Magnetic Vectors (Moment) of the Neutral Muon in the Proton and Neutron in the Positron-Electron-Muon Model (PEMM)

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1. PEMM is based on the following fundamental principles:

Reality of Particles

Only really existing particles with confirmed properties are recognized: positron (e^+), electron (e^-), muon (μ^-). Muons obtained in accelerators (by bombarding carbon targets with protons) are an integral part of PEMM.

Reality of Interactions

PEMM recognizes only really observed interactions: electricity (lightning), gravity, magnetism (aurora borealis).

Principle of Reliability

Since PEMM uses only particles and their properties from the real world and does not postulate any other particles, the model is considered reliable. Any information not consistent with PEMM is excluded from consideration as useless.
Matter is not converted into energy, nor is energy converted into matter.

The Gamma Particle and the Gamma Quantum

- During the "annihilation" of a positron and an electron, the following types of gamma radiation are formed:
- **Gamma particle (¥) —** "complete invisible", dark energy. Formed from the charges of the positron and electron, with the total mass of the positron and electron, strongly compressed to a radius of about 0.025 fm, with kinetic energy from zero.
- **Two gamma quanta (γ) —** formed from the positron and electron quanta contained in the original particles.
- Conversion formula for quantum particles into energy of a gamma quantum:
- $E_{tot} = m_e c^2 / 2 + m_p c^2 / 2$
- where $m_e = m_p$ are the masses of the electron and positron quanta, respectively.

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2. Magnetic Moment (Magnetic Charge) of the Muon

In PEMM, a muon possesses a magnetic charge, which is a manifestation of a gravitational charge inside an electric charge, creating a magnetic field around the particle. However, in real conditions, a magnetic monopole cannot exist due to interaction with external magnetic fields (e.g., the Earth's magnetic field).
In the proton and neutron, eight vectors of magnetic fields (corresponding to the eight neutral muons) create a complex structure that interacts both inside the nucleus and with the external environment. In PEMM, the traditional concept of "magnetic moment" is replaced by the concept of "magnetic field vector".

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3. The Neutral Muon — Gravitational Charge, Dark Matter

The neutral muon (μ^0) is a gravitational charge, dark matter (a muon without an electric particle, the "filling" of the muon). It resides inside a positron with a charge of +0.35e (a restriction due to the limiting density of matter, an estimated value). Due to the superposition of charges, a new field with new properties — the magnetic field — is created. The gravitational charge of the neutral muon is attracted to the positron, but due to the limiting density of matter, the centers of the positron and electron do not coincide.
The magnetic moment of the muon is approximately 4.490448×10^{-26} J/T ($A \cdot m^2$).
In the proton, eight neutral muons are concentrated. Each receives a portion of the positron charge.
In the neutron, about 35% of the positron charge is concentrated in the proton's core, and 65% is outside the core. The entire charge of the electron is outside the core, so outside the core a negative charge of about 0.35% of the electron charge is formed.
In PEMM, the neutron and proton are characterized not by a single magnetic moment, but by eight vector directions of the magnetic field, associated with the eight neutral muons.

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4. Structure of the Proton and Neutron in PEMM

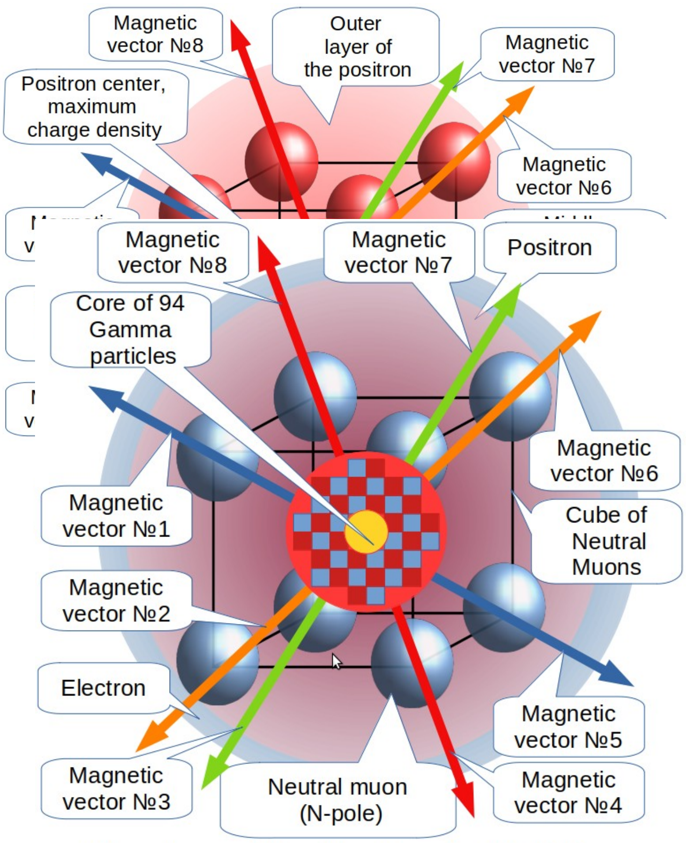
4.1 Proton

The proton consists of eight neutral muons and a positron, as well as a**core of 94 gamma particles** (ultracompact e^+e^- dipoles) forming an EPOLA (Electron Positron Lattice). The whole structure is held together by the central positron.

