



What is antimatter?

R. Michael Barnett of the Lawrence Berkeley National Laboratory and Helen Quinn of the Stanford Linear Accelerator Center offer this answer, portions of which are paraphrased from their book *The Charm of Strange Quarks*:

In 1930 Paul Dirac formulated a quantum theory for the motion of electrons in electric and magnetic fields, the first theory that correctly included Einstein's theory of special [relativity](#) in this context. This theory led to a surprising prediction—the equations that described the electron also described, and in fact required, the existence of another type of particle with exactly the same mass as the electron but with positive instead of negative electric charge. This particle, which is called the positron, is the antiparticle of the electron, and it was the first example of antimatter.

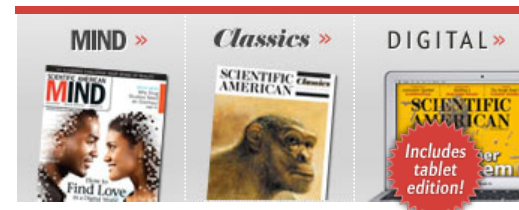
Its discovery in experiments soon confirmed the remarkable prediction of antimatter in Dirac's theory. A cloud chamber picture taken by Carl D. Anderson in 1931 showed a particle entering from below and passing through a lead plate. The direction of the curvature of the path, caused by a magnetic field, indicated that the particle was a positively charged one but with the same mass and other characteristics as an electron. Experiments today routinely produce large numbers of positrons.

Dirac's prediction applies not only to the electron but to all the fundamental constituents of matter (particles). Each type of particle must have a corresponding antiparticle type. The mass of any antiparticle is identical to that of the particle. All the rest of its properties are also closely related but with the signs of all charges reversed. For example, a proton has a positive electric charge, but an antiproton has a negative electric charge. The existence of antimatter partners for all matter particles is now a well-verified phenomenon, with both partners for hundreds of such pairings observed.

New discoveries lead to new language. In coining the term "antimatter," physicists in fact redefined the meaning of the word "matter." Until that time, "matter" meant anything with substance; even today school textbooks give this definition: "matter takes up space and has mass." By adding the concept of antimatter as distinct from matter, physicists narrowed the definition of matter to apply to only certain kinds of particles, including, however, all those found in everyday experience.

Any pair of matching particle and antiparticle can be produced anytime there is sufficient energy available to provide the necessary mass-energy. Similarly, anytime a particle meets its matching antiparticle, the two can annihilate each another—that is,

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they both disappear, leaving their energy transformed into some other form.

There is no intrinsic difference between particles and antiparticles; they appear on essentially the same footing in all particle theories. This means that the laws of physics for antiparticles are almost identical to those for particles; any difference is a tiny effect. But there certainly is a dramatic difference in the numbers of these objects we find in the world around us; all the world is made of matter. Any antimatter we produce in the laboratory soon disappears because it meets up with matching matter particles and annihilates.

Modern theories of particle physics and of the evolution of the universe suggest, or even require, that antimatter and matter were equally common in the earliest stages—so why is antimatter so uncommon today? The observed imbalance between matter and antimatter is a puzzle yet to be explained. Without it, the universe today would certainly be a much less interesting place, because there would be essentially no matter left around; annihilations would have converted everything into electromagnetic radiation by now. So clearly this imbalance is a key property of the world we know. Attempts to explain it are an active area of research today.

In order to answer this question, we need to better understand that tiny part of the laws of physics that differ for matter and antimatter; without such a difference, there would be no way for an imbalance to occur. This distinction is the subject of study in a number of experiments around the world that focus on differences in the decays of particles called B-mesons and their antiparticle partners. These experiments will be done both at electron-positron collider facilities called B factories and at high-energy hadron colliders, because each type of facility offers different capabilities to contribute to the study of this detail of the laws of physics—a detail that is responsible for such an important property of the universe as the fact that there is anything there at all!

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1. **superman**
12:06 PM 3/17/08

Sir it is a very interesting topic where we need a lot of research and its application. I like to have more information of this theory in space applications.

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2. **heyheyeh**
01:25 PM 4/2/08

I hope that anyone that reads this, knows that the quantity of antimatter produced, could only light a lightbulb for a couple minutes. We're lots of years short of having anything antimatter based. As well as if they will even launch it to our government, it's highly dangerous, costs a ton, and uses massive amounts of electricity. So, what they talk about could be very possible, but don't get your hopes up.

