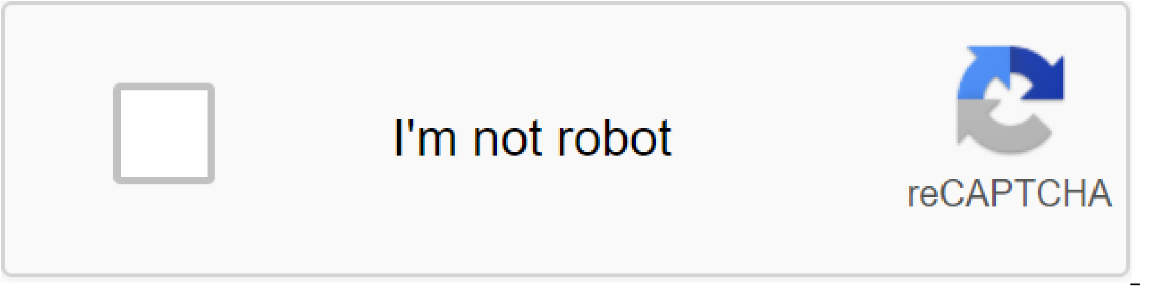
Binding energy per nucleon pdf



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The binding energy curve is derived by dividing the total energy of the nuclear binding by the number of nucleons. The fact that there is a peak curve linking energy in the area of stability near iron, means that either the disintegration of heavier nuclei (cleavage) or the merging of lighter nuclei (merging) will give the nuclei that are more closely related (less mass on the nucleon). The binding nucleon energies are in the range of millions of electron volts compared to dozens of eV for atomic electrons. While the atomic transition may emit photon in the range of several volts of electrons, possibly in the field of visible light, nuclear transitions can emit gamma rays with quantum energies in the MeV range. The accumulation of heavier elements in nuclear fusion processes in stars is limited to elements below iron, as the fusion of iron subtractes energy rather than provides it. The iron-56 is replete with stellar processes, and with the binding energy to the nucleus of 8.8 MeV, it is the third most tightly bound of nuclides. Its average binding energy per nucleus is exceeded by only 58Fe and 62Ni, the nickel isotope is the most tightly bound of nuclides. The most tightly bound nucleus, which calculates the mass defect and the nuclear binding energy of the nuclear binding energy atom, is the energy needed to separate the nucleus of the atom into its components. Nuclear binding energy is used to determine whether division or fusion will be a favorable process. A mass core defect is the mass of energy that binds the nucleus and represents the difference between the mass of the nucleus and the mass of the nuclei from which it is composed. Nuclear binding energy is the energy needed to separate the nucleus of an atom into its constituent parts: protons and neutrons, or, collectively, the nucleus. The energy-binding nucleus is always a positive number, as all nuclei require pure energy to divide into separate protons and neutrons. Mass defective nuclear binding energy makes a noticeable difference between the actual mass of the nucleus of the atom and its expected mass based on the masses of its unrelated components. Recall that energy (E) and mass (m) are connected by equation: latexE'mc/latex Here, c is the speed of light. In the case of nuclei, the energy binding is so large that it accounts for a significant amount of mass. The actual mass is always smaller than the sum of the individual masses of protons and neutrons, because the energy is removed when the nucleus is formed. This energy has a mass that is removed from the total mass of the original particles. This mass, known as a mass defect, is absent from the resulting nucleus and represents the energy released by the formation of the nucleus. Mass defect (Md) can be calculated as the difference between the observed atomic mass (mo) and the expected latex M_d (m_n-m_p)-m_o/latex nuclear binding energy Once a mass defect is known, nuclear binding energy can be calculated by converting this mass into energy with E'mc2. The mass should be in units of kg. Once this energy, which is the number of joules for a single nucleus, is known, it can be reduced in quantity to the nucleus and per mole. To convert into a joule/mole, just multiply by the avogadro number. To convert the joules to the core, simply divide by the number of nucleons. Nuclear binding energy can also be applied to situations where the nucleus breaks down into fragments consisting of several nuclei; in these cases, the binding energies for fragments, compared to the whole, can be positive or negative, depending on where the parent core and daughter fragments fall on the curve of the nuclear binding energy. If a new binding energy is available when light nuclei merge, or when heavy nuclei disintegrate, any of these processes leads to the release of binding energy. This energy, available as nuclear energy, can be used to produce nuclear energy or to create nuclear weapons. When a large nucleus breaks apart, excess energy is emitted as photons, or gamma rays, and as kinetic energy as a number of different particles are emitted. Nuclear binding energy is also used to determine whether division or fusion will be a favorable process. For elements easier than iron-56, synthesis will release energy because nuclear binding energy increases with mass gain. Elements heavier than iron-56 usually release energy during fission, as the lighter elements produced contain greater nuclear binding energy. Thus, there is a peak on iron-56 on the nuclear energy binding curve. Nuclear binding energy curveThis graph shows nuclear binding energy (in MeV) on the nucleus as a function of the number of nuclei in the nucleus. Note that iron-56 has the most binding energy to the core, making it the most stable core. The rationale for this peak of binding energy is the interaction between the coulombic repulsion of the protons in the nucleus, because like accusations repelling each other, and a strong nuclear force, or a strong force. A strong force is what keeps protons and neutrons together at short distances. As the core size increases, a strong nuclear force is felt only between the nuclei that are close to each other, while the coulombic repulsion continues to be felt throughout the core; this leads to instability and, consequently, radioactivity and fissile nature of heavier elements. Example Calculate the average энергию на родинку изотопа U-235. Покажите свой ответ в kJ/mole. Во-первых, необходимо рассчитать дефект массы. U-235 имеет 92 протона, 143 нейтрона, и имеет наблюдаемую массу 235.04393 amu. (латекс) Нет, нет, нет. M_d(m_n)-m_p-m_o/латекс M_d(m_n)-m_p-m_o/латекс - (92(1.00728 amu) - 143 (1.00867 amu)) - 235.04393 amu Md - 1.86564 amu Рассчитайте массу в кг: 1.86564 amu x (латекс) «6.02214»times10»{26} »амуэ/латекс» 3,09797 x 10-27 кг