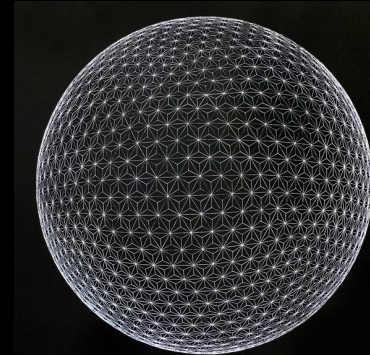


Space Exploration

Unconventional Methods in Propulsion

Mubashshir Uddin
Sunny K. Bhagat
Varun Singh



Contents

Near Future:

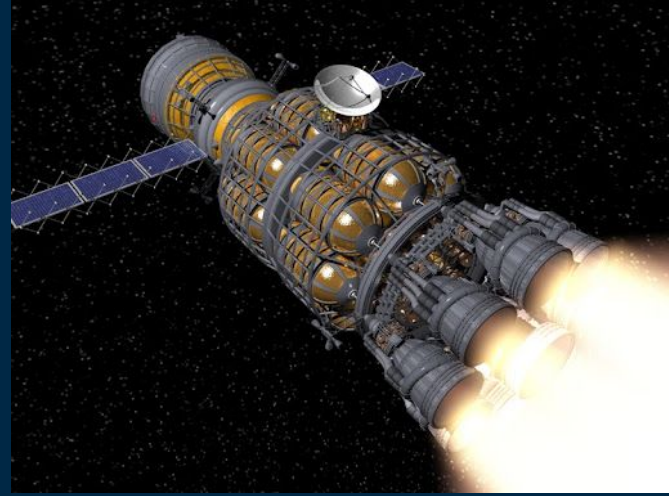
- Explosion Powered
- Fission Powered Rockets

Far Future:

- Fusion Powered
- Antimatter Powered
- Solar sails
- Beam Powered Propulsion

Impossible under Current laws of PHYSICS:

- Alcubierre Drive
- EM drive

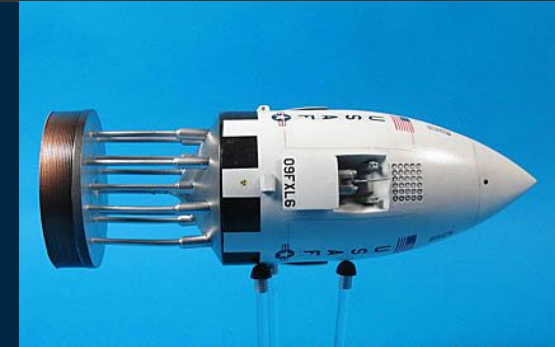
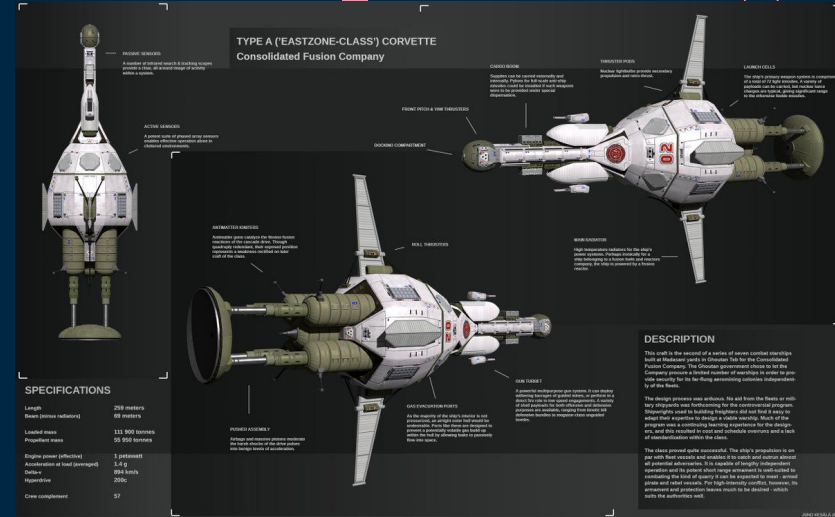


