The Bufallo Field

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The main objective of this publication is to show that a strong momentum field exists, the so called Bufallo Field.

The strongest indication that this field exists is that you can derive gravitational as well as strong nuclear forces from it. This is remarable as the peak of the strong nuclear force of the Reid potential at a distance of about 1.05 fm is 1.47 $*10^{38}$ times higher than the gravitational force.

The following sections show

- how to derive the gravitational and strong nuclear forces from the Bufallo Field,
- how to construct a Bufallo Booster, a propellentless thrust drive which can create thrust from pure energy.

With the exception of the Bufallo Field, no new physics is required for the following explanations. Everything is already available—in particular, Albert Einstein's general theory of relativity and the Schwarzschild metric.

We compare the calculated strong nuclear forces with those calculated from the Reid potential.

Beyond that, no new constants or assumptions are required, as is the case in the Standard Model, for example.

The gravitational and strong nuclear forces

The Bufallo Field embeds all massive particles which are regarded as energy clouds. The Bufallo Field consists of massless light-speedy particals – the Bufallos - that carry momentum and fly in all directions. Eventually they enter an energy cloud and transfer momentum to it and take it back when they leave.

This leads to external pressure on the energy cloud of a massive particle.

The gravitational forces

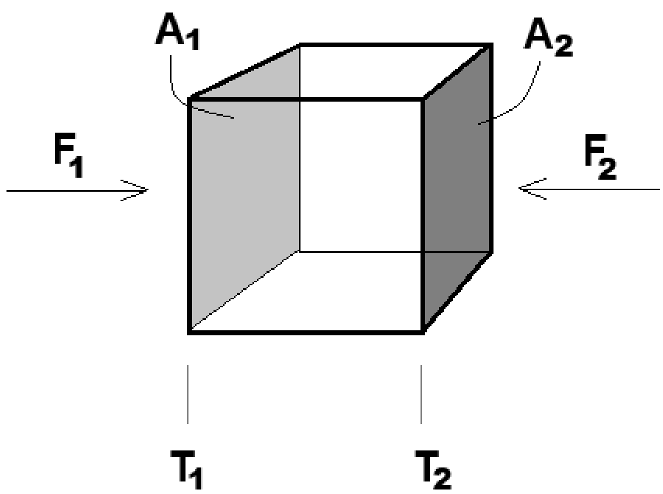
Let us consider a cubic volume V with energy density difference $\Delta\rho$ compared to the environment, which is placed in a gravitational field of a mass M_C that is positioned horizontally on the fare left. Only the horizontally forces are taken into account, as forces in the other directions cancel each other out due to symmetry.

F_i : Bufallo forces in [N]

A_i : Area in [m^2]

$\Delta\rho$: Energy density in [J/m^3]

T_i: Proper Times in [s]



In this case, proper time T_2 runs faster than T_1 because it is further away from the mass M_C.

This means that more momentum is introduced in area A_2 as in A_1 so that force F_2 is greater than F_1.

So far, we know nothing about the forces F_1 and F_2, except that they must be proportional to areas A_1 and A_2 and to the Δρ. This is easy to understand: The Bufallos crossing the surface of the volume V correspond to a momentum flow that corresponds to an external pressure onto the surface. The larger the surface area on which the pressure acts, on the greater the force.

As for the Δρ, the Bufallos react to a change in energy density. The greater the difference between the energy density of the environment and that of volume V, the greater the exchange of momentum.

All other unknown factors should be summarized by the Bufallo constant f_B , which leads us to

$$F_i = f_B \cdot A_i \cdot \Delta\rho \qquad i=1,2 \tag{1}$$

with

$$F_2 = F_1 + \Delta F \tag{2}$$

$$A_2 = A_1 + \Delta A \tag{3}$$

we get

$$\boxed{\Delta F = f_B \cdot \Delta A \cdot \Delta\rho} \tag{4}$$

The difference of forces ΔF presses the energy volume V towards the mass M_C and therefore should equal the gravitational force F_{grav} between mass M_C and energy volume V:

$$\Delta F = F_{grav} \tag{5}$$

Equation (4) and (5) leads to an expression for f_B:

$$\boxed{f_B = \frac{F_{grav}}{\Delta A \cdot \Delta\rho}} \tag{6}$$

with ΔA as the only unknown.

