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# The New 5D Relativity and the Nature of the Dark Matter

----- A New 5D Upgraded Version of Relativity  
and the Nature of the Dark Matter

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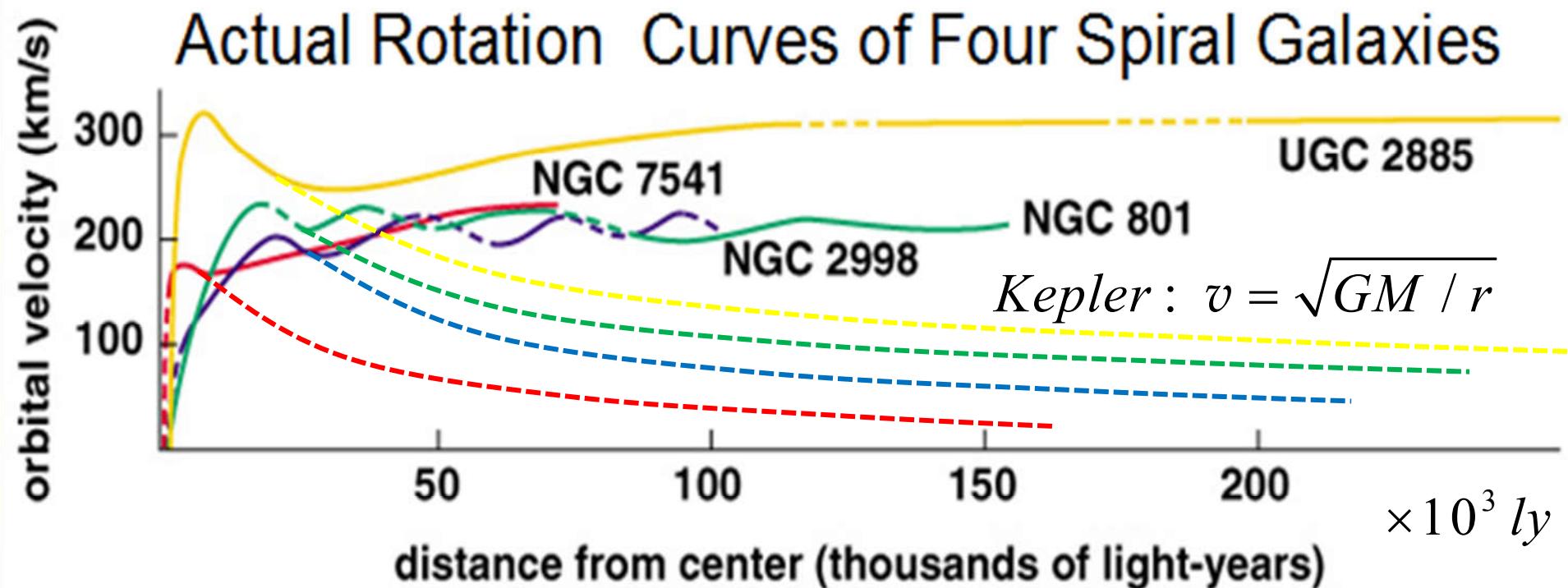
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## (I) 暗物质幽灵的观测事实回顾

四个典型旋涡星系的实际旋转曲线：“不同星系的‘暗物质分布’有所不同”。Evidence about the “Dark Matter” in Galaxies:



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Rotation velocities of satellites of galaxies imply that galaxies have large halos of “non-luminous matter”.

## (II) 暗物质幽灵的理论模型回顾

为了解释漩涡星系中远离核心区域的星体运动速度与距离的大致平坦关系，物理学家们已经提出了下面的三种解决方案。

**【方案一】MOND理论-(Modified Newtonian Dynamics of Mordehai Milgrom)**。该理论很自然地按  $v^2 = \sqrt{a_0 GM}$  形式构造出星系旋转曲线的Tully-Fisher关系  $v^2 \propto \sqrt{L}$ 。其相对论化对应是: 张量-矢量-标量理论 TeVeS model of Bekenstein's Relativistic MOND (astro-ph/0403694)<sup>[4]</sup>。

**【方案二】MOGs - Modified Gravity models**。是提出对牛顿万有引力定律，因而对Einstein广义相对论进行修正，叫做修正引力。典型的有: Brans-Dick 理论和 f(R)-Gravity (Sean Carroll @Caltech)。还有 *DGP braneworld acceleration model of Dvali-Gabadadze-Porrati gravity* (2000)<sup>[5]</sup>, Moffat's STVG (gr-qc/0506021)<sup>[5]-[6]</sup>，Chern-Simons gravity<sup>[7]</sup> 和 Weyl Fluid model及 f(G)-Gravity和含挠率的 f(T)-Gravity等等。

**【方案三】**认为Einstein 方程正确，提出漩涡星系中存在着大量暗物质的假设。**前两类方案有各自的不足 → 此方案几乎被普遍接受。**

### (III) 新五维狭义相对论对暗物质幽灵本质的解释

- 通过引入与固有时间和自旋角动量有关的第五维坐标，把狭义相对论升级为五维形式体系，此即时空时型新五维狭义相对论。
- 这一新的时空时框架产生新的Maxwell方程组。由此得到的静电场要用类似于Proca方程的新泊松方程

$$\nabla^2 \varphi(r) + \eta_0^2 \varphi(r) = -\rho(\vec{r}) / \varepsilon_0$$

来描述，其点电荷解可以写成

$$\varphi(r) = \frac{Q}{4\pi\varepsilon_0 r} (\cos \eta_0 r + C_0 \sin \eta_0 r)$$

对应的Coulomb 定律：

$$\vec{F} = -\nabla \varphi(r) = \frac{Q \vec{r}}{4\pi\varepsilon_0 r^3} [(\cos \eta_0 r + C_0 \sin \eta_0 r) + \eta_0 r (\sin \eta_0 r - C_0 \cos \eta_0 r)]$$

$$\varphi(r) = \frac{Q}{4\pi\epsilon_0 r} (\cos\eta_0 r + C_0 \sin\eta_0 r)$$

- ◆ 该势在  $r \ll 1/\eta_0$  的区域中可以退化为通常的 **Coulomb** 势。  $\square A^\mu(x^\mu) + \eta_0^2 A^\mu(x^\mu) = -\mu_0 J^\mu(x^\mu)$
- ◆ 我们称  $\eta_0$  为电磁相互作用的特征常数，其物理意义：是光子波矢量的第五维分量，可以用  $\eta_0 = \omega_0 / c$  形式表示，其中的  $\omega_0$  电磁波特征频率。新Maxwell 方程组：

$$\nabla \cdot \vec{E} - \eta_0^2 \varphi(\vec{r}, t) = \frac{\rho}{\epsilon_0}, \quad \nabla \times \vec{E} = - \frac{\partial \vec{B}}{\partial t},$$

$$\nabla \times \vec{B} - \eta_0^2 \vec{A}(\vec{r}, t) = \mu_0 \vec{J} + \mu_0 \epsilon_0 \frac{\partial \vec{E}}{\partial t}, \quad \nabla \cdot \vec{B} = 0$$

- ◆ 对应的新牛顿引力场需要用

$$\nabla^2 \Phi(r) + \eta_G^2 \Phi(r) = 4\pi G \rho(\vec{r})$$

来描述。其中  $\eta_G \equiv 2B_0\eta_0$ ，我们称之为引力系统的特性常数，而  $\eta_0 = \omega_0/c$ ，新待定因子  $B_0$  最多依赖于运动质点和引力中心的质量。因子2是因为考虑到引力子的自旋角动量为  $2\hbar$ 。

- ◆ 将关系  $\eta_G \equiv 2B_0\eta_0$  运用到引力子时，其波矢量的第五维应该是  $k_g^5 = \eta_{0G} \equiv 2\eta_0$ 。
- ◆ 以上方程在点质量情况的一般解 (新万有引力势) 为。  $\Phi(r) = -\frac{GM}{r} (\cos \eta_G r + C_0 \sin \eta_G r)$   
 $r \ll 1/\eta_{0G} \Rightarrow \text{Newtonian case.}$

