Geophysical Research Abstracts, Vol. 9, 07474, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07474

Attractive and repulsive ponderomotive forces in space- and astrophysical plasmas

R. Lundin (1) and A. Guglielmi (2)

1. Swedish Institute of Space Physics, Teknikhuset, 90187, Umeå, Sweden
2. Institute of Physics of the Earth, 10 B. Gruzinskaya, 123995 Moscow, Russia

Ponderomotive forces constitute time-averaged nonlinear forces acting on a media in the presence of oscillating electromagnetic fields. Ponderomotive forces are conservative in the same way as "classical" forces, thus representing a useful analytical tool to describe plasma acceleration. The ponderomotive force direction is generally conceived to be along the wave Poynting flux. However, a theoretical analysis suggests a much more complex behaviour. For instance, the force may be unidirectional for magnetized plasmas in a diverging magnetic field (magnetic moment pumping, MMP). Another apparent "anomaly" is the frequency dependence of the so-called Miller force, being attractive for frequencies below the ion gyro-frequency and repulsive at higher frequencies ("classical" Miller force).

In this report we address some interesting aspect of ponderomotive forces in space- and astrophysical plasmas. For instance, external irradiation of magnetized plasma immersed in a magnetic dipole field (e.g. a planetary ionosphere) leads to upward escape of the plasma (MMP force). An interesting new aspect is the non-linear cross-over from attractive to repulsive Miller force in space and astrophysical plasmas. This implies that a highly unstable cross-over may exist in a radiating plasma immersed in a dipole magnetic field (e.g. a star), the plasma imploding on one side and exploding on the other. We will show some examples where we believe the Miller-force instability plays a central role in space plasmas and astro plasmas.