

SOLAR WIND

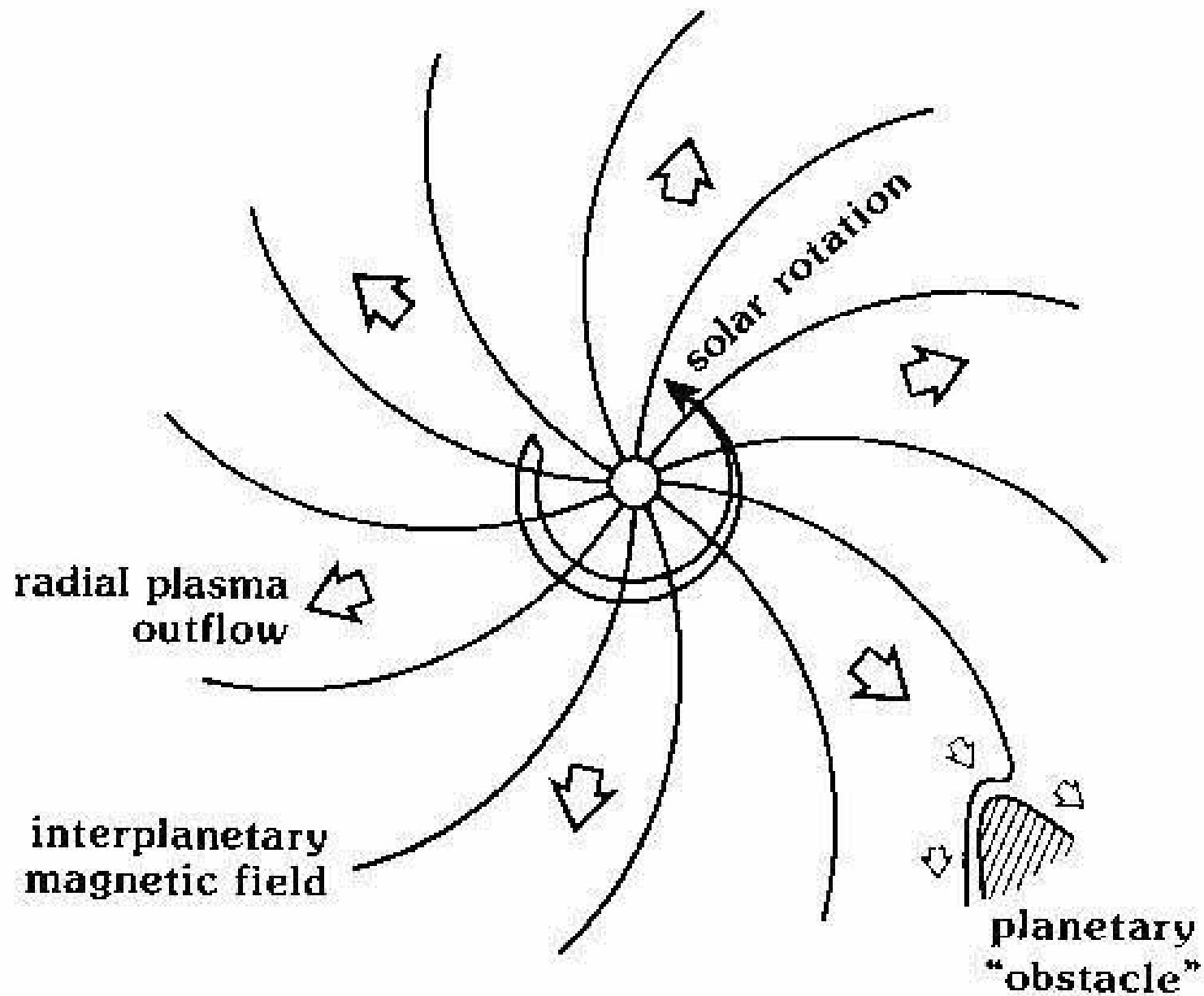


Table 1. Statistical Properties of the Solar Wind at 1 AU

Parameter	Mean	STD	Most Probable	Median	5-95% Range
n (/cm ³)	8.7	6.6	5.0	6.9	3.0 – 20.0
V_{sw} (km/s)	468	116	375	442	320 – 710
B (nT)	6.2	2.9	5.1	5.6	2.2 – 9.9
$A(\text{He})$	0.047	0.019	0.048	0.047	0.017 – 0.078
T_p (x10 ⁵ K)	1.2	0.9	0.5	0.95	0.1 – 3.0
T_e (x10 ⁵ K)	1.4	0.4	1.2	1.33	0.9 – 2.0
T_α (x10 ⁵ K)	5.8	5.0	1.2	4.5	0.6 – 15.5
T_e/T_p	1.9	1.6	0.7	1.5	0.37 – 5.0
T_α/T_p	4.9	1.8	4.8	4.7	2.3 – 7.5
nV_{sw} (x10 ⁸ /cm ² s)	3.8	2.4	2.6	3.1	1.5 – 7.8
C_s (km/s)	63	15	59	61	41 – 91
C_A (km/s)	50	24	50	46	30 - 100

n is proton density, V_{sw} is solar wind speed, B is magnetic field strength, $A(\text{He})$ is $\text{He}^{++}/\text{H}^+$ ratio, T_p is proton temperature, T_e is electron temperature, T_α is alpha particle temperature, C_s is sound speed, C_A is Alfven speed.

The Sun yearly loses $\sim 6.8 \times 10^{19}$ g to the solar wind, a very small fraction of the total solar mass of $\sim 2 \times 10^{33}$ g.

