

Interstellar probes: are they feasible with present technology?

Giancarlo Genta

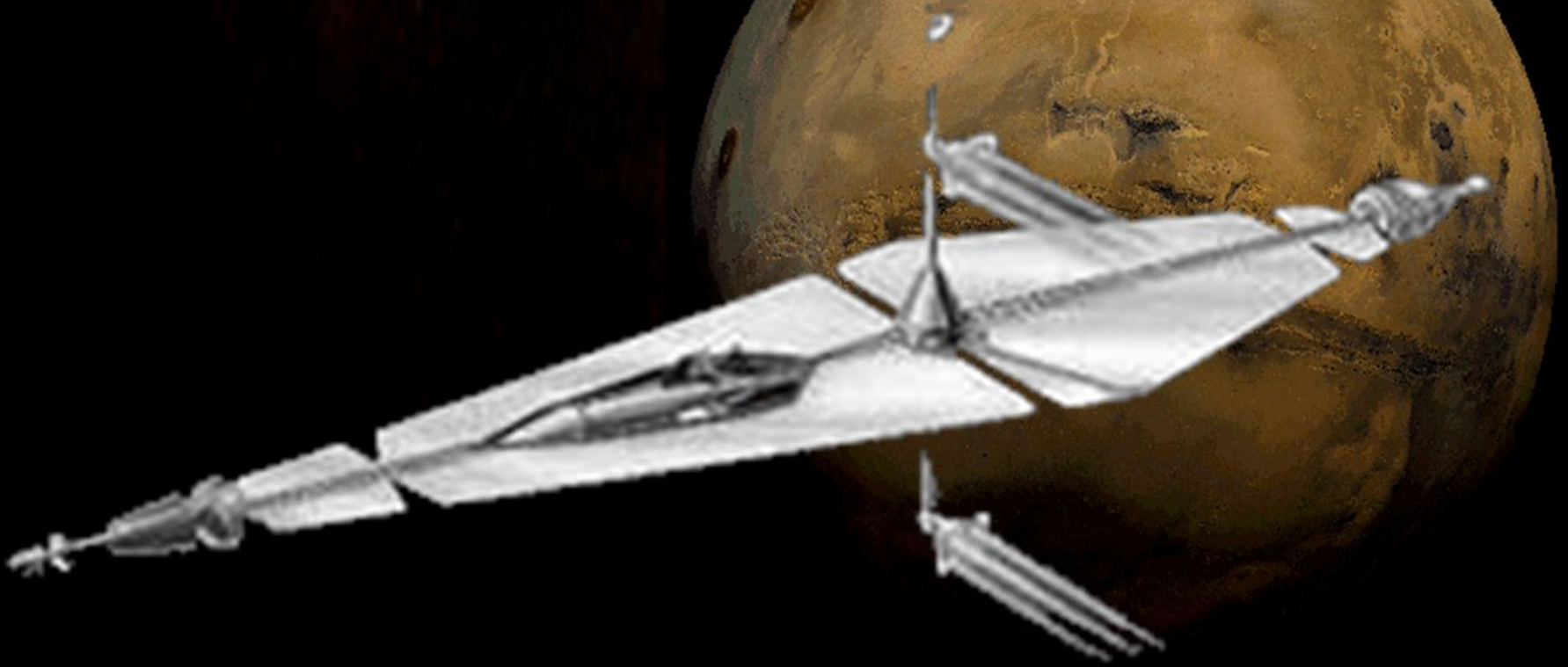
