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Solar Corona Heating

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Abstract

A simple mechanism of anomalous heating of the solar corona based on a four-dimensional representation of our space is considered.

***Keywords:** The temperature of the solar corona; The speed of light; The mass of plasma particles*

Introduction

It is known that the temperature of the solar corona far exceeds the temperature of the photosphere and chromosphere of the Sun and at an average temperature of 1.5×10^6 K can reach tens of millions of degrees, i.e. even exceed the temperature of the solar core [1]. There are many assumptions about the cause of the unusually high temperature of the corona. It is obvious that the energy comes from the underlying layers, including, in particular, the photosphere and chromosphere, but heating occurs at a considerable distance from them. Magnetosonic and Alfven waves, magnetic reconnection, collapsing magnetic traps, nanoflares in the corona are considered as the main elements involved in the heating of the corona [2]. Despite the existence of a number of hypotheses, none of them can fully answer the existing questions [3]. Some of them contradict each other, are unable to explain the observed high velocities of heavy particles - protons, the isothermicity of plasma particles, and, for example, the model with collapsing magnetic traps excludes the appearance of ultrahigh-energy particles [4, 5]. In this regard, it seems possible to formulate another hypothesis, characterized by extreme simplicity and allowing joint action with a number of other factors. The proposed hypothesis is based on a four-dimensional representation of space in which the movement of our closed three-dimensional space in the direction of the orthogonal fourth spatial dimension due to its own expansion is perceived as the passage of time [6, 7].

Solar Corona Heating Mechanism

In accordance with the four-dimensional model of our Universe, formulated theoretically and confirmed experimentally, the curvature of the near-solar space is such that the speed of light in the radial direction c_x increases proportionally to the power of 3/2 of the relative distance from the surface of the Sun R_x [6, 7]:

$$c_x = c_0 \times R_x^{3/2},$$

where c_0 is the speed of light on the surface of the Sun.

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Taking the unchanged energy of the solar corona plasma particle,

$$E = m_0 c_0^2 = m_x c_x^2,$$

where m_0 is the mass of a particle on the surface of the Sun, it is necessary to conclude that the mass of the particle m_x decreases when moving away from the surface of the Sun at a distance of $R_x$according to the law:

$$m_x = m_0 c_0^2 / c_x^2 = m_0 R_x^3.$$

In the absence of external influences, the particle momentum remains constant

$$m_0 v_0 = m_x v_x,$$

where v_0 and v_x are the velocity of the particle, respectively, on the surface of the Sun and at a relative distance R_x from it. Consequently, the velocity of the particle increases with distance from the Sun according to the law,

$$v_x = v_0 R_x^3.$$

Accordingly, at the surface temperature [8],

$$T_0 = m_0 v_0^2 / 3k,$$

where $k = 1.38 \times 10^{-23} JK^{-1}$ is the Boltzmann constant, the temperatureT_x of a plasma particle at a relative distanceR_x from the surface of the Sun will be equal to,

$$T_x = m_x v_x^2 / 3k = (m_0 / R_x^3)(v_0 R_x^3)^2 / 3k = (m_0 v_0^2 / 3k) R_x^3 = T_0 R_x^3, \quad (1)$$

that is, the temperature increases proportionally to the third power of the relative distance from the surface of the Sun. It is known that the plasma temperature T_0 at the boundary of the chromosphere and the solar corona can reach $(0.5 - 1.0) \times 10^5 K$. Consequently, the temperature of the solar corona, in accordance with the presented model, can reach $10^6 K$ already at a distance of 1.7 to 1.2 radii of the Sun from its surface only due to a change in the curvature of space when plasma particles are removed from the solar surface. A characteristic feature of the presented mechanism is the independence of temperature from the mass of particles, i.e. automatic provision of plasma isothermicity (1). The considered hypothesis absolutely does not exclude other mechanisms of corona heating and can act in parallel with them. It does not limit the maximum heating temperature, although the temperature decreases as it moves away from the Sun due to its gravitational influence. At the same time, any local overheating in the lower layers of the solar corona can cause extremely high plasma temperatures in the upper layers.

Conclusion

The considered mechanism of heating of the solar corona makes it possible to explain the abnormally high temperature of the corona at distances comparable to the radius of the Sun, the curvature of the near-solar space on the basis of the previously formulated four-dimensional model of the Universe and the known laws of conservation of energy and momentum of particles, and the data obtained by modern methods on the temperature of the solar corona can serve as another direct experimental confirmation of the four-dimensionality of space, as well as the previously predicted and experimentally confirmed low rate of propagation of relict radiation. The presented simplest mechanism has no theoretical temperature limit, automatically explains the isothermicity of the solar corona plasma and allows joint action with other mechanisms of heating and gravitational braking of the solar corona substance.

Conflict of Interest

The author has no conflict of interest.

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