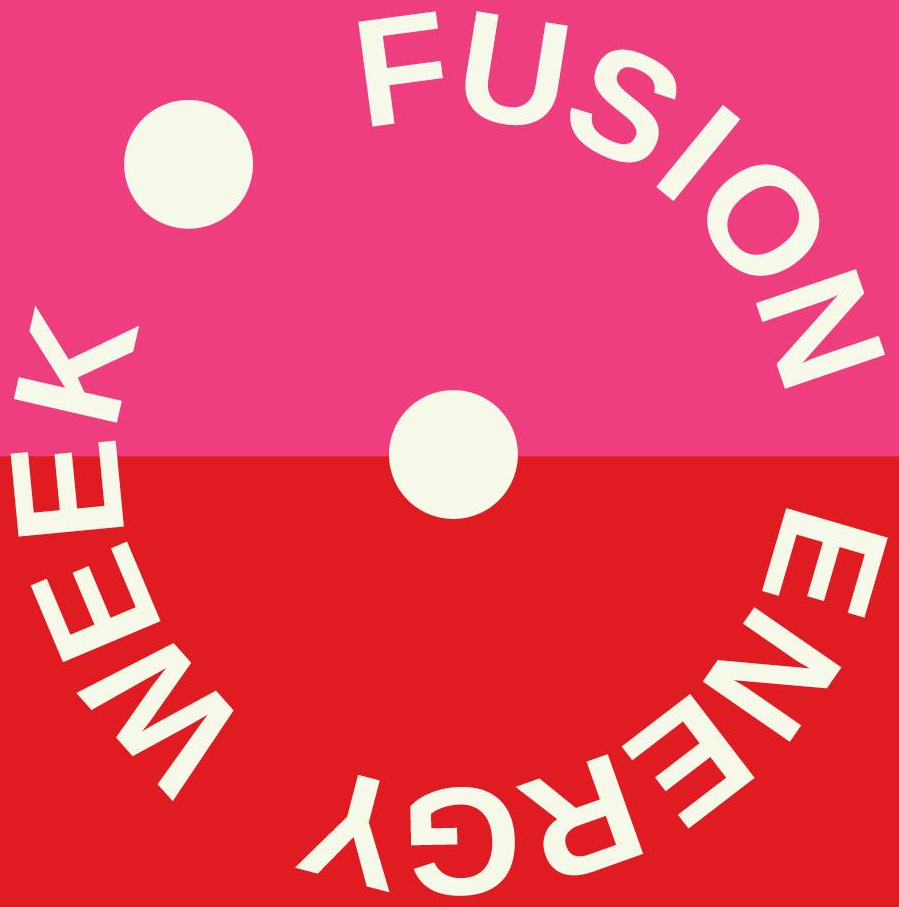


K-12 Fusion Energy Introduction

Cecilia Payne-Gaposchkin

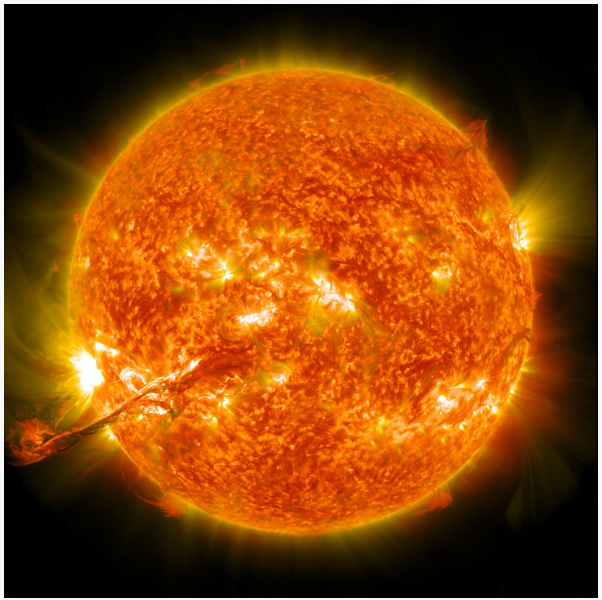
The USFOT's first annual Fusion Energy Week honors the life and contributions of Dr. Cecilia Payne-Gaposchkin

