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Dark Matter, Dark Energy and Something Else in 5D Theory

universe MDPI

Outline

- Introduction.
- Monad and dyad methods.
- 5D Geodetic Equations.
- (4+1) and (3+1+1) reductions of the 5D Geodetic Equations
- Integral of the x^5 projected 5D Geodetic Equations and new concept of the rest mass
- V_4 and V_3 projected 5D Geodetic Equations.
- 4D Lorentz and Brance-Dicke Forces
- New rest mass concept and related matters
- 5D Ricci identities and their physical consequences
- Conclusions

$$\frac{e}{m} \neq const \Rightarrow \text{ No 5D Optics!}$$

5D interval: $dI^2 = ds^2 - d\lambda^2; \quad ds^2 = g_{AB} dx^A dx^B; \qquad d\lambda = \lambda_A dx^A$

5D signature: $(+ - - - -)$

5D metric: $G_{AB} = g_{AB} - \lambda_A \lambda_B = \tau_A \tau_B - \lambda_A \lambda_B - h_{AB}; \qquad \lambda_A \lambda^A = -1; \ \tau_A \tau^A = 1.$

5D Geodetic equations: $G^A \equiv \dfrac{d^2 x^A}{dI^2} + P^A_{BC} \dfrac{dx^B}{dI} \dfrac{dx^C}{dI} = 0.$

Killing Equations

$$\lambda^A \cdot \lambda^B \cdot L_\xi G_{AB} = \lambda^A \lambda^B (\xi_{A;B} + \xi_{B;A}) = -2\bar{\partial}^+_\Lambda \phi = 0 \Rightarrow \bar{\partial}^+_\Lambda \phi = 0;$$

$$\lambda^A g^B_\alpha (\xi_{A;B} + \xi_{B;A}) = \phi^2 \bar{\partial}^+_\Lambda (\lambda_\alpha / \phi) = \frac{2}{c^2} \sqrt{k_0} \phi^2 \bar{\partial}^+_\Lambda A_\alpha = 0 \Rightarrow \bar{\partial}^+_\Lambda A_\alpha = 0;$$

$$g_{\alpha}^{A} g_{\beta}^{B} (\xi_{A;B} + \xi_{B;A}) = \phi \overline{\partial}_{\Lambda}^{+} g_{\alpha\beta} = 0 \Rightarrow \overline{\partial}_{\Lambda}^{+} g_{\alpha\beta} = 0.$$

(4+1) reduction of the 5D Geodetic Equations

$$m_0 \lambda_A G^A = \frac{D^+}{ds} (\phi \hat{p}) = 0 \Rightarrow \phi \hat{p} = const = \frac{ne}{2\sqrt{k_0}} = n \hat{m}_{Pl};$$

$$m_0 g_A^{\alpha} G^A = 0 \Rightarrow \frac{D^+ \overline{p}^{\alpha}}{ds} = \frac{2\sqrt{k_0}}{c^2} \phi \hat{p} \overline{u}^{\beta} F_{\beta\cdot}^{\alpha} + \overline{\partial}^{+\alpha} \hat{m}_0;$$

$$m_0 g_A^{\alpha} G^A = 0 \Rightarrow \frac{D^+ \overline{p}^{\alpha}}{ds} = \frac{Q_0}{c^2} \overline{u}^{\beta} F_{\beta\cdot}^{\alpha} + \overline{\partial}^{\alpha +} \hat{m}_0.$$

(3+1+1) reduction of the 5D Geodetic Equations

$$m_0\tau_A G^A = 0 \Rightarrow \frac{D^+\hat{m}}{d\tau} = \hat{\bar{p}}^i(\bar{F}_i - \bar{v}^k\bar{D}_{ik}) - \frac{Q_0}{c^2}\bar{v}^i\bar{E}_i + \frac{Q_0\sqrt{1-\bar{v}^2}}{2\sqrt{k_0}\,\phi}\bar{\partial}^+_\tau\hat{m}_0$$

$$-m_0 h^i_A G^A = 0 \Rightarrow \frac{D^+\hat{\bar{p}}^i}{d\tau} = \frac{Q_0}{c^2}(\bar{E}^i - \bar{v}^k H^i_{.k}) - \hat{m}\bar{F}^i + 2\hat{\bar{p}}^k\bar{D}^i_k + \frac{Q_0\sqrt{1-\bar{v}^2}}{2\sqrt{k_0}\,\phi}\bar{\partial}^{+i}\hat{m}_0.$$

$$\hat{m}_0 = m_0/\sqrt{1-\hat{u}^2};\;\; \hat{u} = \frac{d\lambda}{ds};\;\; \bar{v}^k = \frac{d\bar{x}^k}{d\tau};\qquad \hat{m}_0 = \sqrt{m_0^2 + \frac{Q_0^2}{4k_0\phi^2}} = \sqrt{m_0^2 + \frac{n^2\hat{m}_{Pl}^2}{\phi^2}}.$$

