# Moon Exploration for Human Lifespan 7500 Years on the Moon

Huaiyang Cui
Department of Physics, Beihang University, Beijing, 102206, China
Email: hycui@buaa.edu.cn
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**Abstract:** It is found that relativistic matter wave provides a biological clock for human beings. Due to gravity, the human mean lifespan on the Earth is calculated to be 84 years, while the human mean lifespan on the Moon extends to about 7500 years. This finding will inspire great enthusiasm for Moon exploration. A scheme to explore the Moon is proposed in terms of relativistic matter waves in quantum gravity theory. The simulation of satellite explosion at the altitude 1000km above the lunar surface is carried out, the trajectories of the space debris can be used to determine the lunar parameters in quantum gravity theory.
**Key words:** relativistic matter wave, biological clock, quantum gravity.

## 1. Introduction

This year is 100th anniversary of the initiative of de Broglie matter wave. In 1923, the Louis de Broglie considered blackbody radiation as a gas of light quanta [1], he tried to reconcile the concept of light quanta with the phenomena of interference and diffraction. In 1923 and 1924, the concept that matter behaves like a wave was proposed by Louis de Broglie [2]. Today it is called as the de Broglie matter wave.

An effort has made to generalize the de Broglie matter wave to planetary wave for a long time, but has faced many difficulties; traditional quantum theory cannot properly deal with some gravity problems [3][4][5]. In recent years, generalized relativistic matter wave has been proposed and applied to the solar system to explain quantum gravity effects, this approach provides a new method for quantum gravity. Consider a particle, its relativistic matter wave is given by

$$\psi = \exp(\frac{i\beta}{c^3}\int_0^x (u_1 dx_1 + u_2 dx_2 + u_3 dx_3 + u_4 dx_4)) \quad . \tag{1}$$

where $u$ is the 4-velocity of the particle, $\beta$ is the ultimate acceleration [6] determined by experiments. This paper show that the relativistic matter wave provides a quantum theory on a planetary scale, which governs planetary dynamics.

## 2. Determining the solar radius

Orbital model as shown in Fig.1(a), the planetary circular orbit can be quantized in terms of the relativistic matter wave, the circumference is $n$ multiple of the wavelength as follows

$$\left.\begin{array}{l}\frac{\beta}{c^3}\oint_L v_l dl = 2\pi n \\ v_l = \sqrt{\frac{GM}{r}}\end{array}\right\} \Rightarrow \sqrt{r} = \frac{c^3}{\beta\sqrt{GM}}n; \quad n = 0,1,2,... \quad . \tag{2}$$

This orbital quantization rule only achieves a half success in the solar system, as shown in Fig.1(b), the Sun, Mercury, Venus, Earth and Mars satisfy the quantization equation; while other outer planets fail. But, since we only study quantum gravity effects among the Sun, Mercury, Venus, Earth and Mars, so this orbital quantization rule is good enough as a foundational quantum theory. In Fig.1(b), the blue straight line expresses a linear regression relation among the quantized orbits, so it gives $\beta$=2.961520e+10 (m/s$^2$). The quantum numbers $n$=3,4,5,... were assigned to the solar planets, the sun was assigned a quantum number $n$=0 because the sun is in the **central state**.

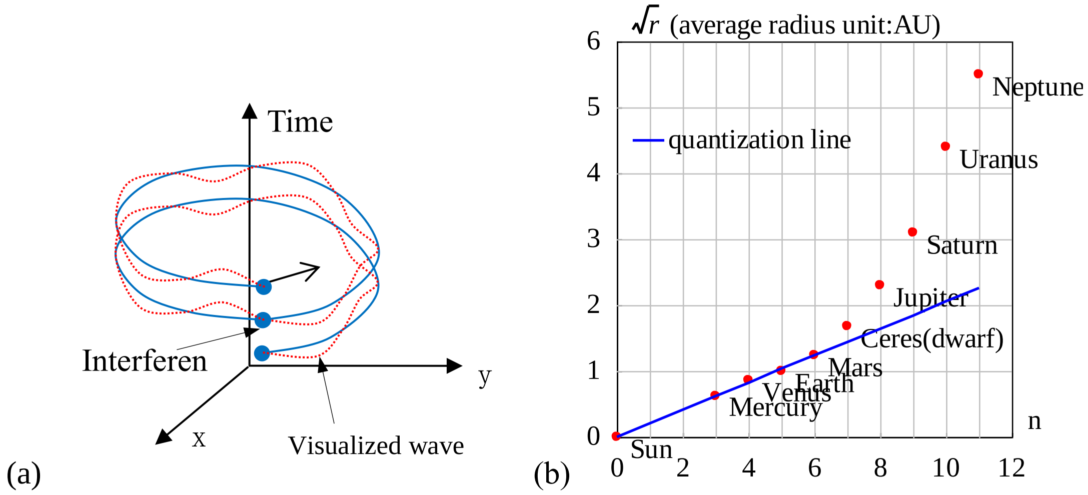


Fig.1 (a)The head of the relativistic matter wave may overlap with its tail. (b) The inner planets are quantized.

The relativistic matter wave can be applied to determine the solar density and radius.

In a central state, if the coherent length of the relativistic matter wave is long enough, its head may overlap with its tail when the particle moves in a closed orbit, as shown in Fig.1(a). The overlapped wave on the equatorial plane is given by

$$\begin{array}{l}\psi = \psi(r)T(t) \\ \psi(r) = 1 + e^{i\delta} + e^{i2\delta} + ... + e^{i(N-1)\delta} = \dfrac{1-\exp(iN\delta)}{1-\exp(i\delta)} \\ \delta(r) = \dfrac{\beta}{c^3}\oint_L (v_l)dl = \dfrac{2\pi\beta\omega r^2}{c^3}\end{array} \quad . \tag{3}$$

where $N$ is the overlapping number which is determined by the coherent length of the relativistic matter wave, $\delta$ is the phase difference after one orbital motion, $\omega$ is the angular speed of the solar self-rotation. The above equation is a multi-slit interference formula in optics, for a larger $N$ it is called as the Fabry-Perot interference formula.

