A temperature-derived solar-mass model and running parameters resolve dark matter

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Abstract

Gravitational lensing and galactic rotation curve data evidence that galactic mass calculations, via the centripetal force method, obtain results significantly less than total matter indicated, by about 5.35:1. This major invisible component is known as dark matter, interacting gravitationally. Newtonian and general relativity gravitational models diverge on multiple fronts, suggesting neither model is complete. Dimensional analysis, when reduced to units of length and time only, identifies the scaling mode for dimensional parameters. Gravity is accordingly modified. Speed of light c is shown to be the velocity of least energy for fundamental particles. Modified gravity reveals that galactic mass calculations via the centripetal force method are incorrect. Comparison of solar volumetric temperature slices against atomic hydrogen temperature, provides a method for calculating solar mass. Recalculating galactic mass via running parameters, and solar temperature analysis in atomic hydrogen terms, fully resolves dark matter.

1. Introduction

Dark matter

Galactic survey data showing dark halos imply a significant portion of mass is unseen, referred to as dark matter [1-3]. This shows up in rotational data and gravitational lensing. In galactic rotation curves, for example, rotational velocities are greater than expected for the mass estimated, and extend well into the furthest reaches of galactic arms [1-2]. Various data [1-5] place the dark matter (DM) proportion at about 84.25% of total matter content. This implies roughly 5.35 times more DM than ordinary matter. Efforts to find the identity of DM have proved fruitless. Carroll [6] states –

> *'Essentially every known particle in the Standard Model… has been ruled out as a candidate for this dark matter.'*

Nearly all the proposed models for DM rely on Newtonian or Einsteinian gravity being correct [2], and that mass for each particle is the invariant rest mass [6].

Gravity models and confusion

Classical Newtonian theory purports gravity to be a force between massive bodies, [7] while general relativity regards gravity as a field-interaction for massive bodies within a curved space-time metric [6]. In the latter, Einstein's field equations require that gravity has dimensions of energy density [6]. Closer examination identifies that gravity under general relativity actually has dimensions energy-density per force, [7] resulting in a per area charge (m^{-2}). This is due to dimensions for c^4 in Einstein's constant k being omitted when expressed as $8\pi G/c^4$, where $c = 1$ [6]. Inherent difficulties exist in both models, with ultimately little common ground.

Adding to the confusion is special relativity, which occurs in Minkowski space by deliberately avoiding gravity. Every particle interacts gravitationally however, irrespective of the model employed.

A poorly understood concept is how dimensional parameters scale with energy. Particle collider experiments have long established that mass is not conserved, [6] thus by Einstein's equivalence equation, neither is energy. Velocity change is at the heart of the matter. If parameters scale with energy, they must necessarily be dimensional. Obviously, if the gravitational constant and gravity are dimensional, they *must* scale with energy. Simple corrections for dimensional analysis identify running modes for dimensional parameters, revealing the route towards quantum gravity. Time-dimensioned parameters (e.g. frequency), retain their values at speed of light, *c*, for all velocities. Below *c*, parameter scaling mode is determined by the exponent on length dimensions. Consequently, non-linear physics emerges at velocities less than speed of light [8].

2. Analysis

Dimensional analyses

An alternative dimensional analysis system [8] reducing dimensions to those of time (s) and distance (m) only, provides insight. Parameters with time dimensions retain their values at *c*, for velocities < *c*. A mode change occurs for running parameters for wave-particle velocities < *c*, where scaling is determined by the exponent on the length component. Scaling of wave-particles with energy is usually linear at *c*, but mostly nonlinear at velocities < *c*. This is synonymous with symmetry-breaking.

This alternative dimensional analysis system – in 'original units' (OU) identifies dimensional errors in the SI system for some parameters, created via the fine structure constant being necessarily dimensional (because it runs, see below). Many particle parameters are wave-particle specific, mostly electron-valued. The subscript $_0$ (in vacuum) is duly removed for the remainder of this work for all dimensional parameters.

