A Source of Energy for Any Kind of Star

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We discuss a recently predicted mechanism whereby energy is produced by the background space non-holonomic field (the global space rotation) in Thomson dispersion of light in free electrons. We compare the mechanism to the relations of observational astrophysics — the mass-luminosity relation and the stellar energy relation. We show that by such a mechanism generating energy in a star, the luminosity of a star L is proportional to its volume, with a progression associated with increasing radius. The obtained relation $L \sim R^{3.4}$ explains why there are no stars of a size close to that of the bulky planets. This also explains the extremely high thermal flow from within Jupiter, which most probably has the same energy sources as those within a star, but with a power much less than that required to radiate like a star. The theory, being applied to a laboratory condition, suggests new energy sources, working much more effectively and safely than nuclear energy.

1 The mechanism that generates energy in stars

By way of introduction, a brief account of my theory of the mechanism producing energy in stars [1] built within the framework of General Relativity, is presented. Then, in the next section, we analyse consequences of the theory in comparison with the correlations of observational astrophysics.

Given a non-holonomic space*, time lines piercing the spatial section (our proper three-dimensional space) are not orthogonal to the spatial section therein, which manifests as the three-dimensional space rotation. If all time lines have the same inclination to the spatial section at each of its points, there is a field of the background space non-holonomity. Such a non-holonomic background field, if perturbed by a local rotation, can produce a force and energy flow in order to compensate for the perturbation in itself. Such a force and energy flow were deduced on the basis of the equations of motion in a non-holonomic space: they manifest as additions to the total force $\Phi^{i}_{(0)}$ driving a particle and the total power $W_{(0)}$ spent on the motion

$$W = \frac{dE}{d\tau} = W_{(0)} + \delta^m_n \frac{\tilde{v}^n}{\bar{v}^m} W_{(0)}\,, \tag{1}$$

$$\Phi^i = \frac{dp^i}{d\tau} = \Phi^i_{(0)} + \delta^m_n \frac{\tilde{v}^n}{\bar{v}^m} \Phi^i_{(0)}\,, \tag{2}$$

where $\bar{v}^i$ is the constant linear velocity of the background space rotation, while $\tilde{v}^i$ is the linear velocity of a local rotation perturbing the background. As obtained within the framework of General Relativity [1], the value of $\bar{v}^i$ is the fundamental constant $\bar{v} = 2.187\,671 \times 10^8$ cm/sec connected to the value $\bar{\mathrm{v}} = \frac{\bar{v}}{2\pi} = 3.481787 \times 10^7$ cm/sec of a dipole-fit velocity $\bar{\mathrm{v}}^i$ characterizing the anisotropy of the rotating background (which is similar to a global gyro). The analytical value $\bar{\mathrm{v}}$ is in close agreement with the dipole-fit velocity 365 ± 18 km/sec extracted from the recently discovered anisotropy of the Cosmic Microwave Background Radiation.

Such an additional factor should appear in Thomson dispersion of light in free electrons in stars. When a light wave of average energy density B encounters a free electron, the flow of the wave energy $c\sigma B$ is stopped in the electron's square $\sigma = 6.65 \times 10^{-25}$ cm^2 (the Thomson square of dispersion). As a result the electron gains an acceleration σB, directed orthogonally to the wave front. With this process the electron oscillates in the plane of the wave at the frequency ω of the wave's electric strength E^i oscillating in the plane. Let the wave travel in the x^1-direction, so $E^2 = E$, $E^1 = E^3 = 0$. The oscillation equation gives the linear velocity $\tilde{v}^i$ of the local space rotation, caused by the oscillating electron,

$$\tilde{v}^2 = \frac{eE}{m_e \omega}\,, \qquad \tilde{v}^1 = 0\,, \qquad \tilde{v}^3 = 0\,. \tag{3}$$