The relativistic matter wave function $\psi$ needs a further explanation. In quantum mechanics, $|\psi|^2$ equals to the probability of finding an electron due to Max Burn's explanation; in astrophysics, $|\psi|^2$ equals to the probability of finding a nucleon (proton or neutron) *averagely on an astronomic scale*, we have

$$|\psi|^2 \propto \text{nucleon-density} \propto \rho \quad . \tag{4}$$

It follows from the multi-slit interference formula that the overlapping number $N$ is estimated by

$$N^2 = \frac{|\psi(0)_{multi-wavelet}|^2}{|\psi(0)_{one-wavelet}|^2} = \frac{\rho_{core}}{\rho_{surface\_gas}} \quad . \tag{5}$$

The solar core has a mean density of 1408 (kg/m$^3$), the surface of the sun is comprised of convective zone with a mean density of 2e-3 (kg/m$^3$) [7]. In this paper, the sun's radius is chosen at a location where density is 4e-3 (kg/m$^3$), thus the solar overlapping number $N$ is calculated to be $N$=593.

Sun's angular speed at its equator is known as $\omega$=2π/(25.05x24x3600) (s$^{-1}$). Its mass 1.9891e+30 (kg), well-known radius 6.95e+8 (m), mean density 1408 (kg/m$^3$), the constant $\beta$=2.961520e+10 (m/s$^2$). According to the $N$=593, the matter distribution of the $|\psi|^2$ is calculated in Fig.2, it agrees well with the general description of star's interior [8]. The radius of the sun is determined as $r$=7e+8 (m) with a relative error of 0.72% in Fig.2, which indicates that the sun radius strongly depends on the sun's self-rotation.

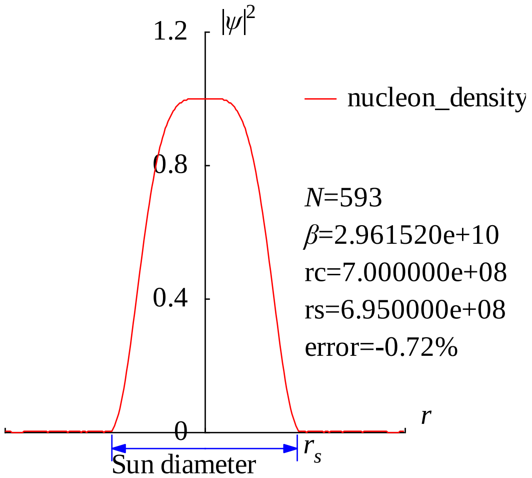


Fig.2 The nucleon distribution $|\psi|^2$ in the Sun is calculated in the radius direction.

```
<Clet2020 Script>//C source code [9]
int i,j,k,m,n,N,nP[10];
double beta,H,B,M,r,r_unit,x,y,z,delta,D[1000],S[1000], a,b,rs,rc,omega,atm_height; char str[100];
main(){k=150;rs=6.95e8;rc=0;x=25.05;omega=2*PI/(x*24*3600);n=0; a=1408/0.004; N=sqrt(a);
beta=2.961520e10;H=SPEEDC*SPEEDC*SPEEDC/beta;M=1.9891E30; atm_height=2e6; r_unit=1E7;
for(i=-k;i<k;i+=1) {r=abs(i)*r_unit;
if(r<rs+atm_height) delta=2*PI*omega*r*r/H; else delta=2*PI*sqrt(GRAVITYC*M*r)/H;//around the star
x=1;y=0; for(j=1;j<N;j+=1) { z=delta*j; x+=cos(z);y+=sin(z);} z=x*x+y*y; z=z/(N*N);
S[n]=i;S[n+1]=z; if(i>0 && rc==0 && z<0.0001) rc=r; n+=2;}
SetAxis(X_AXIS,-k,0,k,"#ifr; ; ; ;");SetAxis(Y_AXIS,0,0,1.2,"#if|ψ|#su2#t;0;0.4;0.8;1.2;");
DrawFrame(FRAME_SCALE,1,0xafffaf); z=100*(rs-rc)/rs;
SetPen(1,0xff0000);Polyline(k+k,S,k/2,1," nucleon_density"); SetPen(1,0x0000ff);
r=rs/r_unit;y=-0.05;D[0]=-r;D[1]=y;D[2]=r;D[3]=y; Draw("ARROW,3,2,XY,10,100,10,10,",D);
Format(str,"#ifN#t=%d#n#ifβ#t=%e#nrc=%e#nrs=%e#nerror=%.2f%",N,beta,rc,rs,z);
TextHang(k/2,0.7,0,str);TextHang(r+5,y/2,0,"#ifr#sds#t");TextHang(-r,y+y,0,"Sun diameter");
}#v07=?>A
```

## 3. Determining the earth's radius

The moon is assigned a quantum number of $n$=2 because some quasi-satellite's perigees have reached a depth almost at $n$=1 orbit, as shown in Fig.3. Here, the ultimate acceleration $\beta$=1.377075e+14(m/s$^2$) is determined uniquely by the line between the earth and moon by Eq. (2).

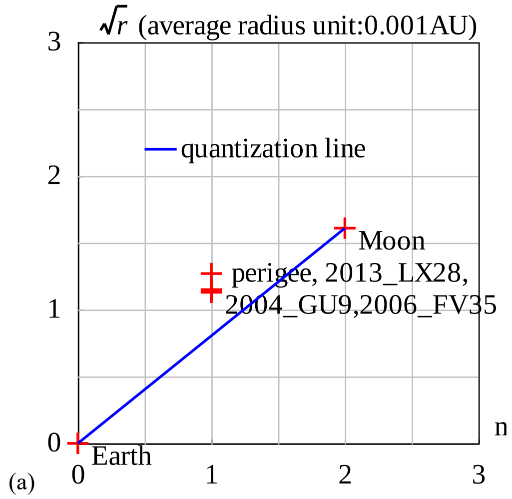


Fig.3 Orbital quantization for the moon.

The earth has a mean density of 5530 (kg/m$^3$), its surface is covered with air and vapor with a density of 1.29 (kg/m$^3$). The earth's radius is chosen at the sea level, it follows Eq.(5) that the earth's overlapping number $N$ is calculated to be $N$=65.

The earth's angular speed is known as $\omega$=2π/(24x3600) (s$^{-1}$), its mass 5.97237e+24 (kg), the well-known radius is 6.378e+6 (m), the earth's constant $\beta$=1.377075e+14 (m/s$^2$). The matter distribution $|\psi|^2$ in radius direction is calculated by Eq.(3), as shown in Fig.4(a). The radius of the earth is determined as $r$=6.4328e+6 (m) with a relative error of 0.86%, it agrees well with common knowledge. The secondary peaks over the atmosphere up to 2000 km altitude are calculated in Fig.4(b) which agree well with the space debris observations [10][11][12].