Теперь рассчитайте энергию: E -2 E 3.09797 x 10-27 кг x (2.99792458 x x 3.09797 x x 10-27 кг x (2.99792458 x x 10-27 кг x (2.99792458 x x 10-27 кг x (2.99792458 x x 10-27 кг x 108(латекс)frac'm's/latex)2 E (2.7843 x 10-10 J Теперь конвертировать в kJ на моль: «латекс» 2.7843 'times10'-10'frac'Joules'atom В этой статье для проверки необходимы дополнительные цитаты в 6,02«times10»{23}» атомов «крот» (frac)1 кДж 1000 йоулз»/латекс 1.6762 x 1011.latex.frac'kJ'mole/latex. Пожалуйста, помогите улучшить эту статью, добавив цитаты в надежные источники. Неисточники материалов могут быть оспорены и удалены. Найти источники : Nuclear Binding Energy - News Newspaper Book Scientist JSTOR (October 2014) (Learn how and when to delete this template message) Core nuclear physics Nucleons (p, n) Nuclear Matter Nuclear Power Nuclear Force Nuclear Reaction Model Nucleus Liquid fall Model Nuclear Shell Interactive model boson Classification Ab initio NuclidesIsotopes - equal to sisobars - equal Aisotone - equal Nizodiafers - equal N and Izomers - equal to all of the aforementioned coresMirror - ↔ N Stable Magic Even/Odd Halo (Borromean) Nuclear StabilityLemable Energy Ratio p-n Drop Line Island Stability Valley Stability Valley Radioactive DecayLief α Beta β (2 , β) Capture K/L Isomerik (Gamma γ Internal Transformation) Spontaneous Division Cluster Decay Neutron Radiation Proton Radiation Proton EmissionDecet Energy Decay Chain Decay Product Radiogenic Nucleid Nuclear DivisionSpontane Products (couple of ruptures) Processes photophysics Captureelectron (2×) neutron (s) proton (r-r) Highly energy-implanting processesSpalation (space beam) Photodisciary Nucleosynthesis and nuclear astrophysicsYnuclear thermonuclear processes : Stellar Big Explosion SupernovaNuclides: Original Cosmogenic Artificial Artificial Nuclear PhysicsCwark-Gluon Plasma RIC LHC ScientistsAlvarez Becquerel Bete A. Bor N. Bor Chadwick Cockcroft Yr Curie O. Curie Pi. Curie Sklodowska-Curie Davisson Fermi Khan Jensen Lawrence Mayer (en) Meifner Oliphant Oppenheimer Proca Purcell (ru) Rabi Rutherford Soddy Strassmann Svelard Teller Thomson These constituent parts are neutrons and protons, collectively called nucleon. The binding energy is always a positive number, as we must expend energy on moving these nuclei attracted to another strong nuclear force, away from each other. The mass of the atomic nucleus is smaller than the sum of individual masses of free protons and neutrons, according to Einstein's E'mc2 equation. This missing mass is known as a massive defect and is an energy that was released when the nucleus was formed. The term nuclear binding energy can also refer to the energy balance in processes in which the nucleus breaks down into fragments consisting of several nuclei. If a new binding energy is available when the lungs are synthesis (nuclear fusion) or when heavy nuclei (nuclear fission) are separated, any process can lead to the release of this binding energy. This energy can be accessed as nuclear energy and can be used to generate electricity in both nuclear and nuclear weapons. When a large nucleus breaks apart, excess energy is emitted as a photon (gamma rays) and as the kinetic energy of a number of various discarded particles (nuclear fission products). These nuclear binding energies and forces are an order of magnitude a million times larger than electronic binding energies of light atoms such as hydrogen. A mass core defect is the amount of mass equivalent to the binding energy of the nucleus (E'mc2), which is the difference between the mass of the nucleus and the sum of the individual nuclei mass of which it consists. The introduction of nuclear-binding energy is explained by the basic principles involved in nuclear physics. Nuclear energy Absorption or release of nuclear energy occurs in nuclear reactions or radioactive decay; those that absorb energy are called endothermic reactions, and those that release energy are exothermic reactions. Energy is consumed or released because of differences in nuclear binding energy between incoming and outgoing nuclear transmutation products. The most famous classes of exoteric nuclear transmutations are division and merging. Nuclear energy can be released as a result of atomic fission, when heavy atomic nuclei (e.g. uranium and plutonium) break down into lighter nuclei. Fised energy is used to generate electricity in hundreds of locations around the world. Nuclear energy is also released during atomic fusion, when light nuclei, such as hydrogen, combine into heavier nuclei such as helium. The sun and other stars use nuclear fusion to generate thermal energy, which is later emitted from the surface, such as stellar nucleosynthesis. In any exothermic nuclear process, the nuclear mass can eventually be converted into thermal energy sucked out as heat. To quantify the energy released or absorbed in any nuclear transmutation, it is necessary to know the nuclear binding energy of the nuclear components involved in transmutation. Electrons and nuclei of nuclear power together with electrostatic attractiveness (negative (negative positive). In addition, electrons are sometimes divided or transmitted by neighboring atoms (by quantum physics); this connection between atoms is called a chemical bond and is responsible for the formation of all chemical compounds. The force of the electric attraction does not hold the nucleus together, because all protons carry a positive charge and repel each other. Thus, the electrical forces do not hold the nuclei together because they act in the opposite direction. It has been established that binding neutrons to nuclei clearly requires an electrical attraction. Thus, another force called nuclear force (or residual strong force) holds the nuclei together. This force is the residence of a strong interaction that binds the quarks to the nucleus at an even smaller level of distance. The fact that the nuclei do not stick together (fuse) under normal conditions suggests that nuclear power should be weaker than electrical repulsion over long distances, but stronger at close range. Thus, it has short-range characteristics. The analogy with nuclear force is the force between two small magnets: magnets are very difficult to separate when stuck together, but once pulled a short distance from each other, the force between them drops to almost zero. Unlike gravitational or electrical forces, nuclear power is only effective at very short distances. Electrostatic force dominates over long distances: protons repel each other because they are positively charged, and charges are repelled. For this reason, the protons that form the nuclei of conventional hydrogen, for example, in a balloon filled with hydrogen, do not combine into helium (a process that will also require some protons to merge with electrons and become neutrons). They cannot come close enough to the nuclear forces that attract them to each other become important. Only in conditions of extreme pressure and temperature (for example, in the core of a star) such a process can occur. Physics Nuclears Main article: Atomic nucleus there are about 94 natural elements on earth. The atoms of each element have a nucleus containing a certain number of protons (always the same number for this element), and a certain number of neutrons, which is often about the same number. Two atoms of the same element, having different amounts of neutrons, are known as isotopes of the element. Different isotopes can have different properties - for example, one can be stable and the other can be unstable, and gradually exposed to radioactive decay to become another element. The hydrogen nucleus contains only one proton. Its isotope deuterium, or heavy hydrogen, contains a proton and a neutron. Helium contains two protons and two neutrons, as well as carbon, nitrogen and oxygen - six, seven and eight particles respectively. However, the helium nucleus Less than the sum weight of the two heavy hydrogen nuclei that combine to do so. The same applies to carbon, nitrogen and oxygen. For example, the carbon core is slightly lighter than the three helium nuclei that can combine to make the carbon core. This difference is known as a massive defect. A mass defect should not be confused with a massive excess in nuclear physics or a massive defect in mass spectrometry. A mass defect (also called a mass deficit) is the difference between the mass of an object and the mass of its constituent particles. Discovered by Albert Einstein in 1905, it can be explained using his formula E and mc2, which describes the equivalence of energy and mass. Reducing mass equals the energy veiled in the reaction of the creation of an atom divided into c2. Under this formula, the addition of energy also increases mass (both weight and inertia), while energy removal reduces mass. For example, a helium atom containing four nuclei has a mass about 0.8% less than the total mass of four hydrogen nucleon nucleon. The helium nucleus has four nuclei connected to each other, and the binding energy that holds them together is, in fact, missing 0.8% mass. If a combination of particles contains additional energy - for example, in an explosive TNT molecule - the weighing shows some additional mass compared to its end products after an explosion. (The end products must be weighed after they have been stopped and cooled, however, as the extra mass has to leave the system as warm before its loss can be noticed, in theory.) On the other hand, if you need to inject energy to divide the particle system into its components, the initial mass is less than the mass of the components after they are separated. In the latter case, the injectable energy is stored as a potential energy, which indicates an increase in the mass of the components that store it. This is an example of the fact that energy of all types is considered in systems as mass, because mass and energy are equivalent, and each of them is the property of the other. The last scenario is the case with nuclei such as helium: to break them into protons and neutrons, you need to inject energy. On the other hand, if the process existed in the opposite direction by which hydrogen atoms could be combined to form helium, the energy would be released. Energy can be calculated using E qm c2 for each nucleus, where m is the difference between the helium nucleus mass and the mass of four protons (plus two electrons absorbed to create helium neutrons). For lighter elements, the energy that can be released by assembling them from lighter elements decreases, and energy can be released when they merge. This is true for kernels lighter than iron/nickel. For more nuclei, more energy is needed to bind them, and that energy may be breaking them into fragments (known as atomic division). Nuclear energy is currently generated by destroying uranium nuclei in nuclear reactors and capturing the released energy as heat converted into electricity. Typically, very light elements can merge relatively easily, and very heavy elements can break down through division very easily; The elements in the middle are more stable, and it's hard to get them to go through either fusion or division in an environment such as a lab. The reason why the trend changes after iron is the growing positive charge of the nuclei, which usually leads to the rupture of the nuclei. It is confronted by a strong nuclear interaction that holds the nuclei together. The electrical force may be weaker than a strong nuclear force, but a strong force has a much more limited range: in the iron core, each proton repels the remaining 25 protons, while nuclear power binds only close neighbors. Thus, for larger nuclei, electrostatic forces tend to dominate and the core will tend over time to break down. As the nuclei grow even more, this destructive effect becomes more significant. By the time polonium has reached (84 