X-621-69-263
PREPRINT

NASA TM X- 63696

COMPARISON OF COINCIDENT OGO 3 AND OGO 4 ION COMPOSITION MEASUREMENTS

J. M. GREBOWSKY
N. K. RAHMAN
H. A. TAYLOR, JR.

JUNE 1969

GSFC
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

X-621-69-263
Preprint

COMPARISON OF COINCIDENT OGO 3 AND OGO 4 ION COMPOSITION MEASUREMENTS

J. M. Grebowsky
N. K. Rahman*
H. A. Taylor, Jr.

June 1969

*Physics Department, University of Maryland

Laboratory for
Atmospheric and Biological Sciences,
GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland

PRECEDING PAGE BLANK NOT FILMED.

CONTENTS

PRECEDING PAGE BLANK NOT FILMED.

COMPARISON OF COINCIDENT OGO 3 AND OGO 4 ION COMPOSITION MEASUREMENTS

by

J. M. Grebowsky, N. K. Rahman and H. A. Taylor

ABSTRACT

Ion composition measurements made on August 8, 1967 and August 28, 1967 by the topside ionospheric polar orbiting satellite OGO 4 and simultaneously by the eccentric orbiting magnetospheric satellite OGO 3 were compared on nightside passes through the plasmasphere. Throughout most of the midlatitude regions sampled, an isothermal diffusive equilibrium model at an ion temperature of 1000°K provides a good approximation for coupling these ionospheric regions. However temperature gradient components directed upwards along the field lines of the order of 1°K/km or greater are required to bring the profiles into agreement near the plasmapause assuming diffusive equilibrium and assuming the magnitude of the temperature gradient does not vary along the field line. Similar gradients are also required along the low latitude field lines traversed on the August 28, 1967 passes.

In agreement with previous studies of t local time asymmetry of the plasmasphere boundary, the plasmapause L coordinates measured by OGO 3 near midnight were greater than the L coordinates associated with the light ion

troughs observed near dawn on the coincident OGO 4 pass. If field line preservation is assumed and the convection streamline pattern in the equatorial plane is known, the H^+ densities measured at different local times along the OGO 3 trajectory can be transformed into densities at a local time characteristic of the OGO 4 measurements so that the transformed OGO 3 plasmapause is located on the same field line as the plasmapause determined from the OGO 4 measurements.

COMPARISON OF COINCIDENT OGO 3 AND OGO 4 ION COMPOSITION MEASUREMENTS

INTRODUCTION

Background

Studies of the propagation of whistler atmospherics by Carpenter (1963) indicated an abrupt drop of the equatorial electron density with increasing distance from the earth at a geocentric distance of a few earth radii. The existence of this knee (also known as the plasmapause) was confirmed by plasma probe measurements (Gringauz, 1963; Taylor et al., 1965).

Whistler measurements by Carpenter have demonstrated that the L coordinate of the plasmapause is strongly dependent upon the local time. From whistler results the position of the plasmapause in the equatorial plane has on the average the shape shown in Figure 1 with the maximum geocentric distance occuring in the dusk-midnight sector. When Kp increases the boundary moves to a lower dipole L position (Carpenter, 1966; Taylor et al., 1968; Binsack, 1967).

Troughs in the latitudinal distributions of electron and light ion densities have been observed on the night side at altitudes below 1000 kilometers near 60° geomagnetic latitude (e.g. Sharp, 1966, Taylor et al., 1969). The results of a statistical study by Rycroft and Thomas (1968) gives strong evidence that the knee in the equatorial plane is located on the magnetic field lines which pass near the minimum of the electron density trough observed at 1000 kilometers.

The origin of the plasmapause and the characteristics described above are qualitatively explainable in terms of a model developed by Nishida (1966). In this model the plasmapause is the boundary between magnetic lines of force that are transported across the magnetospheric tail by electric field convection and field lines that are never transported to the tail. On the former group of field lines, plasma escapes to interplanetary space while the field lines travel across the tail. Since the rate of replenishment from the ionosphere is low, the plasma densities (in particular, the light ion densities) on the field lines may be small compared to the densities on field lines of the latter group on which plasma escape is always prevented by closed field lines.

It is expected that the region of relatively dense plasma (the plasmasphere) bounded by the plasmapause will be closer to a state of thermal diffusive equilibrium than the plasma in the rarified region beyond the plasmapause at high altitudes (Angerami and Carpenter, 1966). This study explores the state of the plasma within the plasmasphere by investigating the relationship between ion densities measured nearly simultaneously by the magnetospheric satellite OGO 3 and the topside ionosphere satellite OGO 4.

Data Selection

In order to investigate the plasma coupling processes in the plasmasphere, ion composition measurements made simultaneously by the polar orbiting OGO 4 and the eccentric orbiting OGO 3 were sought for passes in which the two satellites traversed identical dipole L coordinates from 1.5 to 9 – this range included passage through the plasmapause and trough. Furthermore since plasma coupling is best described as taking place along magnetic field lines, it was desired that the interval of local time sampled by OGO 3 include the corresponding interval of the selected OGO 4 pass.

Two sets of data were selected: one from August 8, 1967 (the magnetic index K_p was 4^- for the chosen sampling period) and the other set from August 28, 1967 (a magnetically quiet day with $K_p = 2^-$ for the three hour period in which the measurements were made). The ranges of the geomagnetic coordinates traversed on the selected trajectories and the measurement times are listed in Table 1. All of the measurements were made in the southern hemisphere and with the exception of a small portion of the August 8, 1967 OGO 3 pass all the data was obtained on the night side of the earth (see Figure 6).

Experimental Equipment

The OGO 3 and OGO 4 satellites carried Bennett RF positive ion mass spectrometers which measured ambient thermal ions in the mass range 1 - 45 amu. The spectrometer efficiency range for the OGO 3 instrument was 1 to 10^6 ions/cm^3 and for OGO 4 it was 5 to 10^6 ions/cm^3 with a resolution of 1 in 20 amu. The OGO 3 spectrometer sweep rate was 61 seconds and for OGO 4 it was 12.8 seconds. The instrumentation is similar to that flown on the OGO 1 satellite and which was described in detail by Taylor et al., (1965) and Brinton et al., (1968).

RESULTS

General Comparison of Ion Densities

On both of the selected OGO 4 passes (Figures 2 and 3) a trough in the H^+ density was observed near 60° geomagnetic latitude (i.e., near L = 4 on the August 8, 1967 pass and near L = 3.5 on the pass of August 28, 1967). The decrease of the H^+ density with increasing L at the low latitude (low L coordinate) side of the trough was accompanied by a similar decrease in the density of He^+. However the O^+ and N^+ densities increased with increasing values of L in this region. These opposing variations lead to a trough in the total ion density (and therefore in the electron density) with the minimum occuring at a value of L less than or equal to that of the H^+ density minimum. The L position of the total density minimum plays a very important role in this study, since it is the field line labeled by this L value which, according to the statistical studies of Rycroft and Thomas (1968) passes through the knee in the equatorial plane.

Near the equator (i.e., near the smallest L positions) the OGO 4 pass on August 28, 1967 showed a depression in the total ion density. This depression is not unexpected since the measurements of Brace et al (1967) have established the existence of an equatorial trough in the latitudinal distribution of the electron density throughout the night near an altitude of 1000 kilometers. In this depression observed by OGO 4 on the August 28, 1967 pass, H^+ was clearly the major ion. On the other hand, the altitude of OGO 4 near the equator on the August 8, 1967 pass was low enough that O^+ densities comparable to those of H^+ were detected in this region.