我们用  $\Phi(r) = -\frac{GM}{r}(\cos \eta_G r + C_0 \sin \eta_G r)$  解释暗物质效应。

- 该势在  $r \ll 1/\eta_0$  区域中 (我们称之为近距离区域) 可以自然地退化为通常的Newton 万有引力势。
- 对于取  $C_0=0$  的情况, 就可以得到新万有引力定律:

$$F = -\frac{GMm_0}{r^2}(\cos \eta_G r + \eta_G r \sin \eta_G r)$$

- 将此运用到太阳在银河系中的圆周运动情况, 可以得到新的机械能守恒定律和圆周运动条件, 得  $E = \frac{1}{2}m_0v^2 - \frac{GMm_0}{r} \cos \eta_G r = E_0$
- $$-\frac{GMm_0}{r^2}(\cos \eta_G r + \eta_G r \sin \eta_G r) = -m_0 \frac{v^2}{r}, \quad \eta_G \equiv 2B_0 \eta_0$$
- $$v^2 = GM(\eta_G \sin \eta_G r + \frac{\cos \eta_G r}{r}) \Rightarrow v^2 = \bar{v}^2 = GM\eta_G.$$

进行稳定性分析, 得到  
在  $r > 1/\eta_G$  区域的稳定  
圆形轨道的条件: 在引力  
势的零点处和拐点处

$$B_0 = \frac{M_0}{\sqrt{M_0^2 + Mm_0}}, \quad M \gg m_0 \approx M_\odot \approx M_0 \Rightarrow v^2 = \bar{v}^2 \approx 2\eta_0 G \sqrt{MM_\odot}$$

.....

## Remarks: Index conventions Throughout the Paper

Latin indices  $i, j, k, l, m, \dots$  etc. go from 1 to 3;

Greek indices  $\mu, \nu, \sigma, \tau, \alpha, \beta, \gamma$  etc. runs 0,1,2,3;

Capital Latin indices  $A, B, C, D, E, \dots$  etc. runs 0,1,2,3,5.

$$d\vec{x} = (\text{3D space element}) = (dx^i) = (dx^1, dx^2, dx^3)$$

$$dx^\mu = (\text{4D space-time elements}) = (cdt, d\vec{x}) = (dx^0, dx^1, dx^2, dx^3)$$

$$dx^A = (\text{5D space-time-time elem.}) = (cdt, d\vec{x}, dx^5) = (dx^0, dx^1, dx^2, dx^3, dx^5)$$

**Einstein's summation convention: paired indices imply summation.**

$$ds^2 = \eta_{\mu\nu} dx^\mu dx^\nu \equiv \sum_{\mu=0}^3 \sum_{\nu=0}^3 \eta_{\mu\nu} dx^\mu dx^\nu, \quad \eta_{\mu\nu} = \text{diag}(-1, 1, 1, 1)$$

$$d\bar{s}^2 = \eta_{AB} dx^A dx^B \equiv \eta_{\mu\nu} dx^\mu dx^\nu + \varepsilon (dx^5)^2, \quad \eta_{AB} = \text{diag}(-1, 1, 1, 1, \varepsilon)$$
$$\varepsilon = \pm 1$$

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## 1. Re-discovery of the Foundations of Special Relativity

爱因斯坦提出两条相对论两条基本假设 (1905) :

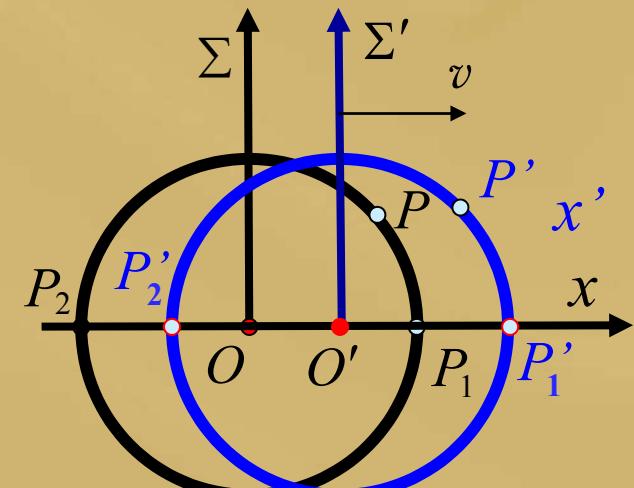
相对论的第一条基本假设：狭义相对性原理——所有物理规律在任何惯性参照系中都应保持相同的形式，没有特殊参考系。

相对论的第二条基本假设：光速不变性原理——真空中的光速相对于任何惯性系沿任一方向都恒为  $c$ ，与光源运动无关。

**Einstein 1905: Derive LT with the same equations of spherical light waves :**

$$x^2 + y^2 + z^2 = c^2 t^2,$$

$$x'^2 + y'^2 + z'^2 = c^2 t'^2.$$



**In 1905 Einstein assumed that: these equations must be correct for all EMWs, they are independent with frequencies.**

如果定义事件间隔:  $S^2 \equiv c^2 t^2 - (x^2 + y^2 + z^2)$ .

则在另一参考系中也有  $S'^2 \equiv (x'^2 + y'^2 + z'^2) - c^2 t'^2$ .

If set  $S^2 = S'^2$  then  $S^2 = S'^2 = 0$  for light.

Minkowski, Space and Time (1907)

这个关系称为Minkowski (1907)间隔不变性, 它表示两个事件间隔不因参考系改变而改变, 称为光速不变原理的数学表示。→ 由此也很自然地推导出 Lorentz 变换。

$$\Sigma: (x_1, y_1, z_1, t_1), (x_2, y_2, z_2, t_2) \quad \Sigma': (x'_1, y'_1, z'_1, t'_1), (x'_2, y'_2, z'_2, t'_2)$$

$$S^2 = c^2(t_2 - t_1)^2 - (x_2 - x_1)^2 - (y_2 - y_1)^2 - (z_2 - z_1)^2.$$

$$S'^2 = c^2(t'_2 - t'_1)^2 - (x'_2 - x'_1)^2 - (y'_2 - y'_1)^2 - (z'_2 - z'_1)^2.$$

Lorentz 变换及其逆:

$$\beta \equiv \frac{v}{c} \quad \gamma \equiv 1 / \sqrt{1 - \frac{v^2}{c^2}}$$

正变换

$$\begin{cases} x' = \gamma(x - vt) \\ y' = y \\ z' = z \\ ct' = \gamma(ct - \beta x) \end{cases}$$

逆变换

$$\begin{cases} x = \gamma(x' + vt') \\ y = y' \\ z = z' \\ ct = \gamma(ct' + \beta x') \end{cases}$$

With the light traveling equations Einstein derived the LT naturally.



Q: Does the inverse process also holds naturally?

$$x^2 + y^2 + z^2 = c^2 t^2 \Leftrightarrow x'^2 + y'^2 + z'^2 = c^2 t'^2. \quad 1905$$

$$\text{Or } x^2 + y^2 + z^2 - c^2 t^2 = x'^2 + y'^2 + z'^2 - c^2 t'^2. \quad 1907$$

- ◆ Our basic conclusion: The space-time interval vanishing condition for light traveling is not necessary. So we can omit the light traveling equation  $S^2 = S'^2 \equiv 0$  of Einstein -Minkowski. This means that, for light rays we can also have  $S^2 = S'^2 \neq 0$ , or the LT is more intrinsic than the invariance of the speed of light.

## New postulates of the New SR

- (a) The postulate of relativity: The laws of physics are the same for observers in all inertial reference frames. No frame is preferred.
- (b) The postulate of 4D intervals invariantness in the ST: The 4D intervals of any two events in the ST are the same in all inertial systems, i.e.  $S^2 = S'^2$ , and omit the intervals vanishing condition  $S^2 = S'^2 \equiv 0$  for EM waves. → New SR .

