Space Exploration

Unconventional Methods in Propulsion

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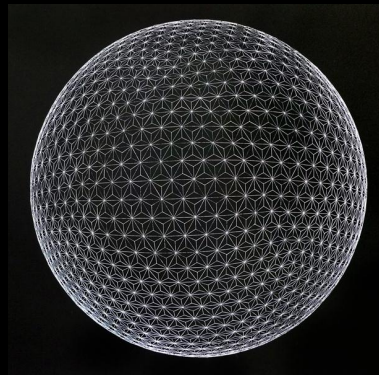


Contents

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

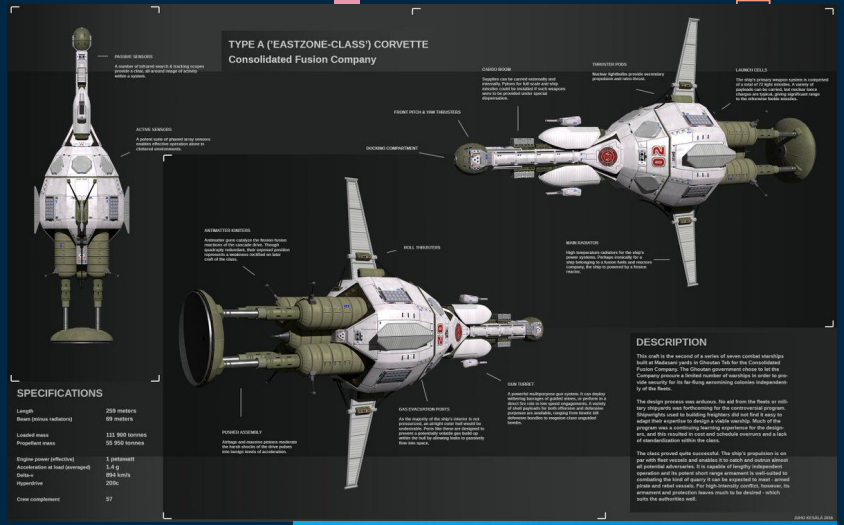
Near Future

Explosion Powered Rockets:

PROJECT ORION

Using the currently most destructive form of atomic energy utilisation:

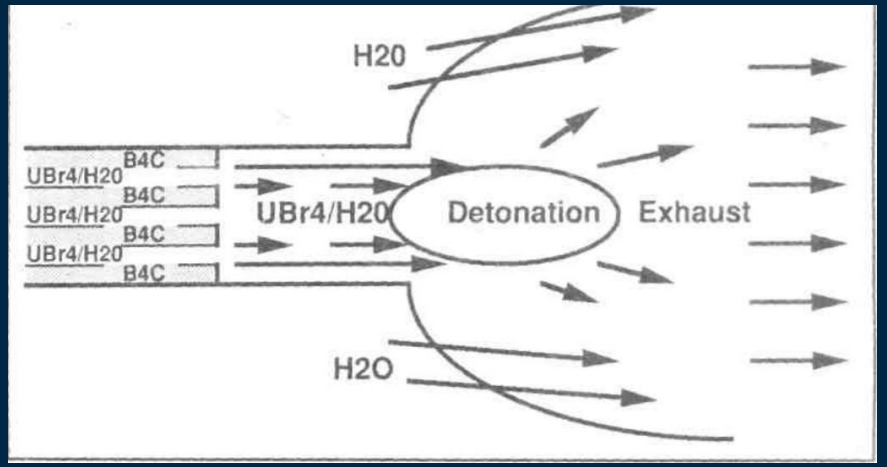
- Uses A- Bombs or H- Bombs
- Can Easily attain 1% of Speed of Light
- 44 years to Alpha Century
- Feasible even by current technology
- Bound only by lack of motivation



Nuclear Salt Water Rocket (NSWR)

Fission Powered Rockets:

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

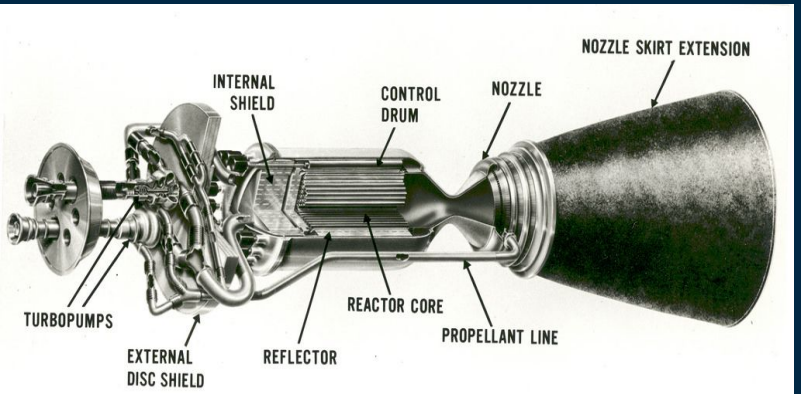


Nuclear Engine for Rocket Vehicle Application(NERVA)

Fission Powered Rockets:

- Only tested type of Nuclear Propulsion System
- Cancelled By political fuss
- 3 months to Mars @ ⅓g for a 220t spacecraft
- Very High Specific Impulse

The Nuclear Engine for Rocket Vehicle Application (NERVA)



