

Magnetic Fields of Stars and Planets

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Abstract. A new version of the appearance of a magnetic field in stars and planets is presented. From the point of view of the theory of an elastic universe, elementary particles are axially symmetric, but spherically not symmetric. They take the form of electric and magnetic dipoles. At high pressures inside the stars and planets elementary particles gradually become the same orientation. In this case, a magnetic field arises around the stars and planets. I core of a star or planet is approaching the structure of a neutron star.

Introduction. Until now, scientists cannot really understand where the magnetic field of stars and planets comes from. There are numerous hypotheses: electric currents inside stars and planets, rotating metal cores, metallic hydrogen, all kinds of induction currents in the core. On closer examination, these hypotheses do not hold water, and are not supported by any experiments. It is hard to believe that if a jar of liquid mercury is rotated, vibrated, and turned over in every possible way, then an electric current will arise in it, and a magnetic field will appear around it.

There are numerous marginal views in physics. Which, however, have a noticeable impact on the general level in science. For example, attempts by young scientists to explain gravity by means of electromagnetism do not cease. Or, some known results are being paraphrased in order to draw false conclusions. For example, the problem and its solution are known, what will be the gravity inside a solid empty planet, with a thickness L and an internal radius R ? The solution is zero. That is, there will be weightlessness inside such a planet. However, insufficiently trained physicists conclude from this problem that there is no pressure inside the stars and planets. This is not true.

According to known calculations given, for example, in the [https://www.academia.edu/34719210/Why there are no black holes Deadlock hypotheses of modern physics](https://www.academia.edu/34719210/Why_there_are_no_black_holes_Deadlock_hypotheses_of_modern_physics), the pressure in the center of the planet, consisting of a fluid of density ρ is equal to:

$$p(0) = \rho \cdot G \cdot M / (2 \cdot R); \quad (1)$$

For water $\rho(0) = 1000 \text{ kg/m}^3 \cdot 6.7 \cdot 10^{-11} \text{ m}^3 \text{ s}^{-2} \text{ kg}^{-1} \cdot 6.0 \cdot 10^{24} \text{ kg} / (2 \cdot 6.4 \cdot 10^6 \text{ m}) = 30.000.000.000$ (SI). It turns out about 3,000,000 atm. Despite the fact that the gravity at the center of the Earth is zero. As can be seen from the formula, the pressure inside a star or planet is proportional to its mass and inversely proportional to its radius. Consequently, in the large stars in the center there is an enormous pressure of millions and billions of atmospheres.

Some figures from the Directories:

The pressure in the center of the Earth is 3.6 million atm.

Sun: density - 160 g/cm^3 . The pressure is 340 billion atmospheres.

Pressure at the center of Jupiter = 100 million atmospheres.

The pressure in neutron stars is 10^{34} degrees of pascals = 10^{29} bar (atmospheres).

There is another misconception. As you know, stars do not have a solid core inside. That is, they do not have a permanent magnet inside. But they also have a magnetic field. From this, insufficiently trained physicists draw the wrong conclusion that it is not the core material that is responsible for the magnetic field, but some dynamic process that takes place in the very matter of the star. About which, supposedly, we simply do

not know anything. Maybe it's some kind of wandering electric currents. There may be some manifestations of induction.

At the moment, the theory of the magnetohydrodynamic dynamo is generally accepted: a magnetic field is generated due to convection flows in a liquid conductive core. It was proposed in 1919 by J. Larmor (at that time to explain the magnetism of sunspots), then the theoretical foundations of the theory were developed by W. Elsasser in 1939 and E. Belord in 1949. A necessary condition for the generation of a magnetic field is the presence of a liquid core that conducts a current, and flows must take place in it. The most probable cause of such flows is thermochemical convection. Of course, when there are no versions, then all that remains is to accept that version.

Our version of the emergence of a magnetic field is as follows. According to the theory of the elastic universe, the proton, neutron and electron are wave vortices in an elastic medium. They have structure and shape. They are axially symmetrical, but not spherically symmetrical. A single electron, proton, neutron has a small magnetic field, and their electric field is also not spherically symmetric. And when, under great pressure in the center of a star or a planet, they approach each other, they begin to line up in a certain orientation, like the arrows of a compass, in one direction. Of course, not all at once, but statistically. It is then that the total magnetic field appears around the planets and stars. Also like around the wire with an electric current magnetic field appears not due to the actual current, and due to the fact that electrons are arranged in one direction.