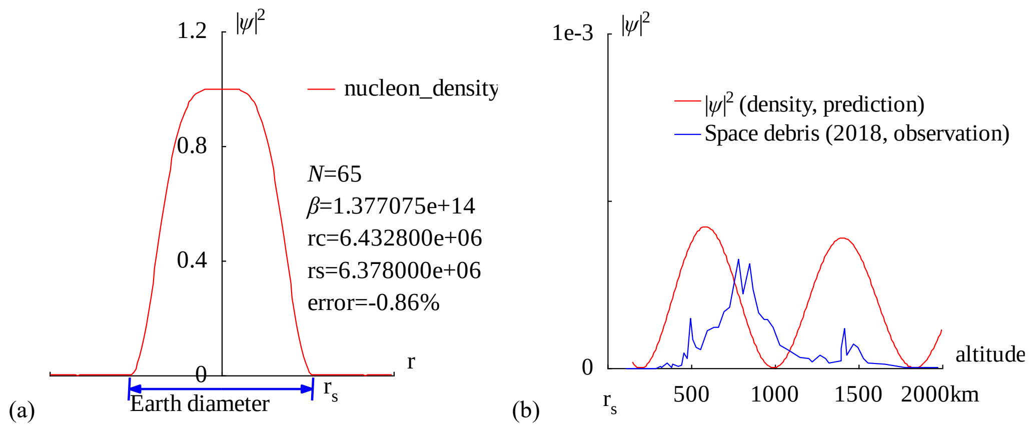


Fig.4 (a) The radius of the Earth is calculated out r=6.4328e+6 (m) with a relative error of 0.86% by the interference of its relativistic matter wave; (b) The space debris distribution up to 2000 km altitude.

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<Clet2020 Script>//C source code [9]
int i,j,k,m,n,N,nP[10]; double H,B,M,v_r,r,AU,r_unit,x,y,z,delta,D[10],S[1000];
```

```
double rs,rc,rot,a,b,atm_height,beta; char str[100];
main(){k=80;rs=6.378e6;rc=0;atm_height=1.5e5;n=0; N=65;
beta=1.377075e+14;H=SPEEDC*SPEEDC*SPEEDC/beta;
M=5.97237e24;AU=1.496E11;r_unit=1e-6*AU; rot=2*PI/(24*60*60);//angular speed of the Earth
for(i=-k;i<k;i+=1) {r=abs(i)*r_unit;
if(r<rs+atm_height) v_r=rot*r*r; else v_r=sqrt(GRAVITYC*M*r);//around the Earth
delta=2*PI* v_r/H; y=SumJob("SLIT_ADD,@N,@delta",D); y=y/(N*N);
if(y>1) y=1; S[n]=i;S[n+1]=y; if(i>0 && rc==0 && y<0.001) rc=r;    n+=2;}
SetAxis(X_AXIS,-k,0,k,"r; ; ; ;");SetAxis(Y_AXIS,0,0,1.2,"#if|ψ|#su2#t;0;0.4;0.8;1.2;");
DrawFrame(FRAME_SCALE,1,0xafffaf); x=50;z=100*(rs-rc)/rs;
SetPen(1,0xff0000);Polyline(k+k,S,k/2,1," nucleon_density");
r=rs/r_unit;y=-0.05;D[0]=-r;D[1]=y;D[2]=r;D[3]=y;
SetPen(2,0x0000ff); Draw("ARROW,3,2,XY,10,100,10,10,",D);
Format(str,"#ifN#t=%d#n#ifβ#t=%e#nrc=%e#nrs=%e#nerror=%.2f%",N,beta,rc,rs,z);
TextHang(k/2,0.7,0,str);TextHang(r+5,y/2,0,"r#sds#t");TextHang(-r,y+y,0,"Earth diameter");
}#v07=?>A#t