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

- Wikipedia

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

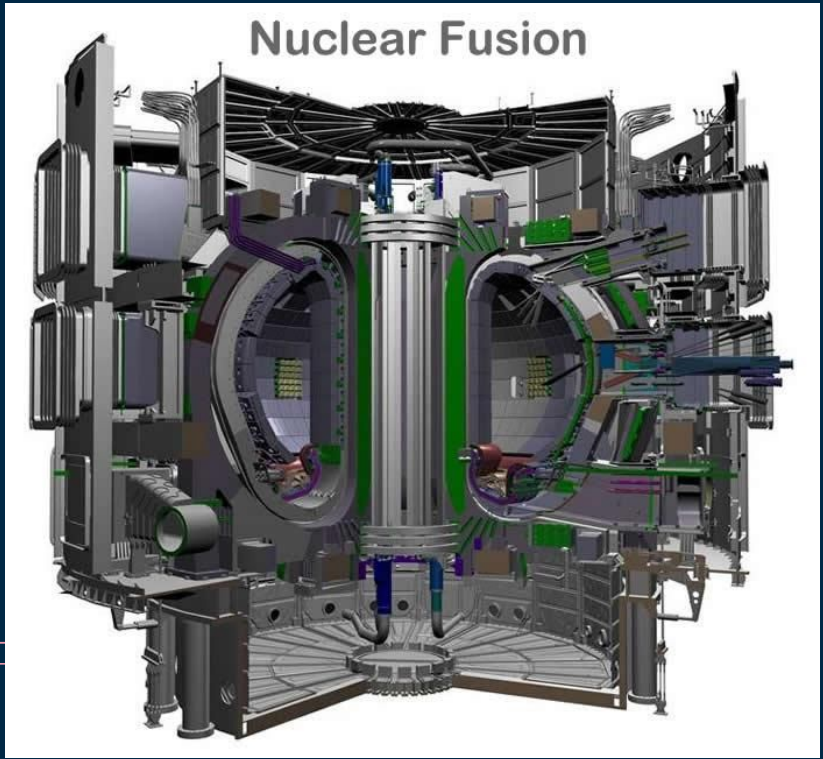
Far Future

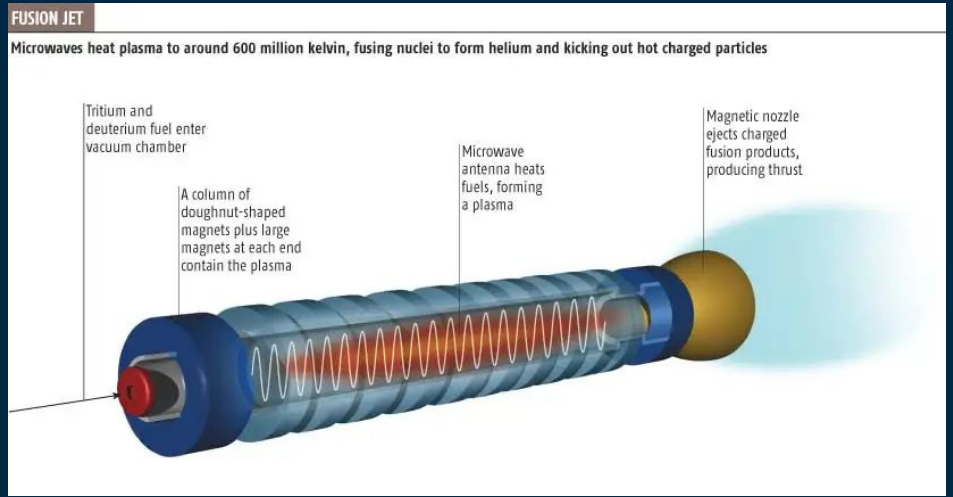
Fusion Powered Engines:

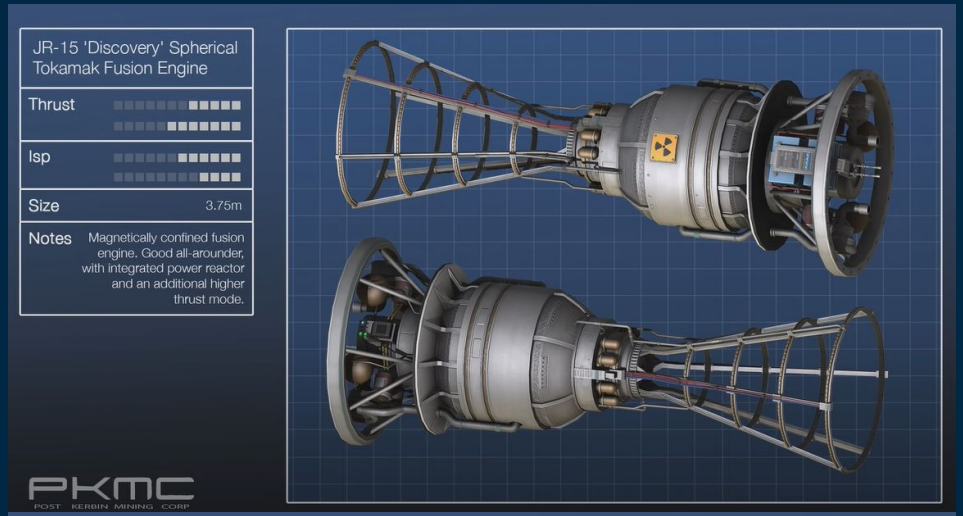
Entirely Theoretical Concept

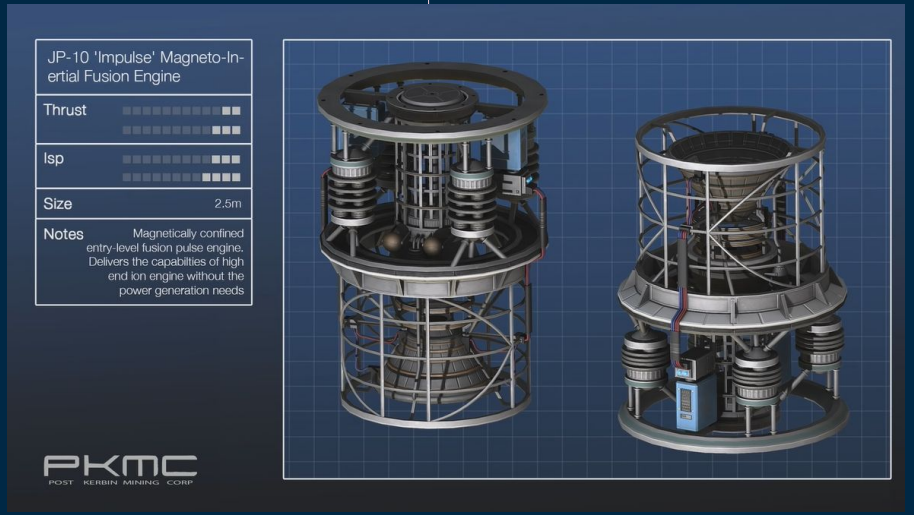
Broadly of Two Types:

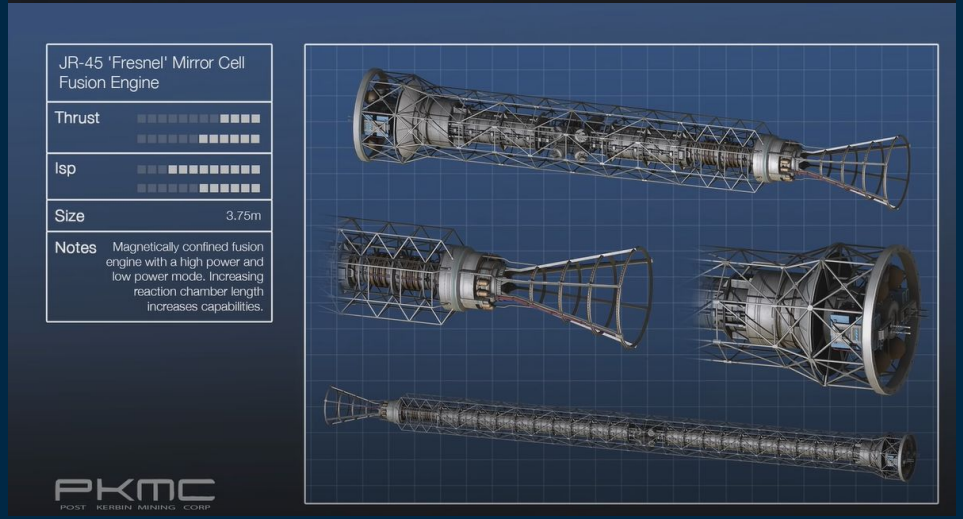
- Inertial Confinement
- Magnetic Confinement