Because the density of energy in an isotropic electromagnetic field is $B = \frac{1}{4\pi} E_i E^i$, the additional force and the power produced in the Thomson process by the global non-holonomic background should be

$$\Delta W = \frac{\tilde{v}^2}{\bar{v}^2} W_{(0)} = \frac{e\sqrt{4\pi}}{m_e \bar{v}} \frac{\sqrt{B}}{\omega} W_{(0)}\,, \tag{4}$$

$$\Delta \Phi^1 = \frac{\tilde{v}^2}{\bar{v}^2} \Phi^1_{(0)} = \frac{e\sqrt{4\pi}}{m_e \bar{v}} \frac{\sqrt{B}}{\omega} \Phi^1_{(0)}\,, \tag{5}$$

so the output of energy ε produced by the non-holonomic background in the process (within one cm^3 per second) is

$$\varepsilon = \frac{\tilde{v}}{\bar{v}} c n_e \sigma B = \frac{c\sigma e\sqrt{4\pi}}{m_e \bar{v}} \frac{n_e B^{3/2}}{\omega}\,. \tag{6}$$

In other words, our equation (6) is the *formula for stellar energy*. The factor $\frac{c\sigma e\sqrt{4\pi}}{m_e \bar{v}}$ is constant, while the second fac-

*A four-dimensional pseudo-Riemannian space, which is the basic space-time of General Relativity.

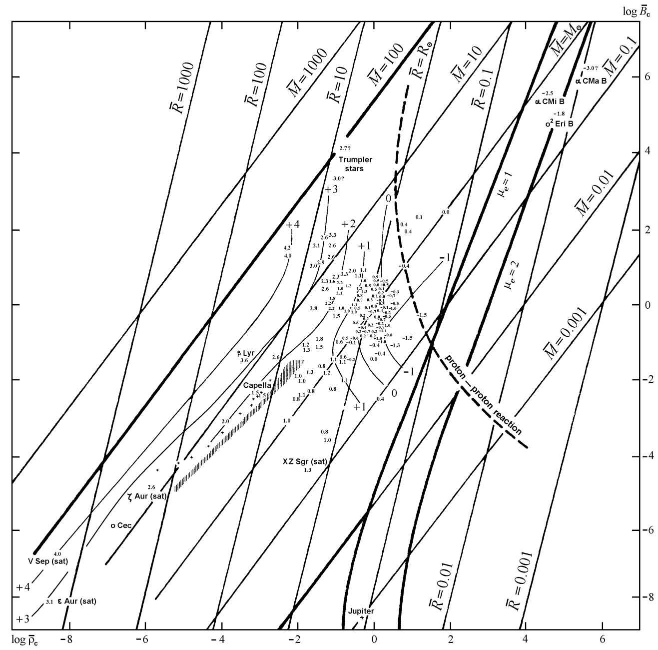

Fig. 1: Diagram of stellar energy: the productivity of stellar energy sources. The abscissa is the logarithm of the density of matter, the ordinate is the logarithm of the radiant energy density (both are taken at the centre of stars in multiples of the corresponding values at the centre of the Sun). Reproduced from [2]. Stars in the diagram are distributed along a straight line that runs from the right upper region to the left lower region, with a ball-like concentration at the centre of the diagram. The equation of the main direction is $\frac{B}{n_e} = 1.4\times10^{-11}$ erg (n_e is the concentration of free electrons).

tor depends mainly on the radiant energy density B in a star*.

Given the frequency $\nu = \frac{\omega}{2\pi} \approx 5\times10^{14}$ Hz (by the spectral class of the Sun), $\tilde{v}$ reaches the background space rotation $\bar{v} \simeq 2.2\times10^{8}$ cm/sec (so the additional energy flow fully compensates for the radiation) at $B = 1.4\times10^{11}$ erg/cm³, which is close to the average value of B in the Sun. The theoretical result coincides with the phenomenological data [2] by which energy is generated throughout the whole volume of a star with some concentration at the centre (in contrast to thermonuclear reactions working exclusively in the central region).

