Sun and nuclear energy notes pdf

Figure 1. The process of proton-proton synthesis, which is a source of energy from the Sun. The specific type of synthesis that occurs inside the Sun is known as proton-proton synthesis. Inside the Sun, this process begins with protons (it's just a lone hydrogen nucleus) and through a series of steps these protons merge together and are turned into helium. This synthesis process takes place inside the sun's nucleus, and the transformation leads to the release of energy that keeps the sun hot. The resulting energy is emitted from the sun's nucleus and travels through the solar system. It is important to note that the nucleus is the only part of the Sun that produces a significant amount of heat through synthesis (this contributes to about 99%). but sometimes one of the protons turns into a neutron through a weak nuclear force. Along with the transformation into a neutron formed positron and neutrino. This is the result of a proton-neutron vapor that is formed sometimes known as deuterium. The third proton collides with formed deuterium. This collision leads to the formation of the helium-3 nucleus and gamma rays. These gamma rays come out of the sun's core and are released as sunlight. Two helium-3 nuclei collide, creating a helium-4 nucleus plus two additional protons that slip away like two hydrogens. Technically, the nuclei of beryllium-6 are first formed, but unstable and thus disintegrate into the nucleus of helium-4. The final helium-4 atom has a smaller mass than the original 4 protons that came together (see E'mc2). Because of this, their combination leads to an excess of energy released in the form of heat and light that comes out of the Sun, taking into account the equivalence of mass energy. To get out of the Sun, this energy must pass through many layers in the photosphere before it can actually go into space like sunlight. Since this proton-proton chain occurs frequently - 9.2 x 1037 times per second - there is a significant release of energy. Of the total mass that undergoes this synthesis process, only about 0.7% of them are converted into energy. Although it seems like a small amount of mass, it equals 4.26 million metric tons of matter converted into energy per second. Using mass-energy equivalence, we find that these 4.26 million metric tons of matter are equal to approximately 3.8 x 1026 joules of energy released per second! For further reading For more information Energy that comes from the Sun, see: Duke Energy References January 30, 2013 Inside the Sun, fusion reactions occur at very high temperatures and huge gravitational pressures inside the Sun, fusion reactions occur at very high temperatures and huge gravitational pressures The basis of nuclear energy uses the power of atoms. Both division and fusion are the nuclear processes by which atoms change to generate energy, but what is the difference between them? Simply put, division is the division of one atom into two, and fusion is a combination of two lighter atoms into larger ones. They are opposed to processes, and therefore very different. The word division means splitting or splitting (Merriam-Webster Online, www.m-w.com). Nuclear fission releases thermal energy by splitting atoms. The surprising discovery that a rupture of the nucleus could have been made was based on Albert Einstein's prediction that the mass could be altered by energy. In 1939, the scientist began experiments, and a year later Enrico Fermi built the first nuclear reactor. Nuclear fission occurs when a large, somewhat unstable isotope (atoms with the same number of protons but different numbers of neutrons) is bombarded by high-speed particles, usually neutrons. These neutrons accelerate and then crash into an unstable isotope, causing it to divide, or break into small particles. In the process, the neutron accelerates and hits the core of the target, which in most nuclear reactors today is Uranium-235. This divides the target nucleus and breaks it down into two small isotopes (fission products), three high-speed neutrons and a large amount of energy. This resulting from energy is then used to heat water in nuclear reactors and eventually produce electricity. Discarded high-speed neutrons become projectiles that initiate other fission reactions or chain reactions. The