To take into account the different proper times, we request thath the proper times have the same ratio as the areas:

$$\frac{A_2}{A_1} = \frac{T_2}{T_1} \tag{7}$$

with equation (3) and

$$T_2 = T_1 + \Delta T \tag{8}$$

we get

$$\frac{A_1 + \Delta A}{A_1} = \frac{T_1 + \Delta T}{T_1}$$

$$1 + \frac{\Delta A}{A_1} = 1 + \frac{\Delta T}{T_1}$$

$$\boxed{\Delta A = \frac{\Delta T}{T_1} \cdot A_1} \tag{9}$$

Now all that’s missing is the term $\Delta T/T_1$, which we can derive from the Schwarzschild metrics.

Schwarzschild metrics are a vacuum solution to Einstein's field equations that describe the gravitational field of a homogeneous, uncharged, and non-rotating sphere.

$$ds^2 = -\left(1 - \frac{2GM_C}{c^2 r}\right)c^2 dt^2 + \left(1 - \frac{2GM_C}{c^2 r}\right)^{-1} dr^2 + r^2 d\Omega^2 \qquad (10)$$

with

M_C: central mass

c: velocity of light

G: Gravitational constant

r: Radial distance to central mass

θ ,ϕ: spatial anlgles

with $d\Omega^2 = d\theta^2 + \sin^2\theta \, d\phi^2$

For a stationary observer (no movement in r,θ,ϕ), the following applies:

dr = dθ = dϕ = 0

This gives the reduces metrics

$$ds^2 = -\left(1 - \frac{2GM_C}{c^2 r}\right)dt^2 \qquad (11)$$

The proper time T_i of a stationary observer is definded as:

$$T_I^2 = -ds^2/c^2$$

This means:

$$\boxed{T_i = \sqrt{1 - \frac{2GM_C}{c^2 r}}\,dt} \qquad (12)$$

with:

- T_i: proper time of a stationary observer at radial distance r
- dt: coordinate time of a remote observer (asymptotically flat, $r \rightarrow \infty$)

If we compare two stationary oberservers, we obtain:

$$\frac{T_2}{T_1} = \frac{\sqrt{1 - 2GM_C/(c^2 r_2)}}{\sqrt{1 - 2GM_C/(c^2 r_1)}} = \sqrt{\frac{1 - 2GM_C/(c^2 r_2)}{1 - 2GM_C/(c^2 r_1)}} \qquad (13)$$

with the Schwarzschild radius r_s:

$$r_s = \frac{2GM_C}{c^2} \qquad (14)$$

we get:

$$\frac{T_2}{T_1} = \sqrt{\frac{1 - r_s/r_2}{1 - r_s/r_1}} \qquad (15)$$

r_s / r_i is several orders of magnitudes smaller than 1. For this reason, equation (14) suffers from catastrophic numerical cancellation. So we have to linearize it e.g. with a robust logarithmical and exponential form:

$$\ln\left(\frac{T_2}{T_1}\right) = \frac{1}{2}\left[\ln\left(1 - \frac{r_s}{r_2}\right) - \ln\left(1 - \frac{r_s}{r_1}\right)\right] \approx \frac{1}{2} r_s \left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

(since $\ln(1-x) \approx -x$ for small x). The exponentation yields with $e^x \approx 1+x$ for small x:

$$\frac{T_2}{T_1} \approx 1 + \frac{r_s}{2}\left(\frac{1}{r_1} - \frac{1}{r_2}\right) \qquad (16$$

This avoid differences next to 1 and is numerically stable.