Besides the main direction $\frac{B}{n_e} = \text{const}$, along which stars are distributed in the stellar energy diagram, Fig. 1 testifies that the power of a mechanism that generates energy in stars is regulated by the density of radiant energy, i. e. by the energy loss by radiation. So the real mechanism producing stellar energy works similar to a self-regulated machine and is independent of the inner resources reserved in stars.

Our formula for stellar energy (6) satisfies this condition, because the energy output is regulated by the radiant energy density B. So a mechanism that works by formula (6) at an oscillation velocity $\tilde{v}$ close to $\bar{v} \simeq 2.2\times10^{8}$ cm/sec behaves as an universal self-regulating generator of energy: the output of energy ε the non-holonomic background produces in order to compensate for a perturbation $\tilde{v}$ in itself is regulated by the density of radiant energy B in the system, while the perturbation in the background $\tilde{v} = \frac{e\sqrt{4\pi}}{m_e\,\bar{v}}\frac{\sqrt{B}}{\omega}$ is caused by the oscillation of free electrons, also regulated by the radiant energy density B. If the average oscillation velocity of electrons $\tilde{v}$ in a star becomes larger than that of the background $\bar{v} \simeq 2.2\times10^{8}$ cm/sec, temperature increases, and so the star expands until a new state of thermal equilibrium is reached, with a larger luminosity that compensates for the increased generation of energy within. If the average oscillation velocity of electrons becomes less than $\bar{v} \simeq 2.2\times10^{8}$ cm/sec, the star contracts until a new thermal equilibrium with lower luminosity is attained.

If there were no other active factors slowly discharging the inner resources of a star (e. g. nuclear transformations of a different kind, etc), such a mechanism could generate stellar energy eternally, keeping stars in a stable radiating state.

*And, to a much smaller extent, on ω, which has changes within 1 order of magnitude along the whole range of the spectral classes of stars.

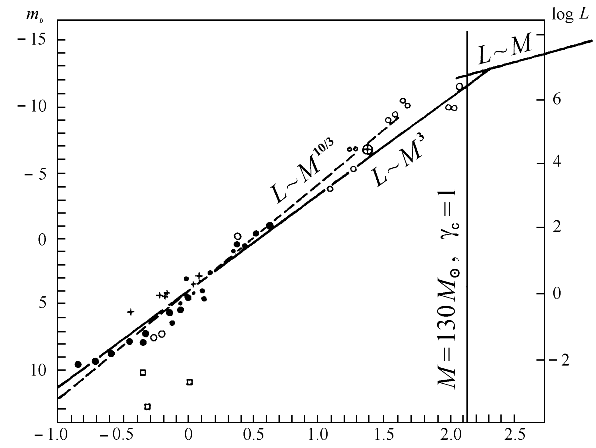

Fig. 2: The mass-luminosity relation. Here points are visual binaries, circles are spectral-binaries and eclipse variable stars, crosses are stars in Giades, squares are white dwarfs, the crossed circle is the satellite of ε Aurigae. Reproduced from [2].

2 Comparing the theory of stellar energy to observational data. The "volume-luminosity" correlation

We now analyse the implications of our formula (6) for stellar energy in comparison to the phenomenological data of observational astrophysics: the stellar energy relation (Fig. 1) and the mass-luminosity relation (Fig. 2).