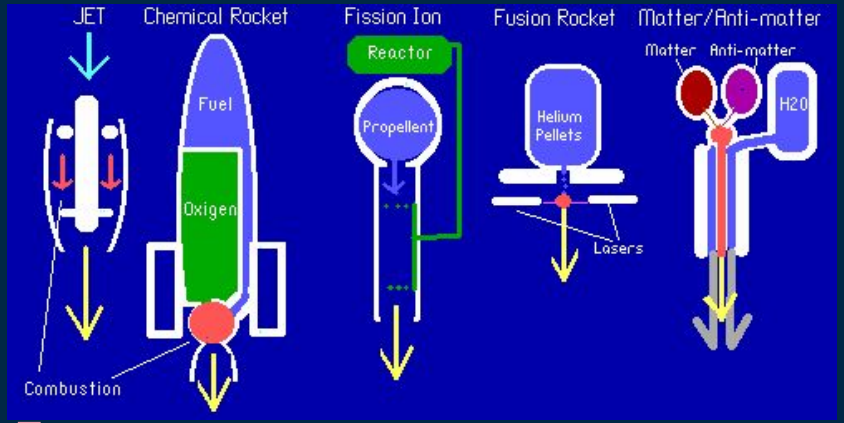


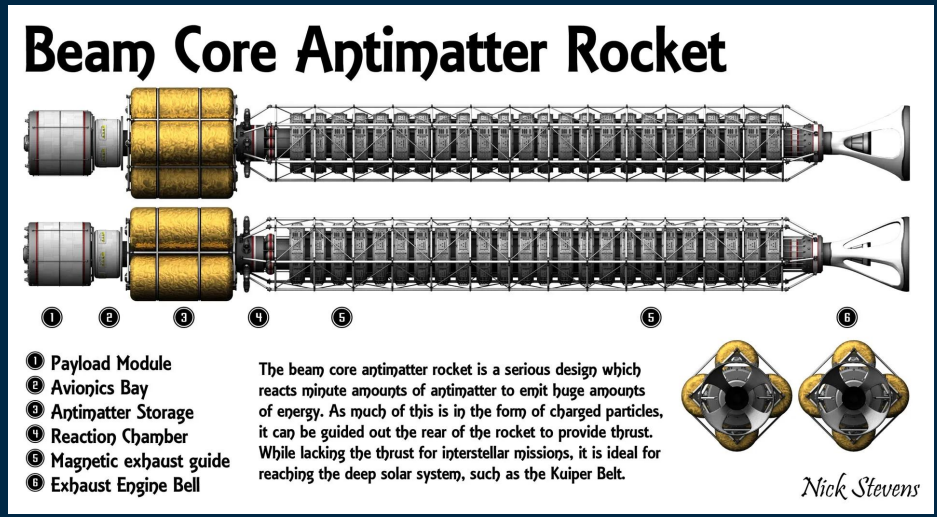
Manley, S. (2021, January 15). *Far Future Rocket Engine Technologies - Fission, Fusion & Antimatter* [Video]. YouTube. https://www.youtube.com/watch?v=QEZv_OXA_NI&feature=youtu.be

Antimatter Powered Rocket Engine:

Three types:

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





Solar Sails

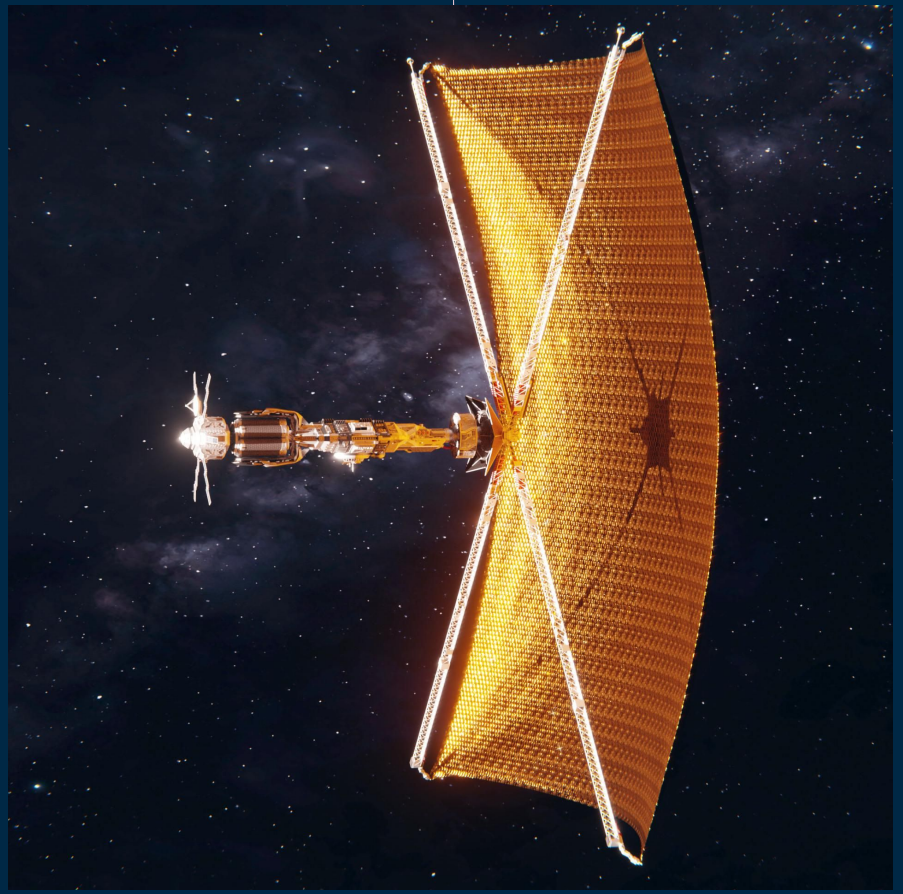
Incredibly Inefficient:

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.

