Femtotechnology. AB-matter. Properties, Stability, Possibility Production and Applications

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Abstract

Designs of new forms of matter composed of nucleons (neutrons, protons), electrons, and other nuclear particles are detailed. This matter is measured in the femtometer (10^{-15} m) scale ("femtotechnology"), which is millions of times smaller than material on the nanometer (10^{-9} m) scale ("nanotechnology"). These new femto-needles, femto-tubes have extraordinary properties such as tensile strength, stiffness, hardness, critical temperature, superconductivity, super-transparency and zero friction. All of these properties are magnified millions of times in comparison to those of conventional molecular matter. Applications include concepts of design for aircraft, ships, transportation, thermonuclear reactors, constructions, and so on from nuclear matter. These vehicles will have unbelievable possibilities such as invisibility, ghost-like penetration through any walls and armor, protection from nuclear bomb explosions and any radiation flux.

But many readers asked about stability of the nuclear matter. It is well-known that the conventional nuclear matter having more than 92 protons or more than 238 nucleons became instable. In given work the author shows the special artificial forms of nuclear AB-matter which make its stability and give the fantastic properties. For example, by the offered AB-needle you can pierce any body without any damage, support motionless satellite, reach the other planet, and research Earth's interior. These forms of nuclear matter are not in nature now, and nanotubes are also not in nature. That artificial matter is made by men. The AB-matter is also not natural now, but researching and investigating their possibility, stability and properties are necessary for creating them.

Key words: femtotechnology, nuclear matter, artificial AB-matter, stability of AB-matter, AB-needles, femtotubes, super strength matter, superthermal resistance, invisible matter, super-protection from nuclear explosion and radiation. Application AB-matter; Stability AB-matter .

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Introduction

In conventional matter made of atoms and molecules the nucleons (protons, neutrons) are located in the nucleus, but the electrons rotate in orbits around nucleus in distance in millions times more than diameter of nucleus. Therefore, in essence, what we think of as solid matter contains a -- relatively! --'gigantic' vacuum (free space) where the matter (nuclei) occupies but a very small part of the available space. Despite this unearthly emptiness, when you compress this (normal, non-degenerate) matter the electrons located in their orbits repel atom from atom and resist any great increase of the matter's density. Thus it feels solid to the touch.

The form of matter containing and subsuming all the atom's particles into the nucleus is named *degenerate matter*. Degenerate matter is found in white dwarfs, neutron stars and black holes. In nature, degenerate matter exists stably to our knowledge only in large astronomical masses because degenerate matter *suddenly* removed from this hypergravitized condition would explosively resume non-degenerate form.

Innovations and computations

Designs of artificial small masses of synthetic degenerate matter which can exist at Earth-normal temperatures and pressures are proposed. Such stabilized degenerate matter in small amounts does not exist in Nature as far as we know, but, nanotubes do not exist in nature either. As the closest to this innovation is nanotubes, this material could have been called femtotubes but our designs are not only tubular in form but also of an extremely thin strong thread (fiber, filament, string), round bar, and net (dense or non dense weave and mesh size) so we name this matter AB-Matter. Some possible forms of AB-Matter are shown in fig.1. Proposed technologies are below. The threads from AB-Matter are stronger by millions of times than normal materials. They can be inserted as reinforcements, into conventional materials, which serve as a matrix, and are thus strengthened by thousands of times (see computation section).

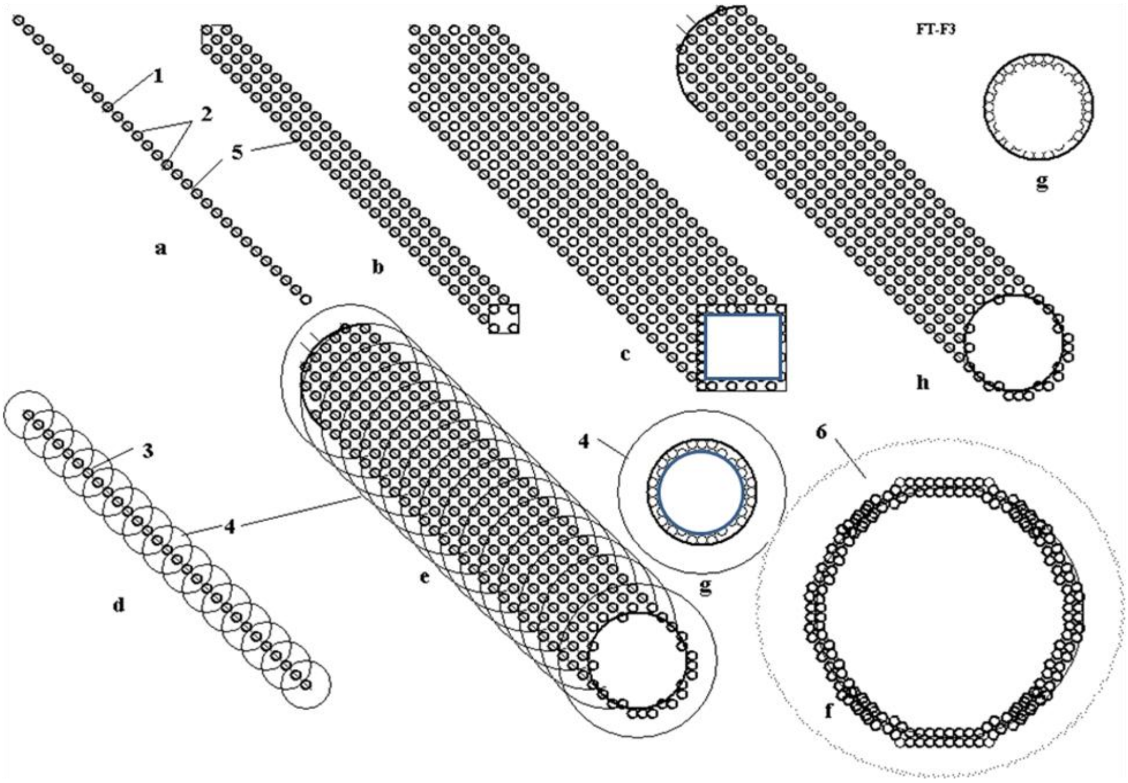


Fig.1. Design of AB-Matter from electrons and nucleons (neutrons, protons, etc.). (**a**) linear one string (monofilament) (fiber, whisker, filament, thread); (**b**) ingot from four nuclear monofilaments; (**c**) multi-ingot from nuclear monofilament; (**d**) string made from protons and neutrons with electrons rotated around monofilament; (**e**) single wall femto tube (SWFT) fiber with rotated electrons; (**f**) cross-section of multi wall femto tube (MWFT) string; (**g**) cross-section of rod; (**h**) - single wall femto tube (SWFT) string with electrons inserted into AB-Matter *Notations*: 1 – nuclear string; 2 nucleons (neutrons, protons, etc.). 3 – protons; 4 – orbit of electrons; 5 – electrons; 6 – cloud of electrons around tube.

Estimation and Computation of properties of AB-Matter

1. **Strength of AB-Matter.**

*Strength (tensile stress) of single string (*AB-Matter *monofilament).* The average connection energy of two nucleons is

$$1 \text{ eV} = 1.6\times10^{-19} \text{ J}, \quad E = 8 \text{ MeV} = 12.8\times10^{-13} \text{ J}. \qquad (1)$$

The average effective distance of the strong force is about l = 2 fm =2×10^{-15} m (1 fm = 10^{-15} m). The average connection force F the single thread is about

$$F_1 = E/l = 6.4\times10^2 \text{ N} . \qquad (2)$$

This is worth your attention: a thread having diameter *100 thousand times less than an atom's diameter* can suspend a weight nearly of human mass. Specific ultimate tensile stress of single string for cross-section area $s = 2\times2 = 4$ fm^2 =4×10^{-30} m^2 is

$$\sigma = F/s = 1.6\times10^{32} \text{ N/m}^2. \qquad (3)$$

Compressive stress for E = 30 MeV and l = 0.4 fm (fig.1) is

$$\sigma = E/sl = 3\times10^{33} \text{ N/m}^2. \qquad (4)$$

The Young's modulus of tensile stress for elongation of break ε =1 is

$$I = \sigma/\varepsilon = 1.6\times10^{32} \text{ N/m}^2. \qquad (5)$$

The Young's modulus of compressive stress for ε =0.4 is

$$I = \sigma/\varepsilon = 7.5\times10^{33} \text{ N/m}^2. \qquad (6)$$

Comparison to steel and nanotubes: Stainless steel has a value of $\sigma = (0.65 - 1)\times10^9$ N/m^2, $I = 2\times10^{11}$ N/m^2 . Nanotubes has $\sigma = (1.4 \div 5)\times10^{10}$ N/m^2, $I = 8\times10^{11}$ N/m^2 . That means AB-Matter is stronger by a factor of 10^{23} times than steel (by 100 thousands billion by billions times!) and by 10^{22} times than nanotubes (by 10 thousand billion by billions times!). Young's modulus, and the elastic modulus also are billions of times more than steel and elongation resistance a thousand times better than the elongation of steel. Strength (average tensile force) of one m thin (one layer, 1 fm) film (1 m compact net) from single strings with step size of grid l = 2 fm =2×10^{-15} m is

$$F = F_1 /l = 3.2\times10^{17} \text{ N/m} = 3.2\times10^{13} \text{ tons/m}. \qquad (7)$$

Strength (average tensile force) of net from single string with step (mesh) size $l = 10^{-10}$ m (less than a molecule size of conventional matter) which does not pass the any usual gas, liquids or solid (an impermeable net, essentially a film to ordinary matter)

$$F = F_1/l = 6.4\times10^{12}\ \text{N/m} = 6.4\times10^{8}\ \text{tons/m}. \qquad (8)$$

That means one meter of very thin (1 fm) net can suspend ***100 millions tons of load.***
The tensile stress of a permeable net (it will be considered later) having $l = 10^{-7}$ m is

$$F = F_1/l = 6.4\times10^{9}\ \text{N/m} = 6.4\times10^{5}\ \text{tons/m}. \qquad (9)$$

2. Specific density and specific strength of AB-Matter.

The mass of 1 m of single string (AB-Matter**.** Monofilament) is

$$M_1 = m/l = 1.67\times10^{-27}/(2\times10^{-15}) = 8.35\times10^{-13}\ \text{kg}. \qquad (10)$$

where $m = 1.67\times10^{-27}$ kg is mass of one nucleon; $l = 2\times10^{-15}$ is distance between nucleons, m., the volume of 1 m one string is $v = 10^{-30}$ m^3. That means the specific density of AB-Matter string and compact net is

$$d = \gamma = M_1/v = 8.35\times10^{17}\ \text{kg/m}^3. \qquad (11)$$

That is very high (nuclear) specific density. But the total mass is nothing to be afraid of since, the dimensions of AB-Matter string, film and net are very small and mass of them are:

a) mass of string $M_1 = 8.35\times10^{-13}$ kg (see (10)), (12)
b) mass of 1 m^2 solid film $M_f = M_1/l = 4.17\times10^{2}$ kg, (13)
c) mass of 1 m^2 impenetrable net $M_i = M_1/l = 8.35\times10^{-3}$ kg, $l = 10^{-10}$ m, (14)
d) mass of 1 m^2 permeable net $M_p = M_1/l = 8.35\times10^{-6}$ kg, $l = 10^{-7}$ m . (15)

As such, nets from AB-Matter have very high strength and very small mass. To provide an absolute heat shield for the Space Shuttle Orbiter that could withstand reentries dozens of times worse than today would take only ~100 kilograms of mass for 1105 square meters of surface and the offsetting supports.