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3. Dov Henis
12:02 PM 2/3/11

Update Concepts

Electron: The Present Universe Runs ONLY Forward

A. From "Sizing up the Electron"

Measuring the inner shape of the famous particle could help solve a cosmic mystery

http://www.sciencenews.org/view/feature/id/69229/title/Sizing_up_the_Electron

- "Physicists suspect that electric dipole moments exist because they allow particles to violate what's known as time-reversal symmetry. Although symmetry sounds like a good thing, scientists know that processes involving other particles (such as B mesons) behave differently whether running forward or backward, a violation of time-reversal symmetry. In order for this to happen, the electron (and other fundamental particles) must have an internal structure, something an electric dipole moment can reveal."

- "The Big Bang should have created matter and antimatter in equal amounts".

B. The Universe is SPACEDISTANCE, NOT SPACETIME. It runs ONLY FORWARD.

From "Commonsensical Cosmic Rebirth", comment on "Cosmic reincarnation idea may be dead"

http://www.sciencenews.org/index/generic/activity/view/id/67788/title/Cosmic_reincarnation_idea_may_be_dead

Rethink

- A Basic Physics Tenet: SpaceDistance, in lieu of SpaceTime.
- The universe in which we live: It is a dualistic, mass-energy, cyclic array.

C. The Big Bang was the start of the still ongoing $D > 0$, of the still growing D
in $E = \text{Total}[m(1 + D)]$

The Big Bang did not create matter or antimatter, in any amount. It was the start of the still ongoing reconversion of m into E . It was the culmination of the 10^{-35} seconds long singularity.

Dov Henis

(Comments From The 22nd Century)

Dispel Some Figments Of 2010 Science Imagination

http://pulse.yahoo.com/_2SF3CJJM5OU6T27OC4MFQSDYEU/blog/articles/245540

03.2010 Updated Life Manifest

<http://www.the-scientist.com/community/posts/list/54.page#5065>

28Dec09 Updated "Implications Of $E = \text{Total}[m(1 + D)]$ "

<http://www.the-scientist.com/community/posts/list/180/122.page#3108>

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Cosmic Evolution Simplified

<http://www.the-scientist.com/community/posts/list/240/122.page#4427>

"Gravity Is The Monotheism Of The Cosmos"

<http://www.the-scientist.com/community/posts/list/260/122.page#4887>

Evolution, Natural Selection, Derive From Cosmic Expansion

<http://darwiniana.com/2010/09/05/the-question-reductionists-fear/>

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4. Dov Henis
03:29 PM 2/10/11

Again:

Matter and antimatter are products of evolution of mass along its route of reconversion into energy, started at Big Bang.

Dov Henis

(Comments From The 22nd Century)

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5. jellyfishsandwich
03:44 PM 7/18/11

If a proton is its own antimatter then how does it exist?

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6. jellyfishsandwich
in reply to
[jellyfishsandwich](#)
03:48 PM 7/18/11

yes i meant photon not proton

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7. Andrew Planet
05:19 AM 4/19/13

Scientists postulate that there is an imbalance to the amount of matter relative to anti matter in the universe seeing as both should have been created equally. If the imbalance of the amount of anti matter in the universe is unaccountable for, is that indicative of there having been unequal amounts of matter to anti matter to begin with and what we have as tangible is more matter than anti matter in the original sum? What we can use as evidence in all of this to explain any existence of anti matter is the fact that we can produce and store it at will, even though that is in minuscule amounts. If anti matter can be produced at will using relatively lots of energy doesn't that mean that anti matter can only be made in all possible settings by energy being applied to matter to the extent that its spin is reversed thus creating anti matter? Maybe the working out that matter and anti matter were created equally at the beginning of this universe is wrong. Anti matter can be shown to be created from matter in laboratories and there is no evidence to show that anti matter can be created from any other source and manner. I wrote the latter some time as questions to CERN's Google + hangouts but they never answered. The text is still retrievable from their Google+

hangout you tube pages.

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8. Andrew Planet
05:22 AM 4/19/13

Scientists postulate that there is an imbalance to the amount of matter relative to anti matter in the universe seeing as both should have been created equally. If the imbalance of the amount of anti matter in the universe is unaccountable for, is that indicative of there having been unequal amounts of matter to anti matter to begin with and what we have as tangible is more matter than anti matter in the original sum? What we can use as evidence in all of this to explain any existence of anti matter is the fact that we can produce and store it at will, even though that is in minuscule amounts. If anti matter can be produced at will using relatively lots of energy doesn't that mean that anti matter can only be made in all possible settings by energy being applied to matter to the extent that its spin is reversed thus creating anti matter? Maybe the working out that matter and anti matter were created equally at the beginning of this universe is wrong. Anti matter can be shown to be created from matter in laboratories and there is no evidence to show that anti matter can be created from any other source and manner. I wrote the latter some time as questions to CERN's Google + hangouts but they never answered. The text is still retrievable from their Google+ hangout you tube pages.

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