Explosion Powered Rockets:

PROJECT ORION

Using the currently most destructive form of atomic energy utilisation:

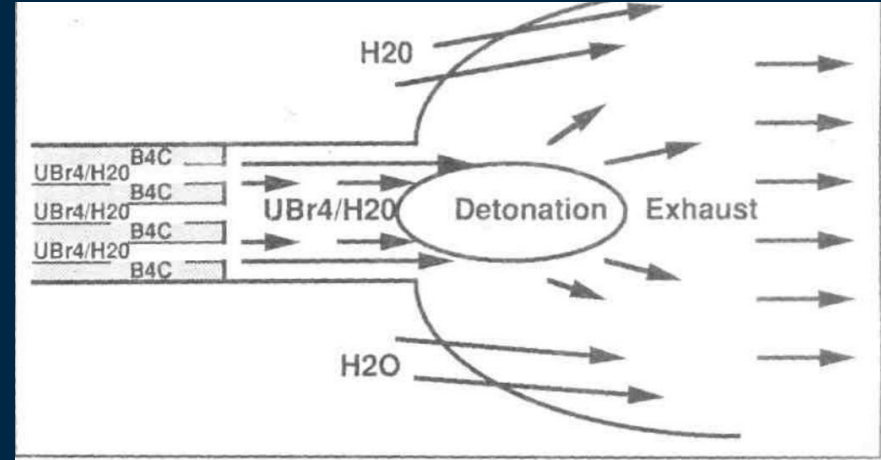
- Uses A- Bombs or H- Bombs
- Can Easily attain 1% of Speed of Light
- 44 years to Alpha Century
- Feasible even by current technology
- Bound only by lack of motivation



NUCLEAR SALT WATER ROCKET (NSWR)

Fission Powered Rockets:

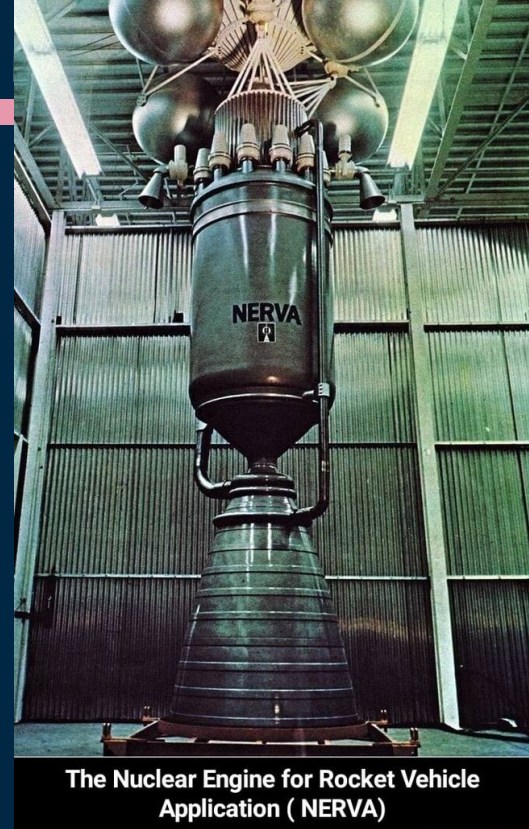
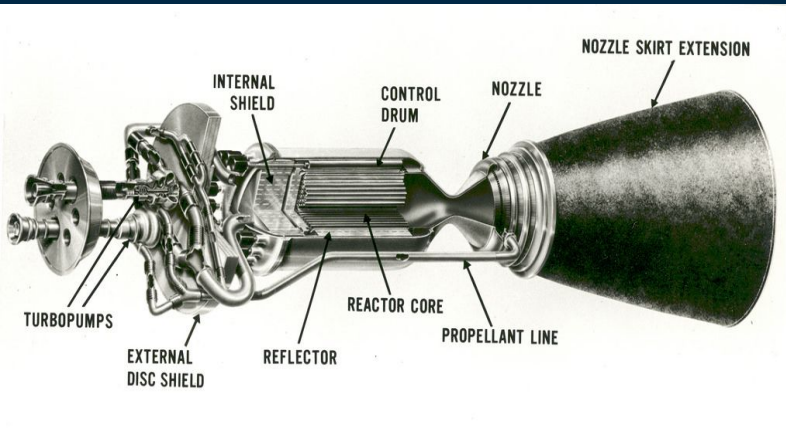
- Incredibly Efficient (10,000s of ISP)
- Uses uranium salts dissolved in water
- 66Km/s of Exhaust Velocity
- Cannot be used as a first stage
- Possible to accelerate a conventional spacecraft to 7% of speed of light