The specific strength coefficient of AB-Matter-- very important in aerospace-- [3]-]5] is

$k = \sigma/d = 1.6\times10^{32}/8.35\times10^{17} = 1.9\times10^{14}\ (\text{m/s})^2 < c^2 = (3\times10^{8})^2 = 9\times10^{16}\ (\text{m/s})^2$.(16)

This coefficient from conventional high strong fiber has value about $k = (1 - 6)\times10^{9}$ [3]-[6].
AB-Matter is 10 million times stronger.

The specific mass and volume density of energy with AB-Matter are

$$E_v = E/v = 1.6\times10^{32}\ \text{J/m}^3, \quad E_m = E/m_p = 7.66\times10^{14}\ \text{J/kg}. \qquad (17)$$

Here $E = 12.8\times10^{-13}$ J is (1), $m_p = 1.67\times10^{-27}$ kg is nucleon mass, kg, $v = 8\times10^{-45}$ m^3 is volume of one nucleon. The average specific pressure may reach

$$p = F_1/s = 12.8\times10^{-13}/4\times10^{-30} = 3.2\times10^{-27}\ \text{N/m}^2.$$

3. Failure temperature of AB-Matter and suitability for thermonuclear reactors.

The strong nuclear force is very powerful. That means the outer temperature which must to be reached to destroy the AB fiber, film or net is $T_e = 6$ MeV. If we transfer this temperature in Kelvin degrees we get

$$T_k = 1.16\times10^{4}\, T_e = 7\times10^{10}\text{K}. \qquad (18)$$

That temperature is 10 thousands millions degrees. It is about 50 - 100 times more than temperature in a fusion nuclear reactor. The size and design of the fusion reactor may be small and simple (for example, without big superconductive magnets, cryogenics, etc). We can add the AB matter has zero heat/thermal conductivity (see later) and it cannot cool the nuclear plasma. This temperature is enough for nuclear reaction of the cheap nuclear fuel, for example, D + D. The AB matter may be used in a high efficiency rocket and jet engines, in a hypersonic aircraft and so on.

No even in theory can conventional materials have this fantastic thermal resistance!

4. Energy generated by production of AB-Matter.

Manufacture of AB-Matter produces a large amount of nuclear energy. That energy is more than the best thermonuclear fusion reaction produces. Joining of each nucleon produces 8 MeV energy, when joining the deuterium D and tritium T (2+3=5 nucleolus) produced only 17.5 MeV (3.6 MeV for every nucleon). If we use the ready blocks of nucleons as the D=^{2}H, T=^{3}H, ^{4}He, etc., the produced energy decreases. Using the ready nucleus blocks may be necessary because these reactions create the neutrons (n). For example:

$$^2\text{H} + {}^2\text{H} \rightarrow {}^3\text{He} + \text{n} + 3.27\ \text{MeV}, \quad {}^3\text{H} + {}^2\text{H} \rightarrow {}^4\text{He} + \text{n} + 17.59\ \text{MeV}, \qquad (19)$$

which may be useful for producing the needed AB-Matter.

Using the ready blocks of nucleons decreases the energy getting in AB-Matter production but that decreases also the cost of needed material and enormously simplifies the technology. A small part (0.7 MeV) of this needed energy will be spent to overcome the Coulomb barrier when the proton joins to proton. Connection of neutrons to neutron or proton does not request this energy (as there is no repulsion of charges). It should be no problem for current technology to accelerate the protons for energy 0,7 MeV.

For example, compute the energy in production of m = 1 gram = 0.001 kg of AB-Matter.

$$E_{1g} = E_1 m/m_p = 7.66\times10^{11}\ \text{J/g}. \qquad (20)$$

Here E_1= 8 MeV= 12.8×10^{-13} J – energy produced for joining 1 nucleon, $m_p = 1.67\times10^{-27}$ kg is mass of nucleon. One kg of gasoline (benzene) produces 44 MJ/kg energy. That means that 1 g of AB-Matter requires the equivalent energy of 17.4 tons of benzene.

5. Super-dielectric strength of AB-Matter film.

Dielectric strength equals

$$E_d = E/l = 8\ \text{MV}/10^{-15}\ \text{m} = 8\times10^{15}\ \text{MV/m}\ . \qquad (21)$$

The best conventional material has dielectric strength of only 680 MV/m [4].

6. AB-Matter with orbiting electrons or immersed in electron cloud.

We considered early the AB-Matter which contains the electrons within its' own string, film or net. The strong nuclear force keeps the electron (as any conventional matter particle would) in its sphere of influence. But another method of interaction and compensation of electric charges is possible– rotation of electrons around AB-Matter string (or other linear member) or immersing the AB-Matter string (or other linear member, or AB-Matter net --) in a sea of electrons or negative charged atoms (ions). The first case is shown in fig. 3d,e,g , the second case is shown in fig. 3f.

The first case looks like an atom of conventional matter having the orbiting electron around the nucleus. However our case has a principal difference from conventional matter. In normal matter the electron orbits around the nucleus as a POINT. In our case it orbits around the charged nuclear material (AB-Matter) LINE (some form of linear member from AB-Matter). That gives a very important difference in electrostatic force acting on the electron. In conventional cases (normal molecular matter) the electrostatic force decreases as $1/r^2$, in our AB-Matter case the electrostatic force decreases as $1/r$. The interesting result (see below) is that the electron orbit in AB-Matter does follow the usual speed relationship to radius. The proof is below:

$$\frac{mV^2}{r} = eE, \quad E = k\frac{2\tau}{r}, \quad mV^2 = 2k\tau e\ , \quad V = \sqrt{\frac{2ke\tau}{m}} = \sqrt{N_p}\,e\sqrt{\frac{2k}{m}} = 22.4\sqrt{N_p}\,, \qquad (22)$$

where $m = m_e = 9.11\times10^{-31}$ kg; V – electron speed, m/s; r is radius of electron orbit, m; τ is charge density in 1 m of single string, C/m; E is electrostatic intensity, A/m or N/C; $k = 9\times10^9$ Nm^2/C^2 is electrostatic constant, $e = 1.6\times10^{-19}$ C is charge of electron, C; N_p is number of proton in 1 m of single string, 1/m. As you see from last equation (22) the electron speed is not relative to radius. The real speed will be significantly less than given equation (22) because the other electrons block the charge of the rest of the string.

The total charge of the system is zero. Therefore we can put N_p =1 (every electron in orbit is kept by only one proton in string). From last equation (22) we find V = 22.4 m/s. That means the electron speed carries only a very small energy. In the second case the AB-Matter (string girder) can swim in a cloud (sea) of electrons. That case occurs in metals of conventional matter. But a lattice of metallic ions fills the volume of conventional metal giving drag to electron flow (causing electrical resistance). The stringers and plate nets of AB-Matter can locate along the direction of electric flow. They constitute only a relatively tiny volume and will produce very small electric resistance. That means the AB-Matter may be quasi-super-conductivity or super-conductivity. The electrons rotate around an AB-Matter string repel one from other. The tensile force from them is

$$F = k\frac{e^2}{d^2}\left(1+\frac{1}{2^2}+\frac{1}{3^2}+\ldots+\frac{1}{n^2}+\ldots\right) = \frac{\pi^2 k}{6}\frac{e^2}{d^2} = 1.476\cdot10^{10}\frac{e^2}{d^2}\ . \qquad (23)$$

For distance $d = 2\times10^{-15}$ m the force equals F = 10.5 N. This force keeps the string and net in unfolded stable form.

Some Properties Of AB-Matter

We spoke about the ***fantastic tensile and compressive strength, rigidity, hardness, specific strength, thermal (temperature) durability, thermal shock, and enormous elongation of*** AB-Matter, there are other almost miraculous properties:

1. *Zero heat/thermal capacity*. That follows because the mass of nucleons (AB-Matter string, film, net) is very small and nucleons have a very strong connection one to other. Conventional atoms and molecules cannot pass their paltry energy to AB-Matter! That would be equivalent to moving a huge dry-dock door of steel by impacting it with very light table tennis balls.

2. *Zero heat/thermal conductivity*. (See above).

3. *Absolute chemical stability*. *No corrosion, material fatigue. Infinity of lifetime*. All chemical reactions are acted through ORBITAL electron of atoms. The AB-Matter does not have orbital electrons (special cases will be considered later on). Nucleons cannot combine with usual atoms having electrons. In particular, the AB-Matter has *absolute corrosion resistance*. *No fatigue of material* because in conventional material fatigue is result of splits between material crystals. No crystals in AB-Matter. That means AB-Matter has lifetime equal to the lifetime of neutrons themselves. Finally a container for the universal solvent!

4. *Super-transparency, invisibility of special AB-Matter-nets*. An AB-Matter net having a step distance (mesh size) between strings or monofilaments of more than 100 fm = 10^{-13} m will pass visible light having the wave length (400 -

800)×10^{-9} m. You can make cars, aircraft, and space ships from such a permeable AB-Matter net and you will see a man (who is made from conventional matter) apparently sitting on nothing, traveling with high speed in atmosphere or space without visible means of support or any visible vehicle! (Any fuel in fuel tanks would be visible also, however…)

5. *Impenetrability for gas, liquids, and solid bodies*. When the AB-Matter net has a step size between strings of less than atomic size of 10^{-10} m, it became impenetrable for conventional matter. Simultaneously it may be invisible for people and have gigantic strength. The AB-Matter net may –as armor--protect from gun, cannon shells and missiles.

6. *Super-impenetrability for radiation.* If the cell size of the AB-Matter net will be less than a wave length of a given radiation, the AB-Matter net does not pass this radiation. Because this cell size may be very small, AB net is perfect protection from any radiation up to soft gamma radiation (include radiation from nuclear bomb).

7. *Full reflectivity (super-reflectivity).* If the cell size of an AB-Matter net will be less than a wavelength of a given radiation, the AB-Matter net will then fully reflect this radiation. With perfect reflection and perfect impenetrability remarkable optical systems are possible. A Fresnel like lens might also be constructible of AB-Matter.

8. *Permeable property (ghost-like intangibility power; super-passing capacity).* The AB-Matter net from single strings having mesh size between strings of more than 100 nm = 10^{-11} m will pass the atoms and molecules through itself because the diameter of the single string (2×10^{-15} m) is 100 thousand times less then diameter of atom (3×10^{-10} m). That means that specifically engineered constructions from AB-Matter can be built on the Earth, but people will not see and feel them. The power to phase through walls, vaults, and barriers has occasionally been portrayed in science fiction but here is a real life possibility of it happening.

9. *Zero friction*. If the AB-Matter net has a mesh size distance between strings equals or less to the atom (3×10^{-10} m), it has an ideal flat surface. That means the mechanical friction may be zero. It is very important for aircraft, sea ships and vehicles because about 90% of its energy they spend in friction. Such a perfect surface would be of vast value in optics, nanotech molecular assembly and prototyping, physics labs, etc.

