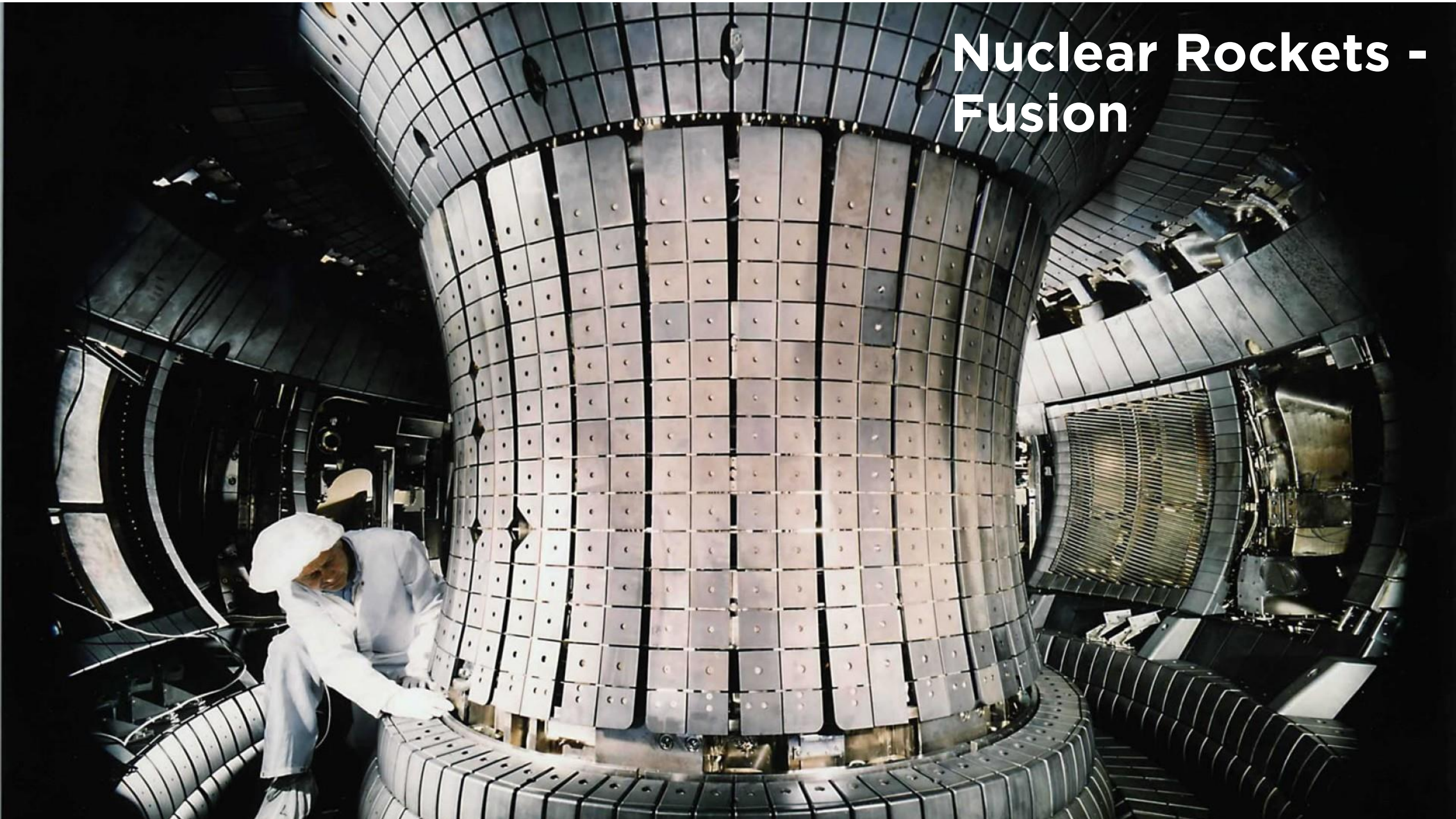
Nuclear Rockets - Fusion



Nuclear Fusion Rockets – Steady-State Propulsion

- Magnetic bottle combustion chamber - a mixture of deuterium and tritium is confined in a magnetic field and ejected.

