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Intermediate transition in the Venus ionosheath

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Abstract. We present the results of an analysis of Pioneer Venus Orbiter (PVO) plasma and electric and magnetic field data with evidence of a plasma transition along the flanks of the Venus ionosheath for 8 PVO passes near the terminator. This transition occurs between the bow shock and the ionopause and represents a stationary change in the properties of the shocked solar wind that streams around the Venus ionosphere. We find that the intermediate transition is characterized by three concurrent features: (1) A noticeable electric field burst measured with the 30 kHz channel of the electric field detector of the PVO; (2) a severe drop of the magnetic field intensity accompanied by a strong rotation of the magnetic field orientation to a direction closer to the Sun–Venus axis in the inner ionosheath; and (3) substantially enhanced plasma fluxes detected at the time when these changes in the electric and magnetic fields are measured. The peak particle flux and the peak magnetic field intensity measured at this transition in the data of the 17 PVO orbits are also presented. It is found that large values of the enhanced particle fluxes occur mostly when the peak magnetic field intensity is large.

Introduction

Concepts regarding the structure of the shocked solar wind flow around Venus have been extensively analyzed from the available experimental data. Over the last few years much has been done to examine the presence of a plasma boundary located between the bow shock and the ionopause. This feature was first identified in the Mariner 5 plasma measurement reported by *Bridge et al.* [1967] and *Sheffer et al.* [1979] and has been reported in studies based in other observations [*Vaisberg et al.* 1976; *Romanov et al.* 1979; *Perez-de-Tejada et al.* 1984, 1991, 1993]. In the Mariner 5 measurements it was pointed out that the density and flow speed of the shocked solar wind begin a strong decrease as the spacecraft approached the Venus wake. These variations are initiated across a sudden transition that extends downstream along the flanks of the ionosheath and that separates two different flow regimes between the inner and outer ionosheath. Those early observations showed that at this transition the speed and the density of the flow in the inner ionosheath begin a steady decrease together with a substantial drop of the magnetic field intensity and an apparent increase in the temperature of the local plasma.

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Measurements conducted with the Venera 9 and 10 spacecraft show plasma variations in the Venus ionosheath which are consistent with those reported from the Mariner 5 experiment [*Vaisberg et al.* 1976; *Romanov et al.* 1979]. In this case there is also evidence of a significant decrease of the flow speed and a strong increase in the plasma temperature beginning at a transition that is encountered between the bow shock and the ionopause. Changes in the local density or in the magnetic field intensity across that transition were not included in those Venera reports.

Information which further supports the presence of a plasma transition in the Venus ionosheath was obtained from the early analysis of the Pioneer Venus Orbiter (PVO) measurements. This was first inferred from measurements conducted with the electric field detector onboard that spacecraft [*Perez-de-Tejada et al.* 1984]. Measurements carried out in a set of selected orbits suggested that electric field signals detected in the 30-kHz channel of the electric field instrument may reflect sudden changes in the plasma properties of the Venus inner ionosheath flow. This view was obtained from measurements made with the PVO plasma analyzer in that region of space [*Intriligator*, 1982]. From observations conducted with both instruments it was argued that across a plasma transition located in the Venus inner ionosheath the shocked solar wind is significantly weaker than that in the outer ionosheath.

More recent studies [*Perez-de-Tejada et al.* 1991] have shown that these changes represent a characteristic feature of the flow conditions in the shocked solar wind. As in the Mariner 5 measurements there are indications in the PVO data that the variations in the flow properties seen in the inner ionosheath are also accompanied by a significant local decrease of the magnetic field intensity [*Perez-de-Tejada et al.* 1993]. In this case we find that the magnetic field between the intermediate transition and the ionopause is oriented along directions near the Sun-Venus axis (the magnetic field acquires a strong draping configuration at the intermediate transition in a configuration similar to that reported by *Fedorov et al.* [1991] from studies of the magnetic field data in the Venus far wake). Despite the different character of the measurements made in the Mariner 5, the Venera 9 and 10 and the PVO experiments it is significant that in all of them the plasma parameters at the intermediate transition exhibit comparable and equivalent changes.

The work conducted on plasma wave activity and electric field structure in the Venus plasma environment was recently reviewed by *Strangeway* [1991]. A summary of observations of the electric and magnetic fields across the intermediate transition and across ionospheric plasma clouds was also presented in that study. Although in some instances the change in both fields at the intermediate transition is similar to that seen across plasma clouds the intermediate transition is usually located farther away from Venus than plasma clouds. While this issue will be discussed in a separate study we wish to note that the drop of the magnetic field intensity across the intermediate transition is different from that observed around plasma clouds. In the latter case the magnetic field intensity is low only in the vicinity of plasma clouds. By contrast when an intermediate transition is located the magnetic field remains low throughout most of the region between that boundary and the ionopause.

In addition to the electric and magnetic field variations seen across the intermediate transition there is new evidence suggesting that simultaneous changes in the plasma flux intensity also occur across that feature. Below we will examine this issue for the first time and show that the electric and magnetic fields variations indicated above are consistently accompanied by a distinct enhancement in the plasma flux. Our results show that the intermediate transition has now been identified from the simultaneous observation of persistent changes in the plasma properties measured in various PVO orbits. The discussion is initiated with the preliminary analysis of two PVO passes (corresponding to orbits 39 and 51) in which strong changes in the plasma flux and in the electric and magnetic fields are detected as a distinguishable intermediate transition. These cases are further substantiated by the presentation of the same plasma data in a comparative figure that better exhibits their time association with the observed electric and magnetic field variations. A similar analysis has also been made for other PVO orbits including a set of six additional passes (corresponding to orbits 52, 70, 72, 87, 120 and 530) which are also described in the text for a better discussion of the intermediate transition measurements.

Electric and Magnetic Field PVO Measurements

In the results reported earlier on the PVO plasma properties of the Venus inner ionosheath [*Perez de-Tejada et al.* 1991] it was noted that there is clear evidence of electric field signals detected as a brief but strong burst in the 30 kHz channel of the electric field instrument. At the present time we have collected about 80 PVO passes in which that event appears as a separate burst at positions located between the bow shock and the ionopause. In most cases the 30-kHz burst occurs on an otherwise flat 30-kHz electric field signature that extends across the entire ionosheath and is associated with noise detected in other (5.4-kHz and 100 Hz) channels of the electric field detector. From the examination of the magnetic field data associated with the PVO passes where the 30-kHz electric field signals are detected in the ionosheath it is found that in many of them there is a local response that nearly coincides in time with the electric field burst. When the 30-kHz burst is observed there is evidence that the magnetic field intensity drops severely and that its orientation rotates to a direction nearly along the Sun-Venus axis. A summary of 26 PVO passes in which these variations are observed is presented in Table 1. In each case we have indicated the time when the ionopause and the bow shock are crossed and when the decrease of the magnetic field intensity is observed at the intermediate transition (the last two columns indicate the altitude and solar zenith angle of the PVO at this latter crossing). While there are examples corresponding to both the inbound and the outbound passes, we find that the later are dominant in the data set (note that in most of the cases included the time difference between the ionopause and the intermediate transition is larger than ~3 min).