10. *Super or quasi-super electric conductivity at any temperature*. As it is shown in previous section the AB-Matter string can have outer electrons in an arrangement similar to the electronic cloud into metal. But AB-Matter strings (threads) can be located along the direction of the electric intensity and they will not resist the electron flow. That means the electric resistance will be zero or very small.

11. *High dielectric strength* (see (21)). AB-Matter may be used for devices to produce high magnetic intensity.

Use of AB-Matter. The simplest use of AB-Matter is strengthening and reinforcing conventional material by AB-Matter fiber. As it is shown in the ‘Computation’ section, AB-Matter fiber is stronger (has a gigantic ultimate tensile stress) than conventional material by a factor of millions of times, can endure millions degrees of temperature, and is invulnerable to any attacking chemical reactions. We can insert (for example, by casting around the reinforcement) AB-Matter fiber (or net) into steel, aluminum, plastic and the resultant matrix of conventional material increases in strength by thousands of times—if precautions are taken that the reinforcement stays put! Because of the extreme strength disparity design tricks must be used to assure that the fibers stay ‘rooted’. The matrix form of conventional artificial fiber reinforcement is used widely in current technology. This increases the tensile stress resistance of the reinforced matrix matter by typically 2 – 4 times. Engineers dream about a nanotube reinforcement of conventional matrix materials which might increase the tensile stress by 10 – 20 times, but nanotubes are very expensive and researchers cannot decrease its cost to acceptable values yet despite years of effort.

Another way is using a construct of AB-Matter as a continuous film or net (fig. 5b,d). These forms of AB-Matter have such miraculous properties as invisibility, superconductivity, zero friction, etc. The ultimate in camouflage, installations of a veritable Invisible World can be built from certain forms of AB-Matter with the possibility of being also interpenetable, literally allowing ghost-like passage through an apparently solid wall. Or the AB-Matter net (of different construction) can be designed as an impenetrable wall that even hugely destructive weapons cannot penetrate.

The AB-Matter film and net may be used for energy storage which can store up huge energy intensities and used also as rocket engines with gigantic impulse or weapon or absolute armor (see computation and application sections). Note that in the case of absolute armor, safeguards must be in place against buffering sudden accelerations; g-force shocks can kill even though nothing penetrates the armor!

The AB-Matter net (which can be designed to be gas-impermeable) may be used for inflatable construction of such strength and lightness as to be able to suspend the weight of a city over a vast span the width of a sea. AB-Matter may also be used for cubic or tower solid construction as it is shown in fig.6.

The applications of the AB-Matter are encyclopedic in scope. This matter will create revolutions in many fields of human activity, transportation, energy, construction, security and even in c**omputer and computer memory**. The AB-Matter film allows to write in 1 cm^2 $N = 1/(4\times10^{-26}) = 2.5\times10^{25}$ 1/cm^2 bits information. The current 45 nanometer technology allows to write only $N = 2.5\times10^{14}$ 1/cm^2 bit. That means the main chip and memory of computer based in AB-Matter film may be a billion times smaller and presumably thousands of times faster (based on the lesser distance signals must travel).

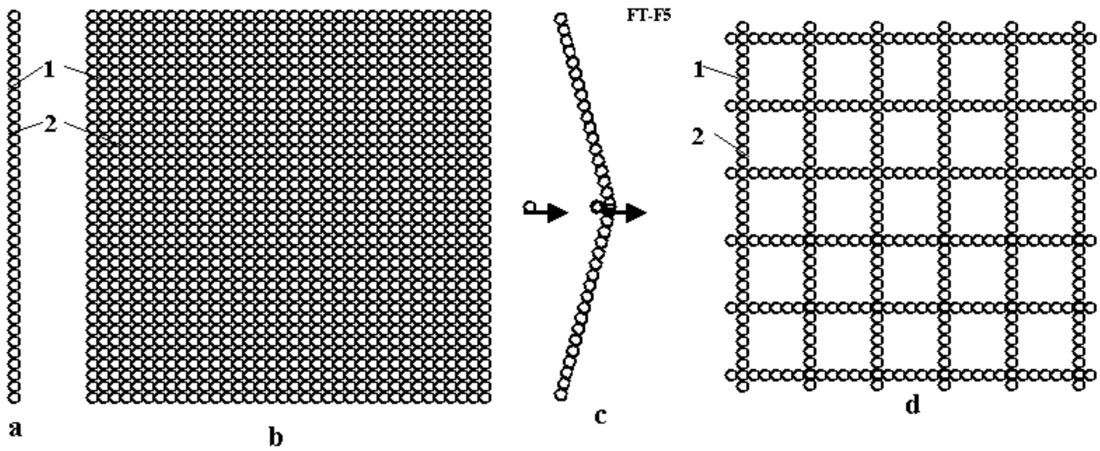
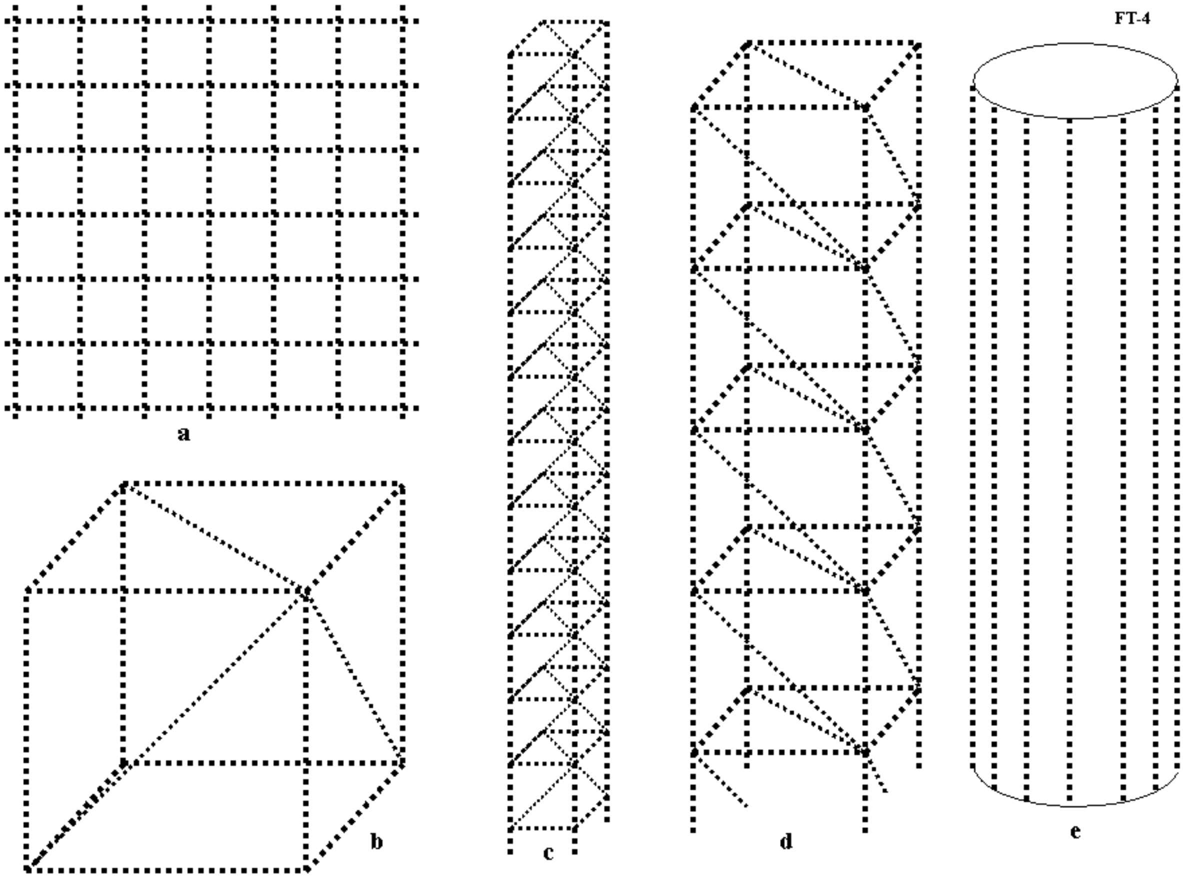


Fig.2. Thin film from nuclear matter. (**a**) cross-section of a matter film from single strings (side view); (**b**) continuous film from nuclear matter; (**c**) AB film under blow from conventional molecular matter; (**d**) – net from single strings. Notations: 1 – nucleons; 2 – electrons inserted into AB-Matter; 3 – conventional atom.



1. **Fig.2.** Structures from nuclear strings. (**a**) nuclear net (netting, gauze); (**b**) cube from matter string; (**c**) primary column from nuclear string; (**d**) large column where elements made from primary columns; (**e**) tubes from matter string or matter columns.

Some proposed technologies for producing AB-Matter.

One method of producing AB-Matter may use the technology reminiscent of a computer chip fab (fig.4). One side of closed box 1 is evaporation mask 2. In the other size are located the sources of neutrons, charged nuclear particles (protons, charged nuclei and their connections) and electrons. Sources (guns) of charged particles have accelerators of particles and control their energy and direction. They concentrate (focus) particles, send particles (in beam form) to needed points with needed energy for overcoming the Coulomb barrier. The needed neutrons are received also from nuclear reactions and reflected by the containing walls.

Various other means are under consideration for generation of AB-Matter, what is certain however is, that once the first small amounts have been achieved, larger and larger amounts will be produced with ever increasing ease. Consider for example, that once we have achieved the ability to make a solid AB-Matter film (a sliced plane through a solid block of AB-Matter), and then developed the ability to place holes with precision through it one nucleon wide, a modified extrusion technique may produce AB-Matter strings (thin fiber), by passage of conventional matter in gas, liquid or solid state through the AB-Matter matrix (mask). This would be a ‘femto-die’. Re-assembling these strings with perfect precision and alignment would produce more AB-Matter film; leaving deliberate gaps would reproduce the ‘holes’ in the initial ‘femto-die’.

The developing of femtotechnology is easier, in one sense, than the developing of fully controllable nanotechnology because we have only three main particles (protons, neutrons, their ready combination of nuclei $_2D$, $_3T$, $_4He$, etc., and electrons) as construction material and developed methods of their energy control, focusing and direction.

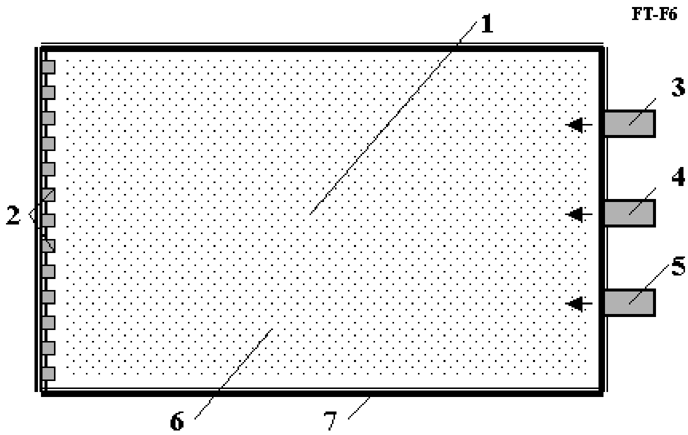


Fig.3. Conceptual diagram for installation producing AB-Matter. Notations: 1 – installation; 2 –AB-Matter (an extremely thin thread round bar, tube, net) and form mask; 3 – neutron source; 4 – source of charged particles (protons, charged nuclei), accelerator of charged particle, throttle control, beam control; 5 - source of electrons, accelerator of electrons, throttle control, beam control; 6 – cloud of particles; 7 – walls reflect the neutrons and utilize the nuclear energy.