word merging means merging individual elements into a single whole. Nuclear fusion refers to the union of atomic nuclei to form heavier nuclei that lead to the release of huge amounts of energy (Merriam-Webster Online, www.m-w.com). The merger occurs when two low-asso isotopes, usually hydrogen isotopes, combine under extreme pressure and temperature. The fusion is what powers the sun. Tritium and deuterium atoms (hydrogen, hydrogen-3 and hydrogen-2 isotopes respectively) combine under extreme pressure and temperature to produce neutron and helium isotope. At the same time, a huge amount of energy is released, which is several times the amount of energy produced as a result of division. Scientists continue to work on nuclear fusion control in an attempt to make a thermonuclear reactor to produce electricity. Some scientists believe that there are opportunities with such a source of energy merger mergers less radioactive material than division and has an almost unlimited fuel supply. However, progress is slow due to problems with understanding how to control the reaction in slow motion. Both division and fusion are nuclear reactions that produce energy, but the application is not the same. Splitting is the splitting of a heavy, unstable nucleus into two lighter nuclei, and fusion is a process in which two light nuclei combine, releasing a huge amount of energy. Cleavage is used in nuclear reactors because it can be controlled, while synthesis is not used to produce energy, as the reaction is not easily controlled and it is expensive to create the necessary conditions for the fusion reaction. Research continues along the way to better harness the power of synthesis, but research is in experimental stages. While these two processes differ from the others, they play an important role in the past, present and future of energy creation. Duke Energy nuclear @DE_Nuclear 📢 attention to Cornelius 📢 There will be retesting outdoor warning sirens near @CorneliusPD today,... your email address to follow this blog and receive notifications about new emails. Abandon these letters (3) Very high energy ions from space (cosmic radiation) arrive at the top of the Earth's magnetosphere, collide with atoms and splash out fragments, some of which are neutrons. Neutrons don't feel magnetic forces, but electrons and protons can fall into the trap, although those splashed out of the atmosphere always come back and go back to the atmosphere. Is this a reliable explanation for the radiation belt that lies in the Earth's magnetic field? Yes. Particles from the atmosphere always come back and are absorbed by the atmosphere, but neutrons can disintegrate in flight and produce energy protons (also electrons) that can appear in a magnetically captured orbit. Van Allen's original belt is believed to have originated in this way. (4) Some radioactive isotope has a period of half-millionths of 2 days. How long will it take until only 1/1000 of them remain in this sample? About 20 days, or 10 half billions, because (1/2)10 and 1/1024 (5) Hydrogen (forming H2 molecules) weighs about 90 grams per cubic meter. How many hydrogen molecules are in one cubic micron (micron is a millionth of a meter)? If A is Avogadro 6.022 1023, 2 grams of hydrogen contains A molecules and 90 grams contain 45A. Cubic microns are 10-12 cubic meters, so the number N No. 45 (6.022 1023) is 10-12 and 271 1053 and 2.71 107 or about 27 million molecules (1) Why can't we find in our environment elements whose atoms weigh 300 times more than a proton, or more? Such kernels contain too much repulsive to each other, and despite the strong nuclear attraction between their particles, unstable. (2) Make a glossary, defining briefly in alphabetical alphabetical in your own words: Alpha radioactivity Nuclear instability leading to the emission of alpha-particles beta radioactivity Nuclear instability Nuclear instability leading to the emission of electrons, from the conversion of neutrons to proton-electronic vapors (plus neutrinos) Binding energy Energy holding the nucleus together - the amount needed to completely break it apart. Controlled nuclear fusion Combines light nuclei with heavier, in the laboratory core of the Sun The Central region of the Sun, where the energy of the Curve binding energy is generated