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Interplanetary Type IV Bursts

A. Hillaris[1], **C. Bouratzis**[1], **A. Nindos**[2]

Abstract In this work we study the characteristics of moving type IV radio bursts which extend to the hectometric wavelengths (*interplanetary type IV* or *type* IV_{IP} *bursts*) and their relationship with energetic phenomena on the Sun. Our dataset comprised 48 Interplanetary type IV bursts observed by the *Wind*/WAVES in the 13.825 MHz–20 KHz frequency range. The dynamic spectra of the RSTN, DAM, ARTEMIS-IV, CULGOORA, Hiraiso and IZMIRAN Radio-spectrographs were used to track the evolution of the events in the low corona; these were supplemented with SXR flux recordings from GOES and CME data from LASCO. Positional information for the coronal bursts were obtained by the Nançay radioheliograph (NRH). We examined the relationship of the type IV events with coronal radio bursts, CMEs and SXR flares. The majority of the events (45) were characterized as *compact*; their duration was on average 106 min. This type of events were, mostly, associated with M and X class flares (40 out of 45) and fast CMEs; 32 of these events had CMEs faster than 1000 Km/s. Furthermore, in 43 *compact* events the CME was, possibly, subject to *reduced aerodynamic drag* as it was propagating in the wake of a previous CME. A minority (3) of long lived type IV_{IP} bursts was detected, with durations from 960 min to 115 hours. These events are referred to as *extended* or *long duration* events and appeared to *replenish* their energetic electron content, possibly from electrons escaping from the corresponding coronal type IV bursts. The latter were found to persist on the disk, for tens of hours to days. Prominent among them was the unusual Interplanetary Type IV Burst of 2002 May 18–23 which is the longest event in the *Wind*/WAVES catalog. The 3 *extended* events were, usually, accompanied by a number of flares, of GOES class C in their majority, and of CMEs, many of which were slow and narrow.

Keywords: Radio Bursts, Dynamic Spectrum, Meter-Wavelengths and Longer, Coronal Mass Ejections

[1] Section of Astronomy, Astrophysics and Mechanics,
Department of Physics,University of Athens, 15783 Athens, Greece
[2] Section of Astro-geophysics, Department of Physics,
University of Ioannina, 45110 Ioannina, Greece

1. Introduction

Solar metric radio bursts provide a unique diagnostic of the development of flare/coronal mass ejection (CME) events in the low corona. Their onset and evolution, is accompanied by energetic-particle acceleration and injection into interplanetary space as well as shocks (see e.g. review by Pick and Vilmer, 2008; Nindos *et al.*, 2008). Their signatures at metric to kilometric wavelengths trace disturbances propagating from the low corona to interplanetary space.

Three types of nonthermal radio bursts are associated with the CME/Flare Events (Sakurai, 1974; White, 2007; Gopalswamy, 2011):

- Bursts of the Type III family: They are produced by energetic electrons accelerated in the Sun and traversing the solar atmosphere, along coronal magnetic lines rooted in these regions. In open field lines, they may escape into interplanetary space (see, for example, fig. 1 of Klein *et al.* (2008), also Alissandrakis *et al.* (2015)). On dynamic spectra these *standard* type III bursts appear as fast drifting bands ($df/fdt \approx 1.0s^{-1}$). When trapped in closed magnetic structures, they eventually turn Sun-wards, resulting in inverted U- or J-shaped bursts on the dynamic spectra (hence type U or J bursts, of the type III family). Often, in flare/CME events, the transition from the type U and J bursts to the typical type III mark the restructuring, or opening, of the magnetic field lines as originally confined, energetic electrons gain access to open magnetic lines. An example of dynamic radio spectra showing this transition from U and J-type bursts to a *standard* type III group at the beginning of the 17 January 2005 event can be found in Hillaris *et al.* (2011). In the hectometric and kilometric regime, long duration *storms* of individual type III bursts (Fainberg and Stone, 1970a,b, 1971; Bougeret, Fainberg, and Stone, 1983) covering several days (5.4 on average after Kayser *et al.*, 1987) were recorded. These are distinct from the hectometric-kilometric extensions of type III bursts and are known as *IP storms* and, more often than not, may appear as *storm continua* on the dynamic spectra. The individual type III components of the *IP storms*, (*micro-type III* bursts, after Morioka *et al.*, 2007) are significantly weaker than the typical type III bursts in the same frequency range. The *IP storms* are well associated with active regions (Kayser *et al.*, 1987) yet the *micro-type III* bursts are not accompanied by significant SXR flare activity. This implies the need of a persistent coronal store of suprathermal electrons (Bougeret, Fainberg, and Stone, 1984a,b) supplying this type of activity.
- Type II bursts: They are the radio signatures of the passage of a MHD shock wave through the tenuous plasma of the solar corona; their radio emission is due to energetic electrons accelerated at the shock front. It is, in general, accepted that Type II bursts at decametric and longer wavelengths are driven by CMEs, bow or flank (Vršnak and Cliver, 2008). At the metric range, on the other hand, they might be also due, apart from the CMEs, to flare blasts (Cane and Reames, 1988; Nindos *et al.*, 2011; Magdalenić *et al.*, 2010, 2012) or reconnection outflow termination shocks (Aurass, Vršnak, and Mann, 2002).

- Type IV bursts: They are radio continua due to the radiation of energetic electrons trapped within magnetic structures and plasmoids. They have been recorded in almost all frequency ranges starting from the microwaves as type IVμ bursts and the decimetric range as Type IVdm (Benz, 1980). In the metric wavelengths the type IVm bursts are divided into moving (IVmA or IVM) and stationary (IVmB). The type IVmB bursts emanate from stationary magnetic structures usually located above active regions or post-eruption arcades behind CMEs (Robinson, 1985; Gopalswamy, 2011). The type IVm burst are, sometimes, referenced as flare continua (FCM when preceding a type IVmA or FCII following a type II burst, see Robinson, 1978). They are also identified as continuum noise storms (Type IVsA and IVsB, corresponding to Type IVmA and IVmB. See discussion in Sakurai, 1974, and their Fig. 14). The type IVmA bursts (Boischot, 1957) appear moving outwards at velocities of the order of 100–1000 km s^{-1} comparable to CME speeds (White, 2007); they sometimes last more than 10 min. A number of these are believed to originate within the densest substructures of CMEs (Klein and Mouradian, 2002; Bastian *et al.*, 2001; Aurass *et al.*, 1999; Bain *et al.*, 2014). These substructures are, possibly, erupting prominences within the CMEs. The type IVmA burst—CME association was found to increase with the speed of the CME (Gergely, 1986, and references within). A subset of the moving type IV radio bursts extend, on dynamic spectra, to the hectometric wavelengths (frequencies less than $\approx$ 20 MHz) and are recorded by the *Wind*/WAVES receivers; these are *interplanetary type IV* or IV_{IP} radio bursts.

In this study we examine the characteristics and the evolution of *interplanetary type IV* bursts and their relationship with energetic phenomena on the Sun such as flares and CMEs.The data used, are from the *Wind*/WAVES receivers and a number of ground based instruments. From the combined data sets an extensive table of type IV_{IP} and associated activity was compiled and is presented in the appendix A. The question addressed in our examination is twofold: Firstly we examine the association of these bursts with intense flares and fast CMEs, examining whether they may be considered as another aspect of the *big flare syndrome* first introduced by Kahler (1982). Secondly we search for other processes affecting, in total or in part, the appearance of this type of radio bursts.

This report on *interplanetary type IV (or Type–IV_{IP})* bursts is structured as follows: In Section 2 we describe the instrumentation and data set used in our study. The data analysis **is** presented in section 3 including an overview of selected events in 3.3, 3.4, and 3.5. In section 4 we present the characteristics and the evolution of different types of Type–IV_{IP} events which, then, are discussed in section 5 while the conclusions are presented in the same section.

2. Observations and Data Selection

The basic data used in this study are dynamic spectra recorded by the R1 and R2 receivers of the *Wind*/WAVES (Bougeret *et al.*, 1995) in the 20kHz–13.825 MHz frequency range from 1998 to 2012. The interplanetary type IV bursts selected were, already, identified in the *Wind*/WAVES on-line catalog[1]. The observations were complemented by data at metric (m) and decametric wavelengths from the following ground-based radio observatories:

- The Artemis–IV[2] radio-spectrograph (20–650 MHz Caroubalos *et al.*, 2001; Kontogeorgos *et al.*, 2006a,b, 2008).
- The Culgoora radio-spectrograph (18-1800 MHz, Prestage *et al.*, 1994).
- The Nançay Decametric Array or DAM[3] (20–75 MHz, Boischot *et al.*, 1980; Lecacheux, 2000).
- The Nançay radioheliograph (Kerdraon and Delouis, 1997) provides daily, 09:00-15:30 UT, two-dimensional images of the Sun at 10 frequencies from 450 to 150 MHz with sub-second time resolution. It was used for positional information of the metric–decametric radio emission; in this study the *quick-look-style* NRH data from the radio-monitoring site[4] were used.
- The Hiraiso Radio Spectrograph (HiRAS)[5] (25–2500 MHz, see Kondo *et al.*, 1995).
- The radio-spectrograph of Izmiran[6] (25–270 MHz, Gorgutsa *et al.*, 2001).
- The Radio Solar Telescope Network (Guidice *et al.*, 1981) or RSTN[7] with a number of solar radio observatories at various locations around the world guaranteeing full, 24 hour, coverage.:
  - Sagamore Hill (K7OL) at Hamilton, Massachusetts, USA (42°33′N 70°49′W)
  - Palehua (PHFF) at Kaena Point, Hawaii (21°24′N 158°06′W)
  - Holloman (KHMN) at New Mexico, USA (32°51′N 106°06′W)
  - Learmonth (APLM) at , WA, Australia (22°13′S–114°06′E)
  - San Vito dei Normanni, Italy (LISS)(40°39′N 17°42′E)

  These observatories provide dynamic spectra in the 25-180 MHz range.

