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Editorial

Particle Beams and Basic Phenomena in the Plasma Universe
A Special Issue in Honor of the 80th Birthday of Hannes Alfvén

This year Professor Hannes Alfvén, the father of magnetohydrodynamics and one of the founders of plasma physics, has attained his 80th birthday—an event which brings him congratulations and good wishes from scores of researchers around the world in the form of papers dedicated to his honor in special issues of *Astrophysics and Space Science* and *Laser and Particle Beams*, as well as the American Geophysical Union's most coveted award, the Bowie Medal.

It is fitting that the massive contributions of Hannes Alfvén to the fields of particle beams, plasma physics, space physics, and astrophysics be again recognized on this occasion. For much of Alfvén's career, his ideas were dismissed or treated with condenscension; he was often forced to publish his papers in obscure journals; and he was continuously disputed by the most renowned senior scientist working in the field of space physics. Even today there is an unawareness of Alfvén's multifaceted contributions to fields of physics were his ideas are used without the knowledge of who originated them.

Hannes Olof Gösta Alfvén was born on 30 May 1908 to Johannes and Anna-Clara Romanus Alfvén in Norrköping, Sweden. He was educated between 1926 and 1934 at

Figure 1

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the University of Uppsala, which conferred upon him the degree Ph.D. in 1934. The same year Alfvén was appointed a docent in physics at the University of Uppsala and at the Nobel Institute in Stockholm. In 1940 he became professor of electromagnetic theory and electrical measurements at the Royal Institute of Technology in Stockholm, and in 1945 he was elected to a newly created Chair of Electronics at the same institute, which was converted to a Chair of Plasma Physics in 1963. Since 1967 Alfvén extended his activities to the United States, at the University of California at San Diego in La Jolla, and in 1969, as visiting Professor of Electrical Engineering at the University of Southern California in Los Angeles. He currently divides his time between the Royal Institute of Technology (April to September) and UCSD (October to March).

It may be said that Alfvén has a knack for publishing 'out of paradigm'. His ideas precede general acceptance by two or three decades. Examples of this include the postulation of the isotropy of extragalactic cosmic rays and the existence of a galactic magnetic field (1937), the concept of a limiting current in relativistic electron beams (1939), the notion of an equivalent magnetic moment which determines the motion of electric charges spiraling in magnetic fields (1942), identification of the synchrotron process in astrophysical sources (1950), collective ion acceleration (1952), and the importance of double layers in laboratory and space plasmas (1958).

Alfvén's approach to physics is based on deep physical insight and an extraordinary physical intuition. He is quick to place new observations into a framework larger than that required to explain the observations themselves. For example, in the early 1930's, cosmic rays were commonly thought to be gamma rays filling the entire universe. When they were discovered to be charged particles, Alfvén, in 1937, made the novel suggestion that the galaxy contained a large-scale magnetic field and that the cosmic rays moved in spiral orbits within the Galaxy, owing to the forces exerted by the magnetic field. He argued that there could be a magnetic field pervading the entire Galaxy if plasma was spread throughout the Galaxy.

This plasma could carry the electrical currents that could then create the galactic magnetic field. Alfvén's work was again dismissed, this time on the grounds that it was well known that interstellar space was a vacuum and certainly could not support the electrical currents and particle beams he was proposing. But he had started the scientific community thinking about an idea that was later to become very fashionable. Today we owe the field of magnetohydrodynamics to this idea and the field of particle beams to his initial study of how cosmic rays propagate in plasma filled interstellar space.

With the advent of space probes and the discovery of electrical currents in our plasma dominated solar system, the nonphysical mathematical formalisms he battled so long were abandoned, and Alfvén has increasingly turned his attention toward the *plasma universe.* Today Alfvén is as active as ever advocating a universe dominated by electromagnetism and directing a study of a unified theory of cosmic plasma covering 27 orders of magnitude in size, from laboratory experiments, up to, and beyond, the Hubble distance. It is to Alfvén's credit when he states: 'there is no reason to grant a cosmological monopoly to those who master the complicated formalism of general relativity'. In surveying his published work one is reminded of another statement, attributed to Galileo, that 'in science the opinion of a single person may mean more than that of a thousand'.

Alfvén's achievements have earned him world-wide recognition, including the Gold Medal of the Royal Astronomical Society (1967), the Nobel Prize in Physics (1970), the Gold Medal of the Franklin Institute in 1971, and the Lomonosov Medal of the USSR

Academy of Sciences (1971). Several academies and institutes claim his name to their rosters including the Institute of Electrical and Electronics Engineers (Life Fellow), The European Physical Society. The American Academy and Sciences, The Royal Swedish Academy, and the Yugoslav Academy of Sciences. Alfvén is one of the very few scientists who are foreign members of both the US and USSR Academies of Science.

Much of the research reported in this special issue, mostly papers presented at the IEEE International Conference on Plasma Science, Washington DC, June 1987, is owed to Alfvén, who has made it easy to think and talk of such ideas. May we—and the world at large—derive the benefits of his counsel for many years to come.

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