by the Nuclear Energy Binding Graph against the Mass. The isotope is the daughter of the isotope as a result of radioactive decay. Deuterium Heavy isotope of hydrogen, contains a proton and neutron mass spectrometer tool to measure the mass of the nuclei, by rejecting the beam of ions magnetically or the timing of their flight Nuclear fusion Nuclear reaction attaching light nuclei to form heavy. Positron Positive Electron Analogue (can be created in the laboratory) Controlled nuclear fusion Combination of light nuclei to heavier, in the laboratory Force of short range Force, which decreases with a distance of r faster than 1/r2 Strong (nuclear) forces Pulling short range in the nucleus, holding protons and neutrons Weak (nuclear) force Weak nuclear force Weak nuclear force short range, trying to balance the number of neutrons and protons. (3) What is the source of the Sun's energy? Nuclear synthesis of hydrogen in the nucleus of the Sun, producing helium (4) Why does the binding energy of the nucleus give a negative sign? The energy of the nucleus is that extra energy is available; zero energy means that all particles are distributed independently. The connected nucleus needs to enter energy to achieve a state of zero energy, so its energy is negative. (5) (a) Atomic weight of deuterium (2H) is 2,0140, helium 4He 4.0026 (in units of proton mass), and the rest energy of the E'mc2 proton is 938.3 Mev (million ev, with 1 ev and one electron-volt; see #9). How many ev are released when two deuterium atoms combine to one of 4He, nuclear fusion? 2 (2,0140) - 4.0026 - 0.0254 atomic mass units Mass converted into energy E and mc2 0.0254 (938.3)Mev 23.8 Mev 2 2.2.38 107 ev (b) If 1 ev 1.60 10-19joule and Avogadro number - is A 6.022 1023, how many joules are released by merging 4 grams of deuterium? 4 grams of helium contain atoms, so released energy E q (6.022 1023) (2.38 107) (1.60 10-19) joule 23 - 7 - 19 y 11 (6.02) 2) (2.38) (1.60) - 22.93 So E - 22.93 1011 joule No2.293 1012 joule (c) One gram of TNT can release 3.8 kilocalria of energy, each is equivalent to 4,184 joules. How many tons of TNT is required to release the energy calculated above? 1 gram TNT (3.8) (4184) - 1.59 104 joules (2,293 1012)/ (1.59 104) - 1,442,108 grams and 144.2 tons of TNT (6) Here is another application of the Einstein E'mc2 equation. be familiar with the scientific notation for very small and very large numbers before trying to solve this problem, and be sure to check all the steps of the calculation. The sun loses mass all the time with at least two mechanisms. First, it emits solar energy E, and by the equivalence of energy and mass, the process should also reduce its mass. The energy emitted in Earth's orbit - 150 million kilometers from the Sun - is about 1,300 watts (solar constant) per square meter of area perpendicular to the sun's rays, and the speed of light is about 300,000 km/s. Second, it also emits a solar wind. For reasons that 70 years later are still unclear, the sun's upper atmosphere (solar corona) is very hot, about a million degrees Celsius, explaining why the atoms in this layer tend to be devoid of most or all of their electrons - for example. Iron atoms are missing a dozen electrons, which requires a huge number of strokes. The sun's gravity can't hold the gas so hot. Instead, the upper solar atmosphere is constantly deflated like a solar wind - a rarefied stream of free ions and electrons moving outwards about 400 km/seconds The density of this wind in Earth's orbit is about 10 protons per cubic centimeter (given the presence of helium ions), and the proton mass is about 1,673 10-27 kilograms. Which of these two processes leads to a greater mass loss of the Sun? The solution allows you to compare the loss of mass due to any process through an area of 1 square meter in the Earth's orbit, perpendicular to the flow of sunlight, within one second. Work in meters, seconds and kilograms, with 3,108 meters/sec, and the flow of energy is 1300 joules/sec. If m is the mass lost during this time through the area chosen by it (by converting to shining solar energy) m - E/c2 - 1300 / 9.1016 - 1,444 10-14 kg. The solar wind passing through the same area includes all the matter contained in the cross-section pole 1 meter2 and 400 kilometers long or 4,105 meters