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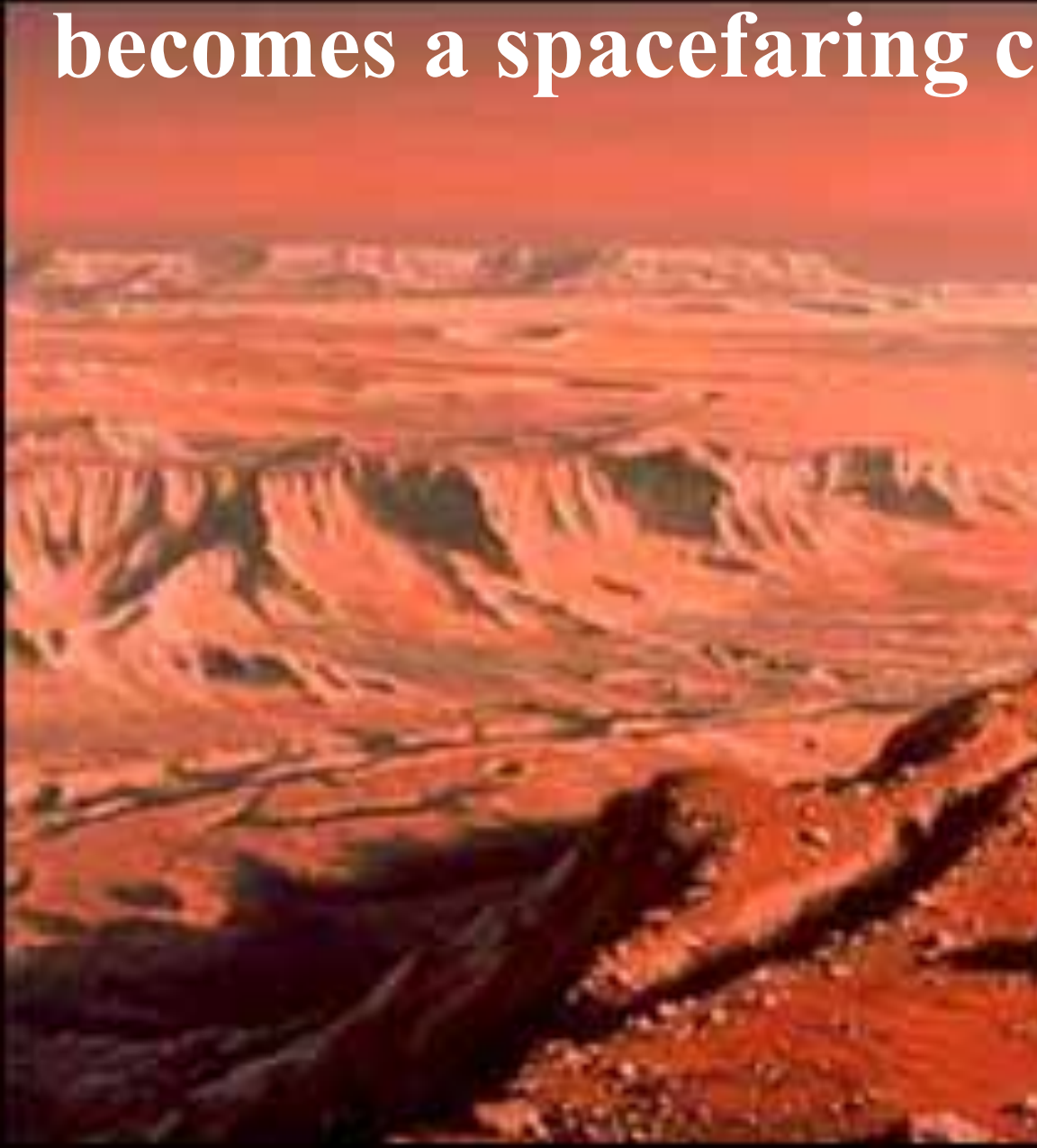
Advisory Board of the Breakthrough Starshot Project

