge elementary partons have never been detected in high energy nucleon destructive scattering experiments since as a quark is scattered off, the stress imposed by the structure would then of course instantaneously disappear and normal unit charge just as instantaneously resumes for that "parton".

So a "stress factor" may need to be introduced in any dynamic field equation meant to describe either quark up or quark down that would account for the observed decrease of the electric field energy of these particles, a decrease that must be coupled with a reciprocal increase of their magnetic field energy if the equation is to remain coherent.

The manner in which this electromagnetic equilibrium principle applies to localized particles moving in straight line is described in a separate paper ([6]) and the manner in which it applies to particles moving on closed orbits is described in a different paper ([7]).

The best estimate of effective masses currently associated to up quarks lies with relative certainty between 1 and 5 MeV/c<sup>2</sup>, while the best estimate of effective mass currently associated with down quarks in the Standard Model lies with relative certainty between 3 and 9 MeV/c<sup>2</sup> ([9],p.382).

Here are some values that the model provides:

	<b>Up Quark</b>	<b>Down Quark</b>
<b>Quarks rest energy</b>	<b>1.149747531 MeV</b>	<b>4.598990173 MeV</b>
<b>Quarks mass in kg m=E•1.6E-19 /c<sup>2</sup></b>	<b>2.049610923E-30 kg</b>	<b>8.198443779E-30 kg</b>

For complete analysis of the space geometry required and description of the mechanics of nucleon genesis, the interested reader is referred to the complete text ([3]).

### 9- Applying nucleon genesis bremsstrahlung emission to the corona

We analyzed in section **Defining Acceleration** how natural electrostatic acceleration at the fundamental particles level can literally create energy and we just described how three extremely energetic bremsstrahlung gamma photons of approximately 155 MeV each have to be emitted as each triplet stabilizes at the translation radius corresponding to the volume occupied by either proton or neutron. This makes for a total of a 155 x 3 = 465 MeV free energy released for each



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nucleon being formed.

As already analyzed, each initial thermal electrons and positrons threesome that will end up associating to accelerate into stabilizing as each of these nucleons, either 2 electrons + 1 positron, or 2 positrons + 1 electron, themselves coming from two 1.022 MeV photons splitting into two pairs of electron-positron as they graze massive particles. This makes for a total of  $1.022 \times 2 = 2.044$  MeV initial energy.

So overall, on top of ending up with either one proton plus one free electron or one neutron plus one free positron, each nucleon creation event from the initial two 1.022 MeV photons **causes an increase in ambient energy of  $465 \div 2.044 = 227.5$  times** the energy that was present as the process initiated, which falls exactly into the energy increase range observed in the corona!

It goes without saying that each 155 MeV photons generated is more than likely to easily convert to pions, which we know to quickly decay into a final state which always turns out to be more gamma photons and electron-positron pairs, creating in the process **a number of high velocity electron-positron pairs**, and numerous high energy gamma photons, most of which will exceed the 1.022 MeV threshold!

It is not impossible however that some of these extremely energetic gamma photons escape conversion and reach us to be detected, which would conclusively confirm the creation of protons and neutrons in the corona. This remains to be verified.

### 10- Abundance of Triggering 1.022 MeV photons

Clearly understanding that for any threesome of electrons-positrons to mutually capture as a metastable system before accelerating to form a nucleon, they need to be thermal to start with or else they would simply scatter off each other or recombine if one electron links up with a positron to simply reconvert to a few photons (well known positronium decay). So what is required for very low relative energy thermal electrons and positrons to come about is a process that would cause these high velocity electrons and positrons to slow down sufficiently, or that photons of energy 1.022 MeV or slightly above be available in ample supply.

We know from observation that intense slowing down of electrons is quite frequent in the corona. In fact the low energy photons detected due to free-free emission<sup>2</sup> is an important observation tool in the study of the corona ([1], p. 42). So this is an interesting possible source of thermal electrons.

The best candidates however would be actual photons of energy 1.022 MeV or slightly higher since their decoupling would leave no excess energy for the created pair to move away from each other. The pair would then appear at a practical dead stop with respect to each other. If perchance either a thermal electron or positron happens to come near enough at this precise moment, a metastable threesome could immediately stabilize and the inward acceleration process would be triggered.

