



Why is the crew not floating?



Star Trek TNG:TM (The Next Generation Technical Manual), S.158:

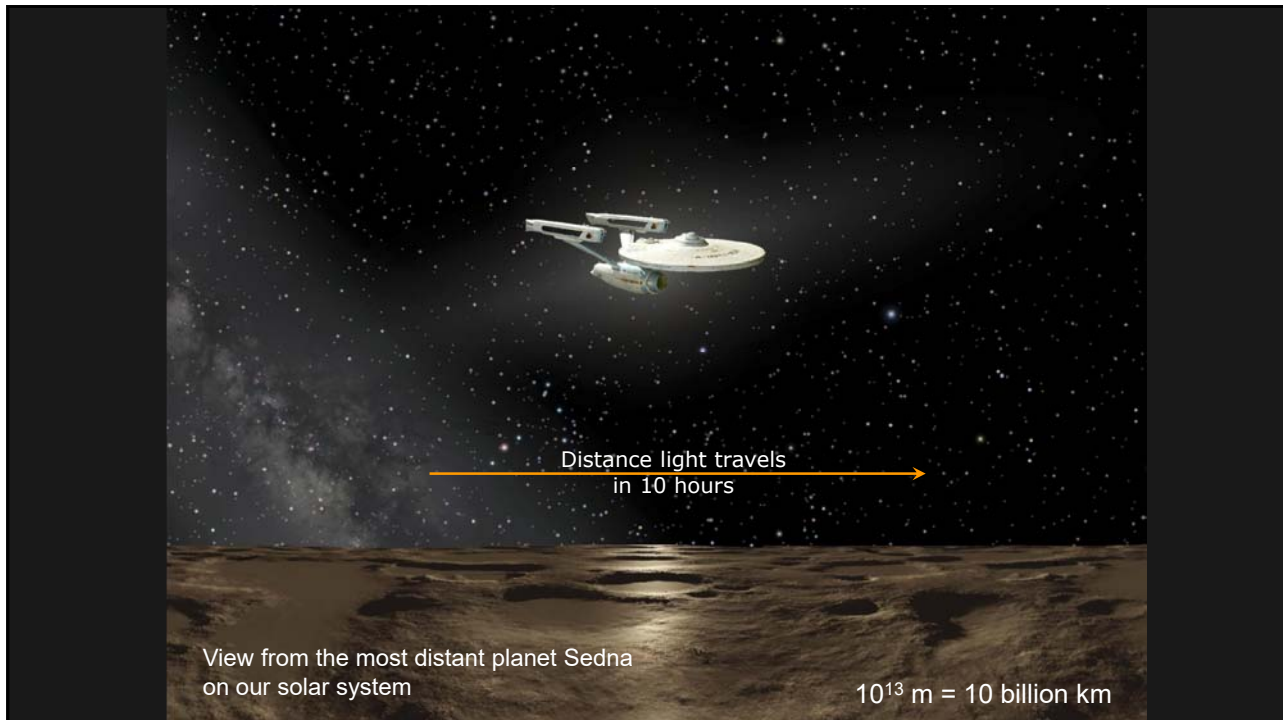
The gravity field is created by ... energy from the electro-plasma system (EPS) which is fed into a high chamber made of anicium-titanide 454 ... In the middle of the cylinder, a superconducting stator made of torgon in arkeide floats in pressurized chrylon gas. The stator, which is set to a rotation rate of over 125,540 rpm, generates a graviton field for only a few picoseconds.

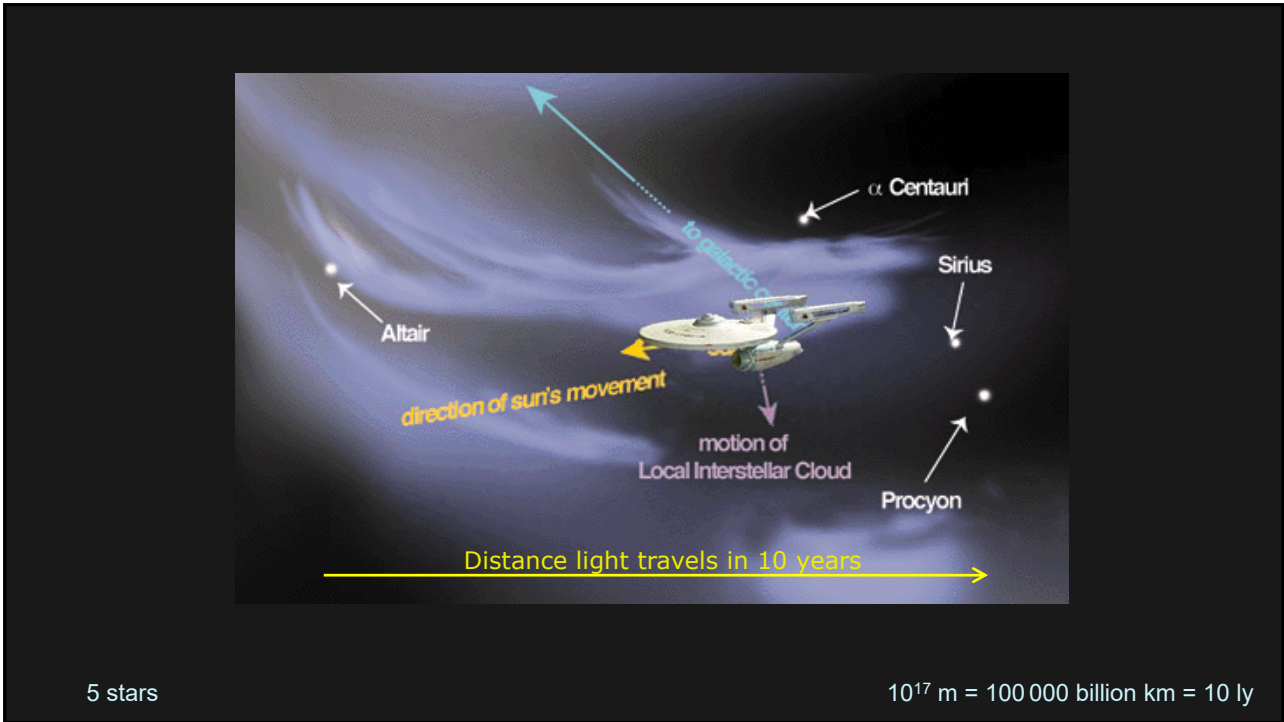
So, what?!

Why is the crew not floating?

