# The interaction of ultra-low-frequency waves with charged particles in Earth's magnetosphere

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Abstract.

Solar wind forcing, e.g. interplanetary shock and/or solar wind dynamic pressure pulses impact on the Earth's magnetosphere manifests many fundamental important space physics phenomena including producing electromagnetic waves, plasma heating and energetic particle acceleration. This paper summarizes our present understanding of the magnetospheric response to solar wind forcing in the aspects of radiation belt electrons, ring current ions and plasmaspheric plasma physic based on in situ spacecraft measurements, ground-based magnetometer data, MHD and kinetic simulations.

It is found that after the impact of solar wind forcing on the Earth's magnetosphere, plasma heating and energetic particle acceleration started nearly immediately and could last for a few hours. Even a small dynamic pressure change of interplanetary shock or solar wind pressure pulse can play a non-negligible role in magnetospheric physics. The impact leads to generate series kind of waves including poloidal mode ultra-low frequency (ULF) waves. The fast acceleration of energetic electrons in the radiation belt and energetic ions in the ring current region response to the impact usually followed by the wave-particle resonant acceleration dominated by global or localized poloidal ULF waves excited at various L-shells.

Generalized theory of drift and drift-bounce resonance with growth or decay localized ULF waves have been developed to explain in situ spacecraft observations. The wave related observational features like distorted energy spectrum, boomerang and fishbone pitch angle distributions of radiation belt electrons, ring current ions and plasmaspheric plasma can be explained in the frame work of this generalized theory. It is worthy to point out here that poloidal ULF wave is much more efficient to accelerate and modulate electrons (fundamental mode) in the radiation belt and charged ions (second harmonic) in the ring current region.