SR555: Heat Transfer in Space Applications

Radiation Analysis

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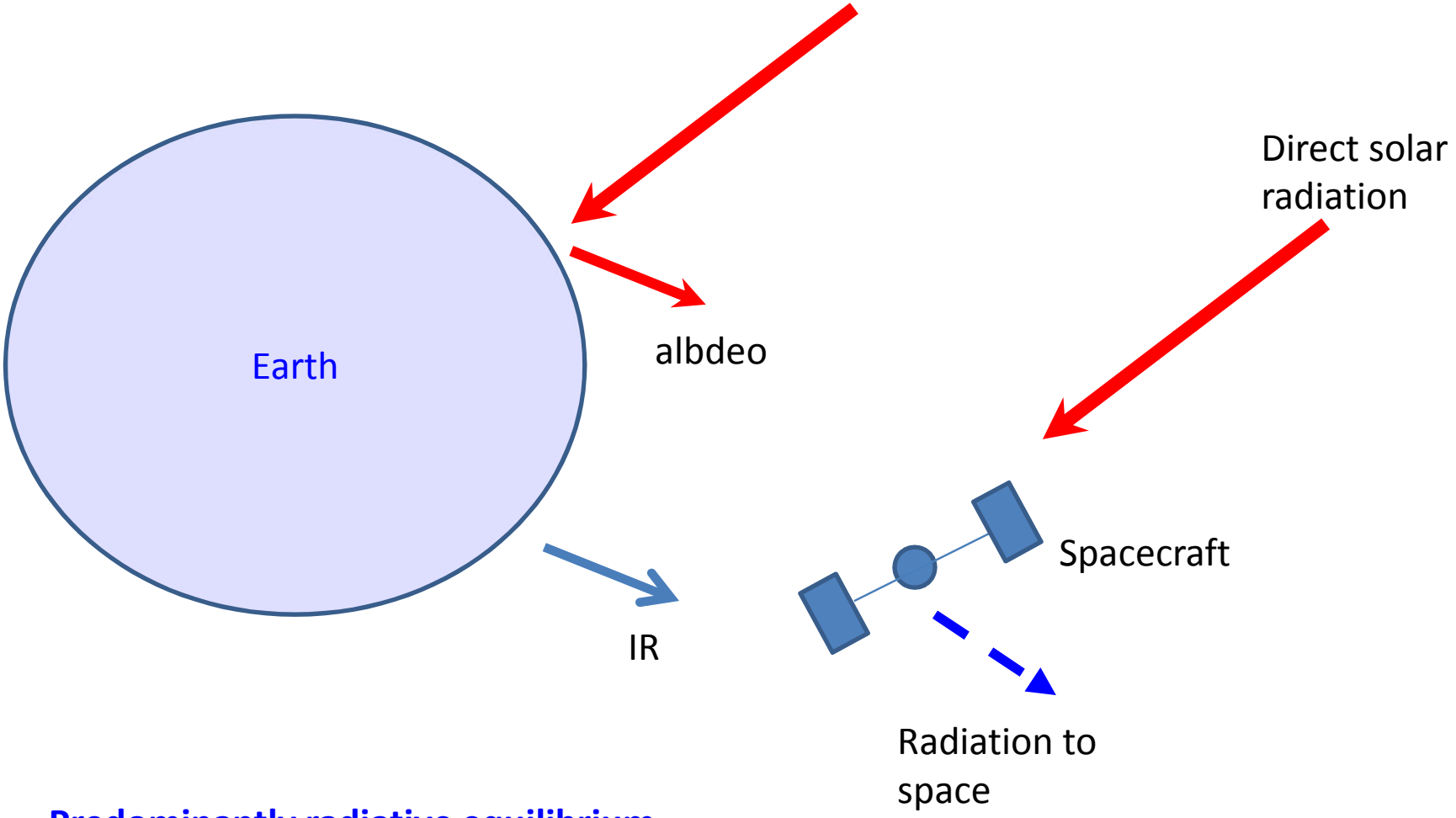
Thermal Environment

- **Principal forms of environmental heating:**
  - Direct sunlight
  - Albedo of Earth
  - IR radiation of Earth
  - Aerodynamic heating

Thermal Environment



Predominantly radiative equilibrium

Thermal Environment

- **To achieve thermal equilibrium:**
  - Spacecraft will balance the absorbed energy from environmental heating and dissipated by its internal components with its own IR radiation
  - thermal control system will help achieve this
  - Proportion of different sources varies with orbit and spacecraft location (LEO? Mars?)
  - **Thermal time constant:** characteristic time required for each type of source term for absorption of a given amount of energy
    - Smaller thermal constant would mean faster absorption
    - Spacecraft response time would decide how many types of sources need to be considered

Thermal Environment

- **Free molecular heating:**
  - Individual molecules bombard the spacecraft once it reaches the outer regions of environment.
  - Valid during launch ascent phase just after booster is ejected.
  - Booster deadweight protects spacecraft → deadweight carriage and need for protection are balanced

Thermal Environment

- **Specifications are required for the following:**

Source	Planet	Perihelion	Aphelion	Mean	Reference
Direct solar					
albedo					
Planetary IR					