A Physical Process that may give a Theoretical Basis for Modified Newtonian Dynamics

Written by Kurt Becker, Hainburg1945@hotmail.com, April 12, 2020

Newton's Law of Universal Gravity does not take into account the interactions of streams of gravitons between stars. (Just as the ideal gas law did not take into account intermolecular forces. It had to be modified to take into account Van der Waals forces.) This paper explores a physical process which amplifies the streams of anti-parallel gravitons flowing between two distant stars. Since there is no universally accepted theory of quantum gravity, the existence of gravitons may be substituted by spin-networks or by the interchange of gravitational information between stars. In all cases, gravitational information and energy is interchanged between stars.

The stream of gravitons between two distant stars is parallel, allowing time for counter-streaming gravitons to interact with each other. This results in an amplification of gravity between any two stars. I have started to make a mathematical model of this physical process.

Fig. 1 shows the basic idea of pulling in adjacent gravitons.

$$a_N = \frac{GM}{r^2}$$

Formula is from Newton's Universal Gravitation

$$g_M = \frac{\sqrt{MA_0}}{r}$$

Formula is from Modified Newtonian Dynamics Ref. 3

$$a_M = \sqrt{a_N a_0}$$

$$\frac{\sqrt{MA_0}}{r} = \sqrt{a_N a_0}$$

New MOND constant $a_0 = 1.2 \times 10^{-10}$ m/s^2 Ref. 2

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K. BECKER

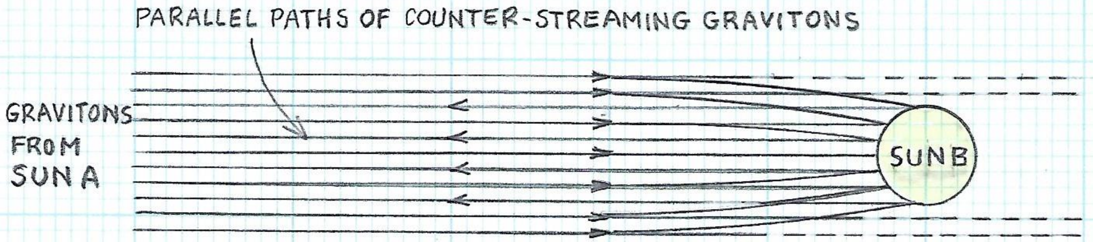


FIG. 1

GRAVITATIONAL ATTRACTION OF COUNTER-STREAMING PARALLEL GRAVITONS

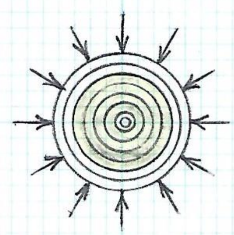


FIG. 2

The starting point is a paper “The gravitational interaction of light: ….” By V. Faraoni and R.M. Dumse; Ref. 1

Quoted from above paper: “Two steady, straight, infinitely long light beams in linearized general relativity do not attract each other if they are parallel. If they are antiparallel, they attract with an acceleration of magnitude

$$\left|\frac{du}{d\lambda}\right| = \frac{16G^2 I_1 I_2}{c^{10} d}$$

Where I_1 and I_2 are the energy currents in the beams, and d is their separation.”

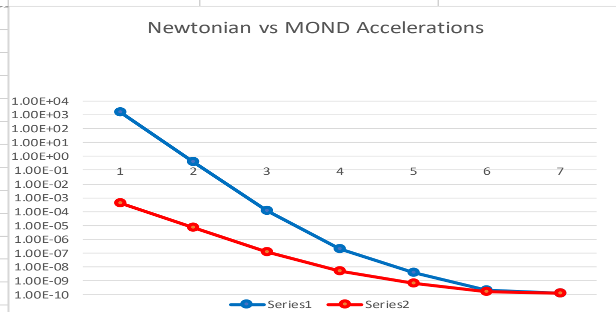
The assumption made here is that the above equation applies to both light and gravitons which are interchanged between stars. They are beams of information passed between two stars and are antiparallel. They both contain energy. Gravity will affect both photons and gravitons.

$\left|\frac{du}{d\lambda}\right|$ represents the inward radial acceleration, as shown in Fig. 2.