When the H^+ densities obtained on the coincident OGO 3 and OGO 4 passes selected from August 28, 1967 (Figure 5) are compared as functions of the L coordinate, it is apparent that there is a deep equatorial depression observed by OGO 3 on the same field lines (i.e., at identical L coordinates and approximately the same local time) as the OGO 4 depression. This gives a vivid indication of the strong plasma coupling which exists along the field lines. A similar comparison of the equatorial H^+ measurements made on the August 8, 1967 passes (Figure 4) does not reveal such behavior. Strong coupling between the equatorial observations on this latter day is not expected since OGO 3 sampled postdawn field lines whereas OGO 4 near the equator was still on the night side of the earth.

Considering a plasmapause crossing by OGO 3 as an abrupt disappearance (i.e., below the ion spectrometer threshold) or reappearance of H^+ ions, and assuming that the L value of the plasmapause associated with the light ion trough detected by the OGO 4 ion spectrometer is that of the minimum of total density, the plasmapause determined by the OGO 4 data is located at a smaller value of the L coordinate than the location of the plasmapause traversed on the corresponding OGO 3 pass (Figure 4 and 5). Viewed as a function of local time (Figure 6) this behavior is consistent with a movement of the plasmapause to smaller L values during the night as observed in previous experiments (see Figure 1).

It is likely that three plasmapause crossings were made by OGO 3 on the August 8, 1967 pass. This is an indication that the satellite skirted the plasmasphere boundary on the segment of the trajectory in which the crossings occurred. Comparing the OGO 3 path qualitatively with the geometry of the plasmasphere boundary (Figure 1) further strengthens this conclusion.

Given these general observations, the physics of the plasma coupling along magnetic field lines can now be explored in more detail. However, before an investigation of the diffusion processes along the field lines using the OGO measurements is initiated, the effects of local time differences between the data to be compared will be explored.

Local Time Effects

The OGO 4 measurements on each of the two passes under consideration can be considered as obtained at essentially a fixed local time since the local time interval covered on each pass was less than one hour in extent. However, the corresponding OGO 3 observations were made over local time spans of more than 6 hours. Hence it is interesting to speculate as to what type of model is needed to transform H^+ densities obtained along the trajectory of OGO 3 into densities at the local times of the OGO 4 measurements.

Assuming that the ambient protonospheric plasma pressure is only a function of density at OGO 3 altitudes and that the electric field component parallel to the magnetic field is conservative or zero the plasma motion is field line preserving (Stern, 1966). Hence if the streamline pattern in the equatorial plane is asymmetric (i.e., the geocentric distance to a streamline in the equatorial plane is a function of local time) it may not be valid to assume a strong coupling between the plasma properties measured at two points located at the same L position but at different local times. There is indeed such asymmetry in the equatorial plane as can be seen in Figure 7 which shows the general features of the convective flow pattern assuming field line merging.

Under the above assumptions, given the magnetic field configuration and the convection streamlines in the equatorial plane, the variation of the L coordinate and local time along a streamline located off the equatorial plane is easily determined. If the magnetic field is dipolar (a good assumption within the plasmasphere) and if the component of the macroscopic plasma velocity along the field direction is zero, the plasma motion in the direction perpendicular to the azimuthal (i.e., local time) direction is along an equipotential line of the dipole field. Using the equation for an equipotential line ($R^2 = \text{constant} \cdot \sin\theta$ where R is the geocentric distance in earth radii and θ is the latitude) and the definition of the dipole L coordinate ($L = R\cos^2\theta$) the variation of geocentric distance along a streamline can be determined. The H^+ density variation along a streamline is then determined by considering the change in volume occupied by a fixed number of H^+ ions which are "frozen-to" the magnetic field lines. Using this transformation technique the OGO 3 measured densities can be mapped into densities at the local times of the OGO 4 measurements.

Since multiple crossings of the plasmapause were made by OGO 3 on August 8, 1967 that portion of the satellite trajectory in the region of the crossings (see

Figure 4 and Figure 6) corresponds approximately to the plasmapause. If it is assumed that the five densities checked in Figure 4 were obtained at the plasmasphere boundary then, since the equatorial knee is identified by a streamline, these densities will be transformed to 0547 LT (a typical value for the OGO 4 measurements) into densities at different altitudes on the same field line. This corresponds to a sharp knee – the knee thickness cannot be determined from this data. The densities measured by OGO 3 at L values less than L = 3 will transform essentially unchanged to 0547 LT since these samples were taken near this local time and in a spatial region where the equatorial streamlines are circles (i.e. corotation dominates the plasma flow). This mapping is not meant to be rigorous but is performed in order to demonstrate the difference between the variation of density with L along the satellite trajectory and that at a fixed local time.

The August 28, 1967 OGO 3 pass must be treated differently than the August 8, 1967 pass since no more than one plasma crossing occurs on the former. Hence in order to transform the OGO 3 densities measured at varying local times on August 28, 1967 into densities at 0419 LT (a characteristic time for the OGO 4 measurements from the day) the streamline pattern in the equatorial plane must be completely specified in the plasmasphere.

The model to be used for determining the equatorial streamlines on August 28, 1967 is of the type constructed by Kavanagh et al (1968) in which a uniform electric field directed from dawn to dusk is superimposed on the radial corotation electric field. The velocity and hence the convection streamlines of the ambient plasma in the equatorial plane are then determined from

$$\vec{v} = \frac{\vec{E} \times \vec{B}}{B^2}$$

where B is the magnitude of the dipole magnetic field and $\vec{E}$ is the total electric field. The magnitude of the uniform dawn-dusk field is chosen as 0.04 mv/m in order that one of the equatorial streamlines passes through the two plasmapause locations determined by the OGO 4 and OGO 3 measurements (see Figure 6). This streamline in the present situation does not correspond to the stagnation streamline due to asymmetries in the actual medium that are not included in the model.

Using the transformation method discussed earlier the OGO 3 densities measured in a wide interval of local time can be mapped into densities at a local time characteristic of the OGO 4 measurements. Such a mapping (Figure 5) shows that the H^+ density decrease with increasing L obtained by this transformation is steeper than the decrease observed along the satellite trajectory and compares more favorably with the H^+ variation in the light ion trough as observed on the coincident OGO 4 pass.

Having seen what type of variations may occur due to local time differences between the measurements, it remains to explore the physics of the plasma coupling along the field lines using the OGO 3 and OGO 4 ion spectrometer measurements made on these coincident passes.

Diffusion Coupling

In this section a comparison of the ion densities observed on the coincident OGO 3 and OGO 4 passes is made to determine whether or not the assumption of diffusive equilibrium along the field lines is a good approximation. For simplicity local time variations are ignored in this analysis. The local time dependency discussed previously will affect the fine structured details of the latitudinal distribution of quantities computed from the coincident observations but will not alter the general conclusions to be arrived at below.

