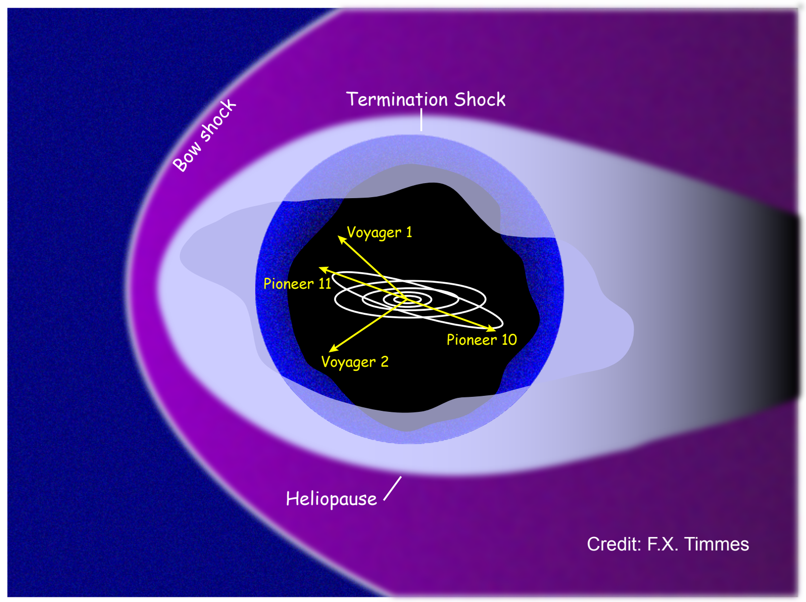
Houston, Tranquillity Base here. The Eagle has landed.
Neil Armstrong

Interstellar Travel

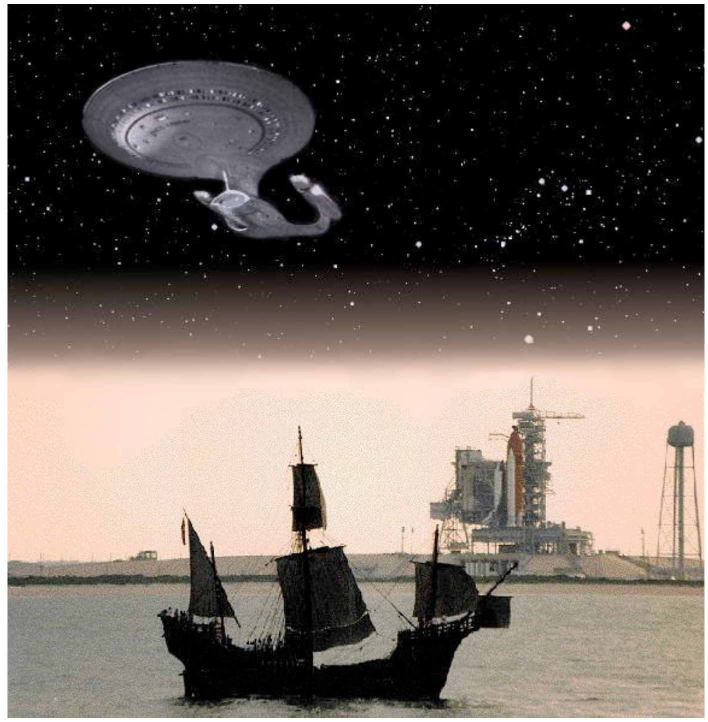
Hi AST 111. In this module we'll begin a two-part series on exploring space travel. Really, how difficult is interstellar travel? To answer that question let's step back a little bit to talk about speeds. Why? Because the distances are so big.



The fastest speeds about 40,000 years ago was on foot, A Neanderthal man, as shown above left, were a few kilometers per hour. Our fastest spacecraft, the Voyager I and II shown above, travel about 10,000 times faster. Still, it will take ~70,000 years for them to reach the nearest stars - Alpha Centauri. We're going to need to travel near the speed of light to traverse the nearest stars within a human lifetime. We're going to need to travel about 10,000 times faster than Voyager missions. In other words, we are as far away from interstellar travel as Neanderthal man was from going to the moon.The good news is most of the speed increase has taken place within the last century.

