Modern Physics Assignment

SPH4U
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Question 1.

If Darth Vader was 50 years old when he left his galaxy in 2007, how old would he be if he returned in 2025 if he had travelled at a rate of 2.8×10^8m/s?

Let Δt_p =the change in time for the person on Earth

Let Δt_m =the change in time for the Darth Vader

Let V =the speed Darth Vader travelled

Let c =the speed of light

$\Delta t_m = 2025 - 2007$

$\Delta t_m = 18$years

$V = 2.8 \times 10^8$m/s

$c = 2.99792458 \times 10^8$m/s

$$\Delta t_m = \frac{\Delta t_p}{\sqrt{1-\frac{V^2}{c^2}}}$$

$$\Delta t_p = (\Delta t_m)(\sqrt{1 - \frac{V^2}{c^2}})$$

$$\Delta t_p = (18)(\sqrt{1 - \frac{(2.8\times10^8)^2}{(2.99792458\times10^8)^2}})$$

$\Delta t_p = (18)(0.3573266797)$

$\Delta t_p \approx 6.4$years

$\Delta t_m = 50 + \Delta t_p$

$\Delta t_m \approx 56.4$years

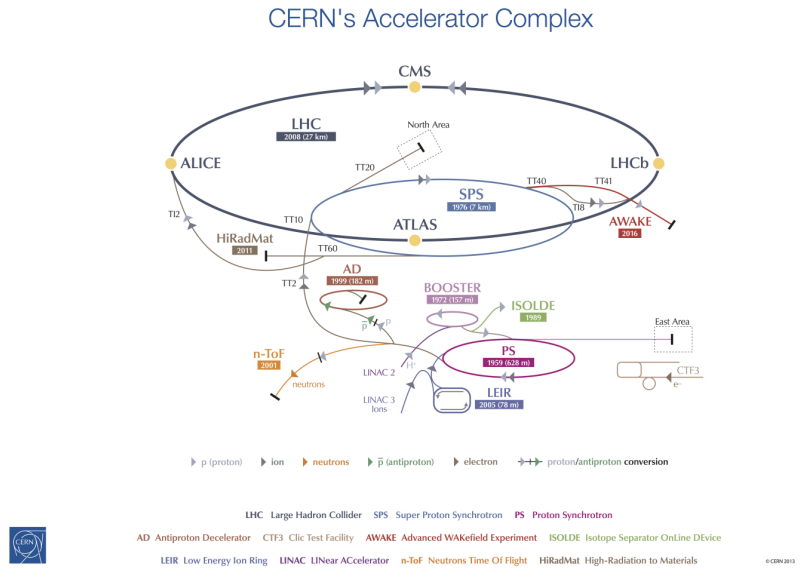
∴The Darth Vader is about 56.4 years old when he returned in 2025.

Question 2.

Using the Internet, find the location of a particle accelerator. In several paragraphs describe its size, what particles are being accelerated, how they are being accelerated, what their target is, how the particles are detected and what subatomic particles have been discovered at the site. Be sure to cite your sources.

One famous particle accelerator in the world is the Large Hadron Collider, also referred to as LHC. This particle accelerator is the most powerful device in the world that is located at CERN, the European Organization for Nuclear Research, near Geneva, Switzerland (Landau, 2013). The LHC allows the protons or ions to be pushed so that the particles can travel in speed very close to the speed of light, which is about 2.99792458×10^8m/s. The word "Large" from LHC is because of the size of the particle accelerator; the size is about 27 km in circumference, being the largest accelerator in the world ("Facts and figures about the LHC", n.d.). "Hardon" is from the concept of accelerating the protons or ions, both being included in the particle group called hadrons ("Facts and figures about the LHC", n.d.). "Collider" is from the functionality of the device, which makes the particles to be shot in two different beams that travel in opposite directions, colliding at four different points in the temperature of -271.3℃ ("Facts and figures about the LHC", n.d.).

The way LHC works is quite complex. There are diverse high-energy machines all combine for the function of the CERN accelerator complex ("Facts and figures about the LHC", n.d.). These machines accumulate the energy in the particles, allowing the ions to accelerate with the energy they gained from the proceeding devices as they travel along the LHC ("Facts and figures about the LHC", n.d.). The energy is transferred to the charged particles like protons and electrons and nuclei of lead, argon, or xenon atoms to electrically "propel" the particles using donut-shaped electromagnets ("Accelerators", n.d.). Inside the accelerator, two particle beams are shot in opposite directions to allow them to collide later on. The ultrahigh vacuums are the beam pipes that shoot the beams in opposite directions so that the two particles can collide at the yellow target point ("Facts and figures about the LHC", n.d.). The particles maintain their route inside the accelerator's path because of the help of the magnetic field called superconducting electromagnets, which creates a centripetal force for the particles ("Facts and figures about the LHC", n.d.). Also, the electromagnets all work to "squeeze" the ions closer together, in order to increase the collisions from happening ("How the LHC works", n.d.). The temperature in which the electromagnets is about -271.3℃ to prevent other materials and substances from creating resistance to the passage of the particles ("Facts and figures about the LHC", n.d.). The chance of particles from reducing in energy becomes very low, allowing collision with larger energy.



The reason for such collision of the particles is to produce massive particles like Higgs boson, which was discovered by LHC on July 4, 2012 (“Accelerators”, n.d.). This allows scientists to use one of Einstein’s equations, $E = mc^2$. The energy that is exerted due to the collision is “transformed into the matter in the form of new particles”, which is the largest energy contained particles existed in the early Universe (“Accelerators”, n.d.). Measuring the properties of the newly formed particles help researchers and scientists to understand the “matter and of the origins of the Universe” (“Accelerators”, n.d.). However, the high-energy particles cannot be observed with human eyes due to the short duration of emission and “decay into lighter particles (“Accelerators”, n.d.). Because it cannot be observed directly, different detectors are used to measure the energy emission and the properties of the particles before and after the collision. The CERN Control Center is the place where scientists observe and detect the subatomic particles (“How the LHC works”, n.d.). The concept is very simple, the detectors identify the traces that the particles left in the accelerator. As the particles gain energy, the detectors gain information about the particles, such as their mass and charge (“How a detector works”, n.d.). Next, as the particles travel in a straight line, which in fact is a curve due to the magnetic field, physicists calculate the momentum of the particles (“How a detector works”, n.d.). After the calculations, the detectors are used. Tracking devices record and identify the patterns of tiny electrical signals. The patterns will then be programmed so that the pattern and path of the particle can be noticed. A calorimeter is another device, which measures the energy loss of a particle when it passes through the device. The device “absorbs” the particles after the collision is made, gaining the particle’s energy; therefore, allow the physicists to measure the energy of electrons and photons when they interact with charged particles in a matter (“How a detector works”, n.d.).

It has been believed that humans cannot reach a point where the matters on Earth can reach the speed of light. However, with the particle accelerators, researchers were able to

discover and prove Einstein's theories in the past. These modern physics technologies are the tools that can lead people on Earth to learn more about space and the Universe; therefore, develop more theories and ideas about outer space.

Works Cited

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