

# **Magnetospheric Physics: The Future after 50 Years of Success**

## ***A unique plasma physics laboratory***

long-lived plasmas with well-separated scales - amenable to in situ investigation

accessible examples of key universal processes

## ***Highlights from the first 50 years***

Unambiguous confirmation of magnetic reconnection as a process that reconfigures magnetic topology and converts magnetic energy into particle energy.

Unambiguous observation of the existence of collisionless shocks and their ability to accelerate particles to high energies.

Unravelling of primary agents that give rise to the aurora

## ***Outstanding questions***

Pathways to particle acceleration: reconnection, shocks, wave-particle interactions. Relative role of steady processes vs intermittent, multi-scaled coupling.

What are the small-scale processes that lead to important macro-scale consequences?

How do the various regions and boundaries from the Sun to the Earth's atmosphere couple to exchange energy and drive the dynamics of the system?

## ***Cross-fertilisation and applications***

Astrophysics: turbulence, shocks, reconnection, particle acceleration

Laboratory and fusion plasmas: instabilities, reconnection, particle acceleration, theory and modelling

Space Weather

Global change and Sun-Earth coupling

Use of space as a observation platform

## ***Conclusions***

another 50 years to:

whole 3D picture of global dynamics through imaging and modelling

resolve in situ the multiplicity of coupled scales using multi-probes