- The system is ignited by very high power electrical stimulation. The temperature for self sustaining fusion is $10\text{^}7\ K$ so this system has potentially very high SI of approx. 10^6 s.

- Engineering feasibility of terrestrial power generation is at demonstration stage (Joint European Torus(JET)).

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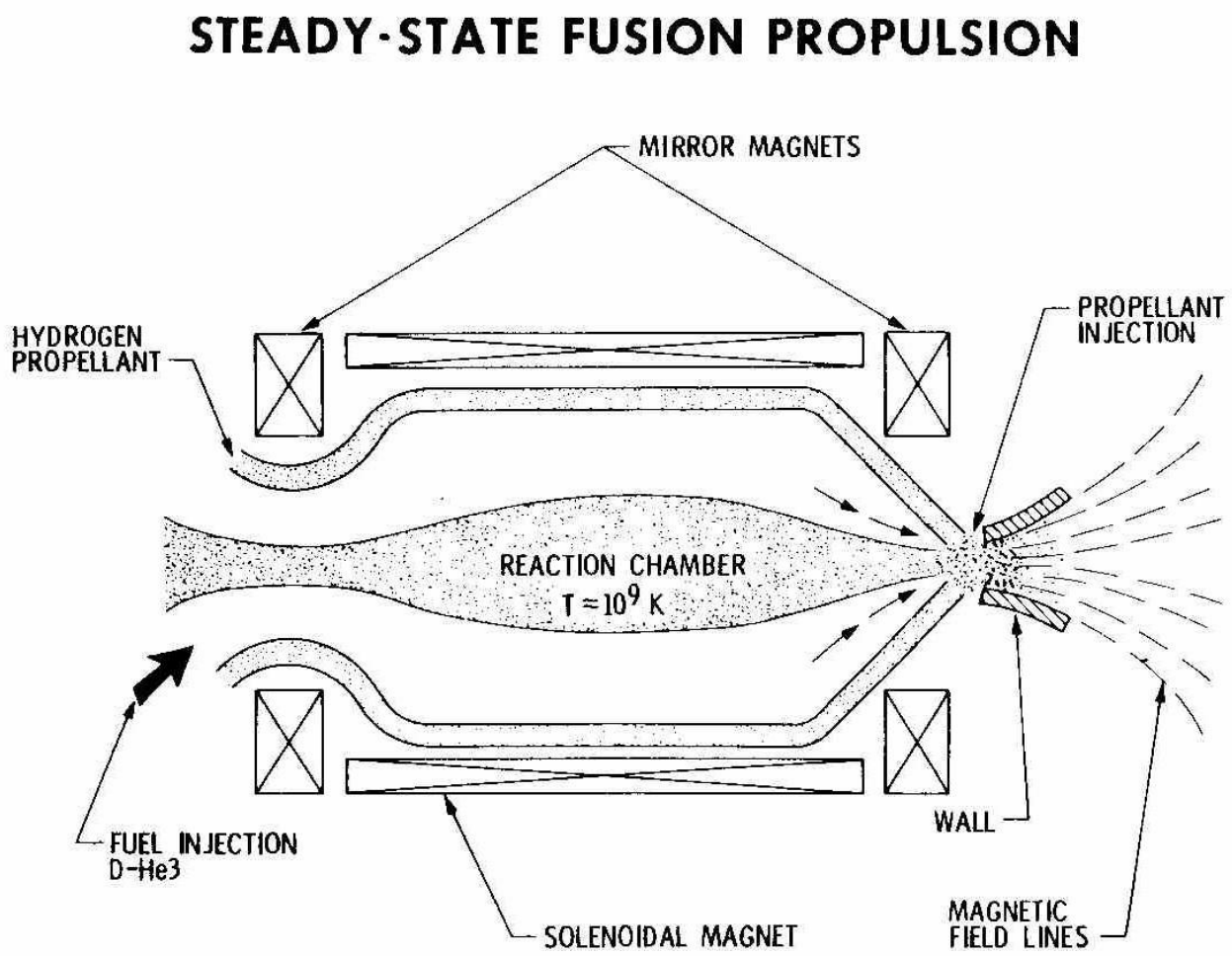
Nuclear Fusion Rockets – Steady-State Propulsion



