

# GEOMETRIZED VACUUM PHYSICS. PART X: NAKED "PLANETS" AND "STARS"

## FÍSICA DEL VACÍO GEOMETRIZADA. PARTE X: PLANETAS Y ESTRELLAS DESNUDAS

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### ABSTRACT

In this article, based on exact solutions of the extended Einstein vacuum equation, metric-dynamic models of stable spherical vacuum formations of planetary scale with a core radius of the order of  $r_4 \sim 10^7 - 10^8 \text{ cm} = 100 - 1000 \text{ km}$  are proposed. These electrically neutral vacuum formations are called naked "planets" and "stars". The concept of a naked "planet" implies that this article does not take into account the presence and influence of small vacuum formations (micro-, nano- and picoscopic "particles"), only curvatures of the vacuum of stellar-planetary scale are considered. In particular, metric-dynamic models of a naked "star" and naked "planets" of the Solar System are proposed. The analogy between the naked "Solar System" and a biological cell is shown. Like the entire project, this article is aimed at implementing the program of complete geometrization physics of Clifford-Einstein-Wheeler.

### RESUMEN

En este artículo, a partir de soluciones exactas de la ecuación de vacío de Einstein extendida, se proponen modelos métrico-dinámicos de formaciones esféricas estables de vacío a escala planetaria con un radio central del orden de  $r_4 \sim 10^7 - 10^8 \text{ cm} = 100 - 1000 \text{ km}$ . Estas formaciones de vacío eléctricamente neutras se denominan "planetas" y "estrellas" desnudos. El concepto de "planeta" desnudo implica que este artículo no considera la presencia ni la influencia de pequeñas formaciones de vacío (partículas microscópicas, nanoscópicas y picoscópicas), sino que solo considera las curvaturas del vacío a escala estelar-planetaria. En particular, se proponen modelos métrico-dinámicos de una "estrella" desnuda y de "planetas" desnudos del Sistema Solar. Se muestra la analogía entre el "Sistema Solar" desnudo y una célula biológica. Al igual que todo el proyecto, este artículo busca implementar el programa de física de geometrización completa de Clifford-Einstein-Wheeler.

Keywords: vacuum physics, vacuum, Algebra of signature, naked planets and stars  
Palabras clave: física del vacío, vacío, álgebra de firmas, planetas y estrellas desnudos

## BACKGROUND & INTRODUCTION

This is the tenth part of a series of articles under the general title "Geometrized Vacuum Physics (GVPh) based on the Algebra of Signatures (AS)". The previous eight articles are listed in the bibliography (Batanov-Gaukhman, 2023a, 2023b, 2023c, 2023d, 2023e, 2023f, 2024a, 2024b, 2024c).

In the article (Batanov-Gaukhman, 2023f) the "Hierarchical Cosmological Model" was proposed, which is developed on the basis of solutions of the third extended Einstein vacuum equation (11) in (Batanov-Gaukhman, 2023f)

$$R_{ik} + \frac{1}{2} g_{ik} (\sum_{m=1}^{\infty} \Lambda_m + \sum_{n=1}^{\infty} -\Lambda_n) = 0. \quad (1)$$

From this equation, one simplified and shortened "chain" of  $\Lambda_m$ -terms (where  $\Lambda_m = 3/r_m^2$ , here  $r_m$  is the radius of the  $m$ -th spherical vacuum formation) was extracted, consisting of only 10 links

$$\begin{cases} R_{ik} + g_{ik} \sum_{m=1}^{10} \Lambda_m = 0, \\ R_{ik} - g_{ik} \sum_{m=1}^{10} \Lambda_m = 0. \end{cases} \quad (2)$$

The metrics-solution of this system of equations have the form (23) – (34) in (Batanov-Gaukhman, 2023f):

- five metrics with the signature (+ - - -)

$$ds_1^{(+2)} = \left(1 - \frac{r_0}{r} + \frac{\Lambda_0 r^2}{3}\right) c^2 dt^2 - \frac{dr^2}{\left(1 - \frac{r_0}{r} + \frac{\Lambda_0 r^2}{3}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (3)$$

$$ds_2^{(+2)} = \left(1 + \frac{r_0}{r} - \frac{\Lambda_0 r^2}{3}\right) c^2 dt^2 - \frac{dr^2}{\left(1 + \frac{r_0}{r} - \frac{\Lambda_0 r^2}{3}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (4)$$

$$ds_3^{(+2)} = \left(1 - \frac{r_0}{r} - \frac{\Lambda_0 r^2}{3}\right) c^2 dt^2 - \frac{dr^2}{\left(1 - \frac{r_0}{r} - \frac{\Lambda_0 r^2}{3}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (5)$$

$$ds_4^{(+2)} = \left(1 + \frac{r_0}{r} + \frac{\Lambda_0 r^2}{3}\right) c^2 dt^2 - \frac{dr^2}{\left(1 + \frac{r_0}{r} + \frac{\Lambda_0 r^2}{3}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (6)$$

$$ds_5^{(+2)} = c^2 dt^2 - dr^2 - r^2(d\theta^2 + \sin^2 \theta d\phi^2); \quad (7)$$

- five metrics with the signature (- + + +)

$$ds_1^{(-2)} = -\left(1 - \frac{r_0}{r} + \frac{\Lambda_0 r^2}{3}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{r_0}{r} + \frac{\Lambda_0 r^2}{3}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (8)$$

$$ds_2^{(-2)} = -\left(1 + \frac{r_0}{r} - \frac{\Lambda_0 r^2}{3}\right) c^2 dt^2 + \frac{dr^2}{\left(1 + \frac{r_0}{r} - \frac{\Lambda_0 r^2}{3}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (9)$$

$$ds_3^{(-2)} = -\left(1 - \frac{r_0}{r} - \frac{\Lambda_0 r^2}{3}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{r_0}{r} - \frac{\Lambda_0 r^2}{3}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (10)$$

$$ds_4^{(-2)} = -\left(1 + \frac{r_0}{r} + \frac{\Lambda_0 r^2}{3}\right) c^2 dt^2 + \frac{dr^2}{\left(1 + \frac{r_0}{r} + \frac{\Lambda_0 r^2}{3}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (11)$$

$$ds_5^{(-2)} = -c^2 dt^2 + dr^2 + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (12)$$

where

$$\Lambda_0 = \sum_{m=1}^{10} \Lambda_m = \sum_{m=1}^{10} \frac{3}{r_m^2}, \quad (13)$$

$$r_0 = \sum_{m=1}^{10} r_m. \quad (14)$$

In (Batanov-Gaukhman, 2023f) it was shown that the zero components and, accordingly, the denominators of the unit components of the metric tensor from the solution metrics (3) – (14) can be represented in the form (35) – (42) in (Batanov-Gaukhman, 2023f)

$$\begin{aligned}
 1 - \frac{r_0}{r} + \frac{A_0 r^2}{3} &= 1 - \frac{r_1+r_2+\dots+r_{10}}{r} + \left( \frac{1}{r_1^2} + \frac{1}{r_2^2} + \dots + \frac{1}{r_{10}^2} \right) r^2 = & (15) \\
 &= 1 + \left( 1 - \frac{r_{10}}{r} + \frac{r^2}{r_9^2} \right) - \left( 1 + \frac{r_9}{r} - \frac{r^2}{r_8^2} \right) + \left( 1 - \frac{r_8}{r} + \frac{r^2}{r_7^2} \right) - \left( 1 + \frac{r_7}{r} - \frac{r^2}{r_6^2} \right) + \left( 1 - \frac{r_6}{r} + \frac{r^2}{r_5^2} \right) - \left( 1 + \frac{r_5}{r} - \frac{r^2}{r_4^2} \right) + \left( 1 - \frac{r_4}{r} + \frac{r^2}{r_3^2} \right) - \\
 &- \left( 1 + \frac{r_3}{r} - \frac{r^2}{r_2^2} \right) + \left( 1 - \frac{r_2}{r} + \frac{r^2}{r_1^2} \right) - \left( 1 + \frac{r_1}{r} - \frac{r^2}{r_{10}^2} \right),
 \end{aligned}$$

$$\begin{aligned}
 1 + \frac{r_0}{r} - \frac{A_0 r^2}{3} &= 1 + \frac{r_1+r_2+\dots+r_{10}}{r} - \left( \frac{1}{r_1^2} + \frac{1}{r_2^2} + \dots + \frac{1}{r_{10}^2} \right) r^2 = & (16) \\
 &= 1 + \left( 1 + \frac{r_{10}}{r} - \frac{r^2}{r_9^2} \right) - \left( 1 - \frac{r_9}{r} + \frac{r^2}{r_8^2} \right) + \left( 1 + \frac{r_8}{r} - \frac{r^2}{r_7^2} \right) - \left( 1 - \frac{r_7}{r} + \frac{r^2}{r_6^2} \right) + \left( 1 + \frac{r_6}{r} - \frac{r^2}{r_5^2} \right) - \left( 1 - \frac{r_5}{r} + \frac{r^2}{r_4^2} \right) + \left( 1 + \frac{r_4}{r} - \frac{r^2}{r_3^2} \right) - \\
 &- \left( 1 - \frac{r_3}{r} + \frac{r^2}{r_2^2} \right) + \left( 1 + \frac{r_2}{r} - \frac{r^2}{r_1^2} \right) - \left( 1 - \frac{r_1}{r} + \frac{r^2}{r_{10}^2} \right),
 \end{aligned}$$

$$\begin{aligned}
 1 - \frac{r_0}{r} - \frac{A_0 r^2}{3} &= 1 - \frac{r_1+r_2+\dots+r_{10}}{r} - \left( \frac{1}{r_1^2} + \frac{1}{r_2^2} + \dots + \frac{1}{r_{10}^2} \right) r^2 = & (17) \\
 &= 1 + \left( 1 - \frac{r_{10}}{r} - \frac{r^2}{r_9^2} \right) - \left( 1 + \frac{r_9}{r} + \frac{r^2}{r_8^2} \right) + \left( 1 - \frac{r_8}{r} - \frac{r^2}{r_7^2} \right) - \left( 1 + \frac{r_7}{r} + \frac{r^2}{r_6^2} \right) + \left( 1 - \frac{r_6}{r} - \frac{r^2}{r_5^2} \right) - \left( 1 + \frac{r_5}{r} + \frac{r^2}{r_4^2} \right) + \left( 1 - \frac{r_4}{r} - \frac{r^2}{r_3^2} \right) - \\
 &- \left( 1 + \frac{r_3}{r} + \frac{r^2}{r_2^2} \right) + \left( 1 - \frac{r_2}{r} - \frac{r^2}{r_1^2} \right) - \left( 1 + \frac{r_1}{r} + \frac{r^2}{r_{10}^2} \right),
 \end{aligned}$$

$$\begin{aligned}
 1 + \frac{r_0}{r} + \frac{A_0 r^2}{3} &= 1 + \frac{r_1+r_2+\dots+r_{10}}{r} + \left( \frac{1}{r_1^2} + \frac{1}{r_2^2} + \dots + \frac{1}{r_{10}^2} \right) r^2 = & (18) \\
 &= 1 + \left( 1 + \frac{r_{10}}{r} + \frac{r^2}{r_9^2} \right) - \left( 1 - \frac{r_9}{r} - \frac{r^2}{r_8^2} \right) + \left( 1 + \frac{r_8}{r} + \frac{r^2}{r_7^2} \right) - \left( 1 - \frac{r_7}{r} - \frac{r^2}{r_6^2} \right) + \left( 1 + \frac{r_6}{r} + \frac{r^2}{r_5^2} \right) - \left( 1 - \frac{r_5}{r} - \frac{r^2}{r_4^2} \right) + \left( 1 + \frac{r_4}{r} + \frac{r^2}{r_3^2} \right) - \\
 &- \left( 1 - \frac{r_3}{r} - \frac{r^2}{r_2^2} \right) + \left( 1 + \frac{r_2}{r} + \frac{r^2}{r_1^2} \right) - \left( 1 - \frac{r_1}{r} - \frac{r^2}{r_{10}^2} \right),
 \end{aligned}$$

$$\begin{aligned}
 - \left[ 1 + \frac{r_0}{r} - \frac{A_0 r^2}{3} \right] &= - \left[ 1 - \frac{r_1+r_2+\dots+r_{10}}{r} + \left( \frac{1}{r_1^2} + \frac{1}{r_2^2} + \dots + \frac{1}{r_{10}^2} \right) r^2 \right] = & (19) \\
 &= -1 - \left( 1 - \frac{r_{10}}{r} + \frac{r^2}{r_9^2} \right) + \left( 1 + \frac{r_9}{r} - \frac{r^2}{r_8^2} \right) - \left( 1 - \frac{r_8}{r} + \frac{r^2}{r_7^2} \right) + \left( 1 + \frac{r_7}{r} - \frac{r^2}{r_6^2} \right) - \left( 1 - \frac{r_6}{r} + \frac{r^2}{r_5^2} \right) + \left( 1 + \frac{r_5}{r} - \frac{r^2}{r_4^2} \right) - \left( 1 - \frac{r_4}{r} + \frac{r^2}{r_3^2} \right) + \\
 &+ \left( 1 + \frac{r_3}{r} - \frac{r^2}{r_2^2} \right) - \left( 1 - \frac{r_2}{r} + \frac{r^2}{r_1^2} \right) + \left( 1 + \frac{r_1}{r} - \frac{r^2}{r_{10}^2} \right),
 \end{aligned}$$

$$\begin{aligned}
 - \left[ 1 + \frac{r_0}{r} + \frac{A_0 r^2}{3} \right] &= - \left[ 1 + \frac{r_1+r_2+\dots+r_{10}}{r} - \left( \frac{1}{r_1^2} + \frac{1}{r_2^2} + \dots + \frac{1}{r_{10}^2} \right) r^2 \right] = & (20) \\
 &= -1 - \left( 1 + \frac{r_{10}}{r} - \frac{r^2}{r_9^2} \right) + \left( 1 - \frac{r_9}{r} + \frac{r^2}{r_8^2} \right) - \left( 1 + \frac{r_8}{r} - \frac{r^2}{r_7^2} \right) + \left( 1 - \frac{r_7}{r} + \frac{r^2}{r_6^2} \right) - \left( 1 + \frac{r_6}{r} - \frac{r^2}{r_5^2} \right) + \left( 1 - \frac{r_5}{r} + \frac{r^2}{r_4^2} \right) - \left( 1 + \frac{r_4}{r} - \frac{r^2}{r_3^2} \right) + \\
 &+ \left( 1 - \frac{r_3}{r} + \frac{r^2}{r_2^2} \right) - \left( 1 + \frac{r_2}{r} - \frac{r^2}{r_1^2} \right) + \left( 1 - \frac{r_1}{r} + \frac{r^2}{r_{10}^2} \right),
 \end{aligned}$$

$$\begin{aligned}
 - \left[ 1 - \frac{r_0}{r} - \frac{A_0 r^2}{3} \right] &= - \left[ 1 - \frac{r_1+r_2+\dots+r_{10}}{r} - \left( \frac{1}{r_1^2} + \frac{1}{r_2^2} + \dots + \frac{1}{r_{10}^2} \right) r^2 \right] = & (21) \\
 &= -1 + \left( 1 - \frac{r_{10}}{r} - \frac{r^2}{r_9^2} \right) - \left( 1 + \frac{r_9}{r} + \frac{r^2}{r_8^2} \right) + \left( 1 - \frac{r_8}{r} - \frac{r^2}{r_7^2} \right) - \left( 1 + \frac{r_7}{r} + \frac{r^2}{r_6^2} \right) + \left( 1 - \frac{r_6}{r} - \frac{r^2}{r_5^2} \right) - \left( 1 + \frac{r_5}{r} + \frac{r^2}{r_4^2} \right) + \left( 1 - \frac{r_4}{r} - \frac{r^2}{r_3^2} \right) - \\
 &- \left( 1 + \frac{r_3}{r} + \frac{r^2}{r_2^2} \right) + \left( 1 - \frac{r_2}{r} - \frac{r^2}{r_1^2} \right) - \left( 1 + \frac{r_1}{r} + \frac{r^2}{r_{10}^2} \right),
 \end{aligned}$$

$$\begin{aligned}
 - \left[ 1 + \frac{r_0}{r} + \frac{A_0 r^2}{3} \right] &= - \left[ 1 + \frac{r_1+r_2+\dots+r_{10}}{r} + \left( \frac{1}{r_1^2} + \frac{1}{r_2^2} + \dots + \frac{1}{r_{10}^2} \right) r^2 \right] = & (22) \\
 &= -1 - \left( 1 + \frac{r_{10}}{r} + \frac{r^2}{r_9^2} \right) + \left( 1 - \frac{r_9}{r} - \frac{r^2}{r_8^2} \right) - \left( 1 + \frac{r_8}{r} + \frac{r^2}{r_7^2} \right) + \left( 1 - \frac{r_7}{r} - \frac{r^2}{r_6^2} \right) - \left( 1 + \frac{r_6}{r} + \frac{r^2}{r_5^2} \right) + \left( 1 - \frac{r_5}{r} - \frac{r^2}{r_4^2} \right) - \left( 1 + \frac{r_4}{r} + \frac{r^2}{r_3^2} \right) + \\
 &+ \left( 1 - \frac{r_3}{r} - \frac{r^2}{r_2^2} \right) - \left( 1 + \frac{r_2}{r} + \frac{r^2}{r_1^2} \right) + \left( 1 - \frac{r_1}{r} - \frac{r^2}{r_{10}^2} \right).
 \end{aligned}$$

Each term enclosed in brackets on the right-hand sides of Exs. (15) – (22), when substituted into metrics (3) – (12), is a separate Kottler solution of the second Einstein vacuum equation of the form

$$R_{ik} + g_{ik}\Lambda_m = 0. \tag{23}$$

Within the framework of Geometricized Vacuum Physics (GVPh) – this means that the metric-solutions (3) – (12) describe stable spherical vacuum formations (see (Batanov-Gaukhman, 2023e)).