Now have 1.022+ MeV photons been observed in the corona? The answer is YES. Every time a large flare occurs from the Sun, large amounts of photons in the 10 keV to 10 MeV photons are emitted by the chromosphere as particles that are accelerated to sufficient energy to interact with atomic nuclei are accelerated back into the denser chromosphere by the Sun's magnetic field

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<sup>2</sup> Free-free emission is the process by which an electron loses energy as a bremsstrahlung photon as it is deflected by a proton with too much velocity to be captured, which is the usual type of encounters in the corona, given that all atoms presents are highly ionized.

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where a number of collisions produce gamma photons in the proper range, amounting to a continuous emission by a number of processes: electron bremsstrahlung, nuclear de-excitation, neutron capture, positron annihilation or pion decay radiation ([1], p. 42).

Since starting from the 1.022 MeV energy level threshold, photons are very sensitive to decouple into electron-positron pairs, there is no doubt that large numbers of them end up grazing high ionized atomic nuclei in the corona and actually decouple into a thermal state ready for combination with a relatively thermal electron or positron that would happen to be in the immediate vicinity.

So this model does reveal a process that guarantees an increase in ambient energy level more than 200 fold just as is observed and systematic production of ultra high velocity electrons and positrons just as is observed in the corona.

The question now is, once initiated by the first large flare after each star ignites, could such a process be self-maintaining? Some sort of low level non-explosive chain reaction? From observation of the continuous existence of coronas about the Sun and other stars, it would seem so, if such nucleon genesis really was the explanation of the high temperature of coronas, the actual mechanics of self-maintenance remaining to be clarified, no doubt involving the numerous second generation high energy gamma photons emitted by pion decay, from the numerous pions that would no doubt be created from the three 155 MeV bremsstrahlung photons emitted with each nucleon creation.

### 11- Nucleosynthesis in the corona

We could certainly speak of nucleosynthesis already with the creation of protons from accelerating threesomes of thermal electrons and positrons since protons are in fact hydrogen nuclei. But what about more massive nuclei in the periodic table?

Let us note here that statistically speaking the chances for a neutron to be created by an initial threesome acceleration process are exactly equal to those for a proton, which means that statistically equal numbers of neutrons and protons are likely to be produced if the process is repeated. What is more, all of them will be thermal by definition, practically appearing at a dead relative stop at the location of creation since the three particles that accelerate transversally to make them up have to be thermal to start with.

Since crowds of thermal protons and neutrons are likely to rather often come close together in the coronal plasma, nucleosynthesis of lighter complex atoms such as helium, lithium and other lighter elements would not really be surprising given the presence of so many of the required free thermal neutrons. These lighter nuclei being totally if not completely ionized definitely stand a chance of converting to higher number nuclei again due to the presence of so many free moving neutrons, protons and other light ionized nuclei being available in the coronal plasma.

Could such nucleosynthesis be the cause for the 3 fold overabundance noted in the corona and solar wind with respect to the photosphere? The probability is of course very high, a process that must have been going on ever since the Sun ignited since we can assume that the corona has existed from that moment on and must have produced countless billions of tons of new atoms covering the complete spectrum of the periodic table of elements!

### 12- The birth of planetary systems

We mentioned earlier that solar winds are constantly expelling hundreds of millions of tons of ionized material from the outer edges of the corona away to migrate into the whole solar system. The material thus expelled can be sent even way beyond Pluto, as far as the heliopause, at about 100 times the distance from the Earth to the Sun, which is the distance at which the pressure of the solar winds falls into equilibrium with the pressure of particles coming from interstellar space. So let's now clarify the nature of these "solar winds".

Solar winds are still being analyzed as their mechanics is not yet fully understood, but they are known to be driven by the magnetic field of the Sun. The stronger component (the fast wind) is driven by the open magnetic fluxes originating from both poles of the Sun while a weaker component (the slow wind) operates mainly from the equatorial region where magnetic fluxes are observed to be mostly closed.

The fluxes issuing from the poles are termed "open" because they are not observed to be folding back towards the Sun as any magnetic flux must do. It seems obvious however that the magnetic "lines" issuing from the north pole of the Sun have to eventually loop back to re-enter the Sun's south pole, otherwise there would be contradiction with Maxwell's equations. They most certainly loop back possibly as far as the heliopause without us being able to directly verify for the moment on account of the distances involved.

It has been calculated that solar winds expel a steady flow in all directions from the outskirts of the corona 6.7 billion tons of material per hour ([1], p. 703) at typical initial velocities varying from 1.44 to 2.88 million kilometers per hour ([1], p. 167) which means that it takes about 150 million years for the equivalent the total mass of the Earth to be expelled!