Table 1. Plasma boundaries in the Venus plasma environment (the PVO altitude and solar zenith angle are at the intermediate transition)

Orbit	Ionopause	Intermediate Transition	Bow Shock	Altitude	SZA
	UT	UT	UT	km	deg
23 outbound	1730	1737	1804	2531	107.5
35 outbound	1856	1902	1928	3686	114.9
39 outbound *	1913	1920	1940	3453	118.0
45 outbound	1944	1948	2014	4241	116.5
46 outbound *	1941	1950	2013	3833	118.9
51 outbound *	2003	2008	2029	3989	118.9
52 outbound *	2002	2009	2033	3605	121.6
60 inbound	1954	1950	1937	2516	92.4
70 outbound *	2022	2028	2049	3763	118.0
72 inbound *	1957	1953	1939	2121	102.3
79 inbound	1947	1941	1929	2472	100.8
83 inbound *	1936	1925	< 1921	3973	88.6
85 outbound *	1942	1959	2016	3242	113.9
87 outbound *	1944	1953	2008	3405	111.2
92 inbound	1913	1903	1849	2099	108.4
94 inbound	1900	1852	1839	3062	99.8
103 outbound *	1921	1928	1946	3180	100.5
120 inbound *	2013	2011	1938	2341	104.8
470 inbound *	1020	1017	1002	1380	82.2
494 outbound *	1115	1120	1142	3988	116.1
508 outbound *	1057	1103	1123	4282	114.4
509 outbound *	1049	1058	1122	3662	118.9
530 outbound *	0948	0952	1009	3706	110.1
538 outbound *	1025	1027	1046	3632	105.8
552 inbound	1120	1115	1056	2980	104.2
562 outbound	1242	1246	1306	2186	95.3

* These are cases in which the plasma probe measurements made across the intermediate transition show enhanced particle flux intensities.

Two of the examples that best represent the observed changes in the electric and magnetic field are the outbound pass of orbits 39 and 51. The data of the latter orbit was briefly discussed in a previous study [*Perez de-Tejada et al.* 1995] and is further examined here to more extensively analyze the behavior of the plasma fluxes throughout the ionosheath. The electric field noise seen in the 5.4 and 30-kHz channels and the magnetic field components measured in orbit 39 are reproduced in Figure 1. The vertical lines at ~ 1833 and at ~1858 UT in the inbound pass and at ~1940 and ~1913 UT in the outbound pass mark the position of the bow shock and the ionopause as recorded along the PVO trajectory. The electric field burst detected outbound at ~1920 UT occurs at a time when the magnetic field components exhibit strong changes (the transverse components B_y and B_z decrease strongly to low values in the inner ionosheath and the B_x component changes sign but remains strong). As a result the magnetic field intensity B_T drops substantially at that time and remains low throughout most of the inner ionosheath. The label "intermediate transition" at the top of Figure 1 marks the changes in the electric and magnetic field seen at ~1920 UT.

The position of the ionopause and intermediate transition detected outbound in orbit 39 are also illustrated in Figure 2. The upper panel shows the electron density profile obtained from the orbit electron temperature plasma (OETP) measurements (L. Brace, personal communication, 1992). The vertical arrow at ~1920 UT represents the intermediate transition which occurs about 7 min after the ionopause. The distance between both boundaries along the PVO trajectory is approximately ~2000 km and implies that they may not be directly connected in space. The lower panel of Figure 2 shows a general view of the position of the bow shock, the ionopause and the intermediate transition in a plane in which the vertical coordinate is the distance to the Sun–Venus axis. The position of the intermediate transition between the bow shock and the ionopause is comparable to that indicated earlier from observations conducted in other orbits [*Perez–de–Tejada et al.* 1991, 1993] and is consistent with the fact that it may appear far from the ionopause.