With these postulates one can also deduce the LT naturally. But there would be something incomplete in the theory structure....

## 2、Construction the New 5D STT Geometry

$$d\bar{s}^2 = \eta_{\mu\sigma} dx^\mu dx^\sigma + \varepsilon (dx^5)^2 \equiv -b^{-2} c^2 d\tau^2, \quad b = 1 / \sqrt{1 - \varepsilon a_0^2}$$

现在, 如果取  $x^5 \equiv c\tau$ , 则对应的 **5D** 动量应改是:  $p^A \equiv m_0 \frac{dx^A}{d\tau} = (m_0 \dot{x}^c, m_0 c)$ 。

然而, 将由此得到的 **5D** 动量守恒定律  $\bar{p}^A = \sum_i \bar{p}_i^A = \sum_j \bar{p}'_j^A$  用于像

$\pi^0 \rightarrow 2\gamma, \eta \rightarrow 2\gamma, \omega(782) \rightarrow 3\gamma, \dots$  方式衰变的微观粒子时, 将出现矛盾。

补充: 只有一部分 (零自旋) 玻色子才有这种衰变方式。

为了解决这个矛盾, 必须以  $x^5 = a_0 c \tau$  形式引入第五维坐标。其中  $a_0$  是依赖于运动质点特性的常数。

将对应的新 **5D** 动量守恒定律  $\bar{p}^A = \sum_i \bar{p}_i^A = \sum_j \bar{p}'_j^A$  运用到以上类型的微

观粒子  $\pi^0 \rightarrow 2\gamma, \eta \rightarrow 2\gamma, \omega(782) \rightarrow 3\gamma, \dots$  时, 得  $a_0 = 0$ 。

根据 **Particle Data Group** 于 2010-2012 年提供的实验数据来看, 目前只有近 80 种玻色子才具有此特性, PDG 数据在 [rpp-2011.zip](#)、[rpp-2012.zip](#) 中, 地址 : <http://pdg.lbl.gov/2011/download/download.html> → [rpp-2014.zip](#), [rpp-2015.zip](#)?

## 2.1 Definition of the New 5<sup>th</sup> Dim. of STT Geometry

$$d\bar{s}^2 = \eta_{\mu\sigma} dx^\mu dx^\sigma + \varepsilon (dx^5)^2 \equiv -b^{-2} c^2 d\tau^2, \quad b = 1 / \sqrt{1 - \varepsilon a_0^2}$$

- 我们可以更普遍性地以  $x^5 = a_0 c \tau$  形式引入第五维坐标，并进一步定义：

$$\bar{p}^5 = m_0 b \frac{dx^5}{d\tau} = a_0 b m_0 c \equiv \eta_0 J_3 = \eta_0 j_3 \hbar \quad (2.1)$$

- 其中  $J_3 = j_3 \hbar$  为微观粒子的总角动量  $z$  分量， $j_3 = l_3 + s_3$  为总角动量  $z$  分量的量子数。显然对基本粒子  $l_3 = 0$ ，而比例因子  $\eta_0$  为具有长度倒数量纲的普适常数。

- 进一步 5D 长度要求  $\eta_{AB} \bar{p}^A \bar{p}^B = -m_0^2 c^2$  (2.2)

则，就可以解出

$$a_0 \equiv \frac{\eta_0 J_3}{bm_0 c} = \frac{\eta_0 J_3}{\sqrt{m_0^2 c^2 + \varepsilon \eta_0^2 J_3^2}}, \quad b \equiv \sqrt{1 + \varepsilon \frac{\eta_0^2 J_3^2}{m_0^2 c^2}}, \quad \varepsilon = \pm 1 \quad (2.3)$$

## 2.2 Light Propagation in the New 5D STT

- 考虑到光子的自旋z分量量子数  $s_3 = \pm 1$ ，由(2.3)就可以得到光子的第五维动量为  $\bar{p}_\gamma^5 = \pm \eta_0 \hbar$ 。其中的 +/- 号表示自旋向上和自旋向下的光子。在当前惯性系K中，如果与狭义相对论中类似地把光子的5D动量写成  $\bar{p}_\gamma^A = \hbar \bar{k}^A$ ，则我们需要定义光子的5D波矢量为

$$\bar{k}^A = (b_0 \omega / c, b_1 \vec{k}, \pm \eta_0), \quad \vec{k}^2 = \omega^2 / c^2 \quad (2.4)$$

- 利用光子的5D类光条件:  $\eta_{AB} \bar{k}^A \bar{k}^B = \eta_{A'B'} \bar{k}^{A'} \bar{k}^{B'} = 0$

得  $b_1^2 - b_0^2 = -\varepsilon \eta_0^2 c^2 / \omega^2$ ,  $b_1'^2 - b_0'^2 = -\varepsilon \eta_0^2 c^2 / \omega'^2$  (2.5)

- 对两个惯性系K、K'的坐标原点重合时刻从公共坐标原点发射的球面波，得到光子的5D运动方程 (光速不变原理的5D形式)

$$\bar{s}^2 = \eta_{\mu\sigma} x^\mu x^\sigma + \varepsilon (x_\gamma^5)^2 = 0, \quad \bar{s}^2 = \eta_{\mu'\sigma'} x^{\mu'} x^{\sigma'} + \varepsilon (x_\gamma^{5'})^2 = 0 \quad (2.6)$$

- 它们是5D单色球面波波前方程。其5D相位运动方程应该为

$$\Phi = \eta_{AB} \bar{k}^A x_\gamma^B = \eta_{A'B'} \bar{k}^{A'} x_\gamma^{B'} = constant \quad (2.7)$$

$$\Phi = \eta_{AB} \bar{k}^A x_\gamma^B = \eta_{A'B'} \bar{k}^{A'} x_\gamma^{B'} = constant \quad (2.7)$$

- ◆ 可以得到每个单色波光子的第五维坐标具有以下结构  $\omega_0 \equiv \eta_0 c$

$$x_\gamma^5 = c \tau_\gamma = \pm \omega_0 ct / \omega \Rightarrow \tau_\gamma = \pm \omega_0 t / \omega \quad (2.8)$$

其中 +/- 号分别对应于自旋向上和自旋向下的光子。这就是光子的固有时间与传播时间  $t$  的关系，可以证明上式 **LT 不变量**。

- ◆ 由此，可以进一步得到单色球面波波前方程  $f(\omega) = \sqrt{1 - \varepsilon \omega_0^2 / \omega^2}$
- $$r = c t \sqrt{1 - \varepsilon \frac{\omega_0^2}{\omega^2}} = f(\omega) c t, \quad r' = c t' \sqrt{1 - \varepsilon \frac{\omega_0^2}{\omega'^2}} = f(\omega') c t' \quad (2.9)$$

- ◆ 5D电磁波在真空中的相位速度和群速度都按相同的规律频率

依赖，即  $u_g = u_p = c f(\omega) = c \sqrt{1 - \varepsilon \omega_0^2 / \omega^2} \quad (2.10)$

同时可以得到了**5D 真空波矢量** (2.4) 的最终表达式

$$\bar{k}^A = \left( \frac{\omega}{c}, f(\omega) \vec{k}, \eta_0 \right) \equiv \left( \frac{\omega}{c}, \vec{\kappa}, \eta_0 \right), \quad \vec{k}^2 = \omega^2 / c^2 \quad (2.11)$$

### 3、New Maxwell Equations in the New 5D STT

- ◆ 我们进一步得到

The first  
4D part

$$\square A^\mu(x^\mu) + \eta_q^2 A^\mu(x^\mu) = -\mu_0 J^\mu(x^\mu) \quad (3.1)$$

$$\square' A^{\mu'}(x^{\mu'}) + \eta_q^2 A^{\mu'}(x^{\mu'}) = -\mu_0 J^{\mu'}(x^{\mu'}) \quad (3.1')$$

$$Gauge Condition: \partial_\mu A^\mu(x^\mu) + \eta_q A^5(x^\mu) = 0. \quad \eta_q \equiv B_q \eta_0$$

