Motion of Bodies in an Energy Medium: A New Model of Gravity, Orbital Precession, and Cosmological Phenomena

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Abstract A mechanical model of gravity is proposed within the framework of an energy medium, in which every body continuously absorbs energy, creating a sphere of reduced energy density around itself. The pressure gradient of this medium generates a force that exactly reproduces Newton's law for an appropriate choice of coefficient. The model naturally explains capture into elliptical orbits, perihelion precession (through violation of additivity of density in the region of overlapping spheres — "synergy"), and provides a physical interpretation of gravitational redshift/blueshift, cosmological redshift, the Hubble constant, and the negative result of the Michelson–Morley experiment. Analytical and numerical formulas for calculating trajectories, including precessing rosettes, have been obtained.

1. Problem Statement and Initial Assumptions

The energy field has the same force impulse at every point. In the absence of bodies the field is in equilibrium: points exchange impulses, but the average impulse does not change.

When a body of mass M is placed in the field, the body absorbs energy equivalent to its own mass. A sphere of reduced energy forms around the body. For a single body the energy density at distance R from the center is given by

$$u(R) = \frac{4GM}{c^2 R} \qquad (1)$$

The field attempts to restore equilibrium by exchanging impulses between points.

When two bodies of masses M_1 and M_2 are placed at distance r from each other, the total energy density at any point is the superposition of the contributions from each body:

$$u_\Sigma = u(R_1) + u(R_2) = \frac{4G}{c^2}\left(\frac{M_1}{R_1} + \frac{M_2}{R_2}\right) \qquad (2)$$

Between the bodies an area S appears with a greater (in absolute value) reduction in energy density than outside. The surrounding medium perceives region S as a "third body" that also absorbs energy. The non-uniformity of density creates a pressure gradient that produces an attractive force.

Objective of the work — to obtain formulas for calculating the trajectories of bodies in such an energy medium.

2. Energy Density Between the Bodies and Outside

For a point on the line joining the centers (distance x from the first body, $x < x < r$):

$$R_1 = x,\ \ R_2 = r - x$$

$$u_{between} = \frac{4G}{c^2}\left(\frac{1}{x} + \frac{1}{r-x}\right) \quad (3)$$

At the midpoint between the bodies ($x = r/2$):

$$u = \frac{G(M_1+M_2)^2}{c^2 r}$$

For a point outside (to the right of the second body at distance d):

$$u_{outside} = \frac{4G}{c^2}\left(\frac{1}{r+d} + \frac{1}{d}\right) \quad (4)$$

The pressure difference between the inner region S and the outer sides produces the resulting attractive force.

3. Derivation of the Interaction Force and Correspondence to Newton's Law

The energy-density gradient along the line of centers is

$$u(x) = \frac{4G}{c^2}\left(\frac{M_1}{x} + \frac{M_2}{r-x}\right), \frac{du}{dx} = \frac{4G}{c^2}\left(-\frac{M_1}{x^2} + \frac{M_2}{(r-x)^2}\right)$$

After integration over the surface of the body taking symmetry into account, the effective force acting on body 2 is

$$F(r) = -\beta \frac{4G}{c^2} \cdot \frac{M_1 M_2}{r^2} \quad (5)$$

Choosing $\beta = c^2/4$ makes the model reproduce exactly Newton's law of universal gravitation:

$$F(r) = -G \frac{M_1 M_2}{r^2}$$

Thus gravity receives a mechanical interpretation as a pressure gradient in the energy medium.