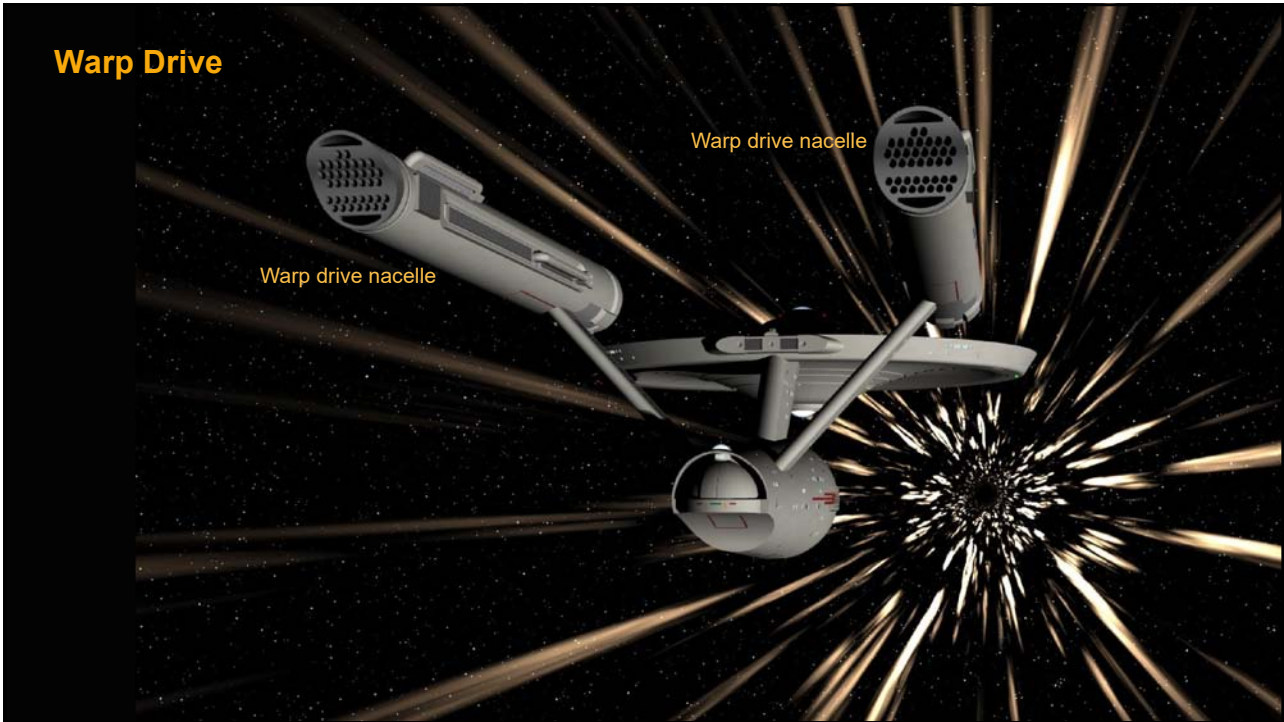


**Most probably because the scenes
couldn't be done in a film studio!**

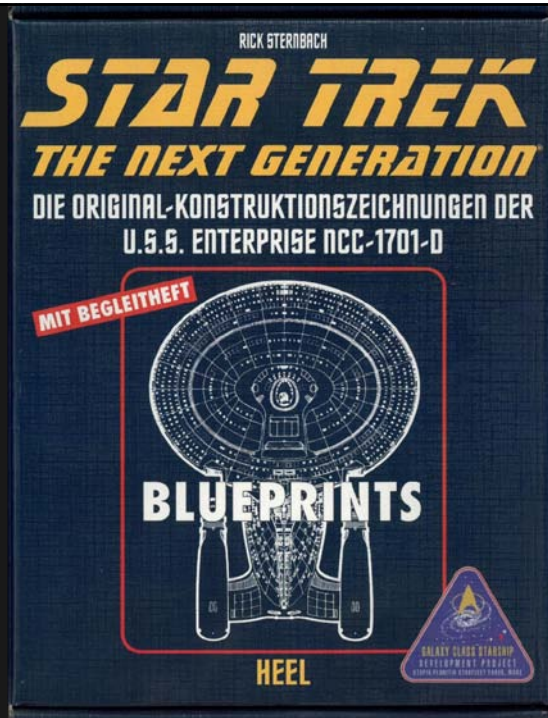




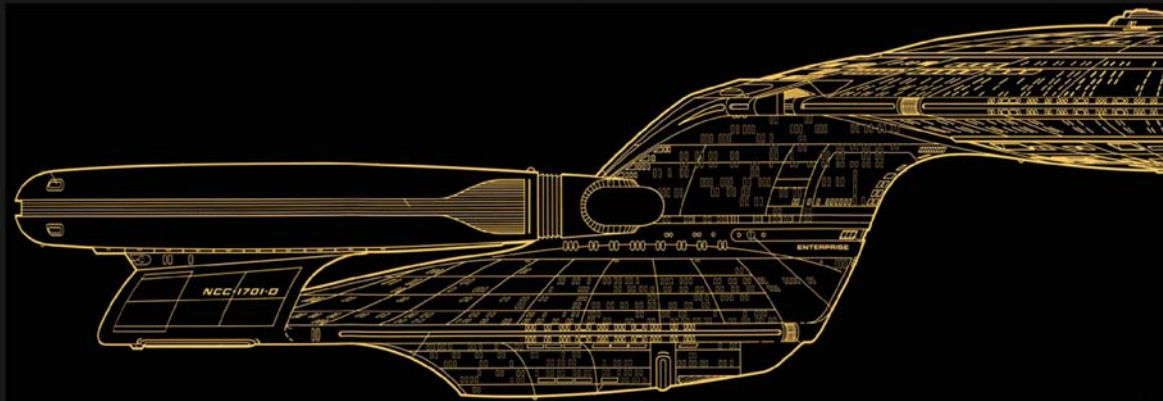
Warp Drive



What do the construction drawings say?