The OU system showed Ω ≡ s^2, H ≡ s^3, F ≡ s^{-1}, and A ≡ m^{-2}. This resulted in the magnetic permeability constant μ having dimensions Ω m^{-1}, or s^2 m^{-1}, and ε having dimensions m^{-1}. [8] Consequently, the kg has OU dimensions s^5 m^{-6}, *E* has dimensions s^3 m^{-4}, as does temperature, K. The coulomb in OU is s m^{-2}, so the SI unit volt is equivalent in OU to s^2 m^{-2}. The Boltzmann constant *k* is dimensionless in OU (J/K cancel out). The Planck constant *h* has OU dimensions s^4 m^{-4}. Relevant parameters are set out below. The quantity *c* is simply velocity.

$$E = h\nu = mc^2 \text{ J} = \text{s}^3 \text{ m}^{-4}, \tag{2.1}$$

$$m = \frac{h}{c\lambda} \text{ kg} = \text{s}^5 \text{ m}^{-6}, \tag{2.2}$$

$$h = \frac{E}{\nu} = m\lambda c \text{ J s} = \text{s}^4 \text{ m}^{-4}, \tag{2.3}$$

$$T = \frac{E}{k} = \frac{hc}{k\lambda} \text{ K} = \text{s}^3 \text{ m}^{-4}. \tag{2.4}$$

Speed of light

The inappropriately named 'speed of light' has a defined value at 299,792,458 m.s^{-1} in vacuum [9]. It relates the electric field E to the magnetic field B as E = B*c*, [7] with dimensions V/m = N/C for E, and tesla T, for B. This velocity *c* may equally be described as the ratio of the electric field strength versus magnetic flux density of a wave-particle duality (wavicle) propagating through some medium. Lowest energy for the wavicle occurs when the ratio E/B is greatest, i.e. at the 'speed of light'. This applies to *all* fundamental wavicles, including photons. Such a concept is the irreducible and irrefutable consequence of quantitative parameters such as *E*, *h*, and *T* having their lowest values at *c*.

The electric field interaction with the wavicle is classically regarded as a 'force' $F_e = k_e \frac{|q_1 q_2|}{r^2}$, where q is a charge, and r is the distance between charges [7]. The distance term simply relates the strength of the interaction as a gradient at some arbitrary length between sources, so r terms do not contribute to the actual interaction. Removal of the distance term provides dimensions for the electromagnetic interaction of C^2 m, rendering the interaction simply as

$$I_e = \frac{e^2}{4\pi\varepsilon} = c\alpha\hbar \,. \tag{2.5}$$

It follows that the magnetic field interaction is $B = \alpha\hbar$, with units $\mathrm{T} = \frac{\mathrm{J}}{\mathrm{A\ m}^2}$. Since A m^2 cancel out, tesla has the same dimensions in OU as energy: after all, magnetic energy, and temperature are all forms of energy [8].

The fine structure constant α is known to run experimentally, [10-11] requiring it to have dimensions *within which* to run. Dimensions for the fine structure constant from the magnetic field interaction B are therefore s^{-1} (or Hz), implying that alpha can *only* vary at the speed of light.

The concept of massless particles is created by the Lorentz factor in special relativity. Further discussion on special relativity is not required here, nor is necessary for the dark matter analysis that follows. A scaling index for running parameters is required for fundamental wavicles, where least energy occurs at c. Our running standard model shows c is the default velocity for all fundamental wavicles, electromagnetic interactions, also gravity. That's why it exists! At velocities less than c, wavicles acquire larger energy and mass. Stated differently, there is an energy cost to *slow* a fundamental wavicle from c. In short, mass must increase. Profound implications arise for special relativity, which actually evidences frame effects caused via relative momentum between macroscopic observers and their macroscopic clocks [12]. Frame effects do not influence or determine fundamental wavicle dimensional values.

Quite clearly, the Planck constant h is inversely proportional to c^4 and therefore has its *least* value at c, where it is actually constant. If these observations (regarding c at least energy) were incorrect, the universe would not exist as we observe it. Conversely, macroscopic matter tends towards lowest velocity, because these are ionically-bound, complex structures with multiple competing and thus cancelling electromagnetic fields.

The amended standard model then becomes invariant under multiple systems of simultaneous assessment, including four running modes, and two systems of dimensional analysis (SI and OU). Gravity is also united with quantum theory. It is anticipated that running parameters will resolve several outstanding problems in physics, including dark matter, strong and weak interactions, and unification of gravity with the electromagnetic interaction. It may identify new physics, perhaps.