We consider characteristics of a star in multiples of the corresponding values of the parameters for the Sun. We therefore operate with dimensionless characteristics: mass $\bar{M} = \frac{M}{M_\odot}$, radius $\bar{R} = \frac{R}{R_\odot}$, luminosity $\bar{L} = \frac{L}{L_\odot}$, productivity of energy $\bar{\varepsilon} = \frac{\varepsilon}{\varepsilon_\odot}$, etc. Using this notation, our formula (6) for stellar energy takes the form

$$\bar{\varepsilon} = \frac{\bar{n}_e \bar{B}^{3/2}}{\bar{\omega}} \simeq \bar{n}_e \bar{B}^{3/2}, \tag{7}$$

or, considering the hydrogen constitution of most stars, so that $n_e = \frac{\rho}{m_p}$ (i. e. $\bar{n}_e = \bar{\rho}$),

$$\bar{\varepsilon} = \frac{\bar{\rho}\,\bar{B}^{3/2}}{\bar{\omega}} \simeq \bar{\rho}\,\bar{B}^{3/2}. \tag{8}$$

By the stellar energy relation $\frac{B}{n_e} = \text{const}$ from the stellar energy diagram (see Fig. 1), we have $\bar{B} = \bar{n}_e = \bar{\rho}$ throughout the whole range of stars. We can therefore write the stellar energy formula (8) in the final form

$$\bar{\varepsilon} = \bar{\rho}\,\bar{B}^{3/2} = \bar{B}^{5/2}. \tag{9}$$

By the data of observational astrophysics, stars obey the principles of an ideal gas, except for the white dwarfs wherein the gas is in a state on the boundary of degeneration. We therefore obtain by the equation for an ideal gas $p = \frac{\Re T \rho}{\mu}$ (where $\Re$ is Clapeyron's constant, μ is the molecular weight), $\bar{p} = \frac{\bar{T}\bar{\rho}}{\bar{\mu}}$, or, with a similar molecular composition throughout the whole range of stars, $\bar{p} = \bar{T}\,\bar{\rho}$. The gaseous pressure p is determined by the state of mechanical equilibrium in a star, according to which the pressure from within is equal to the pressure of a column of the star's contents, so we obtain $\bar{p} = \frac{\bar{M}}{\bar{R}^2}\,\bar{\rho}\,\bar{R} = \frac{\bar{M}}{\bar{R}^2}\frac{\bar{M}}{\bar{R}^3}\,\bar{R} = \frac{\bar{M}^2}{\bar{R}^4}$. Therefore the density of radiant energy in a star is $\bar{B} = \bar{T}^4 = \frac{\bar{M}^4}{\bar{R}^4}$. So the stellar energy formula takes the final form,

$$\bar{\varepsilon} = \bar{B}^{5/2} = \frac{\bar{M}^{10}}{\bar{R}^{10}}\,. \tag{10}$$

We analyze this result, taking the mass-luminosity relation into account. According to well verified data of observational astrophysics, stars satisfy the mass-luminosity relation $\bar{L} = \bar{M}^{10/3} \simeq \bar{M}^{3.3}$ (see Fig. 2). The relation $\bar{L} = \bar{M}^3$ can be deduced from theory. Here is how. Thermal equilibrium in a star is characterized by the equation [2]

$$\varepsilon = -\frac{c}{\kappa\rho}\frac{dB}{dr}\,, \tag{11}$$

which means that the flow of energy generated in a star is balanced by the flow of radiant energy therein (κ is the coefficient of absorption). In other words, this formula is the *condition of energy drainage* in a star — the condition of radiation. From this formula we have, for stars of approximately the same chemical composition,

$$\bar{\varepsilon} = \frac{\bar{B}}{\bar{\rho}\bar{R}} = \frac{\bar{M}^3}{\bar{R}^2}\,, \tag{12}$$

and hence, because the luminosity of a star is $\bar{L} = \bar{\varepsilon}\bar{R}^2$, we obtain the mass-luminosity relation $\bar{L} = \bar{M}^3$.

As a matter of fact, ε determined by the energy drainage condition in a star should coincide with ε determined by the mechanism producing stellar energy — an *energy production condition*. In our theory of stellar energy, such an energy production condition is represented by the stellar energy formula $\bar{\varepsilon} = \bar{n}_e\bar{B}^{3/2} = \bar{\rho}\,\bar{B}^{3/2} = \bar{B}^{5/2}$.