Discussion

Contrast to nanotubes

Strength

Carbon nanotubes are the strongest and stiffest materials yet discovered in terms of tensile strength and elastic modulus respectively. This strength results from the covalent sp^2 bonds formed between the individual carbon atoms. In 2000, a multi-walled carbon nanotube was tested to have a tensile strength of 63 gigapascals (GPa). Since carbon nanotubes have a low density for a solid of 1.3-1.4 $g \cdot cm^{-3}$,[1] its specific strength of up to 48,000 $kN \cdot m \cdot kg^{-1}$ is the best of known materials, compared to high-carbon steel's 154 $kN \cdot m \cdot kg^{-1}$. According to our computations, if AB-Matter is stronger by a factor of 10^{23} times than steel (by 100 thousands billion by billions times!) and by 10^{22} times stronger than nanotubes (by 10 thousand billion by billions times!).

Kinetic

Multi-walled nanotubes, multiple concentric nanotubes precisely nested within one another, exhibit a striking telescoping property whereby an inner nanotube core may slide, almost without friction, within its outer nanotube shell thus creating an atomically perfect linear or rotational bearing. While nanotubes may slide “almost without friction” AB-Matter would slide without any friction making possible the first true perpetual motion machine.

Electrical

Because of the symmetry and unique electronic structure of graphene, the structure of a nanotube strongly affects its electrical properties. For a given (n,m) nanotube, if $n = m$, the nanotube is metallic; if $n - m$ is a multiple of 3, then the nanotube is semiconducting with a very small band gap, otherwise the nanotube is a moderate semiconductor. Thus all armchair (n=m) nanotubes are metallic, and nanotubes (5,0), (6,4), (9,1), etc. are semiconducting. In theory, metallic nanotubes can carry an electrical current density of 4×10^9 A/cm^2 which is more than 1,000 times greater than metals such as copper[2].

Thermal

All nanotubes are expected to be very good thermal conductors along the tube, exhibiting a property known as "ballistic conduction," but good insulators laterally to the tube axis. It is predicted that carbon nanotubes will be able to transmit up to 6000 watts per meter per Kelvin at room temperature; compare this to copper, a metal well-known for its good thermal conductivity, which transmits 385 watts per meter per K. The temperature stability of carbon nanotubes is estimated to be up to 2800oC in vacuum and about 750oC in air. According to our computations, AB-Matter of the same form will have the temperature stability in Kelvin degrees is (7×10^{10}K) which is 7 billion millions degrees. It is about 50 - 100 times more than temperature in a fusion nuclear reactor.

Atoms and nuclei.

There are four forces active between particles: strong interaction, weak interaction, electromagnetic charge force (Coulomb) and gravitational force. The nuclear force dominates at distances up to 2 fm (femtometers, (femto, 1 fm = 10^{-15} m). They are hundreds of times more powerful than the charge force and million-millions of times more powerful than gravitational force. Charge force is effective at distances over 2 fm.

Strong nuclear forces are anisotropic (non spherical, force distribution not the same in all directions equally), which means that they depend on the relative orientation of the nucleus. Typical nuclear energy (force) is presented in fig.4. When it is positive the nuclear force repels the other atomic particles (protons, neutrons, electrons). When nuclear energy is negative, it attracts them up to a distance of about 2 fm. The value r0 usually is taken as radius of nucleus. The computation of strong nuclear force - interaction energy of one nucleus via specific density of one nucleus in given point – is present in Fig.4a. The solid line is as computed by Berkner's method [12] with 2 correlations, dotted line is computer generated with 3 correlations, square is experimental. Average interaction energy between to nucleus is about 8 MeV, distance where the attractive strong nuclear force activates is at about 1 – 1.2 fm

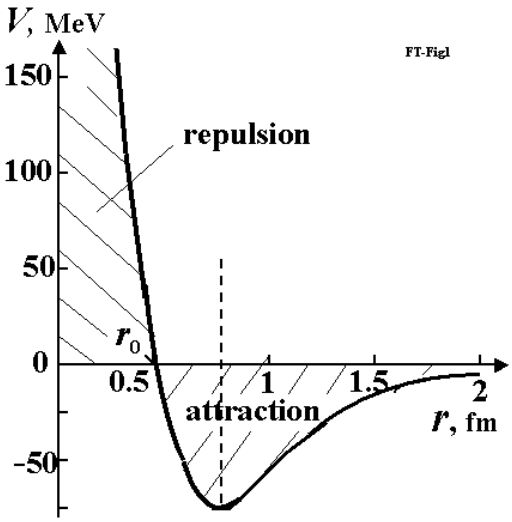


Fig.4. Typical nuclear force of nucleus. When nucleon is at distance of less than 1.8 fm, it is attracted to nucleus. When nucleon is very close, it is repulsed from nucleus.
(Reference from [12] http://www.physicu.narod.ru , Vol. 5 p. 670).

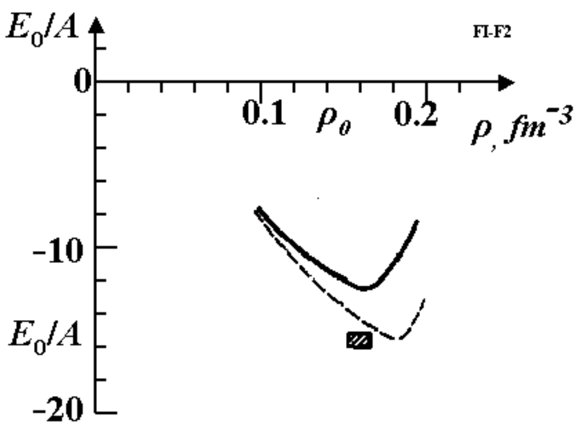


Fig.4a. Connection (interaction) energy of one nucleon via specific density of one nucleon in given point. Firm line is computed by Berkner's method with 2 correlations, dotted line is computer with 3 correlations, square is experiment.
(Reference from [12] http://www.physicu.narod.ru , Vol. 5 p. 655).

While bound neutrons in stable nuclei are stable, outside the nucleus, free neutrons are unstable and have a mean lifetime of 885.7±0.8 s, decaying by emission of a negative electron and antineutrino to become a proton:

$$n^0 \rightarrow p^+ + e^- + \nu e \ .$$

This decay mode, known as beta decay, can also transform the character of neutrons within unstable nuclei. Bound inside a nucleus, protons can also transform via inverse beta decay into neutrons. In this case, the transformation occurs by emission of a positron (anti-electron) and a neutrino (instead of an antineutrino):

$$p^+ \rightarrow n^0 + e^+ + \nu e \ .$$

When bound inside of a nucleus, the instability of a single neutron to beta decay is balanced against the instability that would be acquired by the nucleus as a whole if an additional proton were to participate in repulsive interactions with the other protons that are already present in the nucleus. As such, although free neutrons are unstable, bound neutrons are not necessarily so. The same reasoning explains why protons, which are stable in empty space, may transform into neutrons when bound inside of a nucleus. A thermal neutron is a free neutron that is Boltzmann distributed with kT = 0.024 eV (4.0×10^{-21} J) at room temperature. This gives characteristic, not average, or median speed of 2.2 km/s. Four forces active between particles: strong interaction, weak interacting, charge force (Coulomb force) and gravitation force. The strong interaction is the most strong force in short nuclei distance, the gravitation is very small into atom. Beta decay and electron capture are types of radioactive decay and are both governed by the weak interaction.

Basic properties of the nuclear force.

The nuclear force is only felt among hadrons, a bound state of quarks or particles into nucleous. Hadrons are held together by the strong force, similarly to how atoms are held together by the electromagnetic force. There are two subsets of hadrons: baryons and mesons; the most well known baryons are protons and neutrons. At much smaller separations between nucleons the force is very powerfully repulsive, which keeps the nucleons at a certain average separation. Beyond about 1.7 femtometer (fm) separation, the force drops to negligibly small values. At short distances, the nuclear force is stronger than the Coulomb force; it can overcome the Coulomb repulsion of protons inside the nucleus. However, the Coulomb force between protons has a much larger range and becomes the only significant force between protons when their separation exceeds about 2.5 fm. The nuclear force is nearly independent of whether the nucleons are neutrons or protons. This property is called charge independence. It depends on whether the spins of the nucleons are parallel or antiparallel, and has a noncentral or tensor component. This part of the force does not conserve orbital angular momentum, which is a constant of motion under central forces.

Degenerate matter.

Degenerate matter is matter which has such very high density that the dominant contribution to its pressure rises from the Pauli Exclusion Principle. The pressure maintained by a body of degenerate matter is called the degeneracy pressure, and arises because the Pauli principle forbids the constituent particles to occupy identical quantum states. Any attempt to force them close enough together that they are not clearly separated by position must place them in different energy levels. Therefore, reducing the volume requires forcing many of the particles into higher-energy quantum states. This requires additional compression force, and is manifest as a resisting pressure. Imagine that there is plasma, and it is cooled and compressed repeatedly. Eventually, we will not be able to compress the plasma any further, because the Exclusion Principle states that two particles cannot be in the exact same place at the exact same time. When in this state, since there is no extra space for any particles, we can also say that a particle's location is extremely defined. Therefore, since (according to the Heisenberg Uncertainty Principle) $\Delta p \Delta x = \hbar/2$ where Δp is the uncertainty in the particle's momentum and Δx is the uncertainty in position, then we must say that their momentum is extremely uncertain since the molecules are located in a very confined space. Therefore, even though the plasma is cold, the molecules must be moving very fast on average. This leads to the conclusion that if you want to compress an object into a very small space, you must use tremendous force to control its particles' momentum.

Unlike a classical ideal gas, whose pressure is proportional to its temperature ($PV = NkT$, where P is pressure, V is the volume, N is the number of particles (typically atoms or molecules), k is Boltzmann's constant, and T is temperature), the pressure exerted by degenerate matter depends only weakly on its temperature. In particular, the pressure remains nonzero even at absolute zero temperature. At relatively low densities, the pressure of a fully degenerate gas is given by $P = Kn^{5/3}$, where K depends on the properties of the particles making up the gas. At very high densities, where most of the particles are forced into quantum states with relativistic energies, the pressure is given by $P = K'n^{4/3}$, where K' again depends on the properties of the particles making up the gas.

Degenerate matter still has normal thermal pressure, but at high densities the degeneracy pressure dominates. Thus, increasing the temperature of degenerate matter has a minor effect on total pressure until the temperature rises so high that thermal pressure again dominates total pressure. Exotic examples of degenerate matter include neutronium, strange matter, metallic hydrogen and white dwarf matter. Degeneracy pressure contributes to the pressure of conventional solids, but these are not usually considered to be degenerate matter as a significant contribution to their pressure is provided by the interplay between the electrical repulsion of atomic nuclei and the screening of nuclei from each other by electrons allocated among the quantum states determined by the nuclear electrical potentials. In metals it is useful to treat the conduction electrons alone as a degenerate, free electron gas while the majority of the electrons are regarded as occupying bound quantum states. This contrasts with the case of the degenerate matter that forms the body of a white dwarf where all the electrons would be treated as occupying free particle momentum states.

