Ian Axford's Contributions to our Understanding of Cosmic-Ray Transport and Acceleration

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Ian Axford was one of the founders of the modern theory of cosmic-ray acceleration and transport, which is used through much of modern space physics and astrophysics. Arguably, his most-fundamental contribution was in a paper with Leo Gleeson, published in 1967, in which they derived and significantly extended the original cosmic-ray transport equation first written down by Parker in 1965 (partially anticipated by Krymsky in1964). In this paper Gleeson and Axford presented the first correct expression for the diffusive streaming flux of the cosmic rays. Their result is fundamental to nearly all theoretical discussions of cosmic-ray transport and acceleration, right down to the present. Shortly after this paper appeared, Gleeson and Axford published another paper which presented the so-called 'force-field' approximation to the solution of the transport equation in a steady, spherically symmetric solar wind (solar modulation). Subsequently Ian published (with Leer and Skadron) another exceedingly important paper describing diffusive shock acceleration which is an application of the basic cosmic-ray transport equation to a shock. This process is probably responsible for most if not all of the cosmic rays throughout the universe. There were also many other, important papers. I will go on to summarize briefly some of the recent applications of Ian's ideas to astrophysics and space physics, in the latter part of my presentation.