The colonization of the Moon and of Mars is just at the initial stage...



...does it make sense to speak about interstellar exploration ...

...or we should wait that humankind
becomes a spacefaring civilization?



Giancarlo Genta

NEXT STOP MARS

**The Why, How, and When
of Human Missions**





Exploration is more than science and the final goal is building a spacefaring civilization.



Extrasolar planets

If the stars had no planets there would be no need of sending probes to explore.

The first extrasolar planet was discovered about 20 years ago. Since then more than 3,500 planets have been found (at February 22, 2017).

Now also terrestrial planets have been found.

Now we know that even multiple stars
like Alfa Centauri can have planets



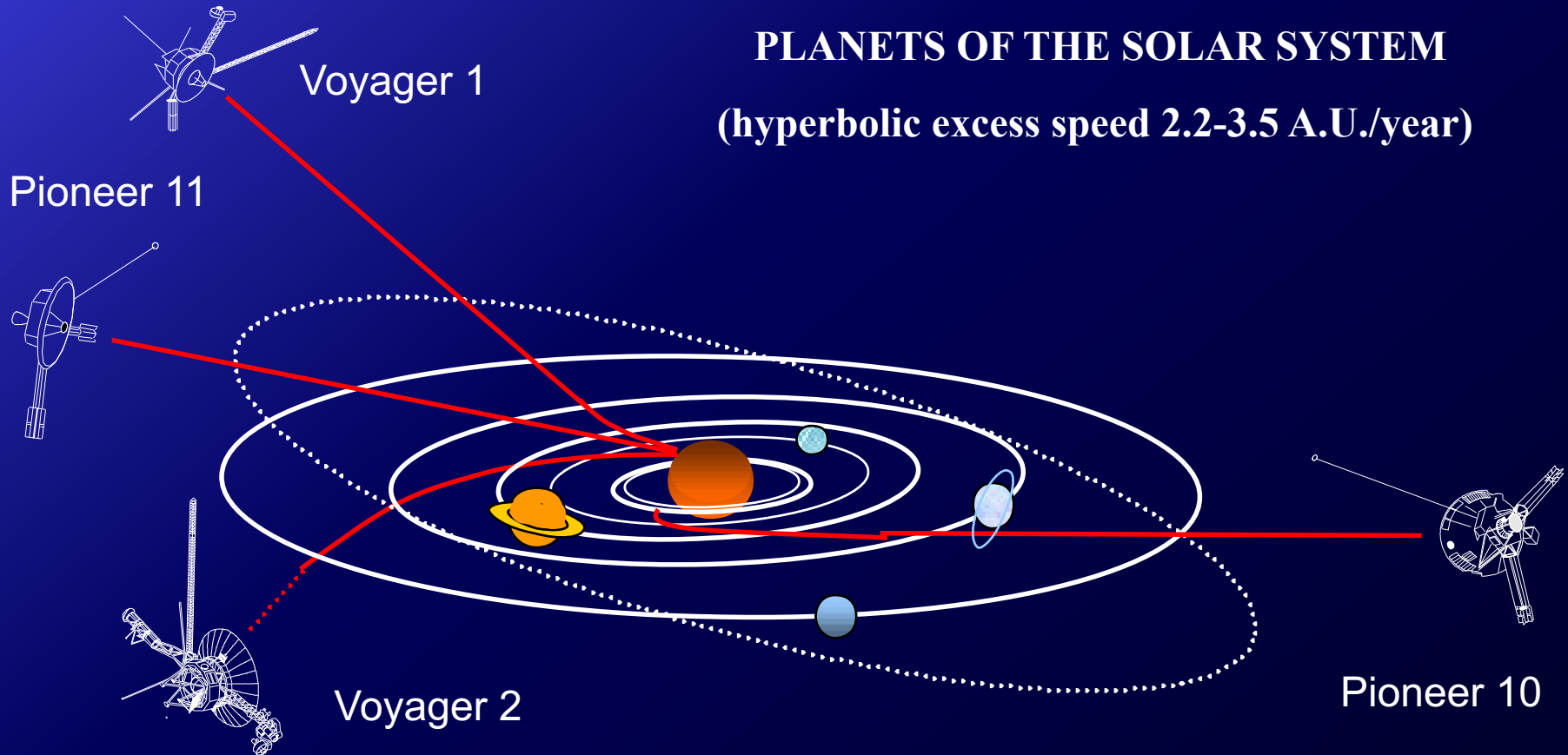
Deep space propulsion

No interstellar space exploration can be performed without improvements in propulsion

