THE RELATIONSHIP OF STABLE AURORAL RED ARCS TO THE PLASMAPAUSE

E. W. Kleckner and L. L. Smith

Battelle Memorial Institute
Pacific Northwest Laboratories
P. O. Box 999
Richland, Washington 99352

and

P. J. L. Wildman

Air Force Cambridge Research Laboratories
Laurence G. Hanscom Field
Bedford, Massachusetts 01730

For Presentation At

AMERICAN GEOPHYSICAL UNION
ANNUAL FALL MEETING

December 12-17, 1974

San Francisco, California

DISCLAIMER

THE RELATIONSHIP OF STABLE AURORAL RED ARCS TO THE PLASMAPAUSE

On the question of cold plasma dynamics, even the most basic correlation--that of the relationship between the plasmapause at high altitudes and the light ion trough in the ionosphere at low altitudes--is subject to considerable controversy. At low altitudes there is a drop in the total F region ionization beginning between L=2 and L=3 and forming a trough located at L=4. At high altitudes the plasmapause signature is characterized by an abrupt density discontinuity near L=4. In order to relate these boundaries physically, one must ascertain the distribution of ionization along the magnetic field line between the ionosphere and the outer magnetosphere. The light-ion trough and the plasmapause are subject to changes in position and steepness as the magnetic activity varies. The relationship between the plasmapause and the light-ion trough offers a potential tie between the low-and-high altitude magnetosphere if the plasma distribution along the field lines between L=2-to-6 region can be measured.

To gain some insight into this question we have examined data from several simultaneous satellite-ground based measurements of ion density and plasmapause position. Specifically, the magnetic storms of September 26/27 and April 21/22 of 1971 were studied using ISIS-I data and the ground based photometric data on SAR-Arc position and intensity from BNW Observatory. Both storms were similar in intensity (DST $\approx -90\gamma$) and the SAR-Arcs occurred at the same time into the recovery phase

(≈5 hours). The ISIS observations were simultaneous with the ground observations and within one hour of local time. The September event, however, was preceded by a smaller storm 24 hours earlier. It is well established that the position of the SAR-Arc marks the location of plasmapause in the outer magnetosphere. The light-ion trough of April has its equatorward edge coincident with the SAR-Arc position at an invariant latitude of 54°, thus indicating the commonality of these features.

By contrast, the September event is characterized by a complex structure in the light-ion trough. If again the SAR-Arc marks the plasmapause position, then its coincidence with the poleward edge of the equatorward boundary of the trough has several implications. There were no multiple arcs on the night in question. The most likely interpretation of the trough structure is that the ragged density profile is a result of density depletion due to incomplete plasmasphere filling following the September 25 storm. That is to say, during the recovery phase of the September 25 storm, upward flows of cold plasma from the ionosphere to the plasmasphere occurred (at an invariant latitude of ≈50°). The subsequent storm of September 26 then compressed the plasmasphere, and the SAR-Arc occurred at the poleward edge of the trough even though there were internal density discontinuities in the plasmasphere. As a follow-up on the storm, note that the plasmasphere is eroded as far as the inner density gradient before gradual filling restores the quiet-time configuration.