ISSN: 2634 - 8853

Journal of Engineering and Applied Sciences Technology

Research Article

Open Access

Topology of Emergent Time

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ABSTRACT

We delve into the topology and morphology of the emergent time that arises from a electrons kinetic cloud virtually confined in a toroidal shape due to high-opacity environments. Different results using the most usual opacity models are shown.

We analyze the dynamics that best represent such complexity, especially for stellar environments, focusing on the inner, mid and outer zones of the radiative layer. Detailed results of the expected induced Gravity, including their values and the time needed to be conserved over cosmological Time are shown.

Then we extrapolate the results of the Gravity induced by the emergent time for different types of stars in function of their percentage per size and by mass, infering that the 95% of the Gravity created in the stars ranges from -43% till 19% of the emergent gravity arised in Sun-like stars.

Finally we show how the variabilty of the gravitational constant could be demonstrated by experiments carried out on the Earth itself and how a new discipline "PaleoGravity" based on them could help us to study the origin of any chemical element present on Earth, the solar system and even asteroids.

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Received: July 23, 2025; **Accepted:** July 25, 2025; **Published:** August 06, 2025

Introduction

We've analyzed in previous works how the Gravity emerges as time dilation from the relationship among electromagnetic energy (photons) and matter (electrons) expressed like kinetic energy [1].

The goal of this paper is going even deeper studying the topology and morphology associated to this phenomenon.

Gravity arised in a first stage in the early Universe as consequence of the interaction among the primitive electromagnetic energy and matter (hydrogen plasma), but under different conditions than the current ones for the stars: lower temperature (likely around 75000 K) and a lower matter and kinetic energy density.

As consequence, the Gravity in the early Universe would have been much lower than the current one (our calculations estimated an initial value around 20%). Then it would have evolved supported by the interactions in the radiative layer of the stars [1].

Therefore it's necessary to study at first the dynamics of an electrons plasma (we'll call it "kinetic cloud") under different conditions of density, opacity and temperature for understanding the underlying topology.

First, we should discern the specific circumstances for an electrons plasma could be considered a ***Coulomb liquid*** or not.

When multiple electrons are brought together, they can form a ***Coulomb liquid phase***. Its key feature is the strong Coulomb repulsion between the charged particles (electrons or ions) which leads to a strongly correlated state where particles are not free to move independently but instead form a liquid-like structure with significants interactions. It's called a Coulomb liquid, where ***the charge play the role of viscosity***. Then we could manage the kinetic cloud like a fluid and applying it Navier-Stokes equations.

We must remark that although this is an exciting new field, it's still in its infancy.

Coulomb liquid has been observed recently with *only a few-electron-droplets* for first time: Researchers have found a Coulomb liquid phase in droplets containing a small number of electrons, demonstrating how strong Coulomb interactions can lead to such unexpected behavior. In fact they've got it with only 3 electrons, with experiments from 3 to 5 electrons [2].

Our kinetic cloud of electrons is estimated to be physically confined due to the high opacity around. In fact, just as we'll see forward, we could consider the kinetic cloud embedded into a dense "scattering cloud" that would act as confinement environment.

When a cloud of electrons with different potential energies is confined in the same space, they will interact and redistribute to minimize their overall energy, following the universal principle of least action. This redistribution can involve several phenomena, including:

- **Charge and Energy Sharing:** Electrons will move to minimize repulsion and lower their potential energy. They will also tend to occupy lower energy levels within the confinement. Electrons, being negatively charged, naturally repeal each other according Coulomb's Law. If they're confined in a space with different potential energies, they will try to arrange themselves to minimize this repulsion and the overall potential energy of the system. This can involve occupying different regions of space and/or different energy levels within the confinement.

- **Potential Well Formation:** the varying potentials can create a complex potential landscape where some areas are more attractive to electrons than others. This can lead to regions of higher electron density. The varying potential energies can create a "potential well" structure. Electrons will tend to accumulate in regions of lower potential energy (deeper parts of the well) and be less likely to occupy regions of higher potential energy. This can lead to a non-uniform distribution of electrons, with some areas having higher electron density than others.
- **Quantum Mechanical Effects:** the electrons' behavior will be governed by quantum mechanics, leading to quantization of energy levels and the possibility of tunneling between potential wells.
- **Possible Instability:** In some cases, if the energy difference between electrons is significant or the confinement is too tight, it could lead to instability.

In a general way, a plasma could be considered a Coulomb liquid if the relation $\mathbf{E_{potential}/E_{kinetic} > 1}$, that is, ***if the Coulomb interactions dominate over the kinetic energy***.

A Coulomb fluid, as commented before, refers to a system where charged particles (here, electrons) interact primarily via Coulomb (electrostatic) forces, and the collective behavior resembles that of a fluid, often a plasma, where long range interactions play a significant role. For an electron cloud to be a Coulomb fluid, it should exhibit plasma-like behavior, with the Coulomb interactions being significant compared to other forces.

We'll do a calculation for a typical early Universe scenario and another one for a typical stellar scenario starting with this last one.

Stellar Scenario

Although the range of kinetic energy density could be estimated among 10^2 to 10^8 J/m^3 depending of different parameters as we'll see later, a kinetic energy density of 10^5 J/m^3 will allow us to do a good approximation.

For a non-relativistic electron gas, the kinetic energy density is related to the electron number density (n) and their average kinetic energy. Assuming a Maxwell-Boltzmann distribution (valid for a non-relativistic, non-degenerate plasma), the average kinetic energy per electron at temperature T is [3,4]:

$Ek = 3/2\, kT$ where $k = 1.380649\times10^{-23}$ J/K is the Boltzmann constant, and $T = 7\times10^6$K is the temperature in the radiative layer closer to the core.

Calculate the average kinetic energy per electron:

$Ek = 3/2 \times 1.380649\times10^{-23}\times 7\times 10^6 = 3/2\times 9.664543\times 10^{-17} = 1.44968145\times10^{-16}$ J

The kinetic energy density is:

$u = n\langle Ek\rangle$: $10^5 = n \times 1.44968145\times10^{-16}$

$$n = \frac{10^5}{1.44968145\times10^{-16}} \qquad n \approx 6.897\times10^{20}\mathrm{m}^{-3}$$

This is the number density of electrons in the cloud.

To ensure the non-relativistic assumption holds, compare the average kinetic energy to the electron rest energy:

$$m_e c^2 \approx 9.1093837\times10^{-31}\times(2.99792458\times10^8)^2 \approx 8.187\times10^{-14}\mathrm{J}$$

$$\langle E_k\rangle = 1.44968145\times10^{-16}\mathrm{J}$$

Since $Ek \ll m_e C^2$, the electrons are non-relativistic, so the Maxwell-Boltzmann assumption is appropriate.

To determine if the electron cloud behaves as a Coulomb fluid, we need to check if it is a plasma and whether Coulomb interactions dominate. The ***plasma parameter Γ, or coupling parameter***, quantifies the ratio of potential energy (due to Coulomb interactions) to kinetic energy:

$$\Gamma = \frac{E_{\text{potential}}}{E_{\text{kinetic}}} \approx \frac{\frac{e^2}{4\pi\epsilon_0 r}}{kT}$$

where r is the average interparticle distance, $e=1.60217662\times10^{-19}$C is the electron charge, and $\varepsilon_0=8.854187817\times10^{-12}$ F/m (1).

The average interparticle distance is estimated from the number density:

$$r \approx n^{-1/3} \rightarrow r \approx (6.897\times10^{20})^{-1/3} \approx 1.132\times10^{-7}\ \mathrm{m}$$

Then $E_{potential} = 2.039\times10^{-21}$ J

On the other hand, the kinetic energy per electron:

$kT = 1.380649\times10^{-23}\times7\times10^6 \approx 9.664543\times10^{-17}$

$$\Gamma = \frac{2.039\times10^{-21}}{9.664543\times10^{-17}} \approx 2.11\times10^{-5}$$

Since $\mathbf{\Gamma \ll 1}$, the system is *weakly coupled, meaning* ***kinetic energy dominates over Coulomb potential energy, characteristic of an ideal plasma rather than a strongly coupled Coulomb fluid*** (where $\Gamma \gtrsim 1$).