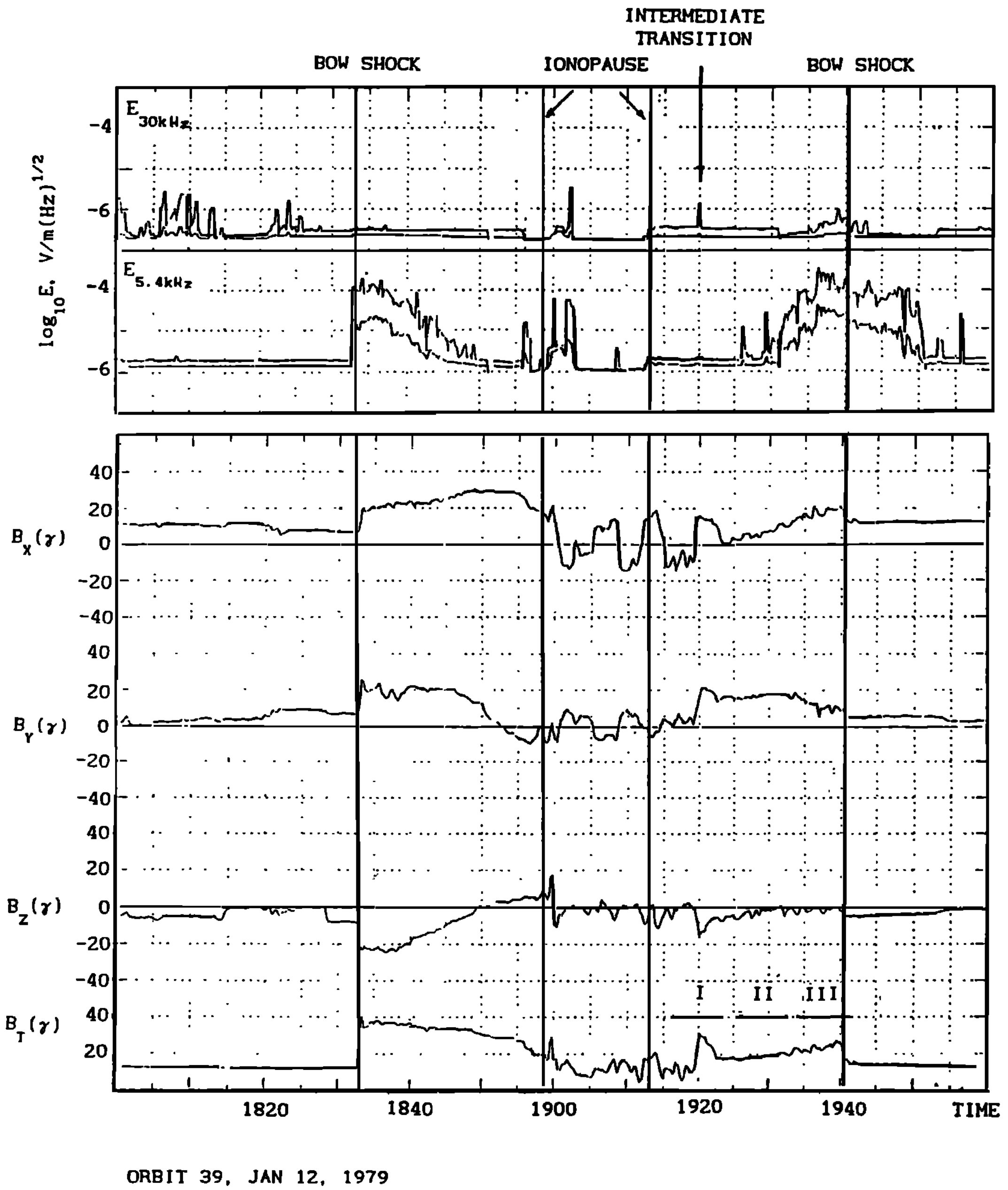

Figure 1. (upper) Electric field signals measured with the 30-kHz and 5.4-kHz channels of the electric field detector of the PVO in the inbound and outbound pass of orbit 39. (lower) Magnetic field components B_x, B_y, and B_z and magnetic field intensity B_T measured during the inbound and outbound pass of orbit 39. The inbound and outbound crossings of the bow shock and ionopause are indicated by the vertical lines (the bow shock crossings are obtained from the electric and magnetic field data and the ionopause crossings from the electron density data).

The electric and magnetic field data measured during the inbound and outbound crossings of the Venus ionosheath in orbit 51 are presented in Figure 3. The behavior of the 30 and 5.4-kHz electric field signals and the magnetic field components seen in the outbound pass of this orbit is similar to that of the outbound pass of orbit 39. We note first of all that in addition to the vertical lines at ~ 2004 and at ~2029 UT, which mark the outbound crossings of the ionopause and bow shock, there are distinct signals at ~2008 UT consistent with the presence of the intermediate transition in the outbound pass. The intense 30-kHz noise detected upstream from the bow shock in both the inbound and outbound passes (at < 1919 UT and at > 2030 UT) is far stronger than that seen in orbit 39. Also notable is the correlation between the enhancements seen at ~ 2008 UT in the 30 and 5.4-kHz electric field noise and sharp changes in the magnetic field components (we note a sharp drop in the B_y component, while the B_x component rotates and remains dominant in the vicinity

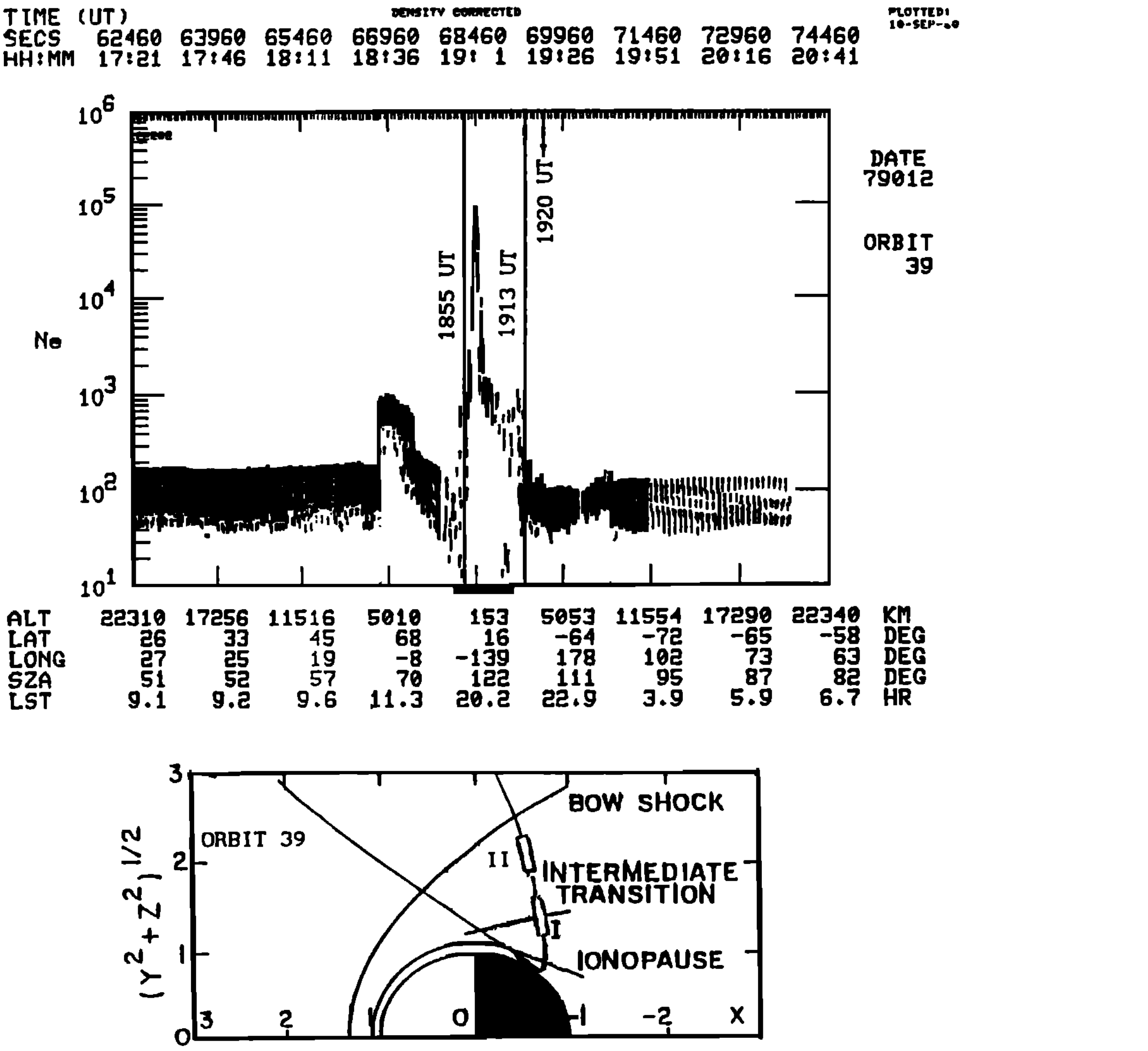

Figure 2. (upper) Electron density profile obtained from the OETP instrument of the PVO across the Venus ionosphere during orbit 39. The position of the ionopause at ~1855 UT (inbound) and at ~1913 UT (outbound) is indicated by the vertical lines (the intermediate transition detected at ~1920 UT is described by the vertical arrow). (lower) Trajectory of the PVO in orbit 39 projected on one quadrant of a plane in which the vertical coordinate is the distance to the Sun–Venus axis. The approximate position of the bow shock, the intermediate transition, and the ionopause detected along the PVO trajectory are also indicated.

of the intermediate transition). As in orbit 39, the magnetic field intensity decreases substantially at the intermediate transition and keeps low values between this boundary and the ionopause.