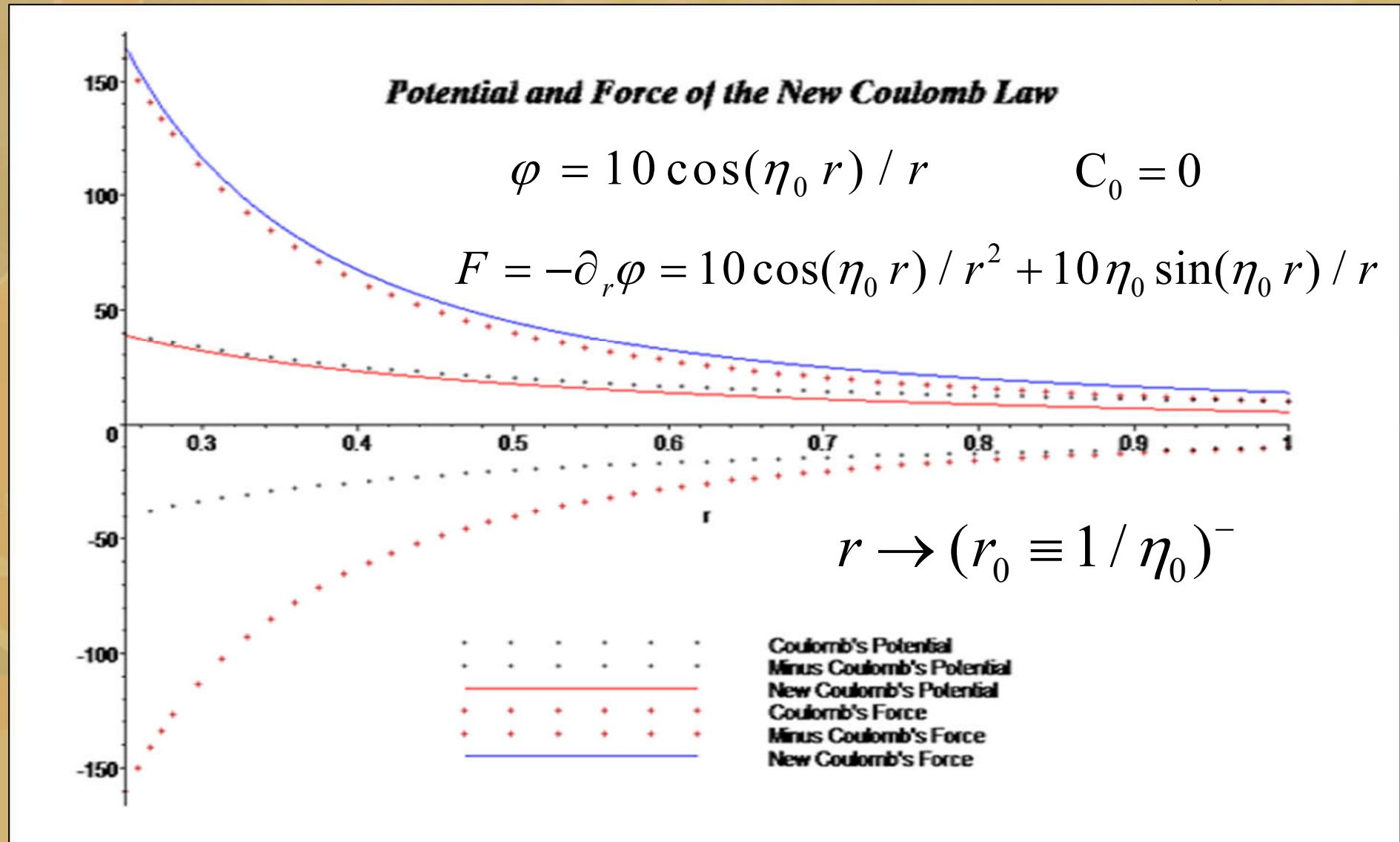
- ◆ 这就是考虑了对象特性后，**5D**势形式的**Maxwell**方程组中的前四个方程，是新的**Maxwell**方程组的4-势形式。对于静电场，以上方程变成新的**Poisson**方程：  $\nabla^2 \varphi(\vec{r}) + \eta_0^2 \varphi(\vec{r}) = -\rho(\vec{r}) / \epsilon_0$

点电荷  $\nabla^2 \varphi(r) + \eta_0^2 \varphi(r) = -\frac{1}{\epsilon_0} Q \delta^3(\vec{r}), \eta_q = \eta_0, B_q \equiv 1 \quad (3.2)$

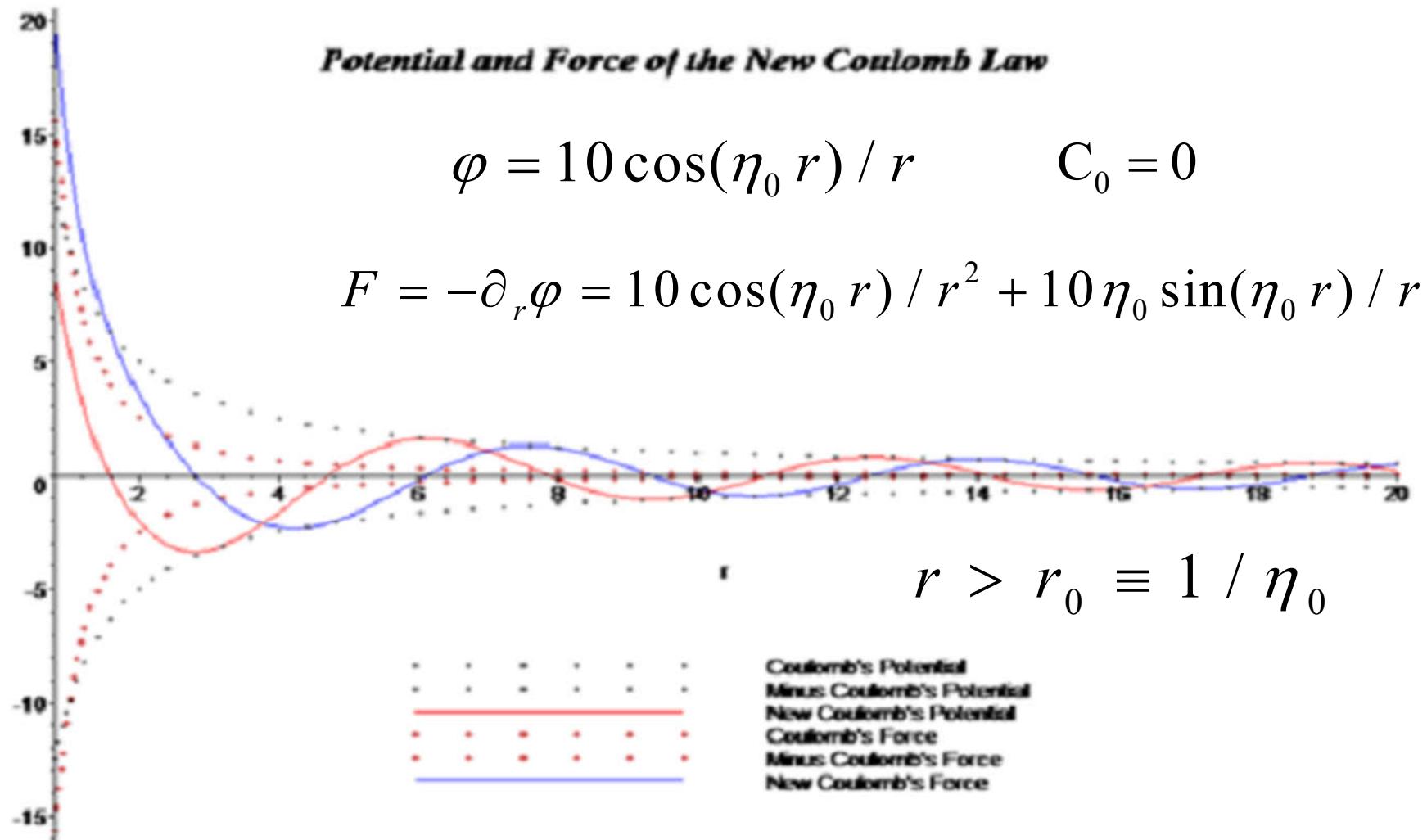
点电荷电势  $\varphi(r) = \frac{1}{4\pi\epsilon_0} \frac{Q}{r} [\cos(\eta_0 r) + C_0 \sin(\eta_0 r)] \quad (3.3)$