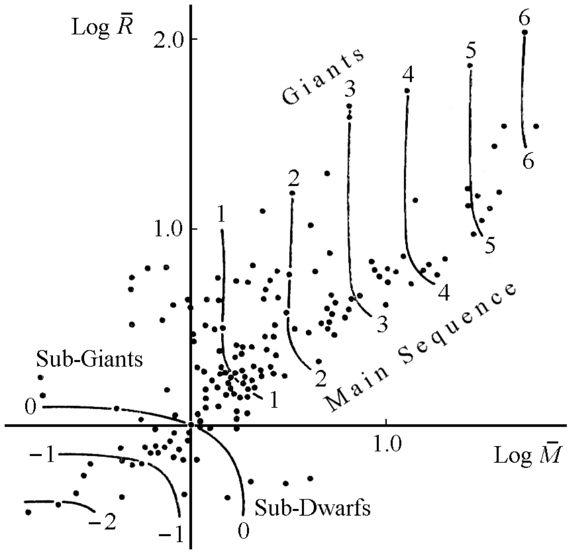

Fig. 3: Diagram of "mass–radius" devised by N. A. Kozyrev, the famous astronomer and experimental physicist, in the late 1970's. The arcs are isoergs of stellar matter. (Courtesy of V. V. Nassonov, Kozyrev's assistant, who had frequent meetings with the author in 1984–1985.)

We therefore substitute the observed mass-luminosity relation $\bar{L} = \bar{M}^{10/3}$ and the theoretical relation $\bar{L} = \bar{M}^3$ into our formula for stellar energy reduced to the absolute mass and radius of a star $\bar{\varepsilon} = \bar{B}^{5/2} = \frac{\bar{M}^{10}}{\bar{R}^{10}}$ (10). Because $\bar{L} = \bar{\varepsilon}\bar{R}^2$, our formula for stellar energy, in common with the observed mass-luminosity relation $\bar{L} = \bar{M}^{10/3}$, gives

$$\bar{L} = \bar{R}^4, \tag{13}$$

while with the theoretical relation $\bar{L} = \bar{M}^3$ our formula gives a slightly smaller exponent,

$$\bar{L} = \bar{R}^{3.4}. \tag{14}$$

In other words, for both the observed and theoretical mass-luminosity relation, our formula for stellar energy says that,

> On the basis of stellar energy being generated by the background space non-holonomity field, in Thomson dispersion of light in free electrons, the luminosity L of a star is proportional to its volume $V = \frac{4}{3}\pi R^3$, with a small progression with an increase of radius. We will refer to the newly discovered correlation as the *volume-luminosity relation*.

The predicted volume-luminosity relation $\bar{L} = \bar{R}^4$–$\bar{R}^{3.4}$ is derived from the condition of energy production by the non-holonomic space background in Thomson dispersion of light in stars (our theory of stellar energy). If such a correlation (the condition of energy production) is true, the correlation, in common with the energy drainage condition (the mass-luminosity relation $\bar{L} = \bar{M}^3$–$\bar{M}^{10/3}$), should produce another correlation; mass-radius $\bar{M} = \bar{R}^{1.1}$–$\bar{R}^{1.2}$. Fig. 3

shows a diagram devised by Kozyrev in the 1970's on the basis of observational data, along with many other diagrams within the framework of his extensive phenomenological research into stellar energy and the internal constitution of stars. As seen from the diagram, stars are distributed along the average direction $\bar{M} \sim \bar{R}$, which perfectly verifies the expected correlation $\bar{M} = \bar{R}^{1.1}$–$\bar{R}^{1.2}$ predicted on the basis of our formula for stellar energy. Hence the relation $\bar{M} \sim \bar{R}$ verifies as well the whole theory of the stellar energy mechanism we have built here and in [1].