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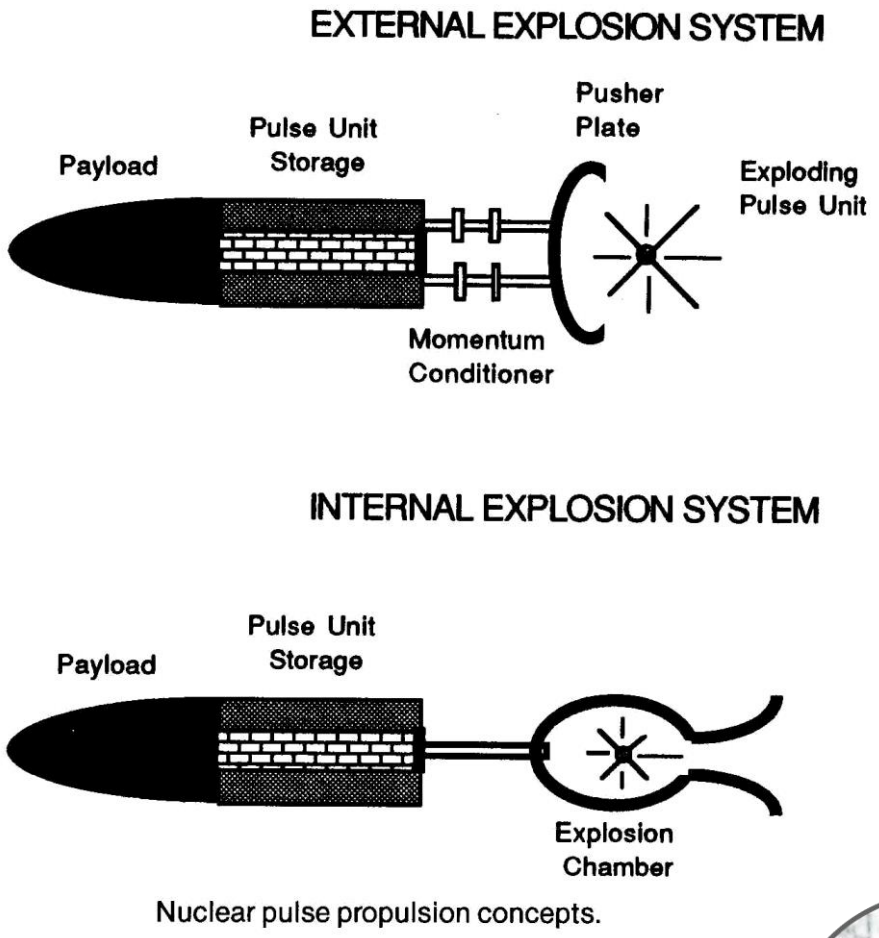
Nuclear Fusion Rockets - Pulse Propulsion

- Utilises a variety of light elements.
- Concept study - Project Orion (1955)
  - Detonation of 1MT fusion bombs at focus of 1km copper reflector.
  - Tested at model scale with conventional explosive.



Nuclear pulse propulsion concepts.