The time and space position of the intermediate transition and the ionopause in orbit 51 are presented in Figure 4. The upper panel shows the electron density profile and the relative position of the ionopause and the intermediate transition detected in that pass. As in the data of orbit 39, the intermediate transition occurs a few minutes after the ionopause so that the distance between both boundaries along the PVO trajectory in this orbit is also similar. The lower panel of Figure 4 describes the geometry of the bow shock, the ionopause, and the intermediate transition as detected in the outbound pass of orbit 51.

PVO Plasma Measurements

Independent of the electric and magnetic field measurements conducted during orbits 39 and 51 there is a substantial amount of PVO plasma data that is connected with the observations shown in Figures 1–4. A composite of three ion energy spectra recorded in each pass is presented in Figures 5 and 6. The starting time of the measured spectra is indicated in each curve and their time extent is described by horizontal lines above the magnetic field intensity profile shown in Figures 1 and 3. In each spectrum of Figures 5 and 6 there are ~12 s (1 spacecraft revolution) between measurements made at successive energy per unit charge (E/q) steps. The first spectrum in both orbits applies to the inner ionosheath and the second and third spectra to the outer

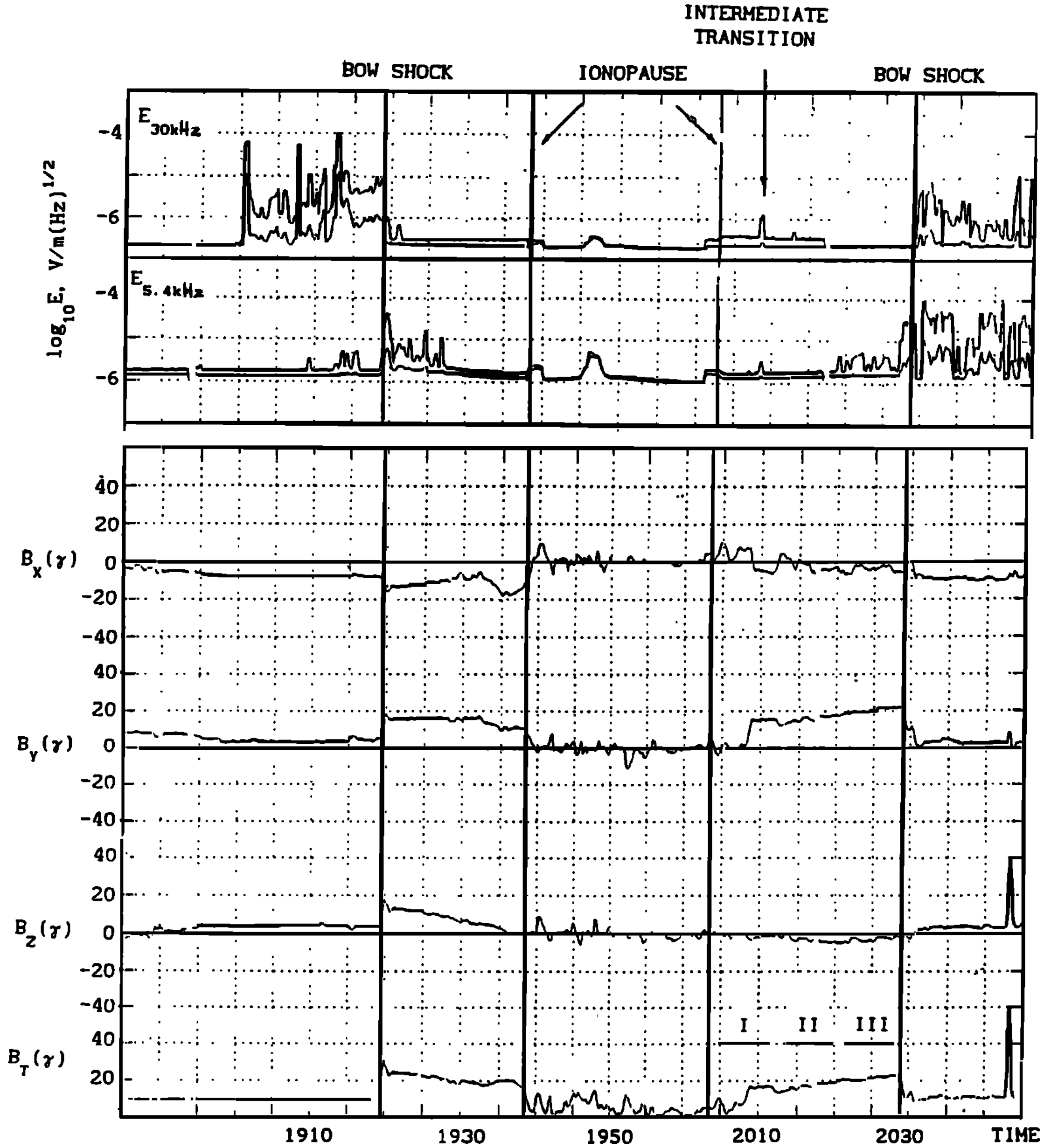

Figure 3. (upper) Electric field signals measured with the 30-kHz and 5.4-kHz channels of the electric field detector of the PVO in the inbound and outbound pass of orbit 51. (lower) Magnetic field components B_x, B_y, and B_z and magnetic field intensity B_T measured during the inbound and outbound pass of orbit 51. The inbound and outbound crossings of the bow shock and ionopause are indicated by the vertical lines (the bow shock crossings are obtained from the electric and magnetic field data and the ionopause crossings from the electron density data).

ionosheath (the PVO position at the time when the spectra I and II were calculated is indicated by the boxes added to its trajectory in the lower panel of Figures 2 and 4). Spectra II and III in Figures 5 and 6 show a general similarity in the energy of their peak values even though their local flux intensity can be different. On the other hand, the first spectrum in both passes has an overall different shape, and its peak flux is shifted to higher energies. Note in particular that in orbit 51 the dominant fluxes of spectrum I involve energies much higher and peak intensities substantially lower than those of spectra II and III.