The image below left is an 1866 engraving from Gustave Dore. Quite the clipper ship! The image below right from Bill Arnett is a summary of travel between Dore's era, today, and where our art tells us we are going. From Clippers to the Enterprise!

Credit: Gustave Doré, 1895, WikiArt, public domain



Credit: Bill Arnett, 2001

How can we get another factor of 10,000 in speed? Well, chemical rockets come to mind. The image below shows Robert Goddard next to his second flight with a kerosene rocket. Chemical rockets have fundamental problem though. The faster you go, the more fuel you're going to need. But the more fuel you have, the more mass you have. The more mass you have, the harder it is to increase your speed. Ugg.

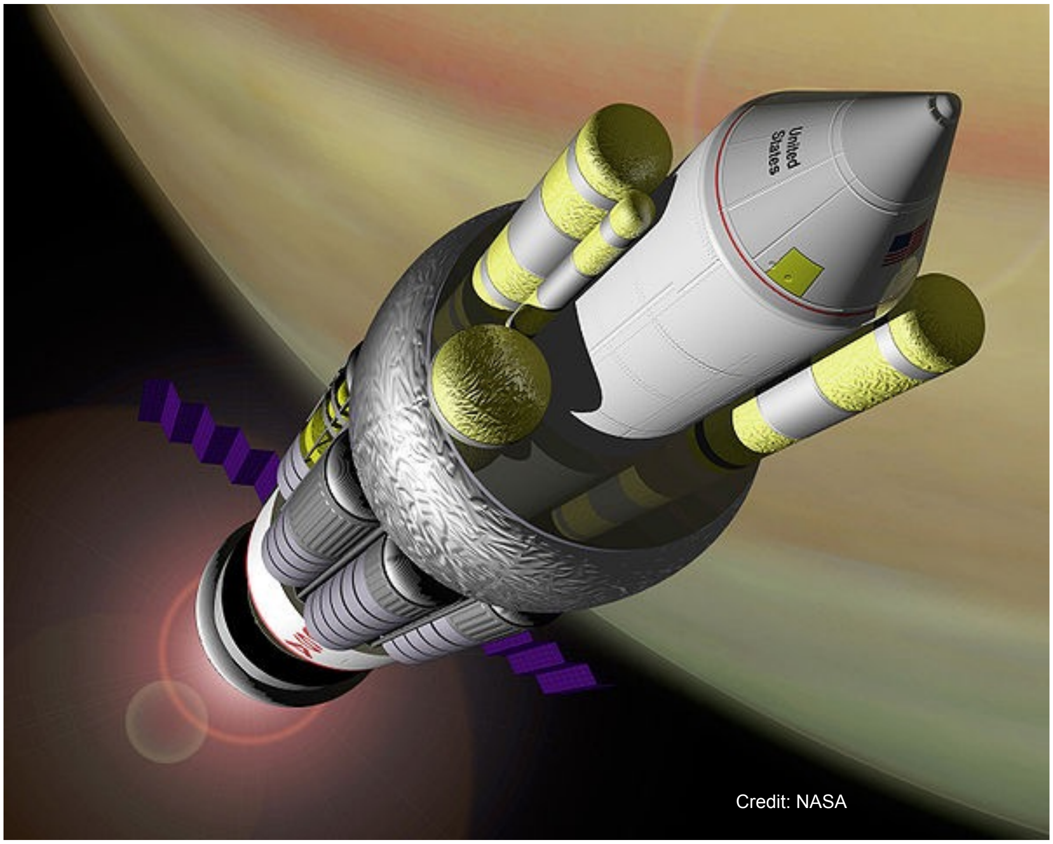
Credit: NASA

In addition, chemical rockets for small robotic spacecraft are limited to speeds of a thousandth of the speed of light. A journey to Alpha Centauri would then take about 4000 years. Plus, there are no gas stations in space. You have to carry all your fuel to get there and return homes, or maybe send the robots on a one way trip to minimize the fuel weight. Sad, but chemical rockets are unlikely to be practical for interstellar travel, especially for the larger ones you'll need for human travel, like the Atlantis shuttle below.

Credit: NASA

How about nuclear? Nuclear reactions are a million times more powerful than chemical reactions!

