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AE 4342 - Lab 4: Requirement tree and flowdown

Missions statement

The purpose of the Parker probe is to explore the inner regions of the heliosphere to investigate the mechanisms and dynamics of the flow of energy from the Sun; this will be achieved by taking data throughout numerous close approaches using magnetometers, telescopes, and energetic particle instruments, which will then be sent back to Earth for processing.

Mission objectives

- Map the energy flows which accelerate the solar wind and heat up the corona
    - Confirm the Parker conjecture which states that the corona is heated up by the ‘tangling’ of magnetic field lines
    - Determine if Ion beam formation originates from the processes in the lower corona
    - Measure the plasma velocity and magnetic fluctuations at varying distances from the Sun
- Establish the makeup and interactions of the magnetic field and plasma which power solar wind
    - Identify the signatures of the physical processes participating in solar wind formation
    - Determine the relationship between the number of kinked magnetic field lines and the distance from the Sun
    - Establish the sources of fast and slow solar wind
- Investigate the processes by which energetic particles are carried and sped up
    - Measure Coronal Mass Ejection shocks to verify the origin of high energy solar energetic particles (SEP)
    - Identify the role of solar energetic particles in building suprathermal trails
    - Determine the evolution of SEP energy spectra at different distances from the Sun

Requirements

The probe shall take images of the corona and inner heliosphere. Stakeholder: Naval Research Laboratory

The probe shall take measurements of the low and high frequency magnetic fields. Stakeholder: Stuart Bale, UC Berkley

The probe and its instruments shall perform measurements within 3.83 million miles of the Sun.

The launch vehicle shall provide a total thrust of <TBR> N to enable the probe to use Venus for a gravity assist maneuver.

The probe shall burn up in the Sun’s corona once it has completed its 26th data uplink.

CONOPS

Perform gravity assist using Venus

Data collection occurs at perihelion

Launched to Venus using Delta IV rocket

Earth

Data transfer to Earth occurs close to aphelion when the probe isn't collecting data

Perform numerous flybys while getting increasingly close to the Sun

Once Science missions are completed burn up in the Sun's corona