thick: speed, thin: density

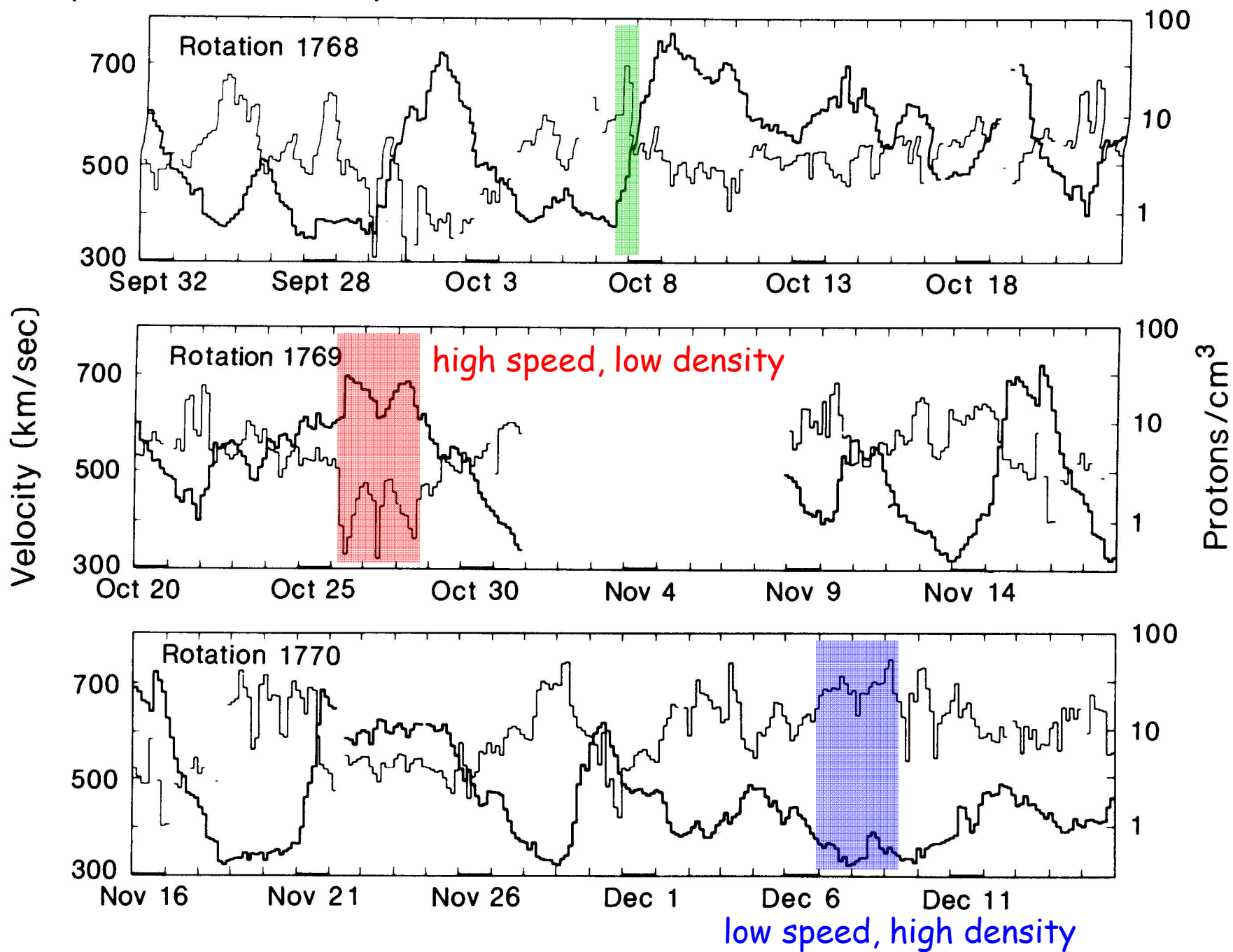


Table 2. Average solar wind parameters at 1 AU, for the time around solar activity minimum.

	Slow wind	Fast wind
Flow speed v_p	250–400 km s ⁻¹	400–800 km s ⁻¹
Proton density n_p	10.7 cm ⁻³	3.0 cm ⁻³
Proton flux density $n_p v_p$	3.7×10^8 cm ⁻² s ⁻¹	2.0×10^8 cm ⁻² s ⁻¹
Proton temperature T_p	3.4×10^4 K	2.3×10^5 K
Electron temperature T_e	1.3×10^5 K	1×10^5 K
Momentum flux density	2.12×10^8 dyn cm ⁻²	2.26×10^8 dyn cm ⁻²
Total energy flux density	1.55 erg cm ⁻² s ⁻¹	1.43 erg cm ⁻² s ⁻¹
Helium content	2.5%, variable	3.6%, stationary
Sources	Streamer belt	Coronal holes ← any others?

↓
Geo-effectiveness?

Heliophysics Missions

Heliophysics Mission Fleet

Heliophysics missions are strategically placed throughout our solar system, working together to provide a holistic view of our Sun and space weather, along with their impacts on Earth, the other planets, and space in general. NASA's heliophysics mission fleet includes 19 operating missions using 26 spacecraft, 13 missions in development, 1 mission under study, a robust sounding rocket program and a variety of CubeSat missions.

- ESA = European Space Agency
- JAXA = Japan Aerospace Exploration Agency

*Numbers in parentheses indicate how many spacecraft each mission includes.