Additional data-sets were used in order to examine the association of the type IV_{IP} bursts with the evolution of flares and CMEs:

- CME data from the LASCO lists on line[8] (Yashiro *et al.*, 2004; Gopalswamy *et al.*, 2009)

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[1] www.lep.gsfc.nasa.gov/waves/data_products.html

[2] Appareil de Routine pour le Traitement et l' Enregistrement Magnetique de l' Information Spectral, http://artemis-iv.phys.uoa.gr/

[3] bass2000.obspm.fr/home.php

[4] http://radio-monitoring.obspm.fr/nrh_data.php

[5] sunbase.nict.go.jp/solar/denpa/index.html

[6] www.izmiran.ru/stp/lars/

[7] ftp://ftp.ngdc.noaa.gov/STP/space-weather/solar-data/solar-features/solar-radio/rstn-spectral

[8] http://cdaw.gsfc.nasa.gov/CME_list

- SXR (GOES) characteristics from on line reports[9] and light curves[10].
- Images from the *Extreme Ultraviolet Imaging Telescope* (EIT) on-board SOHO (Delaboudinière *et al.*, 1995); they were used in order to provide information on flare positions.

From the *Wind*/WAVES catalogue all events indicated as bursts of type IV_{IP} (48 in total) were selected. Many (36) were accompanied by interplanetary type II shocks.

A comprehensive list of the interplanetary type IV bursts and the associated activity including, but not restricted to, coronal burst, flare and CME data is catalogued in table A1. In compiling this catalogue, we included information of all the *Wind*/WAVES type IV_{IP} bursts, their associated CMEs and SXR flares in the 1998-2012 period and the accompanying interplanetary type II and coronal Type II, IV and III bursts. The above mentioned CMEs which are thought to drive the type IV_{IP} bursts are refered to as *main CMEs* in order to distinguish from preceding CMEs along the same path; the latter were included in the table as they may affect the appearace of type IV_{IP} bursts as discussed in sections 4.1 and 5. The selection of the CMEs preceding Main Ejection along the same path is based on a time interval of about 48 hours before the main CME and whether the sectors (or cones in 3D) defined by position angle-width for the main and the preceeding CMEs overlap; occasionally there are more than one preceding CMEs included in the catalogue as the latter overlap with different parts of the main CME sector. The overlap criterion is relaxed when one or both the main and the preceding CMEs are Halo; in this case we assume that an overlap is always possible, at least in part.

The catalogue format is described, in detail, in the beginning of appendix A.

3. Data Analysis

3.1. Data Processing

The combination of hectometric dynamic spectra by *Wind*/WAVES with metric and decametric spectra from the ground based radio-spectrographs (see section 2) was, firstly, plotted in the form of composite dynamic spectra. These were found to include an amount of features, mostly groups of type III and II bursts, embedded in a slowly varying background. More often than not the continuum background is removed by the use of high–pass filtering on the dynamic spectra (usually differentiation). This filtering, however, amplifies the high-frequency noises therefore the smoothed differentiation filter of Usui and Amidror (1982) was used. This performs simultaneously smoothing and differentiation so can be regarded as a low-pass differentiation filter (digital differentiator) appropriate for experimental (noisy) data processing.

[9] ftp://ftp.ngdc.noaa.gov/STP/space-weather/solar-data/solar-features/solar-flares/x-rays/ and https://solarmonitor.org/data

[10] http://satdat.ngdc.noaa.gov/sem/goes/data/

The composite dynamic spectra provide an overview of the evolution of the type IV_{IP} bursts under study, and of the accompanying radio activity, from the corona to the interplanetary space. On each dynamic spectrum several, other, time–histories were superposed:

- The approximate frequency–time trajectories of the CME fronts: These were plotted on the dynamic spectra, using the coronal density model of Vršnak, Magdalenić, and Zlobec (2004), as dashed lines; the model selection details are presented in section 3.2. The linear fits to the height–time trajectories of the CME fronts, from the LASCO images, were converted to the frequency–time traces of the fundamental and harmonic plasma emission; the squares mark the measured positions of the CME front.
- The GOES SXR time–profiles: The solid black (1.0-8.0 Å) and the dotted purple (0.5-4.0 Å) curves display the SXR time history describing thermal emission from the flare-heated plasma.

Of the 48 type IV_{IP} bursts of this report 17 overlapped, at least partly, with the NRH window of observation. For these the position of coronal extension (metric type IV burst) of the interplanetary burst was compared to the SXR flare position and the solar sources of the CME from the EIT images; their spatial relationship was, thus, established. This was obtained by a combination of NRH radio contours overlayed on the EIT 195 Å difference image and combined with the LASCO difference image.

Compact type IV_{IP} bursts: These were, mostly, associated with M and X class flares and fast CMEs; their duration was on average 100 ($\pm$11) min. Their minimum frequency was in the 10-2 MHz range which corresponds to 3-10 $R_{\odot}$ heliocentric distances; the distribution of the low frequency limits and the corresponding distaces, derived from the calculations in section 3.2, are exhibited on Fig. 1. In total, 45 of these events were found in the *Wind*/WAVES lists. An example is presented in section 3.3.

Long Duration or *Extended* type IV_{IP} bursts: They represent a small minority of 3 events with durations from 960 min to 115 hours. Their morphology was found to be less uniform than that of their majority counterparts. Two of them (catalogue numbers 34, 2002 May 18-23, and 45, 1999 May 27, described in sections 3.4 and 3.5) were accompanied by a sequence of small flares and slow–narrow CMEs with an occasional medium or large flare within the sequence. Another (Event 14, 2005 January 17, presented in section 3.6) originated from a fast CME–large flare pair but was found to extend far beyond the duration of a *Compact* event.

The distribution of the interplanetary type IV duration is presented on Fig. 2 for all the events of the study; the three *Extended* events are the outliers of the histogram on the left panel. The distribution of the *Compact* Events duration is also presented, separately, on the right panel of Fig. 2. In section 4 the differences between the characteristics of the *Extended* and the *Compact* events, apart from duration, are examined and discussed.

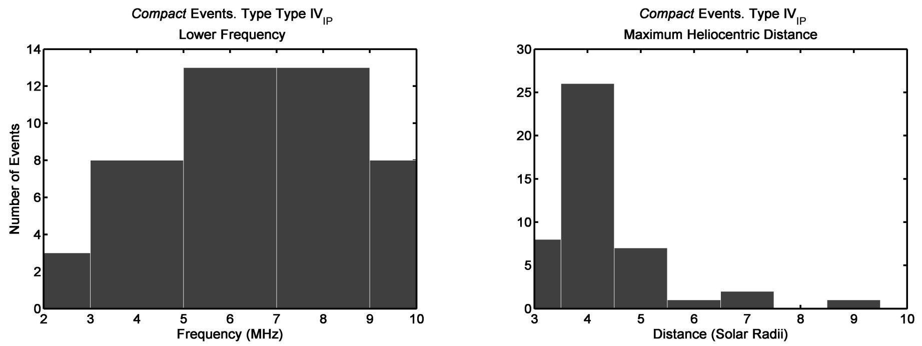

Figure 1. Left: Distribution of the low frequency limit of the *Compact* interplanetary type IV bursts. Right: The corresponding heliocentric distance of these type IV bursts based on the low frequency limit and the model depedent calculations described in section 3.2.

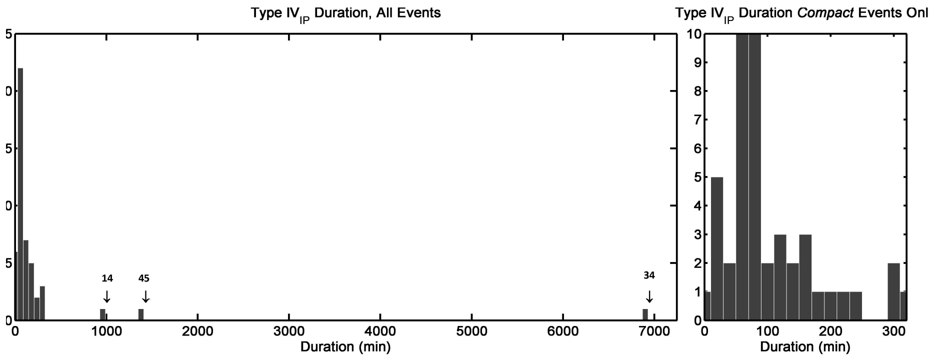

Figure 2. Distribution of the Duration of the interplanetary type IV bursts. Left: All (48) Events; the 3 *Extended* events are annotated with arrows and their catalogue numbers. Right: Histogram of the 45 *Compact* Events only.

3.2. Coronal Density–Height Model Selection

As plasma emission depends on electron density, which in turn may be converted to coronal height using density models, we may calculate estimates for the radio source heights and speeds from dynamic spectra. The establishment of a correspondence between frequency of observation–coronal height and frequency drift rate–radial speed is affected by ambiguities introduced by the variation of the ambient medium properties. These may be the result of burst exciter propagation within undisturbed plasma, over–dense or under–dense structure or CME after–flows (cf. Pohjolainen *et al.*, 2007; Pohjolainen, Hori, and Sakurai, 2008, for a detailed discussion on model selection).