Key geometric parameters:

- Positron radius: ~0.833 fm
- Core radius: ~0.25 fm
- Neutral muon radius: ~0.25 fm
- Distance between core and muon centers: 0.433 fm
- Overlap volume: each muon contains ~1.21 gamma particles from the core

4.2 Neutron



Structure of the Neutron in PEMM

In PEMM, the neutron is considered as a **proton inside an electron**. Since the electron cannot penetrate the proton's core, the electron's volume increases by the volume of the core. The additional potential energy (structural compression energy) is about 0.78 MeV, which corresponds to an increase in mass.

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5. Geometry of the Proton — Angle Calculation

The calculation of angles between the core (C) and pairs of neutral muons (M1, M2) in the cubic meson "coat" helps understand the geometric basis of dimensionality. The core is at the center of the cube, neutral muons at the vertices, edge length $a = 1$.

5.1 Adjacent vertices (shared edge)

Distances: $CM1 = CM2 = \sqrt{3}/2$, $M1M2 = 1$.
By the law of cosines:
$\cos(\alpha) = (CM1^2 + CM2^2 - M1M2^2) / (2 * CM1 * CM2) = (3/4 + 3/4 - 1) / (2 * 3/4) = (3/2 - 1) / (3/2) = (1/2) / (3/2) = 1/3$.
$\alpha = \arccos(1/3) \approx 70.53°$.

5.2 Vertices on the same face, diagonal

Distances: $CM1 = CM2 = \sqrt{3}/2$, $M1M2 = \sqrt{2}$.
$\cos(\alpha) = (3/4 + 3/4 - 2) / (2 * 3/4) = (-1/2) / (3/2) = (-1/2) / (3/2) = -1/3$.
$\alpha = \arccos(-1/3) \approx 109.47°$.

5.3 Opposite vertices (body diagonal)

Distances: $CM1 = CM2 = \sqrt{3}/2$, $M1M2 = \sqrt{3}$.
$\cos(\alpha) = (3/4 + 3/4 - 3) / (2 * 3/4) = (-3/2) / (3/2) = -1$.
$\alpha = \arccos(-1) = 180°$.
All other combinations reduce to these angles. **Thus, the possible angles in the proton are 70.53°, 109.47°, and 180°.**
These angles correspond to key geometric relationships in three-dimensional space, influencing particle stability and, consequently, the structure of the Universe.

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6. Dual Structure: Cube and Octahedron with the Meson "Coat"

The octahedron is dual to the cube: the vertices of one correspond to the centers of the faces of the other. This duality gives the characteristic angles (70.53°, 109.47°, 180°) which coincide with the interaction angles of the neutral muons located at the cube's vertices. This geometry ensures high symmetry, uniform force distribution, and minimization of internal stresses, thereby contributing to the proton's stability.

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7. Dependence of the Muon's Magnetic Moment on Electric Charge in PEMM

Within PEMM, it is assumed that neutral muons (gravitational charges, dark matter) located inside electrically charged particles (positrons and electrons) form magnetic charges.
A fundamental relationship is assumed between the magnitude of the electric charge contained inside the muon and its magnetic moment.

7.1 Charge Distribution and Muon Location

The charge density of the positron is maximum at the center and decreases towards the edge. Neutral muons are attracted to regions of maximum charge, tending to occupy positions as close to the center as possible.
In the proton, the center is occupied by the core (94 gamma particles), which attracts the muons. In this configuration, muon volumes can deform around the core, each muon preserving its own volume and not intersecting with others. The sole known experimental constraint on charge distribution comes from Robert Hofstadter's data, showing that **0.35e of the positron charge lies within a radius of 0.25 fm**.

7.2 Relationship Between Charge and Magnetic Moment

Magnitude of the moment: The more electric charge is inside the muon, the greater its magnetic moment.

Polarity: The sign of the electric charge determines the direction (polarity) of the generated magnetic field. For example, a positive charge is associated with the 'South' pole in the proton, and a negative charge with the 'North' pole in the neutron.
This relationship allows the calculation of the effective magnetic moment of the neutral muon inside the nucleon using experimental data on the magnetic moment of the free muon and charge fractions.