There's just another param usually used to define a plasma behaviour, the Debye length (λ_D) and the number of particles in Debye's sphere N_D, which screens Coulomb interactions [5]. Being

$$\lambda_D = \sqrt{\frac{\epsilon_0 kT}{ne^2}} \quad \text{and} \quad N_D \approx \frac{4}{3}\pi\lambda_D^3 n$$

In our case $Nd = 2.906\times10^5$ .Since $Nd \gg 1$ the system satisfies the plasma condition, exhibiting collective behavior (Coulomb interactions are screened).

Conclusion: The kinetic electron cloud is a weakly coupled plasma, **not a** strongly coupled **Coulomb fluid**. It would happen the same for other lower densities and temperatures along the radiative zone. It means that we should manage the kinetic cloud in the radiative zone ***as a Maxwellian distribution, following***

Boltzmann-Maxwell law.

Note: There're some studies of plasma confined in toroids for fusion projects based on MHD (magneto hydro dynamics) which treat plasma as a fluid. But such plasma is also subjected to external magnetic fields, so we can't rely on them.

Early Universe Scenario
We'll assume at first time a kinetic energy density of $3x10^{-8}$ J/m^3 and a Temperature=24.5 K [1].

Calculating the coupling parameter for this case according to (1), Γ=0.027.

Therefore Γ ,although much higher than the previous scenario, is even much less than 1, indicating that the thermal energy also dominates over the Coulomb potential energy. So the electrons kinetic cloud ***behaves more like a weakly coupled plasma or an ideal gas of charged particles rather than a Coulomb fluid***.

For other early Universe scenarios we would find also $\Gamma < 1$, so we can't use either the Coulomb liquid dynamics.

Sun's Structure

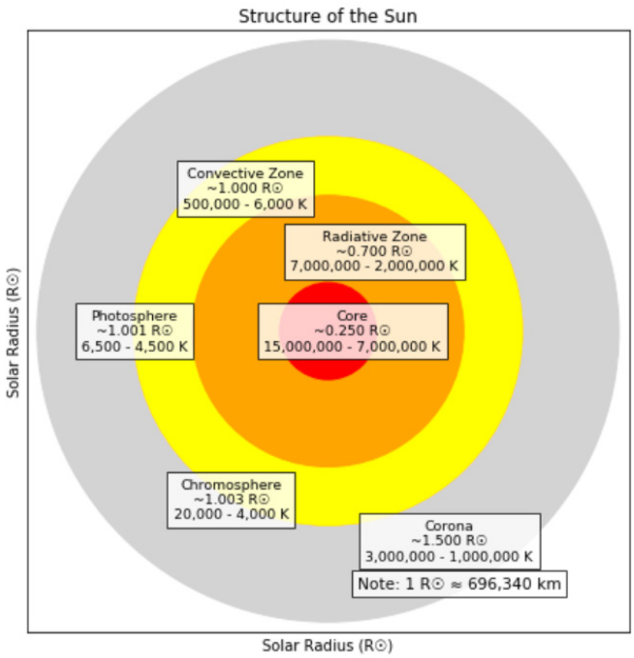

Figure 1

Our goal is studying the topology and morphology of the electrons kinetic cloud in diferent zones of the star radiative layer, taking our Sun as reference. The radiative layer refers to the zone of a star (e.g. the Sun), where energy is transported by radiation. It's located between the core (where nuclear fusion produces energy) and the convective zone (closer to the surface).

Its funcion is transferring energy via photons which move through the highly dense, ionized plasma. Photons are absorbed and re-emitted by particles, taking a "zigzag" path outward, which can take till even millions of years to traverse the radiative zone. Therefore not only photons, but the electrons kinetic cloud produced by photons, can be considered "trapped" because its effective capacity for linear movement over time is very limited.

Radiative layer is subjected to high temperatures and densities: High enough for efficient energy transfer but not so that convection dominates. There's no significant mixing of material, unlike the convective zone, therefore we can consider that is composed 100% by Hydrogen (most of them ionized but with only a small percentage neutral).

We'll divide the radiative layer in inner, mid and outer zones with temperatures from $7x10^6$ K (inner, close to core) till $2x10^6$ K (close to the convective layer), with densities from 20 g/cm^3 (inner) to 0.2 g/cm^3 (outer).

In the Sun, the radiative zone extends from about 0.2 to 0.7 solar radii from the core to the base of the convective zone.

Morphology of the Kinetic & Scattering Clouds
Hydrogen is mostly in plasma state along the radiative layer because of the highly ionized atoms as consequence of the high temperatures. On the one hand, we have a dense "kinetic cloud" due to the influence of the photoelectric effect on a percentage of neutral-not ionized Hydrogen atoms. Electrons are ejected at energies with a wide spectrum from some eV to some hundred of eV. So their average speed is very relevant. On the other hand, there's also a great influence of the scattering effect. Therefore we have a cloud that can be really treated as two: One "***pure kinetic cloud***" produced ***by photoelectric effect***, where the average speed of the ejected electrons is very high due to their energy spectrum and a "***scattering cloud***" whose main influence is helping to ***"trap" the electromagnetic energy and therefore its associated kinetic energy***. We also could consider ***the "kinetic cloud" embedded into a "scattering cloud"***. The first influence of the scattering cloud over the kinetic cloud is the opacity, as we'll study forward. The second one is ***confinement. It would work as a physical confinement for the kinetic cloud***. So we could consider that the kinetic cloud is contained into ***a "virtual toroid"*** whose external radius decreases from the outer zone to the inner zone of the radiative layer. Although it's not a goal of this paper, the effective value of the external radius of the virtual toroid could be studied for every specific case.

Note: *The toroid is really a 2D simplification, because we also could talk about* ***"spherical toroid"*** *in a broader sense*.

Under such circumstances, we can consider that every H atom (mainly H_+ due to the high ionized plasma) is ***surrounded by a kinetic cloud of high energy density*** (in shape of "***virtual spherical toroid***") which is ***the cause of the emerging time***. *The value of such emergent time is directly related with the average speed while the time that is needed for conserving it in cosmological time is directly related to the kinetic energy density of the cloud* [1]. Gravity is a consequence of this emerging time (or time dilation) and not viceversa.

It's the *speed difference*, according to Einstein's theory of Special Relativity, that gives rise to a *time difference*. We call such time difference in this case ***emergent time***. In other words, *General Relativity would arise from Special Relativity* [6,7].

It would be the appendix to the theory which explains in detail and demonstrates how kinetic energy can counteract the gravitational energy produced by another body [8]. Kinetic energy actually counteracts it creating its own gravity as a consequence of the time dilation related to the relative speeds difference.

The fundamental difference is that for this emergent time to be preserved in cosmological time (and therefore its induced gravity), not only time but also a high density of kinetic energy is required according to [1].

The composition of the dense "scattering cloud" is complex. It's formed not only by scattered photons and electrons but by electrons coming from the photoionization of the previous Hydrogen atoms in their path to reach the core.

Opacity is produced by both clouds (mainly by far due to the scattering cloud) and plays a very relevant role, because prevents radiation from reaching directly the atoms. Therefore it must be taken into account for every calculation.

There're two well known methods for calculating the opacity. One of them is Kramer's , a simplified but very useful one. Other one is more specific because it's based on tables and experiments. We're talking about OPAL. We'll use both of them and then compare the results each other [9,10].

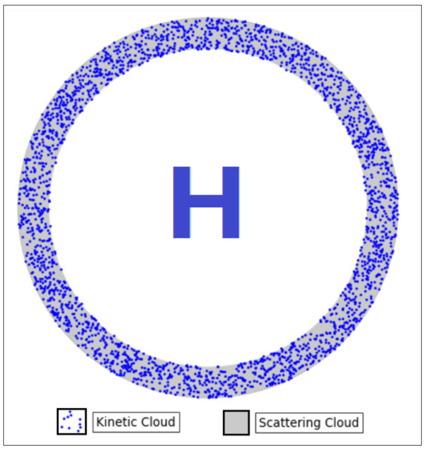

Figure 2

In any case, just as commented before, we could consider that the kinetic+scattering clouds around the atom/ion produces an effective confinement that could be represented by a "toroid".

