

# On the ponderomotive acceleration of ions by relativistic Alfvén waves in underdense plasmas

*R. Lundin, and A. Guglielmi*

*Swedish Institute of Space Physics, Kiruna, Sweden  
Institute of Physics of the Earth, RAS, Moscow, Russia*

We discuss the  $\beta$ -dependence of field aligned ponderomotive acceleration of ions under the action of Alfvén waves. The dimensionless parameter  $\beta = c_A / c$ , where  $c_A$  is the Alfvén velocity, varies in a wide range – from  $\beta \ll 1$  (nonrelativistic limit according to our terminology) in the magnetosphere of the Earth up to  $\beta \gg 1$  (ultrarelativistic limit) in the magnetospheres, for instance in compact magnetized astrophysical objects. The properties of Alfvén waves therefore varies drastically. We show that relativistic Alfvén waves accelerate charge particles much more effective than for the nonrelativistic waves. This pertains to the nonresonant and resonant mechanisms of acceleration equally. Moreover, the relativistic, more effective, acceleration is expected to occur in extreme low-density cavities in the Earth's auroral acceleration region. The energization processes in the space plasmas are discussed briefly in view of an overall picture of  $\beta$ -dependence of the ponderomotive forces induced by the Alfvén waves.