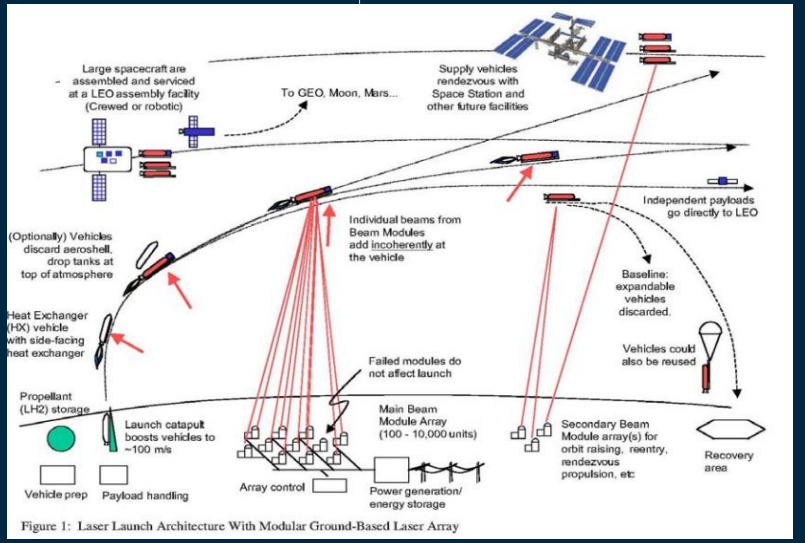
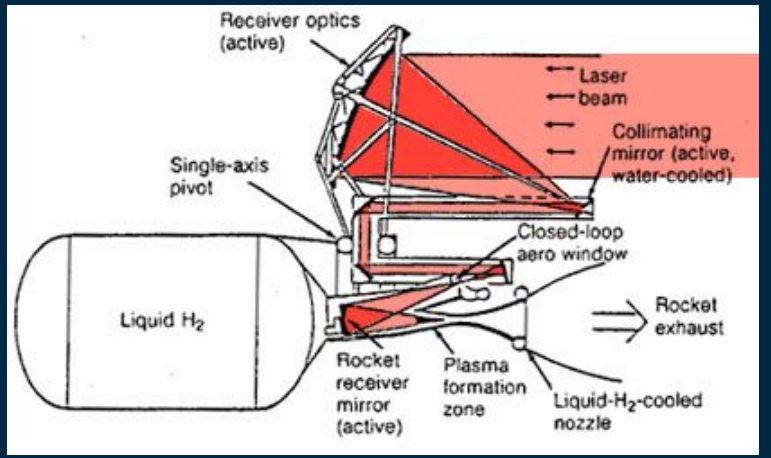


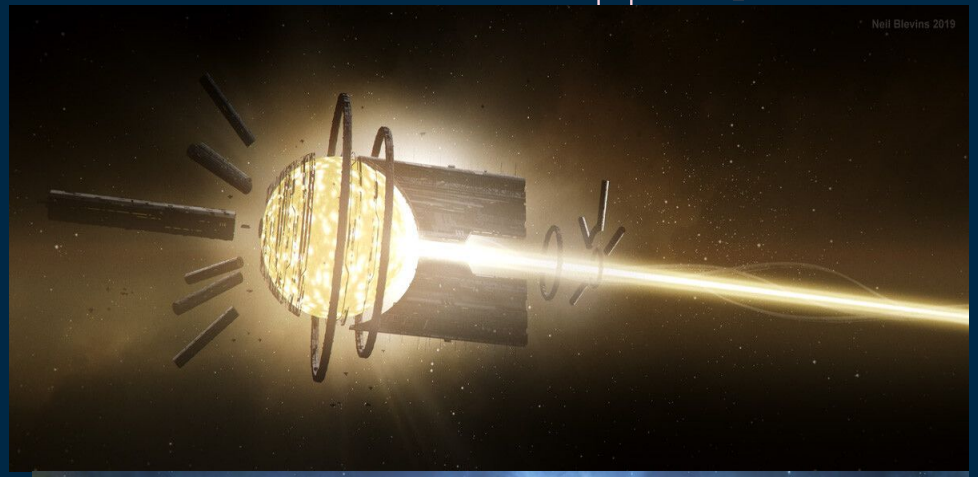
Figure 1: Laser Launch Architecture With Modular Ground-Based Laser Array