There is, in a sense, an analogue of our hypothesis, called piezomagnetism. It has been studied both experimentally and theoretically. This effect appears when the crystal is compressed due to the fact that under the influence of elastic deformation the magnetic symmetry of the substance is broken. We believe that with the all-round compression of the core of a star or planet, a phenomenon similar to piezomagnetism is also possible.

The process of the appearance of a magnetic field around stars and planets can be described as follows. Let's start squeezing the core of the star, starting from the state of the plasma. That is, when the nuclei of the elements exist interspersed with individual electrons and, due to the high temperature, the bond between the nuclei and electrons is broken. And because of the thermal chaos, there is no total orientation of the particles. Every electron, each nucleus, each proton and the neutron have magnetic and electric structure. With further compression, the particles approach each other so much that their interaction begins to exceed the destructive effect of thermal chaos. The free flight distance of particles becomes smaller and smaller, and some of the particles acquire a fixed position or orientation. Of course, with high vibrational energy. In this chaos, statistically, some preferential, preferred orientation of particles is created. Typically, this highlighted orientation coincides with the rotation axis of the star or planet. However, for small stars and planets, the influence of other factors, the influence of solid fragments in the core and on the surface, is possible; therefore, the magnetic pole of the planets does not always exactly coincide with its rotation axis. As, for example, on the Earth. Also, the magnetic moment may not coincide in large stars due to thermonuclear reactions and the ongoing bubbling in the star's core.

Most likely, the orientation of particles in the core of a star is determined by their electric fields, as more powerful. And the appearance of the total magnetic field around the star can be considered a secondary result of ordering the orientation of particles.

Axial symmetry of elementary particles.

According to the theory of the elastic universe
https://www.academia.edu/37601531/2018_10_17_Universe_is_a_solid_elastic_continuum, or on the website <http://universe100.narod.ru/>, elementary particles are wave

vortices in an elastic medium (gukuum). These vortices are axisymmetric; therefore, their electric and magnetic fields have rotational symmetry, but they do not have spherical symmetry. <http://universe100.narod.ru/E200-Kandidats.html>, Figure 6, Figure 7, Figure 8, Figure 10.

For this reason, under strong pressure inside stars or major planets, elementary particles (or the cores of elements consisting of them) are oriented mainly in one direction.

We will estimate numerically whether this assumption contradicts the existing experimental and visual data from astrophysics.

Numerical estimate.

Our plan of action to assess the reality of our hypothesis is as follows. As a model for a neutron star, we take an extreme case of neutron stars: magnetars. We make a fairly plausible assumption that the very compact packing of neutrons has been achieved in magnetars, all neutrons lie densely, are oriented in one direction and create the maximum possible magnetic field. Other neutron stars have “defects” in their packing, have some separate “domains” that are oriented in different directions, and mutually neutralize the total magnetic field. This is why the magnetic field of magnetars is superior to the magnetic field of all other neutron stars.

As you know, magnetars are about 20-30 km in diameter, the magnetic field is about 10^{14} - 10^{15} G, the masses of most magnetars exceed the mass of the Sun by about 1.5 times. For simplicity, we take the mass of the magnetars equal to the mass of the Sun. This is not far from the truth, does not affect the essence of the reasoning, and is acceptable for our rough assessment.

We will assume that when the matter is compressed by a mass equal to the mass of the Sun, to the neutron state and with the full orientation of neutrons in one direction, a magnetic field of about 10^{14} – 10^{15} Gs (Gauss) is achieved. For definiteness, further we take the magnetar field equal to $5 \cdot 10^{14}$ Gs.