The most notable property of spectrum I shown in Figures 5 and 6 is the fact that its peak flux occurs very nearly at the time when the intermediate transition is identified from the electric and magnetic field data. Useful times along that spectrum are indicated by the letters A, B, and C in Figures 5 and 6 with position B

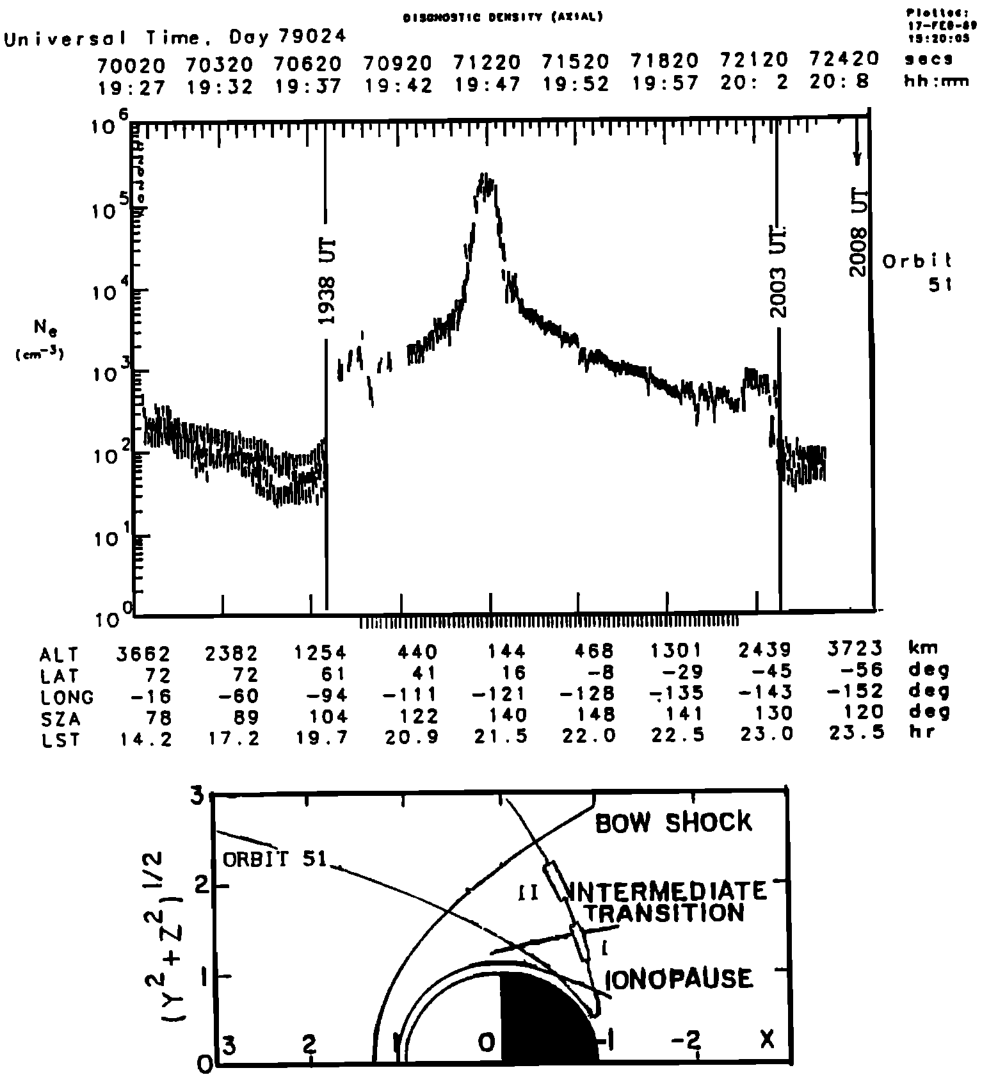

Figure 4. (upper) Electron density profile obtained from the OETP instrument of the PVO across the Venus ionosphere during orbit 51. The position of the ionopause at ~1938 UT (inbound) and at ~2003 UT (outbound) is indicated by the vertical lines (the intermediate transition detected at ~2008 UT is indicated by the vertical arrow). Note that the timescale in this profile is different from that in the upper panel of Fig. 2. (lower) Trajectory of the PVO in orbit 51 projected on one quadrant of a plane in which the vertical coordinate is the distance to the Sun–Venus axis. The approximate position of the bow shock, the intermediate transition, and the ionopause detected along the PVO trajectory are also indicated.

indicating that of the peak flux. For example, in the outbound pass of orbit 39 (Figure 5) the peak flux of spectrum I was detected at 1920:16 UT within a ~90 s-long time interval in which enhanced fluxes were recorded (between 1919:30 and 1921:00 UT). The time position of the peak flux measured in this spectrum coincides with that shown in the upper panel of Figure 1 where a strong 30-kHz electric field burst was detected outbound in the ionosheath. The same agreement is found for the sudden drop of the magnetic field intensity and the strong rotation of the magnetic field orientation that is seen at the intermediate transition. From the comparison of the data shown in Figures 1 and 5 it is apparent that evidence for the intermediate transition is available not only from the electric and magnetic field measurements but also from the plasma flux data analysis.

A similar agreement in the results of all three PVO experiments is also present in Figure 6 for the outbound pass of orbit 51. In this case the peak flux of spectrum I is detected at 2008:15 UT within a nearly 1 min-long time interval of enhanced plasma fluxes (between 2008:00 and 2009:00 UT). As shown in the top panel of Figure 3, the peak fluxes of spectrum I occur at the time when a strong 30-kHz electric field burst was detected within the ionosheath. The same is true for the sudden drop in the magnetic field intensity and the rotation of the magnetic field orientation. All these variations occur nearly simultaneously and thus suggest that the feature

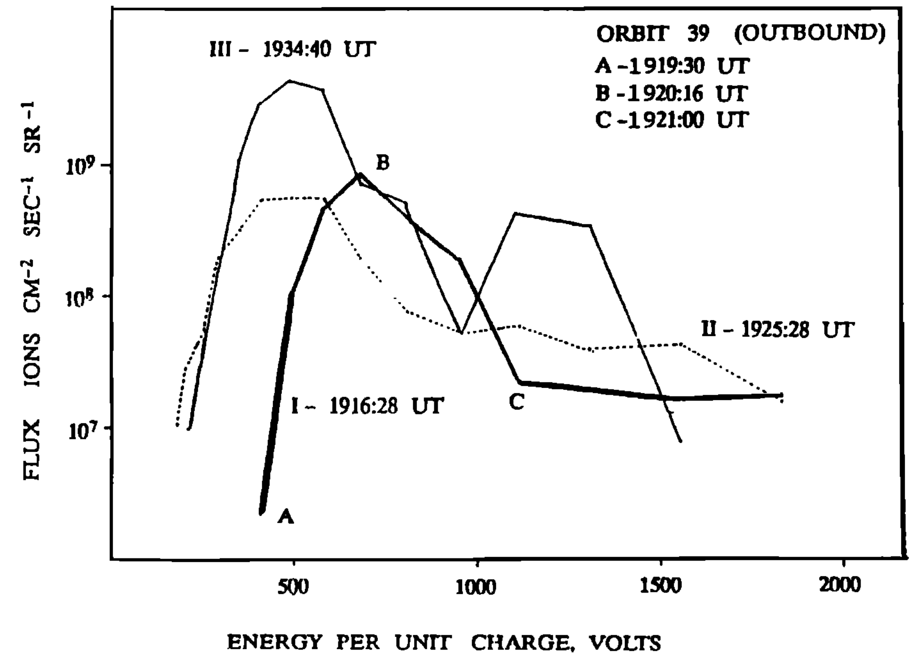

Figure 5. Ion energy spectra measured with the PVO plasma instrument throughout the Venus ionosheath during the outbound pass of orbit 39. Each spectrum shows the starting time of the energy measurements and the entire timing is indicated by the horizontal lines above the magnetic field intensity profile shown in the lower panel of Figure 1 (positions A, B, and C in spectrum I mark the time interval across the intermediate transition reported from the electric and magnetic field measurements).

identified as the intermediate transition in the outbound pass of orbits 39 and 51 is also evident in the plasma data.