The dynamic of the kinetic cloud in the toroid is not easy at all because it's influenced by many parameters. Some models show that the higher energy electrons are distributed around the torus' outer ring, that is, some kind of speed distribution from minimum to maximum could take place from inner to outer.

In any case, we'll consider for this study the toroid/ring like one unique entity with an average speed. The vectors that represent such speed obviously can change continuosly of direction but this fact will be not relevant, because just as it was showed in a previous study, it does not matter if the direction of rotation (even the rotation axis) changes, the relevant fact for getting a gravity effect is the kinetic energy associated to a body [8].

Conservation of the Emergent Time Over the Cosmological Time

The time needed (t_0) for the emergent time is conserved over the cosmological time is direcly related to the kinetic energy density, according to [1].

Therefore ***the time needed in the early universe (respecting the timeline of the currently accepted Lambda-CMB model) is far superior to the needed in stellar contexts, due to the lower matter density***. So for a kinetic density as low as $3x10^{-8}$ J/m^3, the estimated t_0 time would be around 10 millions of years [1]. But if we accept that the CMB does not correspond to the recombination epoque, then t_0 would decrease significantly because the kinetic energy would increase to 2.14 10^2 J/m^3. Therefore t_0=44200s., that is, we could consider that the conversion of kinetic energy in gravitational energy would be inmediate in cosmological time.

For any intermediate value among this kinetic energy density and the calculated for the conventional cosmological model, the according range of times is showed in the next graphs (Figure 3).

In stellar environments a conversion value of 9.47 seconds was calculated for a kinetic energy density of 10^6 J/m^3. Even if we're talking of energies among 10^2-10^6 J/m^3, the range of times would be as maximum of $9.47x10^4$ s., that is, ***we can consider that the conversion of kinetic energy in gravitational energy is always inmediate in cosmological time*** [1].

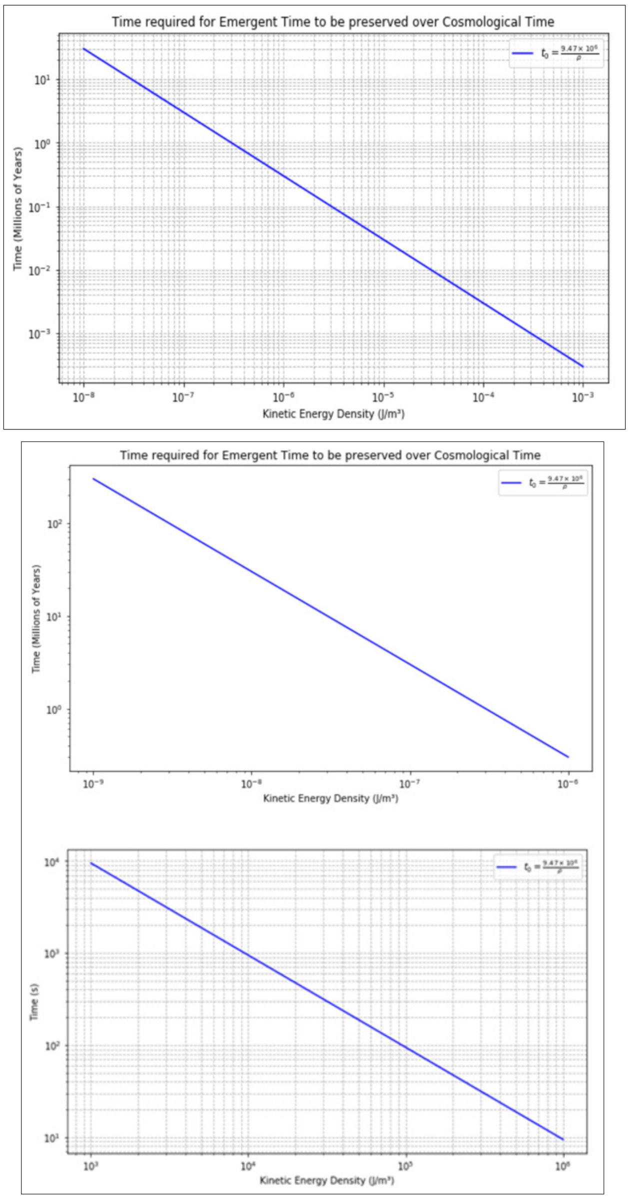

Figure 3

Kinetic Energy Density and Average/Maximum Speeds Produced by Photoelectric Effect on Hydrogen in Sun's Radiative Layer

We'll calculate the kinetic energy density, average speed, and maximum speed of electrons ejected via the photoelectric effect on hydrogen within the Sun's radiative layer at the inner, mid, and outer zones, considering initially a simple opacity model (Kramers') and the according density range (20 g/cm³ at the inner radius to 0.2 g/cm³ at the outer radius). We'll use energy units in J/m³.

Because of the high ionization degree due to the temperature, there will be a relatively small percentage of H atoms not-ionized or recombined susceptible to be affected by the photolectric effect. It's not easy to know exactly such percentage. Therefore the range of the kinetic energy density can be estimated among 10^2-10^8 J/m³ along the radiative layer just as we'll calculate forward. We'll be conservative with the percentage of the not ionized H (0.01%) applying the same value for all the radiative layer, although the percentage of not ionized atoms increase when temperature decreases from inner to outer.

On the other hand, calculating the percentage of influence of the photoionization effect on the "scattering cloud" along the radiative layer is out of the scope of this paper but some models estimate its contribution to the total opacity effect in approx. 5-20% of the total opacity, increasing from inner to outer.

The Sun's radiative layer (Figure 1) extends from approximately 0.25 to 0.7 solar radii, where energy is transported primarily by photons. The density decreases from 20 g/cm³ at the inner radius to 0.2 g/cm³ at the outer radius, and the temperature drops from about 7,000,000 K to 2,000,000 K. The photoelectric effect involves photons ejecting electrons from hydrogen atoms, and we need to account for Kramers' / OPAL opacity, which affects photon interactions in this plasma environment.

Key Parameters (based on):

- **Inner Radius:** ~0.25 solar radii, density = 20 g/cm³ (20,000 kg/m³), temperature ≈ 7,000,000 K.
- **Outer Radius:** ~0.7 solar radii, density = 0.2 g/cm³ (200 kg/m³), temperature ≈ 2,000,000 K.
- **Mid Radius:** Assume ~0.475 solar radii (midpoint of 0.25 to 0.7), with density and temperature interpolated.
- **Composition:** The Sun's radiative zone is primarily ionized hydrogen (plasma).

There're different ways of analyzing opacities. Using one or another have significative impact on the kinetic density energy calculations.

Kramers' Opacity: Describes in a simplified way the opacity due to bound-free and free-free transitions in a plasma, relevant for photon absorption in the photoelectric effect. The opacity scales as κ ∝ ρT^(-3.5), where ρ is density and T is temperature.

OPAL's Opacity: More reliable. Supported by tables and experiments.

Rosseland's Opacity: Based on OPAL's, but with slightly different results.

A good measure of the opacity is the ***mean free path* (l)** which refers to the average distance a photon can travel between interactions. ***It's inversely proportional to the opacity and the density* (l=1/κρ)**. For the inner of the radiative layer such value is less than 0.01 mm. This fact gives us an idea about the high degree of ***effective confinement of the kinetic cloud*** that surrounds the Hydrogen atoms.

The Figure 4 shows a representation of Roseland's Opacity.

