

# Creating The Universal Magnetic Fields



## Abstract

These are the corresponding notes and theory for the “Creating The Universal Magnetic Fields” Tutorial. Enjoy!

## Theory

- Magnetic fields surround the Earth, planets, Stars, and all Galaxies. They also exist in remote regions of the cosmos. They are considered one of the primordial components of the universe. They are everywhere. They are also the only other force that can shape the cosmos besides gravity.
- Around 20-odd years ago , a group of astrophysicists detected magnetic fields from galaxy clusters, and started to look into how they were affecting the formation of galaxies.
- These scientists also found that sections of empty space also emit magnetic fields as well. They describe all of these magnetic fields as filaments moving across the universe. The best answer scientists have as to what created these filaments, is that they are leftover from The Big Bang, and that they might be a corresponding factor on Hubble Tension.

**Hubble Tension:** This is the estimated rate that the universe is expanding. It is currently a bit off, as the universe is expanding faster than we think it is.

- Magnetic fields might be the encouraging factor that is increasing the rate of expansion.
- In 1991, a scientist named Tanmay Vachaspai proposed that magnetic fields were created right after The Big Bang when electromagnetic and weak nuclear forces separated and formed. Or when protons, electrons, and plasma were formed.

- Magnetic fields can originate from charged particles in motion. They can also align with other weaker fields and become stronger. Magnetic fields tap into every free energy force to grow.

### **Other Notes About Magnetic Fields:**

- The study of Magnetic fields in space is called Magnetogenesis.
- Magnetic fields can redirect high speed electrons. This process is called Synchrotron Radiation.
- Scientists are currently studying a magnetic filament between two galaxy clusters. Abell 399 and Abell 4d. They are studying it through observing how many electrons the field is emitting.
- Researchers can also view field distortions through something called Blazars.

**Blazars:** These are bright beams of gamma rays and other large masses of light and matter traveling through space. Based on how the gamma rays travel and are distorted through a magnetic void, they can predict where the magnetic filaments are.

- Depending on how a magnetic filament or field formed, its form will be affected. For example, if a field was formed by electroweak phase transition then they should look Helical(Corkscrew-like).

### **Goal of The Tutorial**

- We will create a 3D simulation on how magnetic fields permeate galaxy clusters