Further, in the article (Batanov-Gaukhman, 2024c), it was proposed that the radii  $r_m$  in Exs. (3) – (22) are members of a discrete hierarchical sequence of characteristic sizes of spherical formations (44a) in (Batanov-Gaukhman, 2023f):

- $r_1 \sim 10^{39}$  cm is radius commensurate with the radius of the mega-Universe core;
  - $r_2 \sim 10^{29}$  cm is radius commensurate with the radius of the observable Universe core;
  - $r_3 \sim 10^{19}$  cm is radius commensurate with the radius of the galactic core;
  - $r_4 \sim 10^7$  cm is radius commensurate with the radius of the core of a planet or star;
  - $r_5 \sim 10^{-3}$  cm is radius commensurate with the radius of a biological cell;
  - $r_6 \sim 10^{-13}$  cm is radius commensurate with the radius of an elementary particle core;
  - $r_7 \sim 10^{-24}$  cm is radius commensurate with the radius of a proto-quark core;
  - $r_8 \sim 10^{-34}$  cm is radius commensurate with the radius of a plankton core;
  - $r_9 \sim 10^{-45}$  cm is radius commensurate with the radius of the proto-plankton core;
  - $r_{10} \sim 10^{-55}$  cm is radius commensurate with the size of the instanton core.
- (24)

As a result, it turned out that metrics (3) – (12), taking into account Exs. (13) – (22), describe a metric-dynamic hierarchical cosmological model of a sequence of 10 spherical vacuum formations, nested inside each other like nesting dolls. That is, the internal nucleolus of each core, in turn, is the core for the next nucleus, and so on up to ten iterations, as shown in Figure 1.

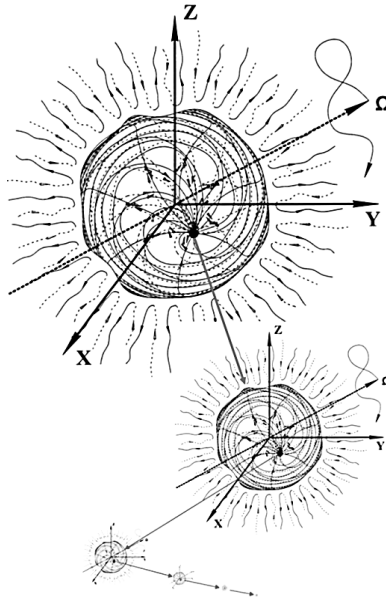


Fig. 1: Hierarchical sequence of spherical formations of different scales, nested inside each other like nesting dolls (repetition of Figure 1 in (Batanov-Gaukhman, 2023f))

In the articles (Batanov-Gaukhman, 2023f, 2024a, 2024b, 2024c), from the hierarchical sequence of spherical vacuum formations described by the set of metrics (3) – (12) taking into account Exs. (13) – (24), only one level of stable vacuum formations was singled out for consideration – the level of picoscopic "particles" (i.e. "particles" with a characteristic size of the nucleus of the order of  $r_6 \sim 10^{-13}$  cm). In this case, a striking coincidence of the

geometrized models of picoscopic "particles" with the currently accepted Standard Model of elementary particles was discovered.

In the works ((Batanov-Gaukhman, 2023f, 2024a, 2024b, 2024c) it was repeatedly noted that everything written in these articles in relation to the level of picoscopic "particles" also applies to all other levels of the hierarchical cosmological model (see Figure 1), i.e. to "proto-quarks", "planets", "galaxies", etc. That is, the levels of organization of stable spherical vacuum formations of different scales are similar to each other.

However, the statement about the similarity of, for example, metric-dynamic models of picoscopic elementary "particles" and macroscopic "planets" met with complete misunderstanding of colleagues, whose thinking is conditioned by the modern scientific picture of the world. Therefore, in this article an attempt was made to isolate from the general hierarchical model (3) – (24) the level of macroscopic stable spherical vacuum formations of a planetary scale and to construct metric-dynamic models of naked "planets" and "stars".

## MATERIALS AND METHOD

### 1 The concept of a naked "planet"

Within the framework of modern natural science, a planet (or star) is perceived as a dense accumulation of a huge number of elementary particles that are united into atoms, molecules, cells, organisms, liquids, stones, etc. (see Figure 2a).

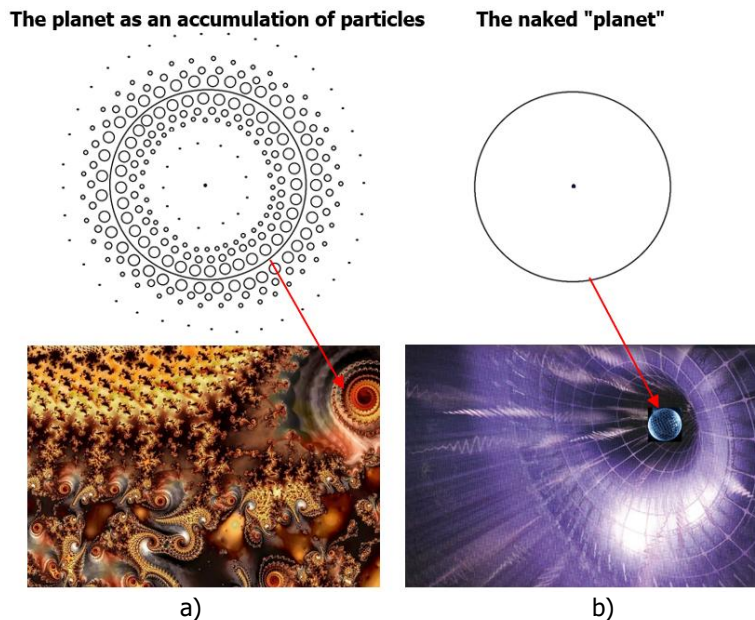


Fig. 2: a) Schematic and fractal illustrations of the planet as a huge accumulation of macro-, mini-, miro-, nano- and picoscopic local stable vacuum formations ("particles", "atoms", "molecules", "cells", etc.) in the vicinity of its core; b) Schematic representation and illustration of a stable spherical curvature of the  $\lambda_{6,7}$ -vacuum of a planetary scale, consisting of a core and an outer shell. This large-scale stable spherical  $\lambda_{6,7}$ -vacuum formation (conditionally cleared of small "particles") will be called a naked "planet"

In GTR, it is believed that this entire innumerable set of small particles has the ability to curve 4-dimensional space-time so that an absorbing space-time funnel is formed, which is usually considered to be the cause of gravity.

In the Geometrized Vacuum Physics (GVPh) developed here, on the contrary, the cause of gravity is a stable funnel-shaped curvature of the  $\lambda_{6,7}$ -vacuum (Figure 2b) (the definition of the  $\lambda_{m,\pi}$ -vacuum is given in §1 in

(Batanov-Gaukhman, 2023a)). This large-scale  $\lambda_{6,7}$ -vacuum funnel draws in "particles" (i.e. the smallest corpuscular  $\lambda_{-12,-15}$ -vacuum formations considered in (Batanov-Gaukhman, 2023f)), clearing the surrounding space of them.

Before investigating the cause of gravity, which attracts a huge number of small "particles" to the core of the planet, it is first necessary to understand how the large-scale  $\lambda_{6,7}$ -vacuum is curved in the region of space under study.

For this, we introduce the concept of a naked "planet". By a naked "planet" we mean a large-scale stable spherical  $\lambda_{6,7}$ -vacuum formation with a characteristic core radius  $r_4 \sim 100 - 1000 \text{ km} = 10^7 - 10^8 \text{ cm}$  (from hierarchy (24)), in the vicinity of which macro-, mini-, micro-, nano- and picoscopic local stable  $\lambda_{m,r}$ -vacuum formations are conditionally absent (see Figures 2b and 3).



Fig. 3: Fractal illustrations of the outer shell of a naked "planet", i.e. a curved region of  $\lambda_{6,7}$ -vacuum, surrounding the core of a stable planetary  $\lambda_{6,7}$ -vacuum formation, from which all pico- and microscopic "particles" are conditionally removed

The definition of  $\lambda_{6,7}$ -vacuum as a 3-dimensional curved landscape, illuminated from the surrounding reality by light rays with a wavelength of  $\lambda_{6,7}$  from the range of  $\Delta\lambda = 10^6 - 10^7 \text{ cm} = 10 - 100 \text{ km}$  (see §1 in (Batanov-Gaukhman, 2023a)), initially suggests that the result of such probing in the case under consideration will be a naked "planet", since for 10 – 100-kilometer electromagnetic waves, small particles are not an obstacle. Such light rays reveal only the large-scale curvature of the surrounding space (vacuum). That is, geodetic lines of light rays with a wavelength of  $\lambda_{6,7}$  from the range of 10 – 100 km immediately indicate a stable spherical formation (see Figure 2b and 3), which we call a naked "planet".

## 2 Naked planetary valence $P_{\kappa}$ -"quarks<sub>10</sub>"

By analogy, as from metrics of the form (3) – (22) in §4.1 in (Batanov-Gaukhman, 2023f) the metric-dynamic models of the "electron" and "positron" were isolated, we will leave in metrics (3) – (7) taking into account (15) – (18) for consideration only those terms that contain the radius  $r_4 \sim 10^7 \text{ cm} = 100 \text{ km}$ , commensurate with the radius of the core of the naked "planet". As a result, we obtain the following multilayer metric-dynamic model of a stable "convex" spherical  $\lambda_{6,7}$ -vacuum formation, which we will call a valence planetary  $P_{E\gamma^+}$ -"quark<sub>10</sub>" (the index 10 means that this planetary  $P_{E\gamma^+}$ -"quark<sub>10</sub>" is in a hierarchical chain of ten stable spherical  $\lambda_{m,r}$ -vacuum formations nested inside each other, see Figure 1):

### The valence planetary $Pe_y^+$ -**"QUARK<sub>10</sub>"**

(25)

Stable "convex" multilayer spherical curvature of  $\lambda_{6,7}$ -vacuum with signature (+ ---), consisting of:

**The outer shell of the  $Pe_y^+$ -**"quark<sub>10</sub>"****  
in the interval  $[r_3, r_4]$  (see Figure 2b and 4)

$$I \quad ds_1^{(+---)2} = \left(1 - \frac{r_4}{r} + \frac{r^2}{r_3^2}\right) c^2 dt^2 - \frac{dr^2}{\left(1 - \frac{r_4}{r} + \frac{r^2}{r_3^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (26)$$

$$H \quad ds_2^{(+---)2} = \left(1 + \frac{r_4}{r} - \frac{r^2}{r_3^2}\right) c^2 dt^2 - \frac{dr^2}{\left(1 + \frac{r_4}{r} - \frac{r^2}{r_3^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (27)$$

$$V \quad ds_3^{(+---)2} = \left(1 - \frac{r_4}{r} - \frac{r^2}{r_3^2}\right) c^2 dt^2 - \frac{dr^2}{\left(1 - \frac{r_4}{r} - \frac{r^2}{r_3^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (28)$$

$$H' \quad ds_4^{(+---)2} = \left(1 + \frac{r_4}{r} + \frac{r^2}{r_3^2}\right) c^2 dt^2 - \frac{dr^2}{\left(1 + \frac{r_4}{r} + \frac{r^2}{r_3^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2); \quad (29)$$

### The core of the $Pe_y^+$ -**"quark<sub>10</sub>"**

in the interval  $[r_4, r_5]$  (see Figure 2b and 4)

$$I \quad ds_1^{(+---)2} = -\left(1 - \frac{r_5}{r} + \frac{r^2}{r_4^2}\right) c^2 dt^2 - \frac{dr^2}{-\left(1 - \frac{r_5}{r} + \frac{r^2}{r_4^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (30)$$

$$H \quad ds_2^{(+---)2} = -\left(1 + \frac{r_5}{r} - \frac{r^2}{r_4^2}\right) c^2 dt^2 - \frac{dr^2}{-\left(1 + \frac{r_5}{r} - \frac{r^2}{r_4^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (31)$$

$$V \quad ds_3^{(+---)2} = -\left(1 - \frac{r_5}{r} - \frac{r^2}{r_4^2}\right) c^2 dt^2 - \frac{dr^2}{-\left(1 - \frac{r_5}{r} - \frac{r^2}{r_4^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (32)$$

$$H' \quad ds_4^{(+---)2} = -\left(1 + \frac{r_5}{r} + \frac{r^2}{r_4^2}\right) c^2 dt^2 - \frac{dr^2}{-\left(1 + \frac{r_5}{r} + \frac{r^2}{r_4^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2); \quad (33)$$

### The substrate of the $Pe_y^+$ -**"quark<sub>10</sub>"**

in the interval  $[0, \infty]$

$$i \quad ds_5^{(+---)2} = c^2 dt^2 - dr^2 - r^2(d\theta^2 + \sin^2 \theta d\phi^2). \quad (34)$$

Similarly, in metrics (8) – (12), taking into account (19) – (22), we will also leave only those terms that contain the radii  $r_4$ . As a result, we will obtain the following multilayer metric-dynamic model of a stable "concave" spherical  $\lambda_{6,7}$ -vacuum formation, which we will call the valence planetary  $Pe_y^-$ -**"antiquark<sub>10</sub>"**.