The density model of Vršnak, Magdalenić, and Zlobec (2004)

$$\frac{n}{10^8\ \mathrm{cm}^{-3}} = 15.45\left(\frac{R_\odot}{R}\right)^{16} + 3.165\left(\frac{R_\odot}{R}\right)^{6} + 1.0\left(\frac{R_\odot}{R}\right)^{4} + 0.0033\left(\frac{R_\odot}{R}\right)^{2}$$

which describes well the coronal density behavior in the large range of distances from low corona to interplanetary space was used for the conversion of the linear

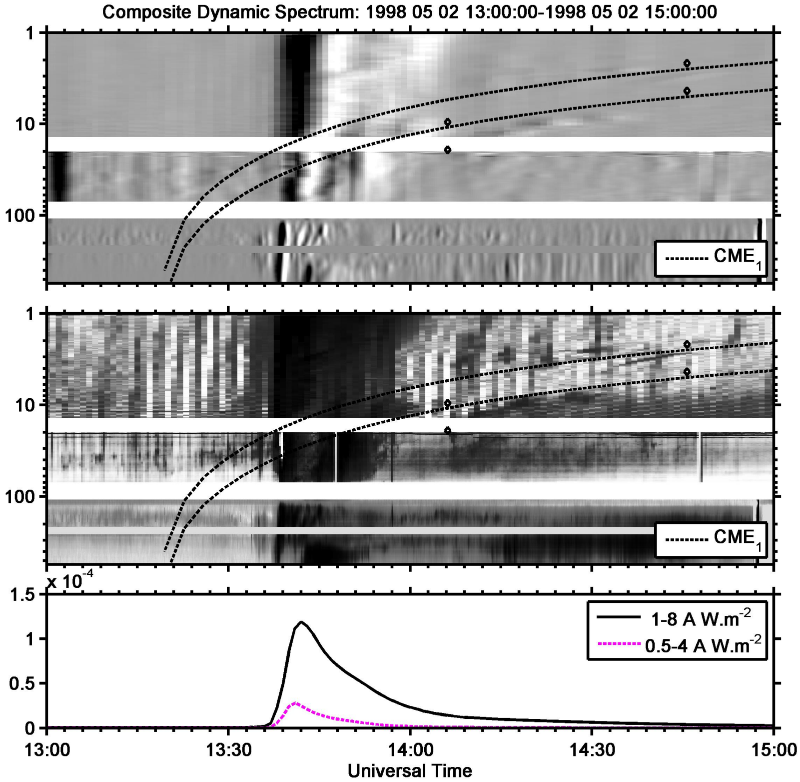

Figure 3. Event 1998 May 02. Top pannel: *Wind*/WAVES/ARTEMIS-IV differential spectrum (inverse grey scale). Middle Panel: Dynamic (Intensity, inverse grey scale) spectrum. The frequency-time plots derived from the linear fits to the front trajectory of the associated CME and an empirical density model (see subsection 3.2) for fundamental and harmonic (dashed curves) plasma emission are overlayed on the spectra. Bottom Panel: The profiles of GOES SXR 1-8 Å (solid black) and 0.4-4 Å (dashed red) flux.

fits to the height-time trajectories of the LASCO CME fronts to frequency-time tracks on the composite dynamic spectra.

3.3. Overview of the 2 May 1998 *Compact* Event Evolution

The May 2, 1998 *Compact* Event (catalogue number 47) is typical of its class. It has drawn considerable attention due to the large number of instruments that have observed it, including *Wind*/WAVES, SOHO/LASCO, EIT, NRH, and several radio spectrographs. It is reported in a number of articles which focus, mainly, on the solar surface *magnetic waves* (Zharkova and Kosovichev, 1999), the pre–CME launch activity (Pohjolainen, Khan, and Vilmer, 1999) and the on disk development of the CME (Pohjolainen *et al.*, 2001).

The interplanetary type IV event (see composite spectrum on Figure 3) starts at 14:10 UT on May 02 and lasts until 15:40 UT of the same day in the frequency range 8-14 MHz; an interplanetary type II burst was recorded from 14:25–14:50

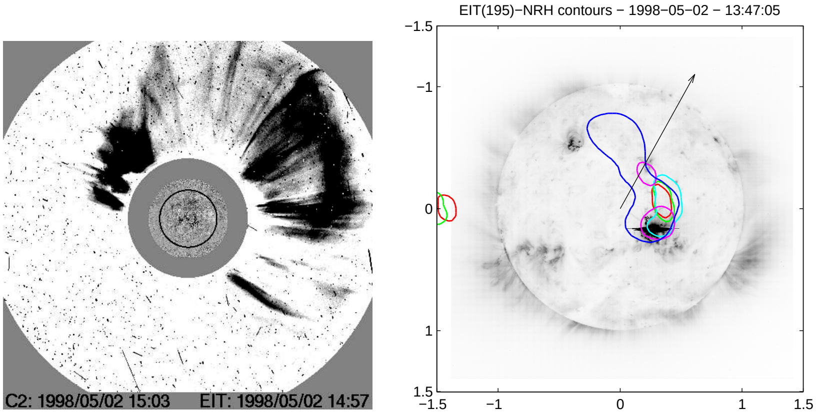

Figure 4. Left: LASCO– EIT 195 Å running difference frames of the 1998 May 02 14:06 UT CME (inverse gray scale). Right: NRH half power contours (at 432 (red), 410 (green), 327 (cyan), 236 (magenta) and 164 (blue) MHz). The contours were recorded an successive times starting with 13:47:05 at 432 MHz to 13:51:53 at 164 MHz thus tracing the outward movement of the type IV burst; the arrow indicates the Halo CME Measured Position Angle from the LASCO lists.

UT in the 5–3 MHz range the *Wind*/WAVES; in the catalogue it is described as *Narrowband wisps* yet it is well associated with the front of the CME. Another type II, without apparent association to the CME front, appears in the 400–6 MHz range, recorded by the ARTEMIS–IV, the Nançay Decametric Array (DAM) and the *Wind*/WAVES from 13:30-13:46 UT; it exhibits multiple band structure and was first reported by Pohjolainen *et al.* (2001). The high frequency extension of the type $\mathrm{IV}_{\mathrm{IP}}$ was recorded by the DAM and the ARTEMIS–IV radio-spectrographs and extends above the 500 MHz (see also Pohjolainen *et al.*, 2001, their figure 8). This activity is accompanied by an X1.1/3B class flare from AR 8210 at heliographic coordinates S15°W15°; the flare started at 13:31 and ended at 13:51 UT peaking at 13:42 UT.

The NRH recordings at 432 and 164 MHz indicate that the type IV continuum appears over AR 8210 and, on the 164 MHz images, starts moving northwards at 13:34 UT; this is consistent with the movement of a rather fast, 938 Km s^{-1} halo CME (first view at 14:06 UT, back extrapolated lift–off at 13:07 UT) with measured position angle 331°(see figure 4). This CME appears driving the fundamental–harmonic pair, mentioned in the previous paragraph. As regards the CME path, there are two preceding HALO CMEs at 1998 May 02 at 05:32 UT and on 1998 May 01 at 23:40 UT.

The broadband dynamic spectra and the NRH images indicate that the *compact* interplanetary type IV burst is associated with an X class flare and a fast halo CME. The latter propagates in the wake of a previous halo CME which was launched approximately eight and a half hours before. This example represents the combined effects of an intense flare/fast CME event with the CME propagating within a low drag region due to the passage of a previous CME.

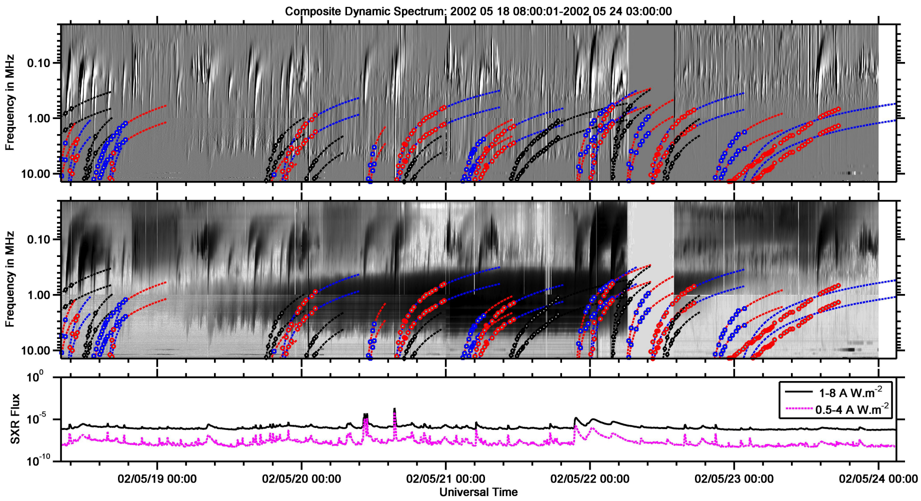

Figure 5. Event 2002 May 18–22 in the 18 08:00 UT to 24 03:00 period. Panels as in Figure 3 except that the CME trajectories are of varying colours. The time is in Date Hour-Minute format.

3.4. Overview of the 2002 May 18–22 *Extended* Event Evolution

The type IV_{IP} event starts at 09:00 UT on May 18 and lasts until 04:00 UT of May 23 in the frequency range 0.3-9MHz (catalogue number 34); it was the only such event observed by *Wind*/WAVES in its years of operation (Reiner *et al.*, 2006). An interplanetary type II burst was recorded from the 22 May at 04:10 UT until the 23 May 10:10 in the 0.5–0.03 MHz range. The *Wind*/WAVES dynamic and differential spectra, with the CME front trajectories overlayed, and the SXR flux are exhibited in figure 5; details in the period May 19, 07:45-12:45 UT are presented in figure 6. This event was briefly reported by Gopalswamy (2004) who, based on polarization measurements, considers a hectometric storm continuum and not a type IV_{IP} burst as reported in the *Wind*/WAVES catalog.

On the solar disk, we see a number of active region complexes in the 18-23 May period. When the continuum started, on May 18 AR9957 (N08°E47°) was the largest and most complex region on the disk. This region was accompanied by AR9958 (N04°E45°) and followed by AR9960 at N5°E74° and AR9962, AR9963 which appeared on the 21st of May at N15°E47° and N17° E63°. South of this group were AR 9954 (S22°E35°), AR9955 (S14°E37°) and in the western hemisphere AR9945 (S02°W73°), AR9948(S21°W20°) and AR9950 (S05°W42°). On the left panel of Figure 7 we present the positions of all SXR flares within the 18–23 period and of the corresponding active regions.