Ignoring local time variations the diffusion equations as developed by Angerami and Thomas (1964) are used to compute the number densities of H^+ at the locations of the OGO 3 sampling points from the OGO 4 ion densities measured on the same field lines (i.e., at the same L coordinates as the OGO 3 samples). The resultant density profiles are plotted in Figure 8 and Figure 9. These diffusive equilibrium calculations were made for two values of the ion temperature (assumed equal to the electron temperature) at the 1000 kilometer base level altitude: 1000°K and 2000°K. The former base level temperature is a characteristic value near the equator and the latter is characteristic of the trough region (Brace et al., 1968). When the H^+ densities computed assuming isothermal diffusive equilibrium differed significantly from the OGO 3 measured densities, calculations were made assuming the existence of a constant upward directed temperature gradient along the field lines.

A direct comparison of OGO 3 and OGO 4 ion densities measured at L coordinates less than L = 2 on the August 8, 1967 passes assuming diffusive equilibrium is not valid since OGO 3 is on the day side of the earth at these L coordinates whereas OGO 4 is on the night side. However, on the segments of the August 28, 1967 trajectories characterized by L coordinates less than L = 2, the OGO 3 and OGO 4 ion spectrometers sampled the ambient plasma on the same group of field lines (see Figure 6). For diffusive equilibirum to exist along the field lines in this region, temperature gradients are required along the field lines to obtain densities at the OGO 3 altitudes which are in agreement with the measured densities. The dashed curves on the left of Figure 9 indicate that the temperature increase along these field lines must produce the same effect as a constant upward directed temperature gradient of the order of 2°K/km.

The model computations in Figure 8 and Figure 9 show that isothermal diffusive equilibrium at a temperature of 1000°K is a good approximation along the field lines sampled between L = 2 and L = 4 on both days. However since the ion (electron) temperature at an altitude of 1000 kilometers increases with increasing values of the L coordinate from approximately 1000°K near the equator to 2000°K or greater in the trough (Brace et al., 1968), temperature gradients are required along the field lines in the outer plasmasphere to obtain H^+ densities comparable to the OGO 3 measured densities. For a model in which the temperature gradient does not vary along the field line, gradients of the order of 1°K/km or greater are required for a diffusive equilibrium state to exist in the outer plasmasphere.

Finally it is seen from these computations (Figure 8 and Figure 9) that along field lines beyond the plasmapause (i.e., along field lines on which the ambient H^+ densities at OGO 3 altitudes were less than the ion spectrometer threshold of 1 ion/cm^3) the assumption of diffusive equilibrium requires the existence of temperature gradients along the field lines of magnitude greater than 10°K/km to couple the OGO 3 and OGO 4 measurements. Such large temperature gradients would imply the existence of temperatures at the OGO 3 altitudes which are more than an order to magnitude greater than the electron temperatures observed by the IMP 2 satellite near the equator (Serbu and Maier, 1966). Hence diffusive equilibrium is not a valid assumption beyond the plasmapause. This is in agreement with the results of a study by Mayr et al. (1968) which shows that particle fluxes exist along the field lines outside of the plasmasphere and that these fluxes dominate the physics of the plasma coupling along the field lines. Further studies are required to determine whether such fluxes are responsible for the effects attributed solely to temperature gradients in this paper.

CONCLUSIONS

A direct comparison of ion densities measured nearly coincidently on the night side of the earth by the OGO 3 and OGO 4 ion spectrometers on passes selected from August 8, 1967 and August 28, 1967 has shown that isothermal diffusive equilibrium at an ion temperature of 1000°K was a good approximation throughout most of the midlatitude regions sampled. On plasmasphere field lines near the plasmapause, a state of diffusive equilibrium exists only if temperature gradients directed upwards along the field lines exist. For a model in which the temperature gradient does not vary along the field lines, gradients of the order of 1°K/km or greater are required to couple the measurements. Similar temperature gradients are also required on the low latitude field lines traversed on the August 28, 1967 passes. Although the ion densities measured within the plasmasphere could be coupled by assuming a state of diffusive equilibrium exists along the field lines, the measurements made outside of the plasmasphere cannot be accounted for by assuming diffusive equilibrium since the temperature gradients required would be inordinately large.

Local time effects were not considered in the diffusion studies. However, if field line preservation is valid in the outer plasmasphere, the H^+ densities measured along the OGO 3 trajectories can be transformed into densities at the local times of the OGO 4 measurements if the convection streamline pattern is known in the equatorial plane. Such a transformation would map the position of the plasmapause as determined by OGO 3 onto the same field line as the plasmapause determined from the OGO 4 measurements. Accurate transformation models of this type are required if a precise determination of plasmasphere parameters is to be made from coincident measurements near the plasmasphere boundary at different local times.

BIBLIOGRAPHY

Angerami, J. J., and D. L. Carpenter, Whistler studies of the plasmapause in the magnetosphere, 2. Electron density and total tube content near the knee in magnetospheric ionization, J. Geophys. Res. 71, 711, 1966.

Angerami, J. J. and J. O. Thomas, Studies of planetary atmospheres, J. Geophys. Res., 69, 4537-4560, 1964.

Binsack, J. H., Plasmapause observations with the M.I.T. experiment on IMP-2, J. Geophys. Res., 72, 5231-5237, 1967.

Brace, L. H., B. M. Reddy, and H. G. Mayr, Global behavior of the ionosphere at 1,000 kilometers altitude, J. Geophys. Res., 72, 265-283, 1967.

Brace, L. H., H. G. Mayr, and B. M. Reddy, The early effects of increasing solar activity upon the temperature and density of the 1,000 kilometer ionosphere, J. Geophys. Res., 73, 1607-1615, 1968.

Brice, N. M., Bulk motion of the magnetosphere, J. Geophys. Res., 72, 5193-5211, 1967.

Brinton, H. C., R. A. Pickett, and H. A. Taylor, Jr., Thermal ion structure of the plasmasphere, Planet. Space Sci., 16, 899-909, 1968.

Carpenter, D. L., Whistler evidence of a "knee" in the magnetospheric ionization density profile, J. Geophys. Res., 71, 1675, 1963.

Carpenter, D. L., Whistler studies of the plasmapause in the magnetosphere, J. Geophys. Res., 71, 693-709, 1966.

Gringauz, K. I., The structure of the ionized gas envelope of earth from direct measurements in the U.S.S.R. of local charged particle concentrations, Planet. Space Sci., 11, 281-296, 1963.

Kavanagh, L. D., Jr., J. W. Freeman, Jr., and A. J. Chen, Plasma flow in the magnetosphere, J. Geophys. Res., 73, 5511-5519, 1968.

Mayr, H. G., J. M. Grebowsky and H. A. Taylor, Jr., High latitude ion composition measurements and the plasmapause, presented at spring 1969 A.G.U. meeting.

Nishida, A., Formation of the plasmapause or magnetospheric plasma knee, by the combined action of magnetospheric convection and plasma escape from the tail, J. Geophys. Res., 71, 5667-5679, 1966.

Rycroft, M. J. and J. O. Thomas, The magnetospheric plasmapause and the electron density trough at the Alouette I orbit, preprint, Imperial College, University of London, 1968.

Serbu, G. P. and E. J. R. Maier, Low-energy electrons measured on IMP 2, J. Geophys. Res., 71, 3755-3766, 1966.

Sharp, G. W., Midlatitude trough in the night ionosphere, J. Geophys. Res. 71, 1345-1356, 1966.

Stern, D. P., The motion of magnetic field lines, Space Sci. Rev., 6, 147-173, 1966.

Taylor, H. A., Jr., H. C. Brinton, and C. R. Smith, Positive ion composition in the magnetoionosphere obtained from the OGO A satellite, J. Geophys. Res., 70, 5769-5781, 1965.

