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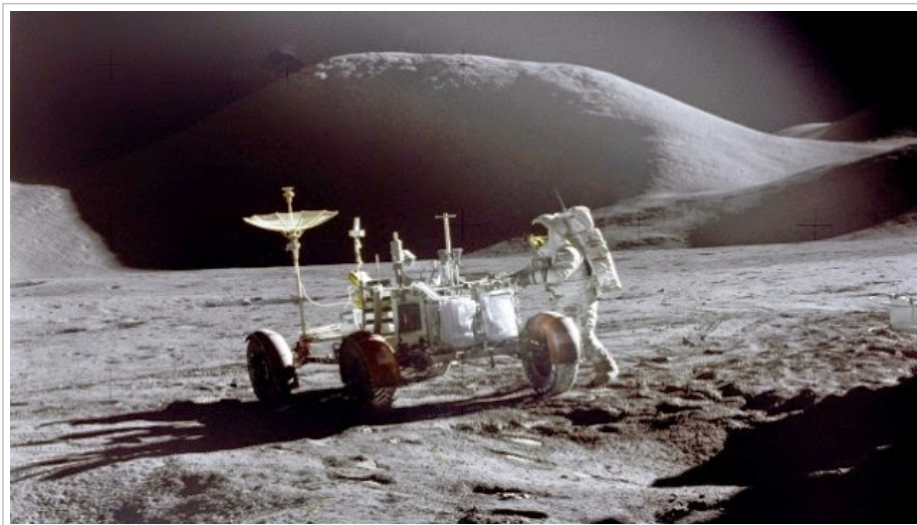
Amazing Facts



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Helium-3

18
Apr
2014



Helium-3 (He-3) is a light, non-radioactive isotope of **helium** with two **protons** and one neutron. It is rare on Earth, and it is sought for use in **nuclear fusion** research. The abundance of helium-3 is thought to be greater on the Moon (embedded in the upper layer of **regolith** by the solar wind over billions of years), though still lower in quantity (28 ppm of lunar regolith is helium-4 and from one ppb to 50 ppb is helium-3) than the **solar system's gas giants** (left over from the original solar nebula).

The **helion**, the **nucleus** of a helium-3 atom, consists of two protons but only one neutron, in contrast with two neutrons in common helium. Its hypothetical existence was first proposed in 1934 by the Australian **nuclear physicist Mark Oliphant** while he was working at the **University of Cambridge Cavendish Laboratory**. Oliphant had performed experiments in which fast **deuterons** collided with deuteron targets (incidentally, the first demonstration of **nuclear fusion**).

Helium-3 was hypothesized to be a **radioactive isotope** until helions were also found in samples of natural helium, which is mostly **helium-4**, taken both from the terrestrial atmosphere and from **natural gas** wells. This was done by **Luis W. Alvarez** and **Robert Cornog** in **cyclotron** experiments at the **Lawrence Berkeley National Laboratory** in **California** in 1939.

Although helium-3 was found to be about 10,000 times rarer than helium-4 in the helium from the gas wells, its significant presence in underground gas deposits implied that either it did not decay, or else it had a very

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Haji Mastan or Sultan Mirza , the first underworld don of Mumbai

Mastan Haider Mirza, popularly known as Haji Mastan, Bawa or Sultan Mirza was born on March 1, 1926 in Panaikulam village near Cuddalore, T...

long **half-life** – billions of years. **Hydrogen-1** and helium-3 are the only stable nuclides that contain more protons than neutrons.

Helium-3 occurs as a primordial nuclide, escaping from the Earth's crust into the atmosphere and into **outer space** over millions of years. Helium-3 is also thought to be a natural **nucleogenic** and **cosmogenic nuclide**, one produced when lithium is bombarded by natural neutrons. Those are released by **spontaneous fission** and by **nuclear reactions** with **cosmic rays**. Some of the helium-3 found in the terrestrial atmosphere is also a relic of atmospheric and underwater **nuclear weapons testing**, conducted by the three big nuclear powers before 1963. Most of this comes from the decay of **tritium** (hydrogen-3), which decays into helium-3 with a **half life** of 12.3 years. Furthermore, some **nuclear reactors** (landbound or shipbound) periodically release some helium-3 and tritium into the atmosphere. The **nuclear reactor disaster at Chernobyl** released a huge amount of radioactive tritium into the atmosphere, and smaller problems cause smaller releases. Furthermore, significant amounts of tritium and helium-3 have been deliberately produced in national arsenal nuclear reactors by the irradiation of **lithium-6**. The tritium is used to "boost" **nuclear weapons**, and some of this inevitably escapes during its production, transportation, and storage. Hence, helium-3 enters the atmosphere both through its direct release and through the **radioactive decay** of tritium. The vast majority of these two gases have been produced and leaked by the former Soviet Union, Russia, the United Kingdom, and France. ^[*citation needed*]

Helium-3 is proposed as a second-generation fuel for **nuclear fusion** in hypothetical **fusion power plants**, but such plants are still very early in their development—especially since first generation reactors have not yet entered into service. Helium-3 can be used in instruments for the detection of free neutrons, such as neutrons leaking from **nuclear reactors**.

Because of its lower atomic mass of 3.02 **atomic mass units**, helium-3 has some **physical properties** different from those of helium-4, with a mass of 4.00 atomic mass units. Because of the weak, induced dipole–dipole interaction between helium atoms, their macroscopic physical properties are mainly determined by their **zero-point energy** (ground-state kinetic energy). Also, the microscopic properties of helium-3 cause it to have a higher zero-point energy than helium-4. This implies that helium-3 can overcome dipole–dipole interactions with less thermal energy than helium-4 can.

The **quantum mechanical** effects on helium-3 and helium-4 are significantly different because with two protons, two neutrons, and two electrons, helium-4 has an overall **spin** of zero, making it a **boson**, but with one fewer neutron, helium-3 has an overall spin of one half, making it a **fermion**.



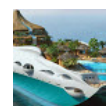
Helium-3 boils at 3.19 **K** compared with helium-4 at 4.23 **K**, and its **critical point** is also lower at 3.35 **K**, compared with helium-4 at 5.2 **K**. Helium-3 has less than one-half of the density when it is at its boiling point: 59 gram per liter compared to the 125 gram per liter of helium-4 — at a pressure of one atmosphere. Its latent heat of vaporization is also considerably lower at 0.026 **kilojoule per mole** compared with the 0.0829 **kilojoule per mole** of helium-4.



Milky Way over Lake Titicaca, Peru.

Largest lake in South America in terms of volume. Highest navigable lake in the world It is

Located at an altitude of approximate...



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The Philippine Island of Luzon

The Philippine Island of Luzon has a lake. The lake contains an island. This island contains a lake, and this lake contains

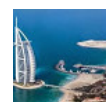
another island...



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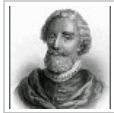
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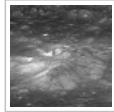
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