This Week's Citation Classic

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Williams D J & Mead G D. Nightside magnetosphere configuration as obtain from trapped electrons at 1100 kilometers. *J. Geophys. Res.* **70**:3017-29, [Johns Hopkins University, Applied Physics Laboratory, Silver Spring, and Goddard Space Flight Center, Greenbelt, MD]

The Earth's basic dipolar magnetic field is greatly distorted at high altitudes by the ever-flowing, fully-ionized, magnetized plasma emitted by the Sun, the solar wind. This paper presents the first analytical description of such a magnetospheric configuration. It was obtained from observations of the behavior of energetic Van Allen belt electrons at low altitudes. The magnetospheric configuration obtained was that which could consistently explain the behavior of these electrons under simple assumptions of charged particle motions in magnetic fields. [The *SCI*® indicates that this paper has been cited over 170 times since 1966.]

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"I feel honored to have my paper chosen as a 'Citation Classic.' I also feel very fortunate to have had access to data that allowed these studies to take place at such an opportune moment in the development of magnetospheric research. The pace of building and launching experiments and receiving and interpreting new results in the field of space research was hectic in the early 1960s. Indeed, there were times when I longed for the peace and tranquility of the course work, final exams, and accelerator runs in graduate school, so recently left behind. However, I did manage to build and help launch an energetic electron detector on board a low-altitude, polar orbiting Navy satellite known as satellite 1963-38C. It was the data from this satellite which resulted in the publication being cited. This paper was the high point of a series of papers both before and after its publication, concerned with the behavior of energetic particles trapped in the Earth's magnetic field.

"Initial studies of the temporal and spatial variations of these energetic electrons showed that: (1) The intensity obtained at a given geomagnetic latitude on the local noontime meridian was higher than that obtained at the same geomagnetic latitude on the local midnight meridian, and (2) this intensity difference decreased as the geomagnetic latitude decreased. These two facts plus results from earlier published work concerning the Earth's magnetic field configuration by my colleague, G. D. Mead, gave me the impetus to strive for an explanation of the electron observations.[1]

"This paper presents an analytical description of the geomagnetic field configuration which consistently explained the energetic electron observations using only the simple assumption of normal charged particle motion in a magnetic field. I should note here that our paper appeared in the same issue of the *journal of Geophysical Research* which contained the first description of the Earth's overall geomagnetic field configuration based on *insitu* measurements. I'm happy to report that our model bore a remarkable resemblance to the *insitu* observations. Using these results I was able to pursue my studies of energetic particles in the geomagnetic field and explain a variety of other phenomena observed in our data.

"I feel that one of the main reasons why this paper has been cited so often in the literature is that the model we presented was analytic. Simple polynomial expressions were used to describe the geomagnetic field configuration and could be used by researchers in the field without resort to large numerical computational models requiring sophisticated computer techniques. Thus, the model became an early standard in testing particle observations throughout the Earth's magnetic field configuration.

"The model is somewhat outdated today. We now know that to describe the overall magnetospheric configuration which exists around the Earth we have to include electric fields collisional effects, wave-particle interactions, and a variety of other plasma processes.

"Rather than being dismayed at this new higher level of sophistication required for an understanding of the system, we now recognize that the overall magnetospheric configuration represents a naturally occurring, magnetized plasma laboratory, which fortunately exists in the relatively accessible neighborhood of the Earth. Fortunate indeed, because such magnetospheric systems are now known to be a common occurrence throughout the universe, comparable systems comprising several planets in our solar system, the extended solar atmosphere (the heliosphere), pulsars, and perhaps galaxies as a whole."

1. **Mead G D.** Deformation of the geomagnetic field by the solar wind. *J. Geophys. Res.* **69**:1181-95, 1964.