Mass angle: $\chi_n = \mathrm{Arcsinh}\dfrac{n\,\hat{m}_{Pl}}{m_0\phi};\;\; \hat{m}_0 = m_0\cosh\chi_n.$

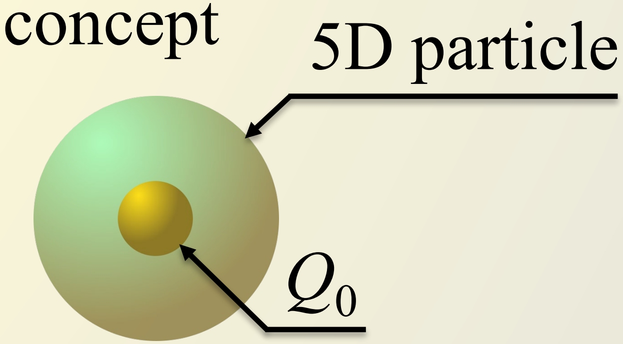
$$\hat{m}_0 = \sqrt{m_{0z}\,\bar{m}_{0z}}\,; \quad m_{0z} = m_0 + i\,n\,\hat{m}_{Pl}\,/\,\phi; \;\; m_{0z} = \hat{m}_0 e^{i\psi_n}$$

$$\psi_n = \arctan\{n\hat{m}_{Pl}\,/\,(m_0\phi)\}; \qquad \bar{m}_{0z} = m_0 - i\,n\,\hat{m}_{Pl}\,/\,\phi.$$

$$f^{\alpha}_{BD} = -\frac{Q_0^2 P^{\alpha\beta}\Phi_\beta}{4k_0\hat{m}_0\phi^2} < 0 \;\; (?). \quad \text{Here} \quad P^{\alpha\beta} = g^{\alpha\beta} - \bar{u}^{\alpha}\bar{u}^{\beta}; \;\; \Phi_\beta = \bar{\nabla}^{+}_{\beta}\ln\phi.$$

$$V_3 \to V_4 \to V_5 \to \ldots \to V_n \;\Rightarrow\; m_0 \to m = m_0\,/\,\sqrt{1-(v/c)^2} \to \hat{m}_0 \to \ldots \to \hat{m}_{0n}.$$

New (generalized) rest mass concept



$$\hat{m}_0 = \sqrt{m_0^2 + \frac{Q_0^2}{4k_0\phi^2}} = \frac{m_0}{\sqrt{1-\hat{u}^2}} = \sqrt{m_0^2 + \frac{n^2\hat{m}_{Pl}^2}{\phi^2}}.$$

No scalar charge!

Brake radiation force (Bremsstrahlung force)

$$g_E^\alpha = \frac{2e^3\overline{u}^\gamma}{3\hat{m}_0c^3}\left(\overline{u}^\beta\overline{\nabla}_\gamma^+F_{\beta\cdot}^\alpha + \frac{e\cdot P^{\alpha\delta}}{\hat{m}_0c^2}F_{\beta\delta}F_{\gamma\cdot}^\beta\right): \text{ Electric}$$

$$g_S^\alpha = -\frac{e^4P^{\alpha\beta}\overline{u}^\gamma}{6ck_0\phi^2\hat{m}_0^2}\left(\overline{\nabla}_\gamma^+\Phi_\beta - 2\Phi_\beta\Phi_\gamma + \frac{3e^2\Phi_\beta\Phi_\gamma}{4k_0\varphi^2\hat{m}_0^2}\right): \text{ Scalar}$$

$$g_{ES}^\alpha = -\frac{e^5}{6c^3k_0\phi^2\hat{m}_0^3}\left(g^{\beta\delta}P^{\alpha\gamma} - 3g^{\alpha\gamma}\overline{u}^\beta\overline{u}^\delta\right)F_{\beta\gamma}\Phi_\delta : \text{ Mixed}$$

$$R_{(BCD)}^A = R_{\cdot BCD}^A + R_{\cdot DBC}^A + R_{\cdot CDB}^A = 0: \text{ 5D Ricci identities}$$