If you look at the magnitude of the magnetic field of the Sun, 5-7 Gs, then it is about 10^{13} – 10^{14} times inferior to the field of the magnetar. For our estimates, for unambiguity of reasoning, we take the magnetic field on the surface of the Sun equal to 6 Gs. It is possible to estimate the field of the magnetar at a distance equal to the radius of the Sun. According to the law of conservation of magnetic flux, the ratio of the magnetic field values will be inversely proportional to the squares of the radii. The radius of the Sun is $1.4 \cdot 10^6$ km. The radius of the magnetar, also for unambiguous estimates, we take 14 km (with a diameter of 20-30 km). The ratio of the squares of the radii of the Sun and the magnetar will be 10^{10} . Consequently, the magnetic field of the magnetar at a distance of the Sun's radius will be 10^{10} less, that is, $5 \cdot 10^4$ Gs. The magnetic field of the Sun, 6Gs. That is $6/(5 \cdot 10^4) = 1.1 \cdot 10^{-4}$ approximately 0,01% of the magnetar field. This is the degree of ordering of neutrons in the middle of the Sun. Quite a reliable figure in order of magnitude.

We have experimental data on the size, mass and magnetic field at the surface of the Sun and the planets of the solar system. They are taken from Wikipedia and are shown in Table 1 and Table 2.

Table 1. Masses and radii of the Sun and planets.

	Magnetar	The Sun	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Weight M kg	$1.99 \cdot 10^{30}$	$1.99 \cdot 10^{30}$	$3.3 \cdot 10^{23}$	$4.9 \cdot 10^{24}$	$6.0 \cdot 10^{24}$	$6.4 \cdot 10^{23}$	$1,9 \cdot 10^{27}$	$5,7 \cdot 10^{26}$	$8,7 \cdot 10^{25}$	$1.0 \cdot 10^{26}$
Radius R km	14	$1.4 \cdot 10^6$	2439.7	6051.8	6378.1	3396.2	69911	58232	2536 2	24622
M/R • 10^{20}	$1.42 \cdot 10^9$	$1.42 \cdot 10^4$	1.35	8.09	9.41	1.88	271.77	97.88	34.31	40,61

Table 2 Magnetic field at the surface of suns and and planets.

The Sun	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto	Moon
6 Gs	0.005 Gs	0.05 Gs	0.5 G	0.0 G	4.28 Gs	0.21 Gs	0.23 Gs	0.014 Gs	No	No

Let's carry out similar calculations for the Earth. For Earth get another appraisal. The radius of the Earth is 6378 km. The ratio of the squares of the radii of the Earth and magnetar equal 207545. Magnetic field magnetar solar mass in the region of radius magnetar (14 km) make $5 \cdot 10^{14}$ gauss. If the magnetar is of the earth's mass, then this number must be multiplied by the ratio of the masses of the Earth and the Sun (= magnetar), by 0.000003. Thus, the magnetic field of the magnetar of the earth's mass at the distance of the magnetar radius will be $1.5 \cdot 10^9$ Gs. Further, if the divide ratio is a number in the square of the radius of the Earth and magnetar, 207545, then n Obtain $7.5 \cdot 10^3$ Gs. This magnetar field is equal in mass to the mass of the Earth and in radius equal to the radius of the Earth. The real field of the Earth is 0.5 Gs. This means that the order of the nuclei of matter in the core of the Earth is $0.5:(7.5 \cdot 10^3) = 0.00007$. Or as a percentage $7 \cdot 10^{-3}\%$. This is also a completely meaningful result. Our old Earth is far from a neutron star.

This operation must be done with all planets! That is, divide the magnetar field by the square of the planet's radius. And compare with the experimental field of the planet. Curious what happens. Further, Φ is the magnetic field e on the surface of the planet if it were a magnetar in size and mass. $5 \cdot 10^{14}$ is the magnetic field of a magnetar with a radius of 14 km and the mass of the Sun. We multiply it by the ratio of the masses of the planet and the Sun and divide by the ratio of the squares of the radii of the planet and the Sun.

$$\Phi = (5 \cdot 10^{14}) \cdot (M_p/M_m) / (R_p/R_m)^2; \Phi_{\text{Earth}} = (5 \cdot 10^{14}) \cdot (3 \cdot 10^{-6}) / (2 \cdot 10^5) = 7.5 \cdot 10^3; \quad (2)$$

Next, we make a comparison. Q is the ratio of the real magnetic field of the planet to the imaginary magnetic field of the magnetar of the radius of this planet. $5 \cdot 10^{14}$ is the magnetic field of a magnetar with a radius of 14 km and the mass of the Sun. We called the quantity Q the coefficient of ordering of matter in the core of a star or planet.