Taylor, H. A., Jr., H. C. Brinton, and M. W. Pharo, III, Contraction of the plasmasphere during geomagnetically disturbed periods, J. Geophys. Res., 73, 961-968, 1968.

Taylor, H. A., Jr., H. C. Brinton, M. W. Pharo, III, and N. K. Rahman, Thermal ions in the exosphere; Evidence of solar and geomagnetic control, J. Geophys. Res., 73, 5521-5533, 1968.

Table 1. Orbital Parameters of the Coincident OGO 3 and OGO 4 passes. The Data Under Investigation was Obtained in the Southern Hemisphere.

	AUGUST 8, 1967 $K_P=4^-$		AUGUST 28, 1967 $K_P=2^-$	
	OGO III	OGO IV	OGO III	OGO IV
GMT	2244–0201	0010–0028	0330–0727	0625–0647
LT	2044–0733	0531–0559	1906–0549	0336–0818
L	8.05–1.4	1.0–10	9.1–1.5	1.0–10
ALTITUDE(km)	13,307–2,909	423–866	17,302–2,819	916–719

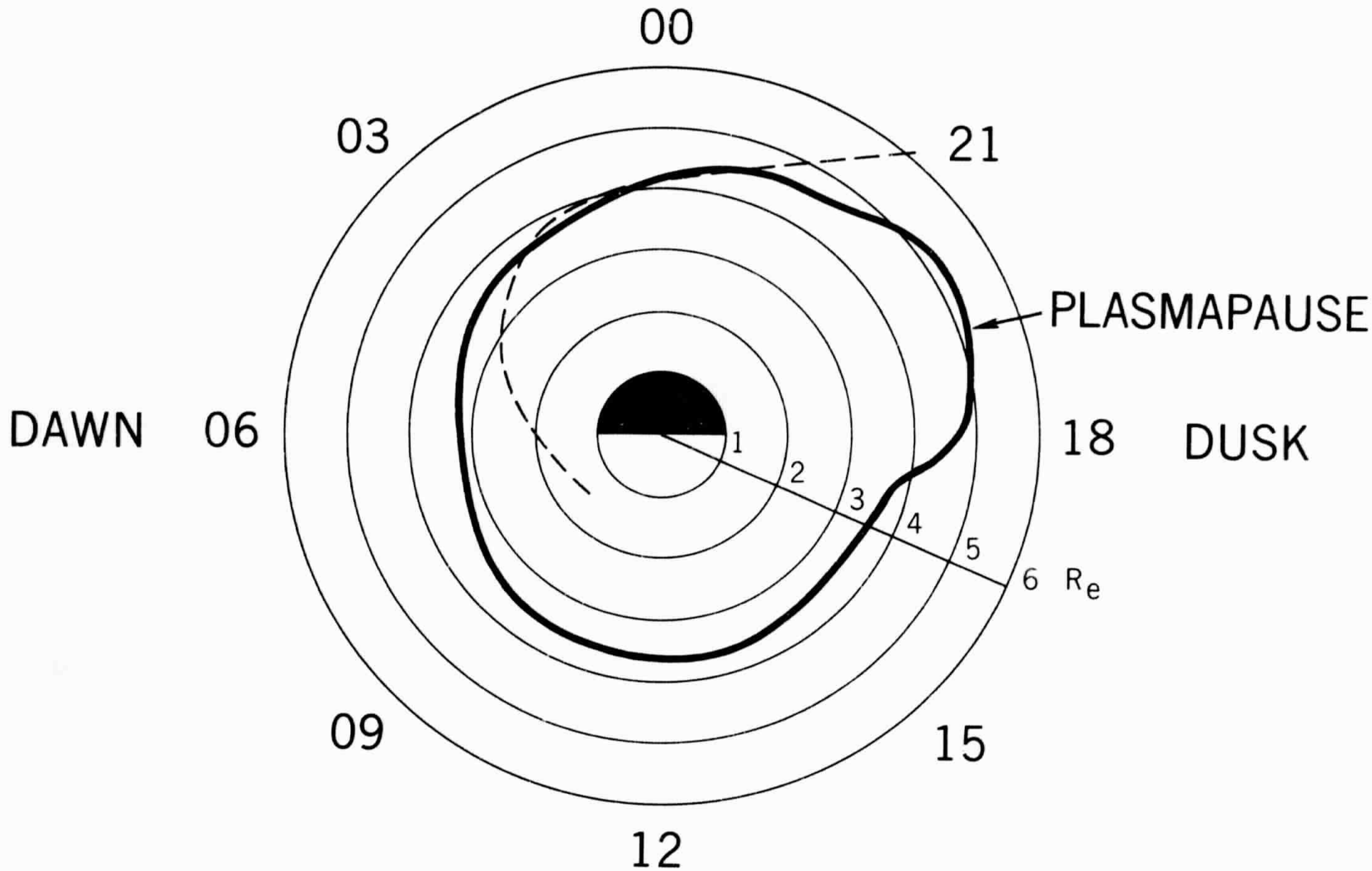

Figure 1—Average equatorial radius of the plasmapause as a function of local time for moderate geomagnetic activity (after Carpenter, 1966). The dashed curve depicts a satellite path which would cross the plasmapause three times.