### The valence planetary $Pe_y^-$ -**"ANTIQUARK<sub>10</sub>"**

(35)

Stable "convex" multilayer spherical curvature of  $\lambda_{6,7}$ -vacuum with signature (- + + +), consisting of:

### The outer shell of the $Pe_y^-$ -**"antiquark<sub>10</sub>"**

in the interval  $[r_3, r_4]$  (see negative of Figure 2b and 4)

$$I \quad ds_1^{(-+++)^2} = -\left(1 + \frac{r_4}{r} - \frac{r^2}{r_3^2}\right) c^2 dt^2 + \frac{dr^2}{-\left(1 + \frac{r_4}{r} - \frac{r^2}{r_3^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (36)$$

$$H \quad ds_2^{(-+++)^2} = -\left(1 - \frac{r_4}{r} + \frac{r^2}{r_3^2}\right) c^2 dt^2 + \frac{dr^2}{-\left(1 - \frac{r_4}{r} + \frac{r^2}{r_3^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (37)$$

$$V \quad ds_3^{(-+++)^2} = -\left(1 + \frac{r_4}{r} + \frac{r^2}{r_3^2}\right) c^2 dt^2 + \frac{dr^2}{-\left(1 + \frac{r_4}{r} + \frac{r^2}{r_3^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (38)$$

$$H' \quad ds_4^{(-+++)^2} = -\left(1 - \frac{r_4}{r} - \frac{r^2}{r_3^2}\right) c^2 dt^2 + \frac{dr^2}{-\left(1 - \frac{r_4}{r} - \frac{r^2}{r_3^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2); \quad (39)$$

**The core of the  $Pe_{\gamma}^{-}$ - "antiquark<sub>10</sub>"**  
in the interval  $[r_4, r_5]$  (see negative Figure 2b and 4)

I  $ds_1^{(-+++)^2} = -\left(1 - \frac{r_5}{r} + \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{r_5}{r} + \frac{r^2}{r_4^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2),$  (40)

H  $ds_2^{(-+++)^2} = -\left(1 + \frac{r_5}{r} - \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 + \frac{r_5}{r} - \frac{r^2}{r_4^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2),$  (41)

V  $ds_3^{(-+++)^2} = -\left(1 - \frac{r_5}{r} - \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{r_5}{r} - \frac{r^2}{r_4^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2),$  (42)

H'  $ds_4^{(-+++)^2} = -\left(1 + \frac{r_5}{r} + \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 + \frac{r_5}{r} + \frac{r^2}{r_4^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2);$  (43)

**The substrate of the  $Pe_{\gamma}^{-}$ - "antiquark<sub>10</sub>"**  
in the interval  $[0, \infty]$

i  $ds_5^{(-+++)^2} = -c^2 dt^2 + dr^2 + r^2(d\theta^2 + \sin^2 \theta d\phi^2).$  (44)

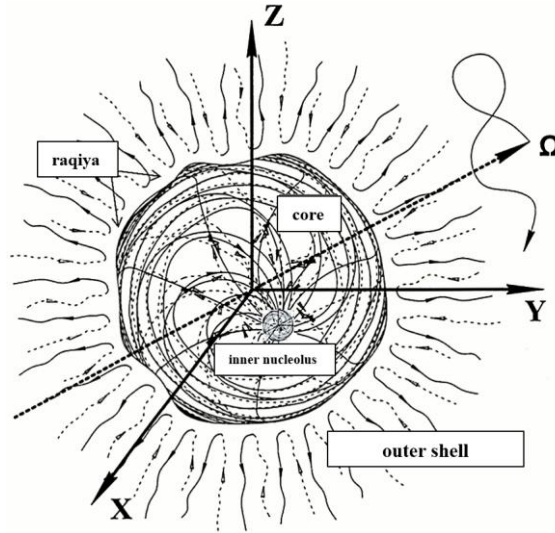


Fig. 4: A fully geometrized model of a convex stable spherical vacuum formation (in particular, a planetary  $Pe_{\gamma}^{+}$ - "quark<sub>10</sub>" ) with four clearly defined regions: The **core** of the planetary  $Pe_{\gamma}^{+}$ - "quark<sub>10</sub>" is a closed spherical region of  $\lambda_{6,7}$ -vacuum with a radius of  $r_4 \sim 10^7$  cm = 100 km; The **outer shell** of the  $Pe_{\gamma}^{+}$ - "quark<sub>10</sub>" is a region of  $\lambda_{6,7}$ -vacuum surrounding the core of the  $Pe_{\gamma}^{+}$ - "quark<sub>10</sub>"; The **raqiya** of the  $Pe_{\gamma}^{+}$ - "quark<sub>10</sub>" is a multilayer spherical abyss-crack separating the core of the  $Pe_{\gamma}^{+}$ - "quark<sub>10</sub>" from its outer shell; The **inner nucleolus** is a closed spherical region of  $\lambda_{12,16}$ -vacuum inside the core of the  $Pe_{\gamma}^{+}$ - "quark<sub>10</sub>" (the core of elementary "particle"); The **substrate**  $Pe_{\gamma}^{+}$ - "quark<sub>10</sub>" shelf is the original undeformed region of  $\lambda_{6,7}$ -vacuum at the location of the  $Pe_{\gamma}^{+}$ - "quark<sub>10</sub>". This is a kind of memory of what this region of  $\lambda_{6,7}$ -vacuum was like before it was deformed and took the stable form of the  $Pe_{\gamma}^{+}$ - "quark<sub>10</sub>"

Recall that according to §1 in (Batanov-Gaukhman, 2024a), the simplest (framework) metric-dynamic models of vacuum formations are called valence, since within the framework of the Algebra of signature, each of the metrics (26) – (34) and (36) – (44) can be represented as a sum of 7 sub-metrics with the corresponding signatures (see the ranking expression (23) in (Batanov-Gaukhman, 2024a)), and this can continue ad infinitum. That is, all the vacuum formations under consideration are infinitely complex. We simplify complex vacuum fluctuations using averaging (see Figure 2 in (Batanov-Gaukhman, 2024a)), as a result we reveal the main framework of the vacuum formation, and the model of the simplified formation is called *valence*.

The sets of metrics (25) and (35) differ only in signature. That is, the planetary  $Pe_y^+$ -“quark<sub>10</sub>” and the planetary  $Pe_y^-$ -“antiquark<sub>10</sub>” are completely identical, but antipodal (mutually opposite) copies of each other. If  $Pe_y^+$ -“quark<sub>10</sub>” is conventionally called a «convex» stable spherical  $\lambda_{6,7}$ -vacuum formation (see Figures 2b and 4), then  $Pe_y^-$ -“antiquark<sub>10</sub>” is exactly the same conventionally «concave» stable spherical  $\lambda_{6,7}$ -vacuum formation. Such a mutually opposite pair of  $\lambda_{6,7}$ -vacuum formations completely correspond to the condition of vacuum balance (see the Introduction in (Batanov-Gaukhman, 2023a)).

The analysis of the sets of metrics-solution (25) and (35) using the mathematical apparatus of Algebra of signature (Batanov-Gaukhman; 2023a, 2023b, 2023c, 2023d, 2023e, 2023f) was performed in (Batanov-Gaukhman, 2023a). That is, everything that was presented in the article (Batanov-Gaukhman, 2025a) is applicable to this article, provided that all triples of radii  $r_5, r_6, r_7$  are replaced by triples of radii  $r_3, r_4, r_5$ , where all  $r_3, r_4, r_5, r_6, r_7$  belong to the same hierarchy of radii (24) (or (44a) in (Batanov-Gaukhman, 2023f)).

### 3 Naked planetary valence $P_k$ -«quarks<sub>3</sub>»

When considering the hierarchical cosmological model proposed in (Batanov-Gaukhman, 2023f), we came to the conclusion (see §6 in [6]) that any variants of hierarchical chains of stable spherical vacuum formations with cores radii from the hierarchical series are possible:  $r_1 \sim 10^{39}$ ,  $r_2 \sim 10^{29}$ ,  $r_3 \sim 10^{19}$ ,  $r_4 \sim 10^7$ ,  $r_5 \sim 10^{-3}$ ,  $r_6 \sim 10^{-13}$ ,  $r_7 \sim 10^{-24}$ ,  $r_8 \sim 10^{-34}$ ,  $r_9 \sim 10^{-45}$ ,  $r_{10} \sim 10^{-55}$ , ... (see the set of vacuum equations (169) in (Batanov-Gaukhman, 2023f)).

We do not know which radius in this hierarchical chain is the largest and which is the smallest. We have conditionally accepted that the largest is the radius of the mega-Universe  $r_1 \sim 10^{39}$  cm, and the smallest is the radius of the instanton  $r_{10} \sim 10^{-55}$  cm. However, as shown in (Batanov-Gaukhman, 2024c), the hierarchical cosmological model clearly dictates the necessity that all hierarchical chains of “corpuscles” nested inside each other must begin with the largest “corpuscle” and end with the smallest “corpuscle”, regardless of the number of links (i.e. intermediate “corpuscles”) in these hierarchical chains.

Therefore, the shortest hierarchical chain can consist of at least 3 links (corpuscles). In relation to the planetary level of stable  $\lambda_{6,7}$ -vacuum formations considered here, the simplest metric-dynamic model of a planetary  $P_k$ -“quarks<sub>3</sub>” and  $P_k$ -“antiquarks<sub>3</sub>” consists of three “corpuscles”: the largest, planetary, and smallest:

#### **The valence planetary $Pe_y^+$ -“QUARK<sub>3</sub>”** (45)

Stable “convex” multilayer spherical curvature of  $\lambda_{6,7}$ -vacuum  
with signature (+ - - -), consisting of:

##### **The outer shell of the $Pe_y^+$ -“quarks<sub>3</sub>”**

in the interval  $[r_1, r_4]$  (see Figure 2b and 4)

$$ds_1^{(+---)^2} = \left(1 - \frac{r_4}{r} + \frac{r^2}{r_1^2}\right) c^2 dt^2 - \frac{dr^2}{\left(1 - \frac{r_4}{r} + \frac{r^2}{r_1^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (46)$$

$$ds_2^{(+---)^2} = \left(1 + \frac{r_4}{r} - \frac{r^2}{r_1^2}\right) c^2 dt^2 - \frac{dr^2}{\left(1 + \frac{r_4}{r} - \frac{r^2}{r_1^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (47)$$

$$ds_3^{(+---)^2} = \left(1 - \frac{r_4}{r} - \frac{r^2}{r_1^2}\right) c^2 dt^2 - \frac{dr^2}{\left(1 - \frac{r_4}{r} - \frac{r^2}{r_1^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (48)$$

$$ds_4^{(+---)^2} = \left(1 + \frac{r_4}{r} + \frac{r^2}{r_1^2}\right) c^2 dt^2 - \frac{dr^2}{\left(1 + \frac{r_4}{r} + \frac{r^2}{r_1^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2); \quad (49)$$

##### **The core of the $Pe_y^+$ -“quarks<sub>3</sub>”**

in the interval  $[r_4, r_{10}]$  (see Figure 2b and 4)

$$ds_1^{(+---)^2} = -\left(1 - \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right) c^2 dt^2 - \frac{dr^2}{-\left(1 - \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (50)$$

$$ds_2^{(+---)^2} = -\left(1 + \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right) c^2 dt^2 - \frac{dr^2}{-\left(1 + \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (51)$$

$$ds_3^{(+---)^2} = -\left(1 - \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right) c^2 dt^2 - \frac{dr^2}{-\left(1 - \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (52)$$

$$ds_4^{(+---)^2} = -\left(1 + \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right) c^2 dt^2 - \frac{dr^2}{-\left(1 + \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right)} - r^2(d\theta^2 + \sin^2 \theta d\phi^2); \quad (53)$$

### The substrate of the $Pe_y^+$ - "quarks"

in the interval  $[0, \infty]$

$$ds_5^{(+---)^2} = c^2 dt^2 - dr^2 - r^2(d\theta^2 + \sin^2 \theta d\phi^2). \quad (54)$$

### The valence planetary $Pe_y^-$ - "ANTIQUARK<sub>3</sub>"

(55)

Stable "convex" multilayer spherical curvature of  $\lambda_{6,7}$ -vacuum  
with signature  $(- + + +)$ , consisting of:

#### The outer shell of the $Pe_y^-$ - "antiquarks"

in the interval  $[r_1, r_4]$  (see negative of Figure 2b and 4)

$$ds_1^{(-+++)^2} = -\left(1 + \frac{r_4}{r} - \frac{r^2}{r_1^2}\right) c^2 dt^2 + \frac{dr^2}{-\left(1 - \frac{r_4}{r} + \frac{r^2}{r_1^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (56)$$

$$ds_2^{(-+++)^2} = -\left(1 - \frac{r_4}{r} + \frac{r^2}{r_1^2}\right) c^2 dt^2 + \frac{dr^2}{-\left(1 + \frac{r_4}{r} - \frac{r^2}{r_1^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (57)$$

$$ds_3^{(-+++)^2} = -\left(1 + \frac{r_4}{r} + \frac{r^2}{r_1^2}\right) c^2 dt^2 + \frac{dr^2}{-\left(1 - \frac{r_4}{r} - \frac{r^2}{r_1^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (58)$$

$$ds_4^{(-+++)^2} = -\left(1 - \frac{r_4}{r} - \frac{r^2}{r_1^2}\right) c^2 dt^2 + \frac{dr^2}{-\left(1 + \frac{r_4}{r} + \frac{r^2}{r_1^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2); \quad (59)$$

#### The core of the $Pe_y^-$ - "antiquarks"

in the interval  $[r_4, r_{10}]$  (see negative Figure 2b and 4)

$$ds_1^{(-+++)^2} = -\left(1 - \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (60)$$

$$ds_2^{(-+++)^2} = -\left(1 + \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 + \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (61)$$

$$ds_3^{(-+++)^2} = -\left(1 - \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \quad (62)$$

$$ds_4^{(-+++)^2} = -\left(1 + \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 + \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right)} + r^2(d\theta^2 + \sin^2 \theta d\phi^2); \quad (63)$$

#### The substrate of the $Pe_y^-$ - "antiquarks"

in the interval  $[0, \infty]$

$$ds_5^{(-+++)^2} = -c^2 dt^2 + dr^2 + r^2(d\theta^2 + \sin^2 \theta d\phi^2). \quad (64)$$

where according to the hierarchy of radii (24):

$r_1 \sim 10^{39}$  cm is radius commensurate with the radius of the mega-Universe core;

$r_4 \sim 10^7$  cm is radius commensurate with the radius of the core of a  $R_k$ - "quark<sub>3</sub>" or  $R_k$ - "antiquark<sub>3</sub>";

$r_{10} \sim 10^{-55}$  cm is radius commensurate with the size of the instanton core.

Let's note once again that the maximum radius of the core of our Universe  $r_1 \sim 10^{39}$  cm, and the radius of the core of the smallest corpuscle  $r_{10} \sim 10^{-55}$  cm are accepted conditionally (heuristically). However, at this stage of

research, these assumptions have practically no effect on the metric-dynamic models of naked  $P_k$ -"quark<sub>3</sub>" (45) and  $P_k$ -"antiquark<sub>3</sub>" (55). These models of naked  $P_k$ -"quarks" can always be corrected by specifying the values of the radii  $r_1, r_4, r_{10}$ .

Naked planetary  $P_k$ -"quark<sub>3</sub>" and  $P_k$ -"quark<sub>10</sub>", as well as naked planetary  $P_k$ -"antiquark<sub>3</sub>" and  $P_k$ -"antiquark<sub>10</sub>" are practically indistinguishable at a large distance from the periphery of their cores. However, in the vicinity of their cores (i.e. in the region of their raqiya, see Figure 4) they differ significantly from each other (see §4.11 in (Batanov-Gaukhman, 2023f) and §6 in (Batanov-Gaukhman, 2024a)).

Planetary  $P_k$ -"quarks" (as well as "quarks" of any level of consideration, for example, the level of elementary "particles" (Batanov-Gaukhman; 2023f, 2024a)) have individual features in the raqiya region, depending on which hierarchical chain of stable  $\lambda_{m,r}$ -vacuum formations they are included in and what place they occupy in this hierarchy.

The valence planetary  $P_{e^+}$ -"quark<sub>3</sub>" of the type (25) or (45) will also be called the valence planetary  $P_k$ -"electron<sub>3</sub>", and the valence planetary  $P_{e^-}$ -"antiquark<sub>3</sub>" of the type (35) or (55) will be called the valence planetary  $P_k$ -"positron<sub>3</sub>".

The metric-dynamic models of the naked valence planetary  $P_k$ -"electron<sub>3</sub>" (25) or (45) and the naked valence planetary  $P_k$ -"positron<sub>3</sub>" (35) or (55) almost completely coincide with the metric-dynamic models of the «electron» (50) in (Batanov-Gaukhman, 2024a) and the "positron" (60) in (Batanov-Gaukhman, 2024a), which were investigated in (Batanov-Gaukhman, 2024a). These macro- and picoscopic stable spherical  $\lambda_{m,r}$ -vacuum formations (corpuscles) differ mainly in scale, with the exception of raqiya (Figure 5). The sizes of planetary corpuscles are approximately 20 orders of magnitude larger than the sizes of elementary "particles", however, all  $\lambda_{m,r}$ -vacuum formations, regardless of their scale, are investigated by the same methods proposed in (Batanov-Gaukhman, 2023a, 2023b, 2023c, 2023d, 2023e, 2023f, 2024a, 2024b, 2024c).