Pauli principle

The **Pauli exclusion principle** states that no two identical fermions may occupy the same quantum state *simultaneously*. A more rigorous statement of this principle is that, for two identical fermions, the total wave function is anti-symmetric. For electrons in a single atom, it states that no two electrons can have the same four quantum numbers, that is, if n, l, and m_l are the same, m_s must be different such that the electrons have opposite spins. In relativistic quantum field theory, the Pauli principle follows from applying a rotation operator in imaginary time to particles of half-integer spin. It does not follow from any spin relation in nonrelativistic quantum mechanics.

The Pauli exclusion principle is one of the most important principles in physics, mainly because the three types of particles from which ordinary matter is made—electrons, protons, and neutrons—are all subject to it; consequently, all material particles exhibit space-occupying behavior. The Pauli exclusion principle underpins many of the characteristic properties of matter from the large-scale stability of matter to the existence of the periodic table of the elements. Particles with anti-symmetric wave functions are called fermions—and obey the Pauli exclusion principle. Apart from the familiar electron, proton and neutron, these include neutrinos and quarks (from which protons and neutrons are made), as well as some atoms like helium-3. All fermions possess "half-integer spin", meaning that they possess an intrinsic angular momentum whose value is $\hbar = h/2\pi$ (Planck's constant divided by 2π) times a half-integer (1/2, 3/2, 5/2, etc.). In the theory of quantum mechanics, fermions are described by "anti-symmetric states", which are explained in greater detail in the theory on identical particles. Particles with integer spin have a symmetric wave function and are called bosons; in contrast to fermions, they may share the same quantum states. Examples of bosons include the photon, the Cooper pairs responsible for superconductivity, and the W and Z bosons.

A more rigorous proof was provided by Freeman Dyson and Andrew Lenard in 1967, who considered the balance of attractive (electron-nuclear) and repulsive (electron-electron and nuclear-nuclear) forces and showed that ordinary matter would collapse and occupy a much smaller volume without the Pauli principle.

Neutrons are the most "rigid" objects known - their Young modulus (or more accurately, bulk modulus) is 20 orders of magnitude larger than that of diamond. For white dwarfs the degenerate particles are the electrons while for neutron stars the degenerate particles are neutrons. In degenerate gas, when the mass is increased, the pressure is increased, and the particles become spaced closer together, so the object becomes smaller. Degenerate gas can be compressed to very high densities, typical values being in the range of 10^7 grams per cubic centimeter.

Pauli exclusion principle and Heisenberg Uncertainty Principle. **General Question of Stability.**

One may question the compatibility of the Pauli exclusion principle and Heisenberg Uncertainty Principle with AB-Matter. The uncertainty principle is

$$\Delta p \Delta x \geq \hbar / 2 \qquad (27)$$

where $\Delta p = mV$ is momentum of particle, kg·m/s; m is mass particles, kg; V is speed particles, m/s; Δx is distance between particles, m; $\hbar = 6.6262\times10^{-34}/2\pi$ is Planck's constant.

Pauli states that no two identical fermions may occupy the same quantum state *simultaneously*. A more rigorous statement of this principle is that, for two identical fermions, the total wave function is anti-symmetric. For electrons in a single atom, it states that no two electrons can have the same four quantum numbers, that is, if particles characteristics n, l, and m_l are the same, m_s must be different such that the electrons have opposite spins.

The uncertainty principle gives a high uncertainty of Δp for nucleons and very high uncertainty for electrons into AB-Matter. But high density matter (of the same order as our suggested AB-Matter) EXISTS in the form of nuclei of conventional matter and on neutron stars. That is an important proof - this matter exists. Some may question its' ability to stay in a super dense state passively. Some may doubt its' stability free of the fierce gravitation of neutron stars (natural degenerate matter) or outside the confines of the nucleus. But there are reasons, not all stated here, to suppose that it might be so stable under normal conditions.

One proof was provided by Freeman Dyson [11] and Andrew Lenard in 1967, who considered the balance of attractive (electron-nuclear) and repulsive (electron-electron and nuclear-nuclear) forces and showed that ordinary matter would collapse and occupy a much smaller volume without the Pauli principle. Certainly, however this very question of stability will be a key focus of any detailed probe into the possibilities of AB-Matter.

Stability of AB-Matter

I. LAW OF STABILITY OF THE NUCLEAR AB-MATTER

A. *Short Information About Atom and Nuclei*

Conventional matter consists of atoms and molecules. Molecules are collection of atoms. The atom contains a nucleus with proton(s) and usually neutrons (except for Hydrogen-1) and electrons revolve around this nucleus. Every particle may be characterized by parameters as mass, charge, spin, electric dipole, magnetic moment, etc. There are four forces active between particles: strong interaction, weak interaction, electromagnetic charge (Coulomb) force and gravitational force. The nuclear force dominates at distances up to 2 fm (femto, 1 fm = 10^{-15} m). They are hundreds of times more powerful than the charge (Coulomb) force and million-millions of times more than gravitational force. Charge (Coulomb) force is effective at distances over 2 fm. Gravitational force is significant near and into big masses (astronomical objects such as planets, stars, white dwarfs, neutron stars and black holes). Strong force is so overwhelmingly powerful that it forces together the positively charged protons, which would repel one from the other and fly apart without it. The strong force is key to the relationship between protons, neutrons and electrons. They can keep electrons into or near nuclei. Scientists conventionally take into attention only the strong force when they consider the nuclear and near nuclear size range, and the other forces on that scale are negligible by comparison for most purposes.

Strong nuclear forces are anisotropic (non-spherical, force distribution not the same in all directions equally), which means that they depend on the relative orientation of the nucleus. The proton has a magnetic moment which produces the magnetic force. This force orients the proton in magnetic field and helps to keep the form of AB-matter.

Typical nuclear energy (force) is presented in Fig. 4. The nuclear and electric forces can be attractive and repulsive. When it is positive the nuclear force repels the other atomic particles (protons, neutrons). When nuclear energy is negative, it attracts them up to a distance of about 2 fm. The value r_0 is usually taken as radius of nucleus.

B. Law (Necessary Conditions) of Stability the AB-matter

The necessary condition (prerequisite law) of stability the AB-matter are as following:

1) The number of protons must be less approximately 90 into a local sphere of radius 3 fm in any point of AB-matter;

2) The number of nucleons must be less approximately 240 into a local sphere of radius 3 fm in any point of AB-matter;

3) The AB-matter contains minimum two protons.

That law follows from relation between attractive nuclear and repulsive electrostatic forces into nucleus. The nuclear force is short distance force (2 fm), the electrostatic force is long distance force. When number of protons is more than 92, the repulsive electrostatic force may become more than nuclear force and electrostatic force may destroy the AB-matter. That law means the number of nucleons in any cross-section area AB-matter design of Fig. 3 must be less than 37.

The press strong possibilities of the AB-matters are very large because AB-needles has the surprising property discovered by author – keep the huge press force in any length of AB-needle (transfer the pressure to any long distance). That property is described in next paragraph.

II. AB-NEEDLES

The most important design of AB-matter is connection of nucleons in string (Fig. 5a, b, c). That may be only protons *pppp*…. (Fig. 5a), proton-neutron-proton-neutron-…. (*pnpn*….)(Fig. 5b), proton-neutron-neutron-proton-neutron-neutron-…. (*pnnpnn….*)(Fig. 5c). The ends of AB-string contains the protons. The electrostatic repulse force of these end protons is not balanced and creates the strong repulsive force 3 (Fig. 5c,d,e) which stretches the AB-string. That helps to keep the string form and other forms (plate, tube, beam, shaft, rod, etc.) of AB-matter presented in Figs. 3, 5. This is very important properties. This property does not have the conventional molecular matter, because the conventional matter contains the neutral molecules. The charges of ions in conventional matter locate far from one another and repulsive force is small. That property discovered by author gives the AB-string the amusing feature: an independence of the safety press stress from length of the nuclear string. Remand: the safety press force of long conventional matter strong depends on length of wire, beam, shaft, etc. According to the Euler's law the safety compressive force in the ordinary matter is inversely proportional to the square of the length of the rod. If the length of rod is more than the safety length, the construction losses the stability (one is bending). You cannot push the car a thread or thin wire having one km length. They bend. The AB thin string can pass the compressive force for any length of string. That is why it is named the AB-needle. AB-needle allows penetrating into any conventional matter, into the interior of Earth, planets, Sun. They allow making the interplanetary trips and investigations of planet from Earth.

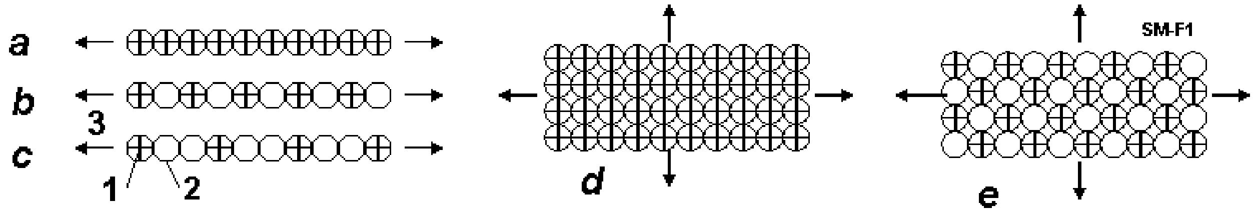


Fig. 5 Connection of nucleons in string (needle) (Fig. 2a, b, c) and film, plate (Fig.5d, e) and Coulomb (electrostatic, repulse) force. *Notations*: 1-protons, 2-neutrons, 3-repulse (Coulomb) force from protons.

A. Computation (Estimation) of Forces in AB-needles

Let us estimate the forces in AB-needle.

1) Nuclear Attractive Force:

The radius of proton is r = 0.877 fm (10^{-15} m). The connection energy of proton and neutron *pn* (^2H or ^2D) is about E = 1 MeV = 1.6×10^{-13} J; the connection energy of *pnn* (^3H or ^3He) is 3 MeV; the energy of *pnpn* (^4He) is 4 MeV. Let us take the average connection energy 2 MeV. The distance (where the nuclear force is active) is about l = 1 fm. Consequently the average attractive nuclear force is

$$F = \frac{E}{l} = \frac{2\times1.6\times10^{-13}}{10^{-15}} = 320\ N \qquad (1)$$

The maximum attractive nuclear force is approximately in two times more, about 600 N. That is huge value because the cross-section area of AB-needle is millions times less than the diameter of the simplest molecules of hydrogen. Note: this force appears only when the outer force went to break the AB-noodle. If there is no outer tensile force, the internal strong nuclear force equals zero.