Table 3. Ratios of the squares of the radii of the planets and the magnetar. Comparison of the magnetic fields of the planets and the magnetar.

	Magnetar	The Sun	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Radius km	15 km	1.410 ⁶	2439.7	6051.8	6378.1	3396.2	69911	58232	25362	24622
Weight kg		1.99•10 ³⁰	3.•10 ²³	4.9•10 ²⁴	6.0•10 ²⁴	6.4•10 ²³	1.9•10 ²⁷	5.7•10 ²⁶	8.7•10 ²⁵	1.0•10 ²⁶
Density		1.4 g/cm ³	5.4 g/cm ³	5.2 g/cm ³	5.5 g/cm ³	3.9 g/cm ³	1.3 g/cm ³	0.7 g/cm ³	1.3 g/cm ³	1.6 g/cm ³
Mp / Ms	1	1	1.65•10 ⁻⁷	2.45•10 ⁻⁶	3•10 ⁻⁶	3.2•10 ⁻⁷	9.5•10 ⁻⁴	2.85•10 ⁻⁴	4.35•10 ⁻⁵	5•10 ⁻⁵
Field Gs	5•10¹⁴	6	0.005	0.05	0.5	0.0	4.28	0.21	0.23	0.014
(Rp/Rm) ²	1	10 ¹⁰	3•10 ⁴	1.8•10 ⁵	2•10 ⁵	5.9•10 ⁴	2.4•10 ⁷	1.7•10 ⁷	3.2•10 ⁶	3•10 ⁶
Φ	5•10¹⁴	5 • 10 ⁴	2.75•10 ³	6.8•10 ³	7.5•10 ³	2.7•10 ³	19.8•10 ³	8.4•10 ³	6.8•10 ³	8.3•10 ³
Q	1	1.1•10 ⁻⁴	1.8•10 ⁻⁶	7.3•10 ⁻⁶	6.7•10 ⁻⁵	0.0	2.16•10 ⁻⁴	2.5•10 ⁻⁵	3.3•10 ⁻⁵	1.6•10 ⁻⁶

So on the bottom line of Table 3, we received a "percentage of ordering the particles" in the core of the planet or the Sun, compared with a magnetar. As can be seen from the table, in order to obtain magnetic fields of the level of those that we observe, it is enough to insist on a very small percentage of the particles of the planet's core.

Let's dream up?

The conclusions from the bottom line of Table 3 are very interesting.
 1. Jupiter has the highest ordering factor, $2,16 \cdot 10^{-4}$!!! This is somewhat unexpected. Probably, here the approximation of our estimates was revealed. However, it is possible that they are true, just in the center of the Sun there is a high temperature, a nuclear reaction is taking place, the substance is boiling, and this is the cause of chaos and a small degree of orientation of the substance. And inside Jupiter, the temperature is not high, no nuclear reactions, the pressure is also high. And this forces the matter of

Jupiter's core to be oriented to a noticeable degree. The magnetosphere of Jupiter more broad and flat than the Earth's magnetosphere, and several orders of magnitude more powerful, and its magnetic moment is roughly 18,000 times more.

2. Earth, Uranus and Saturn are inferior to Jupiter by about an order of magnitude. In that order. This is also strange and unexpected. Again, this may be the cost of roughing our estimates. But if we look at the density of the planets, Earth - 5.5, Uranus - 1.3, Saturn - 0.7, then the reason for this sequence becomes clear. Heavy elements are concentrated in the Earth, including iron, which are easily magnetized and oriented. Uranus is also denser than Saturn.