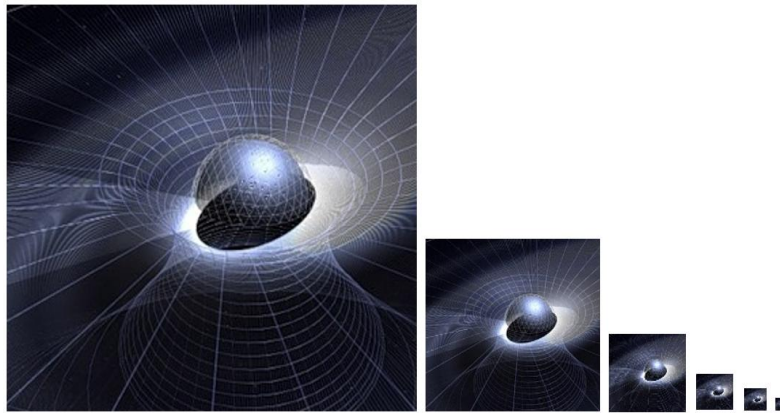


Fig. 5: Hierarchy of stable spherical  $\lambda_{m,r}$ -vacuum formations (corpuscles)

#### 4 Naked colored planetary valence $P_k$ -"quarks<sub>3</sub>"

In the articles (Batanov-Gaukhman; 2023a, 2023b, 2023c, 2023a, 2023e, 2023f, 2024a), where «Geometrized vacuum physics from the standpoint of the Algebra of signature» is consistently developed, it is shown that it is necessary to take into account all 16 signatures:

$$\begin{array}{cccc}
 (+ + +) & (+ + +- ) & (- + +- ) & (+ + -+ ) \\
 (- - -) & (- + ++ ) & (- - ++ ) & (- + -+ ) \\
 (+ - -) & (+ + -- ) & (+ - -- ) & (+ - ++ ) \\
 (- - +- ) & (+ - +- ) & (- + -- ) & (- - -- )
 \end{array} \tag{65}$$

Therefore, by analogy with Table 1 in (Batanov-Gaukhman, 2023f), we introduce the concept of convex-concave  $\lambda_{6,7}$ -vacuum formations, which we will call colored naked valence planetary  $P_k$ -"quarks<sub>3</sub>".

Table 1: Colored naked valence planetary  $P_k$ -"quarks<sub>3</sub>"

Signature type, i.e. number of + and -	$P_k$ -"quarks <sub>3</sub> "		$P_k$ -"antiquarks <sub>3</sub> "		Color $P_k$ -"quarks <sub>3</sub> " or $P_k$ -"antiquarks <sub>3</sub> "
	10 metrics of the type (45) with signature:	Designation $P_k$ -"quark <sub>3</sub> " naked, valent	10 metrics of the type (55) with signature:	Designation $P_k$ -"antiquark <sub>3</sub> " naked, valent	
1-3	(+ - - -)	$Pe_y^+$ -"quark <sub>3</sub> " (or $P_k$ -"electron <sub>3</sub> ")	(- + + +)	$Pe_y^-$ -"antiquark <sub>3</sub> " (or $P_k$ -"positron <sub>3</sub> ")	yellow
1-3	(+ + + -)	$Pd_r^+$ -"quark <sub>3</sub> "	(- - - +)	$Pd_r^-$ -"antiquark <sub>3</sub> "	red
	(+ + - +)	$Pd_g^+$ -"quark <sub>3</sub> "	(- - + -)	$Pd_g^-$ -"antiquark <sub>3</sub> "	green
	(+ - + +)	$Pd_b^+$ -"quark <sub>3</sub> "	(- + - -)	$Pd_b^-$ -"antiquark <sub>3</sub> "	blue
2-2	(+ - - +)	$Pu_r^+$ -"quark <sub>3</sub> "	(- + + -)	$Pu_r^-$ -"antiquark <sub>3</sub> "	red
	(+ - + -)	$Pu_g^+$ -"quark <sub>3</sub> "	(- + - +)	$Pu_g^-$ -"antiquark <sub>3</sub> "	green
	(+ + - -)	$Pu_b^+$ -"quark <sub>3</sub> "	(- - + +)	$Pu_b^-$ -"antiquark <sub>3</sub> "	blue
4	(+ + + +)	$Pi_w^+$ -"quark <sub>3</sub> "	(- - - -)	$Pi_w^-$ -"antiquark <sub>3</sub> "	white

For example, let us represent  $Pu_r^-$ -"antiquark<sub>3</sub>" in expanded form:

**The valence planetary  $Pu_r^-$ -"ANTIQUARK<sub>3</sub>"** (66)

Stable "convex" multilayer spherical curvature of  $\lambda_{6,7}$ -vacuum with signature (- + + -), consisting of:

**The outer shell of the  $Pu_r^-$ -"antiquarks<sub>3</sub>"**

in the interval  $[r_1, r_4]$

$$ds_1^{(-+++)^2} = -\left(1 - \frac{r_4}{r} + \frac{r^2}{r_1^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{r_4}{r} + \frac{r^2}{r_1^2}\right)} + r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2, \quad (67)$$

$$ds_2^{(-+++)^2} = -\left(1 + \frac{r_4}{r} - \frac{r^2}{r_1^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 + \frac{r_4}{r} - \frac{r^2}{r_1^2}\right)} + r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2, \quad (68)$$

$$ds_3^{(-+++)^2} = -\left(1 - \frac{r_4}{r} - \frac{r^2}{r_1^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{r_4}{r} - \frac{r^2}{r_1^2}\right)} + r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2, \quad (69)$$

$$ds_4^{(-+++)^2} = -\left(1 + \frac{r_4}{r} + \frac{r^2}{r_1^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 + \frac{r_4}{r} + \frac{r^2}{r_1^2}\right)} + r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2; \quad (70)$$

**The core of the  $Pu_r^-$ - "antiquark<sub>3</sub>"**

in the interval  $[r_4, r_{10}]$

$$ds_1^{(-++-)^2} = -\left(1 - \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right)} + r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2 \quad (71)$$

$$ds_2^{(-++-)^2} = -\left(1 + \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 + \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right)} + r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2, \quad (72)$$

$$ds_3^{(-++-)^2} = -\left(1 - \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 - \frac{r_{10}}{r} - \frac{r^2}{r_4^2}\right)} + r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2, \quad (73)$$

$$ds_4^{(-++-)^2} = -\left(1 + \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right) c^2 dt^2 + \frac{dr^2}{\left(1 + \frac{r_{10}}{r} + \frac{r^2}{r_4^2}\right)} + r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2; \quad (74)$$

**The substrate of the  $Pu_r^-$ - "antiquark<sub>3</sub>"**

in the interval  $[0, \infty]$

$$ds_5^{(-++-)^2} = -c^2 dt^2 + dr^2 + r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2. \quad (75)$$

The metric-dynamic models of all other  $P_k$ - "quarks<sub>3</sub>" and  $P_k$ - "antiquarks<sub>3</sub>" listed in Table 1 are based on a set of metrics of the form (67) – (75), but with the corresponding signature.

Except for the on-average convex planetary  $P_k$ - "electron<sub>3</sub>" (i.e.,  $Pe_{\gamma^+}$ - "quark<sub>3</sub>") with the signature (+ – – –) and the on-average concave planetary  $P_k$ - "positron<sub>3</sub>" (i.e.,  $Pe_{\gamma^-}$ - "antiquark<sub>3</sub>") with the signature (– + + +), all other planetary  $P_k$ - "quarks<sub>3</sub>" are unstable convex-concave curvatures of the  $\lambda_{6,7}$ -vacuum, since all metrics, for example, of the form (67) – (75) with the signature (– + + –), are not solutions of the Einstein vacuum equation (2). That is, when substituting the components of metric tensors from metrics of the form (67) – (74), with any other signature except (+ – – –) and (– + + +), into Einstein's second vacuum equation (2), equality to zero does not occur.

**5 Naked valence planetary  $P_k$ - "baryons<sub>3</sub>",  $P_k$ - "mesons<sub>3</sub>",  $P_k$ - "bosons<sub>3</sub>" and  $P_k$ - "atoms<sub>3</sub>"**

Similarly, to how it was done in §§4.3 – 4.7 in (Batanov-Gaukhman, 2023f) for the level of elementary "particles", from the set of 16-color naked valence planetary  $P_k$ - "quarks<sub>3</sub>" and  $P_k$ - "antiquarks<sub>3</sub>" the following can be composed:

- three states of the naked valence planetary  $Pp_i^-$ - "proton<sub>3</sub>" ( $i = 1, 2, 3$ ) with the total signature (– + + +):

$Pd_r^+(+ + + -)$	$Pd_g^+(+ + - +)$	$Pd_b^+(+ - + +)$
$Pu_g^-(- + - +)$	$Pu_r^-(- - + +)$	$Pu_r^-(- + + -)$
$Pu_b^-(- - + +)$	$Pu_r^-(+ + + -)$	$Pu_g^-(+ + - +)$
$Pp_1^-(- + + +)_+$	$Pp_2^-(- + + +)_+$	$Pp_3^-(- + + +)_+$

- three states of the naked valence planetary  $Pp_i^+$ - "antiproton<sub>3</sub>" with the total signature (+ – – –):

$Pd_r^-(- - - +)$	$Pd_g^-(- - + -)$	$Pd_g^-(- + - -)$
$Pu_g^+(+ - + -)$	$Pu_b^+(+ + - -)$	$Pu_r^+(+ - - +)$
$Pu_b^+(+ + - -)$	$Pu_r^+(+ - - +)$	$Pu_g^+(+ - + -)$
$Pp_1^+(+ - - -)_+$	$Pp_2^+(+ - - -)_+$	$Pp_3^+(+ - - -)_+$

see §4.3 in (Batanov-Gaukhman, 2023f);

- eight states of the naked valence planetary  $Pn^0$ - "neutrons<sub>3</sub>" (where  $i = 1, \dots, 8$ ) with the total signature (0 0 0 0) (§4.4 in (Batanov-Gaukhman, 2023f)):

$$\begin{array}{cccc}
 Pi_w^- (- - - -) & Pi_w^- (- - - -) & Pi_w^- (- - - -) & Pi_w^- (- - - -) \\
 Pd_b^+ (+ - + +) & Pd_g^+ (+ + - +) & Pd_b^+ (+ - + +) & Pu_g^- (- + - +) \\
 Pu_r^- (- + + -) & Pd_r^+ (+ + + -) & Pu_g^- (- + - +) & Pd_b^+ (+ - + +) \\
 Pd_g^+ (+ + - +) & Pu_b^- (- - + +) & Pd_r^+ (+ + + -) & Pd_r^+ (+ + + -) \\
 Pn_1^0 (0 0 0 0)_+ & Pn_2^0 (0 0 0 0)_+ & Pn_3^0 (0 0 0 0)_+ & Pn_4^0 (0 0 0 0)_+ \\
 \\
 Pi_w^+ (+ + + +) & Pi_w^+ (+ + + +) & Pi_w^+ (+ + + +) & Pi_w^+ (+ + + +) \\
 Pd_b^- (- + - -) & Pd_g^- (- - + -) & Pd_b^- (- + - -) & Pu_g^+ (+ - + -) \\
 Pu_r^+ (+ - - +) & Pd_r^- (- - - +) & Pu_g^+ (+ - + -) & Pd_b^- (- + - -) \\
 Pd_g^- (- - + -) & Pu_b^+ (+ + - -) & Pd_r^- (- - - +) & Pd_r^- (- - - +) \\
 Pn_5^0 (0 0 0 0)_+ & Pn_6^0 (0 0 0 0)_+ & Pn_7^0 (0 0 0 0)_+ & Pn_8^0 (0 0 0 0)_+
 \end{array} \tag{82}$$

- all naked valence planetary  $P\pi$ -"mesons<sub>3</sub>". For example, a naked valence planetary  $P\pi^+$ -"meson<sub>3</sub>":  $P\pi^+ = Pu^- Pd^+$

$$\begin{array}{ccc}
 Pd_r^+ (+ + - -) & Pd_g^+ (+ + - +) & Pd_b^+ (+ - + +) \\
 Pu_g^- (- + - +) & Pu_b^- (- - + +) & Pu_r^- (- + + -) \\
 P\pi_1^+ (0 2 + 0 0)_+ & P\pi_2^+ (0 0 0 2)_+ & P\pi_3^+ (0 0 2 + 0)_+
 \end{array} \tag{83}$$

or a naked valence planetary  $P\pi^0$ -"meson<sub>3</sub>"  $\{P\pi^0 = \frac{1}{\sqrt{2}}(Pu^- Pu^+ - Pd^+ Pd^-)\}$  (see §4.7 in (Batanov-Gaukhman, 2023f))

$$\begin{array}{ccc}
 Pu_r^+ (+ - - +) & Pu_g^+ (+ - + -) & Pu_b^+ (+ + - -) \\
 Pu_g^- (- + - +) & Pu_b^- (- - + +) & Pu_r^- (- + + -) \\
 - & - & - \\
 Pd_r^+ (+ + + -) & Pd_g^+ (+ + - +) & Pd_b^+ (+ - + +) \\
 Pd_g^- (- - + -) & Pd_b^- (- + - -) & Pd_r^- (- - - +) \\
 P\pi_1^0 (0 0 0 0)_+ & P\pi_2^0 (0 0 0 0)_+ & P\pi_3^0 (0 0 0 0)_+
 \end{array} \tag{84}$$

- all naked valence planetary  $P\kappa$ -"atoms<sub>3</sub>". For example, all states of the naked valence planetary  $P_{H2}$ -"deuterium<sub>3</sub>"

$$\begin{array}{l}
 Pp^- \text{"proton}_3\text{"} \\
 + \\
 Pn^0 \text{"neutron}_3\text{"} \\
 + \\
 Pe^+ \text{"electron}_3\text{"} \\
 P_{H2} \text{"deuterium}_3\text{"}
 \end{array}
 \left\{
 \begin{array}{l}
 (+ + + -) \\
 (- + - +) \\
 (- - + +) \\
 (- - - -) \\
 (+ - + +) \\
 (- + + -) \\
 (+ + - +) \\
 (+ - - -)
 \end{array}
 \right.
 P_{H2}(0 0 0 0)_+$$

$$\text{or}$$

$$\left\{
 \begin{array}{l}
 (+ + - +) \\
 (- - + +) \\
 (- + + -) \\
 (+ + + +) \\
 (+ - + -) \\
 (- + - -) \\
 (- - - +) \\
 (+ - - -)
 \end{array}
 \right.
 P_{H2}(0 0 0 0)_+$$

$$\text{or} \dots \tag{85}$$

$$\begin{array}{l}
 Pp^+ \text{"antiproton}_3\text{"} \\
 + \\
 Pn^0 \text{"neutron}_3\text{"} \\
 + \\
 Pe^- \text{"positron}_3\text{"} \\
 P_{H2} \text{"deuterium}_3\text{"}
 \end{array}
 \left\{
 \begin{array}{l}
 (- - - +) \\
 (+ - + -) \\
 (+ + - -) \\
 (+ + + +) \\
 (- + - -) \\
 (+ - - +) \\
 (- - + -) \\
 (- + + +)
 \end{array}
 \right.
 P_{H2}(0 0 0 0)_+$$

$$\text{or}$$

$$\left\{
 \begin{array}{l}
 (- - + -) \\
 (+ + - -) \\
 (+ - - +) \\
 (- - - -) \\
 (- + - +) \\
 (+ - + +) \\
 (+ + + -) \\
 (- + + +)
 \end{array}
 \right.
 P_{H2}(0 0 0 0)_+$$

$$\text{or} \dots \tag{86}$$

where each signature corresponds to a planetary  $P\kappa$ -"quark<sub>3</sub>" from Table 1, i.e. a set of 10 metrics of type (66) with the corresponding signature. See §4.5 in (Batanov-Gaukhman, 2023f).