Gravitational constant

The enigmatic gravitational constant G has not previously been associated with other common constants, yet such relationships must exist in a unified theory. Experimental data values range from ~ 6.67×10^{-11} to ~ 6.68×10^{-11}, [13]. Measurement errors are exacerbated by G scaling with temperature and energy, which must be accounted for. Traditional (and still current) dimensions for G are $m^3\ kg^{-1}\ s^{-2}$, yet dimensional analyses here demonstrate that G with traditional dimensions would decrease in value at n^{-9} at velocities below c, on *increasing* energy! Fortunately, this is not observed, for gravity would be seriously impaired. Gravity is not a force.

From dimensional analyses [8] and discovery of what appears to be a primordial code within the universe [14], the gravitational constant G is almost certainly

$$G=\alpha^{2}\mu=\frac{\alpha^{2}}{\varepsilon c^{2}}=\frac{\pi\phi^{2}\alpha}{3c}=\frac{\pi\phi^{2}\mu e^{2}}{6h}\ \text{m}^{-1}, \tag{2.6}$$

where phi is the golden ratio, and the interaction constant is

$$k_{I}=\frac{\pi\phi^{2}}{3}=\frac{Gc}{\alpha}=c\alpha\mu=2.741\ 598\ 782\ldots \tag{2.7}$$

The value for G above is 6.673 421 016 × 10^{-11} m^{-1}, valid at the electron charge radius at c. [Note: all fundamental wavicles share the same value for G however, when scaled to the electron charge radius at c.] G being velocity dependent (inversely proportional), scaling provides that all experimental values for G will be correct for some mass at some velocity. If gravity propagates at c, then G is also involved at c, irrespective of the expressions and dimensions defining it. G is also proportional to ε, having the same dimensions.

Scaling of G becomes significantly relevant within high energy macroscopic matter states. What value should be assigned to G at high temperatures during the fusion process of hydrogen to helium for example?

Gravity

Gravity may now be treated as an interaction, not a force. In simplest terms, wavicle self-gravity is simply mass times G, providing dimensions kg m^{-1}, or linear density. Equivalently, this is

$$I_{g}=Gm=\frac{GE}{c^{2}}=\frac{k_{I}\alpha m}{c}=\frac{Gh}{c\lambda},\ \text{in}\ \frac{\text{kg}}{\text{m}}=\frac{\text{V Wb}}{\text{m}^{3}}=\frac{\text{s}^{5}}{\text{m}^{7}}. \tag{2.8}$$

The term I_g shows gravity is an interaction, not a force. Gravity runs at the inverse square of distance, as generally observed. Removal of distance terms for the interaction does not prevent gravity retaining its inverse square relationship as a gradient over distance, irrespective of velocity, from its original value at c. Notwithstanding this point, gravity *is* velocity dependent, increasing at n^7 as velocity reduces, i.e. significantly for macroscopic matter. Interestingly, the alternative SI dimensional units volt-webers per cubic metre for gravity, indicate that the electromagnetic interaction is included within mass. It also indicates a non-vanishing, albeit ethereal geometry (no point particles exist). These various features hint that strong and weak interactions are related through gravity, [8] and unification likely occurs during the nuclear fusion process. If so, quantum tunnelling is not required for fusion. Gravity modified via running parameters integrates seamlessly with quantum theory, constituting the quantum gravity standard model. [Note: gravity as Gm with traditional dimensional units for G scales at n^{-3} on increasing energy, (i.e. gravity weakening significantly) which is not observed. Galaxies would not be capable of forming.]

Gravity incudes the Planck constant, via energy, which includes mass, which in turn includes the electromagnetic interaction:

$$m=\frac{2\pi I_{e}}{c^{2}\alpha\lambda},\ \text{so therefore}\ I_{g}=\frac{2\pi G I_{e}}{c^{2}\alpha\lambda}. \tag{2.9}$$

There are no requirements for separate spinor, or gauge fields [6], if wavicles constitute electromagnetic disturbances in the scalar Higgs field. Gravity is a property of, and propagates with, the wavicle, constituting a moving contraction along the wavicle vector. Gravitational radiation via wavicles of all descriptions, including radiating waves following elastic and inelastic collisions, propagates at local c or wavicle velocity. In other words, gravity propagates at the speed of matter. Electromagnetic resistance caused by the passing wavicle ought to result in a small yet measurable energy loss. For photons at c, this would present as a red-shift, perhaps even the Hubble shift.