long. One cubic meter contains 106 cubic centimeters and a mass of 107 protons. Thus, the flow through the region is 4,012 protons, with a weight of 6.69 10-15 kilograms. Thus, the loss due to sunlight is greater in about two factors. However, it is remarkable how close these two numbers are to each other - one is dictated by processes in the inner core of the Sun, the other by processes in its outer layer. Coincidence, you say? (similar calculation can be found in (7) An object (e.g. a spacecraft) ejected from the Earth's surface needs v 1 and 11.3 km/s to avoid Earth's gravity (escape speed), the neutron has the resting energy of E1 and mc2 939.535 MeV (million electronic volts). If the speed of light is 300,000 km/s (close enough) and ejected from Earth with enough speed to avoid gravity, what is its energy in MeV (or in electron volt, eV)? Use a non-retivistic expression when obtaining the kinetic energy of E1 runaway neutrons (that's accurate enough). Solution: If m is the mass of a neutron, E0 and mc2 9.39535 108 ev E1 - m v12 / 2 Dividing the 2nd equation into the first, with all speeds in meters/seconds: E1/ E0 - E1/ 9.39535 108 (0.5) (v1/c) 2 (0.5) (1.13 104 / 3 108)2 0.5 (0.376666 10-4) 2 2 - 0.5 (0.1418777 10-8) - 0.070939 10-8 E1 (9.39535 108) (0.070939 10-8) - 0.6665 eV It is less, than 1 eV! Radiation belt particles have meV energy, and even the electrons of the aurora have about 10,000 eV (the thermal energy of the air molecules in your room is about 0.03 eV). Gravitational energy is thus completely insignificant in comparison - or, in other words, electromagnetic forces on particles in space tend to be much, much larger than their gravitational forces. (1) (For this problem, solve the first problem (5) in the previous section) assuming that the U235 core releases 200 Mev in the case of division (considering some secondary processes, see #10; an average of 215 Mev), how many tons of TNT are needed to generate the energy generated at full division 1 U 235 ? If number A 6022 1023 is the number Avogadro, 1 gram U2355 contains atoms A/235. By (b) of the previous problem (5), each atom gives (2,108 ev) (1.6 10-19) joule. Total energy released is (6.022 1023) (2,108) (1.6 10-19)joule /235 q (6,022 . 2 . 1 .6 / 235) 1012 No 6.2 1010 joule By (c) previous problem (5), 1 gram of TNT contains 3.8 kilocalories or 1.59 . 104 joule So the released energy is the same, as (8.2/1.59) 10 (10-4) gram 5.16 106 grams and 5.16 tons of TNT (2) Make up a glossary, defining briefly in alphabetical order in your own words: shed (unit) Area 10-24 square cm, a unit of nuclear section. Cascade for isotope enrichment Combined many isotopic separators to enrich the Chain Reaction (nuclear) Division Reaction, in which each division produces at least one additional division Critical Mass mass of nuclear fuel, sufficient for a chain reaction. Cross section (for nuclear interaction) Equivalent target area in the nucleus for the incoming particle to receive a reaction. The binding energy curve is the nuclear binding energy-related graph against the mass. Delays of neutron neutrons emitted as a result of fission with 1-2 second delay Enrichment (uranium) Technology increase the proportion of isotopes U235. Splitting (nuclear) splitting the atomic nucleus into two large fragments. The fission of fragments of nuclei of lighter elements produced by nuclear fission. The fuel rods of Childbirth containing fuel inserted into the nuclear reactor. Graphite Carbon Form used as a moderator in nuclear division. water in which deuterium replaces hydrogen isotope centrifuges isotope separation of gas centrifuges. Separation of isotopes by porous septums Separation of isotopes by gas flow through porous septums. Photon Energy Package is formed by the absorption of electromagnetic wave. Plutonium Artificial atomic weight element 94, conventional nuclear fuel. Poisoning a nuclear reactor is the accumulation of neutron-absorbing fission fragments, reducing or stopping fission in the reactor. Fast neutrons, rapidly emitted as a result of nuclear fission, about 98% Nuclear Fuel Recycling Chemical separation of the fission product from unburned nuclear fuels and isotopes of artificial fuel. The thermal neutron neutron A slowed to a moderator to thermal energies, well below 1 eV. Ev.