$$\vec{E}(r) = -\nabla \varphi(r) = \frac{Q}{4\pi\epsilon_0} \left[ \frac{\cos(\eta_0 r) + C_0 \sin(\eta_0 r)}{r^2} + \eta_0 \frac{\sin(\eta_0 r) - C_0 \cos(\eta_0 r)}{r} \right] \quad (3.4)$$

## 新Coulomb定律与原Coulomb定律的比较 (I)



## 新Coulomb定律与原Coulomb定律的比较 (II)



## 4、New Newtonian Gravitation from the New 5D STT

- ◆ 对应的新牛顿引力场需要用

$$\nabla^2 \Phi(r) + \eta_G^2 \Phi(r) = 4\pi G \rho(\vec{r}) \quad (4.1)$$

来描述。其中  $\eta_G \equiv 2B_0\eta_0$ ，我们称之为引力系统的特性常数，而  $\eta_0 = \omega_0/c$ ，新待定因子  $B_0$  最多依赖于运动质点和引力中心的质量。因子2是因为考虑到引力子的自旋角动量为  $2\hbar$ 。

- ◆ 将关系  $\eta_G \equiv 2B_0\eta_0$  运用到引力子时，其波矢量的第五维应该是  $k_g^5 = \eta_{0G} \equiv 2\eta_0$
- ◆ 以上方程在点质量情况的一般解(新万有引力势)为。

$$\Phi(r) = -\frac{GM}{r} (\cos \eta_G r + C_0 \sin \eta_G r) \quad (4.2)$$

$$\vec{g}(r) = -\nabla \Phi(r) = -GM \left[ \frac{\cos(\eta_G r) + C_0 \sin(\eta_G r)}{r^2} + \eta_G \frac{\sin(\eta_G r) - C_0 \cos(\eta_G r)}{r} \right] \hat{r} \quad (4.3)$$

*⇒ This includes the Newtonian case for  $r \ll 1/\eta_{0G}$ .*

## Burhan Salay, The New 5D Relativity and the Nature of the Dark Matter

- 对于取  $C_0=0$  的情况，就可以得到新万有引力定律

$$F(r) = -m_0 \frac{d}{dr} \Phi(r) = -\frac{GMm_0}{r^2} (\cos \eta_G r + \eta_G r \sin \eta_G r) \quad (4.4)$$

- 为了研究太阳系在银河系中的圆周运动情况，首先写出球坐标系中的 Lagrange 函数

$$L = \frac{m_0}{2} \left( \dot{r}^2 + r^2 \dot{\theta}^2 + r^2 \dot{\phi}^2 \sin^2 \theta \right) - V(r), \quad V(r) = -\frac{GMm_0}{r} \cos(\eta_G r) \quad (4.5)$$

- 由此得到质点比角动量和机械能守恒方程：  $V_{\text{eff}}(r) = \frac{m_0}{r^2} h_\phi^2 - \frac{GMm_0}{r} \cos(\eta_G r)$

$$h_\phi \equiv r \dot{\phi}^2 \sin^2 \theta = \text{const.}, \text{ with } \theta = \pi / 2 \Rightarrow \dot{\phi}^2 \equiv h_\phi / r \neq 0 \text{ for } h_\phi \neq 0. \quad (4.6)$$

$$\theta = \pi / 2 \Rightarrow E \equiv \frac{m_0}{2} \left( \dot{r}^2 + r^2 \dot{\phi}^2 \right) + V(r) = \text{const.} \Rightarrow E = \frac{1}{2} m_0 \dot{r}^2 + V_{\text{eff}}(r) = \text{const} \geq 0 \text{ or } < 0. \quad (4.7)$$

径向运动方程和新圆周运动方程 *Bound states*  $E \leq \text{Max}[V(r)] = \frac{GMm_0}{r}$ , for  $r > r_0 \equiv 1$

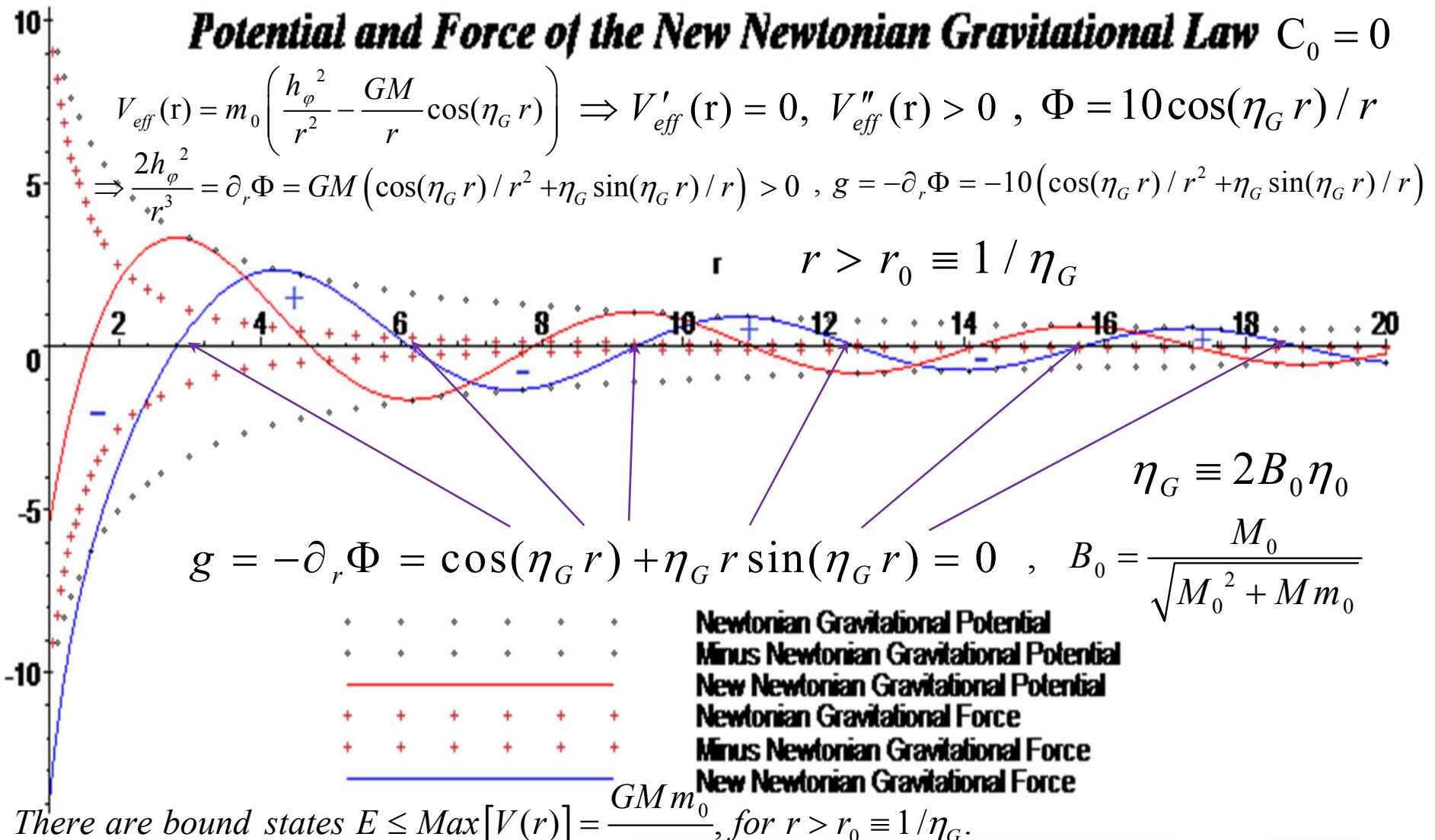
$$\ddot{r} - r \dot{\phi}^2 = \frac{F(r)}{m_0}. \quad F(r) = 0 \Rightarrow \ddot{r} = r \dot{\phi}^2. \quad \text{If } \ddot{r} = 0 \Rightarrow \frac{v_\perp^2}{r} = \frac{GM}{r^2} (\cos \eta_G r + \eta_G r \sin \eta_G r), \quad \eta_G \equiv 2B_0 \eta_0$$

