

**Akasofu S-I.** The development of the auroral substorm.

*Planet. Space Sci.* 12:273-82, 1964.

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**This paper recognized that the auroral activity undergoes a systematic, quasi-cyclic change. This finding has made it possible to study systematically complicated polar upper atmospheric and magnetospheric phenomena. [The SCI® indicates that this paper has been cited over 155 times since 1964.]**

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"It is gratifying to learn that my 1964 article has been included in the list of mostcited papers. A little background of the history of the work leading to this concept and of the subsequent development may be of some interest to the readers.

"My paper is concerned with the dynamics of the aurora (the northern light). Characteristics of auroral activity on a global scale (namely, how auroral displays would appear when one could look down on the Earth from above the north polar region) had not accurately been known before I began to work on the subject. It was for this reason that Sydney Chapman and C.T. Elvey included photographic auroral observations as one of the major projects of the International Geophysical Year (IGY) (1957-58), the greatest enterprise in Earth science history.

"After examining IGY auroral photographs taken simultaneously from a large number of auroral observatories, a rather simple but fascinating pattern of auroral activity over the entire polar region began to emerge, namely, that auroral activity over the entire polar region undergoes a quasicyclic change over a period of a few hours. With great excitement, I drafted an article entitled

'Auroral Activation' and sent it to Chapman for his comments. However, he refused to read it until the title was changed to 'Auroral Substorm.' It was also soon found that many other polar upper atmospheric phenomena, such as polar magnetic and ionospheric disturbances undergo a similar quasi-cyclic change in harmony with the auroral substorm. Thus, I believe that the concept of auroral substorms put forth in the article has become a useful guide in organizing, analyzing, and understanding a variety of complex polar upper atmospheric data.

"I do not believe that this concept was easily accepted by many in those days, since there is no simple way for a single observer on Earth to conclusively prove or disprove it. During this difficult time, a close friendship had developed with several colleagues; among them, Y.I. Feldstein of the USSR. In an effort to prove the validity of the concept, an extensive airborne observation by large jet aircraft was then conducted. One of the happiest occasions in my research career came rather unexpectedly in 1972 when photographs taken from US Air Force satellites indicated clearly auroral patterns which are consistent with those proposed in my 1964 article.

"It has also become apparent that many magnetospheric disturbance phenomena undergo a quasi-cyclic change in harmony with the auroral substorm. Thus, the concept of auroral substorms is now extended to include a variety of magnetospheric phenomena, and the concept of magnetospheric substorms has emerged.<sup>1,2</sup> The auroral substorm is now viewed as one of the manifestations of the magnetospheric substorm. In fact, it is most gratifying that major satellite and theoretical research is now being made in an effort to understand basic plasma processes associated with the magnetospheric substorm."

1. Akasofu S-I. *Polar and magnetospheric substorms*. New York, NY: Springer-Verlag, 1968. 280 p.

2. Akasofu S-I. *Physics of magnetospheric substorms*. Boston, MA: D. Reidel Publishing Co., 1977. 599 p.