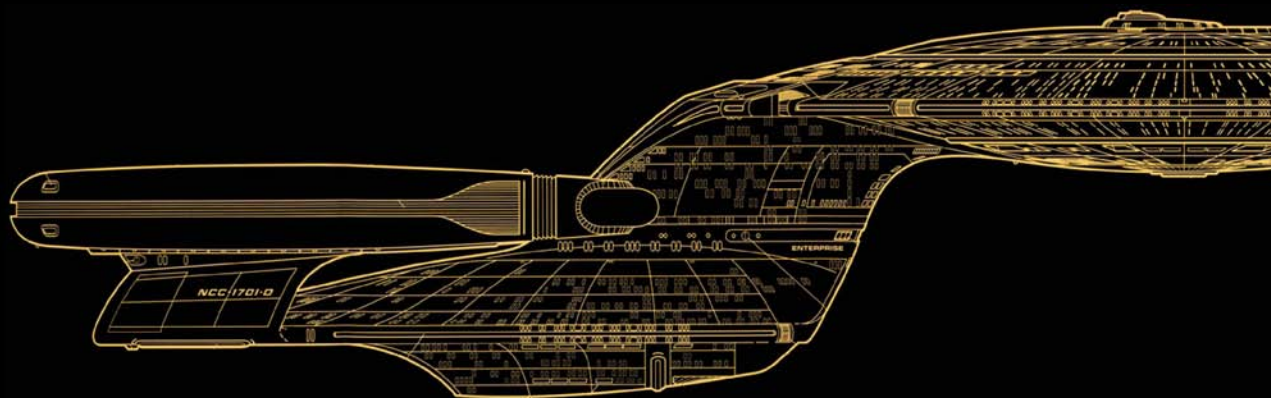


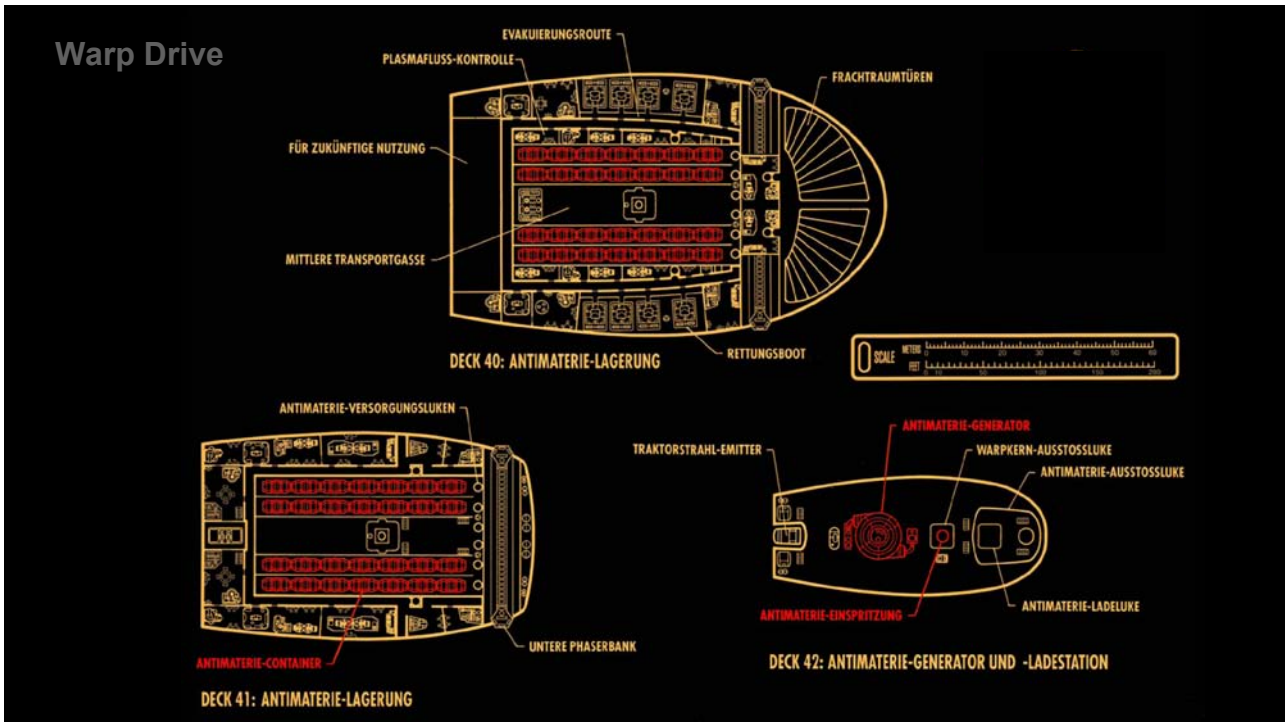
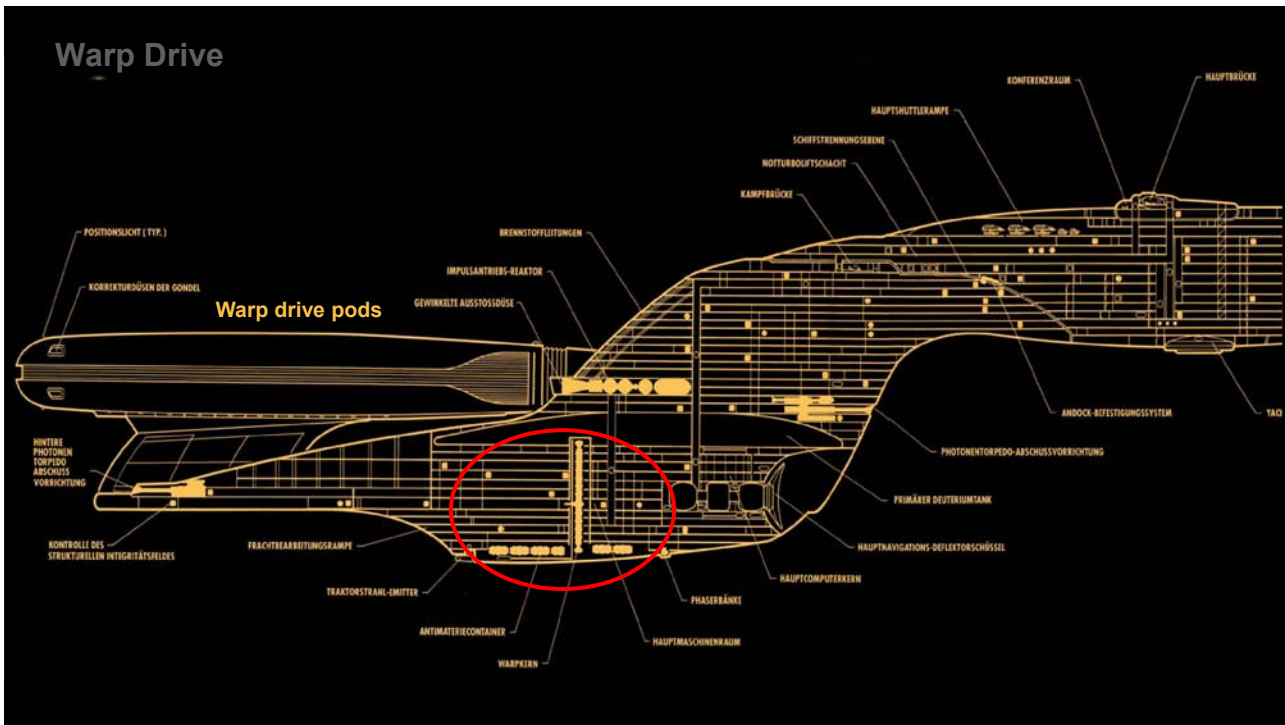
Warp Drive



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Warp Drive





Travelling space at superluminal speed?

Einstein:

$$\tau = \sqrt{1 - \frac{v^2}{c^2}} \cdot t$$

Time in spacecraft
= eigentime

Time on Earth
= reference time

For $v \rightarrow c$ the time in the spacecraft becomes zero!

For $v = c$ every place in the universe can be traveled in zero time!

Less than zero is not possible

Nothing goes faster than the speed of light!

Crossing the Milky Way
with acceleration of 1g



To cross the Milky Way with a matter-antimatter propulsion system the energy equivalent of a 27 x 27 x 27 km tank with antimatter is needed!

43 mg = 0.4 cm³ Anti-Hydrogen holds the same energy as 720 metric tons of hydrogen-oxygen fuel in the External Tank of the Space Shuttle.

Einstein:

Time experienced on Earth:	100 000 years
Time experienced in space ship:	11.9 years
Speed attained:	0.99999999997 c
Speed experienced in the space ship:	12.2 c

Warp drive for faster-than-light travel?



Space Travel – the Fountain of Youth!

In relativistic theory the retardation between two systems with velocities v_G and v_F after flight time T is:

$$(\Delta T)_{rel} = \frac{1}{c^2} \int_0^T \left[\frac{1}{2}(v_G^2 - v_F^2) + \mu \left(\frac{1}{r_G} - \frac{1}{r_F} \right) \right] dt$$

$$(\Delta T)_{rel} \approx (-330.10 + 35.00) 10^{-12} T$$

$$(\Delta T)_{rel} = -295.10 \cdot 10^{-12} T$$

On D1 Mission retardation was measured to be:

$$(\Delta T)_{rel} = -(295.10 \pm 0.30) 10^{-12} T$$

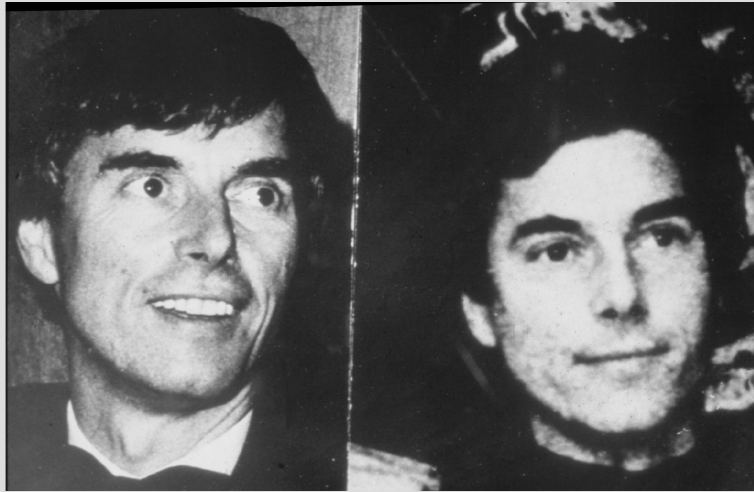


D2 Mission: Flight time $T = 861\,000$ s.

So I remained younger by:

0.000254 seconds !

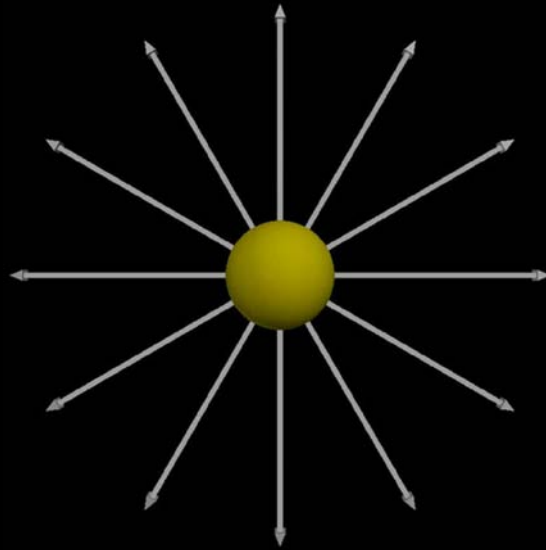
Ulf Merbold
just before and at the end of his mission



Ulrich Walter - Puffy face



Relativistic Beaming (a.k.a. Doppler beaming)