protons), the nuclei can no longer accommodate their large positive charge, but emit their excess protons fairly quickly in the process of alpha radioactivity - the emission of helium nuclei, each containing two protons and two neutrons. (Helium nuclei are a particularly stable combination.) Because of this process, nuclei with more than 94 protons are not naturally on Earth (see periodic table). Isotopes outside of uranium (atomic number 92) with the longest half-life of the year are plutonium-244 (80 million years) and curium-247 (16 million years). Solar energy binding This section does not provide any sources. Please help improve this section by adding links to reliable sources. Non-sources of materials can be challenged and removed. (October 2014) (Learn how and when to remove this message of pattern) The process of nuclear fusion works like this: five billion years ago, a new Sun formed when gravity pulled together a huge cloud of hydrogen and dust from which earth and other planets also originated. Gravitational pull released energy and heated the early Sun, which was largely suggested by Helmholtz. Thermal energy appears as the movement of atoms and molecules: the higher the temperature of particle collection, the greater their speed and the more violent their collisions are. When the temperature at the center of the newly formed Sun became high enough to collide between hydrogen nuclei to overcome their electrical aversion, and bring them into a short range of attractive nuclear force, the nuclei began to stick together. this began to occur, protons merged into deuterium and then helium, with some protons altering the neutron process (plus positrons, positive positive which are combined with electrons and destroyed in gamma-photons). This released nuclear energy currently supports the sun's high core temperature, and the heat also retains the high pressure of the gas, keeping the Sun at its current size, and stopping gravity from compressing it more. There is now a stable balance between gravity and pressure. Different nuclear reactions may prevail at different stages of the Sun's existence, including the proton-proton reaction and the carbon-nitrogen cycle, which includes heavier nuclei, but the final product of which is still a combination of protons to form helium. The physics industry, a study of controlled nuclear fusion, has since the 1950s tried to extract useful energy from nuclear fusion reactions that combine small nuclei into larger ones, usually for thermal boilers whose vapor can turn turbines and produce electricity. Unfortunately, no terrestrial laboratory can match one feature of a solar power plant: the large mass of the Sun, the weight of which keeps the hot plasma compressed and limits the nuclear furnace to the nucleus of the Sun. Instead, physicists use strong magnetic fields to limit plasma, and for fuel they use heavy forms of hydrogen that burn more easily. Magnetic traps can be quite unstable, and any plasma hot enough and dense enough to undergo nuclear fusion usually slips out of them after a short time. Even with ingenious tricks, the conclusion in most cases lasts only a small fraction of a second. Exciton energy binding is projected to be key to effective solar cells due to recent research. The combination of nuclei of small nuclei, which are larger than hydrogen, can combine into larger ones and release energy, but when such nuclei are combined, the amount of energy released is much smaller than hydrogen synthesis. The reason is that while the overall process releases energy from allowing the nuclear attraction to do its job, the energy must first be introduced to force together positively charged protons that also repel each other with their electrical charge. For elements that weigh more than iron (a nucleus with 26 protons), the fusion process no longer releases energy. Even heavier nuclei consume energy that is not released by combining nuclei of a similar size. With such large nuclei, overcoming electrical repulsion (which affects all protons in the nucleus) requires more energy than is released by nuclear gravity (which is effective mainly between close neighbors). Conversely, energy can actually be released by destroying nuclei heavier than iron. With nuclei elements heavier than lead, electrical repulsion is so strong that some of them emit positive fragments, usually helium nuclei, which form very stable combinations (alpha particles). This spontaneous rupture is a form of radioactivity common to some nuclei. The kernels are heavier than (except bismuth, thorium and uranium) spontaneously disintegrate too quickly to appear in nature as primitive elements, although they can be produced artificially or as intermediates in chains of decay of heavier elements. As a rule, the heavier the nucleus, the faster they spontaneously disintegrate. Iron nuclei are the most stable nuclei (in particular, iron-56), and therefore the best sources of energy are the nuclei, the weight of which is as far from iron as possible. You can combine the lightest of them - the nuclei of hydrogen (protons) - to form helium nuclei, and this is how the Sun generates its energy. Alternatively, the heaviest uranium or plutonium nuclei can be broken down into smaller fragments, and that is what nuclear reactors do. The protons are all positively charged and repulse each other, but nuclear power overcomes disgust and forces them to stick together. Nuclear power is a close-range force (it is highly attractive at a distance of 1.0 fm and becomes extremely small at a distance of 2.5fm), and there is virtually no effect of this force outside the nucleus. Nuclear power also combines neutrons, or neutrons and protons. The energy of the nucleus is negative in relation to the energy of particles stretched over an infinite distance (as well as the gravitational energy of the planets of the solar system), because energy should be used to divide the nucleus into