稳定条件： $V'_{\text{eff}}(r) = 0, V''_{\text{eff}}(r) > 0$  for  $E = 0 \Rightarrow \eta_G r = 2n\pi - \varepsilon$  and  $v_{\perp \max}^2 = GM\eta_G$  for  $E > 0$ .

其中  $\mathbf{M}$  为银河系中太阳轨道以内的有效质量， $m_0$  为太阳系质量， $\mathbf{r}$  为太阳系离银河系中心的距离。

.. 符合 Tully-Fisher 关系的  $B_0 = B_0(M, m_0) \rightarrow \dots, B_0 = \frac{M_0}{\sqrt{M_0^2 + Mm_0}}$ .

## 新Newton定律与原Newton定律的比较 (I)

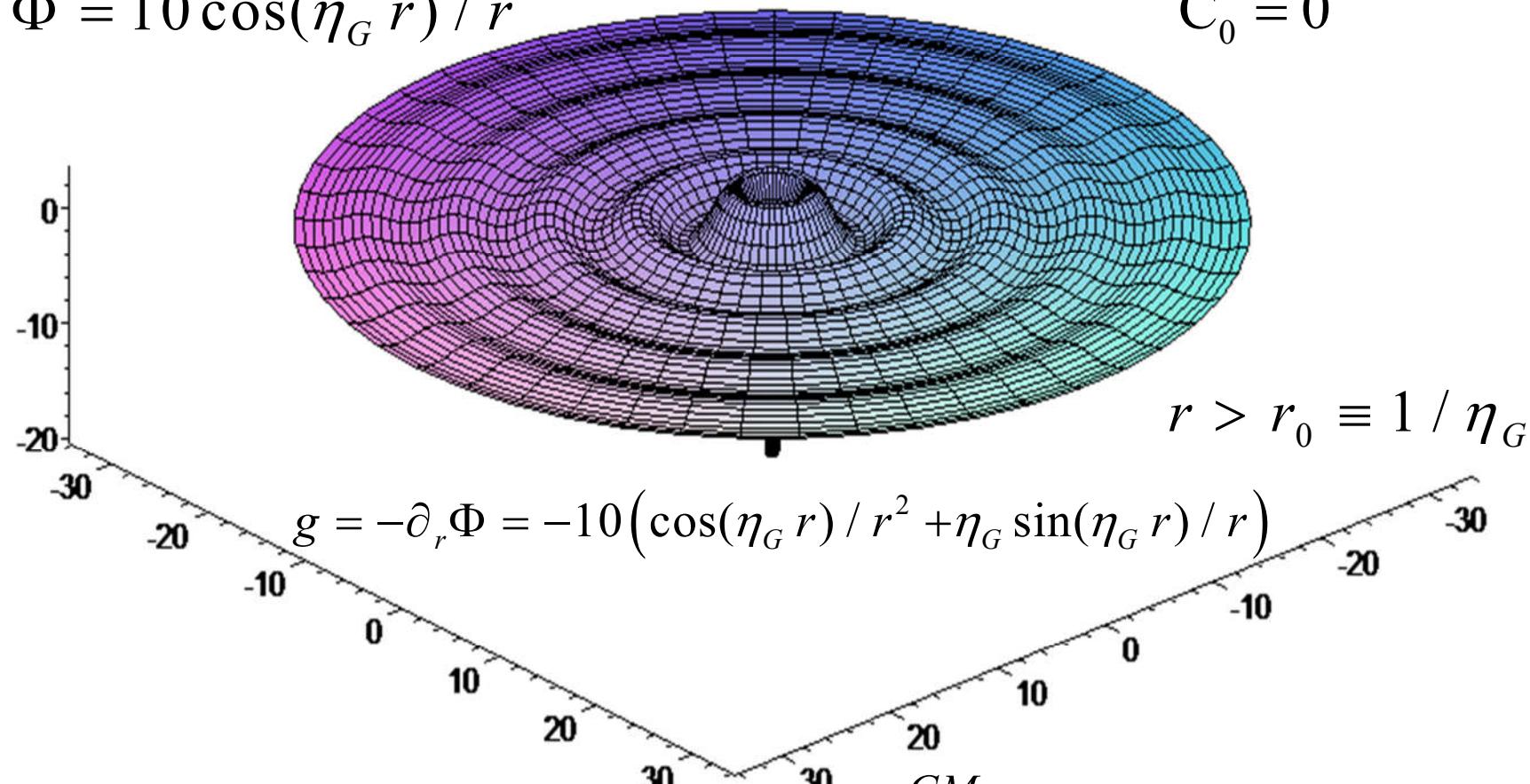


## 新Newton万有引力势在外区的径向分布立体图

***Radial Potential distribution of the New Gravitational Law in the outside of  $r = 1/\eta_G$***

$$\Phi = 10 \cos(\eta_G r) / r$$

$$C_0 = 0$$

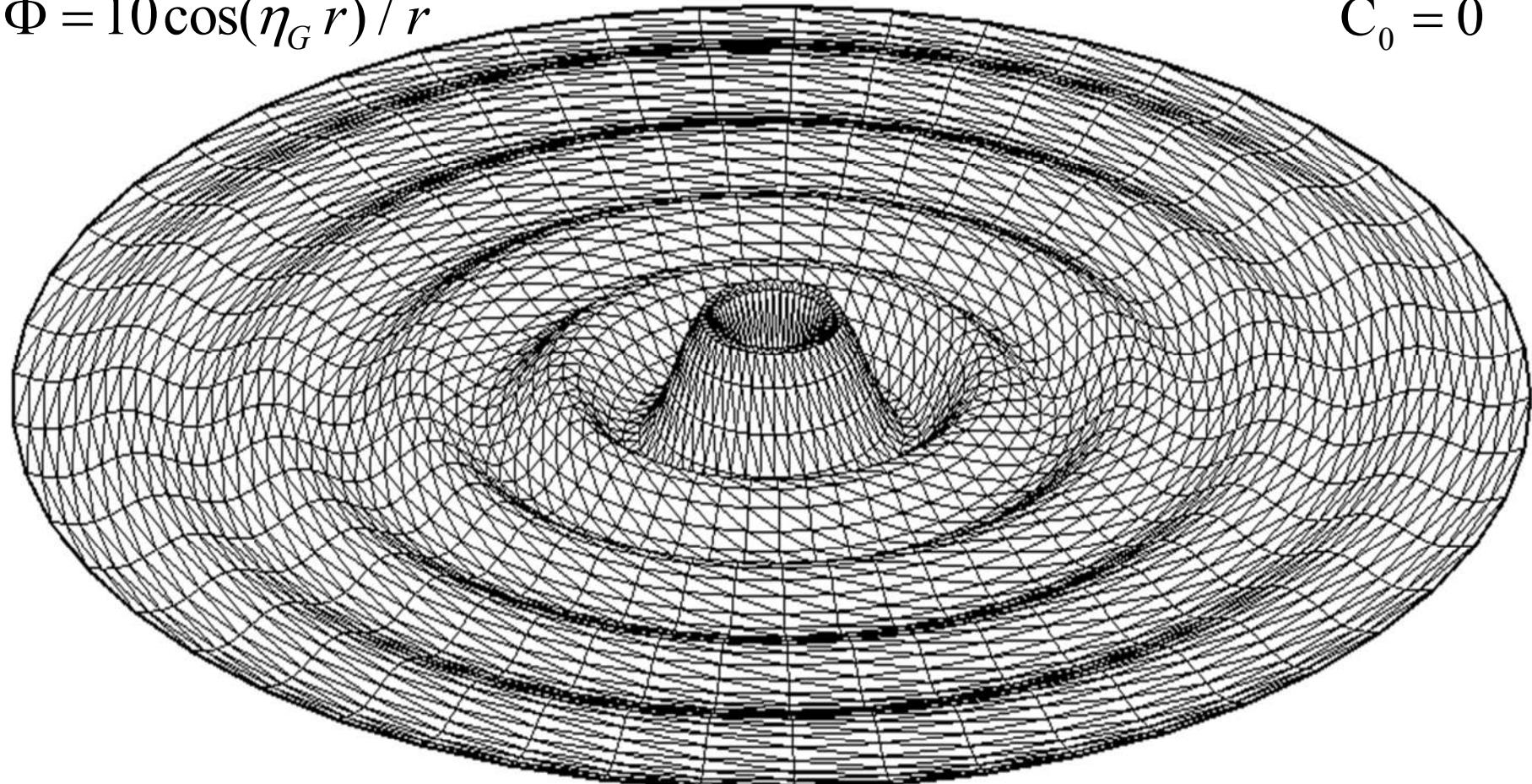


*There are bound states  $E \leq \text{Max}[V(r)] = \frac{GMm_0}{r}$ , for  $r > r_0 \equiv 1/\eta_G$ .*

## 新Newton万有引力势在外区的径向分布立体图

$$\Phi = 10 \cos(\eta_G r) / r$$

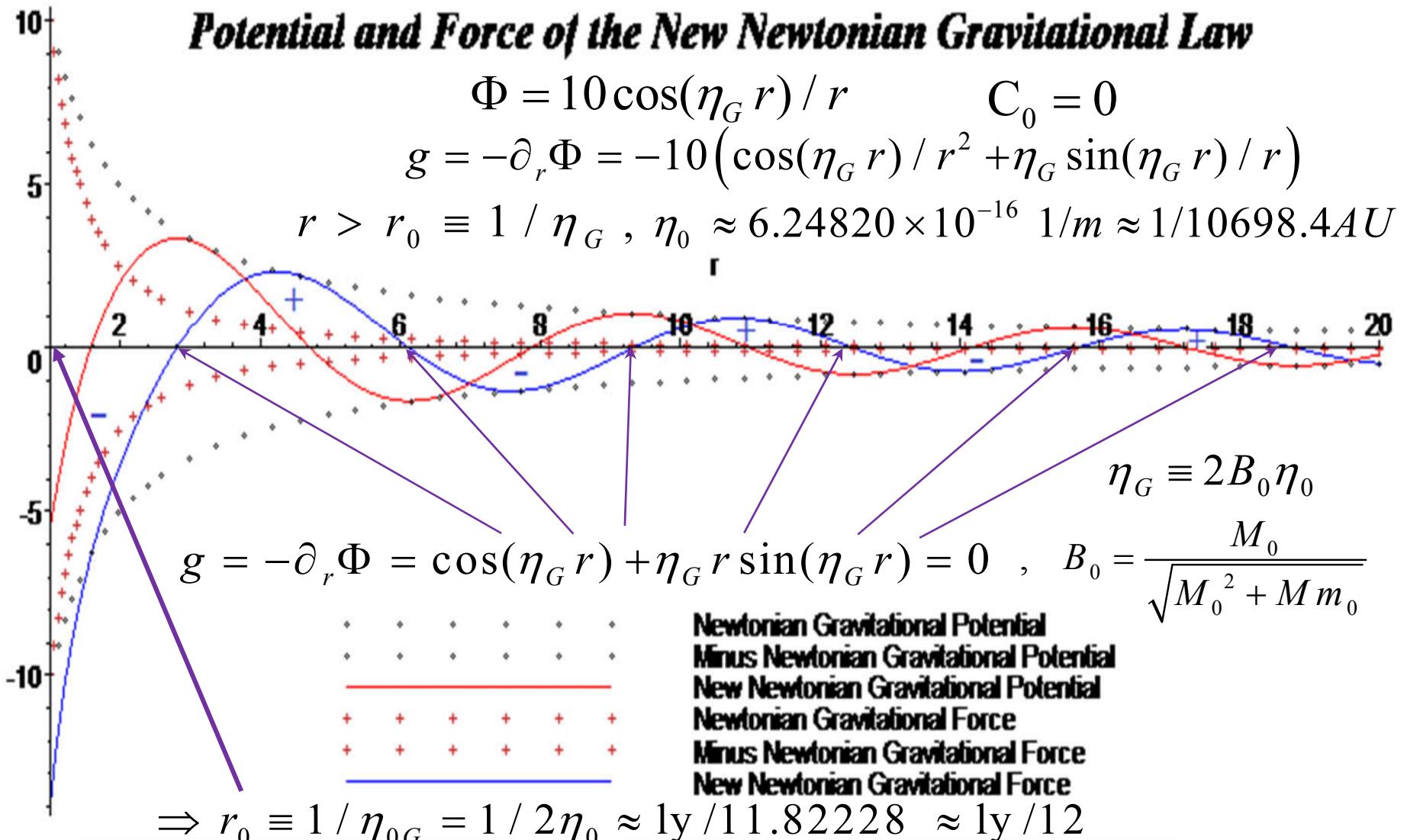
$$C_0 = 0$$



$$r > r_0 \equiv 1 / \eta_G$$

$$g = -\partial_r \Phi = -10 \left( \cos(\eta_G r) / r^2 + \eta_G \sin(\eta_G r) / r \right)$$