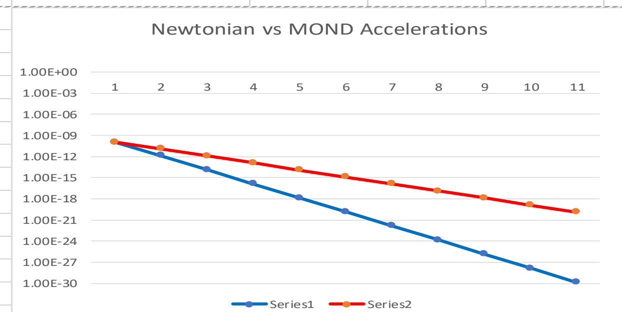
The spreadsheet below shows the relative magnitudes of accelerations to Newton’s and MOND formulas.

The accelerations are equal ($a_N = a_M$ at 1.05E+15m) at 0.111 light years between two stars. It is surprising that at such a short distance Newtonian gravity and modified Newtonian gravity have an equal effect. It must be kept in mind, that the data of Tycho Brahe was taken from our solar system and used by Kepler to formulate his three laws. Milgrom’s empirical equation is analogous to Kepler’s third law.

Distances between stars		$a_N = \frac{GM}{r^2}$	$a_M = \sqrt{a_N a_0}$	$g_M = \frac{\sqrt{MA_0}}{r}$	Constants		
r	Distance light travels in				Values	Symbols	in Units
3.00E+08	one second	1.48E+03	0.000420722	4.21E-04	9.46E+15	ly	m
1.80E+10	one minute	4.10E-01	7.01204E-06	7.01E-06	6.67E-11	G	m^3/kgs^2
1.08E+12	one hour	1.14E-04	1.16867E-07	1.17E-07	1.99E+30	M	kg
2.59E+13	one day	1.98E-07	4.86947E-09	4.87E-09	1.20E-10	a_0	m/s^2
1.82E+14	one week	4.01E-09	6.93733E-10	6.94E-10	8.00E-21	A_0	m^4/kgs^4
7.88E+14	one month	2.14E-10	1.60092E-10	1.60E-10		$A_0 = G*a_0$	
1.05E+15	$a_N = a_M$	1.20E-10	1.20E-10	1.20E-10	M = mass of distant star causing		
9.46E+15	one year	1.48E-12	1.3341E-11	1.33E-11	gravitational field		
9.46E+16	ten years	1.48E-14	1.3341E-12	1.33E-12		$a_M = g_M$	
9.46E+17	hundred years	1.48E-16	1.3341E-13	1.33E-13			
9.46E+18	thousand years	1.48E-18	1.3341E-14	1.33E-14			
9.46E+19	ten thousand	1.48E-20	1.3341E-15	1.33E-15			
9.46E+20	radius of galaxy	1.48E-22	1.3341E-16	1.33E-16			
9.46E+21	million years	1.48E-24	1.3341E-17	1.33E-17			
9.46E+22	ten million years	1.48E-26	1.3341E-18	1.33E-18			
9.46E+23	hundred million	1.48E-28	1.3341E-19	1.33E-19			
9.46E+24	one billion years	1.48E-30	1.3341E-20	1.33E-20			



Blue line is acceleration due to Newton's Universal Law of Gravity
Orange line is acceleration due to MOND equation with A_0.
X (horizontal) axis shows #1 - 1 sec, #2 - 1 min, #3 - 1 hour, #4 -1 day
#5 - 1 week, #6 - 1 month, #7 - 1.33 month of distance of light travel.
Note: At distance between stars of 0.111 light years, gravity due to
Newton and MOND are equal. Nearest star is 4.4 ly distant.
Y (verical) axis scale is logarithmic.



Blue line is acceleration due to Newton's Universal Law of Gravity
Orange line is acceleration due to MOND equation with A_0.
X (horizontal) axis shows #1 - 1.33 month, #2 - 1 year, #3 - 10 years,
#4 - 100 years, #5 - 1,000 years, #6 - 10,000 years, #7 - radius of galaxy
Data points #8 through #11 are distances outside of Milky Way galaxy.
Y (vertical) axis scale is logarithmic.