<Clet2020 Script>//C source code [9]
int i,j,k,m,n,N,nP[10]; double H,B,M,v_r,r,AU,r_unit,x,y,z,delta,D[10],S[10000];
double rs,rc,rot,a,b,atm_height,p,T,R1,R2,R3; char str[100]; int
Debris[96]={110,0,237,0,287,0,317,2,320,1,357,5,380,1,387,4,420,2,440,3,454,14,474,9,497,45,507,26,527,19,557,17,597,34,63
4,37,664,37,697,51,727,55,781,98,808,67,851,94,871,71,901,50,938,44,958,44,991,37,1028,21,1078,17,1148,10,1202,9,1225,6,
1268,12,1302,9,1325,5,1395,7,1395,18,1415,36,1429,12,1469,22,1499,19,1529,9,1559,5,1656,4,1779,1,1976,1,};
main(){k=80;rs=6.378e6;rc=0;atm_height=1.5e5;n=0; N=65;
H=1.956611e11;M=5.97237e24;AU=1.496E11;r_unit=1e4;
rot=2*PI/(24*60*60);//angular speed of the Earth
b=PI/(2*PI*rot*rs*rs/H); R1=rs/r_unit;R2=(rs+atm_height)/r_unit;R3=(rs+2e6)/r_unit;
for(i=R2;i<R3;i+=1) {r=abs(i)*r_unit; delta=2*PI*sqrt(GRAVITYC*M*r)/H;
y=SumJob("SLIT_ADD,@N,@delta",D); y=1e3*y/(N*N);// visualization scale:1000
if(y>1) y=1; S[n]=i;S[n+1]=y;n+=2;}
SetAxis(X_AXIS,R1,R1,R3,"altitude; r#sds#t;500;1000;1500;2000km ;");
SetAxis(Y_AXIS,0,0,1,"#if|ψ|#su2#t;0; ;1e-3;");DrawFrame(FRAME_SCALE,1,0xafffaf); x=R1+(R3-R1)/5;
SetPen(1,0xff0000);Polyline(n/2,S,x,0.8,"#if|ψ|#su2#t (density, prediction)");
for(i=0;i<48;i+=1) {S[i+i]=R1+(R3-R1)*Debris[i+i]/2000; S[i+i+1]=Debris[i+i+1]/300;}
SetPen(1,0x0000ff);Polyline(48,S,x,0.7,"Space debris (2018, observation) "); }#v07=?>A#t
```

## 4. Period of sunspot cycle

The **coherence length** of waves is usually mentioned but the **coherence width** of waves is rarely discussed in quantum mechanics, simply because the latter is not a matter for electrons, nucleon, or photons, but it is a matter in astrophysics. The analysis of observation data tells us that on the planetary scale, the coherence width of relativistic matter waves can extend to 1000 kilometers or more, as illustrated in Fig.5(a), the overlap may even occur in the width direction, thereby bringing new aspects to wave interference.

In the solar convective zone, adjacent convective rings form a top-layer flow, a middle-layer gas, and a ground-layer flow, similar to the concept of **molecular current** in electromagnetism. Considering one convective ring at the equator as shown in Fig.5(b), there is an apparent velocity difference between the top-layer flow and the middle-layer gas, where their relativistic matter waves are denoted respectively by

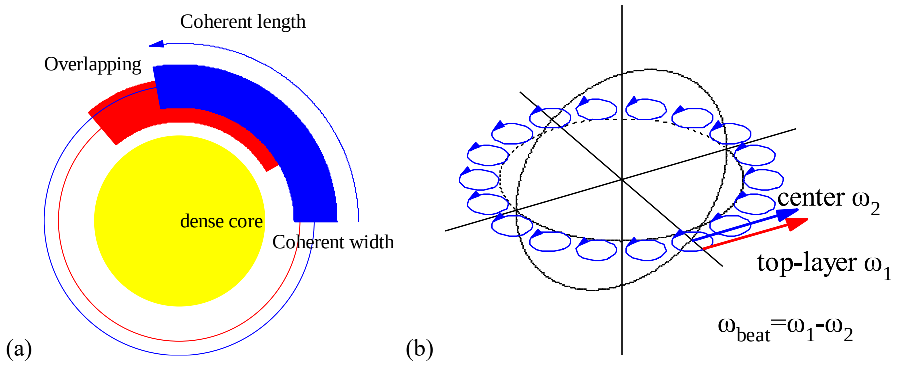


Fig.5 (a) Illustration of overlapping in the coherent width direction. (b) Convective rings at the equator.

$$\psi = \psi_{top} + C\psi_{middle}$$
$$\psi_{top} = \exp[\frac{i\beta}{c^3}\int_L (v_1 dl + \frac{-c^2}{\sqrt{1-v_1^2/c^2}}dt)] \quad . \tag{6}$$
$$\psi_{middle} = \exp[\frac{i\beta}{c^3}\int_L (v_2 dl + \frac{-c^2}{\sqrt{1-v_2^2/c^2}}dt)]$$

Their interference in the coherent width direction leads to a beat phenomenon

$$|\psi|^2 = |\psi_{top} + C\psi_{middle}|^2 = 1 + C^2 + 2C\cos[\frac{2\pi}{\lambda_{beat}}\int_L dl - \frac{2\pi}{T_{beat}}t]$$
$$\frac{2\pi}{T_{beat}} = \frac{\beta}{c^3}(\frac{c^2}{\sqrt{1-v_1^2/c^2}} - \frac{c^2}{\sqrt{1-v_2^2/c^2}}) \simeq \frac{\beta}{c^3}(\frac{v_1^2}{2} - \frac{v_2^2}{2}) \quad . \tag{7}$$
$$\frac{2\pi}{\lambda_{beat}} = \frac{\beta}{c^3}(v_1 - v_2); \quad V = \frac{\lambda_{beat}}{T_{beat}} = \frac{1}{2}(v_1 + v_2)$$

Their speeds are calculated as

$$v_1 \approx 6100\,(m/s) \quad (\approx \text{observed in Evershed flow})$$
$$v_2 = \omega r_{middle} = 2017\,(m/s) \quad (\text{solar rotation}); \quad . \tag{8}$$

Where, regarding Evershed flow as the eruption of the top-layer flow, about 6 (km/s) speed was reported [13]. Alternatively, the top-layer speed $v_1$ also can be calculated in terms of thermodynamics, to be $v_1$=6244 (m/s) [6]. Here using $v_1$=6100 (m/s), their beat period $T_{beat}$ is calculated to be a value of 10.93 (years), in agreement with the sunspot cycle value (say, mean 11 years).

$$T_{beat} \simeq \frac{4\pi c^3}{\beta\left(v_1^2 - v_2^2\right)} = 10.93\,(years) \quad . \tag{9}$$

The relative error to the mean 11 years is 0.6% for the beat period calculation using the relativistic matter waves. This beat phenomenon turns out to be a **nucleon density oscillation** that undergoes to drive the sunspot cycle evolution. The beat wavelength $\lambda_{beat}$ is too long to observe, only the beat period is easy to be observed. As shown in Fig.6, on the solar surface, the equatorial circumference $2\pi r$ only occupies a little part of the beat wavelength, what we see is the expansion and contraction of the nucleon density.

$$\frac{2\pi r}{\lambda_{beat}} = 0.0031 \quad . \tag{10}$$

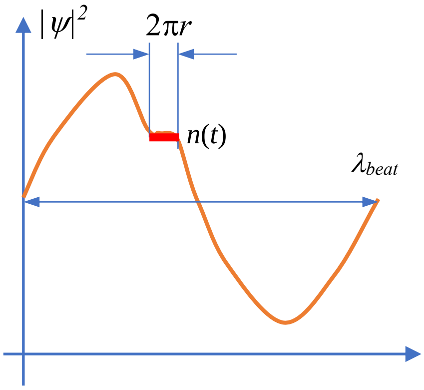


Fig.6 The equatorial circumference 2πr only occupies a little part of the beat wavelength, what we see is the expansion and contraction of the nucleon density.

This nucleon density oscillation is understood as a new type of nuclear reaction on an astronomic scale.

In the above calculation, although this seems to be a rough model, there is an obvious correlation between solar radius, solar rotation, solar density, and solar constant $\beta$.

## 5. Human biological clock

Human body consists of five parts: one head and four limbs, a heart pumps the blood to the whole body circularly. Consider a person sleeping in a bed with the head pointing to the North Pole, as shown in Fig.7(a), the five red lines from the heart represent its five artery tubes.

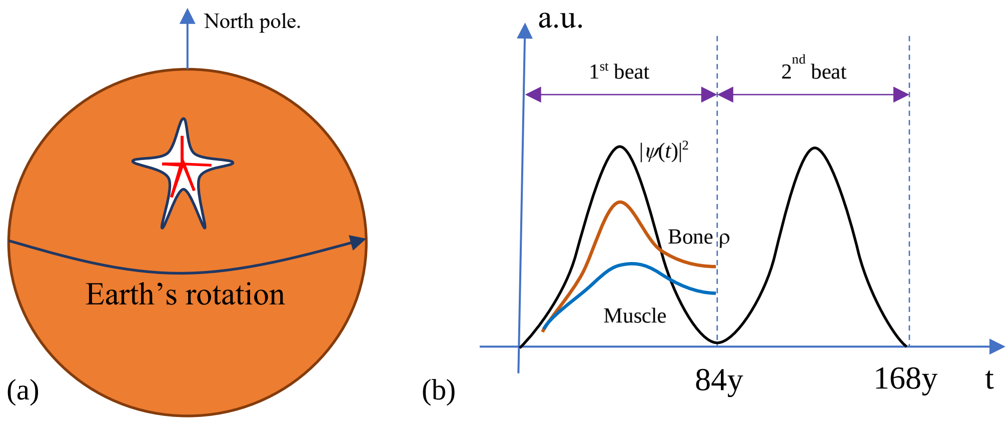


Fig.7 (a)A human sketch with the head pointing to the North Pole. (b) the biological clock.

Apparently, the arterial blood flows into the two arms with a speed, whose matter wave would interfere with the Earth's shell matter wave, producing a beat phenomenon:

$$|\psi|^2 = |\psi_{blood} + C\psi_{shell}|^2 = 1 + C^2 + 2C\cos[\frac{2\pi}{\lambda_{beat}}\int_L dl - \frac{2\pi}{T_{beat}}t]$$

$$\frac{2\pi}{T_{beat}} =\simeq \frac{\beta}{c^3}(\frac{v_{blood}{}^2}{2} - \frac{v_{shell}{}^2}{2}); \quad \frac{2\pi}{\lambda_{beat}} = \frac{\beta}{c^3}(v_{blood} - v_{shell}); \quad v_{shell} = \omega r \quad (11)$$

where $C$ represents the coupling coefficient, $\omega$ is the Earth's angular speed, $r$ the Earth radius, shell's $\psi_{shell}$ is with spherical symmetry, so calculated at the Earth's equator. The blood flow velocity varies with the location of blood vessels. The normal value of aortic valve orifice blood flow velocity in adults is 1.0-1.7m/s, and that in children is 1.2-1.8m/s. The flow velocity of carotid artery is less than 1.2m/s, the normal flow velocity of abdominal aorta is less than 1.8 m/s, and the normal flow velocity of inferior vena cava is 0.05-0.25m/s. Therefore, 1m/s is the order of magnitude of the blood velocities. Suppose the mean blood speed in human arms is 1m/s near the heart, in the Earth's reference frame, the flowing blood suffers a beat with the period as the follows

$$v_{shell} = r\omega = 463.8m/s; \quad v_{blood} = v_{shell} \pm 1m/s$$

$$T_{beat} \simeq \frac{4\pi c^3}{\beta\left(v_{blood}{}^2 - v_{shell}{}^2\right)} = \pm 84\,(years); \quad \lambda_{beat} = 1.2e+12(m) \quad (12)$$