NUCLEAR ENGINE FOR ROCKET VEHICLE APPLICATION(NERVA)

Fission Powered Rockets:

- Only tested type of Nuclear Propulsion System
- Cancelled By political fuss
- 3 months to Mars @ $\frac{1}{3}g$ for a 220t spacecraft
- Very High Specific Impulse



“The AEC, SNPO, and NASA considered NERVA to be a highly successful program”

Reactor ♦	Test date ♦	Starts ♦	Average full power (MW) ♦	Time at full power (s) ♦	Propellant temperature (chamber) (K) ♦	Propellant temperature (exit) (K) ♦	Chamber pressure (kPa) ♦	Flow rate (kg/s) ♦	Vacuum specific impulse (s) ♦
NERVA A2	September 1964	2	1096	40	2119	2229	4006	34.3	811
NERVA A3	April 1965	3	1093	990	2189	>2400	3930	33.3	>841
NRX EST	February 1966	11	1144	830	2292	>2400	4047	39.3	>841
NRX A5	June 1966	2	1120	580	2287	>2400	4047	32.6	>841
NRX A6	November 1967	2	1199	3623	2406	2558	4151	32.7	869
XE PRIME	March 1969	28	1137	1680	2267	>2400	3806	32.8	>841



Far Future

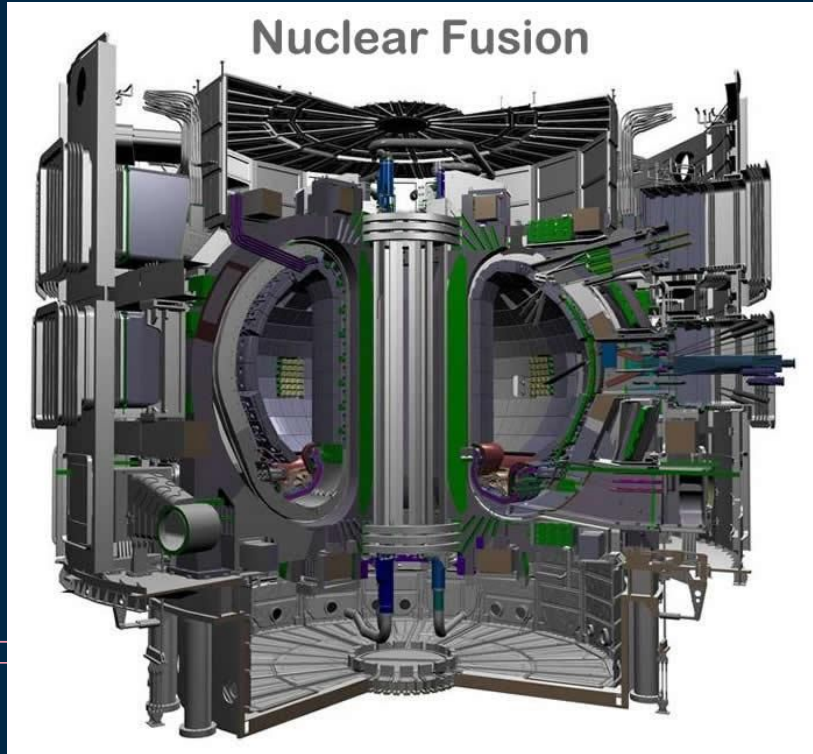


Fusion Powered Engines:

Entirely Theoretical Concept

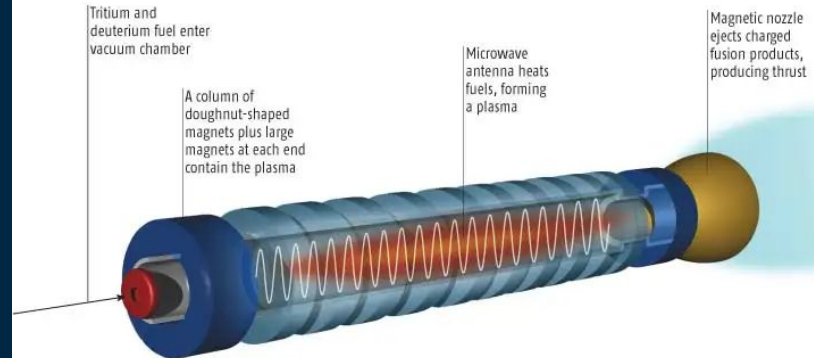
Broadly of Two Types:

- Inertial Confinement
- Magnetic Confinement




FUSION JET

Microwaves heat plasma to around 600 million kelvin, fusing nuclei to form helium and kicking out hot charged particles



JR-15 'Discovery' Spherical Tokamak Fusion Engine

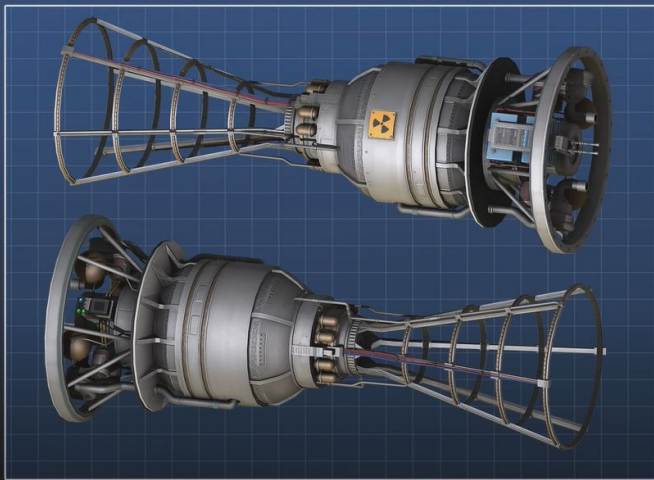
Thrust 

Isp 

Size 3.75m

Notes Magnetically confined fusion engine. Good all-rounder, with integrated power reactor and an additional higher thrust mode.

PKMC
POST KERBIN MINING CORP



JP-10 'Impulse' Magneto-Inertial Fusion Engine

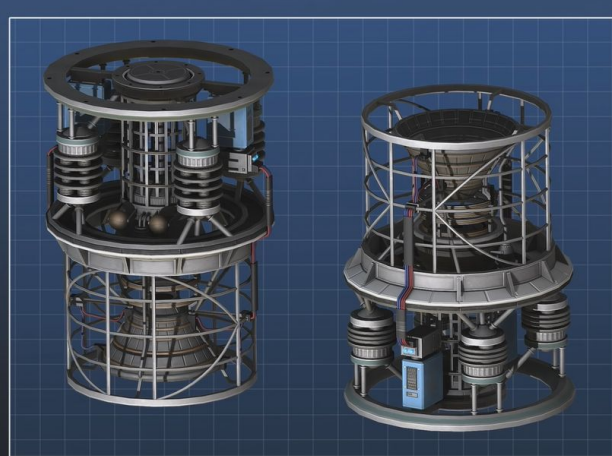
Thrust 

Isp 

Size 2.5m

Notes Magnetically confined entry-level fusion pulse engine. Delivers the capabilities of high end ion engine without the power generation needs

