

# Physics of star trek



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The Physics of Star Trek – Warp Speed “ Engage. ” One simple command that triggers an entire series of complex reactions deep in the core and within the warp nacelles of the Starship Enterprise. Engage implied not only a command to fly off into the unknown reaches of space, but also a revolution of thinking that combined fundamental physics with the innovative ideas of the future. Warp technology, as envisioned by the writers of Star Trek, can be linked to today’s world of physics: Newton’s third law of motion and Einstein’s theory of Relativity, and also the latest advancements at CERN.

The main dilemma for the writers was how to describe and create a world of warp speed without completely disregarding the laws of physics. They therefore decided that they needed to adhere, or attempt to adhere, to the fundamentals of physics by employing some of the basic laws of motion, time and space. The first concept the writers considered, and needed to overcome, for the idea of warp speed was Newton’s third law of motion: for every action, there is an equal and opposite reaction.

However, if this law of motion were simply applied to the speed that the ship was theoretically travelling (or even at half the speed of light), the force of the acceleration would kill a person by smashing them against their seats. Additionally, the fact that matter cannot travel faster than the speed of light caused further predicaments for the Enterprise. The writers attempted to sidestep these problems by utilizing Einstein’s theory of Special and General Relativity, and his ideas about the relationship between space and time.

Einstein's theory of Special Relativity deals with the idea that space and time are relative – an object in motion actually experiences time at a slower rate than an object at rest. In regards to the Enterprise, this means that the closer the ship gets to the speed of light, the slower the rate of time they experience. So, in example, if the Enterprise had to travel to the center of our galaxy at close to the speed of light, they could reach it in about 10 years, an entirely feasible amount of time for those aboard the ship, however it would take about 25, 000 years for the Federation waiting on Earth.

This poses an obvious problem, as the Federation could not hope to run properly if it took 50, 000 years for a ship to reach the center of the galaxy and return. So, the writers had a conundrum: the ship could not travel at the speed of light, because it is impossible as defined by Einstein's theory of Special Relativity and it would be out of synch time-wise with the federation. However, the Enterprise would have to travel faster than the speed of light in order to move around the universe in an effective manner.

Enter Einstein's theory of General Relativity. Einstein's theory of General Relativity describes how gravity affects the shape of space and flow of time. This idea of being able to manipulate space is the key to being able to travel at warp speed. The Enterprise could, theoretically, have a device on board that expands the space behind it and contracts the space in front of it, essentially pulling it's destination toward the ship, all while staying inside a "warp bubble". The warp bubble is essentially a small bubble of "normal" (i. e. unaltered) space. The ship stays encased in the bubble, while outside the bubble space is being manipulated by being pulled forward and expanded behind. By using this idea, the ship could technically travel at the speed of

light, but also avoid the restrictions put of it by Newton's third law and Einstein's theory of Special Relativity. While most of the fundamentals of physics and motion were considered when the writers were envisioning warp speed, only the theory of General Relativity could be employed, because of its complex and ambiguous nature.

Now that the theories of traveling faster than the speed of light were created, the writers needed to invent the technology behind the ideas. This was accomplished through the idea of the warp drive. The warp drive is the system of devices that together create the warp bubble and manipulates the space, allowing the Enterprise to travel faster than the speed of light. The annihilation (or reaction) of matter and antimatter, which creates a plasma substance known as electroplasma, powers the warp drive. The devices that together create the warp drive are: the warp core, the nacelles, the warp coils and plasma conduits.

Because the reaction of matter and antimatter is so unstable, a substance called dilithium crystals regulates the reaction of the matter and antimatter. Dilithium is described on Star Trek as an extremely hard crystalline mineral, which occurs naturally on some planets. The chemical composition of dilithium prevents it from reacting with the antimatter, making it an essential part of the matter-antimatter annihilation. Without the dilithium containing and regulating the reaction of matter and antimatter in the warp core, the core would explode from the uncontrolled annihilation reaction.

As previously mentioned, there are four main parts of the warp drive: the warp core, the nacelles, the warp coils and plasma conduits. Plasma conduits

transport the electroplasma, created in annihilation reaction, so that it can react with the warp core and the warp coils. The warp core, which is the main energy reactor powering the propulsion system on warp-capable starships, is comparable to the engine of a car (i. e. the warp core powers the ship). The warp coils are the devices that actually create the displacement field in space (i. e. the warp bubble) by utilizing the plasma, and are housed in the nacelles of the ship. The full process of the warp drive is, essentially: matter and antimatter collide to create electroplasma, the plasma from the annihilation reaction travels to the warp core via the plasma conduits, which is finally transferred to the warp coils and nacelles, which creates the actual warp bubble. While the actual mechanics of the warp drive may be rooted in a fictitious future, the basic theories and principles of physics were used and adapted in a very real way.

The writers of Star Trek did not only create an amazing idea for a future show, they showed us a way to blast off at the speed of light towards the future. Cites: \* The Physics of Star Trek by Lawrence Krauss \* Time Travel and Warp Drives by Allen Everett and Thomas Roman \* How Stuff Works - <http://science.howstuffworks.com/warp-speed.htm> \* Wikipedia - [http://en.wikipedia.org/wiki/Warp\\_drive\\_%28Star\\_Trek%29](http://en.wikipedia.org/wiki/Warp_drive_%28Star_Trek%29) \* Memory Alpha Star Trek - [http://en.memory-alpha.org/wiki/Portal: Main](http://en.memory-alpha.org/wiki/Portal:Main) (used various links to specific subjects such as nacelles and warp core)