Mass density combines mass, gravity and volume as follows:

$$\rho = \frac{I_g}{GV} = \frac{m}{V} = \frac{2\pi m}{\lambda^3} . \qquad (2.10)$$

[Volume is *V*.]

3. Methodology

Macroscopic matter (and antimatter), bound electromagnetically and gravitationally require that a significant proportion exists at velocities < c, rather than as 'free' fundamental particles. Since mass (matter and antimatter) increases at n^6, a relatively small velocity reduction results in a large mass increase [8]. This is only part of the problem however.

To determine whether dark matter can be exposed as a measurement problem, we model the sun in hydrogen terms, matching volumetric temperature slices against mass. This is despite the fact that solar constituents include helium, and traces of heavier elements. Volumetric temperature slices are then compared to hydrogen (protium) atomic temperature, at c, converted to mass, and summed. The summation mass is then adjusted via an index to normal atomic hydrogen mass (velocity adjusted). This method relies upon the fact that temperature of the hydrogen atom far exceeds that of each temperature shell within the sun. Effectively, the model treats each volumetric shell as a superluminal hydrogen atom, as a ratio against actual hydrogen atomic temperature.

Galactic mass calculations historically have been made from the assumption that gravity is a force, and that gravity is equal to centripetal force [2, 5]. Calculations are generally of the form

$$G\frac{M_r m}{r^2} = \frac{mV_r^2}{G} \rightarrow M_r = \frac{rV_r^2}{G} , \qquad (3.1)$$

where V_r is rotational velocity at distance r from centre of the galaxy; however, the actual dimensions here are $m^4/s^2 \neq$ mass. G scales with energy, so the value used here is unlikely to be correct. Dimensions for G are not correct (m^{-1}). This equation also omits volume, so is thus incorrect on multiple grounds. It becomes obvious that DM exists primarily due to error of measurement. To resolve this issue, we first need to calculate a galactic disk mass as obtained via the centripetal equation. This may then be contrasted with measurements using our modified dimensions above, incorporating running parameters.

Temperature

Solar temperature gradient measurements show a sharp initial increase from the photosphere (~ 5772 K, [15]) inwards to about 80% of the radius, followed by a relatively uniform increase towards the core, where temperatures exceed 10^7 K [16]. Ostlie & Carroll [7] give the core temperature at ~ 1.5×10^7 K. These data allow one to compare mean solar temperature 'slices' (gradient mid-point) at different fractional volume shells, against the temperature of a hydrogen (protium) atom, scaled back to c. For this task we adopt the temperature gradient chart from Christensen-Dalsgaard [16]. (Volume assumes a spherical solar geometry, radius as per [15]). Each shell mass is then calculated and summed for total solar mass. The solar radius is agreed to be 6.957×10^8 m [15], providing a total volume at ~ 1.410×10^{27} m^3.

Solar output is agreed at 3.828×10^{26} W, [15] providing 26.731 MeV [7] which translates to ~ 4.26×10^9 kg s^{-1}. This however, relies on hydrogen propagation at c. Mass is significantly increased at fusion temperatures [12], and calculated here as ~ $4.410\,731 \times 10^{14}$ kg. It is of little consequence, however, since it doesn't even register against the much larger shell masses.

Calculations

Using a galactic disk at 50,000 light years, of uniform mass density (ignoring central bulge and spiral arms), and a rotational velocity of (up to) 250 km/s [3, 17], where G has the value per CODATA 2022 in traditional units [9] provides:

$$M_r = \frac{rV_r^2}{G} \approx 4.43 \times 10^{41} \text{ kg (actually m}^4/\text{s}^2\text{)}. \tag{3.2}$$

The protium atom consists of an electron at 'rest mass' (i.e. c), and a proton at (or near) full mass, from current values [9, 18]. This protium atom must be scaled back to c for initial calculation purposes (mostly for ease of calculation) [8]. (This process described in [12]). Mass scales at n^6, providing a combined index for protium at $n \approx 1.316\,335$. Protium mass at $c \approx 3.216\,88 \times 10^{-28}$ kg, with temperature $T_{1H} \approx 2.0986 \times 10^{12}$ K. Density for the protium atom is obtained from volume (volume = $\lambda^3/2\pi$), [14] where the combined wavelength is obtained at c from $\lambda = h/mc$. Density for the atom $\approx 6.2715 \times 10^{15}$ kg/m^3 at c, is related to gravity I_g via $I_g = \rho VG$ (density, volume and gravitational constant).