## 新Newton定律与原Newton定律的比较 (I)



$$\eta_G r \sim 2n\pi + \pi/2 \Rightarrow v^2 = GM\eta_G, \quad \eta_G \equiv 2B_0\eta_0, \quad B_0 = \frac{M_0}{\sqrt{M_0^2 + Mm_0}} \quad (4.5)$$

- ◆ 对于太阳系  $m_0 \approx M_\odot$  在银河系中运动，显然有  $M \gg m_0 \approx M_\odot$ 。

$$B_0 = \frac{M_0}{\sqrt{M_0^2 + Mm_0}} \approx \sqrt{\frac{M_0}{M}} \quad \Rightarrow \quad v_\odot^2 \approx 2\eta_0 G \sqrt{MM_\odot} \quad (4.6)$$

- ◆ 我们取银河系对太阳系的有效引力质量为  $M = f_0 \times 2.61 \times 10^6 M_\odot$  和太阳系的公转速率  $v = 220 \text{ km/s}$ ，并利用太阳的高斯引力常数  $GM_\odot = 1.327124411 \times 10^{20} \text{ m}^3/\text{s}^2$ ，进一步考虑到太阳系外层球状Oort云的尺寸来确定  $20000 \text{ AU} (0.316 \text{ ly}) \leq r \leq 50000 \text{ AU} (0.791 \text{ ly})$ ，

$$\leftrightarrow f_0 = 32150 \Rightarrow \eta_0 = v^2 / 2G\sqrt{MM_\odot} \approx 6.24820 \times 10^{-16} \text{ 1/m} \approx 1/10698.4 \text{ AU}$$

$$r_{00} \equiv 1/\eta_0 \approx \text{ly}/5.91114 \approx \text{ly}/6 \Rightarrow r_0 \equiv 1/\eta_{0G} \approx \text{ly}/11.82228 \sim \text{ly}/12$$