Using the mean distance d to the central mass M_C and

$$d = (r_1 + r_2) / 2$$

$$r1 = d - \Delta r/2 \qquad (17)$$

$$r2 = d + \Delta r/2$$

we further transform the bracketed part of equation (16) to

$$\frac{1}{r_1} - \frac{1}{r_2} = \frac{r_2 - r_1}{r_1 \cdot r_2} = \frac{\Delta r}{d^2 - \Delta r^2/2} \approx \frac{\Delta r}{d^2} \qquad (18)$$

Substituting equation (8) and (18) into equation (15) yields:

$$\frac{T_1 + \Delta T}{T_1} \approx 1 + \frac{r_s}{2} \cdot \frac{\Delta r}{d^2}$$

$$\frac{\Delta T}{T_1} \approx \frac{r_s}{2} \cdot \frac{\Delta r}{d^2}$$

And substitution of r_s with equation (14) gives:

$$\frac{\Delta T}{T_1} \approx \frac{G M_C}{c^2 d^2} \cdot \Delta r \qquad (19)$$

Now we have all we need to calculate the Bufallo constant f_B. With equation (6), (9) and (19) we get

$$f_B = \frac{F_{grav}}{\frac{G M_C}{c^2 d^2} \cdot \Delta r \, A_1 \cdot \rho} \qquad (20)$$

with volume

$$V = \Delta r \cdot A_1 \qquad (21)$$

with the energy density

$$\rho = \frac{M_N \cdot c^2}{V} \qquad (22)$$

and with the mass M_N of the energy volume we get:

$$f_B = \frac{F_{grav}}{\frac{G M_C}{c^2 d^2} \cdot \Delta r A_1 \cdot \frac{M_N c^2}{V}} = \frac{F_{grav}}{\frac{G M_C M_N}{d^2}} = 1 \qquad (23)$$

The denominator shows exactly the Newtonian definition of the gravitational force F_{grav}. Therefore the Bufallo constant $f_B = 1$.

This changes the equation (1) of the Bufallo forces to:

$$F_i = A_i \cdot \Delta\rho \qquad i=1,2 \qquad (24)$$

From this we can derive a local Bufallo pressure:

$$\frac{F_i}{A_i} = \Delta\rho \qquad i=1,2 \qquad (25)$$

This equation states that the energy density change which is nothing more than a change in pressure, equals the Bufallo pressure regardless of the shape of the enclosing volume.

This is consistent with the fact that the curvature of spacetime depends only on the enclosed mass or energy.

The difference in Bufallo pressures depends on the curvature of spacetime. Therefore, it is only logical that these also depend solely on the enclosed energy density.

As a result, we can conclude that gravity can be attributed to a combination of external Bufallo pressures and curvature of spacetime.

For a neutron with a mass of M_N and a radius r_N, this results in an average Bufallo pressure of

$$\Delta\rho = \frac{M_N * c^2}{V} = \frac{1.675\text{e-}27\, kg * (299792458\, m/s)^2}{4*(8.0\text{e-}16\, m)^3/3} = 7.019058\text{e+}34\, Pa$$

The strong nuclear forces

Now all that remains is to derive the strong nuclear force from the Bufallo pressure. This will then be compared with the force derived from the Reid profile.

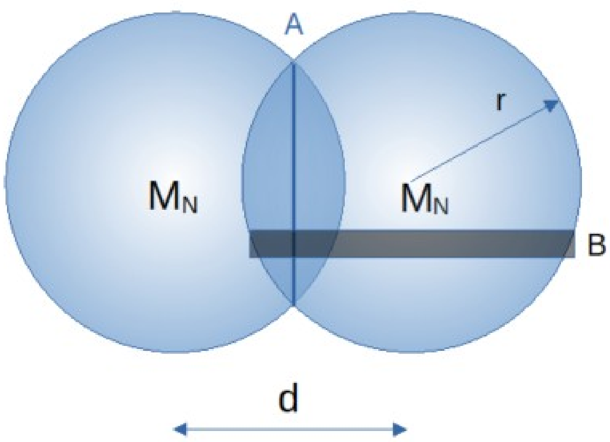
To see if we are on the right track and to gain confidence in the correctness of the calculations, let us take as an example two hard spheres with the radius and mass of a neutron which we can check by hand.

When the two hard spheres with mass M_N and radius r overlap then the Bufallo Field divides in the overlapping region between the two according to their energy densities.

The energy densities are the same so the coupling factor c_B is 0.5. This means that the Bufallo forces only acts with half its strength onto the hard spheres in the overlapping region.

