A Breakthrough Propulsion Architecture for Interstellar Precursor Missions

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Voyager 1 is the fastest spacecraft in history. It travels at 3.6 AU/year. We want to go 10x faster than Voyager 1, or about 40 AU/year. How can we do this?

Would take 150 years to get to the solar gravity lens focus at 550 AU.
Solar Gravity Lens Focus

Closest Star

Solar Range (AU)

1  10  100  1,000  10,000  100,000  1,000,000
Solar Gravity Lens Focus

Closest Star

Solar Range (AU)
Three Key Features of Our Proposed Architecture to Go Fast

1. High Power
   Don’t carry the power source—laser beam power to the spacecraft

2. Small Mass
   Collect the laser power and convert it to electricity to power the ion drive system

3. Not a Lot of Propellant
   Increase the exhaust velocity, $v_{ex}$, by a factor of 10 over the best ion engines today

Artist’s concepts
Pre-Decisional Mission Concept
High-power, space-based laser

- Phased array
- Kilometer-scale aperture
- 100’s of megawatts
Humanity's Biggest Machines Will Be Built in Space
By Avery Thompson, Feb 16, 2018

“A mile-wide satellite might sound impossible, but that’s exactly where the space industry is headed.”
Space-based laser powers a 40,000-s Isp vehicle past Jupiter on a 13-year trip to 550 AU
110-m diameter Photovoltaic Array
Areal density < 200 g/m²

Array cells tuned to the laser frequency for efficiency > 50%

Lithium-fueled ion engines

Array output voltage of 6 kV
Across beam thrusting

Along beam thrusting
Lithium-fueled Ion Thruster

**Xenon-fueled**

Today’s ion engines have 10X the exhaust velocity of the best chemical rockets

Specific Impulse 4,000 s

**Lithium-fueled**

Our ion engines will have 10X the exhaust velocity of the best ion thrusters

Specific Impulse > 40,000 s
What Might this Architecture Be Able to Do?

**Solar Gravity Lens Mission**

**Pluto Orbiter Mission**

**Human Missions to Jupiter**

**Planetary Defense—Ion Beam Deflection**

Artist's concepts

Pre-Decisional Mission Concept