● UNDER DEVELOPMENT

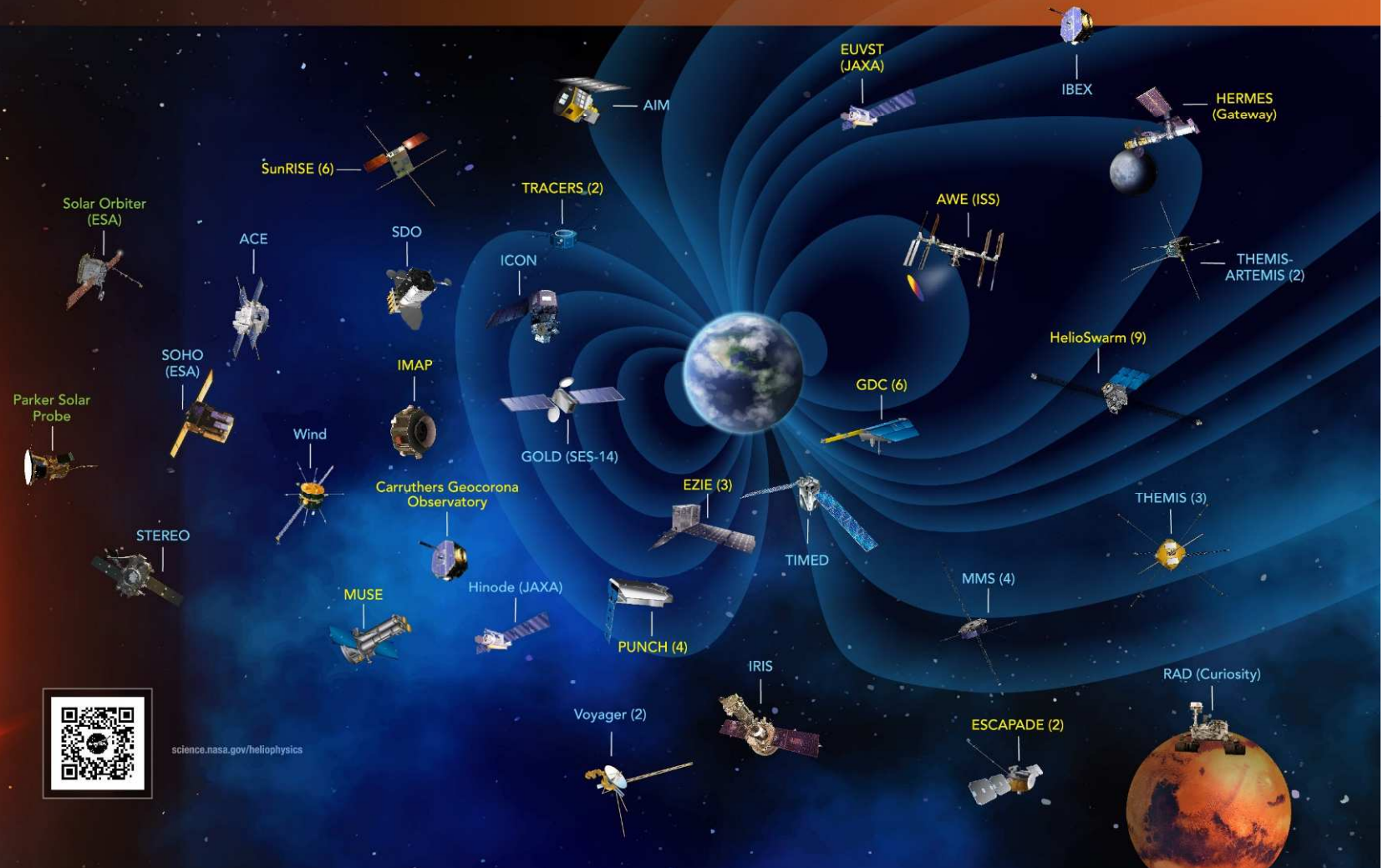
- AWE (ISS)
- Carruthers Geocorona Observatory
- ESCAPADE (2)
- EUVST (JAXA)
- EZIE (3)
- GDC (6)
- HelioSwarm (9)
- HERMES (Gateway)
- IMAP
- MUSE
- PUNCH (4)
- SunRISE (6)
- TRACERS (2)