The fourth-root of the temperature ratio (temperature scales at n^4) between protium and any solar shell mean-temperature, provides the base factor from which to calculate solar shell density in protium terms. Protium atomic density (at c) is then divided by this temperature ratio base-factor at the 9$^{\text{th}}$ power (density scales at n^9), then multiplied by solar shell volume to obtain each shell mass, per (3.3).

$$m_{\odot shell} = \frac{V_{\odot shell}\,\rho_{1H(c)}}{\left[\sqrt[4]{\left(\frac{T_{1H(c)}}{T_{\odot shell}}\right)}\right]^9} = \frac{V_{\odot shell}\,\rho_{1H(c)}}{\left(\frac{T_{1H(c)}}{T_{\odot shell}}\right)^{2.25}} \tag{3.3}$$

Table 1 sets out this analysis.

Shell limit (radius)	Fractional solar volume	Approx. mean temp K	$^4\sqrt{(T_{1H}/T_{shell})}$	atomic density from ρ^1H(c)	Total shell mass
sh_1 core (fusion)	minimal	> 10^7	fusion	fusion	4.411E+14
sh_2 core - 20%	0.008	~ 1.25×10^7	~ 20.242	10992.52	1.240E+29
sh_3 20 - 40%	0.056	~ 6.5×10^6	~ 23.837	2524.09	1.994E+29
sh_4 40 - 60%	0.152	~ 3.25×10^6	~ 28.347	530.624	1.138E+29
sh_5 60 - 80%	0.296	~ 2.25×10^6	~ 31.077	231.985	9.685E+28
sh_6 80 - 100%	0.488	~ 5×10^5	~ 45.262	7.866	5.414E+27

Table 1: Obtaining mass from temperature ratio between protium (at c) and solar shell mass, then converting to density, and subsequently obtaining mass via each shell volume. Temperatures for fractional shells per [16].

Solar shell masses are summed, multiplied by n^6 (protium index) for proper mass in hydrogen terms, then divided by 0.9986 for total solar system mass [19].

$$m_{\odot total} = \sum_{i=1}^{6} m_{\odot shell}\,, \tag{3.4}$$

$$m_{\odot sys} = \left(\frac{m_{\odot total}}{0.9986}\right) n^6 . \tag{3.5}$$

Alternative methods include converting temperature to energy, or gravity to mass, to resolve, with each method providing the same results.

4. Results

From (3.3) to (3.5) provides a solar system mass of ~ 2.81×10^{30} kg. There appears to be no real consensus regarding average stellar distances within a galaxy, but about 5 light years seems useful. This provides a spatial territory for a stellar system at half this distance. One can choose a disk, at 2.5 light years with depth at say, 0.8 light years, or a cube. Dividing the solar system mass by a spatial cube with sides at 2.5 light years (~ 1.323×10^{49} m^3), provides the mean solar system or stellar-district density 'locally' within the galaxy for this task. This result is then multiplied by the disk volume for a galaxy cut off at 50,000 light years, with disk depth at 2,000 light years ($\pi r^2 d \approx 1.330 \times 10^{61}$ m^3) assuming uniform mass distribution.

$$m_{Gxy} = \frac{m_{\odot sys} V_{Gxy}}{V_{\odot sys}} \tag{3.6}$$

A galactic disk mass is thus obtained from (3.6) at ~ 2.82×10^{42} kg, around 6.37 times greater than mass for the same disk via the centripetal method. The solar system disk at 2.5 by 0.8 light years produces a result at ~ 2.81×10^{42} kg, around 6.34 times greater than that obtained by centripetal method. Although electromagnetic solar emissions and intra solar system gases are ignored, this method comprehensively resolves dark matter as a measurement problem.

5. Conclusions

Dimensional analysis using only length and time units amends the standard model. Running parameters scale with energy, uniting gravity seamlessly with quantum theory, resolving anomalies. Comparison of solar volumetric temperature slices against the atomic hydrogen temperature, provides a method of calculating solar mass. Gravity is not a force, thus the centripetal method for calculating galactic mass from rotational velocity is not correct. Dark matter is shown to be a measurement problem, being completely resolved via the running model, and solar temperature analysis.

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