Through out the period of interest 2002/05/18 02:44 to 2002/05/23 04:00 38 SXR flares were recorded by GOES; positional data were obtained for 33 of them. The AR9957, AR 9958, AR9960, AR9962, AR9963 complex, located in the NE quadrant of the disk, gave 10 C class and one M1.5, SXR flares. The single AR9961 in the SE quadrant gave 16 flares (including an X2.1 and an M5.0) starting at 2002/05/19 15:54 UT. Within the same period 24 CMEs were

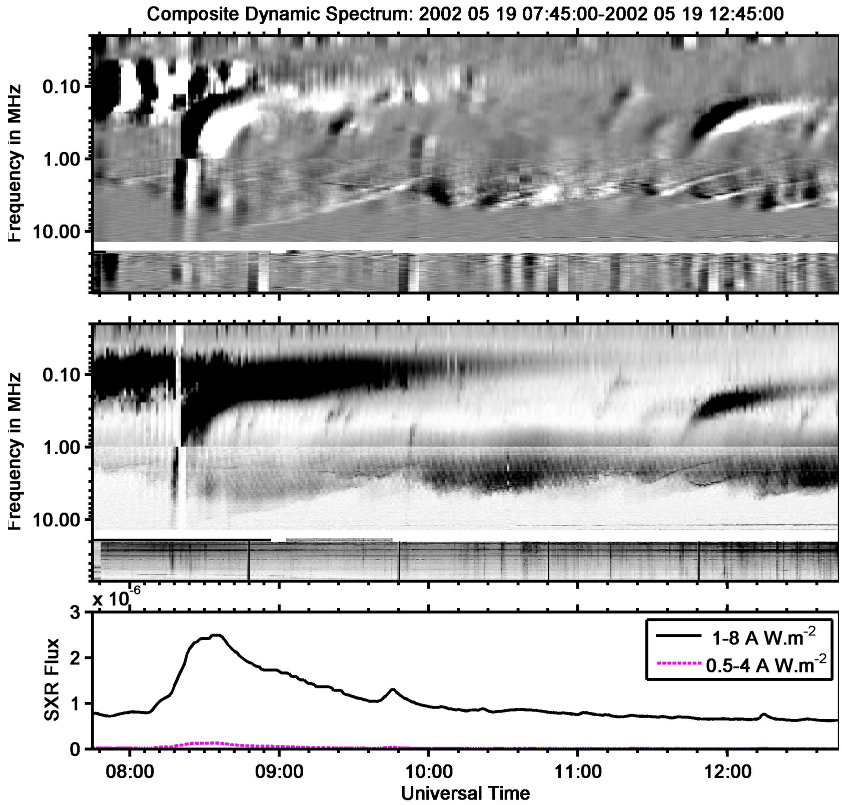

Figure 6. Event 2002 May 18–22 presenting details on the May 19, 07:45–12:45 UT period. Panels as in Figure 3. The dynamic spectra are combined recordings from the *Wind*/WAVES and the DAM and extend in the 0.02–70 MHz range.

recorded in the LASCO lists; the positional angles indicated that they emerged from all quadrants of the Solar Disk. This activity was associated with many type III burst groups, 2-3 type II shocks in the metric range (see A1) and a persistent continuum appearing on the NE quadrant over the AR9957, AR 9958, AR9960, AR9962, AR9963 group in the 19-23 May period; the metric and decametric continuum appears on the SW quadrant, over AR 9948, only on May 18 (figure 8); on this day it coexists with the persistent continuum (over the AR9957) mentioned above.

The SXR activity originates, mostly, in the NE (AR9957, AR 9958, AR9960, AR9962, AR9963 group) and the SE (AR9961) quadrants; most of the CME position angles indicate lift off from the same two quadrants (see figure 7, right panel). The position of the type III bursts which could be localized, were, almost, equally divided between the SE and the NE quadrants but the vast majority appears clearly on the differential spectra to continue into the *Wind*/WAVES hectometric range at frequencies lower that the type IV_{IP}; furthermore the type III and CME activity continues past the end of the interplanetary type IV burst. The metric continuum, on the other hand, appears persistently, on the NRH images, on top of the AR9957, AR 9958, AR9960, AR9962, AR9963 group from the 19 to

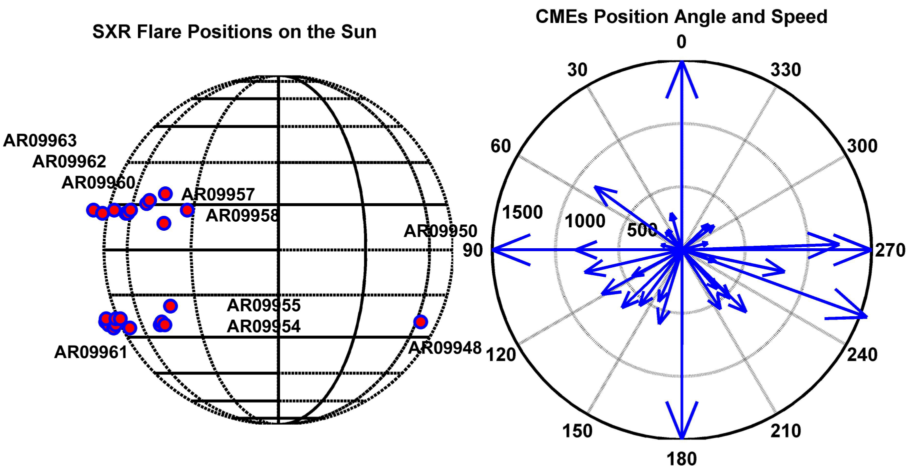

Figure 7. Left: Positions of the SXR flares (purple dots with blue border) and the active regions, as labels (Left). Right: CME position angles (Right); the vector length is proportional to the CME speed; the active region positions were from the Solar Monitor. The flare and CME positions extend in the whole 2002 May 18–23 period; the AR positions are from the middle of this period on May, 20.

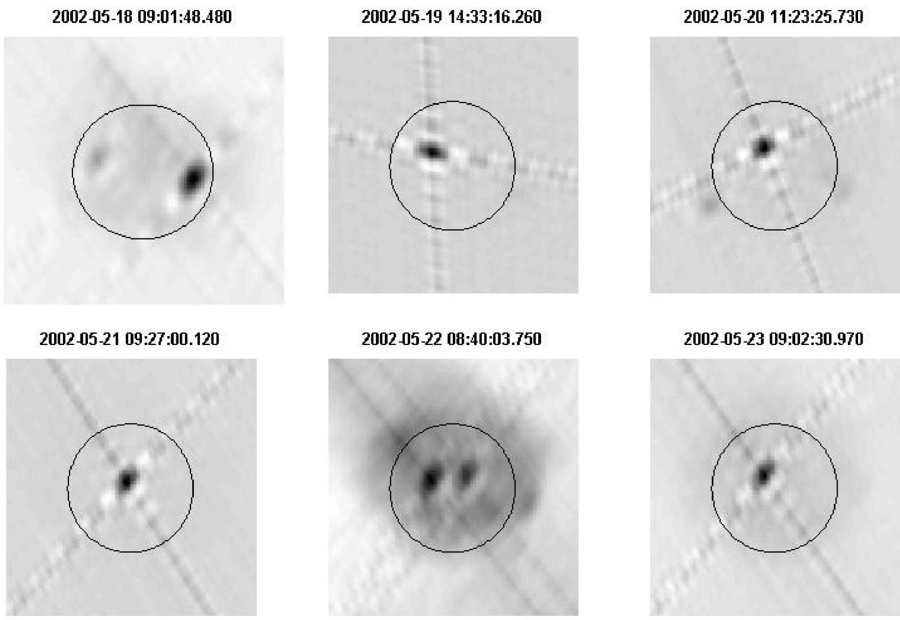

Figure 8. Positions of the Coronal Type IV bursts in the 2002 May 18–22 period, obtained by the Nançay Radioheliograph at 164 MHz.

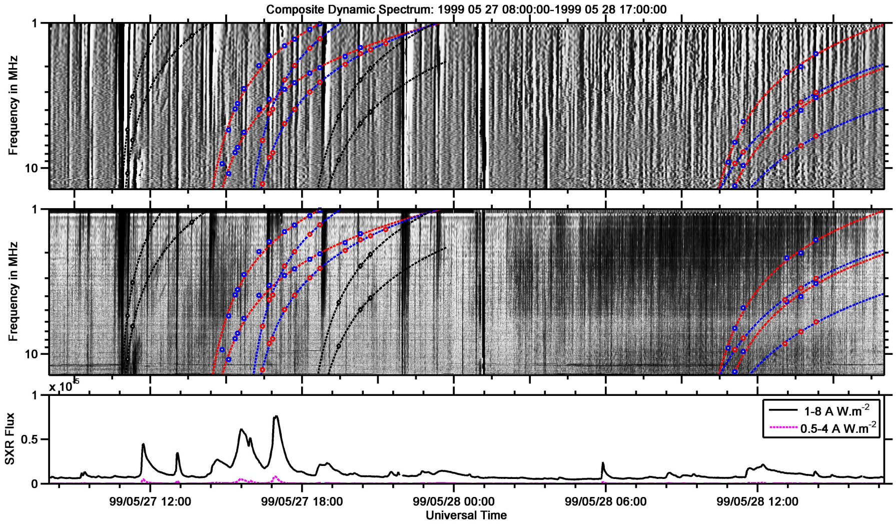

Figure 9. Event 1999 May 27–28. Top: *Wind*/WAVES differential spectrum (inverse gray scale). Middle: Dynamic (Intensity) spectrum in the 27 May 08:00–28 MAY 17:00 UT period. Bottom Panel: The profiles of GOES SXR 1-8 Å (solid black) and 0.4-4 Å (dashed red) flux. The time is in Date Hour-Minute format. The layout and format of all the panels is the same with Fig. 3 & 5. The type $\mathrm{IV_{IP}}$ starts at 14 MHz on the *Wind*/WAVES spectrum and extends below 1 MHz.

the 23 May. This implies a *steady coronal reservoir* of energetic electrons which may follow the magnetic lines trailing CMEs originating at the NE quadrant and replenish the electrons of the interplanetary type $\mathrm{IV_{IP}}$burst.

3.5. Overview of the 1999, May 27–28 *Extended* Event Evolution

The event starts at 1999 May 27 10:55 UT and ends by May 28 at 15:00 UT (catalogue Number 45). It is an interplanetary type II/IV bursts where both interplanetary bursts have coronal extensions. This event is accompanied by a number of C class SXR flares and narrow CMEs. An overview including *Wind*/WAVES dynamic spectrum, the CME front trajectories and SXR flux profiles is presented in Fig. 9. There are only two *wide* CMEs, a HALO on the 27 at 11:06 UT and a rather wide CME on the 28 at 10:26 UT which, almost, mark the start and the end of the event.