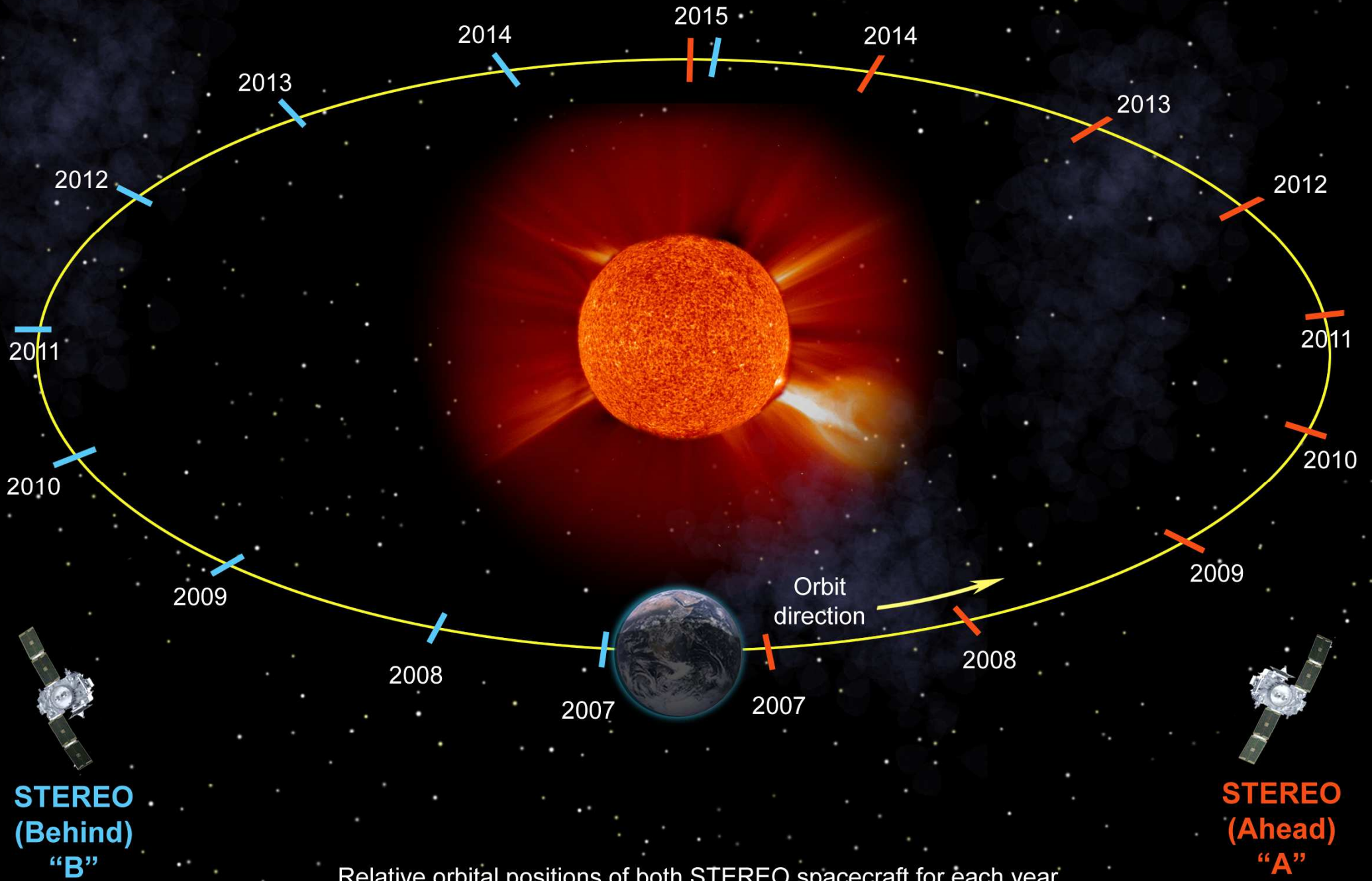
● PRIMARY OPERATION

- Parker Solar Probe
- Solar Orbiter (ESA)