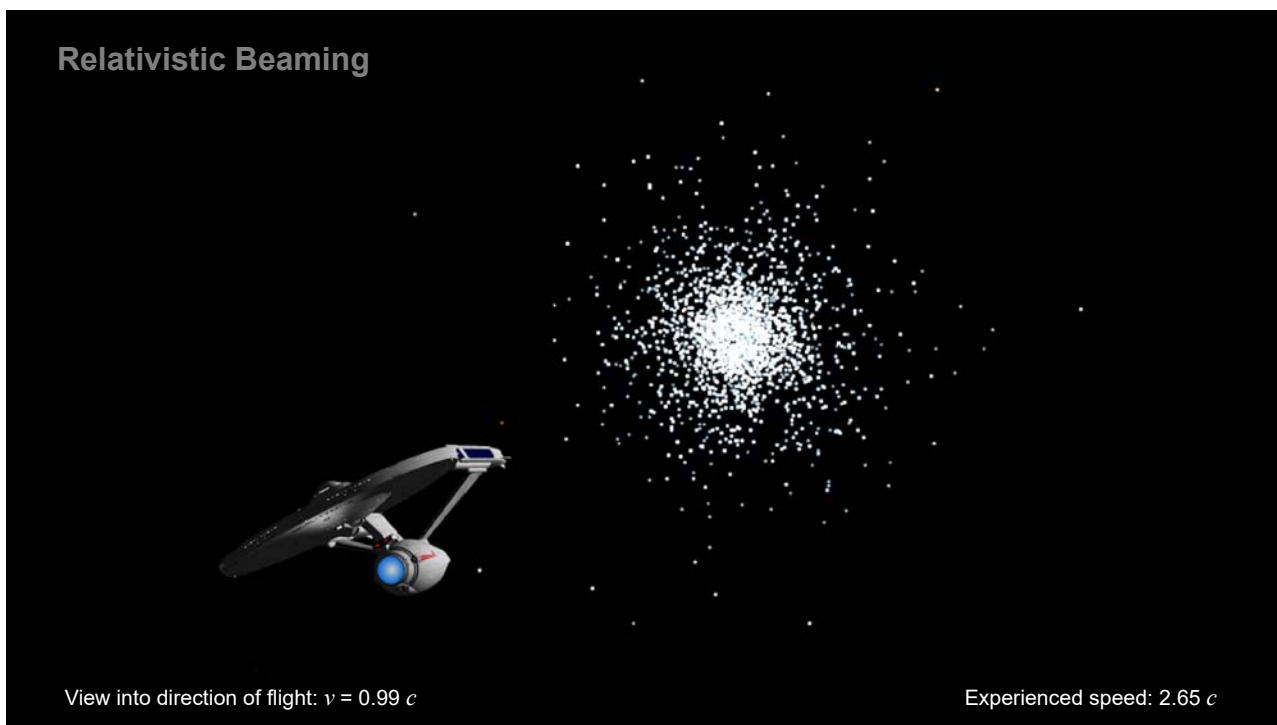
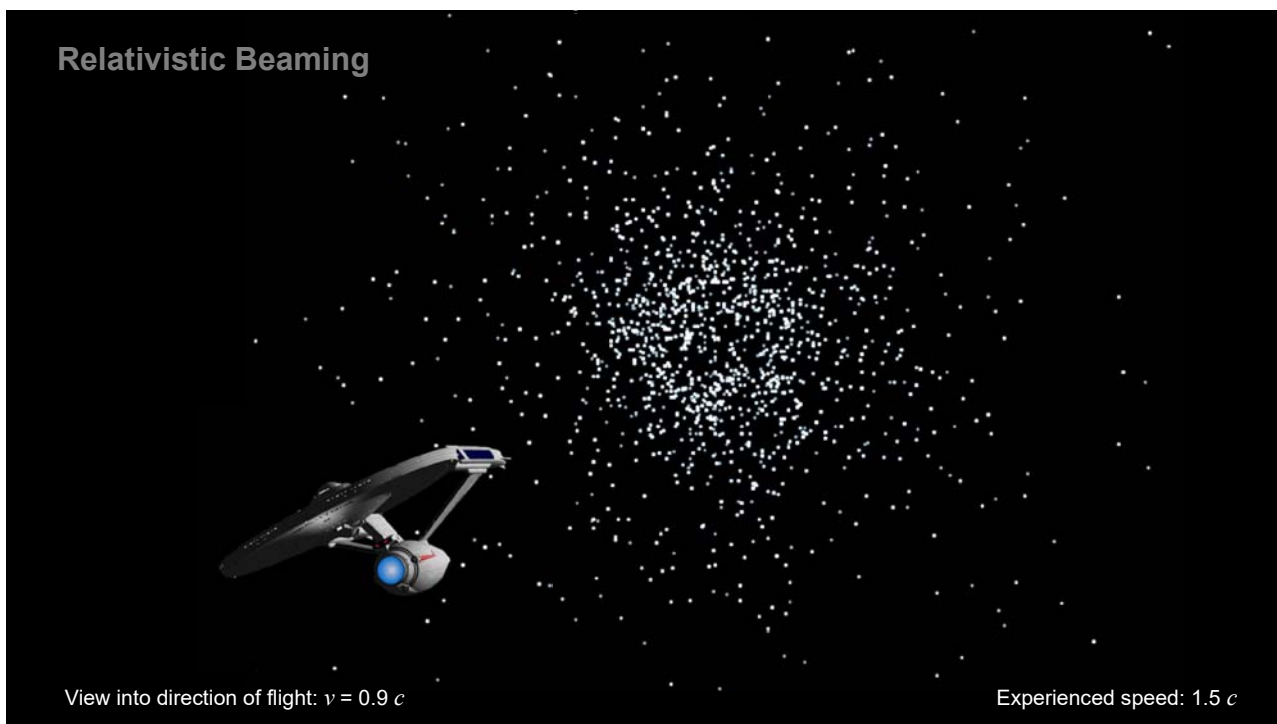