separate protons and neutrons. Mass spectrometers measured the mass of nuclei, which are always smaller than the masses of protons and neutrons that form them, and the difference - according to formula E and m c2 - gives the binding energy of the nucleus. Nuclear fusion Binding helium energy is the energy source of the Sun and most stars. The sun consists of 74 percent hydrogen (measured by mass), an element consisting of a nucleus consisting of a single proton. Energy is released in the sun when 4 protons are combined into the helium nucleus, a process in which two of them are also converted into neutrons. The conversion of protons into neutrons is the result of another nuclear force known as a weak (nuclear) force. Weak force, as well as strong force, has a short range, but is much weaker than a strong force. Weak force tries to make the number of neutrons and protons in the most energetically stable configuration. For nuclei containing less than 40 particles, these numbers are usually roughly equal. Protons and neutrons are closely related and known as nucleons. As the number of particles increases to a maximum of about 209, the number of neutrons to maintain stability begins to outpace the number of protons until the ratio of neutrons to protons three or two. Hydrogen protons combine with helium only if they have enough speed to overcome each other's mutual aversion enough to get within reach of a strong nuclear attraction. This means that synthesis occurs only in very hot gas. Hydrogen is hot enough to combine with helium requires enormous pressure to keep it limited, but suitable conditions exist in the central regions of the Sun, where such pressure is provided by the huge weight of layers above the nucleus, pressed inside by the strong gravity of the Sun. The process of combining protons to form helium is an example of nuclear fusion. Earth's oceans contain large amounts of hydrogen, which could theoretically be used for synthesis, and a by-product of helium synthesis does not harm the environment, so some consider nuclear fusion a good alternative to meet the energy needs of mankind. Experiments on power generation as a result of synthesis have so far been only partially successful. The heat of the hydrogen should be ionized and limited. One method is to use very strong magnetic fields, because charged particles (for example, those that ended up in the Earth's radiation belt) are guided by magnetic field lines. Fusion experiments also rely on heavy hydrogen, which merges more easily and the density of gas can be moderate. But even with these methods much more pure energy is consumed by thermonuclear experiments than is given in the process. The binding energy is maximum and ways to approach it by decaying in the main isotopes of the lung nuclei, such as carbon, nitrogen and oxygen, the most stable combination of neutrons and protons when the numbers are equal (this continues element 20, calcium). However, in heavier nuclei, the destructive energy of protons increases because they are limited by tiny volume and repel each other. The energy of a strong force, holding the nucleus together, also increases, but at a slower pace, as if inside the nucleus, only the nuclei are closely related, rather than those more widely separated. The pure binding energy of the nucleus lies in the energy of the nuclear attraction, minus the destructive energy of the electric force. As the nuclei become heavier than helium, their pure binding energy to the nucleus (derived from the mass difference between the nucleus and the mass of component nuclei) grows more slowly, reaching its peak in the iron. As nucleons are added, the total nuclear binding energy always increases, but the total destructive energy of electrical forces (positive protons repelling other protons) also increases, and past iron, the second increase outweighs the first. Iron-56 (56Fe) is the most effectively connected core, which means it has the lowest average to the core. However, nickel-62 is the most closely related nucleus in terms of energy binding to the core. (Higher nickel-62 binding energy not not more than the average mass loss than 56Fe, because 62Ni has a slightly higher ratio of neutrons/protons than iron-56, and the presence of heavier neutrons increases the average mass of nickel-62 per nucleus). To reduce destructive energy, weak interaction allows the number of neutrons to exceed the number of protons - for example, the main iron isotope has 26 protons and 30 neutrons. Isotopes also exist where the number of neutrons differs from the most stable number for this number of nucleons. If the ratio of protons and neutrons is too far from stability, the nucleus can spontaneously change from proton to neutron or neutron to proton. The two methods for this conversion are mediated by weak force, and include types of beta decay. In the simplest beta decay, neutrons are converted into protons, emitting a negative electron and an antineutrino. This is always possible outside the nucleus, because neutrons are more massive than protons, equivalent to about 2.5 electrons. In the reverse process, which occurs only in the nucleus, and not to release particles, the proton can become a neutron, emitting a positron. This is allowed if there is enough energy between the parent and daughter nuclides (the required energy difference is 1,022 MEV, which is the mass of 2 electrons). If the mass difference between parent and daughter is smaller than this, the proton-rich nucleus can still convert protons into neutrons in the process of capturing an electron, in which a proton simply captures one of the orbital electrons of the K atom, emits a neutrino, and becomes a neutron. Among the heaviest nuclei, starting with holuria nuclei (element 52) containing 104 or more nuclei, electrical forces can be so destabilizing that entire pieces of the nucleus can be thrown away, usually as alpha particles, which consist of