Time Distribution of the PVO Plasma Data

An analysis of plasma properties similar to that presented in Figures 5 and 6 has been conducted on other PVO orbits. From those orbits included in Table 1 we have collected 17 cases in which the plasma probe measurements made across the intermediate transition show particle flux intensities with variations comparable to those described above (these are labeled with the asterisk * in Table 1). In this sense the relation between

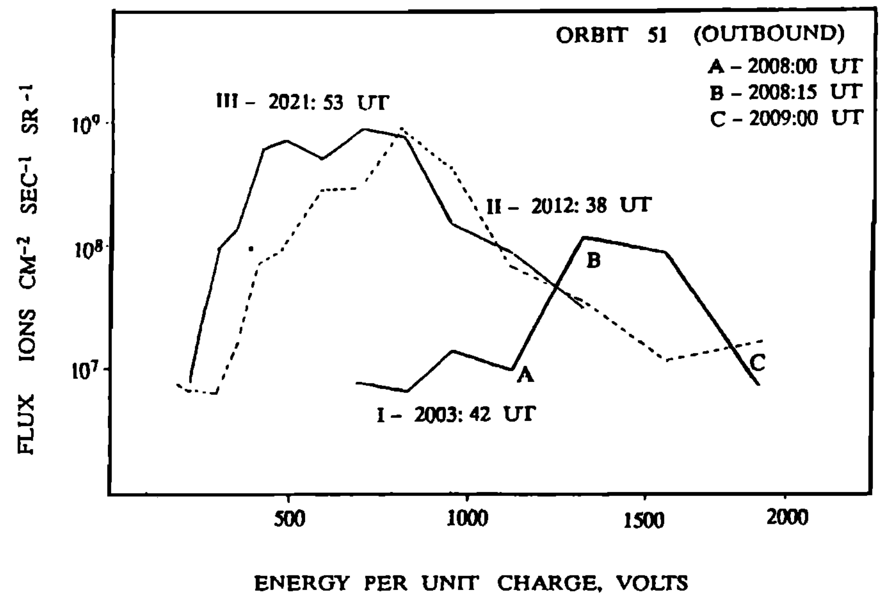

Figure 6. Ion energy spectra measured with the PVO plasma instrument throughout the Venus ionosheath during the outbound pass of orbit 51. Each spectrum shows the starting time of the energy measurements and the entire timing is indicated by the horizontal lines above the magnetic field intensity profile shown in the lower panel of Figure 3 (positions A, B, and C in spectrum I mark the time interval across the intermediate transition reported from the electric and magnetic field measurements).

the changes observed in the electric and magnetic fields and those in the particle flux intensity inferred from the study of the orbit 39 and 51 plasma data are representative of a behavior well documented in other PVO passes. The 9 cases not selected in the 26 listed in Table 1 are those in which the PVO plasma probe did not conduct measurements in the energy range where plasma fluxes are observed at the intermediate transition.

In order to better substantiate the identification of the intermediate transition in terms of concurrent variations in the electric and magnetic fields together with those observed in the plasma fluxes we have displayed the energy spectra in plots in which the particle flux intensity is given as a function of time. This enabled us to show plasma profiles on the same time scale as that of the electric and magnetic field data thus allowing for an accurate time comparison among all three measurements. Below we present these results for eight selected PVO orbits including the outbound pass of orbits 39 and 51. These two latter cases are reexamined in Figure 7 where the curve in the upper panel replaces the flux intensity measured in spectrum I of Figures 5 and 6. The time interval is in the vicinity of the intermediate transition identified from the 30-kHz electric field burst (bottom panel) and the magnetic field intensity profile (middle panel) of Figures 1 and 3. As noted earlier both cases show a notable agreement between the time location of that feature and the time interval where enhanced plasma fluxes are recorded. The most notable result is the fact that strong plasma fluxes are measured at the time when the main decrease in the magnetic field intensity is observed.

Comparable conditions are also obtained from the analysis of the plasma data of orbits 52 and 70 which are presented in Figure 8. In these cases the intermediate transition is also detected as a well-defined feature observed in the electric and magnetic fields and in the plasma fluxes. This is observed at ~2009 UT in orbit 52 and at ~2028 UT in orbit 70 when the magnetic field intensity (middle panel) exhibits a large decrease within the ionosheath. An agreement is also noticeable in the time position of the intense plasma fluxes and the electric field burst seen in the 30-kHz channel shown in the lower panel. Despite the fact that in both cases the latter signals are also detected up to 2 min away from the enhanced plasma fluxes no comparable fluctuations in the electric field are found in other regions of the ionosheath.