The deduced volume-luminosity relation clearly depends upon the chemical composition of stars. Naturally, because the gravitational pressure in a star $\bar{p} = \frac{\bar{M}}{\bar{R}^2}\,\bar{\rho}\bar{R} = \frac{\bar{M}^2}{\bar{R}^4}$ is balanced by the gaseous pressure calculated by the equation for an ideal gas $\bar{p} = \frac{\bar{T}\bar{\rho}}{\bar{\mu}}$, we have $\bar{B} = \bar{T}^4 = \bar{\mu}^4 \frac{\bar{M}^4}{\bar{R}^4}$. On the other hand, Kozyrev has found, from the stellar energy diagram (Fig. 1), that "The main direction wonderfully traces an angle of exactly 45°. Hence, all stars are concentrated along the line, determined by the equation $B \sim \rho\mu^4$" [2]. We therefore substitute $\bar{n}_e = \bar{\rho} = \frac{\bar{B}}{\bar{\mu}^4}$ and $\bar{B} = \bar{\mu}^4 \frac{\bar{M}^4}{\bar{R}^4}$ into our initial formula for stellar energy $\bar{\varepsilon} = \bar{n}_e \bar{B}^{3/2}$ (7). As a result we obtain the formula for stellar energy in the form, where the molecular weight of the stellar contents is taken into account,

$$\bar{\varepsilon} = \bar{\mu}^6\,\frac{\bar{M}^{10}}{\bar{R}^{10}}\,, \tag{15}$$

from which, because $\bar{L} = \bar{\varepsilon}\bar{R}^2$, we obtain, with the observed mass-luminosity relation $\bar{L} = \bar{M}^{10/3}$,

$$\bar{L} = \frac{1}{\bar{\mu}^3}\,\bar{R}^4, \tag{16}$$

while with the theoretical relation $\bar{L} = \bar{M}^3$ our updated formula (8) gives

$$\bar{L} = \frac{1}{\bar{\mu}^{2.6}}\,\bar{R}^{3.4}. \tag{17}$$

As is clearly seen, our deduced relation — the proportionality of the luminosity of a star to its volume $L \sim V \sim R^3$ — is inversely proportional to ~ 3 orders of the molecular weight of the gas consisting a star. The greater the molecular weight of the gaseous contents of a star, the smaller its luminosity for the same volume. For instance, for a star consisting, instead of Hydrogen, of Helium or other heavy elements, the luminosity of such a star should be many times less than a completely hydrogen star of the same size.

3 The same stellar energy formula applied to brown dwarfs and the bulky planets

So the mass-luminosity relation $\bar{L} = \bar{M}^3$ is derived from the energy drainage condition $\bar{\varepsilon} = \frac{\bar{B}}{\bar{\rho}\bar{R}} = \frac{\bar{M}^3}{\bar{R}^2}$. The necessary coincidence with the energy production condition, the stellar energy formula $\bar{\varepsilon} = \bar{n}_e \bar{B}^{3/2} = \bar{\rho}\bar{B}^{3/2} = \bar{B}^{5/2}$, gives a new relation between the observable characteristics of stars — the volume-luminosity relation: $\bar{L} = \bar{R}^{3.4}$ for the theoretical relation $\bar{L} = \bar{M}^3$, or $\bar{L} = \bar{R}^4$ for the observed $\bar{L} = \bar{M}^{10/3}$.

In this section we shall look at how our stellar energy formula can be applied to space objects of extremely small luminosity — recently discovered brown dwarfs, and also the bulky planets (Jupiter, Saturn, Uranus, and Neptune) whose radiated energy exceeds that received from the Sun (so they have their own internal sources of energy).