3. Next are the weaklings: Venus, Mercury, Neptune and Mars. The orientation coefficient of Venus's matter is an order of magnitude less than that of the Earth. How can this be explained? Apparently, yielding to the Earth a little in all parameters, Venus as a whole lagged behind by an order of magnitude. You can also add the high temperature of Venus, which is possible in the core of Venus, and this is also the reason for the lower ordering of matter. Mercury has a density like Earth and Venus, but even higher temperature. Perhaps this is the reason that it is inferior to Venus in the ordering of matter. Neptune is two orders of magnitude heavier than Mercury, an order of magnitude larger in radius. But it has a low density, gas composition. Therefore, it is slightly inferior to Mercury in terms of orientation coefficient. Well, in last place is absolutely non-magnetic Mars. They have been joking about him for a long time that his neighbor giant Jupiter took everything away from him. He also took away the magnetic field. Mars is 10 times lighter than Earth, has a cold surface and interior, and apparently other unfavorable conditions.

4. More about Saturn. Here is what they write about him in official sources. The magnetic field of Saturn, like that of Jupiter, is created due to the dynamo effect during the circulation of metallic hydrogen in the outer core. I think this is just a fiction. The circulation of metallic hydrogen is too loud a phrase, a strong expression. This is for fiction.

Saturn's magnetic field is nearly dipole, just like Earth's, with magnetic north and south. The north magnetic pole is in the northern hemisphere, and the south is in the south, unlike the Earth, where the geographic poles are opposite to the magnetic ones. How can this be explained? Perhaps the Janibekov effect somehow manifested itself here? Maybe the reason is the lowest density of Saturn among all the planets? Or maybe there really is a layer of metallic hydrogen in Saturn, which, in addition, flies, spins, and somersaults according to Dzhaniybekov's law? - It seems that the whole reason is that due to the slow rotation of the planet around the axis, the direction for orientation was chosen randomly, without the influence of the axis of rotation.

Additionally. Saturn's magnetic dipole is rigidly connected to its axis of rotation, so the magnetic field is very asymmetric. The dipole is slightly displaced along the axis of Saturn's rotation to the north pole. Saturn's magnetic axis practically coincides with the axis of its rotation. - This phenomenon can be explained by the presence of the second center of orientation (domain), which is inferior in volume to the first and, at the same time, is normally, in terms of the earthly, oriented.

5. Concerning Uranus. The magnetic field of Uranus has a number of its characteristic features compared to other planets.

The first feature is that the magnetic axis of the planet is shifted from the center of the planet's axis by a third of its radius, and an angle of 60 degrees is formed.

The second feature is the inconstancy of the strength of magnetic fields.

Third, there are several different pairs of magnetic poles, besides the main two, there are 2 other weaker ones.

Our opinion here is. Apparently in the core of Uranus and were created for some reason several centers (domains) began targeting agents. There are two or three of

these centers. And the orientation itself also turned out to be random, not related to the axis of rotation.

6. The magnetic field of the planet Neptune. The Magnetic axis is shifted from the center of the planet by 13500 kilometers to the side. Also the planet axis of rotation deviates from the magnetic axes and at 47° . - Here is our conclusion. It can be assumed that also in the core of Neptune there were 2-3 centers of the beginning of the orientation of the particles of the core. Which led to this situation. This alignment has stabilized along with the distributions of masses and temperatures inside Neptune.

7. And finally, the last. As unpleasant as it is, but having said A, I must say B. The Lord enough for us to deny the structure of elementary particles! This denial has done colossal harm to science. Enough for us to consider electrons point-like and structureless. Electrons are huge in size and structure. Although the recognition of the structure of elementary particles inevitably leads to amendments to Einstein's theory of relativity. Today in physics rules "Einstein Party supporters." They just mock the learned world, they occupied the entire pedestal. And for many years now they have been rewarding themselves, despising the rest of the scientific world. There was once a long period, a couple of centuries, when Newton's authority was indisputable. But then contradictions and disputes began. Finally, the principle of relativity and Einstein's theory were adopted. However, in the 20th and 21st centuries, despite the prohibitions, the theory of the structure of elementary particles was developed. And this theory has been repeatedly and successfully confirmed in the interpretation of all experimental data accumulated over a whole century. And this theory assumes the existence of an absolute frame of reference, whether the supporters of Einstein like it or not. Therefore, Einstein's theory of relativity awaits the same fate as Newton's theory. Einstein's theory of relativity has limited applications. It is feasible only for macro physics. With its rockets, flights, and time paradoxes. However, for the world of elementary particles, Einstein's theory is simply not needed. It does not give any new results. Where the structure of elementary particles begins, the theory of Einstein ends and the theory of Dubinyansky-Churlyayev begins.