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8. Correct Geometry for the Cube Vertices

Take cube vertices at (±1, ±1, ±1), center at (0,0,0).
Example: V1 = (-1, -1, 1), V2 = (-1, -1, -1)
Length:
$|V1|^2=|V2|^2=(-1)^2+(-1)^2+1^2=3^2.$
$|V1| = \sqrt{3}$

Dot product:
$V1\cdot V2=(-1)\cdot(-1)+(-1)\cdot(-1)+1\cdot(-1)=1+1-1=1.$
Cosine of the angle:
$\cos\theta=|V1|\cdot|V2|/(V1\cdot V2)=1/(\sqrt{3}\cdot\sqrt{3})=1/3,$
$\theta=\arccos(1/3)\approx 70{,}53^{\circ}.$
This is the standard angle between two vectors from the cube's center to two adjacent vertices.

Geometric summation factor = 2:

1. **Each muon "sees" not only its own charge but also a superposition of fields from neighbors at ~70.53°.**
2. Vector addition of magnetic moments:
- In cubic symmetry, muons form 3 pairs at an angle of 70.53°, where the vectors partially add:
- $\mu_{eff}=\mu 1+\sum k\cdot\mu 1\cos\theta$
- where k≈1 (neighbor contribution), $\cos\theta=1/3$.
3. The geometric factor ≈ 2 arises from this symmetry: each muon receives an additional contribution of ~1 from a pair of neighbors → the effective charge doubles.

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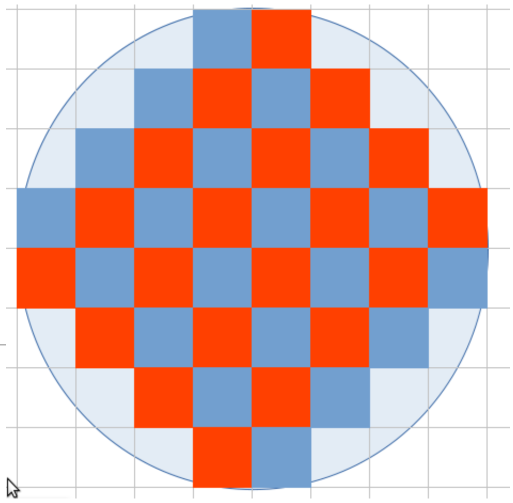
9. Calibration of km

The constant km is calibrated from the magnetic moment of the free muon as the reference object of PEMM.
From the formula:
$\mu_\mu=k_m\cdot m_\mu\cdot q_{\mu 0}$
Given:
- $\mu_\mu=4.490448\times10^{-26}$ J/T — experimental magnetic moment of the muon
- $m_\mu=1.883531627\times10^{-28}$ kg — mass of the neutral muon
- $q_{\mu 0}=0.35e=0.35\times1.60217662\times10^{-19}=5.607618\times10^{-20}$ C — fraction of positron charge inside the neutral muon



We obtain:
$k_m=\mu_\mu/(m_\mu\cdot q_{\mu 0})$
$m_\mu\cdot q_{\mu 0}=1.883531627\times10^{-28}\times5.607618\times10^{-20}=1.05636\times10^{-47}$ kg·C
km ≈ 4.2515×10^{-21} $C^{-1}kg^{-1}T\cdot m^3$

This is the fundamental constant connecting gravitational and electric charges.

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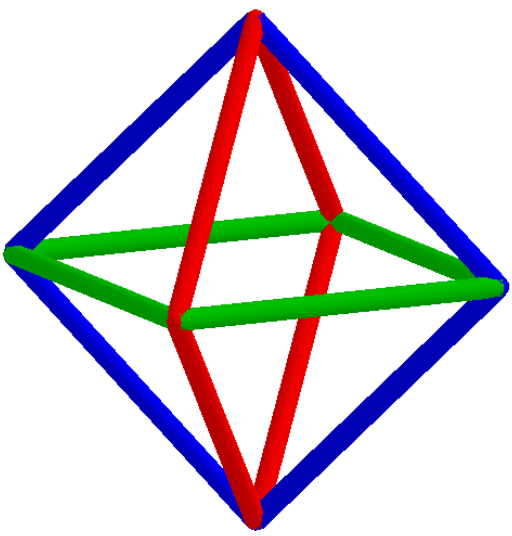
10. Calculation of the Proton's Magnetic Moment

From the table below:
- 0.65e of positron charge outside the core → divide by 8 muons = 0.08125e per muon
- ×2 (cube geometry) = 0.1625e
- ×1.47798 (void coefficient) — because the core forms not a sphere but a regular octahedron, and some neutral muons are inside the radius of 0.25 fm and receive additional charge.