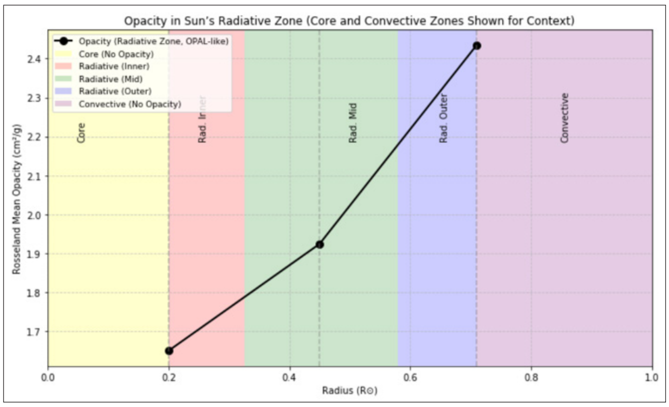

Figure 4

Photoelectric Effect in the Sun's Radiative Layer

The photoelectric effect occurs when photons with energy above the ionization energy of hydrogen (13.6 eV) eject electrons. In the Sun's radiative layer, the high temperatures (2–7 million K) mean hydrogen is almost fully ionized, forming a plasma of H_+ and free electrons. However, some neutral hydrogen exist (not only due to a percentage of neutral hydrogen not-ionized but to recombination) allowing the photoelectric effect to occur.

The photon energy in the radiative zone comes from blackbody radiation at the local temperature. The energy of a typical photon is approximated using Wien's displacement law or the average photon energy in a thermal plasma (~kT). The kinetic energy of ejected electrons is given by:

$$Ek = h\nu - \phi$$

where $h\nu$ is the photon energy, and ϕ = 13.6 eV (ionization energy of hydrogen). For high-energy photons in the radiative zone, $h\nu \gg \phi$, so $Ek \approx h\nu$.

Kinetic Energy Density

The kinetic energy density (ε) is the total kinetic energy of ejected electrons per unit volume (J/m³). Since the radiative zone is a plasma, we calculate the number density of electrons generated by the photoelectric effect and their kinetic energy based on the photon flux and opacity.

Number Density of Ejected Electrons

The number of electrons ("photoelectrons") depends on the photon flux and the opacity. The photon flux is determined by the radiative energy flux in the zone, and Kramers' opacity governs the absorption rate. The radiative flux (F) is related to the energy transport:

$$F = L_\odot \,/\, 4\pi r^2$$

where $L_\odot$ = 3.846×10^{26}W is the Sun's luminosity, and r is the radial distance. Solar radius $R_\odot$ =6.96×10^8m.

Kramers' opacity is approximately: $\kappa = \kappa_0 \rho T^{-3.5}$

where κ_0 is a constant (10^{23} cm^2 g^{-1} K$^{3.5}$ in cgs units in our case for bound-free transitions, 10^{21} m^2 kg^{-1} K$^{3.5}$ in SI units).

We'll use typical (although very conservative) values for not-ionized+recombined hydrogen in plasma. We'll adjust for the plasma environment (0.01% of total plasma=0.0001). With a larger, less conservative value, we'd obtain a higher kinetic energy density, because the absorption coefficient determines the rate of photon absorption, ejecting electrons ("photoelectrons"). With a very low, much more conservative value (according Saha ionization equation), the plasma not-ionized would be 10^{-10} instead 0.0001 (10^{-4}).

There're not currently precise studies about this issue. On the contrary, there're profound discrepancies. What we'll do is getting the more conservative value because:

- Such value has not influence on the average speed, therefore on the emergent time value.
- The resulting kinetic energy density barely influences our calculations because even using the more conservative value, the conversion of kinetic energy in gravitational energy could be considerated inmediate in stellar environments, just as we analyzed before.

The number density of photoelectrons ne is proportional to the photon absorption rate:

$$n_e \approx \frac{F\kappa\rho}{h\nu}$$

where $h\nu \approx kT$ (average photon energy in a thermal plasma), and k=1.38×10^{-23}J/K.

The kinetic energy density is: $\varepsilon = ne \cdot Ek \approx ne \cdot kT$

since $Ek \approx kT$ for high-energy photons.

Previous Step: Values calculated by Interpolation for Mid Radius

For the mid radius (~0.475 $R\odot$), we interpolate density and temperature logarithmically (since they vary steeply):

- **Density:** $\log\rho_{\text{mid}} = \frac{\log 20 + \log 0.2}{2} = \log\sqrt{20 \cdot 0.2} = \log 2 \approx 0.301$, so $\rho_{\text{mid}} \approx 2\text{g/cm}^3 = 2000\text{kg/m}^3$
- **Temperature:** $\log T_{\text{mid}} = \frac{\log 7\times10^6 + \log 2\times10^6}{2} \approx 6.57$, so $T_{\text{mid}} \approx 3.7\times10^6$K

Calculations

Inner Radius (r = 0.25 $R\odot$=1.74×10^{8}m):

- ρ=20,000kg/m3, T=7×10^{6}K.
- F= 3.846×10^{26}/(4π(1.74×10^8)^2) ≈1.01×10^{9}W/m^2.
- $h\nu \approx kT$=1.38×10^{-23}·7×10^6≈9.66×10^{-17} J.
- **Kramers' Opacity:** κ≈0.0001·κ0.20,000·(7×10^6)$^{-3.5}$≈1.2×10^{-4} m^2/kg.
- **Photoelectron Density:** $n_e \approx \frac{F\kappa\rho}{kT} = \frac{1.01\times10^9 \cdot 1.2\times10^{-4} \cdot 20,000}{9.66\times10^{-17}} \approx$

  2.5 x 10^{25} (maximum) -2.5 x 10^{19} (minimum)

- **Kinetic Energy Density:** $\varepsilon = ne \cdot kT$≈2.5×10^{19}·9.66×10^{-17}≈2.42×10^{3}J/m^3 (minimum)-2.42×10^{9}J/m^3(maximum)

Mid Radius (r = 0.475 $R\odot$=3.31×10^{8}m):

- ρ=2000kg/m^3, T=3.7×10^{6}K.
- F= 3.846×10^{26} / (4π(3.31×10^8)^2) ≈2.80×10^{8}W/m^2.
- kT=1.38×10^{-23}·3.7×10^6≈5.11×10^{-17} J.
- κ≈0.0001·κ_0. 2000·(3.7×10^6)$^{-3.5}$≈6.8×10^{-4}m^2/kg.
- ne≈2.80×10^8·6.8×10^{-4}·2000 / (5.11×10^{-17}) ≈7.4×10^{24}m^{-3} (maximum)- 7.4×10^{18}m^{-3} (minimum)
- ε≈7.4×10^{18}·5.11×10^{-17}≈3.78×10^2 J/m^3 (minimum)-3.78×10^8 J/m^3 (maximum).

Outer Radius (r = 0.7 $R\odot$=4.87×10^{8}m):

- ρ=200kg/m^3, T=2×10^{6}K
- F= 3.846×10^{26} / (4π(4.87×10^8)^2) ≈1.29×10^{8}W/m^2.
- kT=1.38×10^{-23}·2×10^6≈2.76×10^{-17} J.
- κ≈0.0001· κ_0. 200·(2×10^6)$^{-3.5}$≈3.5×10^{-3}m^2/kg.
- ne≈1.29×108·3.5×10^{-3}·200 / (2.76×10^{-17}) ≈3.3×10^{24}m^{-3} (maximum)-3.3×10^{18}m^{-3} (minimum).
- ε ≈3.3×10^{18}·2.76×10^{-17}≈9.1×10^{1}J/m^3 (minimum)- 9.1×10^{8}J/m^3 (maximum).

Average Speed of Ejected Electrons

The **average speed** (v_{avg}) of photoelectrons is related to their kinetic energy via the Maxwell-Boltzmann distribution for a non-relativistic plasma. The average kinetic energy is Ek=1/2xm_exv_{avg}^2, but in a thermal plasma, Ek≈3/2 kT. Thus:

$$\frac{1}{2}m_e v_{\text{avg}}^2 \approx \frac{3}{2}kT$$

$$v_{\text{avg}} \approx \sqrt{\frac{3kT}{m_e}}$$

where me=9.11×10^{-31} kg.