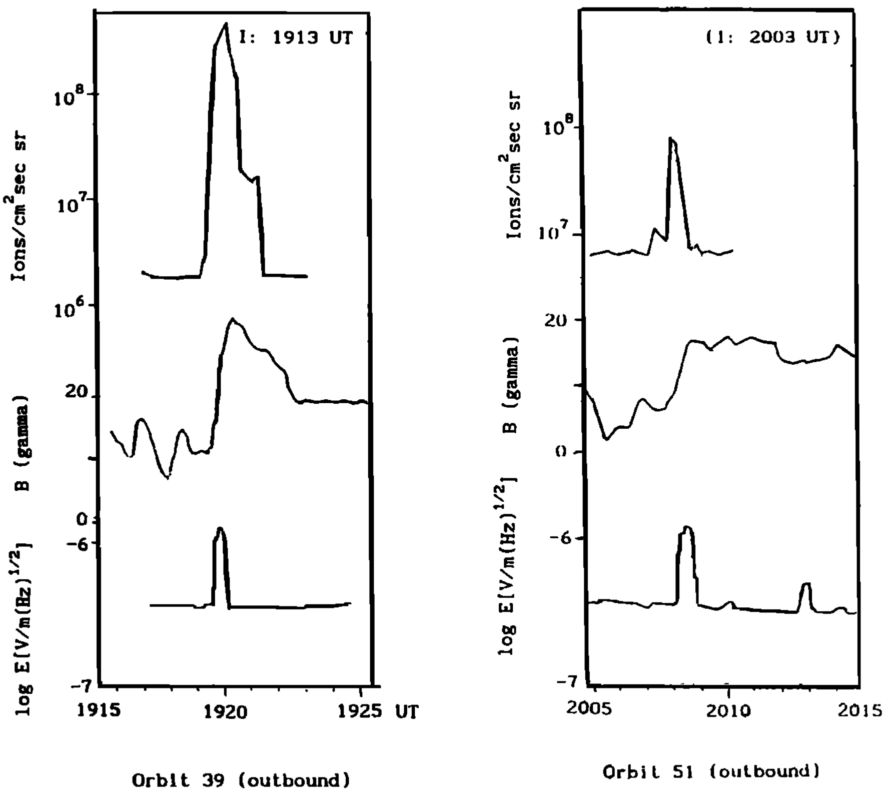

Figure 7. (left) Time distribution of the (upper) particle flux intensity, (middle) magnetic field intensity profile, and (lower) electric field burst in the 30-kHz channel measured across the intermediate transition during the outbound pass of orbit 39. (right) Time distribution of the (upper) particle flux intensity, (middle) magnetic field intensity profile, and (lower) electric field burst in the 30-kHz channel measured across the intermediate transition during the outbound pass of orbit 51. The time when the ionopause is detected in each case is indicated by the label I at the top of each figure.

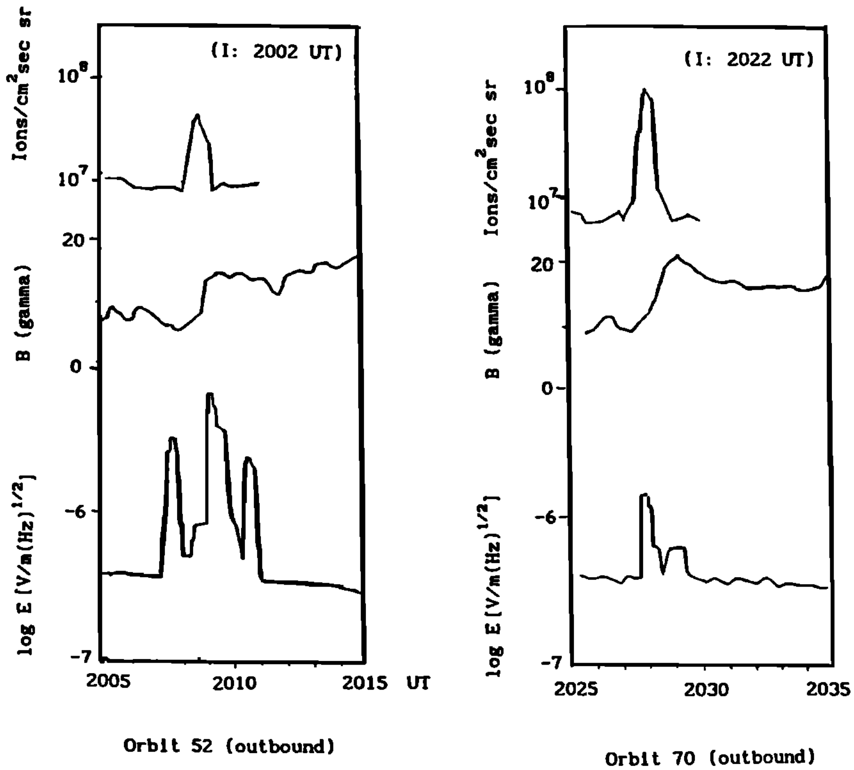

Figure 8. Same as Figure 7 for the (left) outbound pass of orbit 52 and for the (right) outbound pass of orbit 70.

A third pair of orbits with a similar arrangement is presented in Figure 9. In the inbound pass of orbit 72 the crossing of the intermediate transition (at ~ 1953 UT) is evidenced by the agreement in the observation of enhanced plasma fluxes and the strong decrease of the magnetic field intensity that begins nearly at that time. The same is true in the outbound pass of orbit 87 where intense plasma fluxes (at ~ 1952:30 UT) occur within the magnetic field gradient. A discussion of the variations seen in this latter case was presented in a previous report [*Perez-de-Tejada et al.* 1993]. However, the data in Figure 9 expresses more clearly the simultaneous observation of enhanced plasma fluxes (upper panel), the strong drop of the magnetic field intensity (middle panel), and the enhanced noise detected in the 30-kHz electric field channel (lower panel).

Two useful additional examples in which the plasma and the electric and magnetic field data exhibit concurrent variations across the intermediate transition are described in Figure 10. Once again, we can identify that the large enhancement in the plasma flux intensity measured in the inbound pass of orbit 120 (at ~ 2011 UT) and in the outbound pass of orbit 530 (at ~0952 UT) occurs nearly at the time when the magnetic field intensity shows a strong decrease from values seen in the outer ionosheath. A similar agreement between the enhanced plasma fluxes and an appreciable increase in the 30-kHz electric field noise is also evident in both cases. We should also emphasize here that as in the previous examples no concurrent changes in the electric and magnetic fields and in the plasma data are observed anywhere else within the ionosheath.

Discussion

Much of what has been presented here is also applicable to other PVO orbits. So far we have completed a similar plasma data analysis on those orbits of Table 1 marked with the asterisk. In all of them we find that the most severe changes seen across the ionosheath in the magnetic field measurements and in the 30-kHz electric field noise occur at the time when enhanced plasma fluxes are recorded. The cases that were not studied in Table 1 correspond to situations in which the plasma probe did not measure the peak flux of the energy spectrum at the time when the intermediate transition was detected. Using the set of PVO orbits of Table 1 with evidence of this transition in the plasma and magnetic field data we have compared the peak particle flux and the peak magnetic field intensity measured across that feature. The results of this comparison are shown in Figure 11. The data points indicate that the particle flux shows a general increase with the peak magnetic field intensity but no preferred value range for any of these two quantities is evident in that figure. With the plasma