In the 1950s and 1960s, Project Orion offered a novel use of nuclear bombs. The idea here was to drop about 5 nuclear bombs per second out the back and light 'em off. A hefty shock absorber, a pusher plate, would soak up the blasts and propel the ship forward. The thing kinds of put-puts along. It was kind of a nifty idea. At least one way to use nuclear weapons. As originally conceived, Project Orion would take a human crew to Mars but sending sending smaller probes to the stars was also on the drawing board. A potential design is shown below in a modern form.

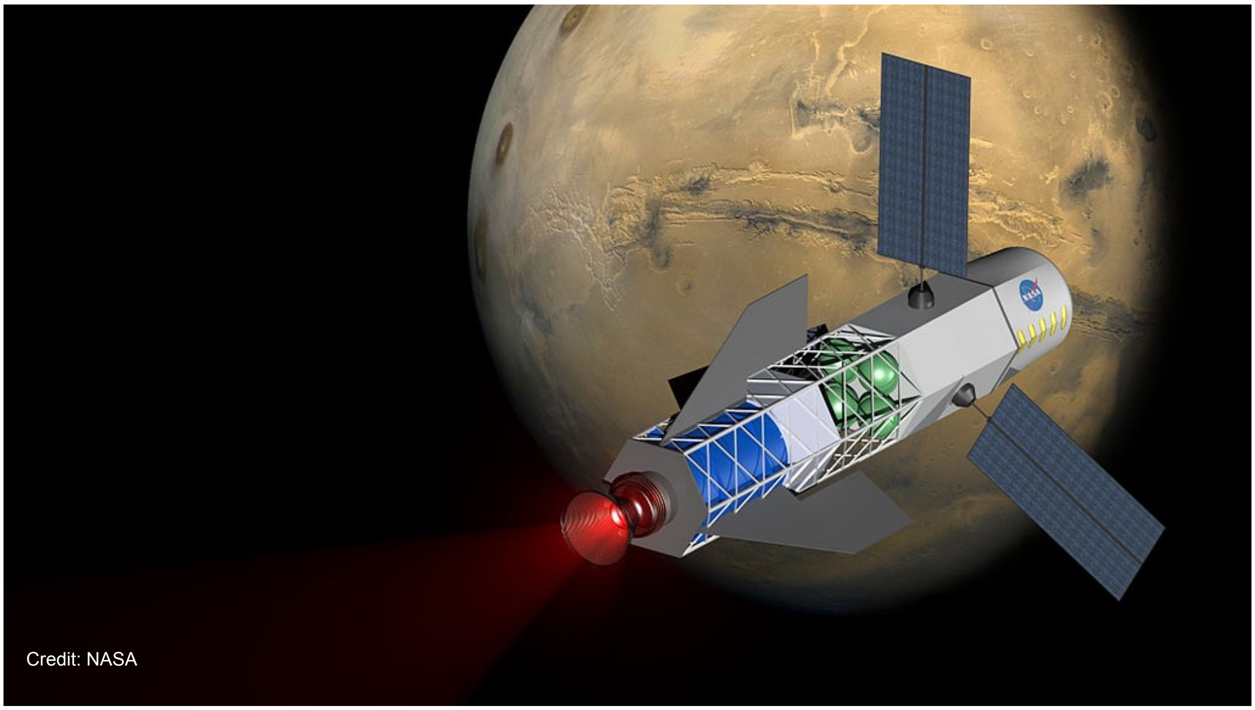


Credit: NASA

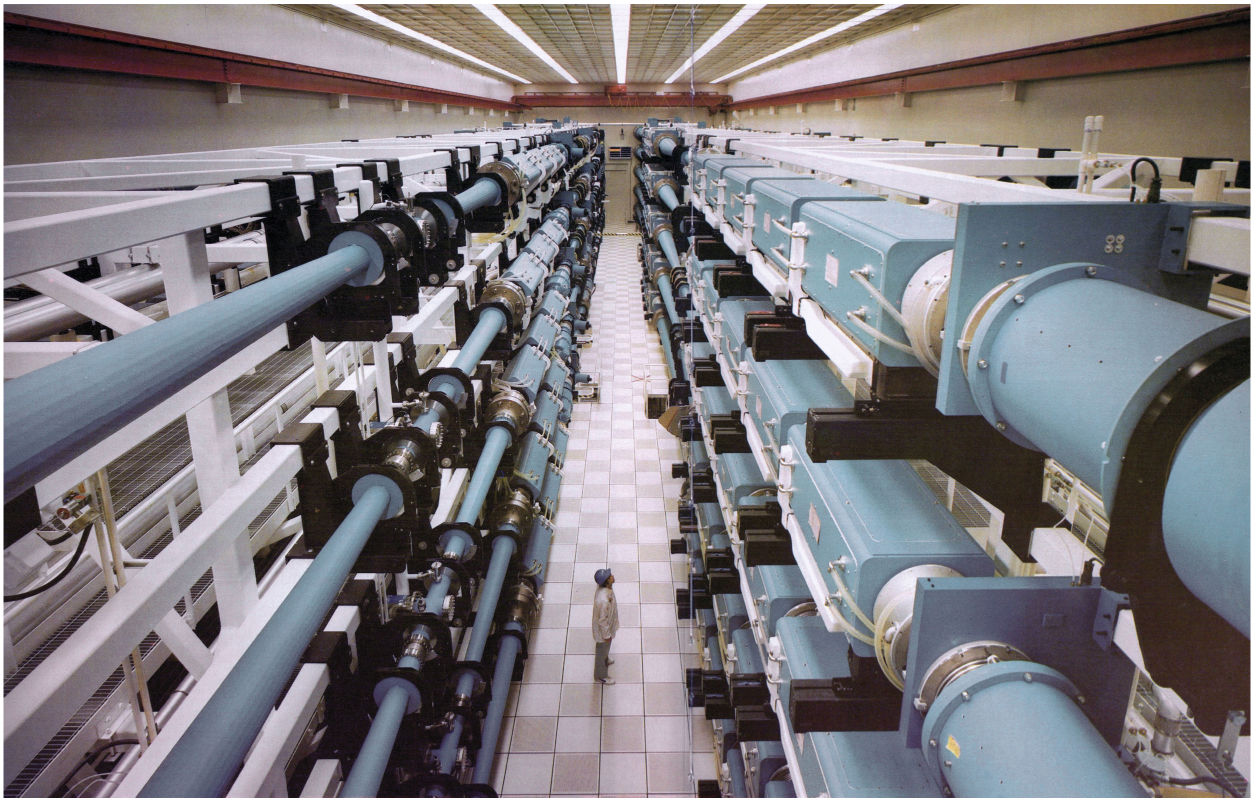
Test devices were actually built. They didn't use nuclear bombs! They used conventional chemical explosives. The image below shows Hot Rod, the only one actually tested. The experiments were conducted off the coast of Point Loma in California. It flew for about 15 seconds, proving the essential idea of an explosive hitting a pusher plate did work. It only flew once. Then it was mothballed. It's now at Smithsonian.

Credit: Smithsonian Air and Space Museum

Project Orion ended with the Nuclear Test Ban Treaty in the 1960s. In the 1970s the British revisited the idea with Project Daedalus from the British. An image in modern is shown below. Instead of dropping bombs out the back though, the idea was to generate nuclear fusion. Pellets of deuterium and tritium, both isotopes of hydrogen, would be blasted with electron beams until the pellets exploded. Certainly gentler then bombs. More controllable speed and acceleration too.



Unfortunately, we have not yet achieved controlled nuclear fusion to the break even point so that you repeatedly get out more energy than what you put in. But you can make it happen. We do it repeatedly in various ways in laboratories. It just costs more energy than the energy you get out. This is why we don't have, for example, electricity from fusion reactions. The image below shows the Nova Laser Project in California. Here we take our pellet of deuterium and tritium and instead of electron beams like Project Daedalus the pellet gets smacked by about a hundred very high powered lasers. You do get a little nuclear burning. You can tell from the image below, note the size of the human in the picture, that this facility is not very portable. You're not gonna put monster weight on a rocket ship!



Credit:Wikipedia, public domain

In the end though, nuclear pulse engines are going to be limited to about 10% the speed of light. This is certainly better than chemical rockets but still too slow.

In the next installment of this two-part series we'll take a look at "alternative fuels" for space travel.

Thanks! Bye Bye.