The whole field of space exploration needs new propulsion devices

Chemical propulsion with gravity assist allows entering the interstellar space

**FOUR SPACECRAFT HAVE PASSED THE
PLANETS OF THE SOLAR SYSTEM
(hyperbolic excess speed 2.2-3.5 A.U./year)**



It is time to start a

PRECURSOR INTERSTELLAR MISSION

- Study of the Heliopause
- Astrometry
- Study of gravitational lensing effect
- Encounter trans-neptunian objects
- Long range testing of advanced propulsion
- Testing interstellar telecommunication, navigation...

Realistic:

- using present-day Physics
- requiring current or near-term technology
- requiring as low cost as possible (compatibly with feasibility)
- entailing data return times well less than a normal job lifetime
- involving truly international co-operation

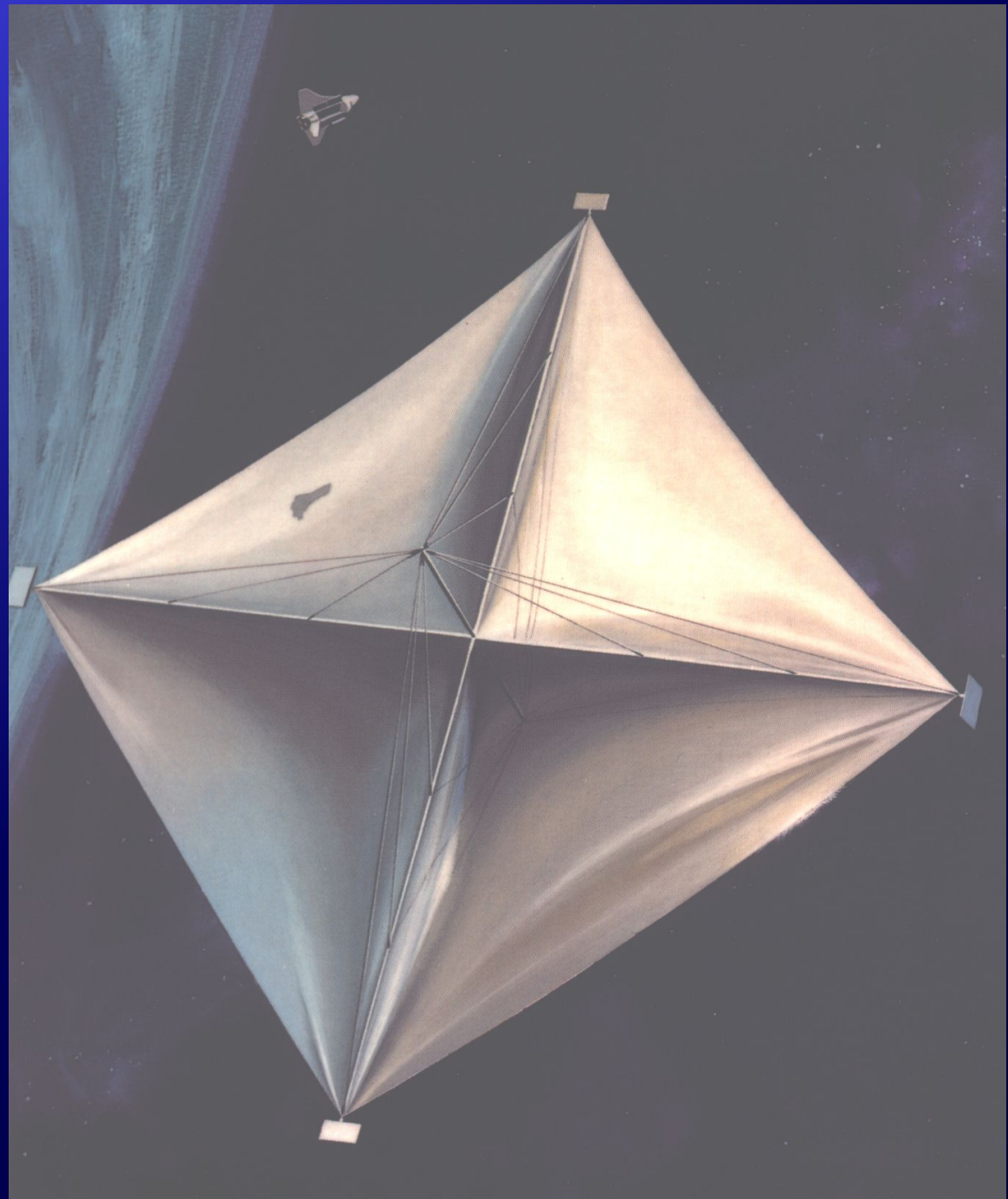
The problem of energy

- To send a 100 kg probe in a realistic time to a nearby system a quantity of energy comparable to the energy consumed in one year by a modern country is required:

Interstellar travel is impossible?

- Some think it will be forever impossible to perform human interstellar missions, others also robotic missions
- At any rate either a huge source of energy or a microscopic spacecraft are needed.

Solar or laser sails



Nuclear fusion

- Micro-explosions
- Fully controlled fusion
- Antimatter catalyzed fusion

However, even fusion is not sufficient

- Antimatter propulsion.

Non-conventional physics

Warp drive?

Worm holes?

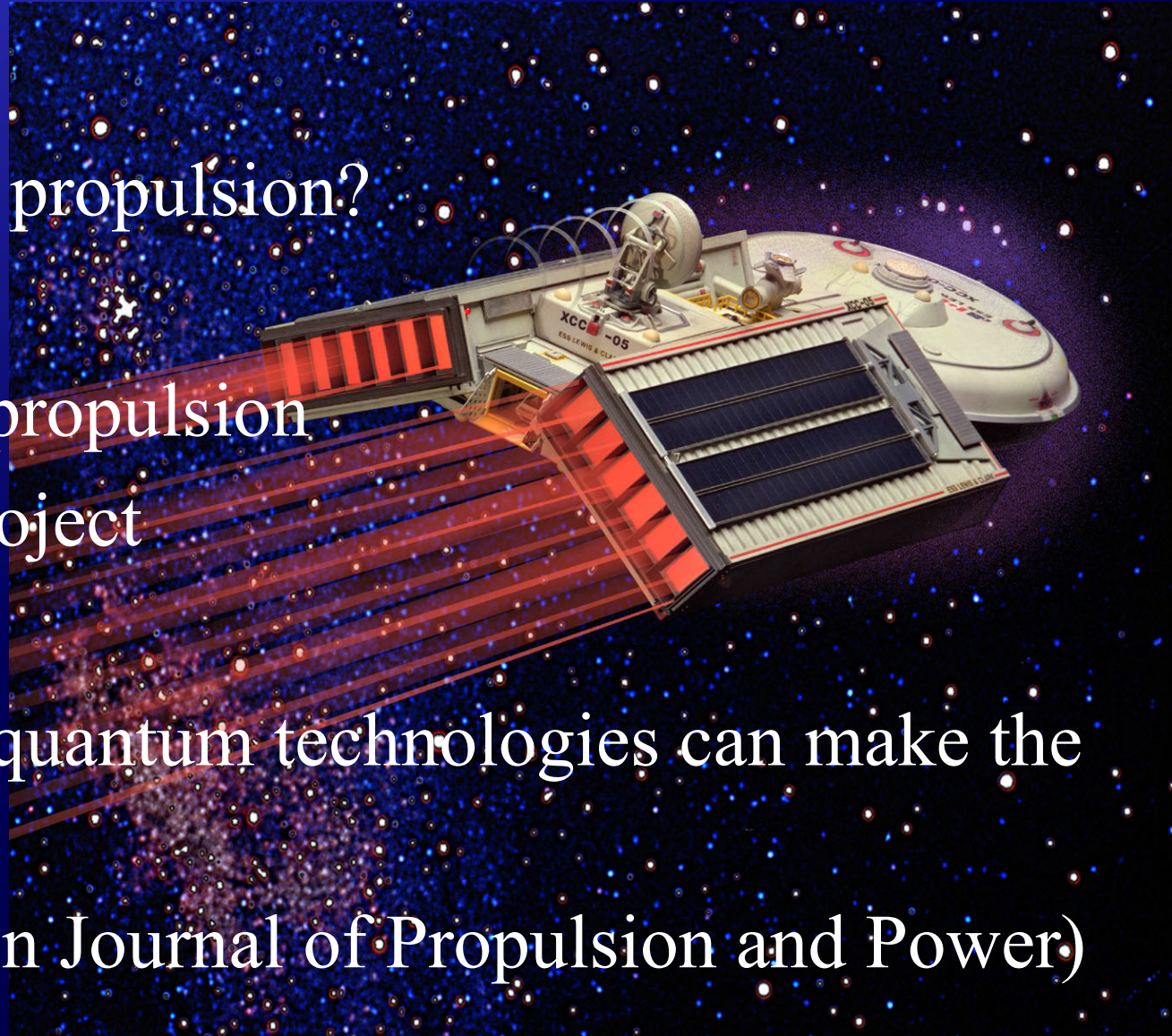
Propellantless propulsion?