- **Cecilia Payne-Gaposchkin was an astrophysicist who discovered that stars were chemically made of hydrogen and helium**
- **Her PhD thesis, "Stellar Atmospheres; a Contribution to the Observational Study of High Temperature in the Reversing Layers of Stars," set the foundation for fusion energy research**
- **She became the first woman professor at Harvard as well as the first woman to chair the Astronomy Department**

https://www.aps.org/publications/apsnews/201501/physicshistory.cfm

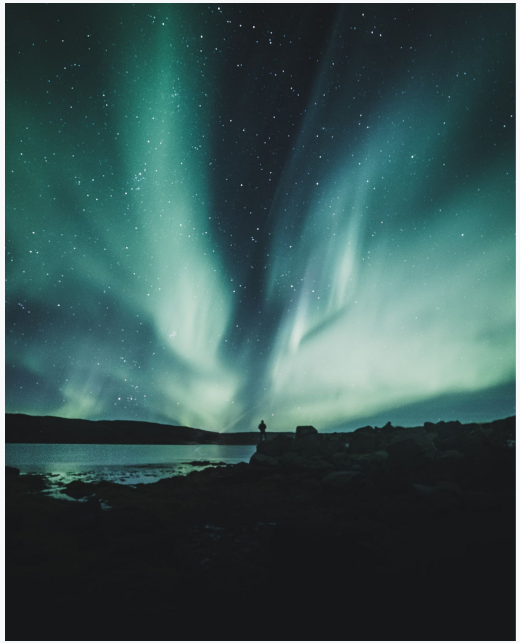
https://adsabs.harvard.edu/full/1925PhDT.....1P

Fusion is found in Nature



- Fusion is the process that has powered the sun (and other stars) for over 4.5 billion years!

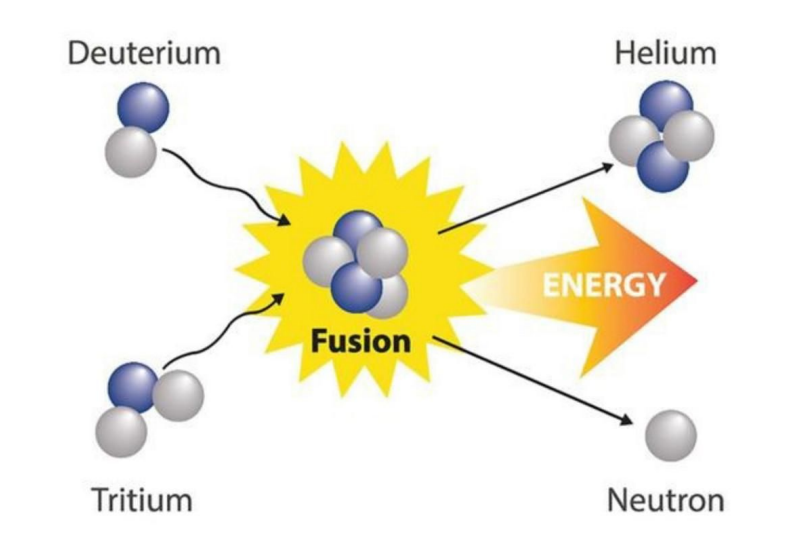
- Fusion energy, auroras, and lightning exist in a plasma state



- A plasma (the 4th state of matter) is an extremely hot state of matter where nuclei are separated from their electrons

https://www.iter.org/glossary
https://www.pppl.gov/about/about-plasmas-and-fusion