PKMC
POST KERBIN MINING CORP



JR-45 'Fresnel' Mirror Cell Fusion Engine

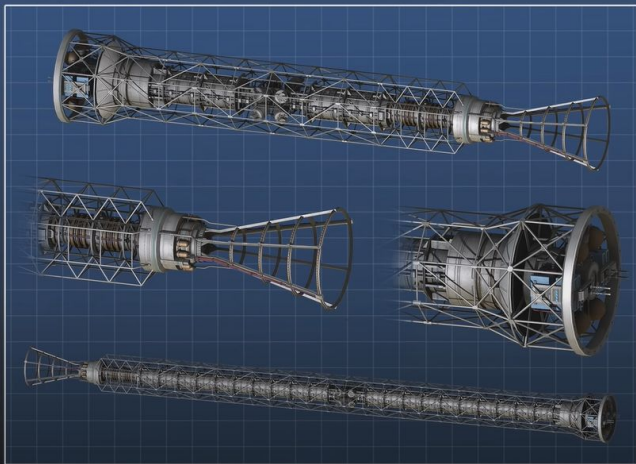
Thrust 

Isp 

Size 3.75m

Notes Magnetically confined fusion engine with a high power and low power mode. Increasing reaction chamber length increases capabilities.

PKMC
POST KERBIN MINING CORP



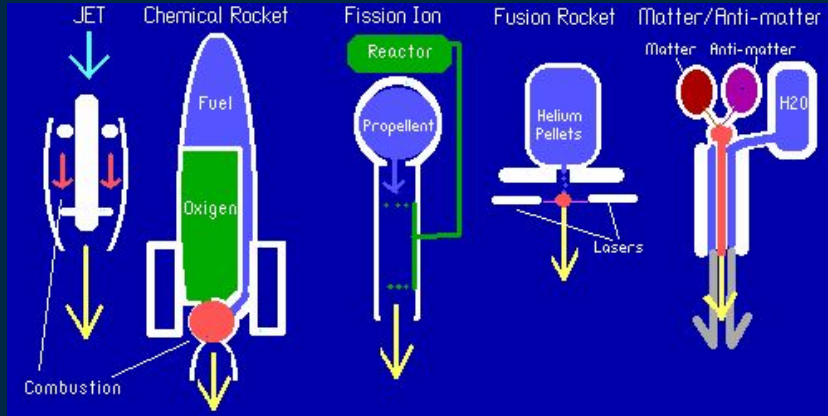
Manley, S. (2021, January 15). *Far Future Rocket Engine Technologies - Fission, Fusion & Antimatter* [Video]. YouTube.

https://www.youtube.com/watch?v=QEZv_OXA_NI&feature=youtu.be

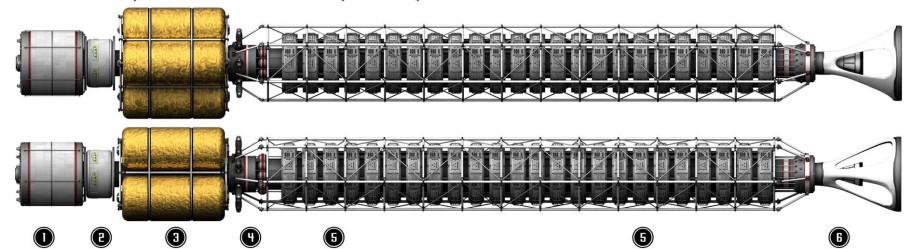
Antimatter Powered Rocket Engine:

Three types:

- Antimatter Drive
- Thermal Antimatter Rocket
- Antimatter catalysed Fission/Fusion Engine

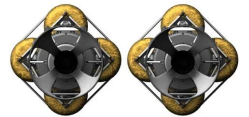


Beam Core Antimatter Rocket



- ① Payload Module
- ② Avionics Bay
- ③ Antimatter Storage
- ④ Reaction Chamber
- ⑤ Magnetic exhaust guide
- ⑥ Exhaust Engine Bell

The beam core antimatter rocket is a serious design which reacts minute amounts of antimatter to emit huge amounts of energy. As much of this is in the form of charged particles, it can be guided out the rear of the rocket to provide thrust. While lacking the thrust for interstellar missions, it is ideal for reaching the deep solar system, such as the Kuiper Belt.