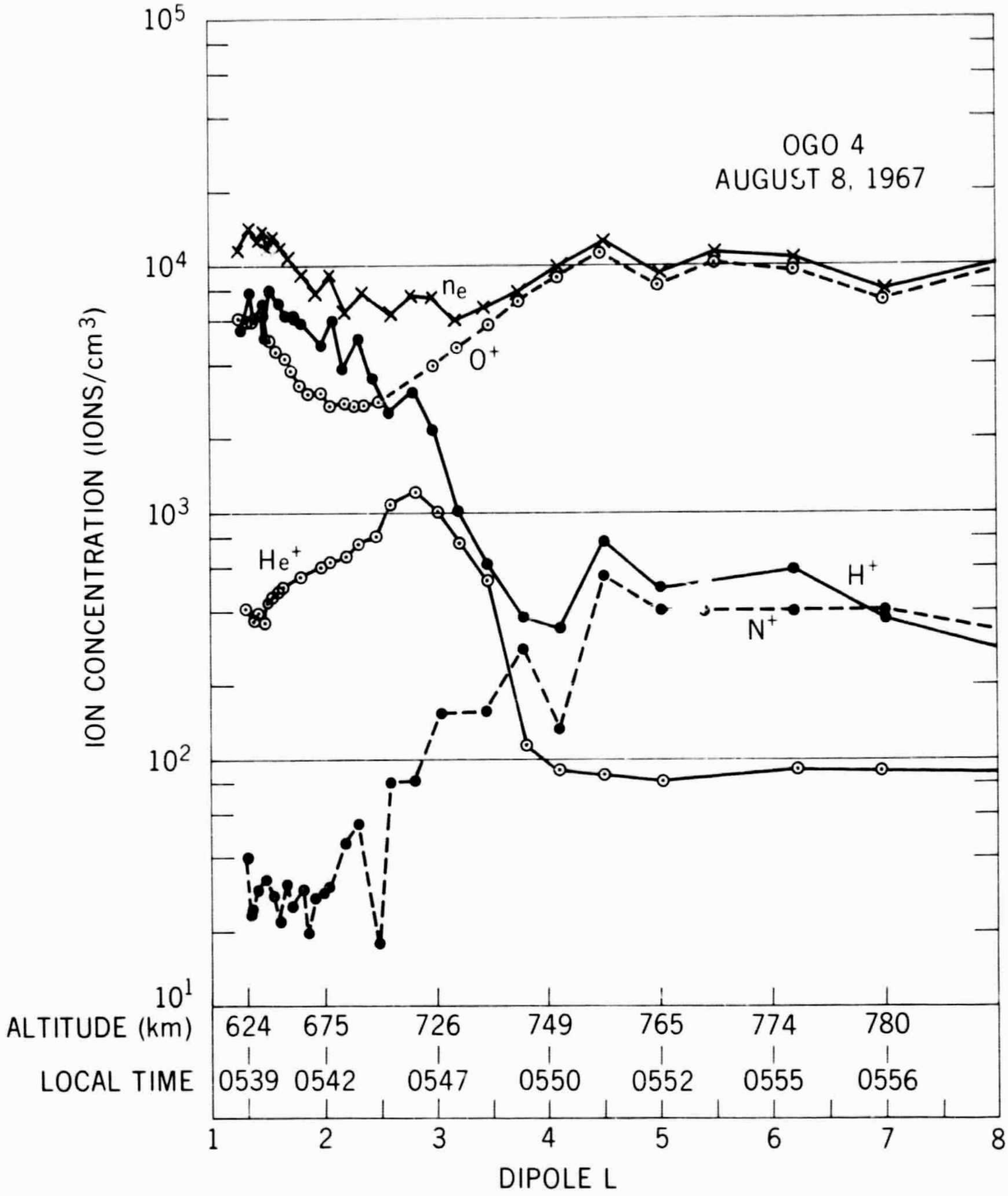

Figure 2–OGO 4 ion composition measurements – August 8, 1967.
The n_e curve refers to the total ion density.

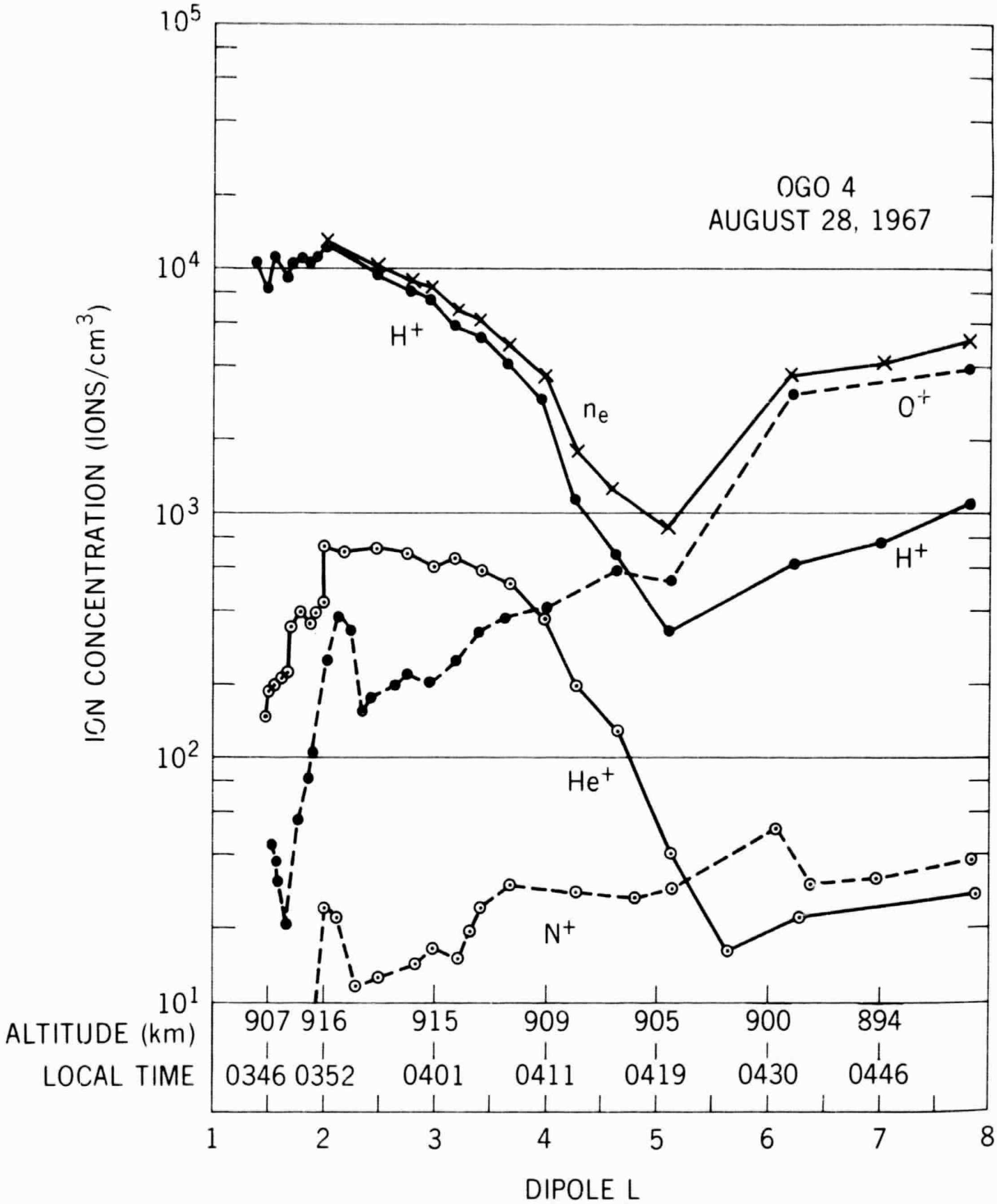

Figure 3–OGO 4 ion composition measurements – August 28, 1967.
The n_e curve refers to the total ion density.