We can approximate a hard sphere with horizontal bars B and add up all the horizontal Forces on its ends. Only the bars crossing the cross area A have on their left end a force only half as great as on the right end. Because on the left end the coupling factor c_B is 0.5.

The difference force F_D of the right hard sphere is the



$$F_D = -c_B \cdot A \cdot \rho$$

A calculates as

$$A = \pi h^2 \qquad \text{with} \qquad h = \sqrt{r^2-(d/2)^2}$$

and

$$\rho = \frac{M_N \cdot c^2}{4\pi r^3/3}$$

In the end we get

$$F_D = -\frac{c_B \cdot \left(r^2-(d/2)^2\right) \cdot M_N \cdot c^2}{4 r^3/3}$$

With real mass M_N and radius r of a neutron

$c_B = 0.5$

$d = 1.5$ fm

$r = 0.8$ fm

$M_N = 1.675 \cdot 10^{-27}$kg

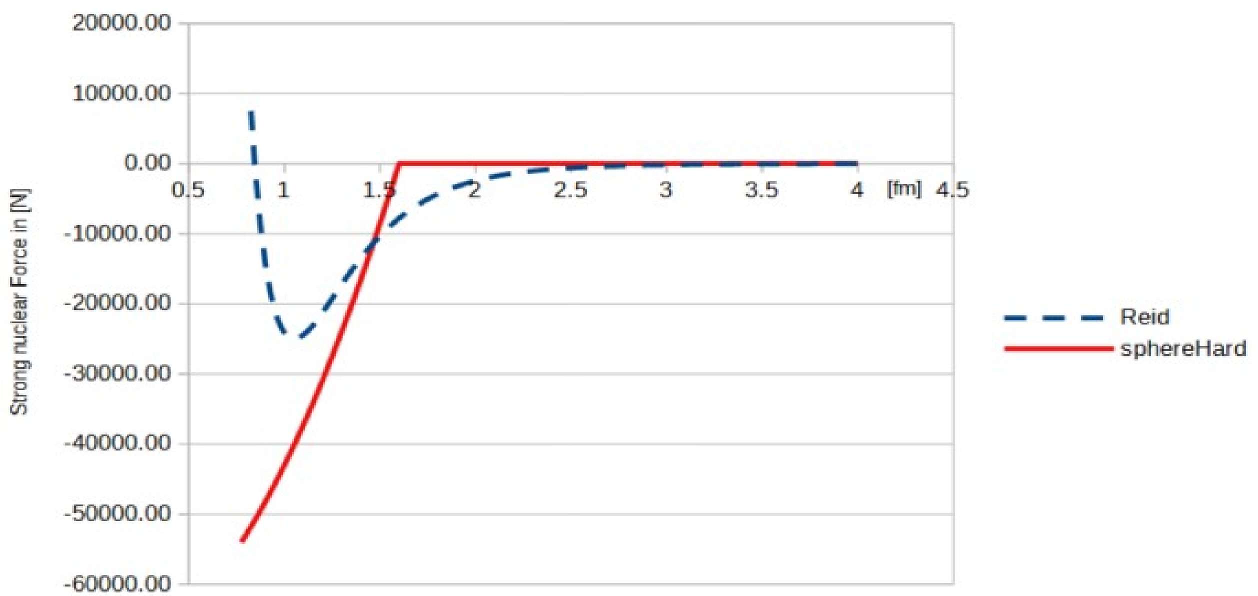
we get the strong nuclear force F_D for the hard sphere from the Bufallo Field

$$F_D = -8.545 \cdot 10^3 N$$

This is already quite close to the strong nuclear force F_R of the Reid profile:

$$F_R = -10.317 \cdot 10^3 N$$

The diagram below shows the complete profile of the Reid force F_R and the hard sphere force F_D.



Although this diagram looks ugly, the main objective of this example is to demonstrate, that the strong nuclear forces derived from the Bufallo Field are of the same order of magnitude as the known ones.

The Reid profile depend heavily on the energy distribution within the neutron and in the next step we will construct such a fine structure.