Inner Radius: T=7×10^{6}K

$$v_{\text{avg}} \approx \sqrt{\frac{3 \cdot 1.38\times10^{-23} \cdot 7\times10^6}{9.11\times10^{-31}}} \approx 6.6\times10^7\text{m/s}$$

Mid Radius: T=3.7×10^{6}K

$$v_{\text{avg}} \approx \sqrt{\frac{3 \cdot 1.38\times10^{-23} \cdot 3.7\times10^6}{9.11\times10^{-31}}} \approx 5.1\times10^7\text{m/s}$$

Outer Radius: T=2×10^{6}K

$$v_{\text{avg}} \approx \sqrt{\frac{3 \cdot 1.38\times10^{-23} \cdot 2\times10^6}{9.11\times10^{-31}}} \approx 3.9\times10^7\text{m/s}$$

Maximum Speed of Ejected Electrons

The maximum speed corresponds to the maximum kinetic energy from the highest-energy photons in the blackbody spectrum. The maximum photon energy is approximated as ~3kT (Wien's law peak). Thus:

$$E_{k,\max} \approx 3kT$$

$$v_{\max} \approx \sqrt{\frac{2 \cdot 3kT}{m_e}} = \sqrt{\frac{6kT}{m_e}}$$

Inner Radius

$$v_{\max} \approx \sqrt{\frac{6 \cdot 1.38\times10^{-23} \cdot 7\times10^6}{9.11\times10^{-31}}} \approx 9.3\times10^7\text{m/s}$$

Mid Radius

$$v_{\max} \approx \sqrt{\frac{6 \cdot 1.38 \times 10^{-23} \cdot 3.7 \times 10^{6}}{9.11 \times 10^{-31}}} \approx 7.2 \times 10^{7} \mathrm{m/s}$$

Outer Radius

$$v_{\max} \approx \sqrt{\frac{6 \cdot 1.38 \times 10^{-23} \cdot 2 \times 10^{6}}{9.11 \times 10^{-31}}} \approx 5.5 \times 10^{7} \mathrm{m/s}$$

Step 6: Summary of Results

Region	Radius (m)	Density (kg/m³)	Temperature (K)	Kinetic Energy Density (J/m³)	Average Speed (m/s)	Maximum Speed (m/s)
Inner (0.25)	1.74×10^{8} m	20,000	7×10^{6}	2.42×10^{3}	6.6×10^{7}	9.3×10^{7}
Mid (0.475)	3.31×10^{8} m	2,000	3.7×10^{6}	3.78×10^{2}	5.1×10^{7}	7.2×10^{7}
Outer (0.7)	4.87×10^{8} m	200	2×10^{6}	9.1×10^{1}	3.9×10^{7}	5.5×10^{7}

Notes
- **Photoelectric Effect in Plasma:** The radiative zone is highly ionized, so the photoelectric effect is less dominant than in neutral environments. The calculations always assume a small fraction of neutral hydrogen.
- **Kramers' Opacity:** The opacity constant was approximated for simplicity.
- **Non-Relativistic Assumption:** Electron speeds approach relativistic limits (~0.2–0.3c), but the non relativistic approximation holds for these calculations.

OPAL Opacity
Unlike Kramers' opacity ($\kappa \propto \rho T^{-3.5}$), OPAL opacity is derived from detailed atomic physics calculations, accounting for bound-free, free-free, and bound-bound transitions in stellar plasmas. OPAL tables provide opacity as a function of density, temperature, and composition, tailored for astrophysical environments like the Sun's interior. For hydrogen-dominated plasma, we use OPAL data for pure hydrogen at the specified densities and temperature.

OPAL opacities are typically given in cm²/g and must be converted to m²/kg (1 cm²/g = 0.1 m²/kg). For the radiative zone conditions:
- **Inner:** $\rho = 20 \mathrm{g/cm^3}$, $\log T \approx 6.85$.
- **Mid:** $\rho \approx 2 \mathrm{g/cm^3}$, $\log T \approx 6.57$.
- **Outer:** $\rho = 0.2 \mathrm{g/cm^3}$, $\log T \approx 6.30$.

From OPAL tables (referenced from Iglesias & Rogers, 1996), approximate opacities for hydrogen at these conditions are [10]:
- **Inner:** $\kappa \approx 0.1 \mathrm{cm^2/g} = 0.01 \mathrm{m^2/kg}$ (high density, high temperature).
- **Mid:** $\kappa \approx 0.5 \mathrm{cm^2/g} = 0.05 \mathrm{m^2/kg}$ (interpolated).
- **Outer:** $\kappa \approx 2 \mathrm{cm^2/g} = 0.2 \mathrm{m^2/kg}$ (lower temperature, lower density).

These values are higher than Kramers' opacity due to OPAL's inclusion of detailed atomic transitions.

Kinetic Energy Density
The kinetic energy density (ε) is the energy of photoelectrons per unit volume (J/m³). The number density of photoelectrons (ne) depends on the photon flux (F) and opacity (κ):

$$F = \frac{L_{\odot}}{4\pi r^2}$$

$$n_e \approx \frac{F\kappa\rho}{kT} \qquad \varepsilon = n_e \cdot E_k \approx n_e \cdot kT$$

Calculations
Inner Radius

- $F = \frac{3.846 \times 10^{26}}{4\pi(1.74 \times 10^8)^2} \approx 1.01 \times 10^9 \mathrm{W/m^2}$
- $kT = 1.38 \times 10^{-23} \cdot 7 \times 10^6 \approx 9.66 \times 10^{-17}$ J
- $\kappa = 0.01 \mathrm{m^2/kg}$
- ne=2.09×10^{18} $\mathrm{m^{-3}}$ (conservative value)
- $\varepsilon \approx 2.09 \times 10^{18} \cdot 9.66 \times 10^{-17} \approx 2.02 \times 10^2$ $\mathrm{J/m^3}$

Mid Radius

- $F = \frac{3.846 \times 10^{26}}{4\pi(3.31 \times 10^8)^2} \approx 2.80 \times 10^8 \mathrm{W/m^2}$
- $kT = 1.38 \times 10^{-23} \cdot 3.7 \times 10^6 \approx 5.11 \times 10^{-17}$ J
- $\kappa = 0.05 \mathrm{m^2/kg}$
- ne=5.48×10^{17} $\mathrm{m^{-3}}$ (conservative value)
- $\varepsilon \approx 5.48 \times 10^{17} \cdot 5.11 \times 10^{-17} \approx 2.80 \times 10^1$ $\mathrm{J/m^3}$

Outer Radius

- $F = \frac{3.846 \times 10^{26}}{4\pi(4.87 \times 10^8)^2} \approx 1.29 \times 10^8 \mathrm{W/m^2}$
- $kT = 1.38 \times 10^{-23} \cdot 2 \times 10^6 \approx 2.76 \times 10^{-17}$ J
- $\kappa = 0.2 \mathrm{m^2/kg}$
- ne=1.87×10^{17} $\mathrm{m^{-3}}$ (conservative value)
- $\varepsilon \approx 1.87 \times 10^{17} \cdot 2.76 \times 10^{-17} \approx 5.16$ $\mathrm{J/m^3}$

Average Speed
The **average speed** (v_{avg}) is based on the thermal distribution of photoelectrons so it's not influenced by opacity. Therefore it will be the same than the previously calculated for Kramers' opacity, that is

$$v_{\mathrm{avg}} \approx \sqrt{\frac{3kT}{m_e}}$$

Inner Radius

$$v_{\mathrm{avg}} \approx \sqrt{\frac{3 \cdot 1.38 \times 10^{-23} \cdot 7 \times 10^6}{9.11 \times 10^{-31}}} \approx 6.6 \times 10^7 \mathrm{m/s}$$

Mid Radius

$$v_{\mathrm{avg}} \approx \sqrt{\frac{3 \cdot 1.38 \times 10^{-23} \cdot 3.7 \times 10^6}{9.11 \times 10^{-31}}} \approx 5.1 \times 10^7 \mathrm{m/s}$$

Outer Radius

$$v_{\mathrm{avg}} \approx \sqrt{\frac{3 \cdot 1.38 \times 10^{-23} \cdot 2 \times 10^6}{9.11 \times 10^{-31}}} \approx 3.9 \times 10^7 \mathrm{m/s}$$

