Using Global Auroral Imaging to Determine the State of the Magnetosphere

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The Earth's auroral ovals map magnetically to many of the critical regions of the magnetosphere. On the dayside of Earth, the auroral oval maps to the magnetopause and near local noon it is connected to the cusp. Auroral brightening near local noon in the dayside oval signal the arrival of dynamic pressure shocks in the solar wind at the magnetopause. The total magnetic flux in the area of the open polar cap is a direct measure of the total magnetic flux in the lobes of the magnetotail and consequently is a measure of the energy stored there. During periods of relatively low auroral activity, the efficiency of dayside merging can be determined. In particular for southward-directed interplanetary magnetic field, the width of the reconnection region can be determined empirically. The pattern of auroral luminosities or morphology is used to determine the substorm phases of growth, onset, expansion, and recovery and the activity of magnetic storms. The intensities and ratios of the visible or far ultraviolet auroral line emissions can be used to determine the energy flux and characteristic energy of the precipitating auroral particles. Thus a complete temporal history of the energy flow from the solar wind to storage in the magnetosphere and eventual deposition in the auroral zone can be obtained. In addition the conductivity of the auroral ionosphere can be estimated.

The energy deposited in the auroral zone ionosphere and thermosphere (IT) is a critical input needed for new global IT models that are proposed to be developed under the Living With a Star (LWS) program. The ideal next generation camera for the LWS geospace mission will be required to image multiple auroral emission lines simultaneously in order to determine the O/N_2 density ratio, the nightside ionospheric density n_e^2, as well as the auroral energy inputs. These observations will need to be acquired with time scales on the order of 1 minute.