We also will separate the Reid force into an attractive and a repelling part. The repelling part comes from internal forces caused by quantum mechanical effects and can not be derived from the Bufallo Field. Therefore we overtake this part as good as possible.

In the contrary the attractive part can be derived from the Bufallo Field. And that is exactly what we will do in the following steps. Todo this, we need to find the appropriate energy distribution of a neutron.

For this, we are setting up a model of the energy distribution of the neutron.

Energy Distribution Model of the Neutron

The energy of the neutron is distributed between rest energy and binding energy.

The neutron has a total mass of 939,6 MeV and consists of one up quark with a rest mass of 2.2 MeV and and two down quarks with a rest mass of 4.7 MeV.

The total rest mass is

$$2.2 + 2 * 4.7 \text{ MeV} = 11.6 \text{ MeV}$$

The bindings energy is

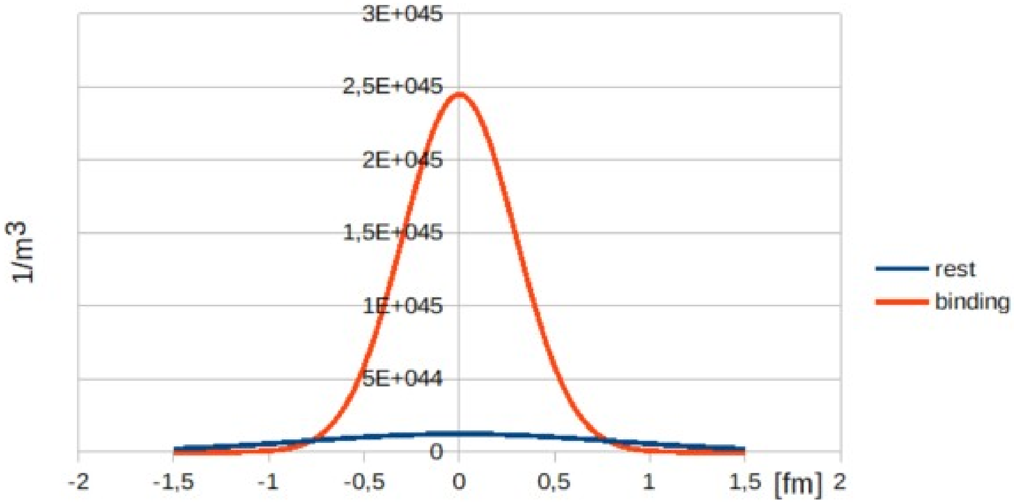
$$939{,}6 – 11{,}6 = 928.0 \text{ MeV}$$

This means the neutron consists of approximately 11.6/939.6 = 0.012 =1.2% of rest energy and 98.8% of binding energy.

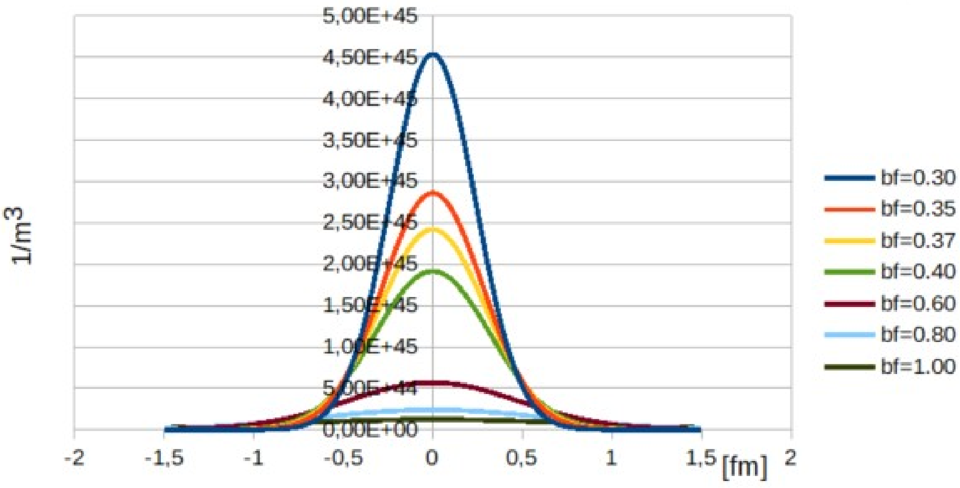
The bindings energy is said to be more concentrated in the center of the neutron than the rest energy. Therefore, we model the fine structure of the neutron as follows:

Two 3D gaussian distributions that are added together . The first for the rest energy with 1.2% of the total nucleons energy and a standard deviation that equals the neutrons radius. And the second with 98.8% of the total nucleons energy with a standard deviation of the nucleons radius times a binding factor b_F between 0.3 to 1.0. 1.0 means the two distributions have the same standard deviation.

