Notice of Intent to Propose in Response to the ESA call for Mission Concepts for the M3 2022 Launch: Investigation of MagnetoPause Activity using Longitudinally-Aligned Satellites (IMPALAS).

Proposal Name: Investigation of MagnetoPause Activity using Longitudinally-Aligned Satellites (IMPALAS).

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Science Summary: The dayside magnetopause is the primary site of energy transfer from the solar wind into the magnetosphere, and activity on this boundary modulates much of the activity observed within the magnetosphere itself (including 'Space Weather'), and indeed that propagating down into the ionosphere. Some specific plasma physical processes are already known to operate on the magnetopause, such as the occurrence of magnetic reconnection, the generation of boundary waves, the propagation of pressure-pulse induced deformations of the boundary, the formation of boundary layers and the generation of Alfven waves and field-aligned current systems that connect the boundary to the inner magnetosphere and ionosphere. However, many of the details of these processes, how they operate on the magnetopause and how they evolve are not fully understood. For example, magnetic reconnection is known to occur sporadically to produce flux transfer events, but how and where these arise, and their importance to the global dynamics of the magnetospheric system is still unresolved.

Mission Concept Summary: Many of the phenomena described above involve propagation of waves and other structures across the magnetopause surface. In many cases (e.g. magnetic reconnection, boundary waves), they are strongly influenced by the northward pointing direction of the terrestrial magnetic field. Understanding of these phenomena would be enhanced by measurements made at widely-spaced ($\Delta \sim 5\ R_E$) intervals along the direction of dayside terrestrial field lines at the magnetopause. We propose a mission involving deployment of a current state-of-the-art fields and plasmas payload package on 3 identical spacecraft. IMPALA 1 would be in a circular equatorial orbit of radius ~10.48 R_E, which has a period of exactly 2 days. Moreover, this orbit radius is also very close to the average location of the dayside magnetopause, such that the spacecraft would be expected to 'skim' along (and thus sample) this boundary over many hours during its dayside passage. The orbit should also be phased such that when the spacecraft was at local midday, northern European ground-based facilities were also at, or very near, local midday. IMPALA 2 and IMPALA 3 would be placed in orbits of +30 degrees and -30 degrees inclination, with slight eccentricity to increase their apogee to ~11 R_E, the typical position of the noon magnetopause at these inclinations, while maintaining the 2 day period and phase with respect to IMPALA 1. These spacecraft would thus skim the magnetopause ~5 R_E above and below IMPALA1 while all 3 spacecraft maintain common longitude and thus sample along the same magnetic field line. The 2 inclined orbit spacecraft should also carry an auroral imaging system aimed at remote sensing the foot-points of the magnetic field lines mapping through the 3 spacecraft locations. Moreover, appropriate phasing of the orbits could ensure that European ground-based facilities would also sample near the foot of that field line when the spacecraft are in their prime science locations.

Critical technologies: None identified at present – mission can be achieved with high-heritage instrumentation.

List of team members: A mission concept paper has recently been circulated to potentially interested parties. At time of writing, statements confirming interest have been received from: O. Amm (FMI, Finland), J. de Keyser (ISA, Belgium), M. Dunlop (RAL, UK), J. Eastwood (Imperial College, UK), A. Fazakerley, C. Forsyth, A. Walsh (all UCL/MSSL, UK), D. Fontaine (LPP, France), H. Hasegawa (ISAS, Japan), P. Hellinger, S. Stverak, D. Hercik (all ASCR, Czech Republic), C. Jacquey (CESR, France), S. Milan (U. Leicester, UK), J. Raeder (UNH, USA), D. Sibeck (NASA/GSFC, USA), P. Travnicek (ASCR, Czech Republic and UCB, USA), J. Wild (U. Lancaster, UK).