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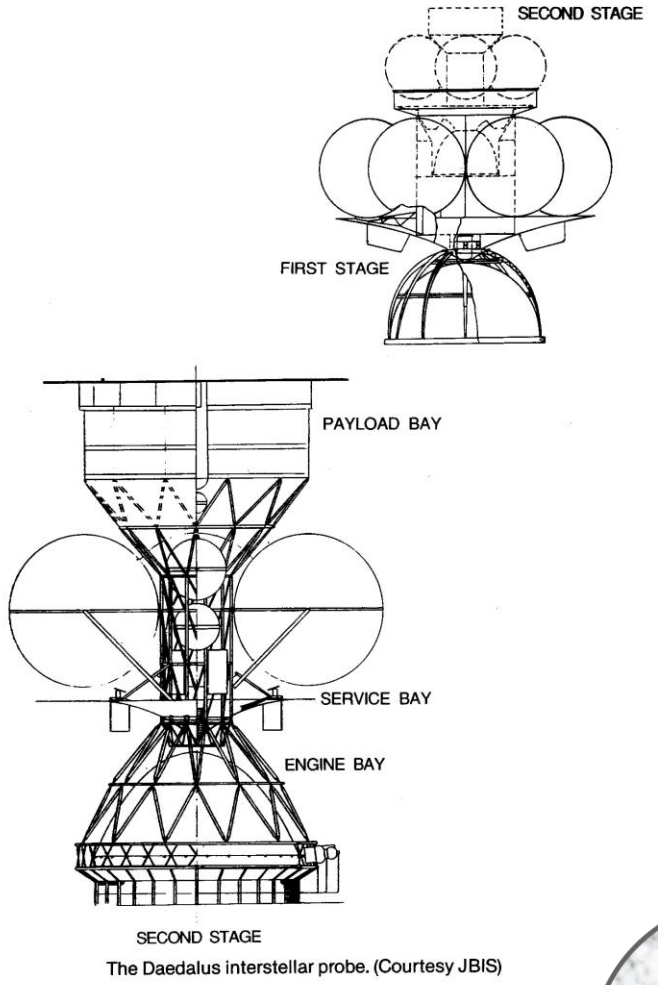
Nuclear Fusion Pulse Rocket – Project Daedalus

- Project Daedalus is feasibility study of sending an unmanned probe to the nearest stars.

- It plans to use pulsed fusion of deuterium/helium3 pellets which are ignited by high power lasers/electron beams.

- The greatest challenge lies in the 40 year long flight reliability which requires self repair systems and AI capabilities way beyond what is presently feasible.



The Daedalus interstellar probe. (Courtesy JBIS)

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Project Daedalus Expected Mission to Barnard Star

- Barnard's star is located 5.9 lightyears away from Earth.
- Departure mass would be 50,000T distributed over 2 Stages.
- D-He3 Fusion triggered by electron beams.
- Expected terminal velocity would be about 12% the speed of light or 36000 km/s.
- The project is currently being updated as Project Icarus in order to potentially investigate the thousands of recently discovered exoplanets.

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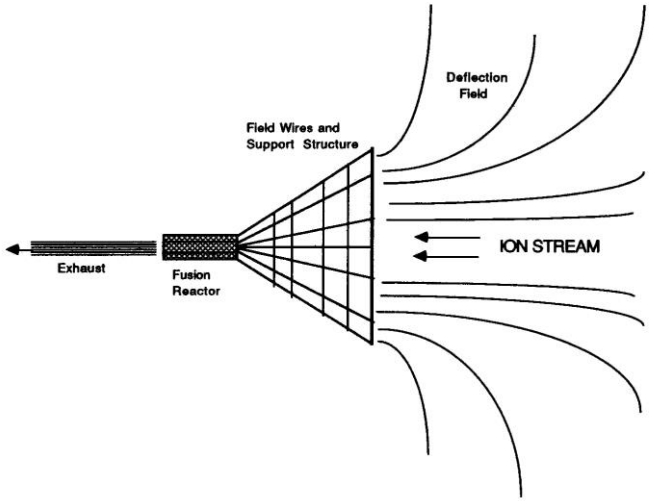
Nuclear Fusion – Bussard Ramjet

- It is theoretically possible to create an interstellar vehicle capable of travelling without carrying its own propellant mass or energy supply.

- The interstellar medium could be suitably collected, confined and compressed by a magnetic field configuration until fusion ignition temperatures are reached.

- It is similar to an atmospheric ramjet and would need to reach a critical speed of about 0.1c before the engine is self-sustaining.



The Bussard ramjet.

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