Relativistic Beaming



View into direction of flight: $v = 0.9c$

Experienced speed: $0.9c$



Relativistic Beaming



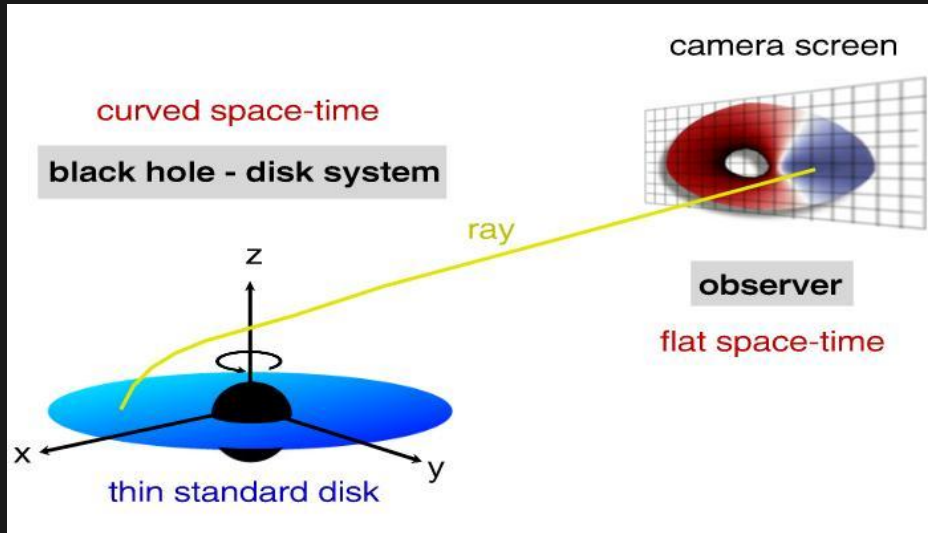
View backwards: $v = 0.80 c$

Experienced speed: $1.1 c$

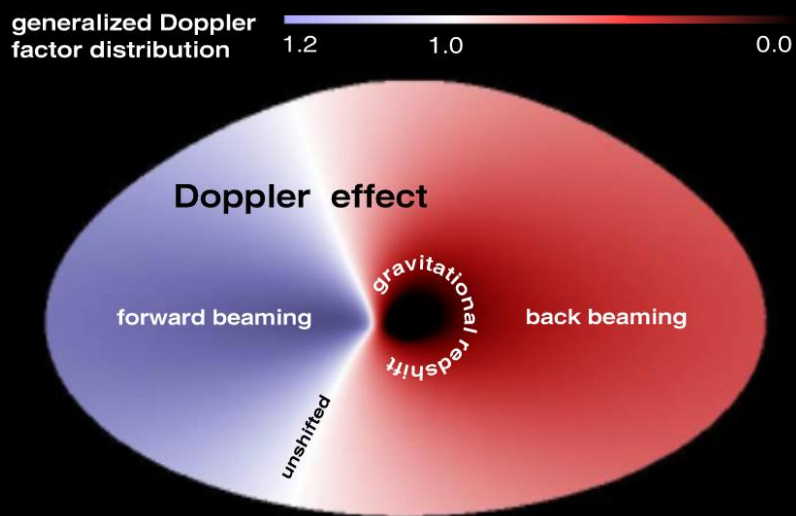


Simulation of mass accretion

Radiating Gas rotating around a Black Hole