two protons and two neutrons (alpha particles are rapid helium nuclei). (Beryllium-8 also disintegrates, very quickly, into two alpha particles.) Alpha particles are extremely stable. This type of decay becomes more and more likely as the elements rise in the atomic mass past 104. The binding energy curve is a graph on the basis of which the energy is connected to the nucleus against the atomic mass. This curve has its main peak on iron and nickel, and then slowly decreases again, as well as a narrow isolated peak on helium, which is noted to be very stable. The heaviest nuclei in nature, uranium 238U, are unstable, but with a half-seine period of 4.5 billion years, close to the age of the Earth, they are still relatively abundant; they (and other nuclei heavier than helium) formed in stellar evolutions, such as supernova explosions preceding the formation of the solar system. The most common thorium isotope, 232Th, is also exposed to the release of alpha particles, and its half-seed period (the time during which half a row disintegrates) even more, several times. In each of them, These radioactive decay produces daughter isotopes that are also unstable, starting a chain of decay that ends in some stable lead isotopes. Calculating the nuclear binding of the energy calculation can be used to determine the nuclear binding energy of the nuclei. The calculation involves determining the defect of the mass, converting it into energy and expressing the result as energy on the mole of atoms, or as energy on the nucleus. The conversion of a mass defect into an energy mass defect is defined as the difference between the mass of the nucleus and the mass of the nuclei of which it consists. A massive defect is determined by calculating three quantities. These are: the actual mass of the nucleus, the composition of the nucleus (the number of protons and neutrons), the mass of the proton and the neutron. This is followed by the conversion of the mass defect into energy. This amount is a nuclear binding energy, but it must be expressed as energy on the mole of atoms or as energy on the nucleus. The fission and fusion of nuclear energy is released by splitting (splitting) or merging (merging) the nuclei of the atom (s). The conversion of nuclear mass energy into a form of energy, which can remove some mass when energy is removed, is consistent with the mass-energy equivalency formula: qE and qm c2, in which, qE - release of energy, the serpent - a mass defect, and c - the speed of light in a vacuum (physical constant 299 792 458 m/s by definition). Nuclear energy was first discovered by French physicist Henri Becquerel in 1896, when he discovered that photographic plates stored in the dark near uranium were blackened like X-rays (X-rays were recently discovered in 1895). Nickel-62 has the highest binding energy on the nucleus of any isotope. If the atom of the lower medium binding energy consists of two atoms of higher medium binding energy, the energy is sucked out. In addition, if two atoms of lower medium binding energy merge into a higher medium binding energy atom, the energy is sucked out. The diagram shows that the fusion of hydrogen, a combination for the formation of heavier atoms, releases energy, as does the division of uranium, breaking the larger nucleus into smaller parts. Stability varies by isotope: the isotope U-235 is much less stable than the more common U-238. Nuclear energy is released by three exoergometical (or exoteric) processes: radioactive decay, when a neutron or proton in a radioactive nucleus is destroyed spontaneously, emitting either particles or electromagnetic radiation (gamma rays), or both. Note that for radioactive decay, it is not strictly necessary to bind energy to increase. What is strictly necessary is that the mass decreases. If the neutron turns into a proton and the decay energy is less than 0.782343 MeV (e.g., rubidium-87 breaks down into strontium-87), binding energy to the core will actually be Merging, the two atomic nuclei merge together to form a heavier fission nucleus, tearing the heavy nucleus into two (or less often three) light nucleus Binding energy for atoms Binding energy of the atom (including its electrons) is not the same as binding energy of the nucleus of the atom. The measured mass deficit of isotopes is always indicated as a mass deficiency of neutral atoms of this isotope, and mainly in MV. As a result, these mass deficits are not a measure for stability or binding energy of isolated nuclei, but for whole atoms. This has very practical reasons because it is very difficult to completely ionize the heavy elements, i.e. deprive them of all their electrons. This practice is useful for other reasons: stripping all electrons from a heavy unstable nucleus (thus producing a bare core) alters the life of the nucleus, or the nucleus of a stable neutral atom may also become unstable after stripping, indicating that the nucleus cannot be independently considered. Examples of this have been shown in a related state β decay performed on GSI) heavy ion accelerator. This is also evident in phenomena such as electron capture. Theoretically, in orbital models of heavy atoms, the electron partially rotates inside the nucleus (it does not rotate in a strict sense, but has no disappearing probability that is inside the nucleus). Nuclear decay occurs with the nucleus, which means that the properties are attributed to the nucleus change in the case. In the field of physics, the concept of mass deficit as a measure of binding energy means massive deficit of a neutral atom (not just the nucleus) and is a measure of the stability of the entire atom. The nuclear binding energy curve In the periodic table of elements, there are a number of light elements from hydrogen to sodium, which show a generally growing binding energy to the nucleus as the atomic mass increases. This increase is generated by an increase in force on the nucleus in the