Addition.

In 1971, the author of this article, as a 1st year student, went on an excursion to the Serpukhov accelerator. It was a dream. It was a song. This was the heyday of nuclear science in the USSR. At that time, studies of the structure of elementary particles were successfully carried out at the Serpukhov accelerator. And fundamental results were obtained on the distribution of mass and electric charge inside the proton and neutron. They were included in the 1973 Yavorsky-Detlaf manual on physics and subsequent years. It exists, it exists, the structure of elementary particles, confirmed by serious experiments. But it puts a constraint on Einstein's theory. She does not let Einstein into the microcosm. Just like Einstein did not let Newton into the region of sublight speeds.

However, by that time, "Annushka had already spilled oil." In 1971, the deputy director of the I.V. Kurchatov for scientific work is appointed by E.P. Velikhov, with the assignment of general scientific leadership and coordination of research in the field of plasma physics and controlled thermonuclear fusion. Some time later, the Serpukhov accelerator was declared "insufficiently powerful" and all research on it was stopped. This was at a time when the greatest results for science were obtained.

In 1974 E.P. Velikhov was elected a full member of the USSR Academy of Sciences. In the USSR and today's Russia, the rule is that the administrative hierarchy must necessarily coincide with the scientific one. The director becomes an academician. Most of today's Duma deputies hold doctoral degrees (mostly purchased). At 39, Velikhov became the youngest academician in the Soviet Union. In the same year, the author of this publication Dubinyansky generates a hypothesis about the Elastic Universe. But he

intuitively feels that it is impossible to stick out with this hypothesis. There, upstairs, they steal everything, they will appropriate everything, there the author of the idea can be appointed the 10th co-author, or they can forget... As, for example, happened with the real inventors of LEDs. There is a cold war with the United States. And besides, the formulas are very complicated and it is very time consuming to shovel them. Moreover, it is necessary to study the History of the Communist Party of the Soviet Union and take an exam...

In 1975 Velikhov it became clear that in the field of thermonuclear fusion the USSR was far behind the United States. The Americans and Europeans have already built large thermonuclear installations. Tokamaks were built in Princeton, Japan, Germany.

In 1975, under the leadership of E.P. Velikhov, the creation of a unique MHD generator with a capacity of more than 500 MW, a voltage of 3 kV, and a current of 200 kA for 10 s was completed ("A terrible sight!" - E.P. Velikhov later recalled).

At the XXV Congress of the CPSU, at the suggestion of Velikhov, a decision was made on the Soviet program for Tokamaks. Well, their to the devil, fundamental research! Shake the apple tree! We must do what they do in the West! At the congress, a decision was made on the Soviet program for the Tokamaks.

In September 1985 E.P. Velikhov accompanied M.S. Gorbachev on a trip to Paris, where Gorbachev put forward an initiative for international cooperation on the thermonuclear program. Gorbachev was already brainwashed about the prospect of thermonuclear projects.

As a result of lengthy negotiations of the interested parties, it was decided to start the development of the ITER project (ITER = International Thermonuclear Experimental Reactor) by specialists from those countries that have the greatest experience in thermonuclear research: the USSR, the USA, the European Union (Euratom) and Japan, first conceptual (1987 –1990), and then technical (1992–2001). During this period, E.P. Velikhov was the head of the ITER International Council.

At present, the construction of the ITER reactor in French Cadarache has begun and is being actively financed by the forces of Russia, Japan, the USA, the EU, South Korea, China and India. On the Cote d'Azur, excellent climate, good salary. What else do young ambitious physicists need to be happy?

Velikhov is justly proud of his brainchild, the ITER project. The latter promises to make a real breakthrough in science and energy. Velikhov promises real results on this device no earlier than 2045. By that time, either the donkey will die, or the padishah will die...