Or, for example, one of the many nodal (topological) configurations of the planetary valence  $P_k$ - "atom<sub>3</sub>" of helium (or  $P_{He4}$ - "helium<sub>3</sub>"), see §4.6 in (Batanov-Gaukhman, 2023f):

$$\begin{array}{ll}
 \begin{array}{l} (+ + - +) \\ (- - + +) \\ (- + + -) \end{array} & \text{the planetary } Pp_2^- \text{-"proton}_3\text{"} \\
 \begin{array}{l} (- + - -) \\ (+ - - +) \\ (+ - + -) \end{array} & \text{the planetary } Pp_3^+ \text{-"antiproton}_3\text{"} \\
 \begin{array}{l} (- + + +) \\ (- - - -) \\ (+ + - +) \\ (+ + + -) \\ (- - + +) \end{array} & \text{the planetary } Pn_2^0 \text{-"neutron}_3\text{"} \quad (87) \\
 \begin{array}{l} (+ + + +) \\ (+ - + -) \\ (- + - -) \\ (- - - +) \end{array} & \text{the planetary } Pn_8^0 \text{-"neutron}_3\text{"} \\
 \begin{array}{l} (+ - - -) \\ \hline P_{He4} (0 \ 0 \ 0 \ 0)_+ \end{array} & \text{the planetary } P_{He4} \text{-"helium}_3\text{"}.
 \end{array}$$

Thus, from the 16-color naked planetary  $P_k$ - "quarks<sub>3</sub>" from Table 1, all planetary  $P_k$ - "atoms<sub>3</sub>",  $P_k$ - "molecules<sub>3</sub>",  $P_k$ - "ions<sub>3</sub>", etc. can be constructed.

The models of planetary  $P_k$ - "bosons<sub>3</sub>" almost completely coincide with the models of picoscopic "bosons", which are presented in §4.8 in (Batanov-Gaukhman, 2023f). The only difference is that in all Exs. (132) – (139) in (Batanov-Gaukhman, 2023f) it is necessary to substitute the wavelength  $\lambda = \lambda_{6,7}$  from the range  $\Delta\lambda = 10^6 - 10^7$  cm = 10 – 100 km.

## 6 The naked "Solar System<sub>3</sub>"

Let's consider the naked planetary stable spherical  $\lambda_{6,7}$ -vacuum formations (i.e.  $P_k$ - "planets<sub>3</sub>") using the example of the "Solar system", which has been studied the most.

### 6.1 Brief information about the Solar System

The author is not an expert in the structure of the Solar System, so inaccuracies are possible, which, however, do not affect the generality of the conclusions.

It is believed that the Solar System includes many celestial bodies (or astronomical objects): one star (the Sun), 11 planets (see Figure 6), many satellites of these planets: moons, asteroids (see Appendix 1), meteorites, comets, etc.



Fig. 6: Solar System

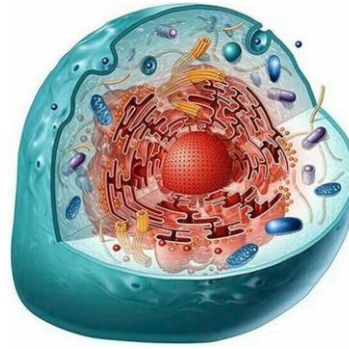


Fig. 7: Biological cell

It is natural to assume that the naked  $P_k$ -“planets<sub>3</sub>” (i.e. funnel-shaped spherical curvatures of the  $\lambda_{6,7}$ -vacuum, see Figures 2b and 3), considered in this article, are located only inside of a spherical celestial material body (i.e. inside a material star, material planets and moons). This assumption is due to the belief that only a spherical curvature of the  $\lambda_{6,7}$ -vacuum (essentially a spherically symmetric gravitational field of a naked  $P_k$ -“planets<sub>3</sub>”) is capable of gathering around itself a huge accumulation of pico- and nanoscopic “particles” (“atoms” and “molecules”) in the form of a regular spherical shape.



The causes of the emergence of the gravitational field in the outer shell of naked  $P_k$ -“stars<sub>3</sub>” and  $P_k$ -“planets<sub>3</sub>” will be (*Be Ezrat ASHEM*) considered in the next (11th) work of this series of articles under the general title «Geometrized Vacuum Physics Based on the Algebra of Signatures».

The remaining celestial bodies (asteroids, comets, meteorites, etc.) also consist of many pico- and nanoscopic “atoms” and “molecules”, but they are held together not by planetary gravity, but by geometrized electromagnetic physical-chemical bonds (considered in §2 in (Batanov-Gaukhman, 2024a) and in (Batanov-Gaukhman, 2024b)). Therefore, as a rule, such natural astronomical objects have an irregular shape.



In that article an attempt was made to estimate the number of planetary  $P_k$ -“quarks<sub>3</sub>” in the cores of a naked  $P_k$ -“star<sub>3</sub>” and  $P_k$ -“planets<sub>3</sub>” of the Solar System. For this purpose, we use an analogue of the phenomenological Ex. (112) in (Batanov-Gaukhman, 2023f)

$$r_{cP} \approx \frac{1}{2} A^{1/3} r_4 \approx \frac{1}{2} A^{1/3} \cdot 10^7 \text{ cm} = \frac{1}{2} A^{1/3} \cdot 100 \text{ km}, \quad (88)$$

which allows us to estimate the radius of the core of a planetary vacuum formation (i.e.  $P_k$ -“planets<sub>3</sub>”) from the number of naked  $P_k$ -“quarks<sub>3</sub>”  $A$  contained in it.

### 6.2 The smallest naked $P_k$ -“planet<sub>3</sub>”

We know well that in the “Solar System” there are no planetary  $P_k$ -“electrons<sub>3</sub>” (45) and  $P_k$ -“positrons<sub>3</sub>” (55), as well as planetary  $P_k$ -“protons<sub>3</sub>” (76) – (78) and  $P_k$ -“antiprotons<sub>3</sub>” (79) – (81), since these stable vacuum formations have powerful geometrized planetary electric fields (see §2.2 in (Batanov-Gaukhman, 2024a)), which are not observed in the “Solar System<sub>3</sub>”.

Similar to §§2 and 10 in (Batanov-Gaukhman, 2024a), in charged planetary  $\lambda_{6,7}$ -vacuum formations (such as planetary  $P_k$ -“electron<sub>3</sub>” or  $P_k$ -“proton<sub>3</sub>” or  $P_k$ -“ion<sub>3</sub>”), subcont currents of colossal intensity flow into and out of the region surrounding their core (i.e., into their raqiya) at speeds close to the speed of light.

Such powerful subcont currents are observed only in the vicinity of the core of naked  $G_k$ -"galaxies<sub>3</sub>" (which are referred to in modern literature as galactic black holes). In other words, naked  $G_k$ -"galaxies<sub>3</sub>" are most likely charged spherical  $\lambda_{18,19}$ -vacuum formations of the galactic type:  $G_k$ -"electron<sub>3</sub>" or  $G_k$ -"proton<sub>3</sub>" or  $G_k$ -"ion<sub>3</sub>".

Inside planetary spherical  $\lambda_{6,7}$ -vacuum formations (i.e.  $P_k$ -"planets<sub>3</sub>" and  $P_k$ -"stars<sub>3</sub>") such powerful subcont currents (with velocities close to the speed of light) are not observed. This is possible only if  $P_k$ -"planet<sub>3</sub>" and  $P_k$ -"star<sub>3</sub>" are electrically neutral  $\lambda_{6,7}$ -vacuum formations of the type planetary  $P_k$ -"atoms<sub>3</sub>" and  $P_k$ -"molecules<sub>3</sub>", in which powerful subcont currents in the outer shell compensate each other's manifestations (see §§4.4 and 4.5 in (Batanov-Gaukhman, 2023f)).

It is possible that stable electrically charged planetary  $\lambda_{6,7}$ -vacuum formations exist in other star systems. It is also possible that when large  $P_k$ -"planets<sub>3</sub>" and/or  $P_k$ -"stars<sub>3</sub>" collide, they disintegrate (i.e. split) into, among other things, planetary  $P_k$ -"electrons<sub>3</sub>",  $P_k$ -"positrons<sub>3</sub>",  $P_k$ -"protons<sub>3</sub>" and  $P_k$ -"antiprotons<sub>3</sub>". But in the nearest Solar System that we are studying, such charged "astronomical objects" are absent. That is, all stable naked spherical  $\lambda_{6,7}$ -planetary vacuum formations in the "Solar System" are electrically neutral. This means that they are either naked planetary  $P_k$ -"atoms<sub>3</sub>" or naked planetary  $P_k$ -"molecules<sub>3</sub>".

Electrically neutral ones include the planetary  $P_k$ -"neutron<sub>3</sub>" (82). But as was shown in §4.4 in (Batanov-Gaukhman, 2024a), when the intranuclear topological (nodal) configuration changes, the planetary  $P_k$ -"neutron<sub>3</sub>" can decay into a  $P_k$ -«electron<sub>3</sub>» and a  $P_k$ -«proton<sub>3</sub>», or into a  $P_k$ -"positron<sub>3</sub>" and a  $P_k$ -"antiproton<sub>3</sub>". Thus, if there were planetary  $P_k$ -"neutrons<sub>3</sub>" in the "Solar System", they have decayed by our time.

Thus, we necessarily come to the conclusion that in the naked "Solar System" only naked stable spherical  $\lambda_{6,7}$ -vacuum formations of the  $P_k$ -«atomic<sub>3</sub>» type can be present.

The simplest neutral stable spherical  $\lambda_{6,7}$ -vacuum formation is the planetary  $P_{H1}^0$ -"protium<sub>3</sub>", which consists only of  $P_k$ -"proton<sub>3</sub>" and  $P_k$ -"electron<sub>3</sub>" or  $P_k$ -"antiproton<sub>3</sub>" and  $P_k$ -"positron<sub>3</sub>". The six possible topological (nodal) states of the planetary  $P_{H1}^0$ -"protium<sub>3</sub>" (similar to the description of the "neutron" in §4.3 in (Batanov-Gaukhman, 2023f)) are:

$$\begin{array}{ccc}
 \begin{array}{l} Pd_r^+(+ + + -) \\ Pu_g^-(- + - +) \\ Pu_b^-(- - + +) \\ Pe_y^+(\underline{+ - - -}) \\ P_{H1}^1(0\ 0\ 0\ 0)_+ \end{array} & \text{or} & \begin{array}{l} Pd_g^+(+ + - +) \\ Pu_b^-(- - + +) \\ Pu_r^-(- + + -) \\ Pe_y^+(\underline{+ - - -}) \\ P_{H1}^2(0\ 0\ 0\ 0)_+ \end{array} & \text{or} & \begin{array}{l} Pd_b^+(+ - + +) \\ Pu_r^-(- + + -) \\ Pu_g^-(- + - +) \\ Pe_y^+(\underline{+ - - -}) \\ P_{H1}^3(0\ 0\ 0\ 0)_+ \end{array}
 \end{array} \quad (89)$$

$$\begin{array}{ccc}
 \begin{array}{l} Pd_r^-(- - - +) \\ Pu_g^+(+ - + -) \\ Pu_b^+(+ + - -) \\ Pe_y^-(\underline{- + + +}) \\ P_{H1}^4(0\ 0\ 0\ 0)_+ \end{array} & \text{or} & \begin{array}{l} Pd_g^-(- - + -) \\ Pu_b^+(+ + - -) \\ Pu_r^+(+ - - +) \\ Pe_y^-(\underline{- + + +}) \\ P_{H1}^5(0\ 0\ 0\ 0)_+ \end{array} & \text{or} & \begin{array}{l} Pd_b^-(- + - -) \\ Pu_r^+(+ - - +) \\ Pu_g^+(+ - + -) \\ Pe_y^-(\underline{- + + +}) \\ P_{H1}^6(0\ 0\ 0\ 0)_+ \end{array}
 \end{array}$$

These states constantly flow into each other so that each of them is realized with a probability of 1/6, while the average state of  $P_{H1}^0$ -"protium<sub>3</sub>" is described by the expression

$$P_{H1}^0 = 1/6 (P_{H1}^1 + P_{H1}^2 + P_{H1}^3 + P_{H1}^4 + P_{H1}^5 + P_{H1}^6). \quad (90)$$

At the same time, from molecular chemistry, we know that hydrogen atoms  $H$  (more precisely, protium atoms) tend to unite into hydrogen molecules  $H_2$ . We assume that the properties of stable vacuum formations at different levels (scales) of matter organization are similar, therefore, at the planetary level, it is also most likely that inside small dense spherical planets there is a planetary  $P_{H2}^0$ -"hydrogen molecules<sub>3</sub>", for example, in the state of the following topological nodes:

$$\begin{array}{l}
 Pd_r^+(+ + + -) \\
 Pu_g^-( - + - +) \ P_k\text{"proton}_3" \\
 Pu_b^-( - - + +) \\
 Pe_y^+(+ - - -) \ Pe^+\text{"electron}_3" \\
 Pd_g^-( - - + -) \\
 Pu_b^+(+ + - -) \ P_k\text{"antiproton}_3" \\
 Pu_r^+(+ - - +) \\
 Pe_y^-( - + + +) \ Pe^-\text{"positron}_3" \\
 P_{H2^1}(0 \ 0 \ 0 \ 0)_+
 \end{array}
 \quad \text{or} \quad
 \begin{array}{l}
 Pd_g^+(+ + - +) \\
 Pu_b^-( - - + +) \ P_k\text{"proton}_3" \\
 Pu_r^-( - + + -) \\
 Pe_y^+(+ - - -) \ Pe^+\text{"electron}_3" \\
 Pd_r^-( - - - +) \\
 Pu_g^+(+ - + -) \ P_k\text{"antiproton}_3" \\
 Pu_b^+(+ + - -) \\
 Pe_y^-( - + + +) \ Pe^-\text{"positron}_3" \\
 P_{H2^2}(0 \ 0 \ 0 \ 0)_+
 \end{array}
 \quad \text{or} \quad \dots
 \tag{91}$$

When the repetition of identical  $P_k$ -quarks<sub>3</sub> with identical colors within one topological node is prohibited, there can be nine such topological combinations (i.e. states of  $P_{H2^0}$ -hydrogen molecule<sub>3</sub>), therefore the planetary  $P_{H2^0}$ -hydrogen molecule<sub>3</sub> is the result of averaging all these states

$$P_{H2^0} = 1/9 (P_{H2^1} + P_{H2^2} + P_{H2^3} + P_{H2^4} + P_{H2^5} + P_{H2^6} + P_{H2^7} + P_{H2^8} + P_{H2^9}). \tag{92}$$

We note once again that within the framework of Geometrized Vacuum Physics (Batanov-Gaukhman; 2023a, 2023b, 2023c, 2023d, 2023e, 2023f, 2024a, 2024b, 2024c), in contrast to modern physics, there is no baryon asymmetry of matter. In particular, the planetary  $P_k$ -hydrogen molecule<sub>3</sub> consists of  $P_k$ -particles<sub>3</sub> and  $P_k$ -antiparticles<sub>3</sub> (more precisely, of colored  $P_k$ -quarks<sub>3</sub> and  $P_k$ -antiquarks<sub>3</sub>), which in principle cannot annihilate, since they are intricately entangled in a single topological knot (i.e., they form a single extremely complex convex-concave curvature of the  $\lambda_{6,7}$ -vacuum). In order for these  $P_k$ -particles<sub>3</sub> and  $P_k$ -antiparticles<sub>3</sub> to annihilate, they must first become untangled.