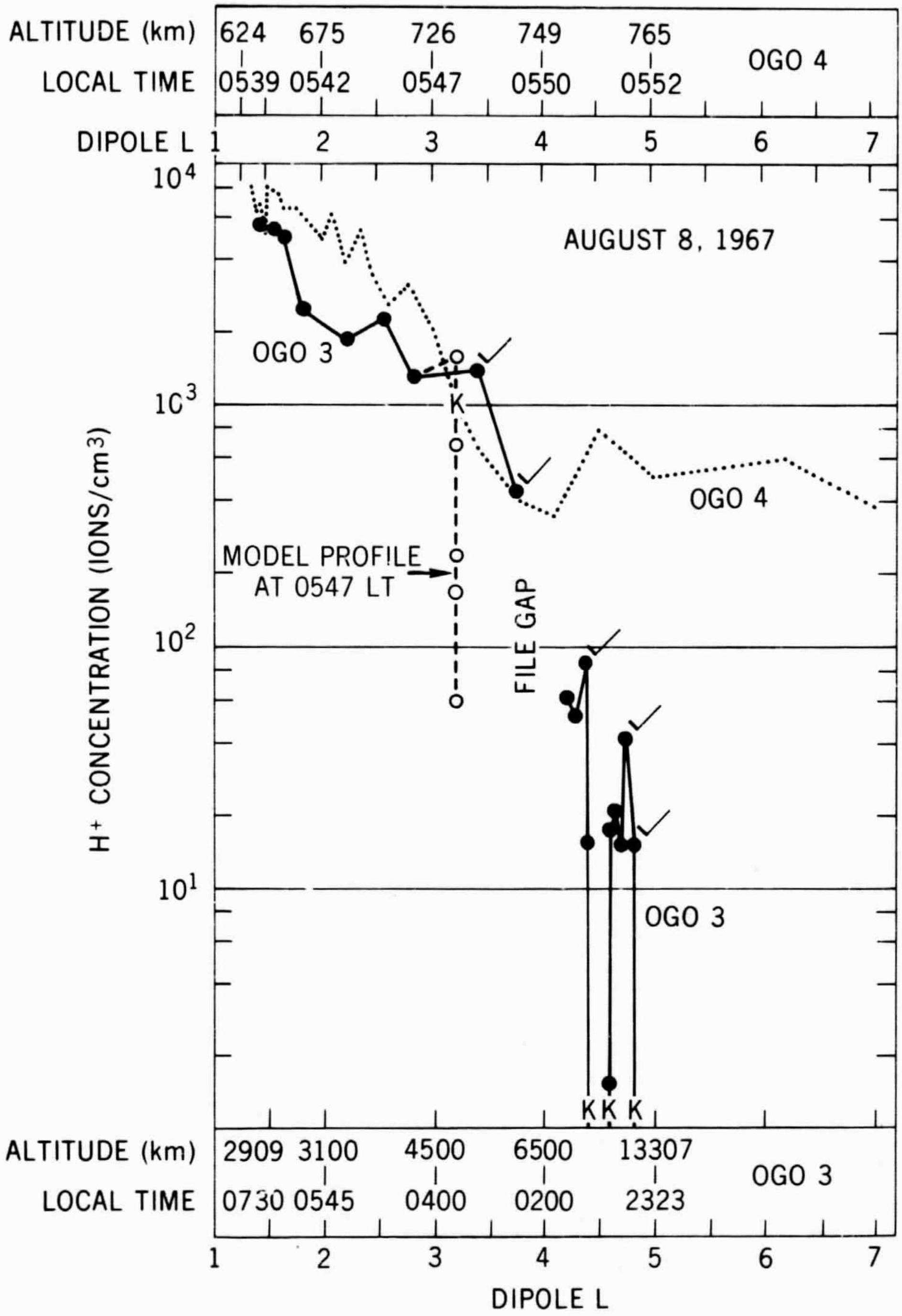

Figure 4–A comparison of the H^+ densities and the plasmapause locations (indicated by k's) observed on the coincident OGO 3 and OGO 4 passes of August 8, 1967. The OGO 3 samples checked are also shown transformed into densities (indicated by the open circles) at 0547 LT assuming they were characteristic plasmapause values and that field line preservation was valid.

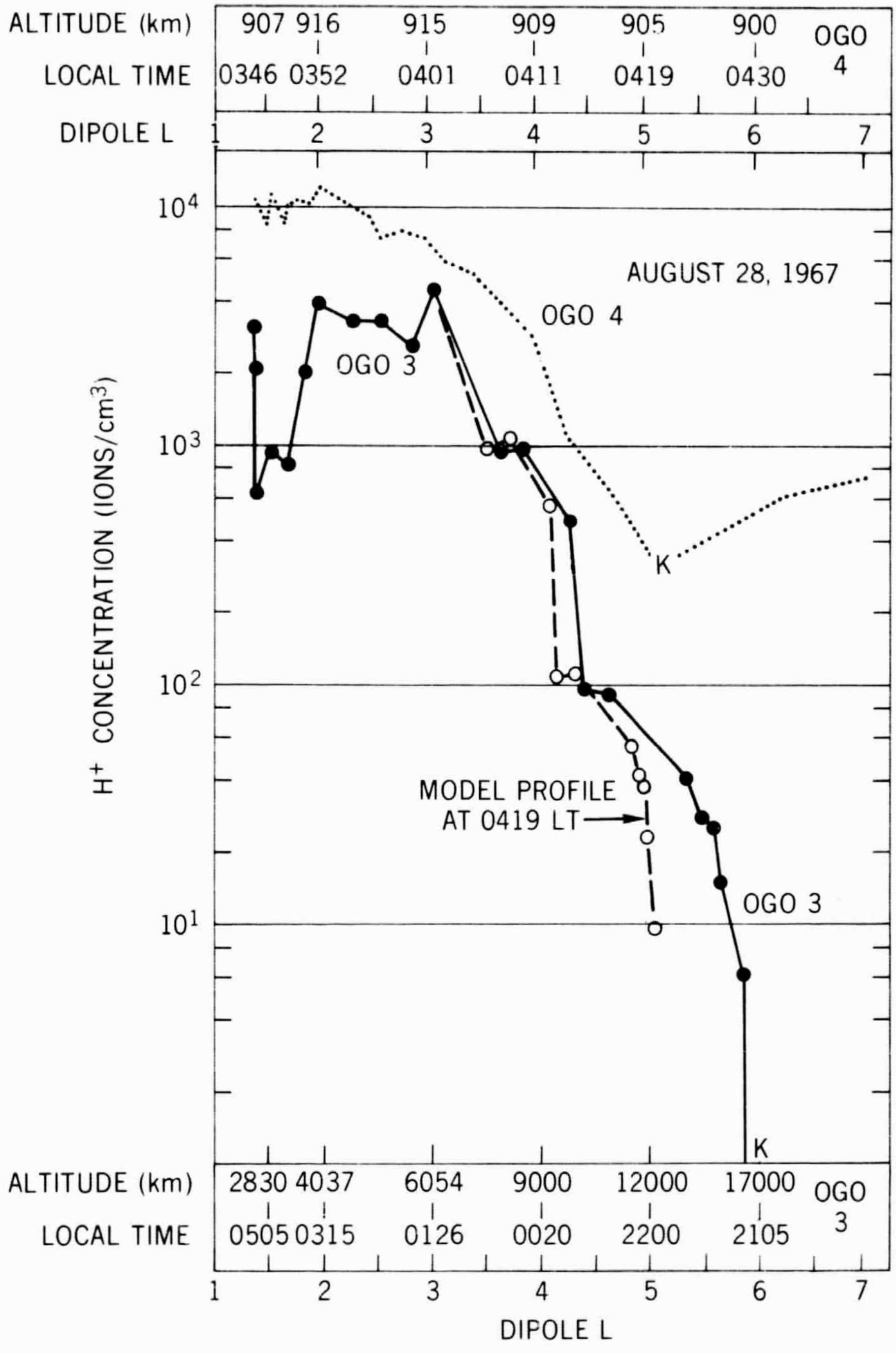

Figure 5–A comparison of H^+ densities and the assumed plasmapause locations (indicated by k's) observed on the coincident passes of August 28, 1967. The OGO 3 density samples are also shown transformed into densities (the open circles) at 0419 LT assuming field line preservation and a model convection streamline pattern in the equatorial plane.

