

They want to know how the solar wind varies with latitude

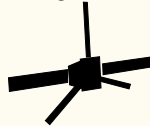
STEREO-A

Age: 14 yrs Alias: STA
 Skills: Orbits behind Earth
 Provides stereoscopic images
 Backstory: Tragically lost its sibling in 2014



SOLAR ORBITER

Age: 1 yrs Alias: SO
 Skills: Has a wide array of instruments and telescopes
 Orbits close to the Sun (0.5AU)
 Backstory: Carries a magnetometer made at Imperial College London



PARKER SOLAR PROBE

Age: ~3 yrs Alias: PSP
 Skills: Fastest manmade object (692,000km/h). Closest ever spacecraft to the Sun (0.07AU)
 Backstory: Named after Eugene Parker, who theorised the solar wind's existence in 1958



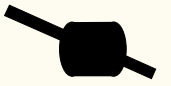
BEPICOLOMBO

Age: ~3 yrs Alias: Bepi
 Skills: Will orbit Mercury in 2025
 Carries a magnetometer
 Backstory: Named after Giuseppe Colombo, who worked out how to get a spacecraft to orbit Mercury



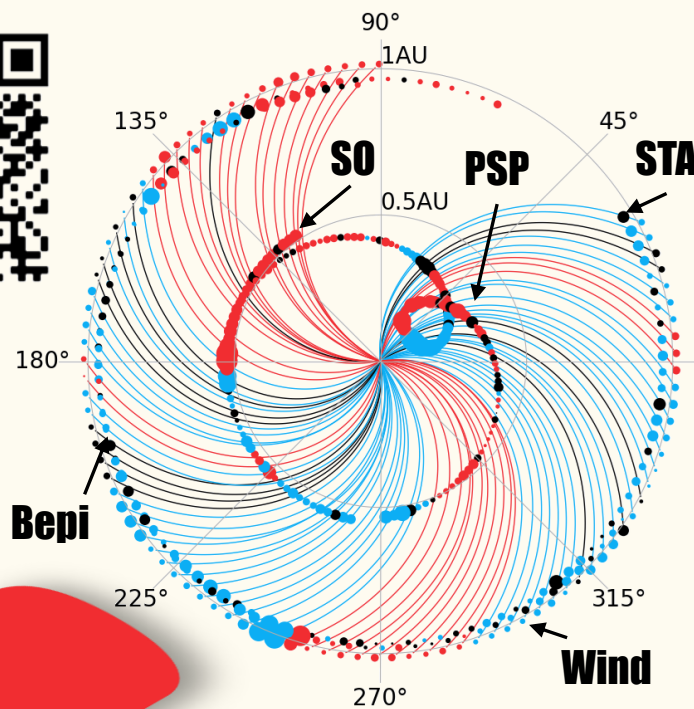
WIND

Age: ~26 yrs Alias: Wind
 Skills: Orbits at L1
 Has a set of telescopes
 Backstory: Provides warning of space weather events



Synopsis

- The solar wind is a supersonic plasma that escapes from the Sun in all directions into space.
- This interacts with planets, and can create space weather events at Earth, which can take down power grids and satellites.
- Many spacecraft have measured the solar wind, but we usually neglect latitude, and just consider longitude, as in the figure on the right.
- But the solar wind is still 3D, so can we improve upon single point measurements?
- We have assembled a crack team (above), each with their own special abilities, to answer this question.



Contrived Plan

- Each particle in the solar wind travels in a straight line, but the Sun rotates every ~27 days, so the solar wind has a spiral pattern.
- The magnetic field also takes this shape, known as the Parker spiral, where the tightness of the spiral is related to the solar wind speed (usually ~400km/s).
- The Sun has a magnetic field that can either point towards (blue) or away (red) from the Sun.
- We can transform into a frame that rotates with the Sun (Figure above). For each spacecraft we plot a point every 6 hours, where the colour indicates magnetic direction, and size is the magnetic field strength.
- PSP travels so fast that it overtakes the Sun, travelling anti-clockwise and creating a loop in the Sun's frame (scan QR code).

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The Score

- We can compare different spacecraft by mapping them back to the Sun's surface (following the Parker spiral).
- We found a clear polarity structure in latitude, which could have implications for predicting space weather.
- This constellation of spacecraft can provide context to solar wind measurements, that would not otherwise be possible.
- Could also be used to test the validity of solar wind models in latitude.
- Since these spacecraft were not a coordinated constellation, their configuration changes over time, leading to lots of interesting line ups.