Another, practically the same, simple planetary  $P_k$ -atom<sub>3</sub> is the planetary  $P_k$ -heavy hydrogen<sub>3</sub> (another name is  $P_D$ -deuterium<sub>3</sub>) (85) – (86):

$$\begin{array}{l}
 Pp^-\text{"proton}_3" \\
 + \\
 Pn^0\text{"neutron}_3" \\
 + \\
 \underline{Pe^+\text{"electron}_3} \\
 P_D^n\text{"deuterium}_3"
 \end{array}
 \left\{ \begin{array}{l}
 (+ + + -) \\
 (- + - +) \\
 (- - + +) \\
 (- - - -) \\
 (+ - + +) \\
 (- + + -) \\
 (+ + - +) \\
 \underline{(+ - - -)}
 \end{array} \right.
 \quad \text{or} \quad
 \begin{array}{l}
 (+ + - +) \\
 (- - + +) \\
 (- + + -) \\
 (+ + + +) \\
 (+ - + -) \\
 (- + - -) \\
 (- - - +) \\
 \underline{(+ - - -)}
 \end{array}
 \quad \text{or} \quad
 \begin{array}{l}
 P_D^1(0 \ 0 \ 0 \ 0)_+ \\
 P_D^2(0 \ 0 \ 0 \ 0)_+
 \end{array}$$
  

$$\begin{array}{l}
 Pp^-\text{"proton}_3" \\
 + \\
 Pn^0\text{"neutron}_3" \\
 + \\
 \underline{Pe^+\text{"electron}_3} \\
 P_D^n\text{"deuterium}_3"
 \end{array}
 \left\{ \begin{array}{l}
 (+ + + -) \\
 (- + - +) \\
 (- - + +) \\
 (- - - -) \\
 (+ - + +) \\
 (- + + -) \\
 (+ + - +) \\
 \underline{(+ - - -)}
 \end{array} \right.
 \quad \text{or} \quad
 \begin{array}{l}
 (+ + - +) \\
 (- - + +) \\
 (- + + -) \\
 (+ + + +) \\
 (+ - + -) \\
 (- + - -) \\
 (- - - +) \\
 \underline{(+ - - -)}
 \end{array}
 \quad \text{or} \quad \dots$$
  

$$\begin{array}{l}
 P_D^3(0 \ 0 \ 0 \ 0)_+ \\
 P_D^4(0 \ 0 \ 0 \ 0)_+
 \end{array}$$

Planetary  $P_D^0$ -deuterium is the result of averaging all  $n$  possible similar states (topological combinations)

$$P_{H2^0} = 1/n (P_D^1 + P_D^2 + P_D^3 + P_D^4 + \dots + P_D^n). \tag{94}$$

Planetary  $P_{H2^0}$ -hydrogen molecule<sub>3</sub> and planetary  $P_D^0$ -deuterium<sub>3</sub> consist of 8  $P_k$ -quarks<sub>3</sub>, and they are apparently the most stable and, therefore, the most frequently encountered small stable electrically neutral spherical  $\lambda_{6,7}$ -vacuum formations.



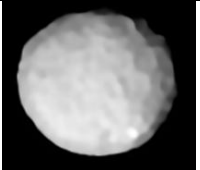

Let's assume that the planetary  $P_{H1}^0$ - "protium<sub>3</sub>" (90) is the smallest naked  $P_k$ - "planet<sub>3</sub>", while, apparently, the most common small naked  $P_k$ - "planets<sub>3</sub>" are the planetary  $P_{H2}^0$ - "hydrogen molecules" (92) and the planetary  $P_D^0$ - "deuterium<sub>3</sub>" (94).



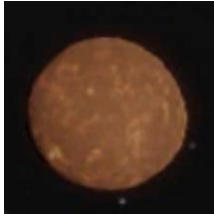


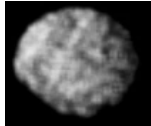
Now let's compare the small naked  $P_k$ - "planets<sub>3</sub>" with the smallest material spherical planets of the Solar System.

### 6.3 Analysis of small celestial bodies of the Solar System

Appendix 1 contains an incomplete list of the largest small satellites of the planets of the Solar System, borrowed from the site "The Solar System Wiki". From this list, material astronomical objects on the border of the transition from spherical celestial bodies to irregularly shaped bodies are selected and presented in Table 2.

Table 2: Parameters of small astronomical objects close to spherical shape

Planet / satellite material	Average radius approximately	Density approximately	Mass approximately	Shape	Image
<b>Ceres</b> , <i>planet, natural satellite of the Sun</i>	475 km	2.2 g/cm <sup>3</sup>	9×10 <sup>20</sup> kg	Close to spherical shape	
<b>Vesta</b> , <i>asteroid, natural satellite of the Sun</i>	263 km	3.5 g/cm <sup>3</sup>	2.6×10 <sup>20</sup> kg	Close to spherical shape	
<b>Pallas</b> , <i>planet, natural satellite of the Sun</i>	256 km	3.9 g/cm <sup>3</sup>	2×10 <sup>20</sup> kg	Close to spherical shape	
<b>Enceladus</b> , <i>natural satellite of Saturn</i>	252 km	1.6 g/cm <sup>3</sup>	1.08×10 <sup>20</sup> kg	Close to spherical shape	

<b>Table 2 continued</b>					
<b>Hygiea</b> <i>natural satellite of the Sun</i>	217 km	1.9 g/cm <sup>3</sup>	8×10 <sup>19</sup> kg	Close to spherical shape	
<b>Proteus</b> , <i>natural satellite of Neptune</i>	209 km	0.7 g/cm <sup>3</sup>	5×10 <sup>19</sup> kg	Close to spherical shape	
<b>Ilmarë</b> , <i>natural satellite of a Kuiper belt planetoid</i>	178 km	0.6 g/cm <sup>3</sup>	2.2×10 <sup>19</sup> kg	Close to spherical shape	
<b>Hyperion</b> , <i>natural satellite of Saturn</i>	135 km	0.54 g/cm <sup>3</sup>	5.6×10 <sup>18</sup> kg	Irregular shape	
<b>Phoebe</b> , <i>natural satellite of Saturn</i>	110 km	1,6 g/cm <sup>3</sup>	8.3×10 <sup>18</sup> kg	Irregular shape	
<b>Larissa</b> , <i>natural satellite of Neptune</i>	97 km	0.9 g/cm <sup>3</sup>	3.72×10 <sup>18</sup> kg	Irregular shape	

#### 6.4 Comparison of the smallest material planets and the smallest naked $P_k$ - "planets"

The following reasoning is preliminary and evaluative. Let's assume that inside the minimal material planet there is the smallest naked  $P_k$ - "planet" whose outer shell attracts pico-, nano- and microscopic stable  $\lambda_{m,n}$ -vacuum formations ("particles") by means of gravity (the nature of "planetary" gravity will be considered in the next 11th work of the proposed series of articles (Batanov-Gaukhman; 2023a, 2023b, 2023c, 2023d, 2023e, 2023f, 2024a, 2024b, 2024c)). In this case, the more planetary  $P_k$ - "quarks" make up a naked "planet" (see, for example, ranking

expression (87)), the greater the intensity of its attraction (gravity), and the more small "particles" it can attract to its core (see Figures 2a and 8) and hold for a long time. Therefore, the mass of a spherical planet can serve as a criterion for the intensity of gravitational attraction.



Fig. 8: Fractal illustration of the attraction of many pico-, nano- and microscopic "particles" to the core of a naked "planet" by means of the mechanism of inter-"planetary" gravity

From Table 2 it is evident that the smallest astronomical objects with a shape close to spherical are Proteus, Ilmarë and Hygiea. These smallest almost-spherical astronomical objects have an average radius of approximately 200 km and a mass of approximately  $5 \times 10^{19}$  kg. An astronomical object with such parameters will be called a minimal material planet.

It is natural to assume that inside the minimal almost-spherical material planet (with an average radius of  $\sim 200$  km and a mass of  $\sim 5 \times 10^{19}$  kg) there is the smallest naked  $P_k$ -"planets" (i.e. planetary  $P_{H_1^0}$ -"protium<sub>3</sub>" consisting of 4  $P_k$ -"quarks<sub>3</sub>" (89)).

After objects like Proteus, Ilmarë and Hygiea, the next largest are practically spherical astronomical objects like Enceladus Vesta and Pallas with a characteristic radius of  $\sim 250$  km and a mass of  $\sim 10^{20}$  kg.

The third largest cosmic spherical material objects are planets like Ceres with a characteristic radius of  $\sim 450$  km and a mass of  $\sim 10^{21}$  kg.

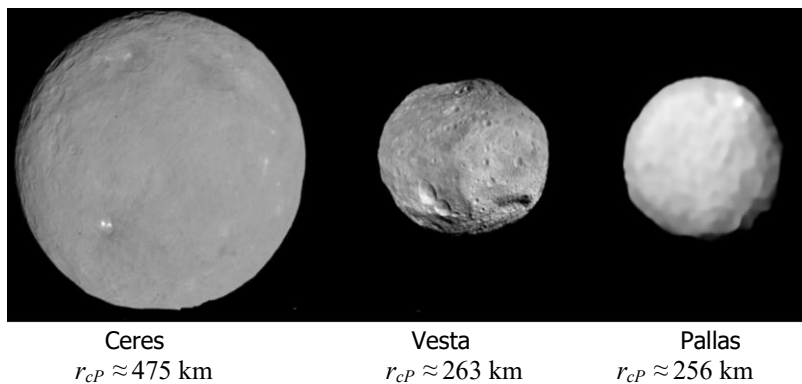


Fig. 9: Dimensions (average radii) of small astronomical objects of nearly spherical shape

Figure 9 shows an obvious partial jump from the smallest nearly spherical objects with an average radius of  $r_{cP} \approx 250$  km (such as Vesta and Pallas) and an almost twice as large spherical object like Ceres with an average radius of  $r_{cP} \approx 480$  km.

To compare the parameters of material spherical astronomical objects, it is convenient to use their mass, since the mass of a planet combines its two main characteristics: dimensions (in particular, volume) and the density of matter.

Let's divide the mass of the smallest material planet (e.g. Proteus) by the mass of the material planet of the next class (e.g. Enceladus),  $10^{20}/(5 \times 10^{19}) = 2$ . Multiply the resulting number 2 by 4 (the minimum number of  $P_k$ - "quarks<sub>3</sub>" in the smallest  $P_k$ - "atom<sub>3</sub>", i.e. in the planetary  $P_{H1}^0$ - "proteus<sub>3</sub>"). As a result, we get 8 – this, within the framework of the proposed methodology, means that material spherical astronomical objects of the second class of smallness (like Enceladus) contain 8  $P_k$ - "quarks<sub>3</sub>".

Table 3: Approximate characteristics of astronomical objects of the Solar System

Star / planet	Radius of the material planet, average $\sim R$	Density of the material planet, average $\sim \rho$	Mass of the material planet, $\sim M$	Ratio of the mass of the celestial body to the mass of the minimal planet $\sim M/m$	Estimate of the number of $P_k$ - "quarks <sub>3</sub> " $\frac{M}{m} \times 4$	Radius of the core of the naked $P_k$ - "planet <sub>3</sub> ", approximately
<b>Minimal material planet, like Proteus</b>	200 km	1.2 g/cm <sup>3</sup>	$m = 5 \times 10^{19}$ kg	1	4	100 km
<b>Sun</b>	696 000 km	1.41 g/cm <sup>3</sup>	$1.99 \times 10^{30}$ kg	$0.4 \times 10^{11}$	$1.6 \times 10^{11}$	316 000 km
<b>Mercury</b>	2439.7 km	5.43 g/cm <sup>3</sup>	$3.33 \times 10^{23}$ kg	$0.7 \times 10^4$	$6 \times 10^4$	780 km
<b>Venus</b>	6051.8 km	5.24 g/cm <sup>3</sup>	$4.87 \times 10^{24}$ kg	$0.97 \times 10^5$	$3.9 \times 10^5$	1250 km
<b>Earth</b>	6378.1 km	5.52 g/cm <sup>3</sup>	$5.97 \times 10^{24}$ kg	$1.2 \times 10^5$	$4.8 \times 10^5$	1320 km
<b>Mars</b>	3389.5 km	3.93 g/cm <sup>3</sup>	$6.42 \times 10^{23}$ kg	$1.3 \times 10^4$	$5.2 \times 10^4$	755 km
<b>Jupiter</b>	69911 km	1.33 g/cm <sup>3</sup>	$1.9 \times 10^{27}$ kg	$0.4 \times 10^8$	$1.6 \times 10^8$	5623 km
<b>Saturn</b>	58232 km	0.69 g/cm <sup>3</sup>	$5.68 \times 10^{26}$ kg	$1.1 \times 10^7$	$4.4 \times 10^7$	4072 km
<b>Uranus</b>	25362 km	1.27 g/cm <sup>3</sup>	$8.68 \times 10^{25}$ kg	$1.7 \times 10^6$	$6.8 \times 10^6$	2553 km
<b>Neptun</b>	24622 km	1.64 g/cm <sup>3</sup>	$1.02 \times 10^{26}$ kg	$0.2 \times 10^7$	$0.8 \times 10^7$	2659 km
<b>Pluto</b>	1188.3 km	1.86 g/cm <sup>3</sup>	$1.3 \times 10^{22}$ kg	$0.3 \times 10^3$	$1.2 \times 10^3$	359 km

This logic indicates that inside the second class of small material planets there is the following quantum (in the sense of discrete) version of a naked  $P_K$ -"planet<sub>3</sub>": 8-"quark<sub>3</sub>" planetary  $P_{H_2^0}$ -"hydrogen molecules" (91) or 8-"quark<sub>3</sub>" planetary  $P_D^0$ -"deuterium<sub>3</sub>" (93).

Continuing this logic, we propose to estimate the number of planetary  $P_K$ -"quarks<sub>3</sub>" that make up naked "planets" located inside the material planets of the Solar System using the following method.

We divide the mass of a material planet  $M$  by the mass of the smallest material planet  $m = 5 \times 10^{19}$  kg and multiply the result of this division by 4 (the number of  $P_K$ -"quarks<sub>3</sub>" that make up the smallest naked  $P_K$ -"planet<sub>3</sub>").

The results of calculations using this method are presented in Table 3.

We apply Ex. (88)

$$r_{cP} \approx \frac{1}{2} A^{1/3} r_4 \approx \frac{1}{2} A^{1/3} \times 10^7 \text{ cm} = \frac{1}{2} A^{1/3} \times 100 \text{ km},$$

where  $A$  is the number of  $P_K$ -"quarks<sub>3</sub>" to estimate the radius of the naked  $P_K$ -"planet<sub>3</sub>" Earth using approximate data from Table 3

$$r_E \approx \frac{1}{2} A^{1/3} r_4 \approx \frac{1}{2} (4.8 \cdot 10^5)^{1/3} \times 100 \text{ km} \approx 1320 \text{ km}, \tag{95}$$

while modern reference books indicate the radius of the inner core of planet Earth as  $\sim 1300$  km.

Similarly, we estimate the radius of the naked "star<sub>3</sub>" the Sun

$$r_S \approx \frac{1}{2} A^{1/3} r_4 \approx \frac{1}{2} (1.6 \times 10^{11})^{1/3} \times 100 \text{ km} \approx 316 \text{ 000 km}. \tag{96}$$

According to modern reference data, the solar core extends from the center of the Sun to a distance of approximately  $\sim 173 \text{ 000 km}$ .

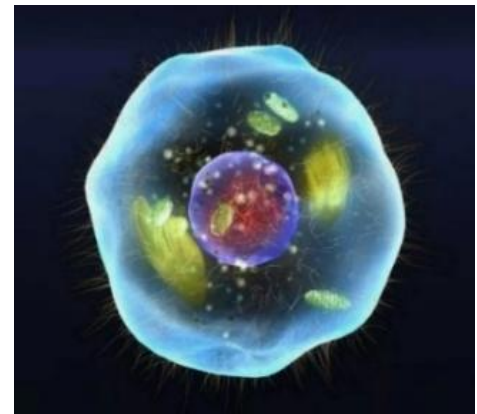
These calculations show that the above-proposed method allows us to obtain estimates of the radii of the cores of astronomical objects that are close in order of magnitude to the known ones (i.e. obtained by other methods).

The last column of Table 3 shows the approximate radii of naked  $P_K$ -"planet<sub>3</sub>" calculated using formula (88).

### 7 Comparison of the naked "Solar System" with a biological cell

The naked "Solar System" considered in this article is in many ways similar to a biological cell (see Figure 6 and 7) not only in structure but also in internal content. For example, as shown in Table 2, the naked "star<sub>3</sub>" the Sun consists of approximately one hundred sixty billion naked planetary  $P_K$ -"quarks<sub>3</sub>" ( $1.6 \times 10^{11}$ ), approximately the same number of quarks are found in the nucleus of a biological cell.

As is known, genetic information in the form of DNA molecules is formed from the quarks located inside the nucleus of a biological cell. Therefore, it can be assumed that the core of the naked "star<sub>3</sub>" the Sun also contains genetic information of the Solar System, which is woven from sixteen colored naked planetary  $P_K$ -"quarks<sub>3</sub>" (see Table 1). The information content of the Algebra of stignatures and the Algebra of signatures was discussed in (Batanov-Gaukhman, 2023a, 2023b).