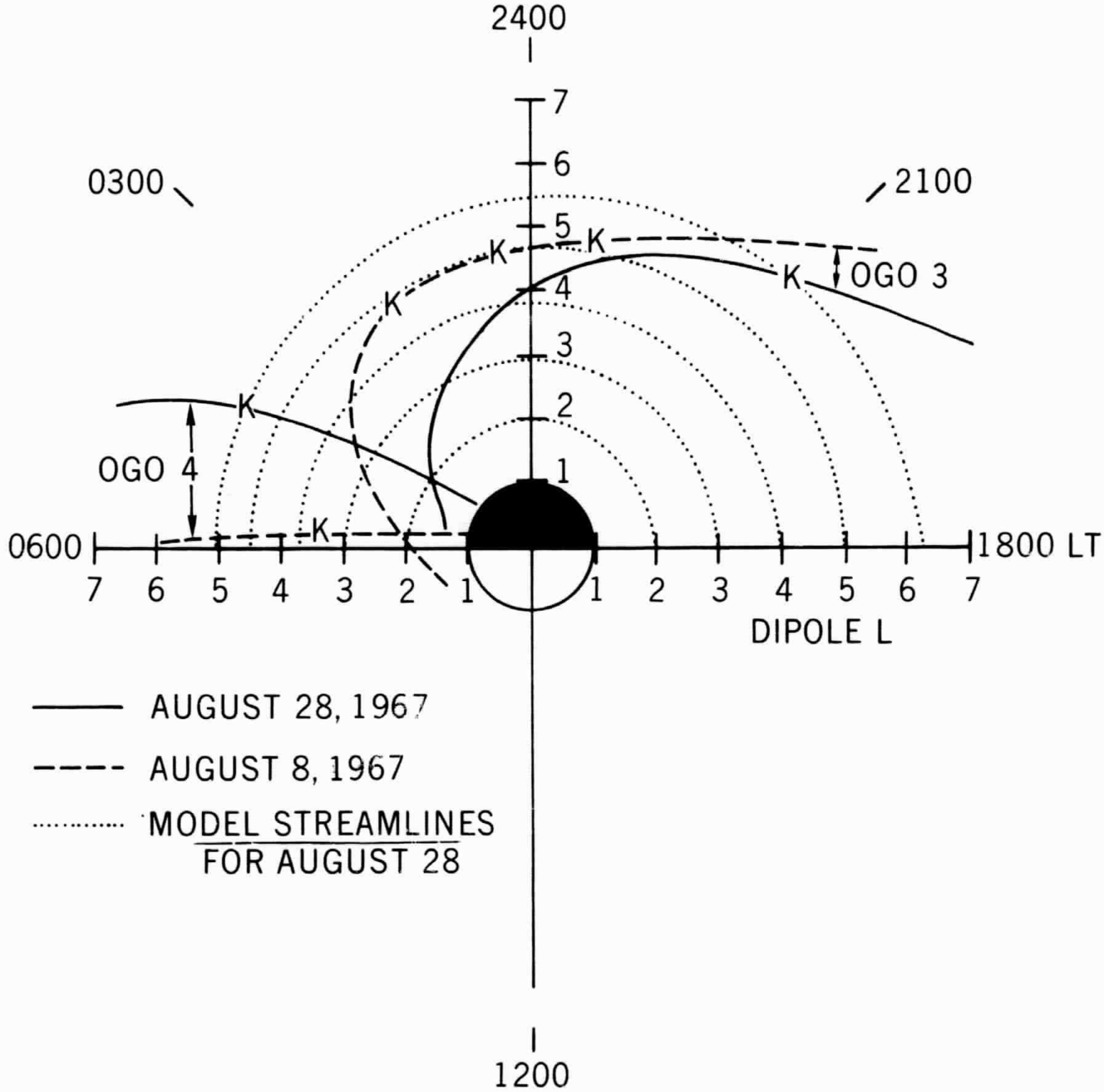

Figure 6–Satellite trajectories in L-local time space with probable plasmapause locations indicated by the letter K. The dotted lines are the convection streamlines for a constant external electric field of magnitude 0.04 mv/m directed from dawn to dusk in the equatorial plane superimposed on the corotation electric field.

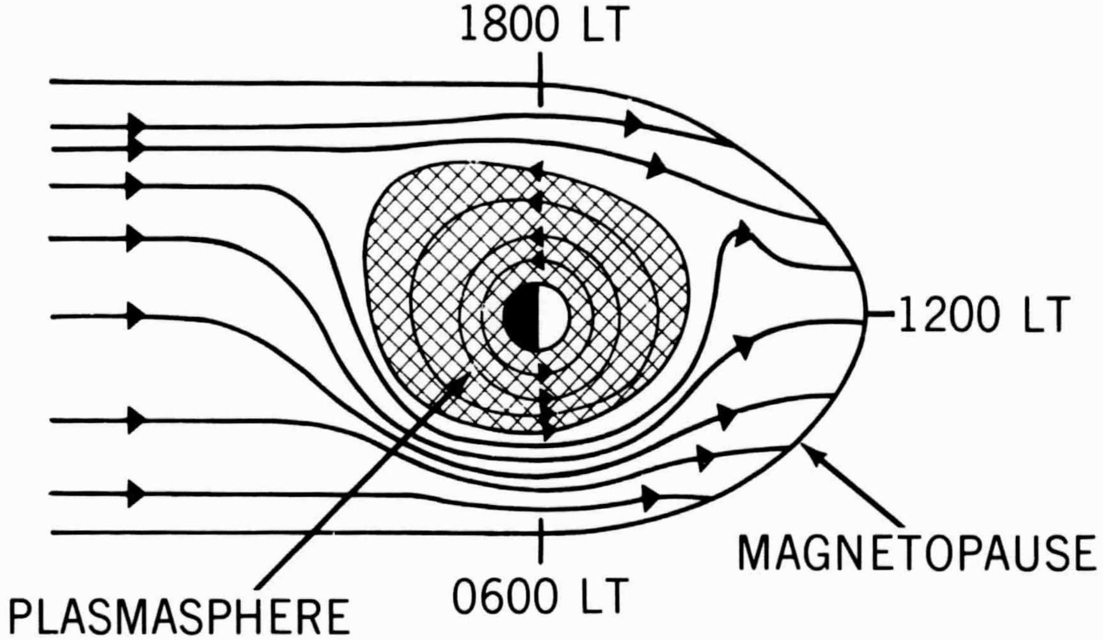

Figure 7—Equatorial convection streamline pattern assuming field line merging in the magnetosphere (e.g., Brice, 1967). The last closed streamline delineates the plasmasphere boundary.