Similar to the 2002 May 18–22 event, in subsection (3.4), there is also a persistent coronal type IV which, on the NRH records, appears over AR 8552 ($N18^{\circ}E31^{\circ}$). This region remains active throughout the duration of the interplanetary type IV burst and most of the small SXR flares as well as a number of type III bursts originate from it. In figure 12 we present the position of the coronal type IV, on May 27 and 28, in the form of NRH images. There is also a long series of Type III bursts and groups, which covers the type $\mathrm{IV_{IP}}$ interval. Most of these type III bursts, however, overshoot the type $\mathrm{IV_{IP}}$ continuum so we expect that the main source of energetic electrons is its coronal counterpart persisting over AR8552.

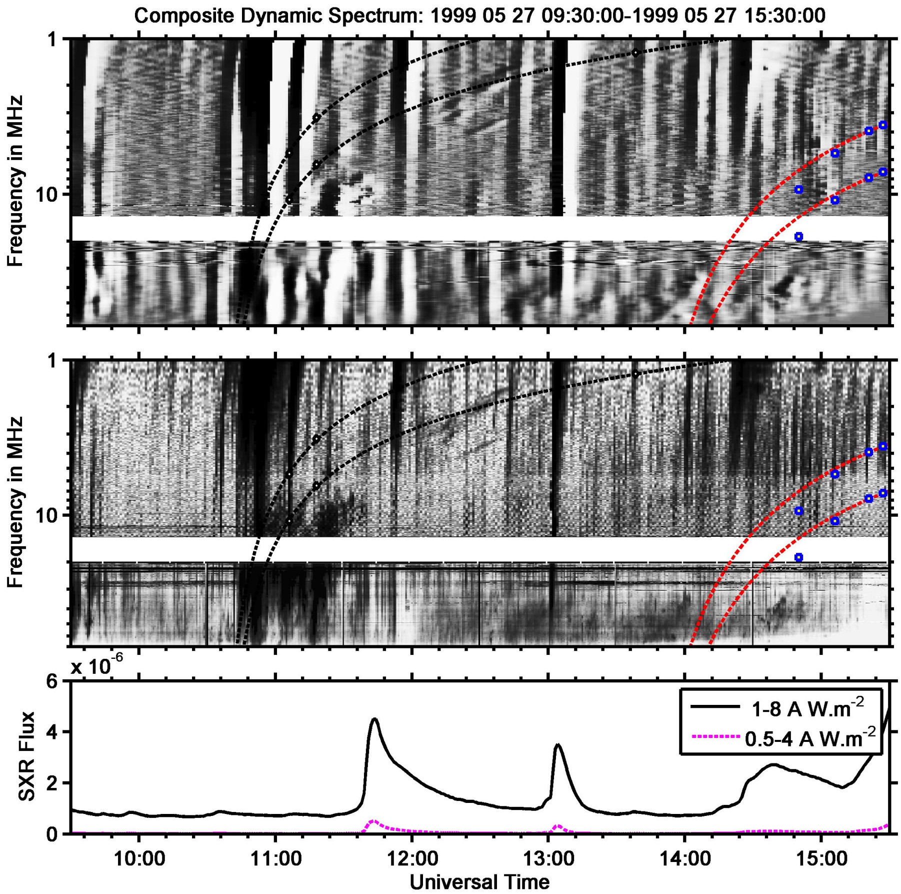

Figure 10. Event 1999 May 27–28, in the 27 May 09:30–15:30 UT period. Panels as Fig. 9. The dynamic spectra are combined recordings from the *Wind*/WAVES and the DAM and extend in the 1–70 MHz range. This section of the type IV_{IP} starts above the 70 MHz and extends to 1 MHz.

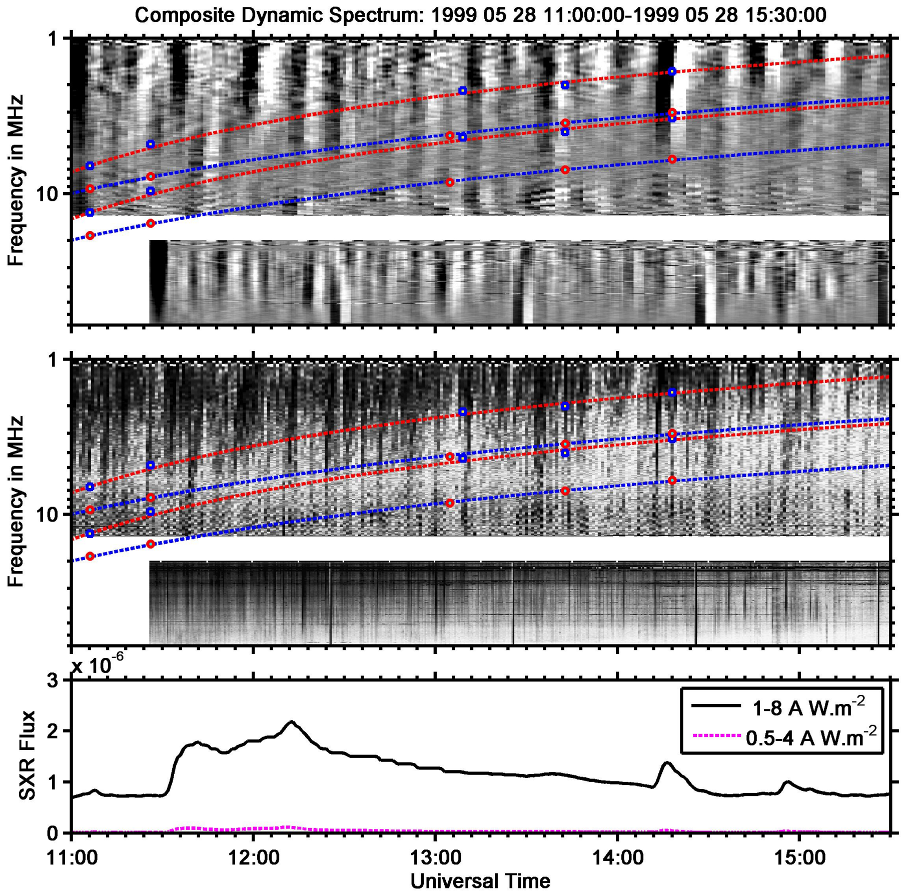

Figure 11. Event 1999 May 27–28 in the 28 May 11:00–15:30 period Panels as in Fig. 10.The type $\mathrm{IV_{IP}}$ has a coronal extension above the 70 MHz; the most prominent part reaches 1 MHz with some parts extending below this frequency.

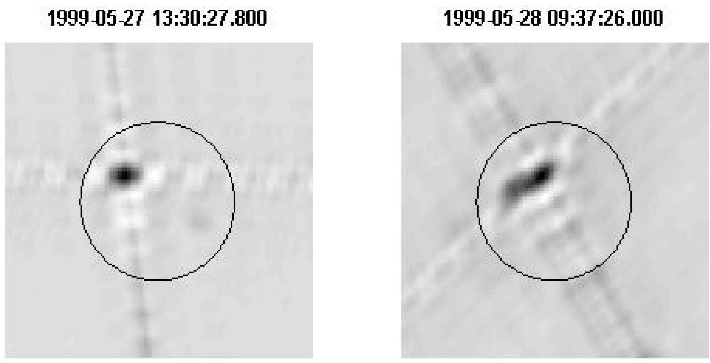

Figure 12. Positions of the Coronal Type IV bursts in the 1999 May 27–28 period, obtained by the Nançay Radioheliograph at 164 MHz.

The end of the 1999, May 27–28 Event coincides with the wide CME mentioned at the beginning of the paragraph.

3.6. Overview of the 2005, January 17 *Extended* Event Evolution

On 17 January 2005 two fast coronal mass ejections were recorded in close succession during two distinct episodes of a 3B/X3.8 flare from the AR10720. The Type IV_{IP} burst started at 10:55 UT on the 17 January and ended by January 18 at 02:00 UT (Event catalogue number 14); for an overview of the dynamic spectrum see figure 3 of Hillaris *et al.* (2011). The coronal extension of the Type IV_{IP} burst was found to originate from AR10720 and persisted throughout the duration of its interplanetary counterpart. The type II activity, on the other hand, was restricted to the frequency range below 14 MHz. The type III groups accompanying the event were found to overshoot the low frequency limit of the type IV_{IP} burst at least after 08:18 UT. Earlier, groups of type U bursts and type IV fine structures indicated acceleration and partial trapping of electrons behind the CME front.

A detailed study of the radio signatures of this event (Table 1 in Hillaris *et al.*, 2011, presents a comprehensive outline of its time evolution) points towards multiple possible acceleration mechanisms. These include CME associated shocks in the high corona and the interplanetary space and, also, shock–independent accelerators at low altitudes associated with the type IV continuum behind the CME.

This event, had distinct features of the *compact* class, associated with an intense flare and two fast CMEs, yet its long duration characterizes it as *extended.* Similar to the previous two long duration events, the energetic electrons provided by low corona sources are well associated with the coronal type IV burst.

