



Mission Specific Needs and Issues

A. Hilgers

- ~All spacecraft must be made immune to detrimental effects of ESD's.
- Some type of missions have specific requirements including:
 - Solar system plasma science missions
 - Electric propulsion sub-system
 - Tether sub-system
 - Magnetised spacecraft
 - Coulomb force interactions
 - Space Situational Awareness programme

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Solar System Plasma Science Missions

- Objectives: Measurement of non-perturbed plasma, currents, E and B fields.
- Issues:
 - Need 3D measurements of rather weak signal.
 - Need to control or to take into account potential perturbation of the order of kT/e (or typical energy) for particle detectors and E/L for electrical sensors.
 - Need to limit charged contaminants (typically photo-electrons) flux level to below ambient flux level.
 - May have strong design impacts.
- Relevance: Cross-scale, Laplace, Tandem,...

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Electric Propulsion sub-system

- Objective: Expel high speed charged particles to produce thrust.
- Issues:
 - Spacecraft potential need to be controlled:
 - for ion emission based systems (e.g., grid, FEEP)
 - Possibly for MHD thruster (e.g., down to -30 V was observed on SMART-1).
 - May need to control the space charge.
 - May need to control backflow and return current.
- Relevance:
 - Small geo, Bepicolombo, Alphasat, etc...

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Tether sub-systems

- Objectives: Could be used for thrust, power generation, wide electron beam source, ELV/VLF emitting antenna.
- Issue:
 - Typically 1 to 10 kilometers long
 - Appearance of $V \cdot B$ field, Lorentz and possibly Coulomb force due to current or charge on the tether.
 - Current closure may be needed especially at cathode end for ion collection or electron emission.
- Relevance: GSTP-5 IOD

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Magnetised spacecraft

- Objectives: Magnetised spacecraft have been considered for magnetic sailing, radiation protection, constellation inter-distance control.
- Issues:
 - Create a cavity in the ambient plasma.
 - Currents are generated on the cavity surface and possibly within the cavity.
- Relevance: early concept studies only

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Coulomb Force interactions

- Objective: Concept proposed for electric sailing, for constellation inter-distance control, and for asteroid tractors.
- Issues:
 - Actual force estimate .
 - Potential control.
- Relevance: Early concept studies only

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Space Situational Awareness Programme – Space weather element

- Objectives:
 - monitoring of the Sun, the solar wind, the radiation belts, the magnetosphere and the ionosphere.
 - provision of reliable local spacecraft (and launcher) radiation, plasma and electromagnetic environment data for historical re-construction, nowcast and forecast of hazardous conditions.
 - provision of timely and reliable ionospheric disturbances nowcast and forecast
 - prediction of thermospheric density for spacecraft drag calculation.
 - provision of timely and reliable ionospheric density profile nowcast and forecast.
 - Provision of results of ground-level magnetic field variations monitoring and forecast
- Issues:
 - Unperturbed plasma environment with strong service requirements in term of coverage and continuity.
- Relevance: Future programme preparation – to be decided upon in next ministerial council meeting.

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