Radial 3D energy distribution of the rest and binding distribution with a binding factor b_F = 0.37.



The energy distribution of the neutrons model for different binding factors b_F



The Reid-Potential

The Reid potential is a semi-empirical quantitative model that describes the nuclear forces phenomenologically e.g. between two neutrons.

See: https://en.wikipedia.org/wiki/Nuclear_force

$$V_{Reid}(d) = A(d) + B(d) + C(d)$$

with

$$A(d) = h(d,-10.463,-1)$$
$$B(d) = h(d,-1650.6,-4)$$
$$C(d) = h(d,\ 6484.2,-7)$$

Helper function:

$$h(d,g,a) = g\cdot\frac{e^{a\cdot m\cdot d}}{m\cdot d}$$

with

V_{Reid}: Potential in [MeV]

d: distance between two neutrons

m: 0.7 fm

a, g: constants

The Reid Strong Force derived by deviation of potential:

$$F_{Reid}(d) = F_{attract} + F_{repel}$$
$$F_{attract}(d) = A(d) + B(d)$$
$$F_{repel}(d) = A(d) + B(d) + C(d)$$

with

$$A'(d) = h'(d,-10.463,-1)$$
$$B'(d) = h'(d,-1650.6,-4)$$

$$C'(d) = h'(d,\ 6484.2, -7)$$

Helper function:

$$h'(d,g,a) = g\cdot(d\cdot a - 1/m)\cdot\frac{e^{a\cdot m\cdot d}}{d^2}$$

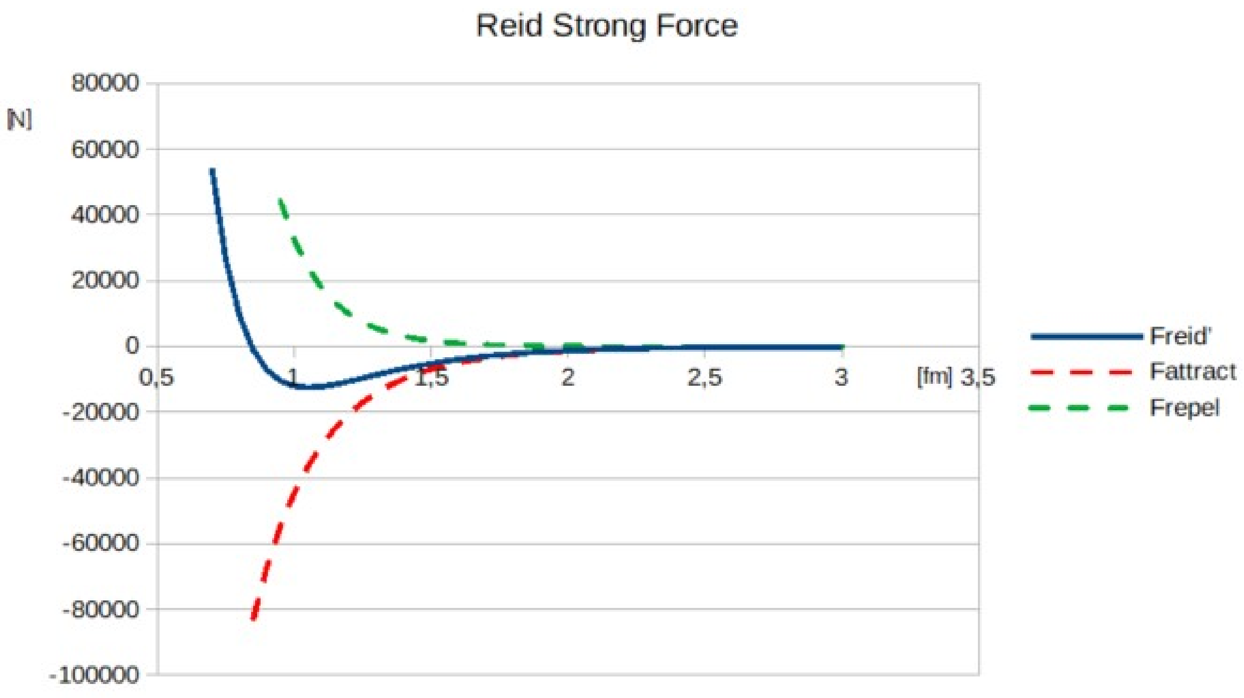
with

F_{Reid}: Strong force in [MeV/m = 1,6*10^{-13} N]

d: distance between two neutrons

m: 0.7 fm

a, g: constants



In the next step, we use a C++ program to calculate the strong force between two neutrons for several binding factors and compare the results with the attractive Force $F_{attract}$ of the Reid potential. In the end ,we can select a suitable binding factor that fits well.

The C++ program divides the space around a neutron B in all spatial directions x, y, z into a grid of 250 x 250 x 250 cells. The spatial coordinates covers a range of -2.4fm to +2.4fm.

A second neutron A is placed in a distance d in negative x-direction. The C++ program loops through the distance d to obtain a profile of the attactive force.

For every cell we have ρ_A and ρ_B the energy densities of nucleon A and B.

From this we can calculate for every cell

the cell cross section ΔA and step sizes

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Δx = Δy = Δz = 2.4fm / 250;
ΔA = Δx²
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the energy density difference of nucleon B

$$\Delta\rho_B = \left(\Delta\rho_B(x+\Delta x/2) - \Delta\rho_B(x-\Delta x/2)\right)\cdot\Delta x$$

the coupling factor as

$$c_F = \Delta\rho_B / (\rho_a + \Delta\rho_B)$$

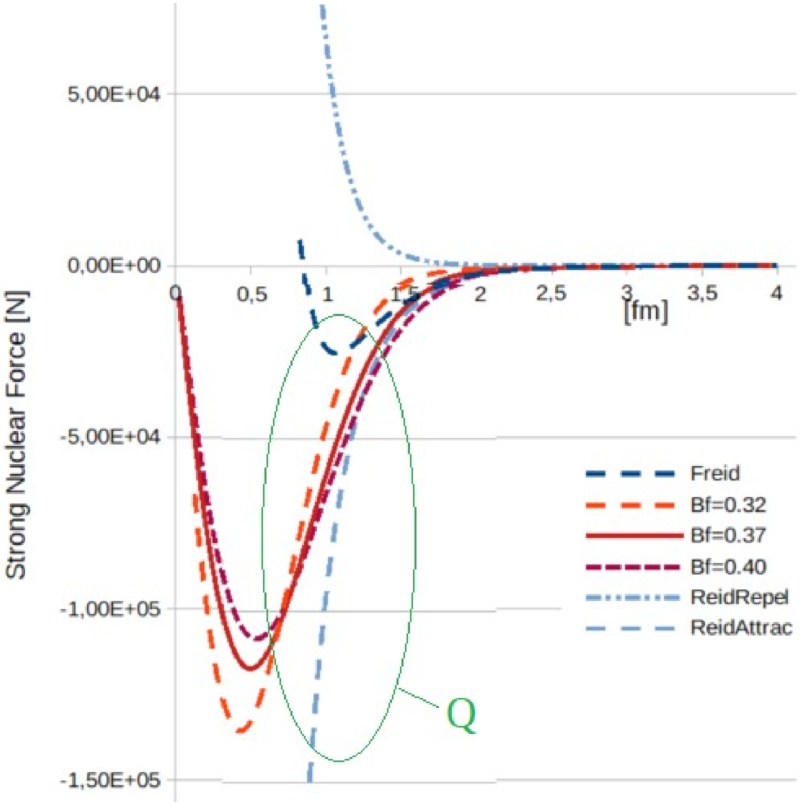
the Bufallo force

$$F_B = c_F \cdot \Delta A \cdot \Delta\rho$$

Adding up the Bufallo forces of all cells gives the strong force acting on the neutron B.