```
<Clet2020 Script>// [9]
double beta,H,M,r,rc, rs, rot,v1,v2, Year,T,Lamda,V,a,b,x,y,w;
int main(){beta=1.377075e+14; H=SPEEDC*SPEEDC*SPEEDC/beta;
M=5.97237e24; rs=6.378e6; rot=2*PI/(24*3600); Year=24*3600*365.2422;
v1=rot*rs;v2=v1+1; a=v2*v2-v1*v1; T=4*PI*H/a;
T/=Year; Lamda=2*PI*H/(v2-v1); b=Lamda/(2*PI*rs);
TextAt(100,20,"v1=%f, v2=%f, T=%f, L=%e, b=%e",v1,v2,T,Lamda,b);
}#v07=?>A
```

In fact, the blood is pumped from the heart into both the eastern arm and western arm in Fig.7(a), producing a positive beat and a negative beat in the two arms with the same period 84 years, the two beats form an overall beat through the two arms. It is found that human mean lifespan is just confined within the single period duration, this beat period is recognized as the **human biological clock**. The beat wavelength λ is 30000 times the circumference of the earth, so its λ effects are hardly observed.

According to the explanation to $\psi$ in the preceding section, the beat $|\psi|^2$ is proportional to the matter density.

$$|\psi|^2 \propto \rho \quad (13)$$

The $|\psi|^2$ oscillation of the beat in Fig.7(b) represents the variation of a human body density in his whole life confined within one beat period. The human bone density (red line) and muscle (blue line) in a human life vary as function of age, also responding to the $|\psi|^2$ oscillation, as shown in Fig.7(b). After astronauts entered the space station, the coupling between the astronauts and the earth's rotation decreased, and there was a significant decrease in bone density, indicating that the bone density of normal people on the earth's surface is strongly related to $|\psi|^2$.

Obviously, the human bone and muscle are irreversible for the life process, they also completely resist the human to enter into the second beat for obtaining a 168 years longevity. Perhaps, some soft animals or cells may enter multi-beat process for a longer life or immortal. Sleep position, walking, running, sitting, etc. may make influences on the human biological clock in some extent, cannot stop ticking of the human biological clock, because the blood never stops as the life. Human life process is accumulated by many instantaneous activities, so the accumulation formula for calculating human lifespan $T$ is

$$\int_0^T \frac{F(C)dt}{T_{beat}(t)} = \int_0^T \frac{F(C)\beta\left(v_{blood}{}^2 - v_{shell}{}^2\right)}{4\pi c^3} dt = 1 \cdot \tag{14}$$

where $F(C)$ is a function of the instantaneous coupling coefficient $C$.

This formula can also be used to estimate animal lifespan. Wikipedia lists some long-lived creatures in the entry of " List of longest-living organisms " [14], for example, Harriet, a Galápagos tortoise, died at the age of 175 years in June 2006. Lin Wang, an Asian elephant, was the oldest elephant in the Taipei Zoo, he died on February 26, 2003 at 86 years. The oldest goat was McGinty who lived to the age of 22 years and 5 months until her death in November 2003 on Hayling Island, UK. The Greenland shark had been estimated to live to about 200 years. A goldfish named Tish lived for 43 years after being won at a fairground in 1956. Geoduck, a species of saltwater clam native to the Puget Sound, have been known to live more than 160 years. The longevity formula in this paper can cover these longevity animal examples.

## 6. How to understand physical effects of the relativistic matter wave

We can understand the physical effect of the $|\psi|^2$ from two aspects.

(1) Albert Einstein's General Relativity is a theory that describes the gravitational interaction between matter. This theory first equates the gravitational field with the curvature of spacetime. In this case, human relativistic matter waves form a local $|\psi|^2$ which is regarded as the local curvature of spacetime about the human body, as illustrated in Fig.8. In other words, the human body's $|\psi|^2$ represents the gravity effect of the human mass that undergoes the interference between the human body and the Earth's gravity in terms of relativistic matter waves.

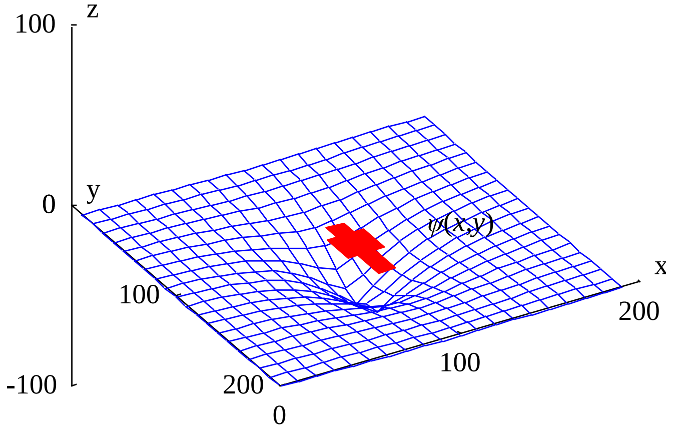


Fig.8 Human relativistic matter waves form a local $|\psi|^2$ which is regarded as the local curvature of spacetime about the human body.

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<Clet2020 Script>
int i,j,k,m,n,s,t; int x1,y1,x2,y2,w,B_Num,P[10],B[100]={90,90,110,110, 95,90,105,70, 95,110,105,120,};
double x,y,r,d,Z[50000];
main(){k=200; B_Num=3; w=-50; s=10; t=0;
```
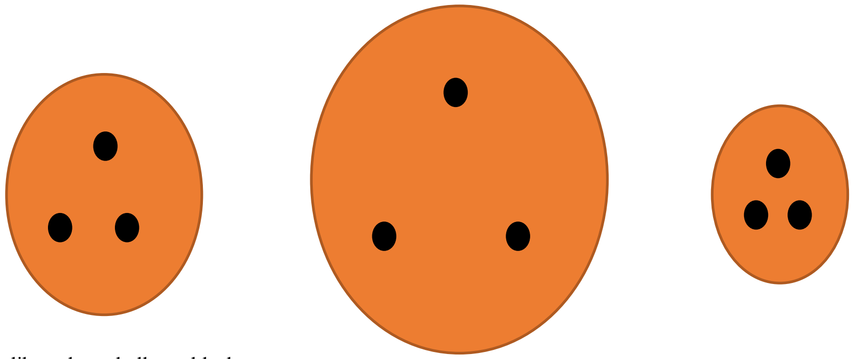

```
for(i=0;i<k;i+=s) {
for(j=0;j<k;j+=s) { GetZ(); Z[t]=d;t+=1;
} }
SetViewAngle("temp0,theta60,phi30");//SetViewAngle(0,60,30);
SetAxis(X_AXIS,0,0,k,"x;0;100;200;");
SetAxis(Y_AXIS,0,0,k,"y; 200;100; 0;");
SetPen(1,0x00);
DrawFrame(FRAME_SCALE,1,0xafffaf);
SetPen(1,0x0000ff);//P[0]=0;
P[0]=0;P[1]=0;P[2]=k;P[3]=k/s;P[4]=0;P[5]=k;P[6]=k/s;P[7]=0x0000ff;P[8]=0xff0000;
Overlook(P,Z);SetPen(1,0xff0000);DrawB();TextHang(140,100,0,"#ifψ(x,y)#t");
}
GetZ(){ d=0;
for(n=0;n<B_Num;n+=1) { m=4*n;
x1=B[m]; y1=B[m+1]; x2=B[m+2]; y2=B[m+3];
if(i>x1 && i<x2 && j>y1 && j<y2) d+=1;
else {x=i+i-x1-x2; y=j+j-y1-y2; r=x*x+y*y; r=sqrt(r)/w; d+=exp(r);}}
d/=B_Num; d*=-50;}
DrawB(){ d=0;
for(n=0;n<B_Num;n+=1) { m=4*n;
x1=B[m]; y1=B[m+1]; x2=B[m+2]; y2=B[m+3];
Z[0]=x1;Z[1]=y1;Z[2]=x2;Z[3]=y1;Z[4]=x2;Z[5]=y2;Z[6]=x1;Z[7]=y2;
Plot("POLYGON,3,4,XY",Z);
}}
#v07=?>A#t
```