- ◆ 进一步可得到电磁波特征频率值和太阳处银河系总质量为

$$\omega_0 = \eta_0 c \approx 1.873162 \times 10^{-7} \text{ Hz}, \quad M = f_0 \times 2.61 \times 10^6 M_\odot \approx 8.391150 \times 10^{10} M_\odot$$

$$\eta_G r \sim 2n\pi + \pi / 2 \Rightarrow v^2 = GM\eta_G, \eta_G \equiv 2B_0\eta_0, B_0 = \frac{M_0}{\sqrt{M_0^2 + Mm_0}}$$

- ◆ 另外，还可进一步讨论不同质量的天体在银河系中的旋转速度是不同的。例如，对于银河系中的小质量物体  $m_0 < 10^{10} \text{ kg}$  和尘埃都有  $M_0 \approx M_\odot \gg \sqrt{Mm_0}$ ，因而可以得到这样的物体在银河系中运动时，都有  $B_0 \approx 1$ 。因此，对小质量物体和尘埃（它们最快）

$$v_{m_0}^2 = 2GM\eta_0 > v_\odot^2 \approx 2\eta_0 G \sqrt{MM_\odot}, \quad \text{for } m_0 < 10^{10} \text{ kg} \quad (4.8)$$

- ◆ 对于质量更大的球状星团  $m_0 = M_{GC} \gg M_0 \Rightarrow B_0 \approx M_0 / \sqrt{MM_{GC}}$  因而，得到

$$v_{GC}^2 \approx 2\eta_0 GM M_0 / \sqrt{MM_{GC}} < v_\odot^2 \approx 2\eta_0 G \sqrt{MM_\odot} \quad (4.9)$$

即质量更大的球状星团的运动比普通恒星慢。总结，得 (4.10)

$$v_{m_0}^2 = 2GM\eta_0 > v_\odot^2 \approx 2\eta_0 G \sqrt{MM_\odot} > v_{GC}^2 \approx 2\eta_0 GM M_0 / \sqrt{MM_{GC}}$$

- ◆ 由此可见，如果接受新万有引力定律，银河系平坦性旋转曲线就是其自然推论，而且同一位置处不同质量物体的运动不同。

..... 2016 Note that, MOND理论给出的旋转速度都是  $v^2 = \sqrt{GMa_0}$  .....

## 5、The New 5D GR and New Schwarzschild STT

- ◆ 第五维具有  $x^5 \equiv c \tau_m = a_0 c \tau$  新5D 时空时线元可以写成

$$d\bar{s}^2 = g_{\mu\sigma} dx^\mu dx^\sigma + \varepsilon \phi^2 (dx^5)^2 = -c^2 d\bar{\tau}^2 \equiv -c^2 b^{-2} d\tau^2, b \equiv d\tau / d\bar{\tau}$$

- ◆ 这种线元描述的是与对象依赖的新“时间-空间-时间”型5维几何结构。第五维动量

$$\bar{p}^5 = m_0 b \frac{dx^5}{d\tau} = a_0 b m_0 c \equiv \eta_G J_3, \quad \eta_G \equiv 2B_0 \eta_0$$

- ◆ 当  $\phi=1$  时，新 Einstein 场方程  $G_{\mu\sigma} = -\kappa (T_{(DM)\mu\sigma} + T_{\mu\sigma})$
- ◆ 球对称纯引力场中运动的实验质点，可以得到以下5D真空线元：

$$d\bar{s}^2 \equiv -(1 + 2\Phi(r)) dt^2 + \frac{dr^2}{1 + 2\Phi(r)} + r^2 (d\theta^2 + \sin^2 \theta d\varphi^2) + \varepsilon (dx^5)^2$$

- ◆ 真空新 Einstein 场方程  $G_{\mu\sigma} = -\kappa T_{(DM)\mu\sigma}$  给出：， $B_0 = \frac{M_0}{\sqrt{M_0^2 + Mm_0}}$
- $$\kappa T_g^{\mu\sigma} = \kappa T_{(DM)}^{\mu\sigma} = \begin{pmatrix} f(r) & 0 & 0 & 0 \\ 0 & f(r) & 0 & 0 \\ 0 & 0 & -\eta_G^2 \Phi(r) & 0 \\ 0 & 0 & 0 & -\eta_G^2 \Phi(r) \end{pmatrix}, \quad f(r) = 2 \frac{\partial}{\partial r} (r \Phi(r)).$$

## 6、Summary (1)

(1) LT is the same as in SR, but the speed of light frequency dependent  $u_g = u_p = c f(\omega) = c \sqrt{1 - \varepsilon \omega_0^2 / \omega^2}$ . where  $\omega_0 \equiv \eta_0 c$ . And there is an invariant proper time  $\tau_\gamma = \omega_0(t - t_0) / \omega = \omega_0(t' - t'_0) / \omega'$  on every photons which proportional to the propagating time.

(2) New Maxwell's equations  $\square A_\mu + \eta_q^2 A_\mu = -\mu_0 J_\mu$ , the gauge condition  $\partial_\mu A^\mu(x^\mu) = 0$ , where  $\eta_q \equiv B_q \eta_0$ , and  $B_q = 1$  for photon.

(3) Newtonian Gravitational field is only a near field approximation of the real one, it should be described by the new Poisson's one

$\nabla^2 \Phi(r) + \eta_G^2 \Phi(r) = 4\pi G \rho(\vec{r})$  with  $\eta_G \equiv 2B_0 \eta_0$ , where source-object dependent factor  $B_0 = \frac{M_0}{\sqrt{M_0^2 + Mm_0}}$  which obeys the Tully-Fisher relation<sup>[20]</sup>.

(4) With the facts of the spherical Oort Cloud  $20000AU(0.316ly) \leq r \leq 50000AU(0.791ly)$ <sup>[8]</sup> and the Solar system in the Galactic structure, we have computed the preliminary value of the EM Characteristic constant  $\omega_0 = \eta_0 c \approx 1.873162 \times 10^{-7} Hz$

## 6、Summary (2)

and the Solar system in the Galactic structure, we have computed the preliminary value of the EM Characteristic constant  $\omega_0 = \eta_0 c \approx 1.873162 \times 10^{-7} \text{ Hz}$  or  $\eta_0 = v^2 / 2G\sqrt{MM_\odot} \approx 6.24820 \times 10^{-16} \text{ 1/m} \approx 1/10698.4 \text{ AU}$

(5) New Einstein's equations  $G_{\mu\sigma} = -\kappa(T_{g\mu\sigma} + T_{\mu\sigma})$ , with the conservation law  $T_g^\mu{}_{\sigma;\mu} + T^\mu{}_{\sigma;\mu} = 0$  give the above new Schwarzschild metric with new gravitational potential  $\Phi(r) = -\frac{GM}{r}(\cos\eta_G r + C_0 \sin\eta_G r)$ , and all these results naturally include the dark matter effects that the Newtonian gravitational law and GR fail to explain.  $\nabla^2\Phi(r) + \eta_G^2\Phi(r) = 4\pi G\rho(\vec{r})$

(6) The nature of the dark matter hides behind the incomplete recognition of Newton about the law of gravitation, and Einstein inherited it accidentally. So GR is also incomplete.  $r_{00} \equiv 1/\eta_0 \approx \text{ly}/5.91114 \approx \text{ly}/6$ ,  $\omega_0 = \eta_0 c \approx 1.873162 \times 10^{-7} \text{ Hz}$

**Conclusion:** *The nature of the dark matter is just the effects of the new gravitational potential or the new gravitational law.*

*Thank You!*

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