How many streams of gravitons, measured in area perpendicular to their path, need to be pulled in to account for the additional gravitational acceleration to satisfy the MOND equation?

$$\frac{a_{MA}}{a_{NA}} = \frac{A_{RB}}{A_{SB}}$$

a_{MA} = acceleration due to sun A and MOND

a_{NA} = acceleration due to sun A and Newton's formula

A_{SB} = area of disk of sun B (facing sun A)

A_{RB} = area of ring around sun B (facing sun A)

$A_{SB} = \pi r^2_{SB}$ r_{SB} =radius of sun B

$A_{RB} = \pi r^2_{RB} - \pi r^2_{SB}$ r_{RB} = outer radius of ring around sun B

$$\frac{a_{MA}}{a_{NA}} = \frac{\pi(r_{RB}^2 - r_{SB}^2)}{\pi r_{SB}^2}$$

$$\frac{a_{MA}}{a_{NA}} r^2_{SB} + r^2_{SB} = r^2_{RB}$$

$$\left(\frac{a_{MA}}{a_{NA}} + 1\right) r^2_{SB} = r^2_{RB}$$

$$\boldsymbol{\sqrt{\frac{a_{MA}}{a_{NA}} + 1}(r_{SB}) = r_{RB}}$$

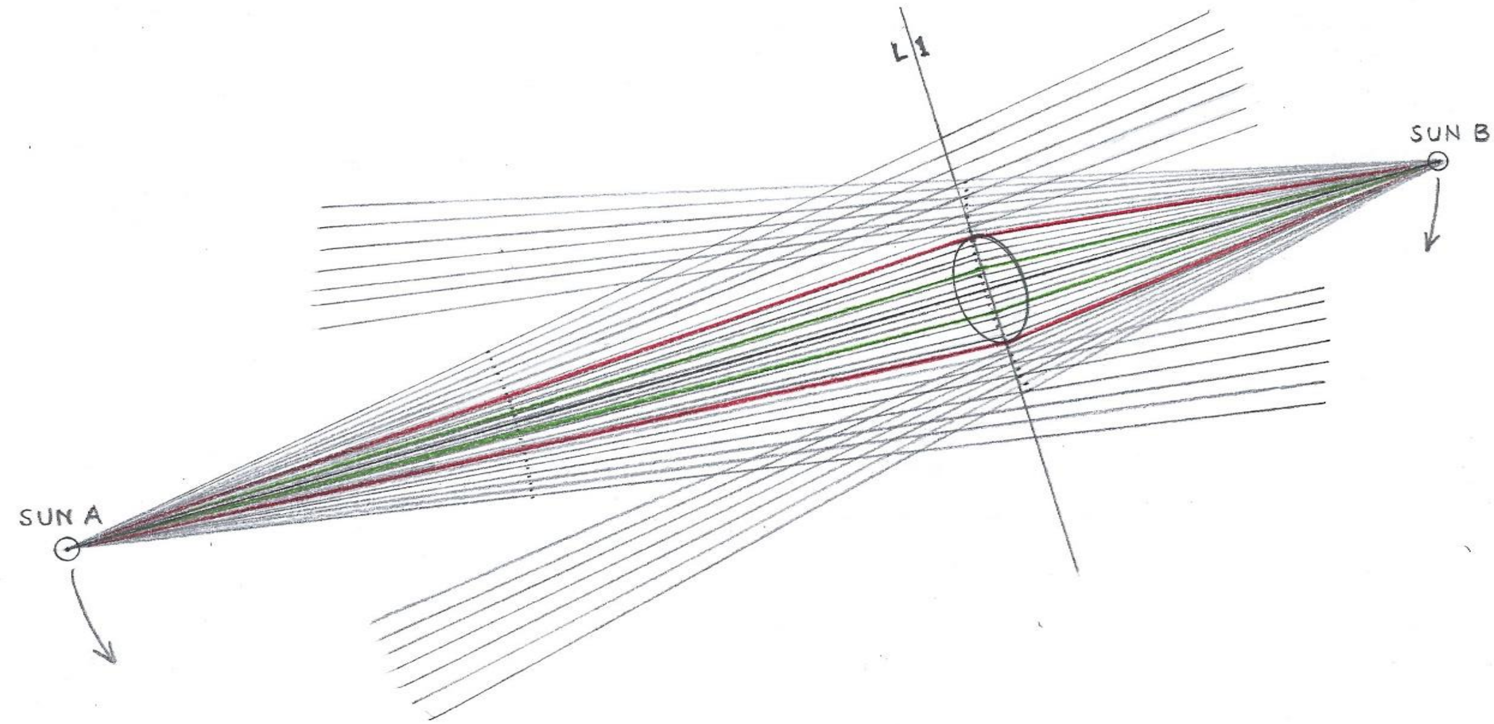
Distances between stars		$a_{NA} = \frac{GM}{r^2}$	$a_{MA} = \frac{\sqrt{MA_0}}{r}$	$\frac{r_{RB}}{r_{SB}} = \sqrt{\frac{a_{MA}}{a_{NA}} + 1}$	**Constants**		
r	Distance light travels in	Acceleration due to Newton's formula	Acceleration due to MOND formula	Ratio of area of ring to area of sun disk	Values	Symbols	in Units
1.05E+15	$a_N = a_M$	1.20E-10	1.20E-10	1.41E+00	9.46E+15	ly	m
9.46E+15	one year	1.48E-12	1.33E-11	3.16E+00	6.67E-11	G	m^3/kgs^2
1.89E+16	two years	3.71E-13	6.67E-12	4.36E+00	1.99E+30	M	kg
4.73E+16	five years	5.93E-14	2.67E-12	6.78E+00	1.20E-10	a_0	m/s^2
9.46E+16	ten years	1.48E-14	1.33E-12	9.54E+00	8.00E-21	A_0	m^4/kgs^4
1.89E+17	twenty years	3.71E-15	6.67E-13	1.34E+01		$A_0 = G*a_0$	
4.73E+17	fifty years	5.93E-16	2.67E-13	2.12E+01	M = mass of distant star A causing gravitational field at star B		
9.46E+17	one hundred years	1.48E-16	1.33E-13	3.00E+01			
1.89E+18	two hundred years	3.71E-17	6.67E-14	4.24E+01	r_{RINGB} = radius of RING B at star B of stream of gravitons flowing from star A		
4.73E+18	five hundred years	5.93E-18	2.67E-14	6.71E+01			
9.46E+18	one thousand years	1.48E-18	1.33E-14	9.48E+01	r_{SB} = radius of sun B		
1.89E+19	two thousand years	3.71E-19	6.67E-15	1.34E+02			
4.73E+19	five thousand years	5.93E-20	2.67E-15	2.12E+02			
9.46E+19	ten thousand years	1.48E-20	1.33E-15	3.00E+02			