Similarly, the average naked  $P_k$ -"planets<sub>3</sub>": Mercury, Venus, Earth, Mars, etc., consisting of about a million colored naked  $P_k$ -"quarks<sub>3</sub>", are associated with organelles of the biological cell such as chloroplasts, peroxisomes and lysosomes, and the naked  $P_k$ -"giant planets<sub>3</sub>": Jupiter ( $1.6 \times 10^8$ ), Saturn ( $4.4 \times 10^7$ ), Uranus ( $6.8 \times 10^6$ ) and Neptune ( $8 \times 10^6$ ) correspond to mitochondria.

Similar analogies between "galaxies" (megascopic level), "star" systems (macroscopic level), biological cells (microscopic level) and molecules (nanoscopic level) can be continued, for example, "galaxies" and "star" systems rotate, just as the cytoplasm in a living biological cell rotates, etc. But for a deeper understanding of the relationship between the various levels of Intelligibly Curved Being, it is necessary to devote a separate study.

### 8 Rotation of a naked $P_k$ -"planets<sub>3</sub>"

At this stage of the study, it is impossible to correctly construct a metric-dynamic model of the rotation of a naked  $P_k$ -"planet", since this phenomenon is associated with planetary gravity, which is planned to be considered in the next article. However, already at this stage, it is possible to formulate some prerequisites for creating such a model for an electrically neutral rotating naked  $P_k$ -"planet", based on (Batanov-Gaukhman, 2024b).

As an example, let's consider the rotation of the neutral naked  $P_k$ -"planets<sub>3</sub>" Earth. The material planet Earth makes a complete revolution around the Sun in approximately 365.26 solar days (i.e. revolutions around its axis, see Figure 10a) with an average speed of  $V_E \sim 110,000 \text{ km/h} \approx 30.5 \text{ km/s}$ . A point on the Earth's equator travels 40,000 km in 24 hours (more precisely, in 23 hours 56 minutes 4.09 seconds), so it moves in a circle at an approximate speed of  $40,000 \text{ km} / 24 \text{ hours} \approx 1,666.7 \text{ km/h} \approx 465 \text{ m/s}$ . The angular velocity of the Earth's rotation around its axis is  $\sim 7.3 \times 10^{-5}$  radians per second (see Figure 10b).

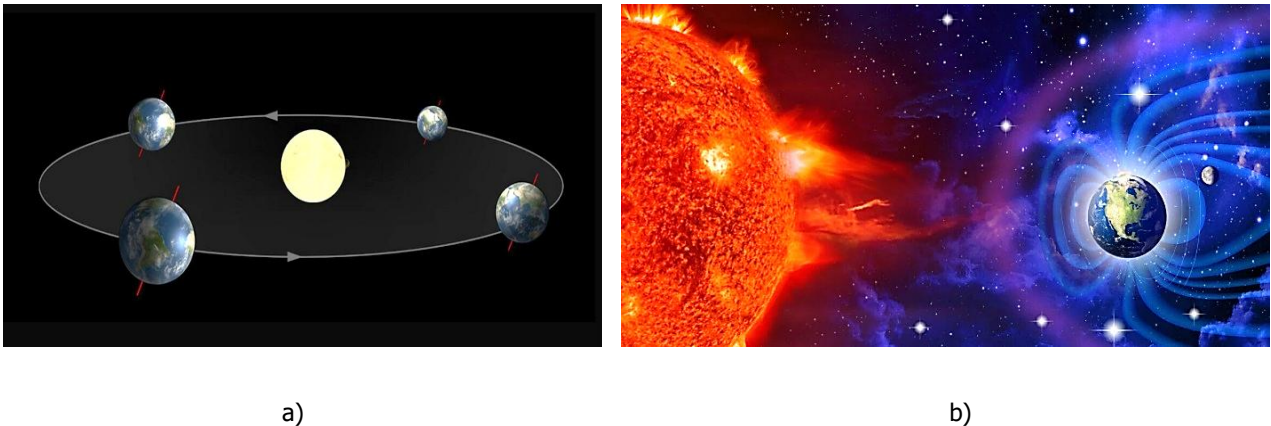


Fig. 10: The material planet Earth moves around the material star Sun with a speed of  $\sim 30.5 \text{ km/s}$ . The Earth also rotates around its axis with an angular velocity of  $7.3 \times 10^{-5}$  radians per second

On the other hand, this article puts forward a hypothesis that the electrically neutral naked  $P_k$ -"planet" Earth is the result of an additive superposition of approximately 480,000 planetary  $P_k$ -"quarks<sub>3</sub>" of type (66) (see Table 2).

Based on the mathematical apparatus of the Algebra of signature (Batanov-Gaukhman, 2023a, 2023b, 2023c, 2023d, 2023e, 2023f, 2024a, 2024b, 2024c), it can be assumed that  $\sim 480,000$  planetary  $P_k$ -"quarks<sub>3</sub>" are thus additively (i.e., on average) superimposed on each other, so that on average the metric-dynamic model of the outer shell of the electrically neutral valence rotating naked  $P_k$ -"planets<sub>3</sub>" Earth is determined by the following set of generalized Kerr metrics (in Boyer–Lindquist coordinates) (see (Batanov-Gaukhman, 2024b)):

**Averaged outer shell of a rotating neutral naked valence  $P_k$ -"planet<sub>3</sub>" Earth** (97)

moving around the Sun at a speed of  $V_E$   
with a common signature

$$(+ \ - \ - \ -) + (- \ + \ + \ +) = (0 \ 0 \ 0 \ 0)$$

I  $ds_1^{(+a1)2} = \left(1 - \frac{r_{Er}}{\rho}\right) c^2 dt^2 - \frac{\rho dr^2}{\Delta^{(a)}} - \rho d\theta^2 - \left(r^2 + a^2 + \frac{r_{Er} a^2}{\rho} \sin^2 \theta\right) \sin^2 \theta d\phi^2 + \frac{2r_{Er} a}{\rho} \sin^2 \theta d\phi c dt,$  (98)

H  $ds_2^{(+a2)2} = \left(1 - \frac{r_{Er}}{\rho}\right) c^2 dt^2 - \frac{\rho dr^2}{\Delta^{(a)}} - \rho d\theta^2 - \left(r^2 + a^2 + \frac{r_{Er} a^2}{\rho} \sin^2 \theta\right) \sin^2 \theta d\phi^2 - \frac{2r_{Er} a}{\rho} \sin^2 \theta d\phi c dt,$  (99)

V  $ds_3^{(+b1)2} = \left(1 + \frac{r_{Er}}{\rho}\right) c^2 dt^2 - \frac{\rho dr^2}{\Delta^{(b)}} - \rho d\theta^2 - \left(r^2 + a^2 - \frac{r_{Er} a^2}{\rho} \sin^2 \theta\right) \sin^2 \theta d\phi^2 + \frac{2r_{Er} a}{\rho} \sin^2 \theta d\phi c dt,$  (101)

H'  $ds_4^{(+b1)2} = \left(1 + \frac{r_{Er}}{\rho}\right) c^2 dt^2 - \frac{\rho dr^2}{\Delta^{(b)}} - \rho d\theta^2 - \left(r^2 + a^2 - \frac{r_{Er} a^2}{\rho} \sin^2 \theta\right) \sin^2 \theta d\phi^2 - \frac{2r_{Er} a}{\rho} \sin^2 \theta d\phi c dt;$  (102)

H'  $ds_1^{(-a1)2} = -\left(1 - \frac{r_{Er}}{\rho}\right) c^2 dt^2 + \frac{\rho dr^2}{\Delta^{(a)}} + \rho d\theta^2 + \left(r^2 + a^2 + \frac{r_{Er} a^2}{\rho} \sin^2 \theta\right) \sin^2 \theta d\phi^2 - \frac{2r_{Er} a}{\rho} \sin^2 \theta d\phi c dt,$  (103)

V  $ds_2^{(-a2)2} = -\left(1 - \frac{r_{Er}}{\rho}\right) c^2 dt^2 + \frac{\rho dr^2}{\Delta^{(a)}} + \rho d\theta^2 + \left(r^2 + a^2 + \frac{r_{Er} a^2}{\rho} \sin^2 \theta\right) \sin^2 \theta d\phi^2 + \frac{2r_{Er} a}{\rho} \sin^2 \theta d\phi c dt,$  (104)

H  $ds_3^{(-b1)2} = -\left(1 + \frac{r_{Er}}{\rho}\right) c^2 dt^2 + \frac{\rho dr^2}{\Delta^{(b)}} + \rho d\theta^2 + \left(r^2 + a^2 - \frac{r_{Er} a^2}{\rho} \sin^2 \theta\right) \sin^2 \theta d\phi^2 - \frac{2r_{Er} a}{\rho} \sin^2 \theta d\phi c dt,$  (105)

I  $ds_4^{(-b2)2} = -\left(1 + \frac{r_{Er}}{\rho}\right) c^2 dt^2 + \frac{\rho dr^2}{\Delta^{(b)}} + \rho d\theta^2 + \left(r^2 + a^2 - \frac{r_{Er} a^2}{\rho} \sin^2 \theta\right) \sin^2 \theta d\phi^2 + \frac{2r_{Er} a}{\rho} \sin^2 \theta d\phi c dt;$  (106)

**The substrate**

of the rotating naked valence  $P_k$ -"planets"  
with common signature

$$(+ \ - \ - \ -) + (- \ + \ + \ +) = (0 \ 0 \ 0 \ 0)$$

*i*  $ds_5^{(+ )2} = c^2 dt^2 - \frac{\rho dr^2}{r^2 + a^2} - \rho d\theta^2 - (r^2 + a^2) \sin^2 \theta d\phi^2,$  (107)

*j*  $ds_5^{(- )2} = -c^2 dt^2 + \frac{\rho dr^2}{r^2 + a^2} + \rho d\theta^2 + (r^2 + a^2) \sin^2 \theta d\phi^2.$  (108)

where  $\rho = r^2 + a^2 \cos^2 \theta,$   $\Delta^{(a)} = r^2 - r_{Er} + a^2,$   $\Delta^{(b)} = r^2 + r_{Er} + a^2;$  (109)

$a = \frac{r_{E} V_E}{2c}$  is ellipticity parameter;

$V_E \approx 30,5$  km/s is speed of movement of the naked  $P_k$ -"planet<sub>3</sub>" Earth;

$r_E \approx 1320$  km is radius of the core of the naked  $P_k$ -"planet<sub>3</sub>" Earth (see the last column in Table 2).

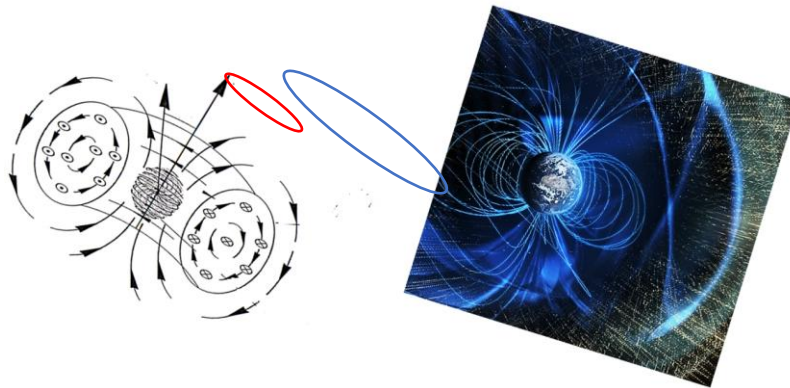


Fig. 11: Schematic representation of subcont-antisubcont currents determining the lines of force of the geometrized magnetic field of a moving neutral valence naked  $P_k$ -"planet<sub>3</sub>"

We recall (see § 5.2 in (Batanov-Gaukhman, 2023c)) that averaged metrics with opposite signatures (+ – – –) and (– + + +) describe metric-dynamic states of the  $\lambda_{6,7}$ -vacuum layers that are rotated (or phase-shifted) by  $90^\circ$  relatives to each other.

A separate, extensive study should be devoted to the metric-dynamic models of rotating electrically neutral naked  $P_k$ -“planets<sub>3</sub>” and  $P_k$ -“stars<sub>3</sub>”. Here we will only note that, for example, the metric-dynamic model of the outer shell of the electrically neutral valence naked  $P_k$ -“planet<sub>3</sub>” Earth (98) – (109) should lead to a description of the magnetic field of this planet (see Figures 10b and 11).

## CONCLUSIONS

“Physics is Geometry”  
John Archibald Wheeler

This tenth part of “Geometrized Vacuum Physics (GVPh) based on the Algebra of signature (AS)” (Batanov-Gaukhman; 2023a, 2023b, 2023c, 2023d, 2023e, 2023f, 2024a, 2024b, 2024c) partly considers metric-dynamic models of electrically neutral valence naked  $P_k$ -“planets” and  $P_k$ -“stars”, which follow from the hierarchical cosmological model proposed in (Batanov-Gaukhman, 2023f).

The concept of naked stable spherical  $\lambda_{6,7}$ -vacuum formations ( $P_k$ -“planets” and  $P_k$ -“stars”) implies the conditional absence of pico-, nano- and microscopic  $\lambda_{m,r}$ -vacuum formations (i.e. elementary “particles”, “molecules”, “cells”, etc.) in the studied region of  $\lambda_{6,7}$ -vacuum. That is, only curvatures of macroscopic areas of  $\lambda_{6,7}$ -vacuum of planetary and stellar scale are considered, provided that small fluctuations of  $\lambda_{m,r}$ -vacuum are not taken into account. It is assumed that the next article will consider the mechanism of attraction of small “particles” by naked  $P_k$ -“planets” and  $P_k$ -“stars”, i.e. another attempt will be made to unravel the mystery of planetary and stellar gravity based on the mathematical apparatus of the GVPh and AS, presented in (Batanov-Gaukhman; 2023a, 2023b, 2023c, 2023d, 2023e, 2023f, 2024a, 2024b, 2024c).

It is shown that 16 colored naked planetary  $P_k$ -“quarks<sub>3</sub>” with the corresponding signatures (65) are sufficient for constructing metric-dynamic models of all stable  $\lambda_{6,7}$ -vacuum formations of stellar-planetary scale. Colored planetary  $P_k$ -“quarks<sub>3</sub>” are presented in Table 1, from them naked planetary  $P_k$ -“baryons<sub>3</sub>”,  $P_k$ -“mesons<sub>3</sub>”,  $P_k$ -“atoms<sub>3</sub>” and  $P_k$ -“molecules<sub>3</sub>” can be composed by analogy with the construction of picoscopic elements of the Standard Model of elementary “particles” in the articles (Batanov-Gaukhman; 2023f, 2024a, 2024b, 2024c).

A comparison of naked  $P_k$ -“planets<sub>3</sub>” and  $P_k$ -“stars<sub>3</sub>” with material astronomical objects of the Solar System is given. A method for estimating the number of planetary  $P_k$ -“quarks<sub>3</sub>” inside the material Sun and material planets of the Solar System is proposed. Calculations using this method led to results similar in order of magnitude to known modern reference data on the parameters of material planets and the Sun.

A number of similar features between the naked “Solar System” and a biological cell are identified. It is noted that the naked  $P_k$ -“star<sub>3</sub>” Sun can be compared to the nucleus of a biological cell, and the naked  $P_k$ -“planets<sub>3</sub>” of this system are similar to other organelles of a biological cell, such as, for example, mitochondria and lysosomes.

A preliminary metric-dynamic model of a rotating electrically neutral valence naked  $P_k$ -“planet<sub>3</sub>” is proposed.

As has been repeatedly noted within the framework of the GVPh and AS (Batanov-Gaukhman; 2023a, 2023b, 2023c, 2023d, 2023e, 2023f, 2024a, 2024b, 2024c), a completely geometrized description of the “star-planetary” level of organization of the curved  $\lambda_{6,7}$ -vacuum has its own characteristics, but is in many ways similar to the geometrized description of all other layers of the bottomless emptiness (vacuum). By comprehending one of the levels (or layers) of curvatures of the  $\lambda_{m,r}$ -vacuum, we simultaneously supplement the ideas about all other stable and unstable  $\lambda_{m,r}$ -vacuum formations of various scales, since they are fractally repeated in each other.

We hope that this article is another step towards the implementation of the program of full geometrization physics of Clifford-Einstein-Wheeler (Misner & Wheeler, 1957; Wheeler, 1962; Shipov, 1998).