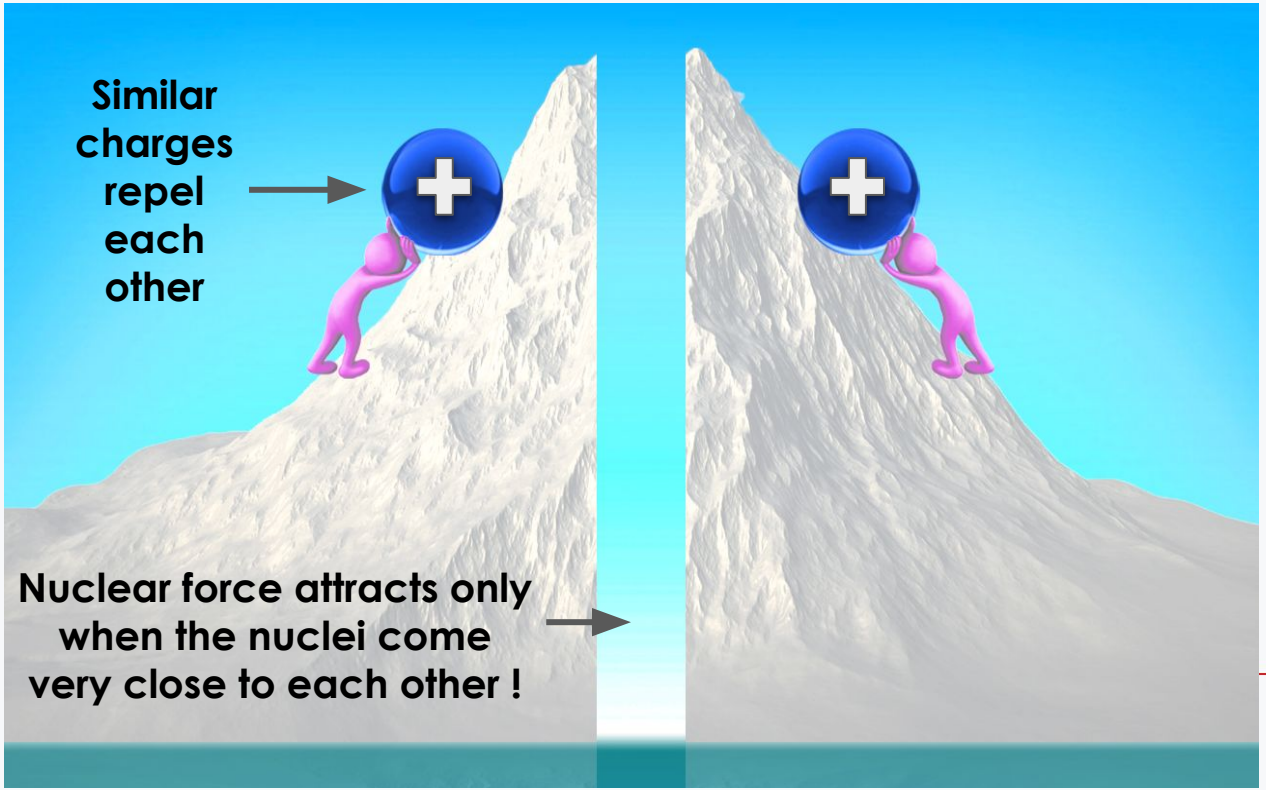
Fusion Energy Reaction - Making Stars on Earth



- **The fuels of nuclear fusion are deuterium and tritium, isotopes of hydrogen.**
- **Deuterium can be extracted inexpensively from seawater.**
- **Tritium has to be made from lithium, which is abundant in nature.**

https://www.scientificamerican.com/article/what-is-the-future-of-fusion-energy/
https://www.iaea.org/newscenter/news/nuclear-fusion-basics#:~:text=The%20main%20fuels%20used%20in,is%20also%20abundant%20in%20nature.