At a distance of 50 light years, the ratio of area of ring to area of of sun disk is only about 21 times larger.

I am working on deriving an equation, (somewhat similar to the equation below, which is for anti-parallel beams of laser light), that will show radial acceleration of anti-parallel streams of gravitons between two stars.

$$\left|\frac{du}{d\lambda}\right| = \frac{16G^2 I_1 I_2}{c^{10} d}$$

In the unlikely event, someone reads this paper, and is able to derive this equation, my email is Hainburg1945@hotmail.com.



ENVELOPE OF PATHS BEING COMPRESSED

ENVELOPE OF PATHS OF GRAVITONS

Fig. 3

References:

Ref 1 arXiv:gr-qc/9811052v1 16 Nov 1998 “The gravitational interaction of light: from weak to strong fields” by V. Faraoni, Bruxelles, Belgium and R.M. Dumse, Dallas, Texas

Ref 2 MOND theory, Mordecai Milgrom; Department of Particle Physics and Astrophysics, Weizmann Institute

Ref. 3 Modified Newtonian Dynamics, an Introductory Review; Riccardo Scarpa currently works at the Department of Astrophysics Research, Instituto de Canarias. Dr. Scarpa does research in Cosmology, AGN (Active Galactic Research) and Newtonian Dynamics.

Ref. 4 Mass Distribution in Our Galaxy; Ortwin Gerhard; Astronomisches Institute, Universität Basel; Switzerland