The next diagram shows the results for different binding factors b_F.= 0.32, 0.37, and 0.40.

You can see that the Bufallo Force curve Bf=0.37, coming from the right, closely follows the Reid potential curve up to a certain point where the repulsive forces become too great. The Bf=0.37 curve then follows the attractive Reid potential ReidAttrac, but the former is significantly flatter. See area Q.

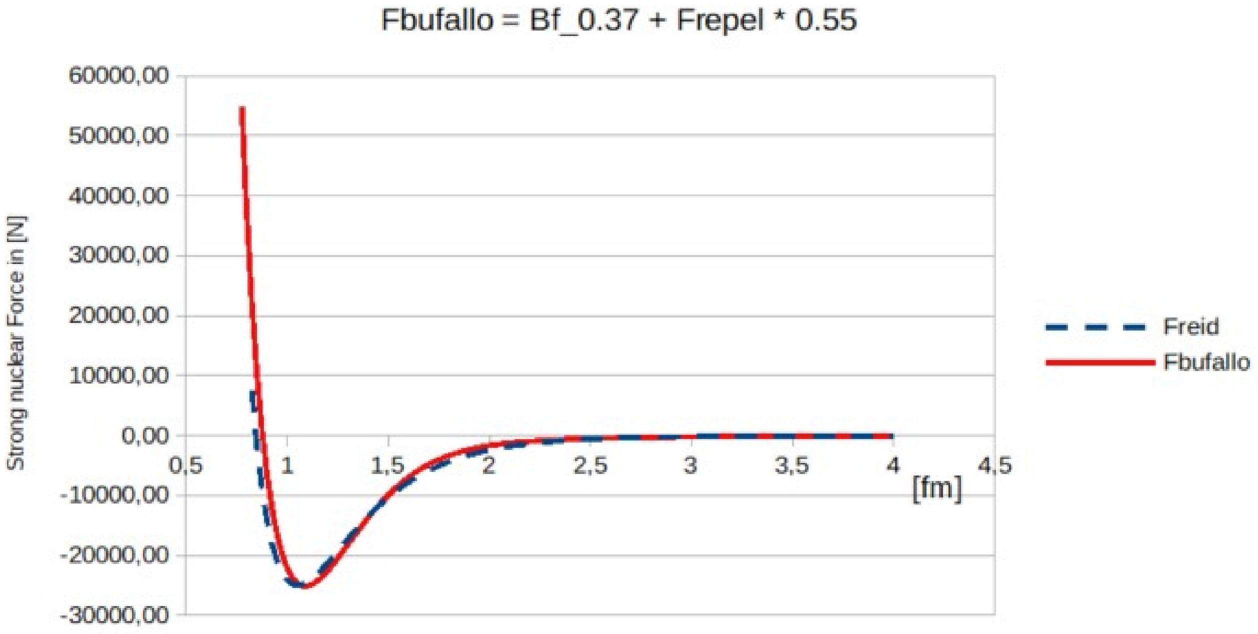


The last step combines the the Bufallo force curve Bf=0.37 with the repelling Reid force ReidRepel.

The ReidRepel cure was adapted to the steeper ReidAttrac profile to construct a suitable Reid profile. To adjust the ReidRepel curve to the flatter Bf=0.37 curve, we flatten it with a correction factor of 0.55 and add this to the Bufallo force curve Bf=0.37.

$$F_{Bufallo} = Bf\,0.37 + 0.55 \cdot F_{Repel}$$

This gives us a Bufallo calculated Reid profile that fits the original one quite well as the next diagram shows.



This completes the derivation of gravitational and strong nuclear forces from the BF with a convincing result.

The Bufallo Field gives gravity a completely different basis. The source of gravitation is the change in energy density in combination with proper time differences. And since the loalization of energy is limited by the uncertainty limit of Heisenberg's principle there is an upper limit to the change in energy distribution and thus an upper limit to the strength of the Bufallo forces.