Maximum Speed
The **maximum speed** assumes electrons gain energy from the peak photon energy (~3kT):

$$v_{\mathrm{max}} \approx \sqrt{\frac{6kT}{m_e}}$$

Inner Radius

$$v_{\mathrm{max}} \approx \sqrt{\frac{6 \cdot 1.38 \times 10^{-23} \cdot 7 \times 10^6}{9.11 \times 10^{-31}}} \approx 9.3 \times 10^7 \mathrm{m/s}$$

Mid Radius

$$v_{\mathrm{max}} \approx \sqrt{\frac{6 \cdot 1.38 \times 10^{-23} \cdot 3.7 \times 10^6}{9.11 \times 10^{-31}}} \approx 7.2 \times 10^7 \mathrm{m/s}$$

Outer Radius

$$v_{\mathrm{max}} \approx \sqrt{\frac{6 \cdot 1.38 \times 10^{-23} \cdot 2 \times 10^6}{9.11 \times 10^{-31}}} \approx 5.5 \times 10^7 \mathrm{m/s}$$

Summary of Results

Region	Radius (m)	Density (kg/m^3)	Temperature (K)	Kinetic Energy Density (J/m^3)	Average Speed (m/s)	Maximum Speed (m/s)
Inner (0.25)	1.74×10^8 m	20,000	7×10^6	2.02×10^2	6.6×10^7	9.3×10^7
Mid (0.475)	3.31×10^8 m	2,000	3.7×10^6	2.80×10^1	5.1×10^7	7.2×10^7
Outer (0.7)	4.87×10^8 m	200	2×10^6	5.16	3.9×10^7	5.5×10^7

(2)

Comparison with Kramers' Opacity
Using OPAL opacity results in ***lower kinetic energy densities*** compared to Kramers' opacity (previous results: 2.42×10^3, 3.78×10^2, 9.1×10^1 J/m³). This is because OPAL opacities are generally lower at high temperatures and densities due to detailed atomic modeling, reducing the photoelectron production rate. The average and maximum speeds remain unchanged, as they depend only on temperature.

Notes
- **OPAL Opacity:** Values are approximated from OPAL tables for pure hydrogen. Actual opacities vary with photon frequency and ionization state.
- **Photoelectric Effect:** The radiative zone's high ionization limits neutral hydrogen, so results assume a small neutral fraction just as in the Kramers' case.
- **Non-Relativistic:** Electron speeds (~0.2–0.3c) justify the non-relativistic approximation.
- **Interpolation:** Mid-radius values are logarithmically interpolated for consistency.

Emergent Time along the Radiative Layer
The radiative layer is composed by ionized Hydrogen and neutral Hydrogen (H+ and H) almost 100%. The emergent time happens only along the Radiative Layer. Therefore the interaction among electromagnetic energy and matter is almost limited 100% to Hydrogen in the Radiative Layer.

The following question is … how evolves the Gravity of the Hydrogen in its way from the outer to the inner zone, that is, from the convective layer till reach the core layer?...

$$\Delta Ts^2 = \frac{v^2}{c^2}$$

The answer can be found in (2). According to the table, due to the Gravity is directly proportional to ΔTs^2, the emergent time (and consequently its associated Gravity) for the different zones would be the following one [8]:

Radiative Zone	Average Speed (v)	ΔTs (v/c)	ΔTs2	% Total Gravity
Inner	6.6×10^7	22%	0.0484	**100%**
Mid	5.1×10^7	17%	0.0289	60%
Outer	3.9×10^7	13%	0.0169	35 %

We've seen previously that the time needed for the emerging time to be conserved on cosmological time can be considered almost priceless regardless the radiative zone.

Therefore, the Hydrogen goes reaching increased gravity values through its travel from the outer to the inner of the radiative layer (35% to 100%).

If we take the value of ***ΔTs (v/c)*** estimated for the early Universe as reference, approx. 20% of the current estimation for Gravity is reached in the early Universe, the 100% would be reached finally in the inner zone of the radiative layer closer to the core layer (*) [1].

Note: *We're supposing for simplification that the basal gravity of the Hydrogen in the Earth took place in a star like the Sun, that is, a G type star. Obviously the Gravity reached would be different for any kind of star as analyzed previously. And the according Gravity for every chemical element would be consequence of the Hydrogen Gravity.*

(*) *Another possibility is Hydrogen had passed by more than one star having the second star larger size than the previous one* [1].

Extrapolation of the Results for Other Stars (e.g. 2x,5x the Size of the Sun)
To extrapolate the results for other stars (e.g. with 2x, 5x the mass of the Sun), we'll calculate their kinetic energy density, average speed, and maximum speed of electrons ("photoelectrons") in the radiative layers of these stars, using OPAL opacity for hydrogen, as in the previous calculation for the Sun. The Sun's properties serve as the baseline, and we'll scale them for more massive stars, assuming similar physics for the photoelectric effect in their radiative zones.

Baseline Solar Parameters

From the previous calculation for the Sun ($M\odot$ = 1.989×10^{30}kg, $R\odot$ = 6.96×10^8m):

- **Radiative Layer:** 0.25 to 0.7 $R\odot$
- **Densities:** 20 g/cm³ (20,000 kg/m³) at inner radius, 0.2 g/cm³ (200 kg/m³) at outer radius, 2 g/cm³ (2,000 kg/m³) at mid radius.
- **Temperatures:** 7 × 10^6 K (inner), 3.7 × 10^6 K (mid), 2 × 10^6 K (outer).
- **Luminosity:** $L\odot$ = 3.846×10^{26}W.
- **OPAL Opacities:** 0.01 m²/kg (inner), 0.05 m²/kg (mid), 0.2 m²/kg (outer).
- **Kinetic Energy Density:** Calculated as $\varepsilon = ne{\cdot}kT$, where $ne \approx F\kappa\rho\ /kT$ and F=L/($4\pi r^2$).
- **Average Speed:** $v_{\text{avg}} \approx \sqrt{\ } 3kT/m_e$
- **Maximum speed:** $v_{\max} \approx \sqrt{\ } 6kT/m_e$

Scaling for Massive Stars

For stars with masses M=2$M\odot$,5$M\odot$, we need to estimate their radius, luminosity, density, temperature, and opacity in the radiative zone. Massive stars have different structures, but for main-sequence stars, we can use approximate scaling relations:

- **Luminosity:** $L \propto M^{3.5}$ (for main-sequence stars, based on mass-luminosity relation).
- **Radius:** $R \propto M^{0.7}$ (approximate for main-sequence stars; more massive stars are larger but denser).
- **Central Density:** $\rho c \propto M^{-0.2}$ (massive stars are denser in their cores but have larger radiative zones).
- **Central Temperature:** $Tc \propto M^{0.5}$ (higher mass increases core temperature due to greater gravitational pressure).
- **Radiative Zone:** Assumed to extend to ~0.7 R , similar to the Sun, though the exact extent varies with mass.

Scaling Relations

- **Luninosity:** $L = L_{\odot}\left(\frac{M}{M_{\odot}}\right)^{3.5}$
- **Radius:** $R_{\odot}\left(\frac{M}{M_{\odot}}\right)^{0.7}$
- **Density:** The radiative zone's density decreases with radius. We scale the Sun's densities profile, assuming $\rho \propto M/R^3$. For the inner 0.25 R, mid 0.475 R , and outer 0.7 R radii:

$$\rho = \rho_{\odot}\left(\frac{M/M_{\odot}}{(R/R_{\odot})^3}\right) = \rho_{\odot}\left(\frac{M}{M_{\odot}}\right)^{1-3\cdot 0.7} = \rho_{\odot}\left(\frac{M}{M_{\odot}}\right)^{-1.1}$$

- **Temperature:** Temperature scales with the central temperature, adjusted for radial position. For the radiative zone:

$$T \approx T_{\odot}\left(\frac{M}{M_{\odot}}\right)^{0.5}$$

- **Opacity:** OPAL opacities depend on ρ and T. We interpolate from OPAL tables, adjusting for scaled densities and temperature.

