A Breakthrough Propulsion Architecture
for Interstellar Precursor Missions

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Voyager 1 is the fastest spacecraft in history
Would take 150 years to get to the solar gravity lens focus at 550 AU

We want to go 10x faster than Voyager 1, or about 40 AU/year
How can we do this?
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

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NIAC
NASA Innovative Advanced Concepts

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

- Phased array
- Kilometer-scale aperture
- 100’s of megawatts

Beam Power Across the Solar System

![Artist's concept](image-url)
“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

Artist's concept
Pre-Decisional Mission Concept
Across beam thrusting

Artist's concept

Along beam thrusting

Pre-Decisional Mission Concept
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