4. Characteristics of All Events

4.1. Characteristics of the 45 *Compact* Events

Of the 48 type IV_{IP} bursts of our sample 45, classified as *compact*, were found to conform to the *big flare syndrome* which suggests that, statistically, energetic flare phenomena are more intense in larger flares, regardless of the detailed physics. In fact 19 were associated to X class flares and 21 to M class with only 5 events having C class flares.This represents a significant deviation with respect to the general GOES SXR flare distribution studied by Veronig *et al.* (2002). In the general case it is expected that $\sim$66% of the SXR flares will be of class C with $\sim$9.5% M and just $\sim$0.7% X flares. The general case percentage is, also, consistent with the power-law distribution of the peak SXR flux (I), where the probability density, $p(I) \sim I^{-b}$ with $b \approx 2$ (see Aschwanden and Freeland, 2012). As regards CME–*Compact* event association, 32 of these events were trailing CMEs with speeds $\sim$1400 Km/sec on average with only 11 events having CMEs slower than 1000 Km/s (600–900 Km/s range). This deviates significantly from the LASCO CME distribution in 1998-2011; the comparison of the distributions is presented

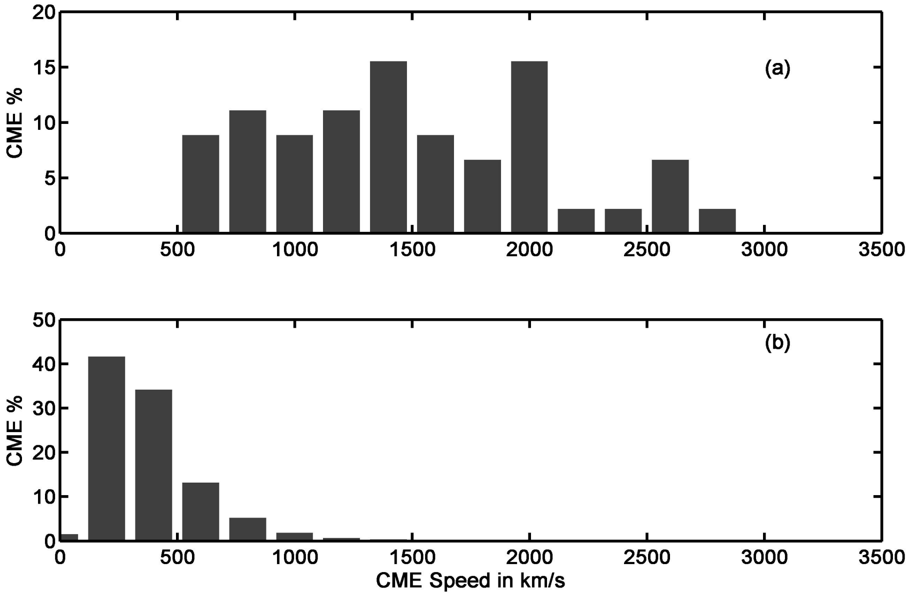

Figure 13. Distribution (%) of CME speeds in Km/s. (a) The LASCO CMES associated with *Compact* events. (b) All LASCO CMES in the 1998–2012 period for comparison.

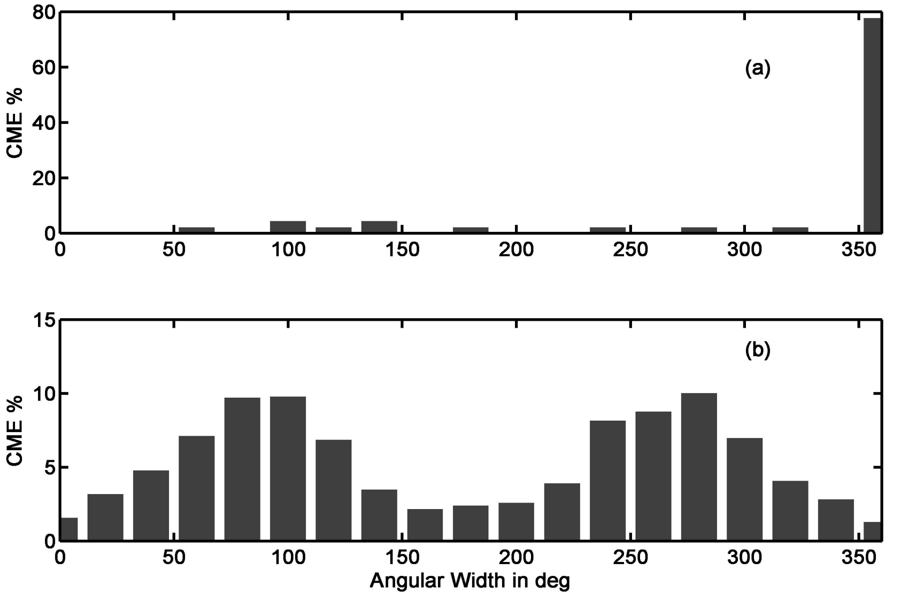

Figure 14. Distribution (%) of CME widths. (a) The LASCO CMES associated with *Compact* events. (b) All LASCO CMES in the 1998–2012 period for comparison.

on figure 13. The same CMEs were found, systematically, in the $\sim 360°$ tail of the width distribution (see figure 14). These fast and wide CMEs were expected to transfer the type IV emitting energetic electrons confined within their cavities. Bain *et al.* (2014) calculated that the electrons accelerated during the CME initiation or early propagation phase, trapped in the magnetic structure of the CME, do not need to be replenished for times of the order of 4 hours; this is consistent with the duration of the *compact* type IV bursts which is, on average, about 106 minutes. Furthermore, 43 *compact* events were characterized by a CME preceding by some hours the associated fast CME along the same path (Similar Measured Position Angle on the LASCO CME lists) could have reduced the propagation drag of the trailing CME.

Contrary to the discussion in the previous paragraph, within the 28/10/2003 11:30-29/10 10:17 UT interval no CME was reported in the SOHO/LASCO catalogue, yet two type IV_{IP} bursts, in close succession, were recorded by the *Wind*/WAVES. These correspond to entries 28 and 29 in Table A1 and represent two *compact* events associated with M Class flares. In the remarks column of the CME catalogue, at the line corresponding to the 28 October 2003 11:30 Halo CME and the associated X17.2 flare it is noted that «*all images after 13:00 UT, particularly C3, are severely degraded due to the ongoing proton storm*». The non-detection of CMEs associated with events 28 and 29 may, threfore, be due to this.

4.2. Characteristics of the Three (3) *Extended* Events

As regards the 3 *extended* or *long duration* type IV_{IP} events, they seem to need a resupply of the continuum as it lasts from 960 min to 115 hours (examples in Fig. 9 and 5); this requirement holds regardless of the intensity and speed of the first associated flare/CME. Now the energetic electron sources in the corona manifest themselves as metric–decametric type III and type IV radio bursts. These electron sources need be associated with the lift-off and propagation of CMEs as they deform the solar magnetic field providing a propagation path for the energetic electrons and, at the same time, a moving magnetic trap.

In the examples of *extended* interplanetary type IV bursts presented in 3.4, 3.5 and 3.6 we see the *replenishment* process, mentioned above, at work; **in all cases** we have, in addition to the dynamic spectra a partial coverage with NRH images. The energetic electron sources in the corona manifesting themselves as metric and decametric type IV radio bursts persist, in the same position, for the duration of each of the interplanetary type IV bursts.

There are, however, other possible sources of energetic electrons. Firstly, the type III bursts; these appear, on dynamic spectra, to extend far beyond the low frequency limits of the type IV_{IP} bursts therefore a mechanism of electron deposition into the type IV_{IP} is not easily envisaged. The Type III–like activity, however, embedded within the type IV continua as part of the type IV fine structure is linked to the type IV energetic population and the corresponding acceleration process. nother type of Type III–like activity, are the *micro-type III* bursts which are parts of the *IP storms.* As they are significantly weaker than the standard type III (six orders of magnitude, after Morioka *et al.*, 2007) they are difficult to detect, especially in the presence of type IIIs but they cannot be ruled out.

Secondly, the type IV_{IP} replenishment from the shock accelerated electrons is considered. The type II bursts appear, mostly, piston driven by CMEs and preceding the type IV continuum, interplanetary and coronal, which evolves in their wake, possibly within the CME core. This implies a sort of magnetic isolation from energetic populations about the CME bow shock. This been said, we note that the possibility of acceleration in the low corona by shocks distinct from those preceding the type IV cannot be precluded; the observational confirmation is difficult however as these are often burried in other types of radio activity.

5. Discussion and Conclusions

The present study was based on a multi–frequency and multi–instrument study of a sample of 48 interplanetary type IV (type IV_{IP}) bursts identified from the *Wind*/WAVES on-line catalogue. The dynamic spectra obtained from the *Wind*/WAVES R1 and R2 receivers, in the hectometric frequency range, were combined with metric and decametric dynamic spectra and supplemented with GOES SXR light curves and LASCO CME data.

In most cases, 45 out of 48, the extension of a metric–decametric moving type IV bursts in the hectometric frequency range was found to be associated to a fast and wide CME (see section 4.1) capable of driving the embedded type IV source into the high corona. This type of bursts have duration of about 106 minute, on average; they were dubbed *compact* type IV_{IP} bursts. The reduced *aerodynamic drag* in the wake of a previous CME, along the same propagation path, appears to increase the probability of the appearance of a type IV_{IP} burst. This preconditioning of interplanetary space by a previous CME was first proposed, before the discovery of CMEs, by Caroubalos (1964) who stated that a disturbance following a preceding disturbance encounters much more regular conditions than the first. This result corresponds to the effect of CMEs on the structure of the ambient magnetic field and solar wind flow which in turn controls the propagation behavior of trailing CMEs as discussed in a number of publications (Vršnak and Žic, 2007; Gopalswamy, 2008; Baker *et al.*, 2013; Vršnak *et al.*, 2014; Liu *et al.*, 2014; Temmer and Nitta, 2015). The basic argument, in all cases, is that a CME may be subject to a *minimal slow down* in the wake of a preceding CME, as it encounters a *preconditioned* region of depleted ambient plasma density and almost radial magnetic field lines; within this region a reduced *aerodynamic drag* is expected. The efficiency of this effect increases, possibly, if the *main* CME is quite dense (as discussed by Temmer and Nitta, 2015, based on detailed modelling of a CME propagation). It is also expected that a wide preceding CME will result in a greater drop of the *aerodynamic drag* compared to a narrow CME along the path of the *main* CME. Further complications may arise due to more than one CMEs, preceding the *main* CME, to the projection effects as regards CME paths and speeds and the ambiguities of CME mass. Despite these, this report provides qualitative support to the reduced *aerodynamic drag* due to *preconditioning* hypothesis.

Appart from the *preconditioning* of space by a preceding CME, discussed in the previous paragraph, the characteristics of these events were consistent with the *big flare syndrome* since they were mostly associated with medium to large flares and fast CMEs (see section 4.1). As regards the small number (5 of 45) events associated with smaller flares we found that either the type IV burst was originating at the solar limb (37, 44), or (35, 42, 43) the origin of the flare was not known; in both cases the flare association was quite uncertain. There were also intense flares within the period of interest, 1998–2012, which did not give type $\mathrm{IV_{IP}}$ bursts. This may be interpreted, at least in part, by the fact that in the *Wind*/WAVES catalogue some are not listed as type IV bursts. On January 20, 2005, for example the interplanetary radio signature of the X7.1/2B flare accompanied by a fast (≈900 Km/s) halo CME was described as *very diffuse* in the catalogue. The same holds for the major solar eruption of 7 March 2012 (X5.4 and X1.3 flares associated with two fast (> 2000 km/s) CMEs, see Patsourakos *et al.*, 2013, 2016); this is mentioned as *Strong intermittent multiple tones.*

In the 3 *long duration*, or *extended*, type $\mathrm{IV_{IP}}$ bursts, the energetic electron population, which is the type $\mathrm{IV_{IP}}$ source, seems to be replenished from the lower solar corona. This implies the possibility of a connection of the type $\mathrm{IV_{IP}}$ enclosing magnetic structure to low coronal electron accelerators or coronal reservoirs. The NRH images, when available, indicate that these are possibly associated to the high frequency type IV which persists through out the duration of the *extended* type $\mathrm{IV_{IP}}$ burst.