Nick Stevens

Solar Sails

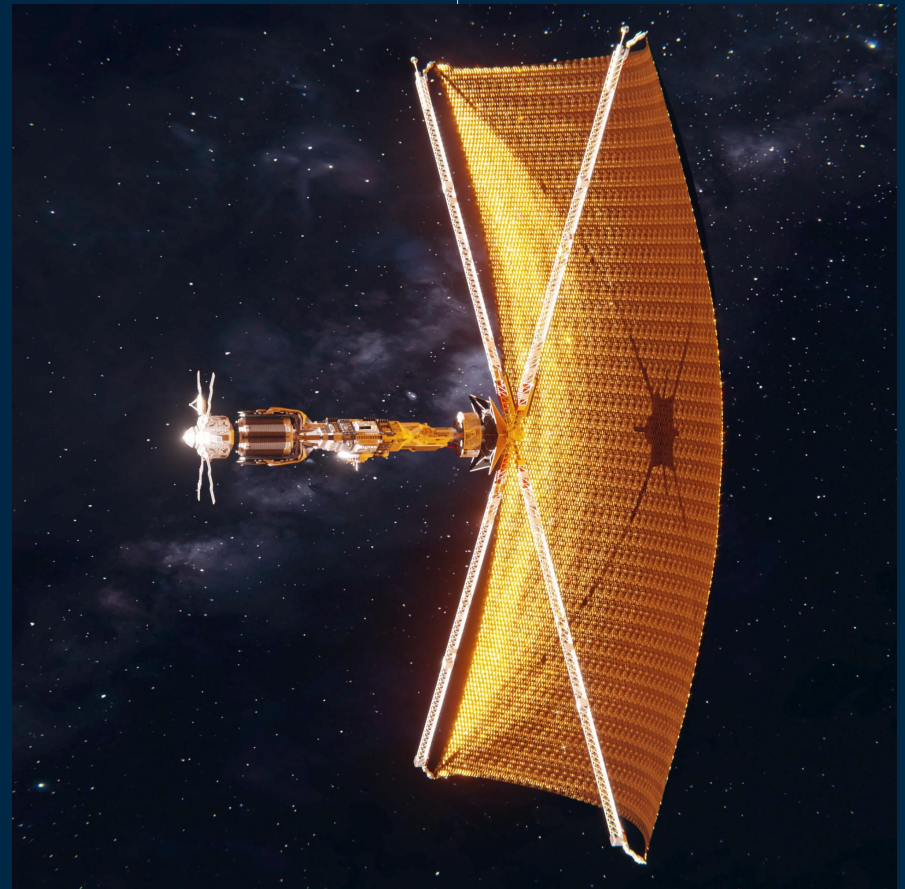
Incredibly Inefficient:

800x800 sq.m foil => 5 Newtons

At 1 AU

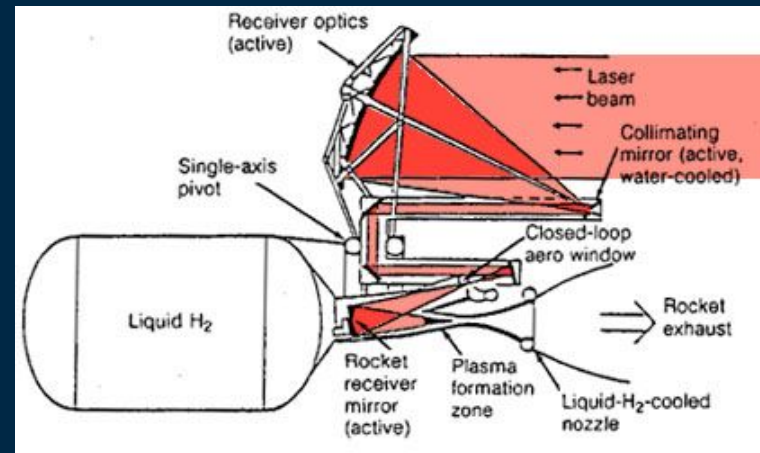
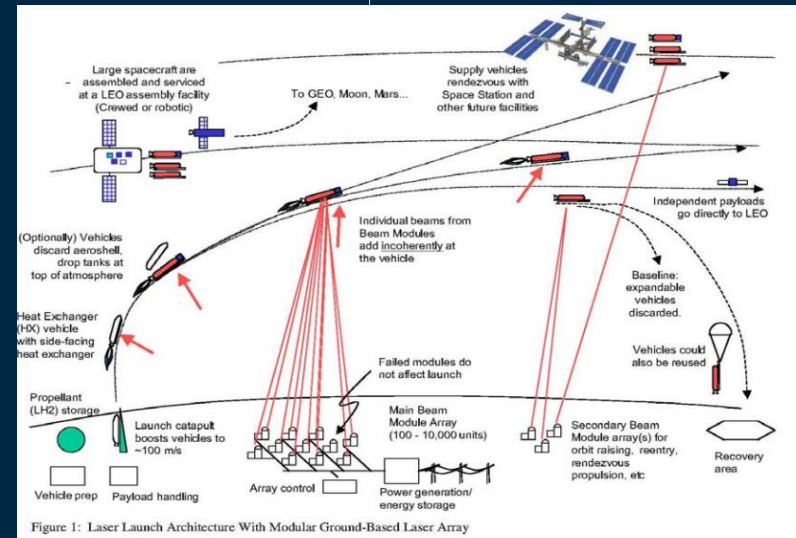
Might be good for certain non-manned missions

Require Infrastructure and Tech well beyond what is currently available.



Beam Powered Propulsion:

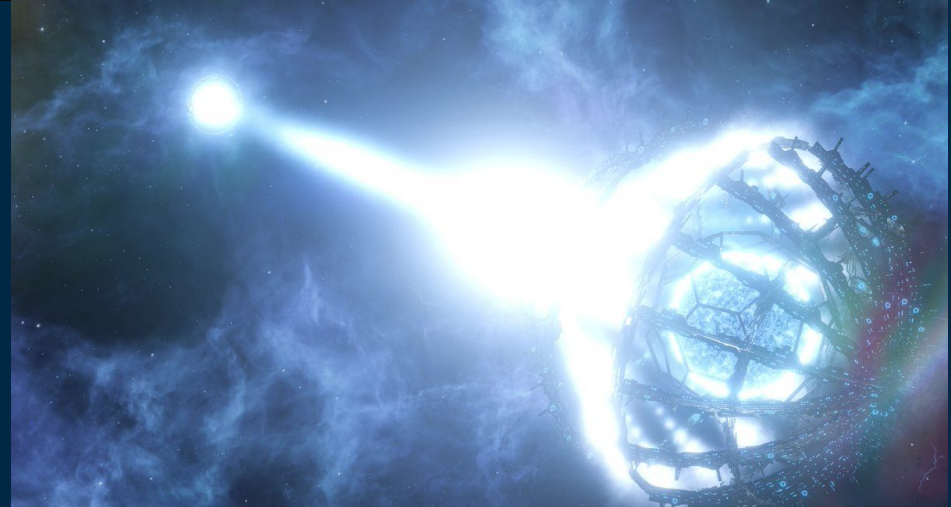
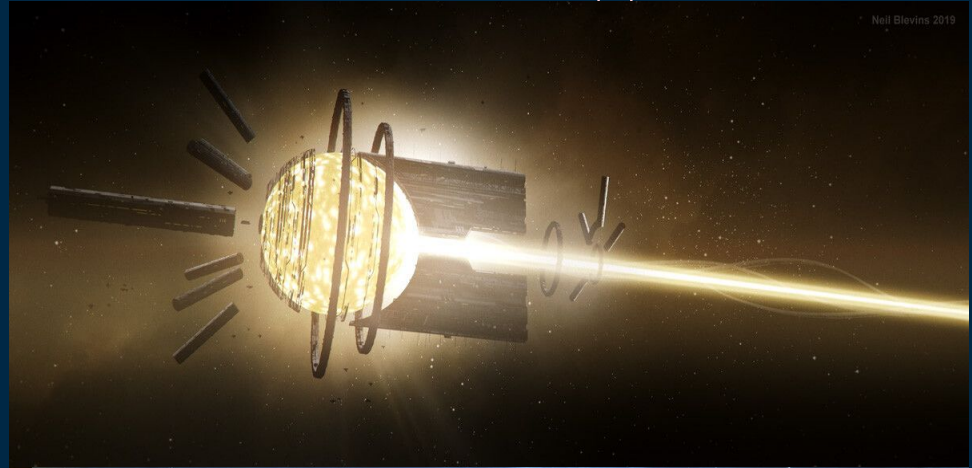
- A far future technology
- Available only if efficient laser technologies arrive in future.
- Still requires assistance from earth, thus not feasible for interstellar travel.