OPAL Opacity Adjustments

OPAL opacities are sensitive to ρ and T. For higher-mass stars, higher temperatures and densities shift opacities. We approximate:

- **Inner:** Higher T, similar ρ, so $\kappa \approx 0.008–0.01\text{m}^2/\text{kg}$.
- **Mid:** $\kappa \approx 0.04–0.05\text{m}^2/\text{kg}$.
- **Outer:** Lower T, lower ρ, so $\kappa \approx 0.15–0.2\text{m}^2/\text{kg}$.

Calculations for Each Star

We calculate for each mass (2x, 5x $M\odot$) at inner, mid, and outer radii.

2 x Sun (M=2$M\odot$)

- **Luminosity:** L=3.846×10^{26}·23.5≈2.72×10^{27}W
- **Radius:** R=6.96×10^8·20.7≈1.12×10^9m.
- **Density:** $\rho=\rho\odot\cdot 2^{-1.1}\approx\rho\odot/2.14$
- Inner: 20,000/2.14≈9,346kg/m³
- Mid: 2,000/2.14≈935kg/m³.
- Outer: 200/2.14≈93.5kg/m³.

- **Temperature:** $T=T\odot$**·20.5≈**$T\odot$**·1.414**
- Inner: 7×10^6·1.414≈9.9×10^6K.
- Mid: 3.7×10^6·1.414≈5.23×10^6K.
- Outer: 2×10^6·1.414≈2.83×10^6K

- **Kinetic Energy Density**
- **Inner:** r=0.25·1.12×10^9=2.80×10^8m, F= 2.72×10^{27}/(4π(2.80×10^8)²) ≈2.76×10^9W/m², kT=1.38×1^{0-23}·9.9×10^6≈1.37×10^{-16} J, κ≈0.01m²/kg.
  ne≈1.88 x 1018 m⁻³ (conservative)
  ε≈ 1.88 x 10^{18} x 1.37 x 10^{-16} ≈ 2.58 x 10^2 J/m³
- **Mid:** r=0.475·1.12×10^9=5.32×10^8m, F≈7.67×10^8W/m2, kT≈7.22×10^{-17} J, κ≈0.05m²/kg.
  ne≈4.97 x 10^{17} m⁻³ (conservative)
  ε≈ 4.97 x 10^{17} x 7.22 x 10^{-17} ≈ 3.59 x 10^1 J/m³
- **Outer:** r=0.7·1.12×10^9=7.84×10^8m, F≈3.54×10^8W/m², kT≈3.91×10^{-17} J, κ≈0.2m²/kg.
  ne≈1.69 x 10^{17} m⁻³ (conservative)
  ε≈ 1.69 x 10^{17} x 3.91 x 10^{-17} ≈ 6.61 J/m³

- **Speeds**
  - Inner: $v_{\text{avg}} \approx \sqrt{\frac{3\cdot 1.38\times 10^{-23}\cdot 9.9\times 10^6}{9.11\times 10^{-31}}} \approx 7.8\times 10^7\text{m/s}$, $v_{\max} \approx \sqrt{\frac{6\cdot 1.37\times 10^{-16}}{9.11\times 10^{-31}}} \approx 1.10\times 10^8\text{m/s}$.
  - Mid: $v_{\text{avg}} \approx 5.9\times 10^7\text{m/s}$, $v_{\max} \approx 8.3\times 10^7\text{m/s}$.
  - Outer: $v_{\text{avg}} \approx 4.5\times 10^7\text{m/s}$, $v_{\max} \approx 6.4\times 10^7\text{m/s}$.

5x Sun (M=5$M\odot$)

- **Luminosity:** L=3.846×10^{26}·$5^{3.5}$≈6.77×10^{28}W.
- **Radius:** R=6.96×10^8·50.7≈2.20×10^9m.
- **Density:** $\rho=\rho\odot\cdot 5^{-1.1}\approx\rho\odot/3.62$.
- **Inner:** 20,000/3.62≈5,525kg/m³.
- **Mid:** 2,000/3.62≈552kg/m³.
- **Outer:** 200/3.62≈55.2kg/m³.

- **Temperature:** $T=T\odot$·50.5≈$T\odot$·2.236.
- **Inner:** 7×10^6·2.236≈1.57×10^7K.
- **Mid:** 3.7×10^6·2.236≈8.27×10^6K.
- **Outer:** 2×10^6·2.236≈4.47×10^6K.

- **Kinetic Energy Density**
- **Inner:** r=5.50×10^8m, F≈1.78×10^9W/m², kT≈2.17×10^{-16} J, κ≈0.008m²/kg.
  ne≈3.62 x 10^{17} m⁻³ (conservative)
  ε≈ 3.62 x 10^{17} x 2.17 x 10^{-16} ≈ 7.85 x 10^1 J/m³
- **Mid:** r=1.05×10^9m, F≈4.89×10^8W/m², kT≈1.14×10^{-16} J, κ≈0.04m²/kg.
  ne≈9.46 x 10^{16} m⁻³ (conservative)
  ε≈ 9.46 x 10^{16} x 1.14 x 10^{-16} ≈ 1.08 x 10^1 J/m³
- **Outer:** r=1.54×10^9m, F≈2.27×10^8W/m², kT≈6.17×10^{-17} J, κ≈0.15m²/kg.
  ne≈3.05 x 10^{16} m⁻³ (conservative)
  ε≈ 3.05 x 10^{16} x 6.17 x 10^{-17} ≈ 1.88 J/m³

Speeds

- **Inner:** v_{avg}≈9.8×10^7^m/s, v_{max}≈1.39×10^8^m/s.
- **Mid:** v_{avg}≈7.4×10^7^m/s, v_{max}≈1.04×10^8^m/s.
- **Outer:** v_{avg} ≈5.6×10^7^m/s, v_{max} ≈7.9×10^7^m/s.

Emergent Time Value Related to Every Star Type

We've seen previously how to calculate the values of the average speed of the kinetic cloud for different type of stars (2x, 5x the Sun's mass) in different zones of their radiative layer.

Such speed is directly related to the emergent time value, according to [1]

Obviously the higher speed is reached in the inner zone. What we're interested now is comparing the value of the emergent time for each kind of star, extending a bit more the previous results for the conventional type of stars (O,B,A,F,G,K,M).

In the next Figure, we've extrapolated the values for every star type.

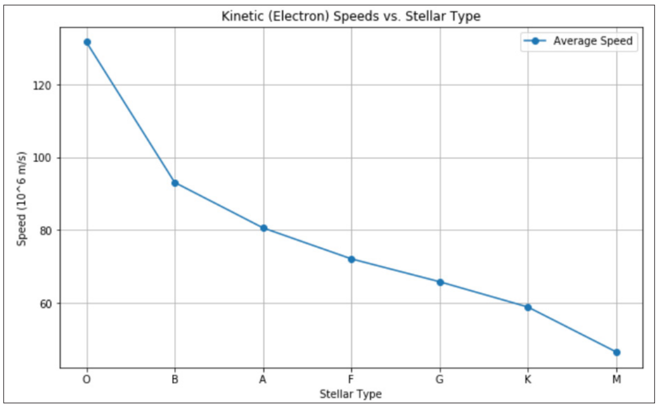

Figure 5

We take the Sun and the maximum average speed of its kinetic cloud (Sk) as reference. We can observe (Figure 5) that the relative average kinetic speed for the most massive star is less than double than a G star type like the Sun. For a small star (K type) is around 90% of the produced in the Sun. For a F type is around 110%. For a very small star (M type) is around 75%. In other words: The value of the emergent time ranges from 0.75 x Sk (smallest star) till almost 2 x Sk (largest stars).

F,G,K and M are the most common size of stars in the Universe (Figure 6).

$$\Delta Ts^2 = \frac{v^2}{c^2}$$

Gravity is directly proportional to ΔTs^2, then the gravity associated to every kind of star, taking as reference the Gravity produced in the Sun (G_0) and the percentage of mass suggested for every kind of stars in the Universe, can be estimated as follows [8]:

The approx. distribution of the Gravity shaped in the stars according of the mass percentage of every type of star is 20% like the Sun (G), 10% 119% the gravity reached in Sun (F), 20% 77% the gravity reached in Sun (K), 43% 57% of the Gravity reached in the Sun, and the rest (approx. 5%) from 110% to 200%.