● EXTENDED OPERATION

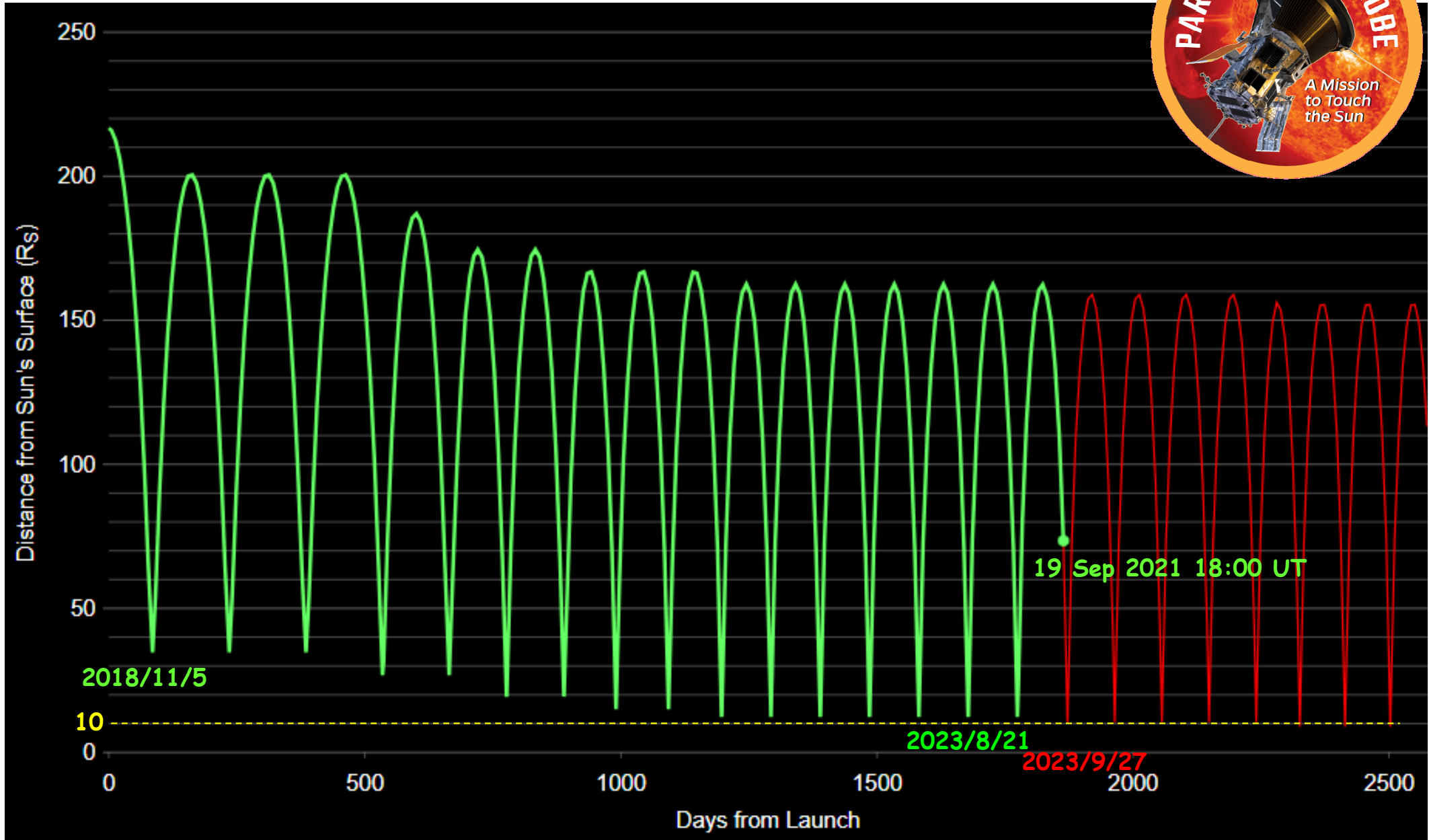
- ACE
- AIM
- GOLD (SES-14)
- Hinode (JAXA)
- IBEX
- ICON
- IRIS
- MMS (4)
- RAD (Curiosity)
- SDO
- SOHO (ESA)
- STEREO
- THEMIS-ARTEMIS (2)
- THEMIS (3)
- TIMED
- Wind
- Voyager (2)





Relative orbital positions of both STEREO spacecraft for each year from June 2007 to June 2015 (Diagram not to scale)