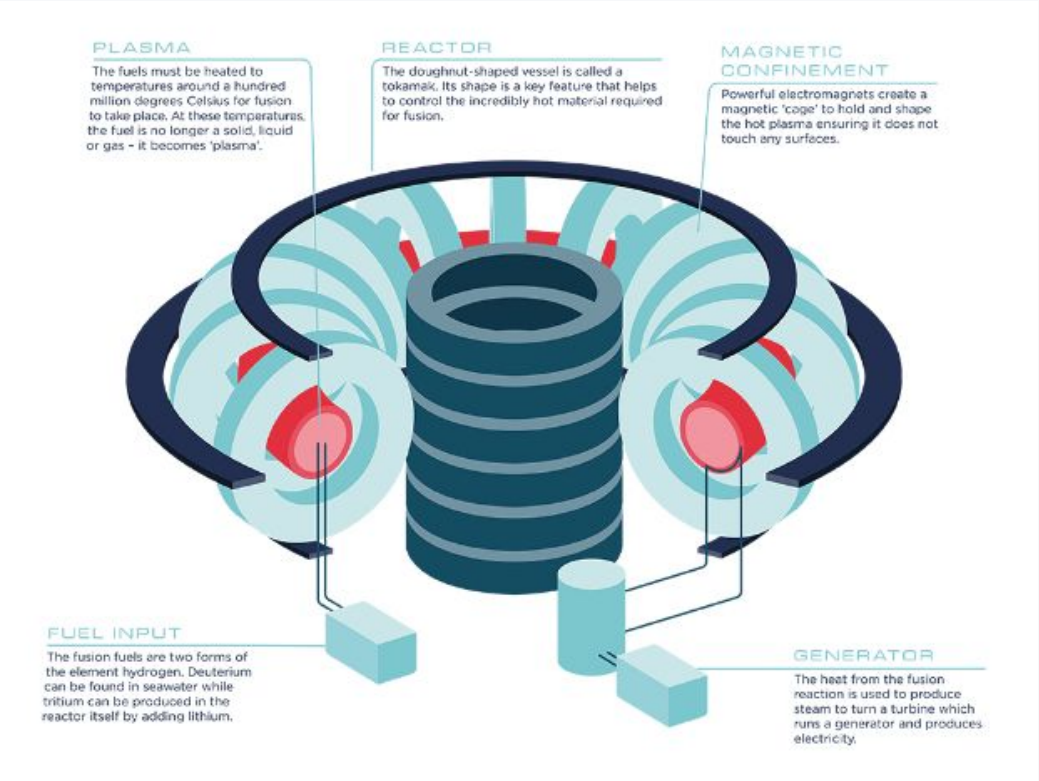
Why is fusion difficult?



What is the solution?

- Increase particle density
- Increase temperature
- Increase time

Tokamak - Fusion confinement chamber



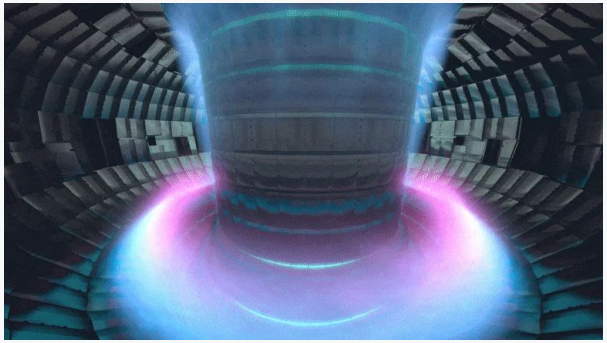


Fig. 1 Inside a tokamak - plasma circulating via magnetic confinement

- **Using magnetic or inertial confinement, Tokamaks allow hot, charge, magnetic plasma particles to interact and fuse - creating energy**
- **Benefits to Fusion energy**
  - Abundant
  - Will last millions of years
  - No CO_2
  - No long-lived radioactive waste
  - Limited risk of proliferation
  - No risk of meltdown
  - Cost

https://www.iter.org/sci/Fusion
https://ourfuture.energy/bright-idea/nuclear-fusion/