

# **From Magnetohydrodynamic waves to plasma universe - highlights of Hannes Alfvén's scientific work**

**C.-G Fälthammar**

Alfvén Laboratory, Royal Institute of Technology, Stockholm, Sweden  
(carl-gunne.falthammar@alfvenlab.kth.se)

Few contemporary space scientists have had an impact comparable to that of Hannes Alfvén. Although most widely known for discovering a new kind of waves, nowadays called Alfvén waves, and thereby opening an entirely new field of physics - magnetohydro-dynamics - he had several other pioneering achievements to his credit. One was the invention of the guiding centre theory, which dramatically simplified analysis of many space plasma problems and became the starting point for a highly sophisticated adiabatic theory of charged particle motion. Both these contributions were initially met with great skepticism or even hostility by the contemporary scientific community, but were finally universally accepted and he was awarded the Nobel Prize for Physics in 1970. It is not widely known that Hannes Alfvén predicted the interstellar magnetic field many years before it was observed. In his attempts to explain the formation of planets and satellites he intuitively introduces a concept, the Critical Ionization Velocity, which was observed experimentally only years later and was given a rigorous theoretical explanation still much later. As it became evident that the completely dominating part of known matter in the Universe is in the plasma state, Hannes Alfvén recognized the profound, but until then largely neglected, role plasma physics has for our understanding of the Universe in which we live. He argued this point vigorously and eloquently and had the vision of a new paradigm - the Plasma Universe.