Table 1: Brown dwarfs

	$\bar{L} = \bar{M}^{10/3}$	$\bar{L} = \bar{M}^3$	$\bar{L} = \bar{R}^4$	$\bar{L} = \bar{R}^{3.4}$
$\bar{L} = 10^{-4}$	$\bar{M} = 0.06$	$\bar{M} = 0.05$	$\bar{R} = 0.1$	$\bar{R} = 0.07$
$\bar{L} = 10^{-5}$	$\bar{M} = 0.03$	$\bar{M} = 0.02$	$\bar{R} = 0.06$	$\bar{R} = 0.03$

Brown dwarfs

These have masses $\bar{M} \leqslant 0.08$, luminosity $\bar{L} = 10^{-4}$–10^{-5}, and temperature at the surface $T \approx 700$ K, which determines their observed brown colour.

Proceeding from the luminosity $\bar{L}$ of brown dwarfs, we calculate: (1) their masses $\bar{M}$ by the mass-luminosity relation (the energy drainage condition), and also (2) their radii $\bar{R}$ by the volume-luminosity relation (the energy production condition) that characterizes the generation of stellar energy by the background space non-holonomity in Thomson dispersion of light. The results are given in Table 1.

By the observed mass-luminosity relation $\bar{L} = \bar{M}^{10/3}$, we obtained the masses in the range $\bar{M} = 0.03$–0.06 that satisfies the masses $\bar{M} \leqslant 0.08$ required for stars of such class. Brown dwarfs therefore satisfy the condition of energy drainage.

The radii of brown dwarfs $\bar{R} = 0.06$–0.1 we calculated by the condition of energy production — the volume-luminosity relation $\bar{L} = \bar{R}^4$ — are within the range of the bulky planets (from $\bar{R} = 0.034$ for Uranus to $\bar{R} = 0.10$ for Jupiter). Hence, from our calculations we conclude that:

> Brown dwarfs are stars of a size similar to Jupiter or Saturn. Their energy source is the same as that in stars of other kinds — the background space non-holonomity that generates energy in Thomson dispersion of light in free electrons. However, in contrast to the bulky planets, the radii of brown dwarfs satisfy the volume-luminosity relation, so the physical conditions therein are such that the stellar energy mechanism produces enough energy to compensate for the radiation from the surface.

The bulky planets

By direct measurements made by NASA's space missions (Pioneer, Voyager, Galileo, Cassini), the bulky planets have $\sim$75–90% hydrogen content (see http://www.nasa.gov for the details). So, because of the huge pressure in the central region, enough to ionize hydrogen, we propose the same energy source as that in any star. We can therefore calculate a table similar to that herein for brown dwarfs.

Table 2: The bulky planets

	$\bar{R}$	$\bar{M}$	T_{eff}	T_{ac}	B_{eff}	B_{ac}	$\bar{L}_{\text{p}}$	$\bar{L}=\bar{M}^x$	$\bar{L}=\bar{R}^y$	$\bar{L}=\bar{R}^4$
JUPITER:	0.10	9.5×10^{-4}	125 K	105 K	1.3×10^4	0.69×10^4	1.0×10^{-9}	$x=3.0$	$y=9.0$	$R=4{,}000$ km
SATURN:	0.086	2.9×10^{-4}	95 K	74 K	4.6×10^3	1.7×10^3	3.4×10^{-10}	$x=2.7$	$y=8.9$	$R=3{,}000$ km
URANUS:	0.034	4.4×10^{-5}	57 K	55 K	6.0×10^2	5.2×10^2	1.5×10^{-12}	$x=2.7$	$y=7.8$	$R=770$ km
NEPTUNE:	0.036	5.2×10^{-5}	59 K	38 K	6.9×10^2	1.2×10^2	1.2×10^{-11}	$x=2.5$	$y=7.4$	$R=1{,}300$ km

In Table 2 we use the effective temperature T_{eff} and the temperature T_{ac} acquired from the Sun, determined from the direct measurements made by the NASA satellites. The proper luminosity of each planet $L_{\text{p}}=4\pi R^2 B_{\text{p}}$ is calculated through the density of the proper radiant energy $B_{\text{p}}=B_{\text{eff}}-B_{\text{ac}}= =\sigma\left(T_{\text{eff}}^4-T_{\text{ac}}^4\right)$, where $\sigma=5.67\times10^{-5}$ erg/cm^2×sec×deg.