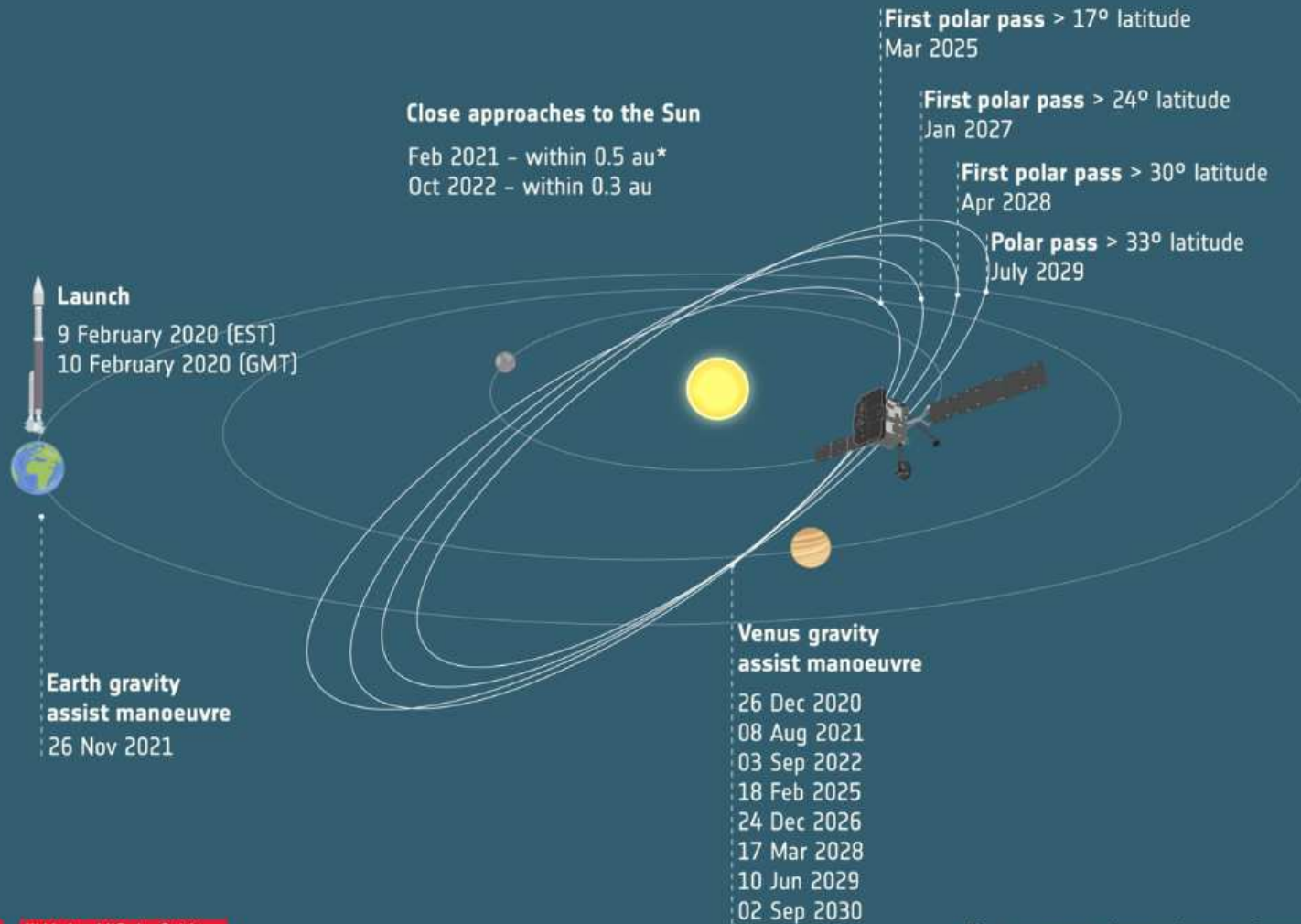
Parker Solar Probe



Solar Orbiter



SOLAR ORBITER JOURNEY AROUND THE SUN



300 million km
Maximum distance between Earth and Solar Orbiter

16.5 min
Maximum time for a radio signal to travel one way between Earth and Solar Orbiter

22 orbits
around the Sun

Nov 2021
Start of main mission

Dec 2026
Expected start of extended mission



#SolarOrbiter #WeAreAllSolarOrbiters

*1 au = average distance between Sun and Earth (149 597 870 700 m)



23 Mar 2020



Feb 2020 – Launch

