

# BASIC THEORY OF A MAGNETOSPHERIC SUBSTORM

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## ABSTRACT

A magnetospheric substorm is found to be produced by the electron precipitation that produces the aurora during a substorm, where the resulting current provides the current source that produces the accompanying dipolarization of the Earth's magnetic field. This model thereby explains the basic features of a substorm and predicts that the electron precipitation during a substorm must be the actual cause of a magnetospheric substorm.

## INTRODUCTION

As described by Akasofu [1], a substorm consists of the sudden onset and latitudinal expansion of the aurora during a substorm. The aurora during a magnetospheric substorm can then be attributed to the electron precipitation during substorm expansion, where substorm expansion is caused by the predicted latitudinal expansion of the electron precipitation during a substorm [2]. A substorm is also characterized by the accompanying dipolarization of the Earth's magnetic field that is produced by the substorm current wedge that consists of upward and downward field-aligned currents in the evening and post-midnight sectors of the auroral zone. The upward current in the evening sector can then be attributed to the electron precipitation that produces the aurora, where according to Kirchoff's law, the downward current supplies the return current that is needed to complete the current circuit for the substorm current wedge [3].

## CONCLUSION

Although it should have been obvious decades ago, substorm expansion is therefore caused by the latitudinal expansion of the electron precipitation that produces the aurora, where the resulting current produces the accompanying dipolarization of the Earth's magnetic field. This model thereby explains both substorm expansion and the previously unexplained dipolarization of the magnetic field during a substorm. Although it may come as a surprise to the substorm research community, this theory thereby solves the substorm problem and predicts that the predicted electron precipitation during a substorm has to be the basic cause of a magnetospheric substorm [4].

## References

- [1] Akasofu, S-I., Dynamical morphology of the aurora polaris, *J. Geophys. Res.*, 68, 1667-1673, 1963.
- [2] Calvert, W., The gotcha-kata-kata or "domino" theory of substorm expansion, in *Substorms-4, International Conf. on Substorms*, edited by S. Kokubun and Y Kamide, pp. 259-263, Terra Sci. Publ. Co., Tokyo, 1998.
- [3] Calvert, W., Theory for the electron precipitation and current system that produce a magnetospheric substorm, *Physics of Plasmas*, 8, 1099-1103, 2001.
- [4] Calvert, W., An explanation for auroral structure and the triggering of auroral kilometric radiation, *J. Geophys. Res.*, 100, 14,887-14,894, 1995.