A *steady coronal reservoir* of energetic electrons appears to be the metric type IV continuum as most of the type IIIs tend to overshoot the interplanetary type IV. The *micro-type III* bursts, on the other hand, may trace the electrons' path from the *coronal reservoir* to the type $\mathrm{IV_{IP}}$. We state, at this point, that the term *coronal reservoir* is used in order to distinguish from the *heliospheric reservoirs* (see Roelof *et al.*, 1992; Sarris and Malandraki, 2003) beyond 1AU. The fact that the *extended* type $\mathrm{IV_{IP}}$ bursts appear to result, cumulatively, from relatively small energetic events, suggests the presence of some type of trapping structure for the exciter energetic electrons. The type $\mathrm{IV_{IP}}$ heliocentric distances, however, are $\sim$ 25–95$R_{\odot}$ which are quite smaller than the 1AU, and beyond, distance of the *heliospheric reservoirs.*

The question of the confinement of the energetic electrons, producing this type of bursts, at heliocentric distances of the order of some tens of $R_{\odot}$ remains open.

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Appendix

A. Comprehensive Catalogue of the Type IV_{IP} Burst Recordings

In table A1 we provide a summary of the interplanetary type IV bursts recorded by the *Wind*/WAVES R1 and R2 receivers in the 13.825 MHz–20 KHz frequency range, with their associated CMEs and SXR flares in the 1998–2012 period. The coronal extensions of these bursts by the RSTN, DAM, ARTEMIS-IV, CULGOORA, Hiraiso and IZMIRAN radio-spectrographs are included for comparison.

The headline to each event includes event number, date of observation and characterization of the event as *compact* or *extended* following **the** classification introduced in section 3. Column 1 gives the type of activity; for SXR flares we give the GOES class .The secondary headline, *CME preceding Main Ejection*, stands for CMEs preceding the *main* CME associated with the event by $\sim$ two days along the same path; the path similarity is determined by the comparison of the Position Angle (PA) and width of the preceding CME to the main. In the *Extended Events* the secondary headline is, sometimes, absent as, they may originate from a number of energetic events (flares and CMEs) and not from a powerful flare/fast CME with the latter propagating in the wake of preceding ejections (see discussion in 5). **Columns 2-3** give start, peak, end of each type of activity in UT and Month Day Hour Minute (MM/DD HH:MM) format for Start, End; D indicates that the event extends in time beyond the observation period. The CME start time, in column 2, is the first C2 appearance, while its extrapolated lift–off time appears in **the next row as a remark (see below for the description of the remark lines). In column 4** we give the SXR flare 1-8 Å integrated flux ($\mathbf{F^{tot}_{SXR}}$ **in** $\mathbf{J/m^2}$) and, in the same column, the CME speed ($\mathbf{V_{CME}}$) in km/s. The location of the flare on the disk and the CME Measurement Position Angle (MPA) of the CMEs with their angular width in parenthesis are given in **column 5**; the SXR flare location is determined from the position of the associated $H\alpha$ flare on disk or the Solar X-ray Imager of GOES report if available. In **column 5** we also give the position of the coronal radio bursts when NRH recordings are available. In **column 6** we give the frequency range of the radio bursts in MHz; the L indicates that the burst extends to lower frequencies, H stands for high frequency extension.

Comments and remarks, when necessary, **are in separate lines under the description of the activity line. The comments include the reporting stations from which the data of each observation was obtained and the quality of the *Wind*/WAVES and the SOHO/LASCO recordings the NOAA active region number of the event. For the SXR flares the SXR peak and the** $H\alpha$ **category when available are reported while for the CMESs the extrapolated lift-off time is presented. Lastly, in the comments lines data gaps, if any, are repoted**.

The reporting observatory **or space experiment abbreviations used** in Table A1 are:

ART-4 ARTEMIS-IV, Greece

CUL Culgoora, Australia
SAG RSTN Network: Sagamore Hill (K7OL), Massachusetts, USA
PAL RSTN Network: Palehua (PHFF), Hawaii
HOL RSTN Network: Holloman (KHMN), New Mexico, USA
LEA RSTN Network: Learmonth (APLM), Australia
SVI RSTN Network: San Vito, Italy (LISS))
RAM Ramey AFB, Puerto Rico, USA
IZM The radio-spectrograph of Izmiran
KANZ Kanzelhöhe Solar Observatory
MIT National Astronomical Observatory of Japan, Mitaka
HiRAS Hiraiso Radio Spectrograph
DAM The Nançay Decameter Array
NRH The Nançay radioheliograph
XFL SXR flare from the GOES Solar X-ray Imager (SXI)
Gxx **SXR flare from the GOES xx (for example G08 stands for GOES 08)**

All abbreviations with the only exception of NRH, DAM and ART-4 were adopted from the Space Weather Prediction Center[11] *station list*

Table A1.: Type IV_{IP} Radio Bursts and Associated Activity

Obs.	Start	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
	Universal Time				
***Compact Event*: 01/2012 March 05**					
Type IV	03/05 04:15	03/05 07:00			14-7.0
Type II	03/05 04:00	03/05 12:20			14-0.4
	Type IV_{IP}& II (F-H), by Wind/*WAVES*				
Type IV	03/05 03:33	03/05 08:33			25L-500H
	Coronal Type IV by LEA, HiRAS				
Type III	03/05 03:33	03/05 04:48			500-1L
	Two Groups (GG) by Wind/*WAVES HiRAS & LEA*				
X1.1	03/05 02:30	03/05 04:43	$3.70{\cdot}10^{-1}$	N17°E52°	
	Peak at 04:09, Br./Import. 2B, in AR11429 by G15 & LEA				
CME	03/05 04:00		1531	61°Halo	
	CME Lift-off: 03/05 03:31				
CME(s)Preceding Main Ejection					
CME	03/05 03:12		594	46°(92°)	
CME	03/04 20:48		720	52°(65°)	
CME	03/04 11:00		1306	52°Halo	