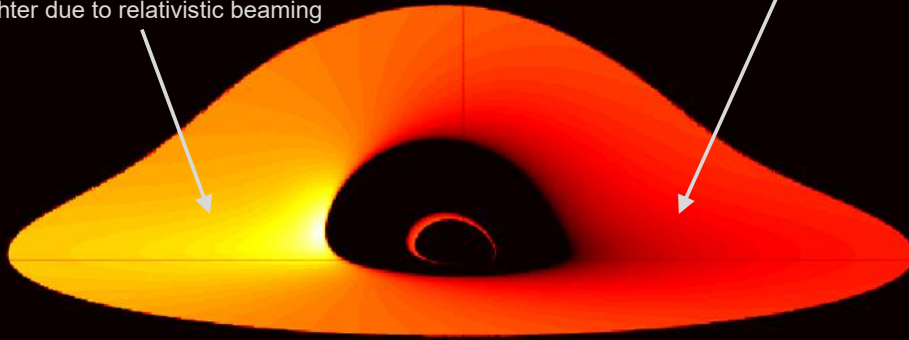
Black Hole – Doppler Effect



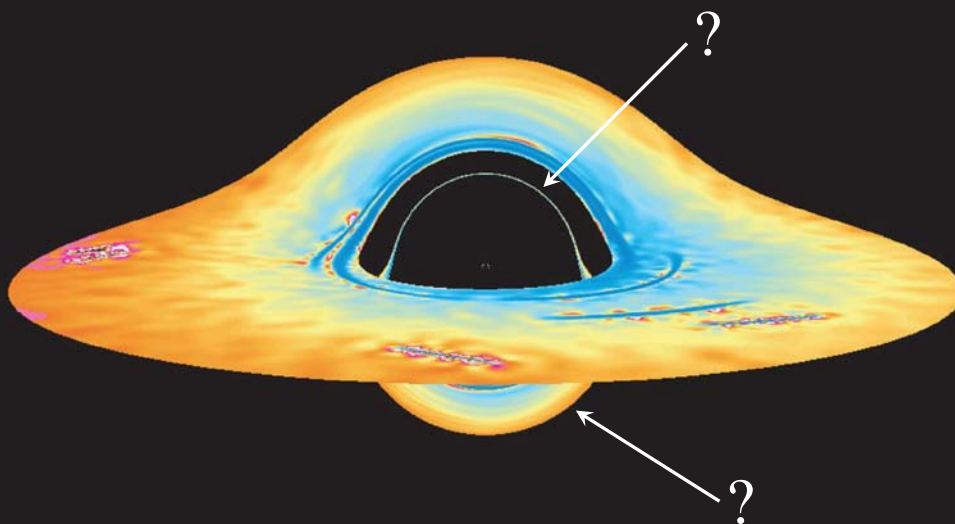
Combined Effect

Doppler „to blue“ shift = yellow
+
brighter due to relativistic beaming

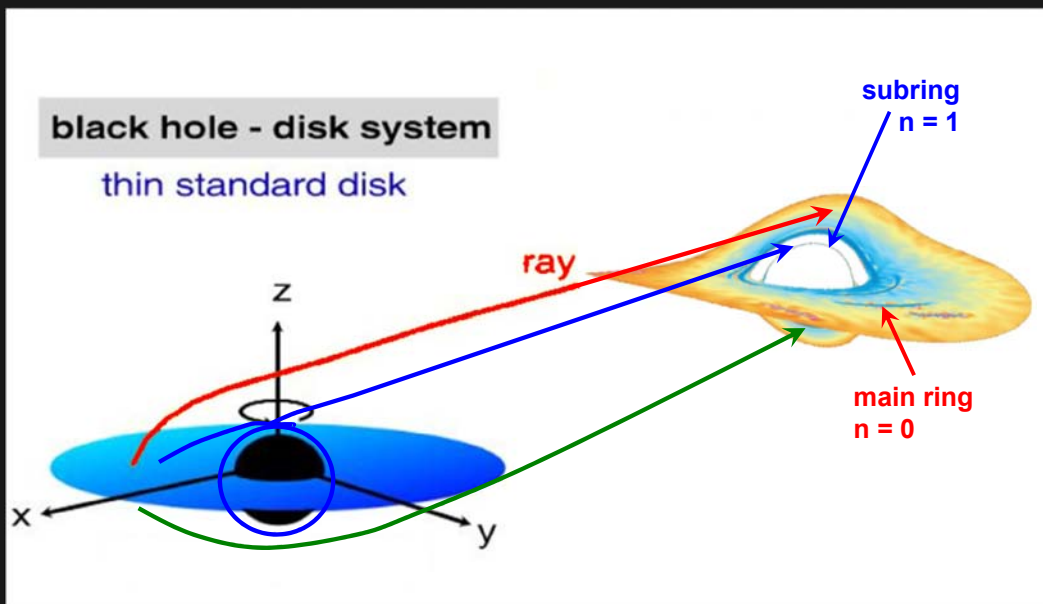
Doppler red shift

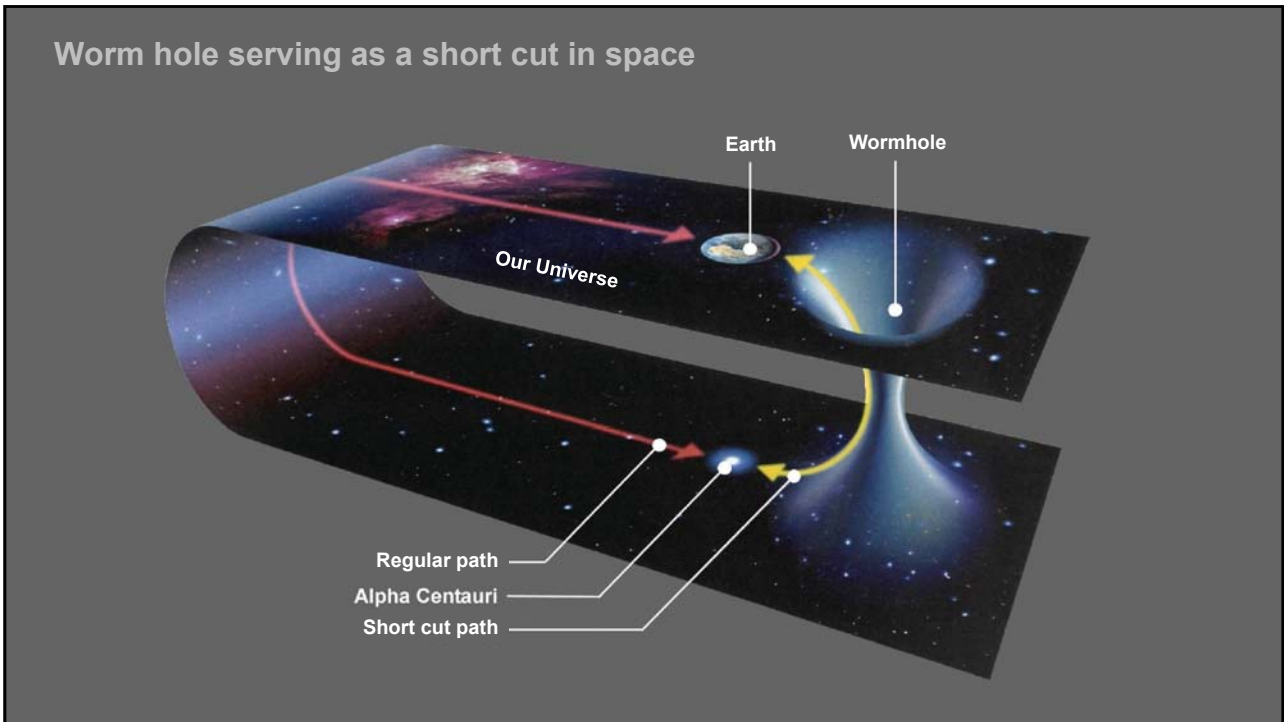
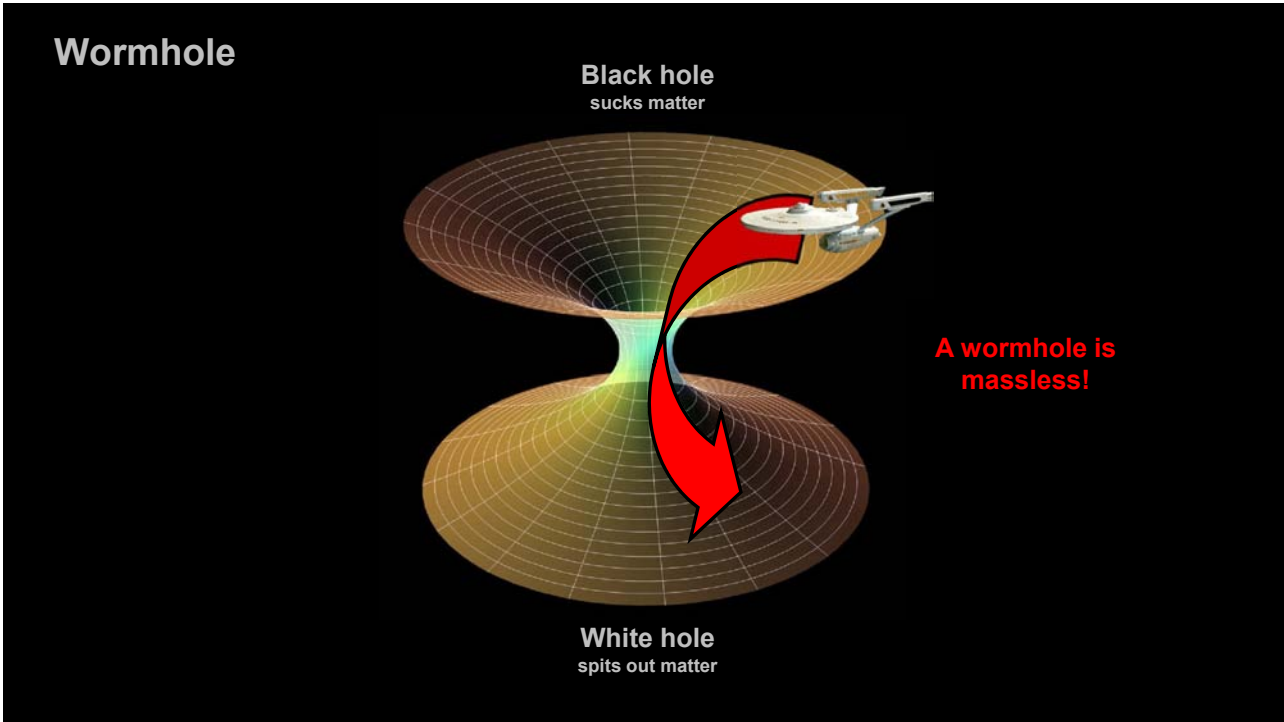


