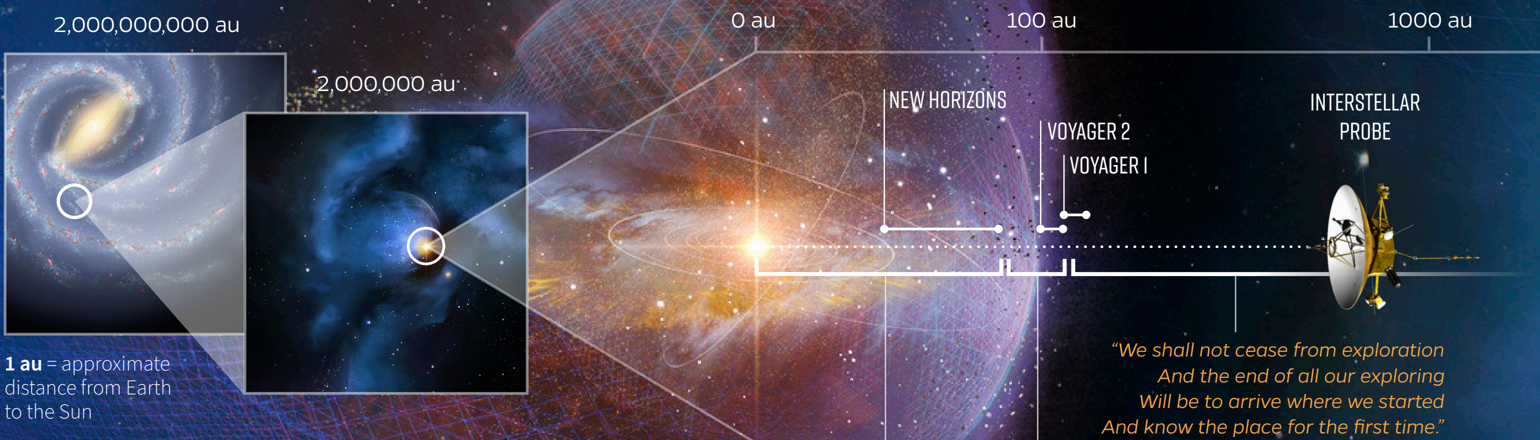
INTERSTELLAR PROBE

Humanity's Journey to Interstellar Space

Traveling far beyond the Sun's sphere of influence, Interstellar Probe would be the boldest move in space exploration to date. This pragmatic near-term mission concept would enable groundbreaking science using technology that is near-launch-ready now. Flying the farthest and the fastest, it would venture into the space between us and neighboring stars, discovering uncharted territory. It would provide the first real vantage point of our life-bearing system from the outside, allowing us to better understand our own evolution. In an epic 50-plus-year journey, Interstellar Probe will explore questions about our place in the universe, enabled by multiple generations of engineers, scientists, and visionaries.



1 au = approximate distance from Earth to the Sun

"We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time."

—T. S. Elliott (1943)

Baseline Goal

Understand our habitable astrosphere and its home in the galaxy

	HELIOSPHERE PHASE	HELIOSHEATH PHASE	INTERSTELLAR PHASE

SCIENCE QUESTIONS

1 How is our heliosphere upheld by the physical processes from the Sun to the very local interstellar medium?

2 How do the Sun's activity as well as the interstellar medium and its possible inhomogeneity influence the dynamics and evolution of the global heliosphere?

3 How do the current interstellar medium properties inform our understanding of the evolutionary path of the heliosphere?

OBJECTIVES

- Pickup ion evolution/acceleration
- Interstellar neutrals
- Ribbon/belt remote
- Ribbon/belt in situ
- Heliospheric dynamics
- Galactic cosmic ray modulation and shielding
- Termination shock
- Heliosheath dynamics
- Heliopause
- Anomalous cosmic ray acceleration
- Extent of solar disturbances
- Bow wave
- Hydrogen wall
- Interstellar medium
- Galactic cosmic ray origin

Optional Cross-Divisional Science Goals:

Planetary flybys, dust studies, astrophysical observations

BASELINE MISSION CHARACTERISTICS

Launch
2036

Mass
860 KG

Trajectory
Passive Jupiter Gravity Assist To (−22°S, 180°E)

Peak Exit Speed
7.0 au/year

Telecommunication
X-band with 5-m fixed antenna capable of sufficient downlink (~10 Mbit/week) at 1000 au using Next Generation Very Large Array or equivalent resource

Power
Two Next Generation Radioisotope Thermoelectric Generators for 300 W (electric) at end of mission

Mechanical
Spin-stabilized, 50-m PWS wire antennas

Launch Vehicle
Super Heavy-Lift Launch Vehicle with additional third and fourth stages

Lifetime
50-year lifetime drives reliability and longevity, requiring a multigenerational approach to staffing be built in from the beginning

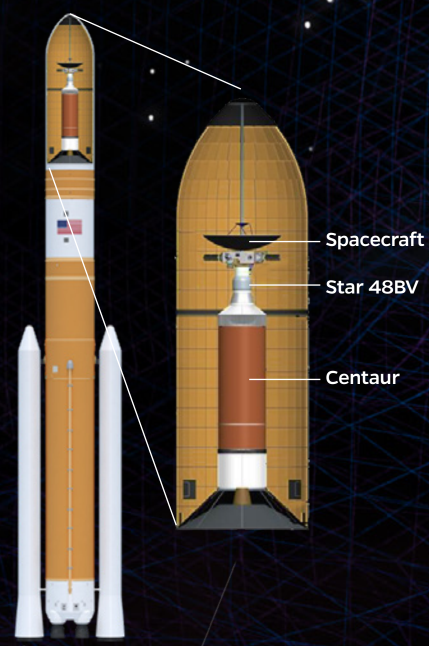
Launch Opportunities
Every 13 months, from 2036 to 2042, exiting forward hemisphere of heliosphere at similar speed to baseline trajectory

Technology Horizon
Could be ready to launch by 1 January 2030 (independent of funding and policy constraints)

SPACECRAFT MASTER EQUIPMENT LIST SUMMARY

Equipment	Mass (kg) (includes contingency)
Payload (including accommodation hardware)	100.5
Telecommunications	83.4
Guidance and Control (G&C)	16.8
Power	169
Thermal Control	70.8
Avionics	12.8
Propulsion	37.2
Mechanical/Structure	150
Harness	29.3
Propellant	106
Total	776
Margin	84
Launch Mass	860

Example Stack Configuration



ESTIMATED COSTS (FY25$)

Phases A–D without launch costs $1689M*
Phase E ~$230M/decade*

*without reserves

BASELINE EXAMPLE PAYLOAD

87.4 KG | 86.7 W

INSTRUMENTS

30% — **CHARGED PARTICLES**
Plasma Subsystem (PLS)
Pickup Ions (PUI)
Energetic Particles (EPS)
Cosmic Rays (CRS)

19% — **FIELDS AND WAVES**
Magnetometer (MAG)
Plasma Waves (PWS)

14% — **ENERGETIC NEUTRAL ATOM IMAGING**
ENA Imager (ENA)

12% — **DUST**
Interstellar Dust Analyzer (IDA)

11% — **NEUTRALS**
Neutral Mass Spectrometer (NMS)

14% — **LYMAN-ALPHA**
Lyman-Alpha Spectrograph (LYA)

PERCENTAGE OF PAYLOAD MASS