(2)How do biological cells perceive $|\psi|^2$ ? As we know, $|\psi|^2$ represents the probability of finding nucleon on the macro scale. It can be likened to a balloon with the local curvature of spacetime about the human body, as illustrated in Fig.9. The three black dots on the balloon represent three molecules of a biological cell. When the balloon or the $\psi$ expands, the space between the three molecules of the biological cell becomes larger, thus weakening the binding force between them. When the balloon or the $\psi$ shrinks, the space between the three molecules of the biological cell becomes smaller, so that the binding force between them increases. Therefore, biological cells can sense the physical changes of the $\psi$.



$\psi$ is likened to a balloon, black dots represent molecules. — the balloon or the $\psi$ expands — the balloon or the $\psi$ shrinks

Fig.9 The ψ as if a balloon, the three dark dots represent tree molecules of a biological cell.

## 7. Moon exploration

Consider migration to other planets. For Mars, Jupiter, Saturn, Uranus, Neptune, their parameters ($\beta$, etc.) are collected in Ref. [6]. Regardless their atmospheres, using the above beat period formula, the human biological clocks on these planets are calculated, their beat periods are: Mars 8.6 years; Jupiter 10.6 years; Saturn 7.3 years; Uranus 1.04 years; Neptune 0.96 years. No one will be happy with the shorter life on these planets; migration to Mars always stays in our illusion. In addition, the $\beta$ parameter of the earth is calculated based on the lunar orbit. To maintain the human biological clock, we must protect the moon, call for stopping landing on the Moon [15] [16]. A guidance of anti-ageing is devised for the biological clock [17].

```
<Clet2020 Script>// [9]
double ABeta[10]={ 2.961520e+10, 1.377075e+14 , 2.581555e+15, 4.016793e+13,
7.183397e+13, 1.985382e+15, 2.077868e+15, 1.377075e+14,};
double Ar[10]={1, 1,   0.5326, 11.209, 9.449, 4.007, 3.882, 0.273,};
double AD[10]={1, 24, 24.6,   9.9,    10.35,   17.25, 16.1,655.68,};
int i,j; double beta,H,M,r,rs,rot,v1,v2, Year,T,Lamda,a,b,d;
int main(){j=50; rs=6.378e6; Year=24*3600*365.2422;
for(i=1;i<=7;i+=1) {
beta=ABeta[i]; H=SPEEDC*SPEEDC*SPEEDC/beta; r=Ar[i]*rs; d=AD[i];
rot=2*PI/(d*3600); v1=rot*r; v2=v1+1; a=v2*v2-v1*v1; T=4*PI*H/a;
T/=Year; Lamda=2*PI*H/(v2-v1); b=Lamda/(2*PI*r);
TextAt(100,j,"i=%d, v1=%f, v2=%f, T=%f, L=%e, b=%e",i,v1,v2,T,Lamda,b);
j+=30;}
}#v07=?>A
```

Since the lunar ultimate acceleration $\beta$ is unknown, we have to use the Earth's ultimate acceleration $\beta$ to estimate the lunar human biological clock, because the Moon and the Earth are in a strongly interacting system so that they should share almost the same $\beta$; even there is an opinion that the Moon is a part of the Earth. According to the formula of human biological clock, the human lifespan on the Moon is approximately 7500 years, a number that human beings on the Earth like very much. This finding will inspire great enthusiasm for Moon exploration, even Moon warfare.