Beam Powered Propulsion:

DYSON BEAM

Only available once humanity becomes a type 2 Kardashev scale civilisation



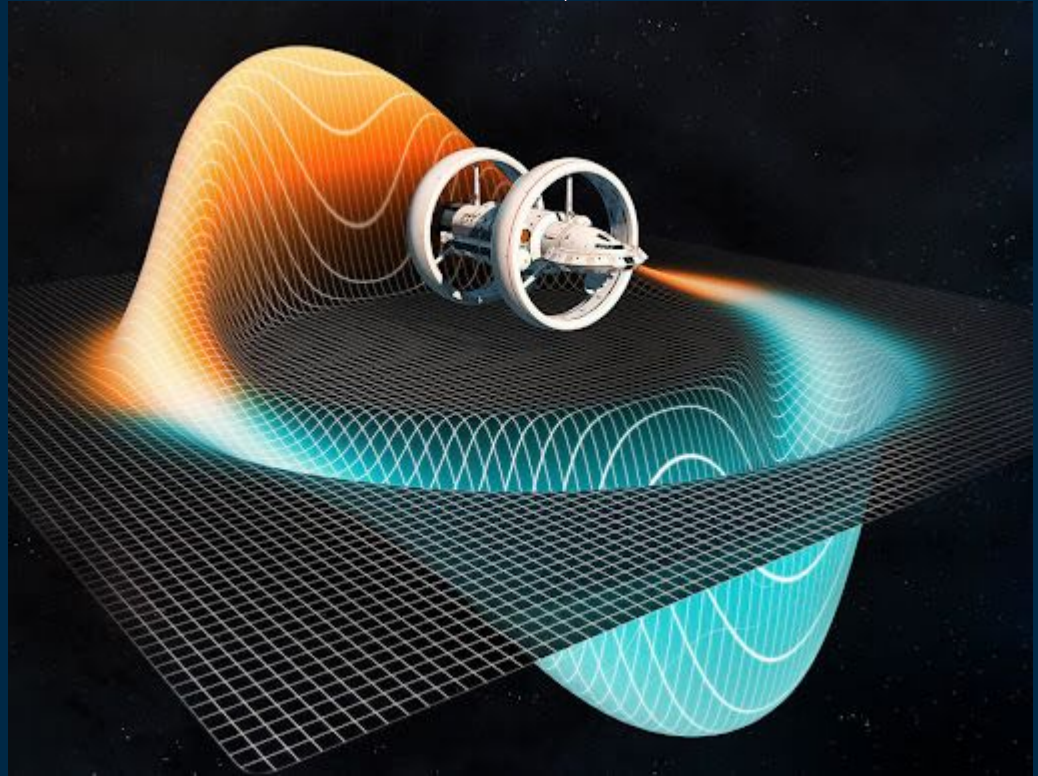
Exotic Propulsion

Impossible under Current laws of PHYSICS



Alcubierre Drive:

- FTL
- Impossible
- Impossible
- Impossible
- Requires negative energy Density
- Works on the principle of Alcubierre Metric



EM drive

- Flawed Design
- Challenges the Principle of conservation of momentum