Kind of Star	Average Speed (v x 10^7)	ΔTs (v/c)	ΔTs^2	% Gravity/G_0	% Mass	%Total Gravity
M	5.0	16.67%	0.0278	57	43.02	24.52
K	5.8	19.33%	0.0374	77	20.38	15.69
G	6.6	22.00%	0.0484	100 (G_0)	21.51	21.51
F	7.3	24.00%	0.0576	119	10.19	12.13
A	8.2	27.33%	0.0747	154	3.06	4.71
B	9.4	31.33%	0.0982	200	1.66	3.3
O	12.8	42.66%	0.1820	376	0.04	0.2

Total Gravity/G_0 **81.66**

Obviously this table and these values (Figure 7) are a basic approximation but it could serve as reference. It's very significant that we reach, simply taking as starting point our emerging time dilation estimation for every star, to results fully consistent. In fact, if we had taken as reference G_0 the gravity value from an intermediate star among types K and G instead the Sun's/G, the estimated total gravity shaped by the stars had been 100%:

Kind of Star	Average Speed (v x 10^7)	ΔTs (v/c)	ΔTs^2	% Gravity/G_0	% Mass	%Total Gravity
M	5.0	16.67%	0.0278	70	43.02	30.11
K	5.8	19.33%	0.0374	95	20.38	19.36
K-G	6.0	19.88%	0.0395	100 (G_0)	-	-
G	6.6	22.00%	0.0484	123	21.51	26.45
F	7.3	24.00%	0.0576	146	10.19	14.88
A	8.2	27.33%	0.0747	189	3.06	5.78
B	9.4	31.33%	0.0982	249	1.66	4.10
O	12.8	42.66%	0.1820	461	0.04	0.20

Total Gravity/G_0 ≈ **100**

Our next question is … where do "our" Gravity come from?... In what kind of star(s) was shaped the Gravity of the celestial bodies of our solar system?...Is the gravity of our solar system a good average of the current state of the Gravity in the Universe?....

All the Hydrogen of the Sun (formed 4.6 billions of years ago) is more than likely comes from the Big-Bang. Its primordial gravity had been shaped by the interaction among the primordial electromagnetic energy and the matter [1].

The matter of the planets would have different procedences. Although the stars have a "natural death" date in function of their size, there're a lot of cosmological events that could lead to their previous death or transformation. In fact we have exposed the theory that many early stars had not been able to evolve because of their low gravity [1].

Therefore although the matter could also come from smaller stars, it's expected that the heaviest elements would come from massive stars due to their shorter life expectancy. So it's very likely that most of the heaviest elements on the Earth share a same origin (3).

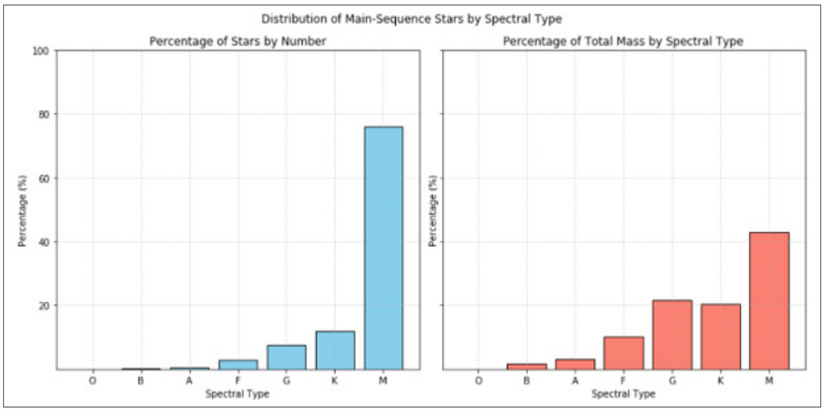

Figure 6

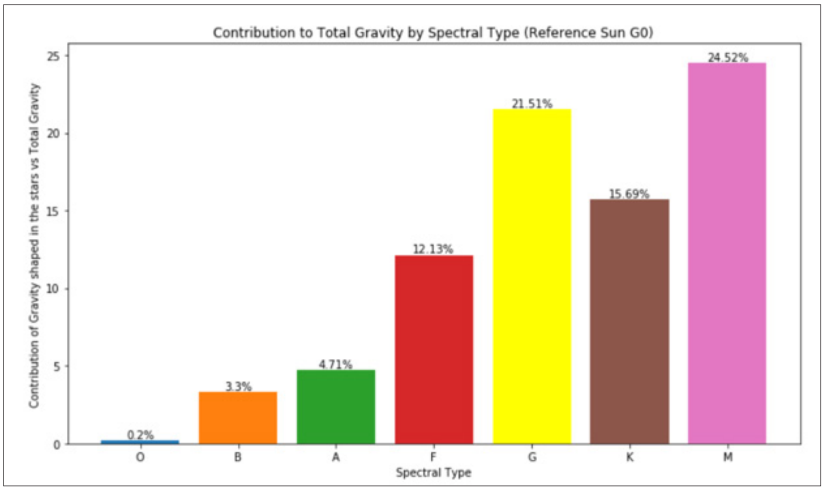

Figure 7

Paleogravity
Before introducing this new concept, we should talk a bit about the G gravitational constant.

According to [1], ***G should not be considered constant anymore***. Gravity had evolved over the cosmological Time, therefore we ***would refer it as G(t) instead***. G(t) would not be the same in different locations of the Universe, although its estimated value could be enough for calculations related to our closest environment.

From the first ingenious experiment carried out by Cavendish other many efforts have been done to measure the G value although showing relevant discrepancies [11].

The actual Cavendish goal was measure the Earth density but it led as consequence to get the G value. He used Lead spheres due the high density of this element. After Cavendish other experiments have been carried out, most of them with very heavy elements. As we commented before (3), it's very likely that most of the heaviest elements on Earth share a same origin, or at least come from the same type of stars. Therefore the value of G obtained by these methods would not be the most reliable.

Some very promising researchs based on atom interferometry have been done recently. They have used other chemical elements like Rubidium and Cesium, but such elements are expected to share the same origin than the heaviest ones, that is, massive stars. In any case there're also some relevant discrepancies in the results obtained by this method.

My view is no one has taken into account the possibility that the induced gravity by different elements could differ from that expected.

It's very likely that extending methods like atom interferometry to most of the chemical elements could be the first way of demonstrating my work and my new cosmological model, although there're obviously other ways.

What's more, using the material coming from asteroids, Moon, Mars and other planets would be specially relevant.

This would be the birth of a new discipline. It's what I call ***PaleoGravity***, whose function would be to ***study the origin of any chemical element present on Earth and in the solar system***, with the possibility of extending the research to any point of the Universe.

Discussion
We've studied in depth the topology and morphology of the electrons kinetic cloud associated to the emergence of the emergent time specially in the Sun's radiative layer. We've ruled out (based on the current knowledgment) that the kinetic cloud could be considered a Coulomb liquid, but the interesting studies about this emergent subject are still in an early stage so it should not be ruled out for the future. Even more taking into account the role played by the scattering cloud, its special topology and close relationship with the kinetic cloud.

The current confinement technologies related to the new fusion projects could be of great interest not only for demonstrating this theory about the origin and evolution of Gravity but for researching in detail the behaviour and properties of the kinetic and scattering clouds.

Other interesting results that could be achieved when simulating the conditions in the different zones of the radiative layer are the correct ionization degrees.

We're facing an amazing opportunity to simulate in a lab the behaviour of the plasma in the Sun's radiative zone, not only in the core. What's more: such studies would be also very useful to improve fusion technologies, because one of the main problems that are facing currently the fusion researchers is linked to "runaway electrons" which affect to drastic drops in temperature [12].

These suggested experiments should not be so difficult due to the temperature requirements are lower than those achieved in current magnetic confinement systems.

I think the effort is well worth it.

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