nucleus, as each additional nucleus is attracted by other nearby nuclei, and thus more tightly tied to the whole. The area of increasing binding energy is followed by an area of relative stability (saturation) in a sequence from magnesium to xenon. In this region, the nucleus has become large enough that nuclear forces are no longer fully expanded effectively across their entire breadth. Attractive nuclear forces in this region, as the atomic mass increases, are almost balanced by repellent electromagnetic forces between protons as the atomic number increases. Finally, in the elements heavier than xenon, there is a decrease in binding energy to the nucleus as the atomic number increases. In this nuclear-sized region, electromagnetic repulsive forces are beginning to overcome the strong pull of nuclear forces. At the peak of the binding energy, nickel-62 is the most (to the core), followed by iron-58 and iron-56. This is the approximate main reason why iron and nickel are very common metals in planetary nuclei, as they are produced abundantly as end products in supernovae and in the final stages of silicon combustion in stars. However, it is not the binding of energy to a particular nucleus (as defined above) that controls which exact nuclei are made, because inside the stars, neutrons are free to convert into protons to release even more energy to the common nucleus if the result is a stable nucleus with a greater proportion of protons. In fact, it has been proven that photodisteinculation of 62Ni to form 56Fe can be energetically possible in an extremely hot star nucleus, due to this beta decay of the conversion of neutrons into protons. The conclusion is that under pressure and temperature conditions in the nuclei of large stars, energy is released by converting all matter into 56Fe nuclei (ionized atoms). (However, at high temperatures, not all matter will be in the lowest energy state.) This energy maximum should also be held for environmental conditions, say T 298 K and p 1 3, for neutral condensed matter consisting of 56Fe atoms, however, in these conditions the nucleus of atoms inhibited from alloy to the most stable and low energy state of matter. Iron-56 is thought to be more common than nickel isotopes in the universe for mechanistic reasons, because its unstable nickel-56 progenitor is abundantly made by phasing up 14 helium nuclei inside supernovae, where it has no time to disintegrate into iron before being released into an interstellar environment within minutes as the supernova explodes. However, nickel-56 then breaks down into cobalt-56 within a few weeks, then this radioisotope finally breaks down into iron-56 and a half lives about 77.3 days. It was noted that the radioactive curve of light, powered by the disintegration of such a process, occurs in type II supernovae such as SN 1987A. There are no good ways to create nickel-62 through alpha-adding processes, otherwise, apparently, the universe will have more of this highly stable nucleida. The binding of energy and nuclides mass This section does not cite any sources. Please help improve this section by adding links to reliable sources. Non-sources of materials can be challenged and removed. (October 2014) (Learn how and when to remove this pattern message) The fact that the maximum binding energy is contained in medium-sized nuclei is a consequence of compromises in the influence of two opposing forces that have different range characteristics. Attractive nuclear force (strong nuclear force), which equally binds protons and neutrons to each other, has a limited because of the rapid exponential decline of this force at a distance. However, the repulsive electromagnetic force that acts between the protons to force the nuclei apart, falling from a distance much more (as a reverse square distance). For nuclei with a diameter of more than four nuclei, the additional force of the reflection of additional protons more than compensates for any binding energy, which leads to the further addition of nucleons as a result of additional strong power interactions. These nuclei become less closely related as they become larger, although most of them are still stable. Finally, the nuclei containing more than 209 nucleons (more than about 6 nucleons in diameter) are too large to be stable, and are prone to spontaneous decay into smaller nuclei. Nuclear fusion produces energy by combining the lightest elements into more closely related elements (such as hydrogen in helium), and nuclear fission produces energy by dividing the heaviest elements (such as uranium and plutonium) into more closely related elements (such as barium and krypton). Both processes produce energy because medium-sized nuclei are the most closely related of all. As shown above in the deuterium example, nuclear binding energies are large enough to be easily measured as fractional mass deficits, depending on mass and energy equivalence. Atomic binding energy is just the amount of energy (and mass) released when a collection of free nuclei combines to form a nucleus. Nuclear binding energy can be calculated from the difference in the mass of the nucleus and the amount of mass of the number of free neutrons and protons that make up the nucleus. Once this massive difference, called a massive defect or mass deficit, is known, Einstein's E and mc2 mass energy equivalence formula can be used to calculate the binding energy of any nucleus. Early nuclear physicists referred to calculations of this value as packing fraction calculation. For example, a unit of atomic mass (1 u) is defined as 1/12 of the mass of an atom 12C, but the atomic mass of the 1H atom (which is a proton plus electron) is 1.007825 u, so each nucleon in 12C lost on average about 0.8% of its mass in the form of binding energy. Seven-empiric Formula for Nuclear Energy Binding Main Article: Semi-empiric mass formula for nucleus with nucleus A, including protons and N neutrons, semi-imperial