2) The Repulse Electric Force Between Protons:

Let us consider the AB-needle contains only protons *pppp…* (Fig. 5, mark 1). The repulse force between two protons equals

$$F_{1p} = k\frac{e^2}{(2r)^2}, \qquad (2)$$

where $k = 9\cdot10^9$. Substitute an electric charge $e = 1.6\cdot 10^{-19}$ C and $2r = d$ = 1.754 fm. We receive F_{1p} = 74.8 N. The electric repulsive force decreases with distance $d = 2r$ between protons. If we summarize the repulsive force from all protons in line *pppp*…. of AB-needle (fig.5, marked 1), we receive

$$F_p = 1.64\, F_{1p} \approx 123 \text{ N}. \qquad (3)$$

That means the AB-needle has gigantic internal stress which extends the AB-needle. That extended stress is less than the attractive maximum nuclear force and one does not depend on length of AB-needle. This extended stress decreases the maximal outer stretch force but one allows to keep the AB-needle the compress force while they are less than extended force. If the press force is more than extended force the AB-needle does not break that only bends and continues to keep the maximal press force.

In case the AB-needle has form *pnpn…* (Fig. 5 marked 2) the distance between protons decreases in two times. That means the force F_p (3) decreases in four times ($2^2 = 4$) and equals $F_p \approx 30$ N. In case *pnnpnn…* (Fig. 5, mark 3) the force F_p (3) decreases in nine times ($3^2 = 9$) and equals $F_p \approx 14$ N. This tensile stress is transmitted through the protons to other end of AB-needle. That means the large pressure on the ends of AB-needle is passing along thin AB-needle through electrostatic repel force and one does not depend on length of AB-needle.

Some constructions from AB-string are shown in Fig.6.

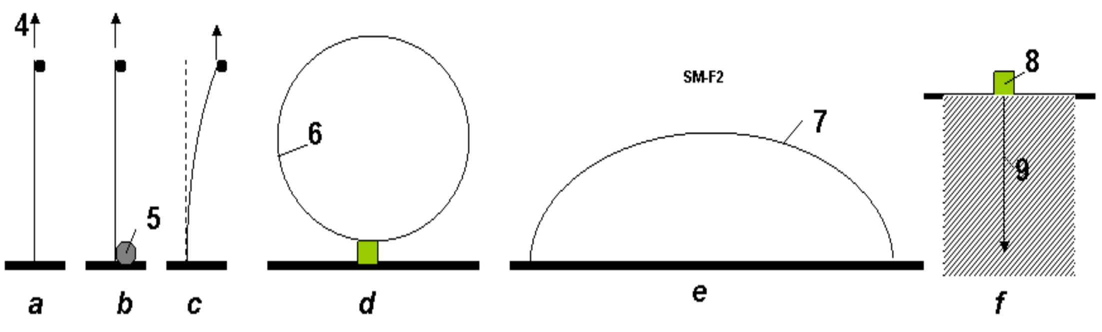


Fig. 6. Some construction from AB-string. *Notations*: *a* – vertical string (AB-needle). The big lift (support) force 4 does not depend from length; *b* – lifting the load to any altitude. 5 - spool of AB-string; *c* – stability of AB-string; *d* – ring 6 from AB-string; *e* – bridge (long arm) from AB-string; *f* – research of the Earth crust interior: 8 - installation (spool of AB-needle), 9 – AB-needle (string, cable).

AB-needls may be illustrated by a children long inflatable air-balloon (Fig. 7a). This press force also does not depend on length of balloon. The force is transferred by compressed air. This idea was used by author in designing the inflatable space tower [5].

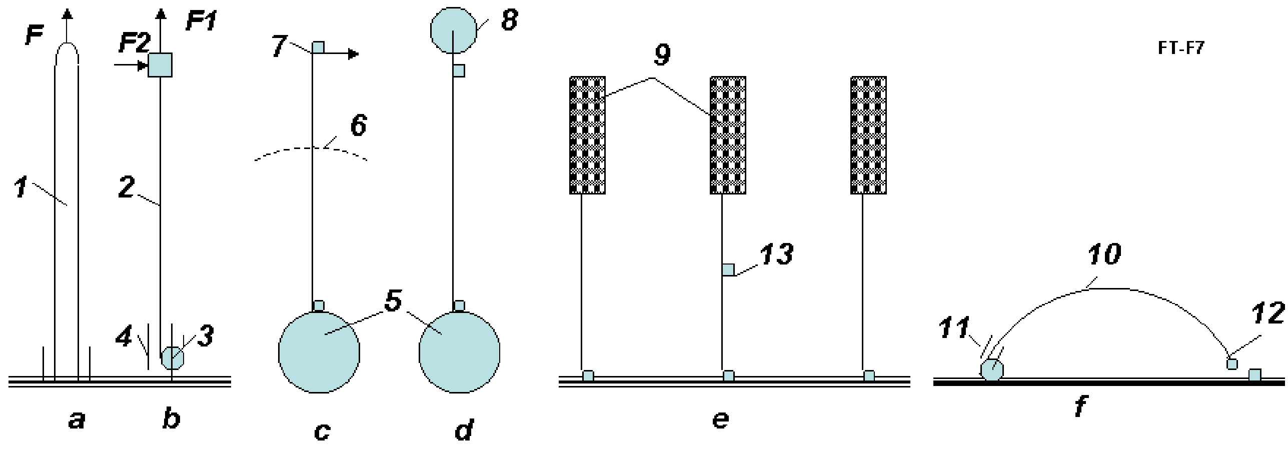


Fig. 7 Applications of AB-needles. *Notations*: *a* – conventional children inflatable long tube illustrated the capability to accept the pressure in end of tube (*F* – force); *b* – illustration of AB-needle to lift the load, accepts the vertical and horizontal forces (*F*1, *F*2 = 0.5*F*1); *c* – AB-needles as the over GSO Space Elevator; *d* – AB-needles as space ship and the investigator of the planet interior (for example Moon); *e* – the building suspended at high altitude by AB – needles, *f* – the investigation of interior of building, men, etc. by AB-needles. 1- conventional children inflatable long tube (air balloon); 2 – AB-needles; 3 – reel of AB-needles; 4 – the guides of AB-needles; 5 – Earth; 6 – Geosynchronous orbit; 7 – space ship; 9 - building; 10 – AB-needle; 11 - the guides of AB-needles; 12 – devices (TV-camera, capture grid, weapon, etc.); 13 – elevator.

The tension F_p activates along all lengths of AB-needle and does not allow to curl the AB-string into the lamb – conventional nucleus. This tension works when there are no other closed protons with a side of the string. When AB-needle is created, the outside protons cannot joint to AB-needle because the protons repel each other. The proton and neutron have the magnetic dipole moments. Magnetic dipole moment of proton equals $+1.41{\cdot}10^{-26}$ J/T, and magnetic dipole moment of neutron equals $-0.966{\cdot}10^{-26}$ J/T. They are small magnets having magnetic force some newtons. That also allows creating the stable AB-needles, to arrange them in a certain position and order. The AB-needle can also keep the maximal side force $F2 \approx 0.5F1$ (Fig. 7b). That allows accelerating anybody (for example space ship) in side direction, to produce an elastic design (for example, air bridge, storage of mechanical energy, long arm (hand), etc.). AB-matter designs do not have the drawbacks of the ordinary matter as fatigue, residual strain and the susceptibility to the external environment.

One meter of AB-needle has line having $n = 5.7{\cdot}10^{-14}$ nucleons with mass $m = 1.67{\cdot}10^{-27}$ kg. Total mass of one meter AB-needle equals only 10^{-12} kg/m.

$$M_1 = nm = 5.7{\cdot}10^{-14} \times 1.67{\cdot}10^{-27} = 10^{-12} \text{ kg/m}.$$

One million kilometers of AB-needle weights only 10^{-3} kg/Mm. For transferring the large force we can take the thin cable from AB-needles.

B. Summary

Three above necessary conditions, repulsive force of protons and magnetic force of nucleons can make the stability of AB-matter.

III. **APPLICATION OF AB-NEEDLES**

Some properties of AB-matter are considered in [1] and here. That has a gigantic strength. The maximal tensile stress equals $\sigma_t \approx 8{\cdot}10^{31}$ N/m^2 (nanotubes has only $\sigma_t \approx 2{\cdot}10^{11}$ N/m^2, that is 100 billion times less), high maximal pressure stress of the long stability AB-needle equals about $\sigma_t \approx 7.5{\cdot}10^{30}$ N/m^2, and the safety temperature is millions of degrees. The many applications of super strong AB-matter are shown in [1-6]. The discovery by author the unique property of super thin AB-needle to transfer the pressure in any long distance opens the new gigantic application of AB-needles. Some of these applications are shown below. In our consideration you must remember that nuclear AB-needle in million times is less than the simplest hydrogen molecule. Our AB-needles in this molecule is as conventional rod traveling in solar system. The probability to meet planet, asteroid or meteor in space is very small. The tens of thousands of the artificial wastes are rotating around (near) Earth. The meet with any of them is catastrophe for satellite or space ship or station. Into molecular space the AB-needle can only meet very rare nucleus. But they charged positive as AB-needle and they will move away by electric force from AB-needle.

A. Penetration into Human Body

We can penetrate into the human body by AB-needle (cable from AB-needles) without body damage. We reach any cells of human body. We can design the artificial arm (hand) (Fig. 7f) of the length in hundreds of kilometers, connect to end of arm the femto TV, femto devices, observe and manipulate into human body.

We can work from distance in hundreds of kilometers. The man will not see our artificial arm and not feel that AB-needle penetrates into his body. We can repair or damage his body. Any conventional wall, armor, underground shelter cannot protest him, except special AB-matter (AB-armor).

We can build (work) the home by AB-hand when we locate hundreds or thousands of kilometers from objects.

B. Geological Exploration

Capability of AB-needle to penetrate into any conventional matter is very useful in geology. The AB-needle having the need of femto devices can reach any depth of the Earth (include kernel) and investigate and research them (Fig. 6f). Search for minerals is greatly simplified. You can find oil, gas, water, gold under your house. Moreover, as it will be shown later you can search minerals in other planets, asteroids without space flight, sitting at home. You can research the internal kernel of Sun because the AB-needle can keep the millions of degrees of temperature.

C. Transportation of Any Body

You can take anything by artificial AB-hand in distance hundreds of kilometers away and move to you or any other place.

D. Air Transportation

You can connect any city by air line of AB-needles (Fig. 7f) and delivery loads. This line is not an obstacle for general aviation and matter. They will not see and not feel it. The cars, tracks, and individual men can move along them using the special hook and motor. For people on ground they are flying in the sky. The invisible air bridge through the strait, river, gulf, canyon, and mountain may be built in some minutes.

E. Suspending Houses

The building may be suspended over Earth (include sea, ocean) surface. The invisible, permeable AB-rod will support them (Fig. 7e). They do not damage environment and conventional building because they do not have the house foundation. People have a beautiful view. The humanity can colonize the sea and ocean.

F. Storage of Mechanical Energy

The AB-cable wounded on a microscopic coil is capable of accumulating the gigantic energy and return it as mechanical energy with 100% efficiency. That may be rotation (as spring in old mechanical clock) or a push force as is shown in Fig. 7b.

Estimation of a maximal specific storage energy E_{ms} [N/kg] approximately is

$$E_{ms} = \frac{F_p L}{2M} \tag{3}$$

where L is length of AB-cable, m; M is mass of AB-cable, kg; F_p is maximal safety repulse force of cable, N. For cable *pnpn…* this energy may be about 10^{13} J/kg. Cable may contain thousands of AB-needles. That is millions of time more than energy in explosive TNT. The density of energy may be also very high value up to 10^{21} J/m^3. That is thousand billions of time more than energy density of a rocket fuel.