The moon was the first extraterrestrial celestial body that humans had ever landed on. The lunar probes launched by the United States and the former Soviet Union in 1958 both failed. In 1959, the former Soviet Union and the United States successfully launched the "Moon" and "Pioneer" lunar probes, respectively. In 1969, Apollo 11 in the United States achieved the first manned lunar landing, followed by Apollo 12, 14, 15, 16, and 17. A total of 12 American astronauts landed on the moon to conduct scientific investigations, collect lunar samples, and bury scientific instruments for long-term exploration. A total of 381.7 kilograms of lunar samples were brought back to Earth, greatly increasing human understanding of the origin and evolution of the moon. So far, only these 12 American astronauts have landed on Earth

The Lunar Reconnaissance Orbiter (LRO) is the first mission of NASA's New Space Exploration Program, proposed in 2004 to return to the moon, land on Mars, and advance further into space. The mission includes finding safe landing points on the lunar surface, searching for potential resources, studying the radiation environment on the lunar surface, and demonstrating some new technologies. This probe operated for one year in a polar lunar orbit at a height of 50 kilometers. LRO would return a large amount of data, including full day monthly temperature maps, lunar geodetic coordinates, high-resolution color images, and lunar ultraviolet reflectance. However, the top priority of this task is to search for traces of water in the dark areas of the lunar poles where sunlight is not visible for years.

At 10:26 on January 3, 2019, the "Chang'e-4" probe launched by China successfully landed at the pre-selected landing area near 177.6 degrees east longitude and 45.5 degrees south latitude on the far side of the Moon. The world's first close-up image of the lunar back was sent back to Earth through the "Queqiao" relay star, which opened the mystery of the ancient lunar back.

The above USA lunar missions and Chinese missions did not concern with quantum gravity and relativistic matter waves, even their exploration has in an extent sabotaged the pure and naiver environment around the Moon.

On the behalf of human beings on the Earth, a primary task should arrange to measure the lunar ultimate acceleration $\beta$. Fig.10 shows the simulation of satellite explosion at the altitude 1000km above the lunar surface. Here, we employ the Earth's ultimate acceleration $\beta$ instead of the lunar ultimate acceleration to estimate the lunar relativistic matter waves. Fig.10(a) shows the trajectories of the space debris after satellite explosion in the pure gravity space, while Fig.10(b) shows the trajectories of the space debris after satellite explosion in the quantum gravity space, where there is the interference of relativistic matter waves between the Moon and the space debris. The distinct trajectories of the space debris can be used to determine the lunar ultimate acceleration $\beta$ and other parameters, i.e. so-called quantum gravity test. Of cause, the explosion is truly not required, but each trajectory representing possible orbit of the satellite around the Moon in various cases is truly valuable.