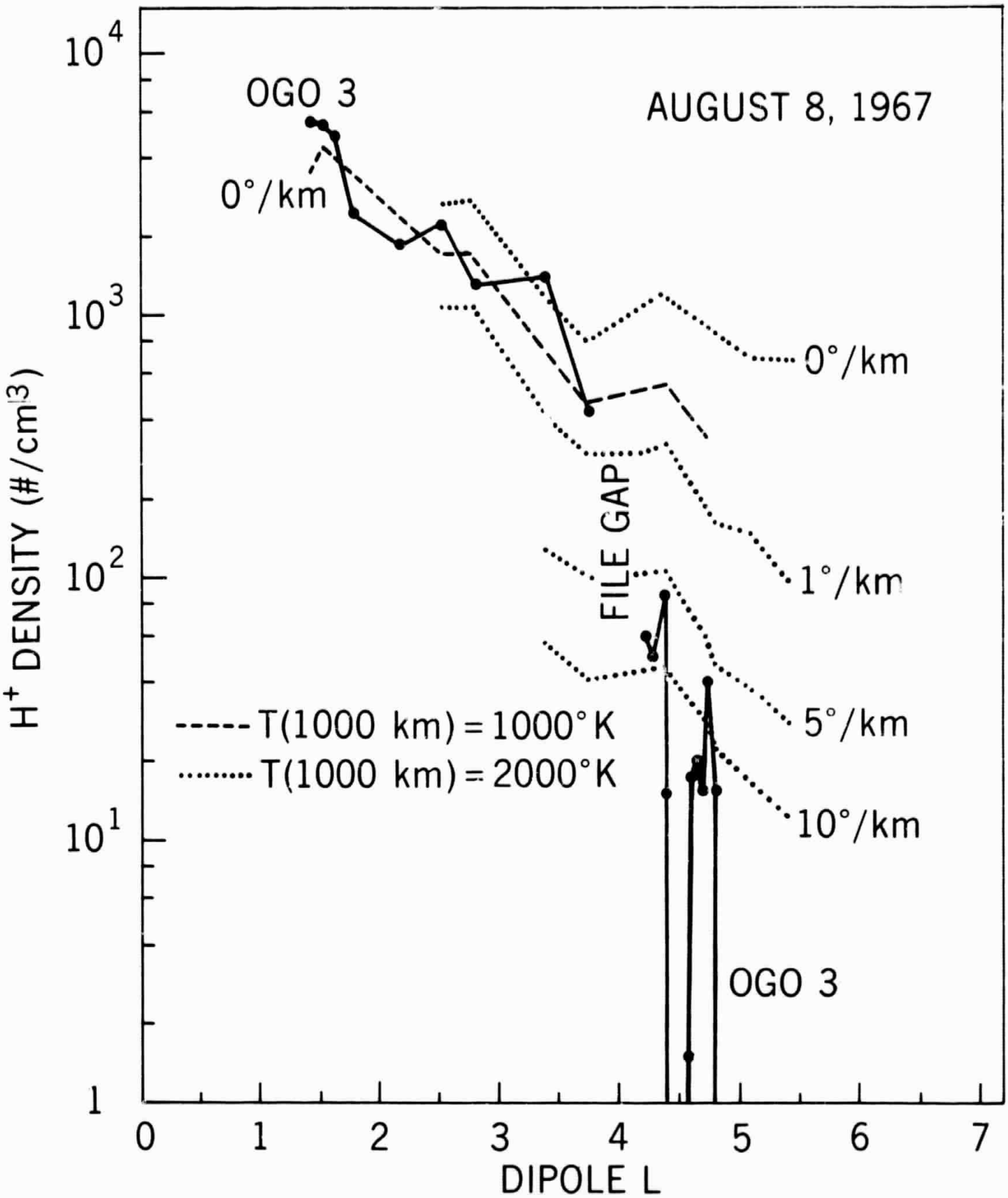

Figure 8—August 8, 1967 H^+ density profile along the OGO 3 trajectory. Compared with this are H^+ densities computed at the OGO 3 sampling points from the OGO 4 measurements at the same L value assuming diffusive equilibrium. These computations were done for a spectrum of constant temperature gradients along the field lines. The base temperature of 1000° K is a value characteristic of the low latitude (i.e., small L values) region whereas 2000° K is a more representative value for the higher L values near the plasmapause.

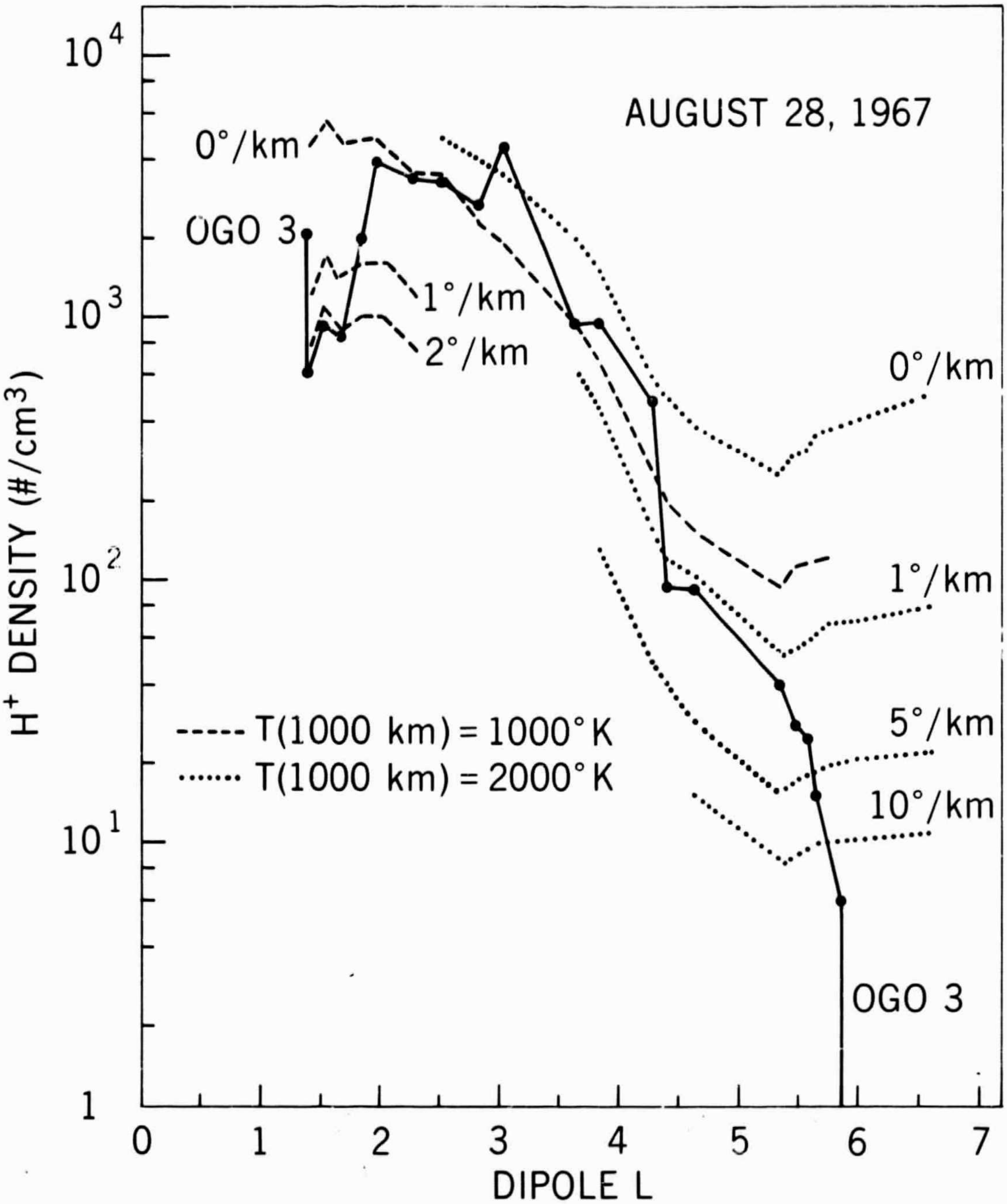

Figure 9—August 28, 1967 H^+ density profile along the OGO 3 trajectory. Compared with this are H^+ densities computed at the OGO 3 sampling points from the OGO 4 measurements at the same L value assuming diffusive equilibrium. These computations were done for a spectrum of constant temperature gradients along the field lines. The base temperature of 1000° K is a value characteristic of the low latitude (i.e. small L values) region whereas 2000° K is a more representative value for the higher L values near the plasmapause.