Subtle Effects

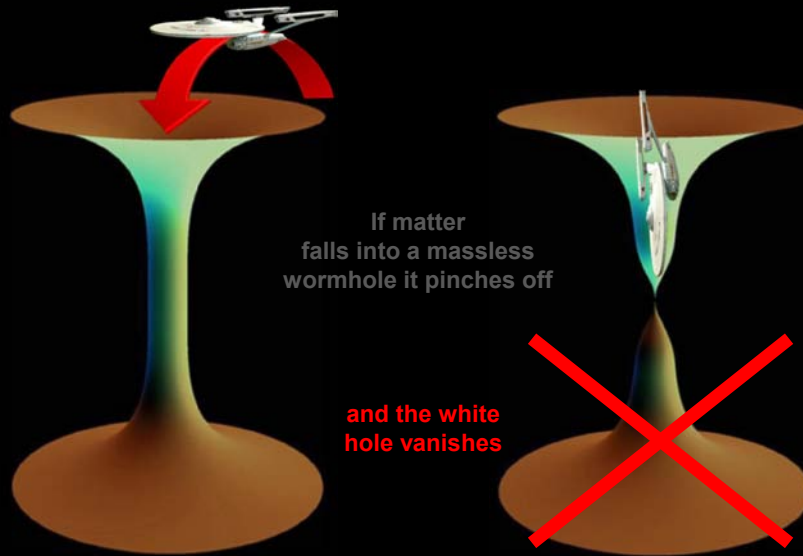


Explanation of subtle effects

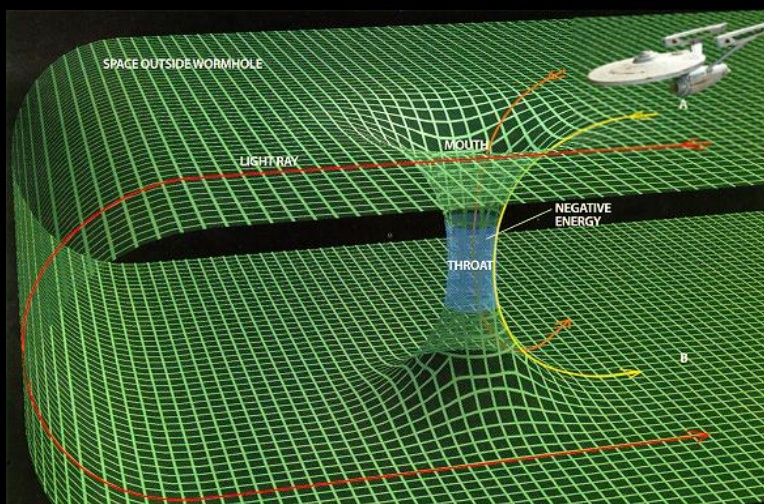




Wormhole Dynamics



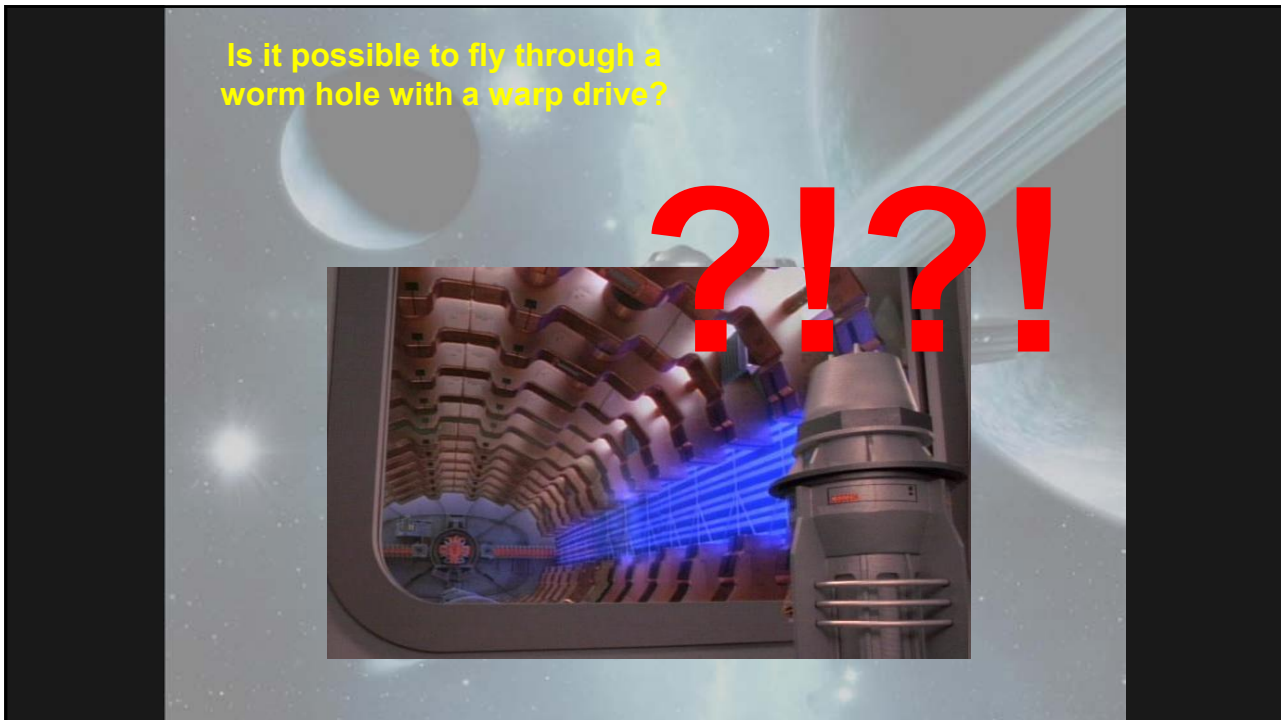
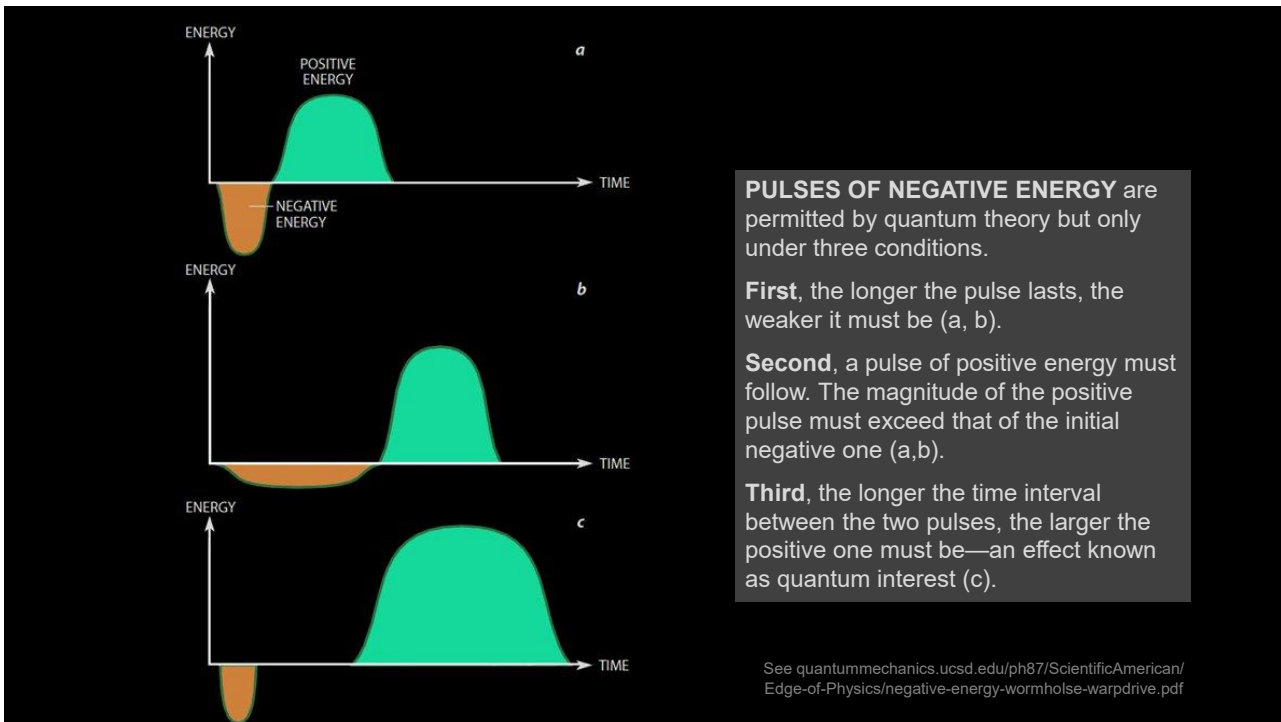
Preventing the Pinch



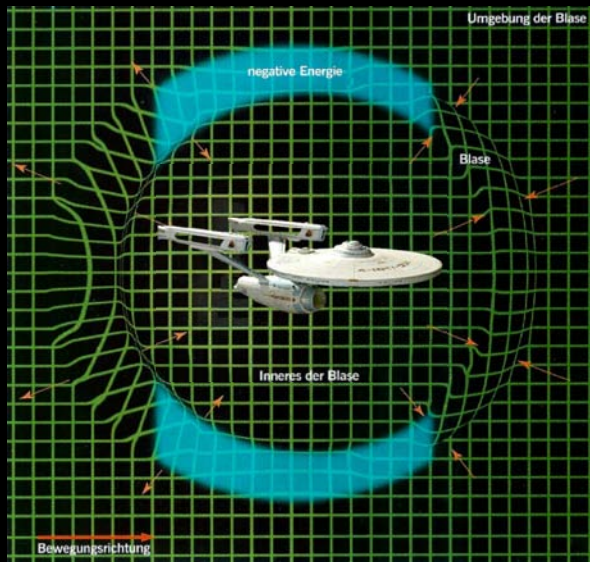
Negative energy prevents the throat from collapse.

However, a coat of negative energy is needed with a thickness of less than a billionst of an atomic diameter and a value equaling that of the energy production of 10 billion stars in a year.

Kip S. Thorne, W. W. Norton, 1994. *Black Holes and Time Warps: Einstein's Outrageous Legacy*



Warp Drive – Warp Sphere



Properties of a warp bubble

Negative energy is required on either side of the bubble.

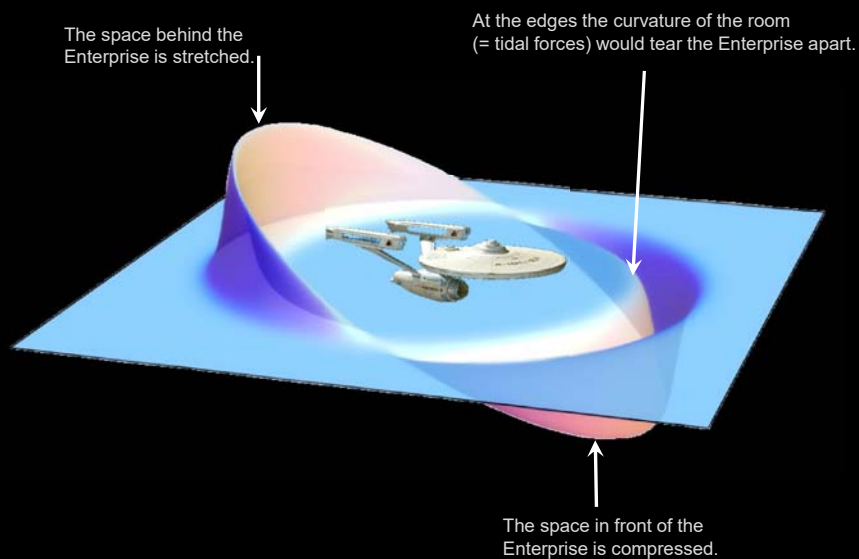
The spaceship rests relative to its immediate surroundings and is always in free fall. So the astronauts do not experience any acceleration.