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## Appendix 1

A partial list of the small satellites of the planets in the Solar System

Taken from the website "The Solar System Wiki"

Nº	Astronomical object	Diameter km	Nº	Astronomical object	Diameter km	Nº	Astronomical object	Diameter km
1	<a href="#">Ganymede</a>	1,527 <sup>[5]</sup>	41	<a href="#">Despina</a>	148 <sup>[5]</sup>	81	<a href="#">S / 2002 N 5</a>	33.45 <sup>[29][27]</sup>
2	<a href="#">Titan</a>	1,522.8 <sup>[6]</sup>	42	<a href="#">Himalia</a>	139.6 <sup>[20]</sup>	82	<a href="#">Stefano</a>	32 <sup>[26][27]</sup>
3	<a href="#">Callisto</a>	1,468.8 <sup>[7]</sup>	43	<a href="#">Xiangliu</a>	136 <sup>[21][22]</sup>	83	<a href="#">Atlas</a>	30.2 <sup>[31]</sup>
4	<a href="#">Io</a>	1,212 <sup>[8]</sup>	44	<a href="#">Portia</a>	135 <sup>[19]</sup>	84	<a href="#">Ananke</a>	29.1 <sup>[20]</sup>
5	<a href="#">Moon</a>	1,169.4 <sup>[6]</sup>	45	<a href="#">Hänuu</a>	122 <sup>[13]</sup>	85	<a href="#">Paaliaq</a>	29 <sup>[17]</sup>
6	<a href="#">Europa</a>	1,157.8 <sup>[6]</sup>	46	<a href="#">Epimetheus</a>	116.4 <sup>[5]</sup>	86	<a href="#">Telesto</a>	28.8 <sup>[32]</sup>
7	<a href="#">Triton</a>	1,122.8 <sup>[7]</sup>	47	<a href="#">Gl'ó'é !Hú</a>	112 <sup>[23]</sup>	87	<a href="#">Pan</a>	28 <sup>[33]</sup>
8	<a href="#">Titania</a>	1,062.2 <sup>[7]</sup>	48	<a href="#">Thebe</a>	98.6 <sup>[5]</sup>	88	<a href="#">Perdita</a>	26.6 <sup>[34]</sup>
9	<a href="#">Rhea</a>	700 <sup>[9]</sup>	49	<a href="#">Juliet</a>	94 <sup>[19]</sup>	89	<a href="#">Mab</a>	24.8 <sup>[34]</sup>
10	<a href="#">Oberon</a>	504.2 <sup>[7]</sup>	50	<a href="#">Belinda</a>	90 <sup>[19]</sup>	90	<a href="#">Phobos</a>	22.16 <sup>[35]</sup>
11	<a href="#">Iapetus</a>	471.6 <sup>[6]</sup>	51	<a href="#">Prometheus</a>	86.2 <sup>[5]</sup>	91	<a href="#">Francisco</a>	22 <sup>[26][27]</sup>
12	<a href="#">Charon</a>	443 <sup>[9]</sup>	52	<a href="#">Caliban</a>	84 <sup>[24]</sup>	92	<a href="#">S/2021 N 1</a>	21.95 <sup>[29][27]</sup>
13	<a href="#">Umbriel</a>	418 <sup>[10]</sup>	53	<a href="#">Pandora</a>	81.2 <sup>[5]</sup>	93	<a href="#">Leda</a>	21.5 <sup>[20]</sup>
14	<a href="#">Ariel</a>	396.4 <sup>[7]</sup>	54	<a href="#">Cressida</a>	80 <sup>[19]</sup>	94	<a href="#">Ferdinand</a>	21 <sup>[26][27]</sup>
15	<a href="#">Dione</a>	~356 <sup>[11]</sup>	55	<a href="#">Thalassa</a>	80 <sup>[5]</sup>	95	<a href="#">Margaret</a>	20 <sup>[26][27]</sup>
16	<a href="#">Tethys</a>	340 <sup>[5]</sup>	56	<a href="#">Elara</a>	79.9 <sup>[20]</sup>	96	<a href="#">Calypso</a>	19.2 <sup>[32]</sup>
17	<a href="#">Dysnomia</a>	~320 <sup>[12]</sup>	57	<a href="#">Rosalind</a>	72 <sup>[19]</sup>	97	<a href="#">Ymir</a>	18.8 <sup>[29][36]</sup>
18	<a href="#">Enceladus</a>	284 <sup>[13]</sup>	58	<a href="#">Desdemona</a>	64 <sup>[19]</sup>	98	<a href="#">Trinculo</a>	18 <sup>[26][27]</sup>
19	<a href="#">Miranda</a>	270 <sup>[7]</sup>	59	<a href="#">Halimeda</a>	~62 <sup>[25]</sup>	99	<a href="#">Kiviuq</a>	18 <sup>[37]</sup>
20	<a href="#">Vant</a>	213 <sup>[7]</sup>	60	<a href="#">Naiad</a>	58 <sup>[5]</sup>	100	<a href="#">Cupid</a>	17.8 <sup>[34]</sup>
21	<a href="#">Proteus</a>	213 <sup>[14]</sup>	61	<a href="#">Pasiphae</a>	57.8 <sup>[20]</sup>	101	<a href="#">Themisto</a>	16.4 <sup>[17]</sup>
22	<a href="#">Mimas</a>	210 <sup>[14]</sup>	62	<a href="#">Prospero</a>	52.8 <sup>[26][27]</sup>	102	<a href="#">Adrastea</a>	16.4 <sup>[5]</sup>
23	<a href="#">Ilmara</a>	~200 <sup>[15]</sup>	63	<a href="#">Bianca</a>	51 <sup>[19]</sup>	103	<a href="#">Tavros</a>	15.5 <sup>[37]</sup>
24	<a href="#">Nereid</a>	192 <sup>[5]</sup>	64	<a href="#">Neso</a>	48.8 <sup>[25][28]</sup>	104	<a href="#">Ijirak</a>	13.5 <sup>[37]</sup>
25	<a href="#">Hiaka</a>	186 <sup>[16]</sup>	65	<a href="#">Setebos</a>	47 <sup>[26][27]</sup>	105	<a href="#">Deimos</a>	12.54 <sup>[35]</sup>
26	<a href="#">Actaea</a>	183.4 <sup>[17]</sup>	66	<a href="#">Carme</a>	46.7 <sup>[20]</sup>	106	<a href="#">Kerberos</a>	12 <sup>[5]</sup>
27	<a href="#">Hyperion</a>	178.4 <sup>[5]</sup>	67	<a href="#">Sao</a>	~44 <sup>[25]</sup>	107	<a href="#">S/2023 U 1</a>	10.6 <sup>[29][27]</sup>
28	<a href="#">Phoebe</a>	1,527 <sup>[5]</sup>	68	<a href="#">Siarnaq</a>	43.2 <sup>[17]</sup>	108	<a href="#">Erriapus</a>	10.5 <sup>[37]</sup>
29	<a href="#">S/2012 (38628) 1</a>	1,522.8 <sup>[6]</sup>	69	<a href="#">Metis</a>	43 <sup>[5]</sup>	109	<a href="#">Styx</a>	10.4 <sup>[5]</sup>
30	<a href="#">S/2005 (55637) 1</a>	1,468.8 <sup>[7]</sup>	70	<a href="#">Ophelia</a>	43 <sup>[19]</sup>	110	<a href="#">S / 2002 N 5</a>	33.45 <sup>[29][27]</sup>
31	<a href="#">Weywot</a>	1,212 <sup>[8]</sup>	71	<a href="#">Lysithea</a>	42.2 <sup>[20]</sup>	111	<a href="#">Stefano</a>	32 <sup>[26][27]</sup>
32	<a href="#">Larissa</a>	1,169.4 <sup>[6]</sup>	72	<a href="#">Laomedeia</a>	~42 <sup>[25]</sup>	112	<a href="#">Atlas</a>	30.2 <sup>[31]</sup>
33	<a href="#">S/2018 (532037)</a>	1,157.8 <sup>[6]</sup>	73	<a href="#">Cordelia</a>	40 <sup>[19]</sup>	113	<a href="#">Ananke</a>	29.1 <sup>[20]</sup>
34	<a href="#">Sycorax</a>	1,122.8 <sup>[7]</sup>	74	<a href="#">Psamathe</a>	~40 <sup>[25]</sup>	114	<a href="#">Paaliaq</a>	29 <sup>[17]</sup>
35	<a href="#">Janus</a>	1,062.2 <sup>[7]</sup>	75	<a href="#">Albiorix</a>	37 <sup>[17]</sup>	115	<a href="#">Telesto</a>	28.8 <sup>[32]</sup>
36	<a href="#">S/2015 (136472)</a>	~175 <sup>[18]</sup>	76	<a href="#">Hydra</a>	37 <sup>[5]</sup>	116	<a href="#">Pan</a>	28 <sup>[33]</sup>
37	<a href="#">Amalthea</a>	167 <sup>[5]</sup>	77	<a href="#">Helen</a>	36 <sup>[7]</sup>	117	<a href="#">Perdita</a>	26.6 <sup>[34]</sup>
38	<a href="#">Puck</a>	162 <sup>[19]</sup>	78	<a href="#">Nyx</a>	36 <sup>[5]</sup>	118	<a href="#">Mab</a>	24.8 <sup>[34]</sup>
39	<a href="#">Namaka</a>	~160 <sup>[12]</sup>	79	<a href="#">Sinope</a>	35 <sup>[20]</sup>	119	<a href="#">Phobos</a>	22.16 <sup>[35]</sup>
40	<a href="#">Galatea</a>	158 <sup>[5]</sup>	80	<a href="#">Hippocamp</a>	34.8 <sup>[30]</sup>	120	<a href="#">Francisco</a>	22 <sup>[26][27]</sup>

Nº	Astronomical object	Diameter km	Nº	Astronomical object	Diameter km	Nº	Astronomical object	Diameter km
121	S/2021 N 1	21.95 <sup>[29]</sup>	159	Styx	10.4 <sup>[5]</sup>	198	Narvi	5.4 <sup>[38][37]</sup>
122	Leda	21.5 <sup>[20]</sup>	160	Callirrhoe	10.2 <sup>[17]</sup>	199	Aegir	5 <sup>[37]</sup>
123	Ferdinand	21 <sup>[26][27]</sup>	161	Hyrrokkin	7.8 <sup>[38][37]</sup>	200	Eggther	5 <sup>[37]</sup>
124	Margaret	20 <sup>[26][27]</sup>	162	Daphnis	7.6 <sup>[32]</sup>	201	Greep	5 <sup>[37]</sup>
125	Calypso	19.2 <sup>[32]</sup>	163	Thrymr	7.4 <sup>[38][37]</sup>	202	Hati	5 <sup>[37]</sup>
126	Ymir	18.8 <sup>[29]</sup>	164	Mundilfari	7.5 <sup>[38][37]</sup>	203	Loge	5 <sup>[37]</sup>
127	Trinculo	18 <sup>[26][27]</sup>	165	Praktika	7 <sup>[20]</sup>	204	Skoll	5 <sup>[37]</sup>
128	Kiviug	18 <sup>[37]</sup>	166	Kalike	6.9 <sup>[20]</sup>	205	S/2019S1	5 <sup>[37]</sup>
129	Cupid	17.8 <sup>[34]</sup>	167	Megaclite	6.6 <sup>[39][40][38]</sup>	206	Aoede	4.6 <sup>[38][40]</sup>
130	Themisto	16.4 <sup>[17]</sup>	168	Skathi	6.6 <sup>[37]</sup>	207	Helike	4.6 <sup>[38][40]</sup>
131	Adrastea	16.4 <sup>[5]</sup>	169	Bergelmir	6.5 <sup>[38][37]</sup>	208	Thyon	4.6 <sup>[38][40]</sup>
132	Tarvos	15.5 <sup>[37]</sup>	170	Narvi	6 <sup>[37]</sup>	209	Alvaldi	4.5 <sup>[37]</sup>
133	Ijirak	13.5 <sup>[37]</sup>	171	Aegir	6 <sup>[37]</sup>	210	S/2006S1	4.5 <sup>[37]</sup>
134	Deimos	12.54 <sup>[35]</sup>	172	Styx	6 <sup>[38][40]</sup>	211	Pallene	4.46 <sup>[32]</sup>
135	Kerberos	12 <sup>[5]</sup>	173	Callirrhoe	5.8 <sup>[38][37]</sup>	212	Harpalike	4.4 <sup>[41][40]</sup>
136	S/2023 U 1	10.6 <sup>[29]</sup>	174	Hyrrokkin	5.8 <sup>[38][37]</sup>	213	Euanthe	4 <sup>[38][40]</sup>
137	Erriapus	10.5 <sup>[37]</sup>	175	Daphnis	5.8 <sup>[38][37]</sup>	214	Farbauti	4 <sup>[37]</sup>
138	rgaret	10.4 <sup>[5]</sup>	176	Thrymr	5.5 <sup>[37]</sup>	215	Narvi	5.4 <sup>[38][37]</sup>
139	Calypso	10.2 <sup>[17]</sup>	177	Mundilfari	5.4 <sup>[38][37]</sup>	216	Aegir	5 <sup>[37]</sup>
140	Ymir	7.8 <sup>[38][37]</sup>	178	Praktika	5 <sup>[37]</sup>	217	Eggther	5 <sup>[37]</sup>
141	Trinculo	7.6 <sup>[32]</sup>	179	Kalike	10.4 <sup>[5]</sup>	218	Greep	5 <sup>[37]</sup>
142	Kiviug	21.9 <sup>[29]</sup>	180	Megaclite	10.2 <sup>[17]</sup>	219	Hati	5 <sup>[37]</sup>
143	Cupid	21.5 <sup>[20]</sup>	182	Skathi	7.8 <sup>[38][37]</sup>	220	Loge	5 <sup>[37]</sup>
144	Themisto	21 <sup>[26][27]</sup>	183	Tarqeq	7.6 <sup>[32]</sup>	221	Skoll	5 <sup>[37]</sup>
145	Adrastea	20 <sup>[26][27]</sup>	184	Bebhionn	7.4 <sup>[38][37]</sup>	222	S/2019S1	5 <sup>[37]</sup>
146	Tarvos	19.2 <sup>[32]</sup>	185	Fornjot	7.5 <sup>[38][37]</sup>	223	Aoede	4.6 <sup>[38][40]</sup>
147	Ijirak	18.8 <sup>[29]</sup>	186	Germippe	7 <sup>[20]</sup>	224	Helike	4.6 <sup>[38][40]</sup>
148	Deimos	18 <sup>[26][27]</sup>	187	Bestla	6.9 <sup>[20]</sup>	225	Thyon	4.6 <sup>[38][40]</sup>
149	Kerberos	18 <sup>[37]</sup>	188	Suttungr	6.6 <sup>[39][40][38]</sup>	226	Alvaldi	4.5 <sup>[37]</sup>
150	S/2023 U1	17.8 <sup>[34]</sup>	189	Kari	6.6 <sup>[37]</sup>	227	S/2006S1	4.5 <sup>[37]</sup>
151	Erriapus	16.4 <sup>[17]</sup>	190	Bergelmir	6.5 <sup>[38][37]</sup>	228	Pallene	4.46 <sup>[32]</sup>
152	S/2021 N 1	16.4 <sup>[5]</sup>	191	Styx	6 <sup>[37]</sup>	229	Harpalike	4.4 <sup>[41][40]</sup>
153	Leda	15.5 <sup>[37]</sup>	192	Callirrhoe	6 <sup>[37]</sup>	230	Euanthe	4 <sup>[38][40]</sup>
154	Ferdinand	13.5 <sup>[37]</sup>	193	Hyrrokkin	6 <sup>[38][40]</sup>	231	Farbauti	4 <sup>[37]</sup>
155	Margaret	12.54 <sup>[35]</sup>	194	Daphnis	5.8 <sup>[38][37]</sup>	232	Narvi	5.4 <sup>[38][37]</sup>
156	Calypso	12 <sup>[5]</sup>	195	Thrymr	5.8 <sup>[38][37]</sup>	233	Aegir	5 <sup>[37]</sup>
157	Ymir	10.6 <sup>[29]</sup>	196	Mundilfari	5.8 <sup>[38][37]</sup>	234	Eggther	5 <sup>[37]</sup>
158	Trinculo	10.5 <sup>[37]</sup>	197	Praktika	5.5 <sup>[37]</sup>	235	Greep	5 <sup>[37]</sup>