G. Protection by AB-matter

The AB-net (Figs. 1d, 2a) may be used as filter for the radiation and molecules (matter). It is known, if the length of radiation wave is less than filter cell, the given type of radiation cannot penetrate through this grid. If diameter of molecule is more than filter cell, the molecule cannot penetrate through the given net. The AB-net (grid) may be used for the separation of different matters (gas or liquid), for example: for getting the fresh water from sea water cheaply; for separation of the carbon dioxide from atmosphere, chimneys, car exhaust tubes, oxygen from atmosphere, radioactive dust from atmosphere and water, etc. The AB-net may be used for protection from dangerous nuclear radiation, poisonous gases, and so on. We can create the invisible light wall which will protect us from terrorists.

Below is Table 1 which shows some properties of protection of some AB-nets.

TABLE 1 PROTECTION OF SOME AB-NETS (PNPN…) AND THEIR PROPERTIES

No	Type of radiation or molecules	Size of AB-net sell, m	Mass of AB-net kg/m^2	Max. press stress, N/m	Max. tensile stress, N/m
1	Visible light	10^{-7}	$2\cdot10^{-5}$	$3\cdot10^{8}$	$3.35\cdot10^{9}$
2	Hard X-ray radiation	10^{-12}	2	$3\cdot10^{13}$	$3.35\cdot10^{14}$
3	Gamma (nuclear) radiation	10^{-13}	20	$3\cdot10^{14}$	$3.35\cdot10^{15}$
4	Protection from AB-needles	$2\cdot10^{-15}$	420	$1.5\cdot10^{16}$	$1.6\cdot10^{17}$
5	Protection from molecules	$2.7\cdot10^{-8}$	$7.4\cdot10^{-5}$	$1.11\cdot10^{9}$	$1.2\cdot10^{10}$

H. AB-needles and Space Flight

The AB-needles (cables) open the gigantic possibilities in the space research and flight.

You can use the AB-hand manipulator (arm) from AB-needs having length of hundreds of millions kilometers and keeping the femto devices in end (Fig. 7d). If mass of devices is 1 – 10 kg, the mass of AB-hand must be 1 – 10 grams for 1 million of kilometers. The distance to Moon is 384,400 km, to Mars 78 millions km (when Mars is closest position, every two years). You can study and research these space bodies (include interior) from your home. Moreover, using the power AB-hand, you can build house on the planet before you will travel to it.

We can lift by AB-cable the loads into space in a distance in thousand km (Figs. 6b, 7b), keep the motionless satellites, and delivery the satellites to other planets. There is no problem to build the Space Elevator including GEO (and over) Space Elevator from Earth surface (Fig. 7c). There is no problem with conventional cable for Space Elevator. Any space garbage, meteorite from conventional matter cannot damage the femto cable because the femto cable penetrates the nano matter.

We can free and quick flight to space in the manner space ships (Fig. 7d). The small spool of AB-cable will accelerate and inhibit the space ships and permanent connection of him to Earth. Below in Table 2 reader finds computation of the time, speed and some other parameters of space flights to planets of solar system by offering AB-space ship.

TABLE 2. COMPUTATION OF SPACE FLIGHT TO SOLAR PLANETS BY MANNER AB-SPACE SHIP. THE ACCELERATION AND INHIBITION HAVE G = 10M/S^2, MASS OF SPACE SHIP IS 3 TONS.

No.	Planet	Distance from Sun 10^{10} km	Distance from Earth 10^{10} km	Flight* time, 10^3 sec	Flight time, Days	Max. speed, km/s	Mass of AB-cable kg
1	Mercury	5.79	9.2	19.2	2.22	1382	184
2	Venus	10.8	4.2	13	1.5	1140	84
3	Earth	15	0	-	-	-	-
4	Mars	22.8	7.8	17.7	2.04	883	154
5	Jupiter	77.8	62.8	50.1	5.8	2239	1356
6	Suturn	142.7	127.7	71.5	8.28	2674	2550
7	Uranus	286.9	281.9	107	12.4	3271	5638
8	Neptune	449.7	434.7	132	15.3	3633	8694
9	Moon	-	0.0384	1.24	0.14	352	0.77
10	Sun	-	15	25.5	3	1597	300

*include inhibition with g = 10 m/s^2.

In any case the safety press force is very high because we can take thousands of AB-needles and push any load (space ship, anybody) or keep them at any altitude.

IV. PRODUCTION OF AB-NEEDLES

The charged particles interact with electric and magnetic fields. The magnetic moment interacts with magnetic field. That allows designing the technologies for production of artificial AB-matter. Some offered technologies were described in [1]. Here the author offers some new technologies.

The possible particles are shown in Table 3.

TABLE 3 CHARGE, IMPULSE AND MAGNETIC MOMENTS OF SOME NUCLEUS

Z	Nucleus (particles)	Charge $+e$=1.6·10^{-19} C	Mass number	Impulse moment, $\hbar$	Magnetic* moment, μ_N
0	n	0	1	1/2	-1.9125
1	p	1	1	1/2	2.7828
1	^{2}H = D	1	2	1	0.8565
2	^{3}He	2	3	1/2	-2.121
2	^{4}He	2	4	0	0
3	^{6}Li	3	6	1	0.821
3	^{7}Li	3	7	3/2	3.2332

*Nuclear magnetron μ_N = 5.051·10^{-27} J/T. Sign "-"shows: magnetic moment is opposite the impulse moment.

A. Notes About Possible Form AB-needles

The possible form of AB-needles is shown in Fig. 8.

The first form marked 1 (pppp…) contains only line of protons. This form is cheapest and has maximum pressure strength. But it is unknown whether this form is possible or not. It is known the single hydrogen and single proton are stable. In other side the fusion of two single hydrogen nuclei ^{1}H (protons) produces deuterium ^{2}H= D (*pn*) releasing a positron and a neutrino as one proton changes into a neutron:

$$^1\text{H} + {}^1\text{H} \rightarrow {}^2\text{H} + \underline{e^+} + \underline{\nu_e} + 0.42 \text{ MeV} \qquad (4)$$

The fusion reaction released in this step produces energy up to 0.42 MeV. The most of this energy is taken away by neutrino.

The positron immediately annihilates with an electron, and their mass energy is carried off by two gamma ray photos:

$$e^{+} + e^{-} \rightarrow 2\gamma + 1.02 \text{ MeV} . \qquad (5)$$

But most nucleuses have a lot of protons and they do not rely on the reaction (4). The AB-needle also has a lot of protons. If reaction (4) is released, the form 1 transfers in form 2 (Fig. 8) and the process produces a lot of nuclear energy. The ionized conventional hydrogen ^1H may be used for production of AB-matter. I remain: the Universe is composed of about 80% hydrogen. As a result we will have the AB-needle in form *npnp*… .

The second form of AB-needle is *pnpn*… marked 2 (Fig. 8). This form may be produced directly from deuterium *D* oriented by magnetic field along axis of AB-needles. The third form of the double AB-needles marked 3 (Fig. 8) may be also produced directly from deuterium *D* oriented by magnetic field perpendicular of axis of AB-needles. The forth form of four-needles marked 4 (Fig. 8) may be produced directly from helium ^4He oriented by magnetic field perpendicular of axis of AB-needles.

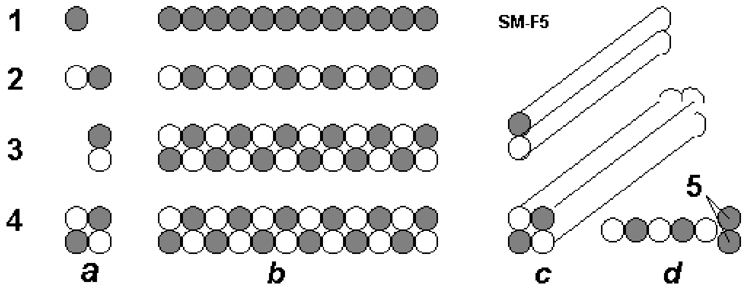


Fig. 8 Types of AB-needles. *Notations*: *a* – Nucleus: black is *p*, white is *n*; *b* – AB-needles (side view); c – AB-needles in isometrical view; *d* – increasing the internal tensile stress by the double protons (5) located in the end of single AB-needle from protons (for increasing the tensile stress); 1- protons (p). Single AB-needles from proton; 2 – deuterium ^2H = D (*pn*). Single AB-needles from deuterium; 3 - deuterium ^2H (*pn)*. Double AB-needles from deuterium; 4 – helium ^4He. 4 – square AB-needles from helium. 5 – double protons in end of single AB-needle.

B. Installations for Production AB-needles

1) The First Method: Toroid Method:

One of installation for production of AB-needles is shown in Fig. 9. The installation has a vacuum topoid 1 and particles gun 4 which injects charged particles into toroid. The perpendicular (to fig.) magnetic lines 2 penetrate the toroid. As a result the charged particles 3 move in circles inside the toroid. This electric current of particles produces the magnetic field 5 (pinch-affect). This field pulls the particles in a cord and helps to keep them into the toroid ring.

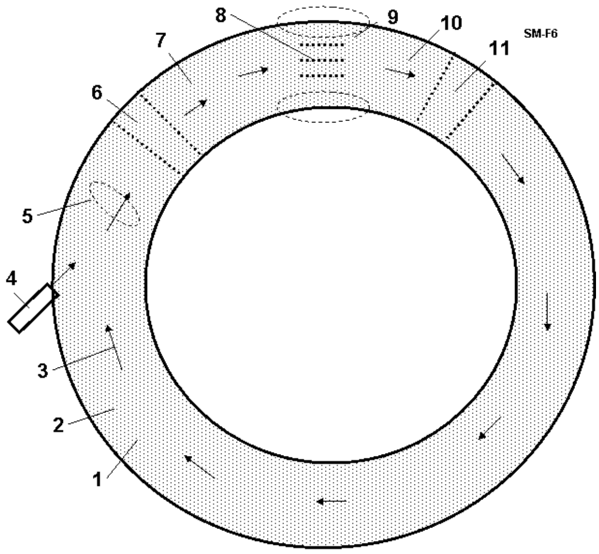


Fig. 9 Toroid producer of AB-needles (AB-matter). *Notations*: 1 – vacuum toroid; 2 – perpendicular (to sketch) magnetic lines; 3 – particles; 4 - particles gun; 5 – round magnetic lines from motion charged particles; 6 – electric accelerator; 7 – electric focuser; 8 – AB – needles; 9 – magnetic field keeping the AB-needles; 10 – electric focuser; 11 – electric accelerator.

The producing AB-needles 8 locate inside the toroid ring and are kept by special local magnetic field 9 in position along the circle axis of the toroid ring. That means the moving particles can connect to AB-needles only to end nucleus when they collide the forward end of AB-needle and their energy is sufficient to overcome the Coulomb repulsion. The toroid ring has the accelerators 6, 11 and focusers 7, 10 of particles. Their electric fields collect the scattered charged particles back to toroid axis.

Probability of hitting in the front end of the AB-needles is small. But the charged particles rotate into toroid a lot (millions) of times and join to end of AB-needles. Note they can connect only to end of AB-needle. Their perpendicular speed to the toroid circle axis is not enough to overcome the nuclear repulsion force.