formula for binding energy (BE) on the core: BE A · MeV - a b A 1 / 3 - c 2 A 4 / 3 q (N) 2 A 2 ± e A 7 / 4 (display) 3'-Frak (KK-{2})A-4/3'-Frak (left (N-W {2} {2} right) (frak) (a)7/4, Where odds are given: a 14.0 (display a'14.0); b 13.0 (display b'13.0); c 0.585 (display c'0.585); d 19.3 (display d'19.3); e y 33 (e-33 display). The first term displaystyle a is called saturation contribution and ensures that the energy binding on the core is the same for all cores Approximation. The term b/A 1/3 displaystyle-b/A1/3 is a surface tension effect and is proportional to the number of nuclei located on a nuclear surface; It is the largest for light cores. The term c 2/A 4/3 display-c{2}/A4/3 is an electrostatic repulsion of the coulomb; this becomes more important as the display increases. The term symmetry correction : d (N) 2 / A 2 (displaystyle -d(N-I) {2}/A'{2}) takes into account the fact that in the absence of other effects the most stable location has an equal number of protons and neutrons; this is because the n-p interaction in the kernel is stronger than the n-n or p-p interaction. The term pairing ± e/A 7/4 display (pm e/A'7/4) is purely empirical; it's - for even cores and -- for the odd cores. When A is odd, the term pairing is equally zero. Graphic representation of the semi-imperial binding energy formula. The binding energy to the nucleus in MeV (the highest numbers in yellow, over 8.5 meV per nucleus) is built for various nucleids as a function of q, atomic number (y-axis), vs. N, number of neutrons (x-axis). The highest number is observed for No. 26 (iron). An example of the values derived from the experimentally measured nucleid nuclid masses The following table lists some binding energies and values of mass defects. Note also that we use 1 u (931.494028 ± 0.000023) MeV. To calculate the binding energy, we use the formula n mn and mn, where it means the number of protons in nuclides and N their number of neutrons. We take mp q (938.2720813±0.000000058) MeV, meV (0.5109998999461±0000000000003) MeV and mn (939.5654133 ± 000058) MeV. The letter A indicates the amount of y and N (the number of nucleons in nuclide). Assuming that the reference nucleus has a neutron mass (so that all common binding energies calculated are maximum), we could determine the total binding energy as the difference between the core mass and the mass of the collection of free neutrons. In other words, it would be (I N) mn and mnuclide. Общая связывающая энергия на ядро будет это значение делится на A. Наиболее сильно связанные нуклиды атомов нуклида N масса превышает общую массу общей массы / Общая связывающая энергия / Массовый дефект, связывающий энергию связывания энергии / A 56Fe 26 30 й 60.6054 MeV 55.934937 u 0.9988372 u 9.1538 MeV 0.528479 u 49 2.275 MeV 8.7906 MeV 58Fe 26 32 q62.1534 MeV 57.932276 u 0.9988496 u 9.1432 MeV 0.547471 u 509.966 MeV 8.7925 MeV 60Ni 28 32 x 64,472 Мв 59,93079 u 0.9988464 u 9.1462 MeV 0.565612 u 526.864 MeV 8.7811 MeV 62Ni 28 34 66.7461 MeV 61.928345 u 0.9988443 u 9.1481 MeV 0.585383 u 545.281 MeV 8.7948 MeV 56Fe имеет самую низкую нуклеон-специфическую массу из четырех нуклидов, перечисленных в этой таблице, но это не означает that it is the strongest connected atom Adron, if the choice of the beginning of the Hadrons is completely free. The iron releases the largest energy if any 56 nuclei are allowed to build nuclide-change from one to another, if necessary, the highest binding energy on the adron, with hadrons, starting with the same number of protons and the entire nucleus A, as in the associated nucleus, is 62Ni. Thus, the true absolute value of the common binding energy of the nucleus depends on what we are allowed to build the nucleus from. If all the mass A nuclei were allowed to be built from neutrons A, 56Fe would release most of the energy to the nucleus, as it has a larger proportion of protons than 62Ni. However, if the nuclei are to be built only from the same number of protons and neutrons that they contain, then nickel-62 is the most tightly bound nucleus, to the nucleus. Some light nuclides resp. atoms nuclide Z N mass excess total mass total mass / A total binding energy / A mass defect binding energy binding energy / A n 0 1 8.0716 MeV 1.008665 u 1.008665 u 0.0000 MeV 0 u 0 MeV 0 MeV 1H 1 0 7.2890 MeV 1.007825 u 1.007825 u 0.7826 MeV 0.0000000146 u 0.0000136 MeV 13.6 eV 2H 1 1 13.13572 MeV 2.014102 u 1.007051 u 1.50346 MeV 0.002388 u 2.22452 MeV 1.11226 MeV 3H 1 2 14.9498 MeV 3.016049 u 1.005350 u 3.08815 MeV 0.0091058 u 8.4820 MeV 2.8273 MeV 3He 2 1 14.9312 MeV 3.016029 u 1.005343 u 3.09433 MeV 0.0082857 u 7.7181 MeV 2.5727 MeV In the table above it can be seen that the decay of a neutron as well as turning tritium into helium-3, releases energy; therefore, it exhibits a stronger connected new state when measuring the mass of an equal number of neutrons (as well as a lighter state by the number of common Hadrons). Such reactions are not due to changes in binding energies calculated from previously recorded N and No numbers of neutrons and protons, but by a decrease in the total mass of nuclide/nucleon with reaction. (Note that the binding energy provided above for hydrogen-1 is an atomic binding energy, not a nuclear binding energy that would be zero.) Inquiries: Dr. Rod Nave from the Department of Physics and Astronomy, Dr. Rod Neu (July 2010). Nuclear binding energy. Hyperphysics is a free web resource from GSU. Georgia State University. Received 2010-07-11. b c d Nuclear binding energy. How to solve for nuclear binding energy. Guidelines to address many types of quantitative problems found in Chemistry 116. Purdue University. July 2010. Received 2010-07-10. Guides - Nuclear energy. Energy Education is an interactive supplement to a curriculum for high school students funded by the U.S. Department of Energy and the Texas Energy Saving Authority (SECO). 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