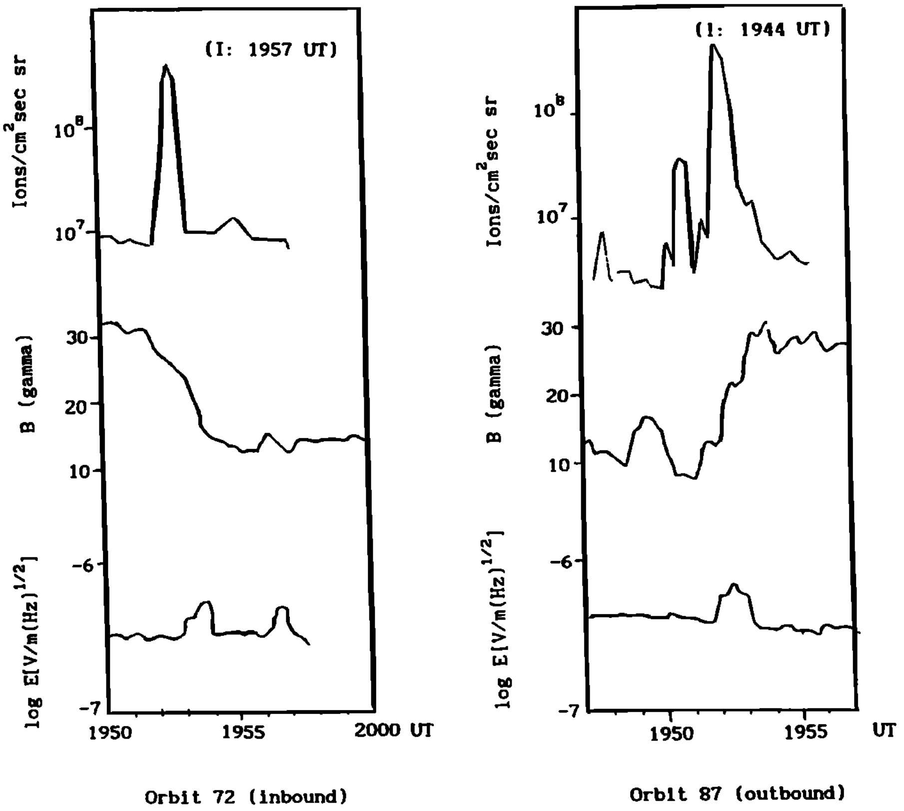

Figure 9. Same as Figure 7 for the (left) inbound pass of orbit 72 and for the (right) outbound pass of orbit 87.

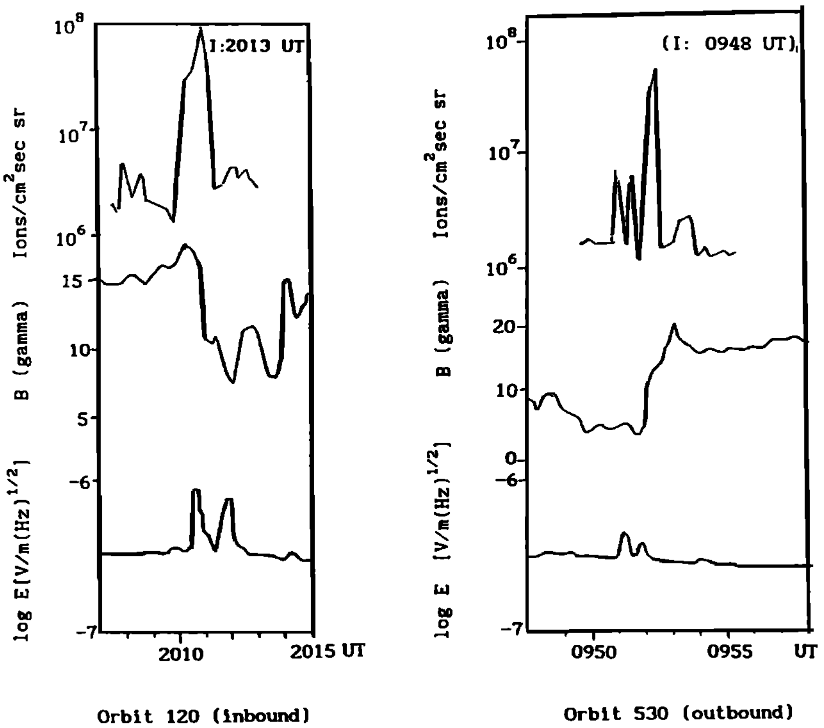

Figure 10. Same as Figure 7 for the (left) inbound pass of orbit 120 and for the (right) outbound pass of orbit 530.

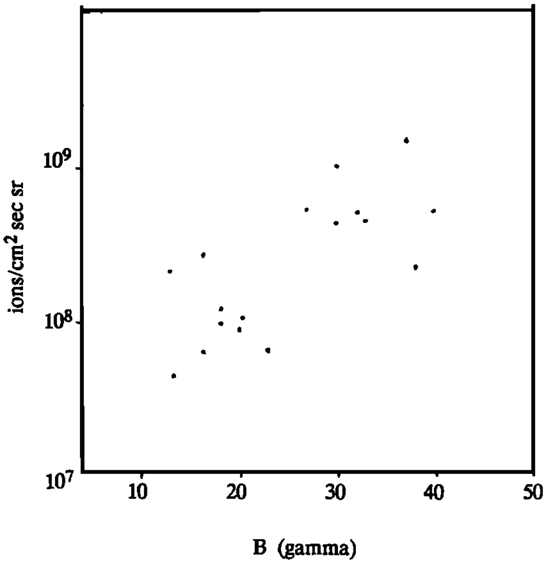

Figure 11. Peak particle flux intensity and peak magnetic field intensity measured at the intermediate transition in 17 PVO passes of Table I.

flux and the electric and magnetic field profiles shown in Figures 7–10 we conclude that there is now a wide range of experimental information supporting the existence of the intermediate transition.

Arguments related to the presence of this transition in the Venus ionosheath have been advanced in connection with the dynamics of gasdynamic flows streaming around obstacles. In that view the intermediate transition may represent the outer boundary of a friction layer that is produced through the anomalous transfer of solar wind momentum to the Venus ionospheric plasma [*Perez de–Tejada,* 1995]. While studies are required to examine the origin of this process it is necessary to resolve whether the properties of the intermediate transition are adequate to that interpretation. For example, an alternative view of that transition may be related to the observation of plasma clouds near the magnetic polar regions of the Venus plasma environment [Russell et al. 1982, Scarf et al. 1985]. In this case the B_x component would be required to reverse polarity as in the outbound pass of orbit 39 (Figure 1). We should note, however, that in many PVO passes the B_x component does not reverse polarity at the intermediate transition. A further examination of this issue will be addressed in a separate study.

The presence of the intermediate transition in the inner ionosheath may also be relevant to examine a similar feature in the Mars plasma environment. Measurements conducted with instruments onboard the Phobos spacecraft [*Lundin et al.,* 1990a,b, 1991] indicate the presence of a feature in the Mars magnetosheath with properties similar to those of the intermediate transition in the Venus ionosheath. A strong velocity shear is observed beginning at that transition with a change in the plasma composition from mostly solar wind particles outside to a population dominated by particles of planetary origin below. At that feature the magnetic field also exhibits changes that are similar to those detected across the intermediate transition in the Venus inner ionosheath [*Sauer et al.,* 1992]. Further studies are required in order to compare the properties of this transition in the Venus and Mars plasma environments. At Venus this should involve the analysis of the data of more PVO orbits including the distribution of thermal and suprathermal ions between the ionopause and the intermediate transition.

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