Breakthrough propulsion

NASA BPP Project

Here is where quantum technologies can make the difference

(recent paper on Journal of Propulsion and Power)



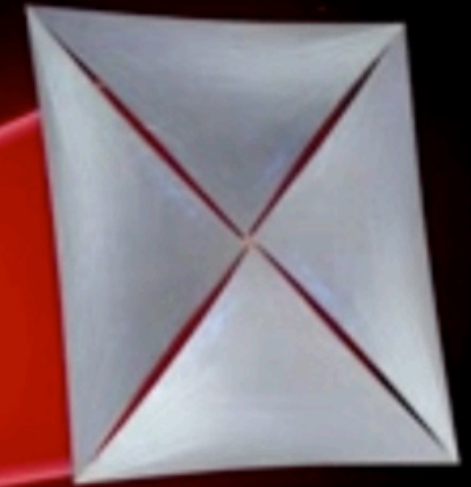
However, propulsion is not all

- Artificial intelligence. The ultimate problem of deep space exploration may not be propulsion but artificial intelligence (the lack of it)?
- Interstellar navigation and control
- Reliability.
- On-board power generation.
- Telecommunications from huge distances.
- Miniaturisation.
-

Nanoprobes can be the answer to short (medium) term interstellar exploration

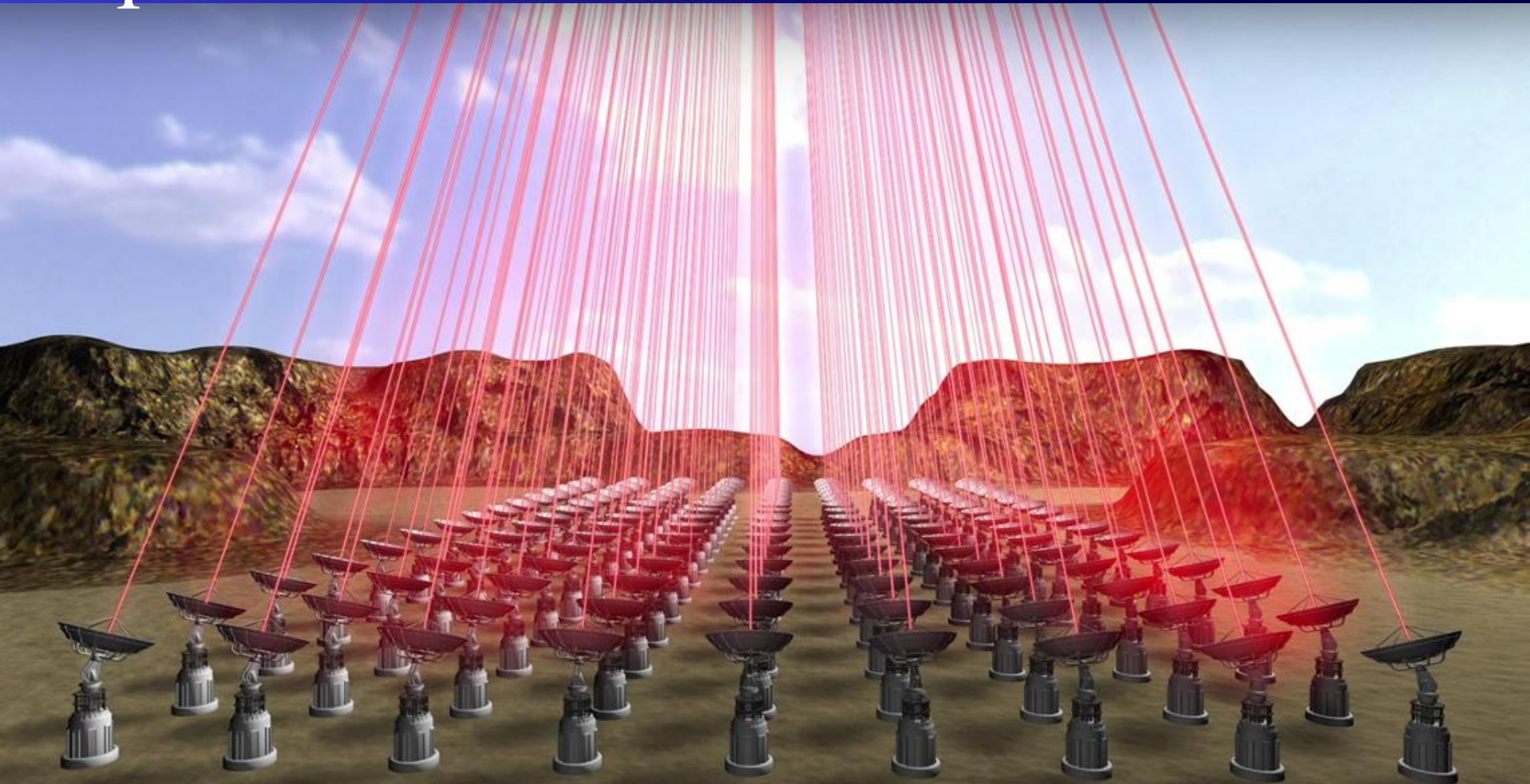


A 10 g microprobe will use the
amount of energy a nation
uses in 2 minutes to
reach Proxima



Centauri
in 20 years

A battery of powerful lasers can be located on Earth, on the Moon or in space



Breakthrough Starshot Project

Basically the project is feasible, and does not require a physics to be developed or unrealistic quantities of energy

but

There are many aspects which require much research in the above mentioned fields.

A particularly difficult field is the stability of the spacecraft in the laser beam.

Breakthrough Starshot Project

Likely the project will require 20 or 30 years to reach the operational stage.

The project is privately funded, so it will not interfere with other project which are more in line with short-term goals.

The creation of a spacefaring society will produce synergies to make interstellar exploration easier.

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Towards the Moon Village and Beyond

27 – 29 June 2017

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