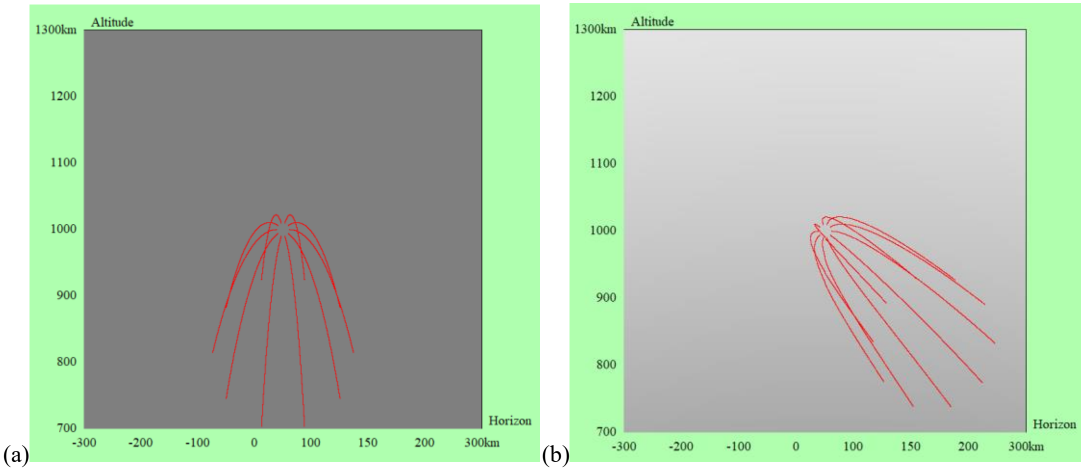



Fig.10 (a)The trajectories of the space debris after satellite explosion in the pure gravity space. (b)The trajectories of the space debris after satellite explosion in the quantum gravity space.

```
<Clet2020 Script>//[9]
int i,j,k,m,n,t,Type,N,nP[50], particle_num;
double a,b,c,d,g,AU,beta,H,M,r,r0,r1,r2,r3,rs,height,acc,x,y,z,v,phase,w,h,w0,h0,Grid_unit,dP[10],S[2000], D[1000];
double step,time_step,Z[10],Psi[10],Psi1[10],Psi2[10];
double K,v0,vx,vy,vx1,vy1,x1,y1,couple;

int main(){beta=1.377075e+14; H=SPEEDC*SPEEDC*SPEEDC/beta;
rs=1738.14e3; M=7.342e22; AU=1.496E11;
Grid_unit=1e3; Check(15, Type);    w0=300e3; h0=1000e3; w=30e3;
r0=rs+h0; v0=sqrt(GRAVITYC*M/r0); K=-GRAVITYC*M;
SetAxis(X_AXIS,-300,-300,300,"Horizon;-300;-200;-100;0;100;150;200;300km;");
SetAxis(Y_AXIS,700,700,1300,"Altitude;700;800;900;1000;1100;1200;1300km;");
DrawFrame(FRAME_BOX,2,0xafffaf);
time_step=0.2*Grid_unit/v0; step=1e-6*Grid_unit;
Scope();
couple=1e-4; particle_num=10;
for(i=0;i<particle_num; i+=1) {a=i*(360/particle_num)*(PI/180);b=10*Grid_unit; j=8*i; v=0.1*v0;
D[j]=0; D[j+1]=0; D[j+2]=b*cos(a); D[j+3]=r0+b*sin(a); D[j+4]=v*cos(a); D[j+5]=v*sin(a); D[j+6]=0; }
SetPen(1,0xff0000); n=2; k=300;
for(t=0;t<5000; t+=1) {Track(); for(i=0;i<particle_num; i+=1) {j=8*i;
nP[0]=D[j]/Grid_unit; nP[1]=(D[j+1]-rs)/Grid_unit;nP[2]=D[j+2]/Grid_unit; nP[3]=(D[j+3]-rs)/Grid_unit;
if(nP[0]>k ) continue;
//if(t==5) ClipJob(APPEND,"x1=%f, y1=%f, x=%f, y=%f, ",nP[0],nP[1],nP[2],nP[3]);
Polyline(n,nP);}}
TextAt(100,50,"click Selector to change Type: %d",Type); TextAt(100,80,"v0=%f, v=%f ",v0,v );
r=H/sqrt(GRAVITYC*M);r*=r; TextAt(100,110,"r=%e, r=%f ",r,r );
}

Scope(){ N=65; b=1e-20; nP[0]=SET; nP[1]=1; nP[2]=PX;
for(j=0;j<2000;j+=1) { r=rs+j*Grid_unit;
```

```
if(Type==1) {r1=(r-r0+100*Grid_unit)/w; a=exp(-r1*r1); }
else if(Type==2) {c=2*PI*sqrt(GRAVITYC*M*r)/H; x=0; y=0;
for(k=0; k<N; k+=1) { d=c*k; x+=cos(d); y+=sin(d);} a=(x*x+y*y)/(N*N);}
else a=0;
S[j]=a; if(b<a) b=a;} //ClipJob(APPEND,"Type=%d, j=%d, b=%e ",Type,j,b);
for(j=0;j<2000;j+=1) S[j]/=b;
m=600; n=300; for(i=0;i<m; i+=1) {
for(j=0;j<m; j+=1) { x=(i-n)*Grid_unit;y=r0+(j-n)*Grid_unit;
b=x*x+y*y; r=sqrt(b);    k=(r-rs)/Grid_unit; a=S[k];
nP[3]=Colorize(1,0xffffff,a);D[0]=200+i;D[1]=200+m-j;D[2]=0;PixelJob(nP,D);
}}}

Psi_Value(){ r=sqrt(x*x+y*y);a=asin(x/r);
b=sqrt(GRAVITYC*M/r)*r*a/H; m=(r-rs)/Grid_unit; d=couple*sqrt(S[m]);
Psi1[0]=d*cos(b);Psi1[1]=d*sin(b);Psi1[2]=d;
c=vx*(x-x1)+vy*(y-y1);b=phase+c/H;
Psi2[0]=cos(b);Psi2[1]=sin(b);Psi2[2]=1;
Psi[0]=Psi1[0]+Psi2[0]; Psi[1]=Psi1[1]+Psi2[1]; Psi[2]=Psi[0]*Psi[0]+Psi[1]*Psi[1];}

Psi_Velocity(){//known: step
Psi_Value();Z[0]=Psi[0];Z[1]=Psi[1];Z[2]=Psi[2];
h=x;x+=step;Psi_Value();x=h;
Complex(SUBTRACT,Psi,Z,Z[4]);Psi[1]=-Psi[1];Complex(MULTIPLY,Psi,Z[4],Z[6]);
vx1=H*Z[7]/(step*Z[2]);
h=y;y+=step;Psi_Value();y=h;
Complex(SUBTRACT,Psi,Z,Z[4]);Psi[1]=-Psi[1];Complex(MULTIPLY,Psi,Z[4],Z[6]);
vy1=H*Z[7]/(step*Z[2]);
}

Track(){ for(i=0;i<particle_num;i+=1) {j=i*8;
x1=D[j];y1=D[j+1]; x=D[j+2];y=D[j+3]; vx=D[j+4];vy=D[j+5]; phase=D[j+6];
x1=x; y1=y; x=x1+vx*time_step; y=y1+vy*time_step; Psi_Velocity();
r2=x*x+y*y;    r=sqrt(r2); r3=r*r2;
vx=vx1+K*time_step*x/r3; vy=vy1+K*time_step*y/r3;
c=vx*(x-x1)+vy*(y-y1); phase+=c/H;
D[j]=x1; D[j+1]=y1; D[j+2]=x; D[j+3]=y; D[j+4]=vx; D[j+5]=vy; D[j+6]=phase;
}
}#v07=?>A#t
```

How to calculate the influence of relativistic matter waves on the dynamical trajectories? One piece of debris subjects to two forces:(1) the gravitational force; (2) the adaptive force due to relativistic matter waves. Stemming from the double-slit electron interference algorithm, we first consider how to describe the quantum behavior of single debris. Consider two particles 1 and 2, if the relativistic matter wave of the particle 1(matter wave $\phi_1$) overlaps with the relativistic matter wave of the particle 2 (matter wave $\phi_2$), then we can calculate out the adaptive force acting on the particle 1 by

$$\begin{aligned} &\psi = \phi_1 + \phi_2; \quad \mathbf{p} = \frac{1}{\psi\psi^*} \cdot \frac{mc^3}{2\beta i}(\psi^* \nabla \psi - \psi \nabla \psi^*) \\ &f_x = \frac{d}{dx}\left(\frac{p^2}{2m}\right) \end{aligned} \quad . \tag{15}$$

Using the adaptive force which contains "quantum ingredient", the particle 1 moves step by step as like in Newtonian mechanics. For detailed information about the interference algorithm, see its source codes in the Fig.10.

## 8. Conclusions

It is found that relativistic matter wave provides a biological clock for human beings. Due to gravity, the human mean lifespan on the Earth is calculated to be 84 years, while the human mean lifespan on the Moon extends to about 7500 years. This finding will inspire great enthusiasm for Moon exploration. A scheme to explore the Moon is proposed in terms of relativistic matter waves in quantum gravity theory. The simulation of satellite explosion at the altitude 1000km above the lunar surface is carried out, the trajectories of the space debris can be used to determine the lunar parameters in quantum gravity theory.

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