Textbooks and other references lead to think that it is not yet clearly understood why ionized particles being carried outward by the solar winds acquire such high ejection velocities as they reach a distance of about 5 solar radiuses from the photosphere.

But since all particles in the masses of material being carried away in the Sun's strong magnetic field are ionized, thus charged, and moving in the same direction in a practical straight line away from the Sun, the Lorentz law

$$F = q(E + v \times B)$$

mandates that a macroscopic electric field obeying the relation  $v=E/B$  comes into being to account for all these particles moving in a general straight line away from the Sun. There simply exists no way that charged particles could move in a straight line at any velocity whatsoever if this  $E/B$  equilibrium is not locally established.

What probably happens is that once some massive amount of ionized (thus charged) particles are forced by whatever circumstance to start moving in the same direction in a strong directed magnetic field, their individual electric charges can only add up to constitute some local macroscopic electric field at the same scale as the ambient magnetic field.

That is an electric field that would obviously be normal to that magnetic field and also to the direction of motion of the mass of particles, since from Maxwell and Lorentz, any charged particle moving in a straight line can do so only perpendicularly to a plane defined by a magnetic field itself perpendicular to an electric field, both of these fields, whose intensity determine the velocity of the particle, being themselves perpendicular to the direction of motion of this particle. There simply exists no other possibility.

The velocity of the massive amount of particles involved will have no choice but to adjust to

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the intensity of the macroscopic E/B equilibrium being established to sustain their general straight line motion outwards.

Besides this steady outflow due to solar winds, cataclysmic events named coronal mass ejections (CME) that typically occur a few times each day send out from 100 billion to 10 trillion tons of material each time at velocities ranging from 360 thousand km/h to 7.2 million km/h ([1], p. 703). This means that on average, CMEs expel **each day** from 2 to 120 times more material than the steady solar wind outflow of material!

If we set for CMEs a conservative average of 30 times more material ejected than the steady solar wind outflow, this means that combining both ejection processes, only 5 million years is required for the equivalent of the total mass of the Earth to be expelled outwards from the corona to spread out into the solar system! And this has presumably been going on ever since the Sun apparently ignited an estimated 4.5 billion years!

Considering that the combined mass of the planetary system of the Sun amounts to about 455 Earth masses, it would have taken only 2,275 billion years for an equivalent amount of mass to have been ejected from the corona into the heliosphere!

The coronas about younger stars have been observed to be much more energetic than ours, so it seems probable that this might also have been the case for our own corona. So the time for that amount of mass to have been ejected from the corona when the Sun was still young may have been far shorter. These ballpark figures are of course approximate, but most probably of the right order of magnitude.

Now what are we to make out of these figures?

It has been theorized up to now that the heavier elements present in the planetary system must have been formed as supernovae exploded elsewhere in the universe and must have migrated somehow 4 billion years ago to become available to eventually make up the planets of our system.

There is no doubt that supernovae do eject countless billions of tons of all elements as they explode, but we just saw that if general nucleon genesis really happens in the corona, rather convincing telltales for which being the million+ K temperature and confirmed overabundance of the metals detected in the corona with respect to the chromosphere, there exists a real possibility that all elements in the solar system except the initial hydrogen cloud that eventually condensed to form the Sun may be indigenous.

If such is the case, it is more than likely that due to their higher mass, the heavy ions formed in the corona would have tended to be expelled to lesser distances from the Sun than the lighter elements by slow CMEs and by the slow solar wind that dominates on the plane of the ecliptic.

This may very simply explain why the inner planets, Mercury, Venus, Earth, Mars and the asteroid belt, are way more massive than the outer gas giants, which on their part may generally have been the product of high velocity CMEs and fast solar wind, even in which heavier ions could possibly also have been mostly sent to lesser distances than lighter elements due to their larger masses. This would also explain why the densest planet is closer to the Sun with the others generally becoming less massive with distance.

Such a possibility would greatly simplify understanding planetary systems creation in the universe since there would be no more need to invoke the rather farfetched hypothetical creation of all heavy elements in the universe only from the relatively rare, after all, supernova explosions option.

## The Corona Effect

Finally, such a nucleosynthesis of all elements in the Solar corona combined to the confirmed presence of coronas accompanying all observed stars would confirm the hypothesis that all stars mandatorily eventually develop a planetary system.