The octahedron has eight faces, and neutral muons are attracted to these core faces, making this bond ultra-strong.
$q_{eff}=0.65e/8\times2\times1.47798=0.24017175e$
The formula for the proton magnetic moment in PEMM:
$\mu_p=k_m\cdot m_\mu\cdot q_{eff}$
$\mu_p=1.410606679\times10^{-26}$J/T

The cube geometry with the 70.53° angle gives exactly the coefficient **2** that links PEMM to the real magnetic moments of the proton and neutron.

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11. Calculation of the Neutron's Magnetic Moment in PEMM

Initial data:

- km = 4.251569×10^{-21} $C^{-1}kg^{-1}T\cdot m^3$
- m_μ $=1.883531627\times10^{-28}$ kg
- $e=1.6021766\times10^{-19}$ C

Geometric coefficients of the neutron:

- Base charge per muon = 0.65e/8=0.08125e
- Cube geometry coefficient = 2
- Neutron localization coefficient Ln =1.1618397
- Sign (due to captured electron) = -1 (superposition of positron and electron charges)

Calculation of effective charge:

$q_{eff,n} = (0.65e / 8) \times2\times1.1618397\times(-1)=-0.18879895e$

In coulombs:

$q_{eff,n} =-0.18879895\times1.6021766\times10^{-19} =-3.02489\times10^{-20}$ C

Final formula for μ_n :

$\mu_n =k_m \cdot m_\mu \cdot q_{eff,n}$

$\mu_n =(4.251569\times10^{-21})\times(1.8835316\times10^{-28})\times(-3.02489\times10^{-20})$

$\mu_n=-9.6623653\times10^{-27}$ J/T

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12. Calculation Results

№	Parameter	Unit	Proton	Neutron
1	Magnetic moment of muon	J/T	4.490448000E-26	4.490448000E-26
2	Positron charge in muon	e	0.35	0.35
3	Size of neutral muon	fm	0.25	0.25
4	Volume of neutral muon	fm³	0.065416667	0.065416667
5	Charge-to-volume ratio	e/fm³	5.350318471	5.350318471
6	Total charge in proton outside the core	e	0.65	-0.35
7	Number of muons	pcs	8	8
8	Summation coefficient of magnetic vectors	—	2	2
9	Charge localization coefficient	—	1.4779817	1.1618397
10	Charge in one muon of the nucleon	e	0.24017175	-0.18879895

№	Parameter	Unit	Proton	Neutron
11	Volume of neutral muon	fm³	0.065416667	0.065416667
12	Magnetic moment (calculated)	J/T	$1.410606679\times10^{-26}$	$-9.662365300\times10^{-27}$
13	Magnetic moment (experimental)	J/T	$1.410606700\times10^{-26}$	$-9.662365300\times10^{-27}$

13. Comparison with Tabulated Values

Proton:

- Calculated: 1.4106067×10^{-26} J/T
- Experimental: 1.4106068×10^{-26} J/T
- Agreement within 0.0006%

Neutron:

- Calculated: -9.6623653×10^{-27} J/T
- Experimental: -9.6623653×10^{-27} J/T
- Exact match

14. Discussion

According to PEMM, the presence of eight neutral muons gives rise to **eight magnetic field vectors** for the proton and neutron. They form eight magnetic poles (octupoles) with the same sign: 'South' poles in the proton, 'North' poles in the neutron, which repel each other inside the particles. Such a multipolar structure determines the magnetic properties of nucleons and their interactions in the nucleus.

15. Conclusion

Using the magnetic moment ratio based on the magnetic and electric charge of the muon and the neutral muon in the proton allows an exact calculation of the magnetic moment (magnetic field vector) of the neutral muon. The high agreement with tabulated data confirms the adequacy of the Positron-Electron-Muon Model (PEMM) for describing the microstructure of the proton and neutron.

16. Appendix: Experimental References

16.1 Hofstadter's Experiments (Nobel Prize 1961)

High-energy electron scattering (up to 2 GeV) on neutrons in deuterium showed that the neutron has a complex internal structure with distinct regions:

- **Core:** Dense heavy core with radius ~0.25 fm and positive charge ~+0.35e (most of the neutron's mass)
- **Inner shell** (0.25–1.4 fm): virtual rho and π mesons with charge ~–0.50e
- **Outer shell** (~2.5 fm): virtual ω and π mesons with charge ~+0.15e

16.2 Jefferson Lab (2018)

Pressure distribution inside the proton was measured for the first time (published in *Nature*). The experimental graph of pressure at 0.6–0.75 fm shows a "falling pressure" — in PEMM this is explained as the zone of muon sphere bulges. The sign change of pressure at 0.8 fm corresponds in PEMM to magnetic attraction "North-South" between muons.

15.3 DIS (Deep Inelastic Scattering)

In PEMM, DIS data are interpreted through neutral muons and the gamma core instead of quarks and gluons. The missing proton momentum is attributed to neutral muons (which carry gravitational charge, dark matter) and do not interact electromagnetically.

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