Anti-Matter

Introduction

Ordinary matter has negatively charged electrons circling a positively charged nuclei. Anti-matter has positively charged electrons - positrons - orbiting a nuclei with a negative charge - anti-protons. Only anti-protons and positrons are able to be produced at this time, but scientists in Switzerland have begun a series of experiments which they believe will lead to the creation of the first anti-matter element -- Anti-Hydrogen.

The Research

Early scientists often made two mistakes about anti-matter. Some thought it had a negative mass, and would thus feel gravity as a push rather than a pull. If this were so, the antiproton's negative mass/energy would cancel the proton's when they met and nothing would remain; in reality, two extremely high-energy gamma photons are produced. Today's theories of the universe say that there is no such thing as a negative mass.

The second and more subtle mistake is the idea that anti-water would only annihilate with ordinary water, and could safety be kept in (say) an iron container. This is not so: it is the subatomic particles that react so destructively, and their arrangement makes no difference.

Scientists at CERN in Geneva are working on a device called the LEAR (low energy anti-proton ring) in an attempt to slow the velocity of the anti-protons to a billionth of their normal speeds. The slowing of the anti-protons and positrons, which normally travel at a velocity of that near the speed of light, is neccesary *so that they have a chance of meeting and combining into anti-hydrogen.*[1]

The problems with research in the field of anti-matter is that when the anti-matter elements touch matter elements they annihilate each other. The total combined mass of both elements are released in a spectacular blast of energy. Electrons and positrons come together and vanish into high-energy gamma rays (plus a certain number of harmless neutrinos, which pass through whole planets without effect). Hitting ordinary matter, 1

[1] Swiss boldly poised to produce anti-matter - John Eades, researcher at CERN

kg of anti-matter explodes with the force of up to 43 million tons of TNT - as though several thousand Hiroshima bombs were detonated at once.

So how can anti-matter be stored? Space seems the only place, both for storage and for large-scale production. On Earth, gravity will sooner or later pull any anti-matter into disastrous contact with matter. Anti-matter has the opposite effect of gravity on it, the anti-matter is 'pushed away' by the gravitational force due to its opposite nature to that of matter. A way around the gravity problem appears at CERN, where fast moving anti-protons can be held in a 'storage ring' around which they constantly move - and kept away from the walls of the vacuum chamber - by magnetic fields. However, this only works for charged particles, it does not work for anti-neutrons, for example.

The Unanswerable Question

Though anti-matter can be manufactured, slowly, natural anti-matter has never been found. In theory, we should expect equal amounts of matter and anti-matter to be formed at the

beginning of the universe - perhaps some far off galaxies are the made of anti-matter that somehow became separated from matter long ago. A problem with the theory is that cosmic rays that reach Earth from far-off parts are often made up of protons or even nuclei, never of anti-protons or antinuclei. There may be no natural anti-matter anywhere.

In that case, what happened to it? The most obvious answer is that, as predicted by theory, all the matter and anti-matter underwent mutual annihilation in the first seconds of creation; but why there do we still have matter? It seems unlikely that more matter than anti-matter should be formed. In this scenario, the matter would have to exceed the anti-matter by one part in 1000 million.

An alternative theory is produced by the physicist M. Goldhaber in 1956, is that the universe divided into two parts after its formation - the universe that we live in, and an alternate universe of anti-matter that cannot be observed by us.

The Chemistry

Though they have no charge, anti-neutrons differ from neutrons in having opposite 'spin' and 'baryon number'. All heavy particles, like protons or neutrons, are called baryons. A firm rule is that the total baryon number cannot change, though this apparently fails inside black holes. A neutron (baryon number +1) can become a proton (baryon number +1) and an electron (baryon number 0 since an electron is not a baryon but a light particle). The total electric charge stays at zero and the total baryon number at +1. But a proton cannot simply be annihilated.

A proton and anti-proton (baryon number -1) can join together in an annihilation of both. The two heavy particles meet in a flare of energy and vanish, their mass converted to high-energy radiation wile their opposite charges and baryon numbers cancel out. We can make antiprotons in the laboratory by turning this process round, using a particle accelerator to smash protons together at such enormous energies that the energy of collision is more than twice the mass/energy of a proton. The resulting reaction is written:

p + p p + p + p + p

Two protons (p) become three protons plus an antiproton(p); the total baryon number before is:

1 + 1 = 2

And after the collision it is:

1 + 1 + 1 - 1 = 2

Still two.

Anti-matter elements have the same properties as matter properties. For example, two atoms of anti-hydrogen and one atom of anti-oxygen would become anti-water.

The Article

The article chosen reflects on recent advancements in anti-matter research. Scientists in Switzerland have begun experimenting with a LEAR device (low energy anti-proton ring) which would slow the particle velocity by a billionth of its original velocity. This is all done in an effort to slow the velocity to such a

speed where it can combine chemically with positrons to form anti-hydrogen.

The author of the article, whose name was not included on the article, failed to investigate other anti-matter research laboratories and their advancements. The author focused on the CERN research laboratory in Geneva. '*The intriguing thing about our work is that it flies in the face of all other current developments in particle physics*' .[2]

The article also focused on the intrigue into the discovering the anti-matter secret, but did not mention much on the destruction and mayhem anti-matter would cause if not treated with the utmost care and safety. Discovering anti-matter could mean the end of the Earth as we know it, one mistake could mean the end of the world and a release of high-energy gamma rays that could wipe out the life on earth in mere minutes.

It was a quite interesting article, with a lot of information that could affect the entire world. The article, however, did not focus on the benefits or disadvantages of anti-matter nor did it

[2] Swiss boldly poised to produce anti-matter - John Eades, researcher at CERN

mention the practical uses of anti-matter. They are too expensive to use for powering rocket ships, and are not safe for household or industrial use, so have no meaning to the general public. It is merely a race to see who can make the first anti-matter element.

Conclusion

As research continues into the field of anti-matter there might be some very interesting and practical uses of anti-matter in the society of the future. Until there is a practical use, this is merely an attempt to prove which research lab will be the first to manufacture the anti-matter elements.