Author wrote only the principal scheme (schematic diagram) of the AB-needle producing. The developing of this method may request a big research and work.

2) The Second Method: Method Particles Traps:

That is shown in Fig. 10. That is closed to method described in [1]. Feature is the net of traps 8 (Fig. 10a and 10b). They catch the particles and direct them to end of creating AB-needles. Advantage is high efficiency of production AB-matter (every charged particle will be used, small of energy consumption). Lack is the request of a special form of AB-matter (see 8 in Fig. 10b). That method may be useful when we have enough AB-matter.

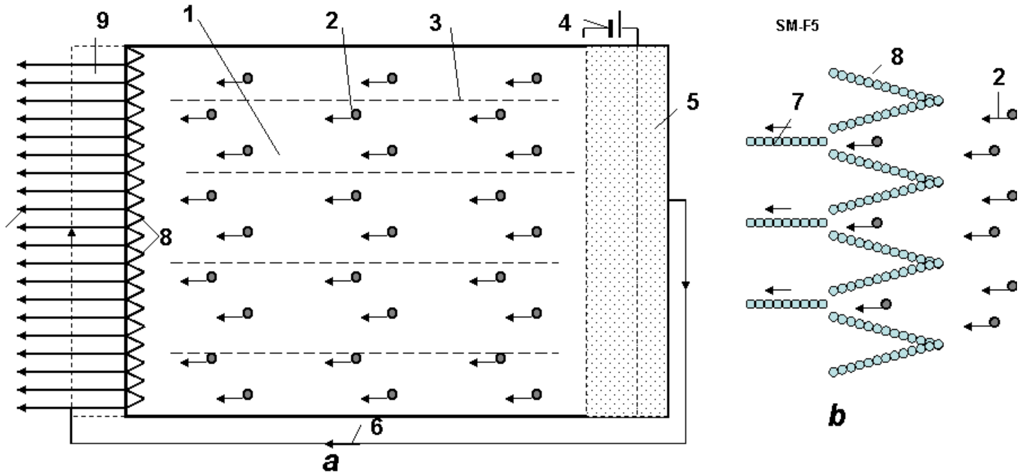


Fig. 10. Method particle traps for production of the AB-needles. *Notations*: *a* – device; *b* – particle traps; 1 - vacuum cell; 2- charged particles; 3 – magnetic lines; 4 – electric issue for the acceleration nets; 5 - plasma from particles; 6 – flow of electrons; 7 – AB-needles; 8 – trap made from AB-matter for the charged particles (p, ^{2}H, ^{4}He, etc.); 9 – cell for cover the AB-needles by electrons.

3) The Third Method: Method Standing Waves:

The current special mirrors [4, Ch.12] and lasers allow to create the net of electromagnetic traps for AB-matter producer (Fig. 11) from the monochromatic polarized electromagnetic standing waves (Fig. 11a, b). That net may partially change the net of AB-matter traps of the Fig. 10b and increase the efficiency. This method may be useful for AB-matter producer in [1].

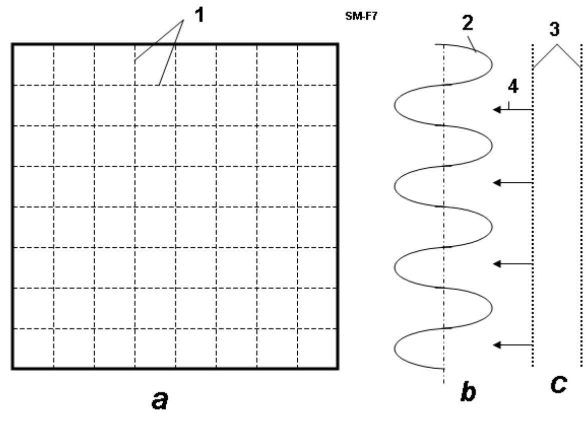


Fig. 11. Net of electromagnetic traps for AB-matter producer. *Notations*: *a* – forward view; *b* – the monochromatic polarized electromagnetic standing waves (electrostatic part, side view); *c* – particles storage and accelerator; 1 – net from the perpendicular monochromatic polarized electromagnetic standing waves; 2 - the electromagnetic monochromatic polarized standing wave; 3 – electric accelerator of particles; 4 – particles.

The threads from AB-matter are stronger by millions of times than normal materials. They can be inserted as reinforcements, into conventional materials, which serve as a matrix, and are thus strengthened by thousands of times (see computation section in [1]).

The offered AB-producers can be used for producing the new NANO-matters. Now the scientist offers to produce nano-matters by nano-robots. I think that is a very difficult way. The nano-robot must have the devices for searching, recognizing, catching the flying molecules, deliver them in given place, and connect to other selected molecules. That means the nano-robot must have a million molecules. It is difficult to get an elephant to catch the flies and glue them from the device. This productivity will be very low. The production of AB-matter may be easy.

Also we can ionize the molecules (create the charged particles!) and apply the modified offered methods for design and production of the nano-matters.

V. **DISCUSSION**

The humanity will make a gigantic jump in technology when one will produce AB-matter. We consider unconventional application of AB-matter.

A. Super Micro-World from AB-Matter: An Amusing Thought-Experiment

AB-matter may have $10^{15} \div 10^{43}$ times more particles in a given volume than a single atom. A human being, man made from conventional matter, contains about 5×10^{26} molecules. That means that 'femto-beings' of equal complexity from AB-matter (having same number of components) could be located in the volume of one microbe having size 10 μ = 10^{-5} m. It is difficult to make the nano-robot (one is large for Nano World). But the smart small femto-robot is suitable for Nano World. In future the people could make the artificial intelligent super micro F-beings which can withstand a huge temperature, acceleration of electric field, travel to other stars, other galactic, live in stars and travel through black holes to other universes and times.

B. Stability of AB-matter

Readers usually ask: the connection (proton to proton) gives a new element when, after 92 protons, this element is unstable?

Answer: That depends entirely on the type of connection. If we conventionally join the carbon atom to another carbon atom a lot of times, we then get the conventional piece of a coal. If we join the carbon atom to another carbon atom by the indicated special forms, we then get the very strong single-wall nanotubes, graphene nano-ribbon (super-thin film), armchair, zigzag, chiral, fullerite, torus, nanobud and other forms of nano-materials. That outcome becomes possible because the atomic force (van der Waals force, named for the Dutch physicist Johannes Diderik van der Waals, 1837-1923, etc.) is non-spherical and active in the short (one molecule) distance. The nucleon nuclear force is also non-spherical and they may also be active about the one nucleon diameter distance (Fig. 1). Moreover, the nucleus has a tensile electrostatic force which allows designing the long linear structures. Moreover, the proton is a small magnet. The magnets (and nucleus) connect one to other specific side. That means we may also produce with them the strings, tubes, films, nets and other geometrical constructions.

The further studies are shown that AB-matter will be stable if:

1) The any sphere having radius $R \approx 6\times10^{-15}$ m in any point of structure Figs. 1- 4 must contain no more than 238 nucleons (about 92 of them must be protons). That means any cross-section area of the solid rod, beam and so on of AB-structure (for example figs. 1b,c,g) must contain no more than about 36 nucleons in any circle with $R \approx 6\times10^{-15}$ m.

2) AB-matter must contain the proton in a certain order because the electrostatic repel forces of them give the stability of the given structure.

3) The magnetic force of protons also allows giving the different forms of AB-matter.

Conclusion

The author offers a design for a new form of nuclear matter from nucleons (neutrons, protons), electrons, and other nuclear particles. He also suggests the necessary conditions of stability of AB-matter. He shows that the new AB-matter has most extraordinary properties (for example, (in varying circumstances) remarkable tensile strength, stiffness, hardness, critical temperature, superconductivity, super-transparency, ghostlike ability to pass through matter, zero friction, etc.), which are millions of times better than corresponded properties of conventional molecular matter. He shows (in [2]) how to design aircraft, ships, transportation, thermonuclear reactors, and constructions, and so on from this new nuclear matter. These vehicles will have correspondingly amazing possibilities (invisibility, passing through any wall and amour, protection from nuclear bombs and any radiation, etc).

People may think this is fantasy. But fifteen years ago most people and many scientists thought nanotechnology is fantasy. Now many groups and industrial labs, even startups, spend hundreds of millions of dollars for development of nanotechnological-range products (precise chemistry, patterned atoms, catalysts, metamaterials, etc) and we have nanotubes (a new material which does not exist in Nature!) and other achievements beginning to come out of the pipeline in prospect. Nanotubes are stronger than steel by a hundred times—surely an amazement to a 19th century observer if he could behold them.

Nanotechnology, in near term prospect, operates with objects (molecules and atoms) having the size in nanometer (10^{-9} m). The author here outlines perhaps more distant operations with objects (nuclei) having size in the femtometer range, (10^{-15} m, millions of times smaller than the nanometer scale). The name of this new technology is femtotechnology.

Researching and developing femtotechnology may progress more quickly than the further prospects of nanotechnology, because we have fewer (only 3) initial components (proton, neutron, and electron) and interaction between them is well-known (3 main forces: strong, weak, and electrostatic). The different conventional atoms number about 100, most common molecules are tens thousands and interactions between them are very complex (e.g. Van der Waals force). It may be however, that nano and femto technology enable each other as well, as tiny bits of AB-Matter would be marvelous tools for nanomechanical systems to wield to obtain effects unimaginable otherwise.

I want to explain the main thrust of this by analogy. Assume some thousands of years ago we live in a great river valley where there are no stones for building and only poor timber. In nature we notice that there are many types of clay (nuclei of atom—types of element). One man offers to people to make from clay bricks (AB-Matter) and build from these bricks a fantastic array of desirable structures too complex to make from naturally occuring mounds of mud. The bricks enable by increased precision and strength things impossible before. A new level of human civilization begins.

What time horizon might we face in this quest? The physicist Richard Feynman offered his idea to design artificial matter from atoms and molecules at an American Physical Society meeting at Caltech on December 29, 1959. But only in the last 15 years we have initial progress in nanotechnology. On the other hand, progress is becoming swifter as more and better tools become common and as the technical community grows.

Now we are in the position of trying to progress from the ancient ‘telega’ haywagon of rural Russia (in analogy, conventional matter composites) to a ‘luxury sport coupe’ (advanced tailored nanomaterials). The author suggests we have little to lose and literal worlds to gain by simultaneously researching how to leap from ‘telega’ to ‘hypersonic space plane’. (Femotech materials and technologies, enabling all the wonders outlined here) [1 – 18].

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Bolonkin is the author of more than 200 scientific articles and books and has 17 inventions to his credit. His most notable books include The Development of Soviet Rocket Engines (Delphic Ass., Inc., Washington , 1991); Non-Rocket Space Launch and Flight (Elsevier, 2006); New Concepts, Ideas, Innovation in Aerospace, Technology and Human Life (NOVA, 2007); Macro-Projects: Environment and Technology (NOVA, 2008 LIFE; Human Immortality and Electronic Civilization, 3-rd Edition, (Lulu, 2007; Publish America, 2010): LIFE. SCIENCE. FUTURE (Biography notes, researches and innovations). Scribd, 2010, 208 pgs. 16 Mb. http://www.scribd.com/doc/48229884 ; Innovations and New Technologies. Scribd, 2013. 309 pgs. 8 Mb. http://viXra.org/abs/1307.0169.

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