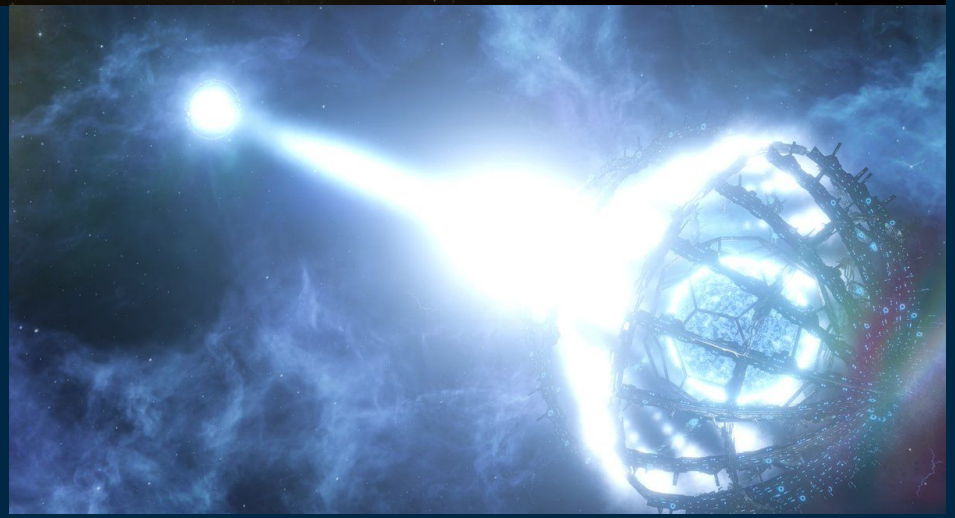


Beam Powered Propulsion:

Dyson Beam

Only available once humanity becomes a type 2 Kardashev scale civilisation



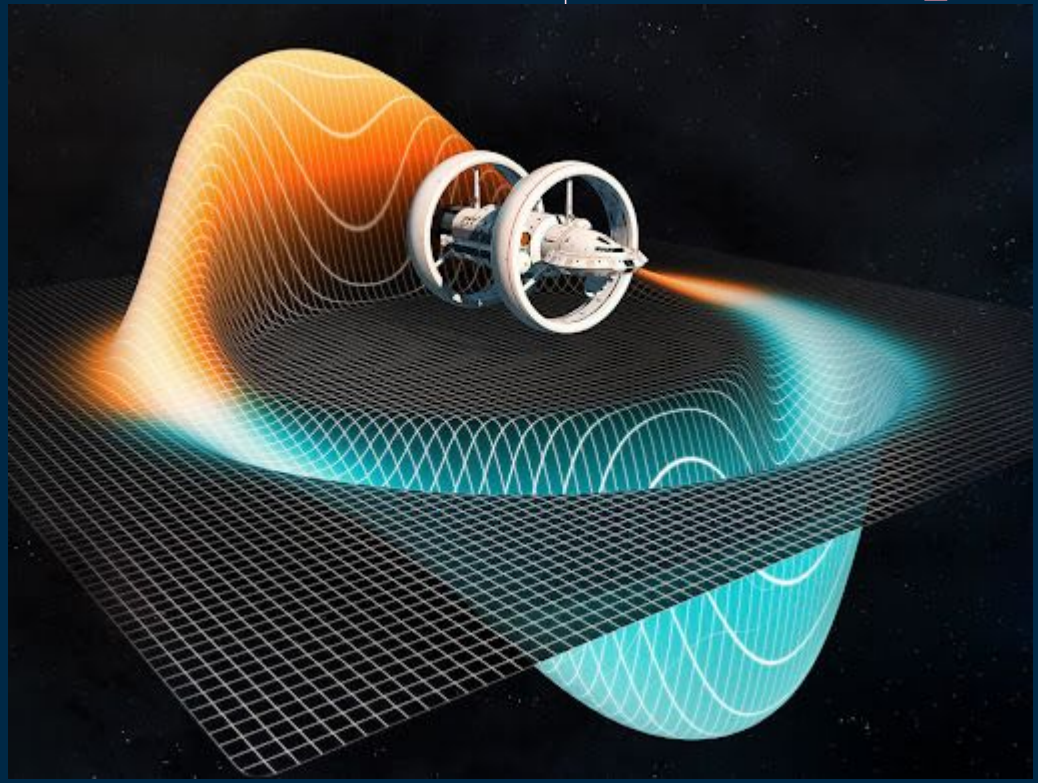


Exotic Propulsion

Impossible under Current laws of PHYSICS

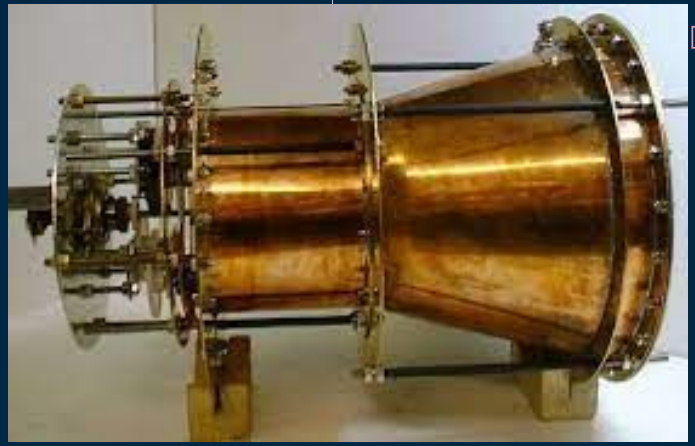
Alcubierre Drive:

- 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



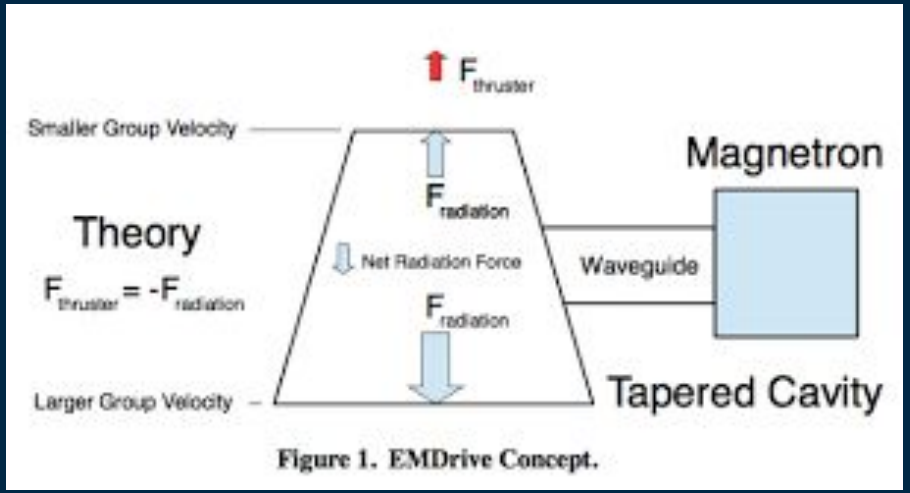


Figure 1. EMDrive Concept.