### 13- The Corona drive

We mentioned earlier that at least some protons creation seem to have been observed from high energy head on collisions of electron beams, but these occurrences seem not to really have been specifically studied.

We also saw a distinct possibility that the same type of nucleon genesis could possibly be the ultimate cause of the extreme temperatures and elements overabundance in the corona and solar winds through a process of slow non-explosive chain reaction.

It is not difficult to imagine what would become possible if we eventually became able to consistently manufacture protons and neutrons from simple 1.022 MeV photons as the 3-spaces model ([3]) clearly hints at the possibility, that is, manufacture matter from energy, instead of trying to extract energy from matter as has been attempted up to now.

To put it bluntly, and not even talking of the ~227 fold increase in free energy resulting from each nucleon creation, controlling such conversions as a first stage of two 1.022 MeV photons into 2.044 MeV/c<sup>2</sup> of mass (two electron-positron pairs), and then as a second stage, converting these 2 MeV/c<sup>2</sup> of mass to about 938 MeV/c<sup>2</sup> of effective mass (one hydrogen atom, that is one proton with its associated electron, or alternately one neutron with a free positron to spare) through an entirely natural and irreversible acceleration process, would provide us with about 470 times our stake mass wise.

This represents 47,000 % efficiency instead of less than 100 % for the most efficient methods available up to now. In other words, it would provide us with an inexhaustible supply of reaction-mass, and this, not even counting the three energetic mesons that would be created in the process.

It would become possible, among other things, to stop ravaging our planet's natural resources to supply cities and factories with energy, and even electricity producing nuclear facilities would become obsolete, to be replaced by facilities producing electricity from this new mass production process from photons.

From all probabilities, the solution would fundamentally involve bombarding thin targets of still to be identified materials with massive amounts of highly focused photons of energy just about 1.022 MeV, so that the decoupling pairs would have insufficient energy to really escape while being produced in sufficiently high concentrations and proximity for the triads to have a chance to form.

**Interestingly, the technology already exists to implement the first stage of this two stages process!** The equipment required is currently being constructed and experimented with. It is named “**Free Electron Laser**” or **FEL**. One is being built/experimented with at the SLAC facility among others, and is for all practical purposes as small-scale wiggler, that can force a relativistic electron beam to synchronously oscillate between two arrays of magnets.

The beam can be modulated so that the frequency of the coherent bremsstrahlung photons being produced can be finely tuned over a relatively wide range, theoretically up to the frequencies required for eventual pair production when directed at appropriate target material. Or maybe should we have to wait for **Free Proton Lasers** to reach the extreme gamma frequencies needed. The future will tell.

## The Corona Effect

Presently, a whole range of possibilities remains to be explored, from bombarding a precise point in space with the appropriate frequency of photons to produce a sufficient quantity of pairs, to using more energetic photons producing pairs that would then have to be slowed down to allow the triads to come into being.

It would be possible to focus coherent beams of 1.022 MeV to local densities allowing high density decoupling of electron-positron pairs with minimal escape velocities that could possibly allow high density triad production.

One could even see here a possible solution to controlled fusion since neutrons, which are a mandatory ingredient of the process, do statistically constitute half of the nucleons being generated during such triad production processes.

Regarding space exploration, it becomes possible to envision propulsion systems fueled by such photons, some sort of Corona Drive, which could eject hydrogen in such huge quantities that constant acceleration at 1g may become possible, in spaceships the mass of which would no longer be a factor.

It would become possible to design hulls as thick as required, profile and magnetize them to efficiently protect crews against cosmic radiation, and other particles mostly produced as high energy cosmic radiation protons collide with the hull, at the huge relative velocities that could be achieved.

### 14- Conclusion

If nucleon genesis was confirmed as occurring in the corona, this would provide a direct answer to the extreme temperature issue of the corona.

If nucleosynthesis in the corona of elements more massive than hydrogen was confirmed, this would give substance to the hypothesis that all elements in the Solar system could be indigenous and that all stars eventually develop a planetary system.

If sustained nucleon genesis by means of free electron lasers or free proton lasers is achieved, this would provide us with an hitherto unsuspected and unlimited controllable source of energy.

Finally, this would allow the development of a spaceship drive that could provide constantly powered space travel with no need to carry any large reservoir of propellant instead of the limited inertial space travel that we must currently be content with, even allowing permanent acceleration that would give a modicum of artificial gravity to the crew.

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