$$g_A^\alpha g_\beta^B g_\gamma^C g_\delta^D R_{(BCD)}^A = R_{(\beta\gamma\delta)}^\alpha = R_{\cdot\beta\gamma\delta}^\alpha + R_{\cdot\delta\beta\gamma}^\alpha + R_{\cdot\gamma\delta\beta}^\alpha = 0: \text{ 4D Ricci identities}$$

$$\lambda_A g_\alpha^B g_\beta^C g_\gamma^D R^A_{(BCD)} = 0 \Rightarrow F_{(\alpha\beta;\gamma)} + 2F_{(\alpha\beta}\Phi_{\gamma)} = 0;$$

$$\lambda_A \lambda^D g_\alpha^B g_\beta^C R^A_{(BCD)} = 0 \Rightarrow \frac{2\sqrt{k_0}}{c^2} F_{\alpha\beta}\bar{\partial}^+_\Lambda \phi = \Phi_{\alpha;\beta} - \Phi_{\beta;\alpha}.$$

$$\Phi_{\beta;\alpha} - \Phi_{\alpha;\beta} = m_{\alpha\beta} : \ curl \neq 0; \quad \Phi_{\alpha;\beta} = \Phi_{\beta;\alpha} : \ curl = 0.$$

$m_{\alpha\beta} \rightarrow$ north (n-monopole); $m_{\beta\alpha} \rightarrow$ south (s-monopole)

or vise versa

1st pair of Maxwell's equations

$$F_{(\alpha\beta;\gamma)} \equiv F_{\alpha\beta;\gamma} + F_{\gamma\alpha;\beta} + F_{\beta\gamma;\alpha} = \frac{c^2}{\sqrt{k_0}\,\bar{\partial}^+_\Lambda \phi}\left(\Phi_\alpha m_{\beta\gamma} - \Phi_\beta m_{\alpha\gamma} + \Phi_\gamma m_{\alpha\beta}\right): \ \text{r.h.s.} \neq 0$$

$$F_{\alpha\beta;\gamma} + F_{\gamma\alpha;\beta} + F_{\beta\gamma;\alpha} = 0 : \quad \text{r.h.s.} = 0.$$

$\overline{\nabla}^{+}_{\nu}(\phi^3 F^{\mu\nu}) = -\frac{8\pi}{c^2}\sqrt{k_0}\,\phi\, Q^{\mu}_{5}$: 2nd pair of Maxwell's equations

$Q^{AB} = \mu_0 c \frac{dx^A}{dI}\frac{dx^B}{d\tau}$: 5D energy-momentum tensor of 5D dust.

Here μ_0 is matter density.

$$\nabla^{+}_{\nu}F^{\mu\nu} = \frac{3c^2\Phi_{\nu}m^{\mu\nu}}{2\sqrt{k_0}\,\overline{\partial}^{+}_{\Lambda}\phi} = -\frac{4\cdot\pi}{c}\overline{j}^{\mu}_{m}; \quad \nabla^{+}_{\nu}F^{\mu\nu} = -\frac{4\pi}{c\phi^2}\overline{j}^{\mu}_{e};\ \overline{j}^{\mu}_{e} = \rho_0\overline{v}^{\mu} = \rho_0\frac{d\,\overline{x}^{\mu}}{d\tau};$$

ρ_0 is electric charge density. $\overline{\nabla}^{+}_{\nu}F^{\mu\nu} = -\frac{4\cdot\pi}{c}\left[\theta(t_0 - t)\overline{j}^{\mu}_{m} + \theta(t - t_0)\phi^{-2}\overline{j}^{\mu}_{e}\right];$

$$\theta(t - t_0) = \begin{cases} 0 \ \text{at}\ t < t_0 \\ 1\ \text{at}\ t \geq t_0 \end{cases}$$

Here t_0 is cylindrical phase.

Conclusions

- If one goes beyond the 5D optics, certain new and very non-trivial properties of the matter and 4D Universe may come into being. Specifically, a new concept of the rest mass may be obtained.
- The implementation of the monad method to the (4+1) splitting of the 5D Ricci identities makes it possible to understand how the Riemannian structure of the World affects its physical properties.
- It permits one to approach closer to the understanding of the magnetic monopole problem and the origins of the Maxwell equations.
- The obtained results also provide new insight into the mechanism of the expansion of the 4D Universe and its acceleration.

Thank you very much for your attention!