As seen from Table 2, the bulky planets have the luminosity $\bar{L}=\bar{M}^{2.5}$–$\bar{M}^{3.0}$. Many stars have a greater deviation from the average mass-luminosity relation $\bar{L}=\bar{M}^{10/3}$ (see Fig. 2), than the planets. We therefore conclude that,

> The bulky planets satisfy the mass-luminosity relation, which is the condition of energy drainage, so they radiate energy similar to stars.

Another result is provided by the volume-luminosity relation $\bar{L}\sim\bar{R}^y$, which characterizes the condition of energy production. The bulky planets have $\bar{L}=\bar{R}^{7.4}$–$\bar{R}^{9.0}$, while the coincidence of the energy drainage with the energy production in stars requires $\bar{L}=\bar{R}^{3.4}$–$\bar{R}^{4.0}$. The last column in Table 2 gives the values of the radii which should result if the energy loss is completely balanced by the energy produced within. So the bulky planets would be like stars. As seen, in such a case the bulky planets would be a bit smaller than the Earth: Jupiter and Saturn would have a size similar to Mars, Neptune would be similar to the Moon, while Uranus would be half the Moon. The obtained result implies that:

> The real radii of the bulky planets are so large that the energy produced within the planets is substantially less than that radiated from the surface: the planets are cooling down, in contrast to stars whose temperature is stable on the average.

So there is no crucial difference between stars and the bulky planets built on the gaseous contents. Looking at the evolution of the bulky planets, we see that as soon as the gravitational pressure compresses the planets down to radii satisfying the volume-luminosity relation $\bar{L}=\bar{R}^{3.4}$–$\bar{R}^{4.0}$, the energy output within the planets becomes balanced by the radiation from the surface, so the planets become stars. In such a case the density of the planets would become enormous.

Such high densities are conceivable, along the whole range of known stars, only within white dwarfs, which are mostly satellites of the most bulky stars. Compare Sirius' satellite ($\bar{R}=0.025$) and Procyon's satellite ($\bar{R}=0.013$), typical white dwarfs, which have a density $\rho\approx10^4$. We there therefore conclude that:

Table 3: The bulky planets, if becoming stars

	Radius, $\bar{R}$	Radius, km	Average density
JUPITER:	0.0057	4,000 km	7.1×10^3 g/cm^3
SATURN:	0.0043	3,000 km	5.0×10^3 g/cm^3
URANUS:	0.0011	770 km	4.6×10^4 g/cm^3
NEPTUNE:	0.0019	1,300 km	1.1×10^4 g/cm^3

> White dwarfs were formerly bulky planets like Jupiter and the great jovian planets, which, containing mostly hydrogen, were compressed by gravitational pressure to such a state that the energy produced within is the same as that radiated from the surface.
>
> So Jupiter and the jovian planets are stars in an early stage of their evolution. As soon as the gravitational pressure compresses each of them to the appropriate radius, they become white dwarfs — star-satellites of the Sun, so that the solar system becomes a multiple-star system.

4 A perspective for the new energy source

Accordingly, our theory that stellar energy is generated by the background space in Thomson dispersion of light in free electrons is readily verified. All that we need to reproduce the mechanism is ionized hydrogen: even if the temperature is much lower than in stars, we should obtain some energy output if the theory is correct. The ionization energy of a hydrogen atom is 13.6 eV; suitable equipment is accessible in even a junior college laboratory. Moreover, proceeding from the above theory, we can predict additional forces and energy output produced by the non-holonomic space background in phenomena other than Thomson dispersion of light. So the stellar energy theory herein, applied to laboratory conditions, predicts new energy sources working much more effectively and safely than nuclear energy.

References

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