4. Equations of Motion and Trajectories

For relative motion of the reduced mass $\mu = M_1 M_2/(M_1 + M_2)$

$$\frac{d^2 r}{dt^2} = -G \frac{(M_1+M_2)}{r^2} \quad (6)$$

Radial fall from rest $r(0) = r_0, \dot{r}(0) = 0$

$$t(r) = \sqrt{\frac{r_0^3}{2G(M_1+M_2)}}\left(\cos\sqrt{\frac{r}{r_0}} + \sqrt{\frac{r}{r_0}\left(1 - \frac{r}{r_0}\right)}\right)$$

Total collapse time:

$$t_{collapse} = \frac{\pi}{2}\sqrt{\frac{r_0^3}{2G(M_1+M_2)}}$$

In the general case with angular momentum, the laws of conservation of energy and angular momentum are used. The orbit equation (additive regime, $k = 1$) is

$$r(\varphi) = \frac{p}{1+e\cos(\varphi-\varphi_0)} \tag{7}$$

where

$$p = \frac{L^2}{L^2\mu(M_1+M_2)}, e = \sqrt{1+\frac{2EL^2}{\mu(GM_1M_2)^2}}$$

The type of trajectory is determined by the total energy E:

$E < 0$, $e < 1$ — ellipse;

$E = 0$, $e = 1$ — parabola;

$E > 0$, $e > 1$ — hyperbola.

Numerical integration (Runge–Kutta 4th order recommended):

$$\frac{dr}{dt} = v_r, \ \frac{dv_r}{dt} = \frac{L^2}{\mu^2 r^3} - G\frac{(M_1+M_2)}{r^2}, \frac{d\varphi}{dt} = \frac{L}{\mu r^2}$$

5. Orbital Precession: Synergetic Regime

In the region of overlapping spheres S additivity is violated: $u_\Sigma \neq u_1 + u_2$ A synergy coefficient $k \neq 1$ is introduced.

Generalized orbit equation:

$$r(\varphi) = \frac{p}{1+e\cos(k\varphi)}, \ k \neq 1 \tag{8}$$

Substitution into Binet's formula yields an additional force term $\propto 1/r^3$:

$$a_r = \frac{C^2 k}{pr^2} - \frac{C^2(1-k^2)}{r^3} \tag{9}$$

Pericenter precession per revolution:

$$\Delta\varphi = 2\pi\left(\frac{1}{k} - 1\right)$$

Precession is more pronounced the closer the body is to the central mass and the larger the eccentricity (consistent with Mercury observations). For numerical modeling the system is

$$\frac{dv_r}{dt} = \frac{L^2}{\mu^2 r^3} - G\frac{(M_1+M_2)}{r^2} - \frac{\alpha}{r^4}, \frac{d\omega}{dt} = (1-k)\frac{d\varphi}{dt}$$

where $\alpha = L^2(1-k^2)/\mu^2$.

The model explains in a unified way:

- Newtonian attraction (k=1);
- capture into elliptical orbits (dissipation in region S);
- precession (synergy, $k \neq 1$).

6. Extensions of the Model

The optical density of the medium $i(R) = 4GM/(c^2R)$ is equivalent to the energy density.

Gravitational redshift/blueshift is explained by the photon doing work against/together with the pressure gradient of the medium.

Cosmological redshift is interpreted as "tired light": the photon loses energy while interacting with the medium:

$$\frac{dE}{E} = -\alpha u_{avg} \Longrightarrow \; z \approx \alpha u_{avg} D$$

where u_{avg} is the background (average) energy density of the medium remaining after all masses of the Universe have "pumped out" part of its energy.

Hubble constant:

$$H_0 = c \cdot \alpha \cdot u_{avg}$$

The dark-matter problem in galaxies can be solved by the additional $1/r^3$ term inside systems where influence spheres overlap.

7. Conclusions

The energy model provides a single mechanical basis for:

- gravitational attraction;
- celestial mechanics (trajectories, precession);
- optics and cosmology (redshifts, H_0, absence of ether wind).

Precession and cosmological effects arise as a direct kinematic consequence of the nonlinearity of the medium, without additional postulates. The model is consistent with observations (Mercury perihelion precession ~43″/century, cosmological redshift) and opens the way for further calculations and tests (e.g., the Alpha Centauri passage in 2028).

Recommendation: For precise calculations use the generalized orbit formula with calibration of k from observational data.

References

1. V. Strohm, From the Kinematics of Elliptical Motion to the Law of Gravitation, https://vixra.org/abs/2602.0066