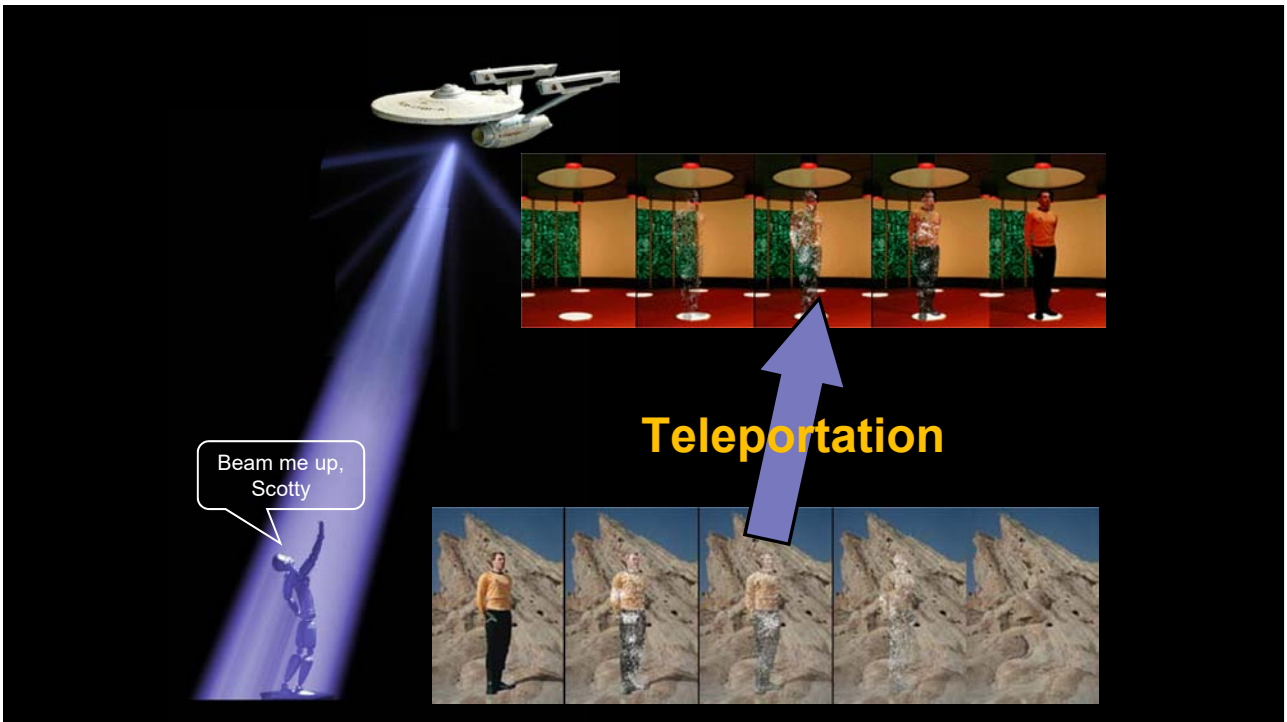
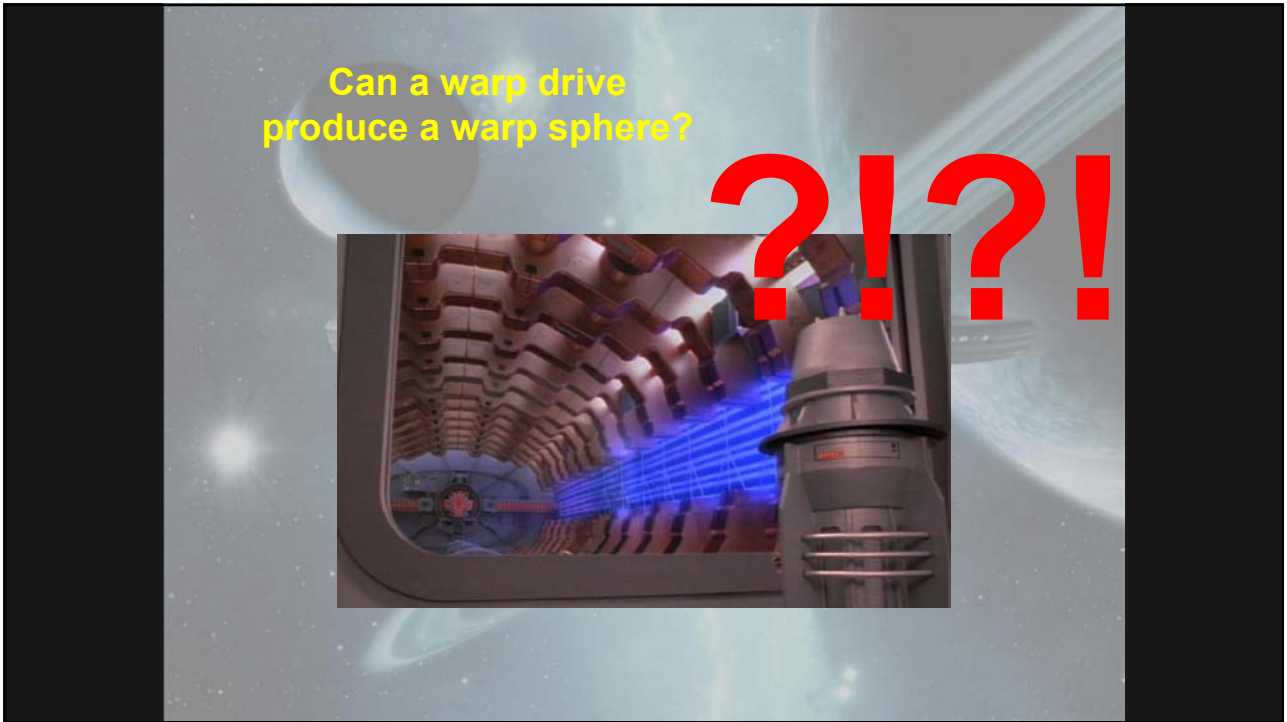
Since there is no causal relationship between the inside and the outside of the bubble, the spaceship cannot control the bubble ☹️.

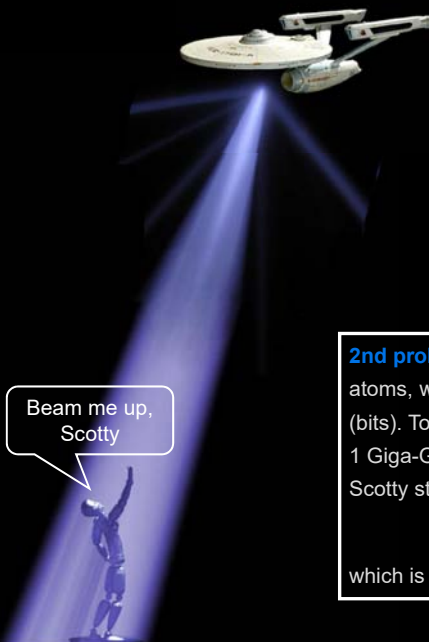
A few solar masses of negative mass are necessary for a bubble with a diameter of 200 m. ☹️

The bubble itself may have thickness of only 10^{-35} cm = 10^{-27} of an atom diameter. ☹️

Enterprise Warp Drive







Beam me up, Scotty!

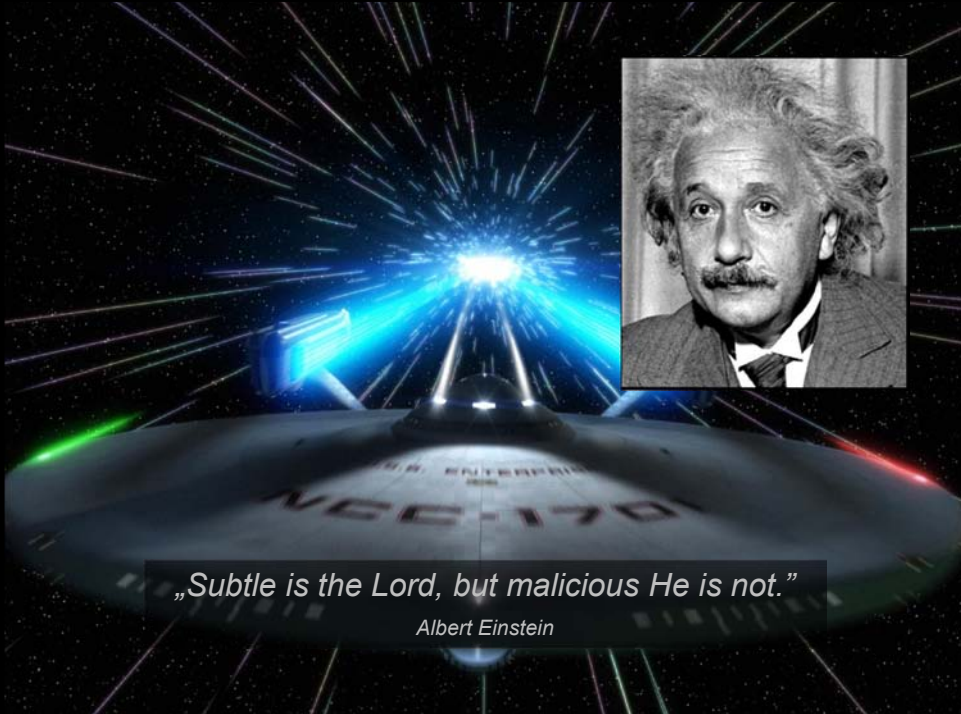
Is beaming, i.e. the transfer of a body to another remote location, possible?

1st problem: No-Clone Theorem of Physics

2nd problem: A human body consists of approx. 10^{27} atoms, which can be in $10^{10^{42}}$ different quantum states (bits). To transmit this amount of information at a rate of 1 Giga-Giga-Giga-Giga-Giga-Giga-Giga-Giga-Giga-Giga bps Scotty still needs

$$10^{10^{42}-81} \approx 10^{10^{42}} \text{ seconds}$$

which is much longer than the age of our universe!



„Subtle is the Lord, but malicious He is not.“

Albert Einstein