[11] ftp.swpc.noaa.gov/pub/welcome/stations

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
	Universal Time				
***Compact Event*: 02/2012 March 04**					
Type IV	03/04 11:15	03/04 12:15			14-8.0
Type II	03/04 12:15	03/04 17:00			0.9-0.3
Type IV_{IP}& II, by Wind/*WAVES*					
Type IV	03/04 10:00	03/04 12:15		N19°E61°	550H-20L
Coronal Type IV by ART-IV, NRH & SVI					
Type III	03/04 10:58	03/04 11:43			500-1L
Group (GG) by Wind/*WAVES ART-IV, NRH & SVI*					
M2.0	03/04 10:29	03/04 12:16	$9.20{\cdot}10^{-2}$	N19°E61°	
Peak at 10:52, Br./Import. 1N, in AR11429 by G15 & SVI					
CME	03/04 11:00		1306	52°Halo	
CME Lift-off: 03/04 10:31					
CME(s)Preceding Main Ejection					
CME	03/04 05:00		584	52°(160°)	
Partial Halo CME					
***Compact Event*: 03/2012 January 27**					
Type II	01/27 18:30	01/28 04:45			14-0.150
Type IV	01/27 18:45	01/27 20:20			14-10
Type IV_{IP}& II (F-H, intermittent), by Wind/*WAVES*					
Type II	01/27 18:13	01/27 18:25			25L-75
Type IV	01/27 18:14	01/27 18:44			25L-180H
Coronal Type II & IV by SAG					
Type III	01/27 17:37	01/27 18:31			180H-1L
Group (GG) by Wind/*WAVES & SAG*					
X1.7	01/27 17:37	01/27 18:56	$3.20{\cdot}10^{-1}$	N27°W71°	
Peak at 18:37, Br./Import. 1F, in AR11402 by G15 & HOL					
CME	01/27 18:28		2508	296°Halo	
CME Lift-off: 01/27 18:14					
CME(s)Preceding Main Ejection					
CME	01/27 03:47		415	230°(92°)	
CME	01/26 04:36		1194	327°Halo	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start	End	F^{tot}_{SXR} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 04/24 September 2011**					
Type IV	09/24 19:45	09/24 21:15			14-7.0
Type IV_{IP} by Wind/*WAVES*					
Type IV	09/24 18:30	09/24 20:30			180H-25L
Coronal Type IV by LEA					
Type III	09/24 19:09	09/24 21:05			180H-1L
Four Groups (GG) by Wind/*WAVES & LEA*					
M3.0	09/24 19:09	09/24 19:41	$4.60 \cdot 10^{-2}$	N15°E56°	
Peak at 19:21, in AR11302 by G15					
CME	09/24 19:36		972	43°Halo	
CME Lift-off: 09/24 18:55					
CME(s)Preceding Main Ejection					
CME	09/24 12:48		1915	78°Halo	
***Compact Event*: 05/24 September 2011**					
Type IV	09/24 13:00	09/24 14:15			14-8.0
Type II	09/24 12:50	09/24 22:45			14-0.3
Type IV_{IP}& II (Multiple tones), by Wind/*WAVES*					
Type IV	09/24 12:30	09/24 15:00D		N15°E56°	200-20L
Coronal Type IV by ART-IV, DAM & NRH					
Type III	09/24 12:30	09/24 13:26			200H-1L
by Wind/*WAVES, ART-IV, DAM & NRH*					
M7.1	09/24 12:33	09/24 14:10	$2.90 \cdot 10^{-1}$	N15°E56°	
Peak at 13:20, Br./Import. 1B, in AR11302 by G15 & HOL					
CME	09/24 12:48		1915	78°Halo	
CME Lift-off: 09/24 12:33					
CME(s)Preceding Main Ejection					
CME	09/24 09:48		1936	90°(145°)	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 06/22 September 2011**					
Type IV	09/22 11:15	09/22 12:30			14-10
Type II	09/22 11:05	09/22 24:00			14-0.07
Type IV_{IP}& II (Multiple tones), by Wind/*WAVES*					
Type IV	09/22 10:38	09/22 14:00		N13°E78°	180H-25L
Type II	09/22 10:38	09/22 10:45			100H-25L
Coronal Type IV &II by ART-IV, SVI & NRH					
Type III	09/22 10:38	09/22 11:20			180H-1L
Two Groups (GG) by Wind/*WAVES, ART-IV, SVI & NRH*					
X1.4	09/22 10:29	09/22 1144	$4.50{\cdot}10^{-1}$	N13°E78°	
Peak at 11:01, Br./Import. 2N, in AR11302 by G15 & SVI					
CME	09/22 10:48		1905	72°Halo	
CME Lift-off: 09/22 10:28					
CME(s)Preceding Main Ejection					
CME	09/21 22:12		1007	305°(>255°)	
Uncertain Width, Partial Halo.					
CME	09/21 10:12		229	50°(74°)	
CME	09/21 04:36		290	71°(73°)	
Two Poor Events					
***Compact Event*: 07/2006 December 14**					
Type II	12/14 22:30	12/14 23:40			14-1.5
Type IV	12/14 22:30	12/14 23:45			14-5.0
Type IV_{IP}& II, by Wind/*WAVES*					
Type II	12/14 22:06	12/14 22:18			200H-18L
Type IV	12/14 22:06	12/14 23:30			500H-18L
Coronal Type IV(F-H) &II by CUL & HiRAS					
Type III	12/14 22:06	12/14 23:37			300-1L
Group (GG) by Wind/*WAVES, CUL & HiRAS*					
X1.5	12/14 21:07	12/14 22:26	$1.20{\cdot}10^{-1}$	S06°W46°	
Peak at 22:15, in AR10930 by G12 & XFL					
CME	12/14 22:30		1042	248°Halo	
CME Lift-off: 12/14 21:49					
CME(s)Preceding Main Ejection					
CME	12/13 23:48		388	237°(40°)	
CME	12/13 02:54		1774	193°Halo	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start	End	F^{tot}_{SXR} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
	Universal Time				
***Compact Event*: 08/2006 December 13**					
Type II	12/13 02:45	12/13 10:40			12-0.150
Type IV	12/13 03:00	12/13 04:15			14-7.0
Type IV_{IP}& II (Fast F-H), by Wind/*WAVES*					
Type II	12/13 02:25	12/13 02:44			300-20
Type IV	12/13 02:25	12/13 10:00			600H-20L
Coronal Type IV &II by CUL, LEA & HiRAS					
Type III	12/13 02:33	12/13 04:07			600H-1L
Several Groups (GG) by Wind/*WAVES, CUL, LEA & HiRAS*					
X3.4	12/13 02:14	12/13 02:57	$5.10 \cdot 10^{-1}$	S06°W23°	
Peak at 02:40, Br./Import. 4B, in AR10930 by G12, XFL & LEA					
CME	12/13 02:40		1774	193°Halo	
CME Lift-off: 12/13 02:19					
CME(s)Preceding Main Ejection					
CME	12/12 21:47		146	207°(75°)	
CME	12/12 20:28		474	198°(50°)	
***Compact Event*: 09/2005 September 13**					
Type IV	09/13 20:05	09/13 21:00			14-3.0
Type II	09/13 20:20	09/15 06:00			1.1-0.035
Type IV_{IP}& II, by Wind/*WAVES*					
Type IV	09/13 19:44	09/13 22:00			180H-25L
Type II	09/13 19:45	09/13 20:20			80-25L
Coronal Type IV &II by PAL & SAG					
Type III	09/13 19:40	09/13 20:09			180H-1L
Two Groups (GG) by Wind/*WAVES, PAL & SAG*					
X1.5	09/13 19:19	09/13 20:57	$5.50 \cdot 10^{-1}$	S09°E10°	
Peak at 19:27 (Second Peak at 20:05), Br./Import. 2B, in AR10808 by G12 & HOL					
CME	09/13 20:00		1866	149°Halo	
CME Lift-off: 09/13 19:35					
CME(s)Preceding Main Ejection					
CME	09/12 09:12		511	135°(22°)	
CME	09/11 13:01		1922	125°Halo	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F^{tot}_{SXR} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 10/2005 September 09**					
Type IV	09/09 20:15	09/09 21:10			14-5.0
Type II	09/09 19:45	09/09 22:00			10-0.05
Type II (diffuse) & IV_{IP} by Wind/*WAVES*					
Type IV	09/09 19:34	09/09 21:23			180H-25L
Type II	09/09 19:34	09/09 19:49			180-25L
Coronal Type IV &II by PAL & HOL					
Type III	09/09 19:30	09/09 20:17			180H-1L
Group (GG) by Wind/*WAVES, PAL & HOL*					
X6.2	09/09 19:13	09/09 20:36	1.70	S12°E58°	
Peak at 20:04, Br./Import. 2B, in AR10808 by G12, XFL & HOL					
CME	09/09 19:48		2257	115°Halo	
CME Lift-off: 09/09 19:30					
CME(s)Preceding Main Ejection					
CME	09/07 05:48		195	85°(74°)	
***Compact Event*: 11/2005 August 22**					
Type IV	08/22 01:45	08/22 03:15			14-10
Type II	08/22 01:30	08/22 03:35			8-0.550
Type II (Strong F, weak H) &Type IV_{IP} Weak, by Wind/*WAVES*					
Type IV	08/22 00:59	08/22 04:00D			500H-20L
Type II	08/22 01:00	08/22 01:45			200-20L
Coronal Type II & IV, by CUL & HiRAS					
Type III	08/22 01:01	08/22 01:22			100-1L
Group (GG) by Wind/*WAVES, CUL & HiRAS*					
M2.6	08/22 00:44	08/22 02:18	$9.60 \cdot 10^{-2}$	S11°W54°	
Peak at 01:33, Br./Import. 1F, in AR10798 by G12, XFL & LEA					
CME	08/22 01:32		1194	220°Halo	
CME Lift-off: 08/22 0:52					
CME(s)Preceding Main Ejection					
CME	08/21 12:06		287	255°(61°)	
C2 Only					

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 12/2005 May 11**					
Type IV	05/11 20:05	05/11 20:20			14-8.0
Type II	05/11 20:05	05/11 20:35			14-2.5
Type II (F-H) & IV_{IP}, by Wind/*WAVES*					
Type II	05/11 19:29	05/11 21:00			180H-4L
Type IV	05/11 19:40	05/11 21:00D			180H-25L
Coronal TypeII & IV by PAL					
Type III	05/11 19:30	05/11 19:53			180H-1L
Two Groups (GG) by Wind/*WAVES & PAL*					
M1.1	05/11 19:22	05/11 19:55	$1.60{\cdot}10^{-2}$	S10°W47°	
Peak at 19:38, Br./Import. 1F, in AR10758 by G12, HOL & XFL					
CME	05/11 20:13		550	232°Halo	
CME Lift-off: 05/11 18:36					
CME(s)Preceding Main Ejection					
CME	05/11 07:32		305	238°(95°)	
CME	05/10 16:06		609	275°Halo	
***Compact Event*: 13/2005 January 19**					
Type IV	01/19 08:45	01/19 09:55			14-4.50
Type II	01/19 09:20	01/19 24:00			5.3-0.040
Type II (Complex, intermittent) & IV_{IP}, by Wind/*WAVES*					
Type II	01/19 08:12	01/19 08:20			300-20L
Type IV	01/19 08:05	01/19 10:50D		N15°W51°	600-20L
Coronal Type IV &II by ART-IV & NRH					
Type III	01/19 08:14	01/19 08:45			400-1L
Two Groups by Wind/*WAVES, ART-4 & NRH*					
M6.7	01/19 06:58	01/19 07:55	$7.7{\cdot}10^{-2}$	N15°W51°	
Peak at 07:31, in AR10720 by G12 & XFL					
X1.3	01/19 08:03	01/19 08:40	$2.20{\cdot}10^{-1}$	N15°W51°	
Peak at 08:22, Br./Import. 2N, in AR10720 by G12, LEA & XFL					
CME	01/19 08:29		2020	320°Halo	
CME Lift-off: 01/19 08:02					
CME(s)Preceding Main Ejection					
CME	01/18 17:14		287	305°(43°)	
CME	01/17 09:30		2094	334°Halo	
CME	01/17 09:54		2547	309°Halo	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start	End	F_{SXR}^{tot}	Position	Freq.
	Universal Time		(J/m^2)	PA	MHz
			V_{CME}	(Width)	
			(Km/s)		
***Extended Event*: 14/2005 January 17**					
Type IV	01/17 10:00	01/18 02:00			14-4.0
Type II	01/17 09:25	01/18 16:00			14-0.030
Complex, Multi-component Type II & Longest Duration IV_{IP}, by Wind/*WAVES*					
Type IV	01/17 08:40	01/17 15:24D		N15°W25°	630-20L
Coronal Type IV &II by ART-IV & NRH					
Type IV	01/17 17:17	01/18 03:00D			630H-20L
Coronal Type IV &II by CUL, PAL & LEA					
Type III	01/17 09:07	01/17 09:59			630-1L
Two Groups (GG) by Wind/*WAVES, ART-4 & NRH*					
X3.8	01/17 06:59	01/17 10:07	$8.40{\cdot}10^{-01}$	N15°W25°	
Peak at 09:52, Br./Import. 3B, in AR10720 by G12, XFL & KANZ					
CME	01/17 09:54		2547	309°Halo	
CME Lift-off:01/17 09:38					
CME(s)Preceding Main Ejection					
CME	01/17 09:30		2094	334°Halo	

***Compact Event*: 15/2005 January 15**					
Type IV	01/15 23:30	01/16 02:00			14-7.0
Type II	01/15 23:00	01/16 24:00			3-0.040
Type II (Fast Multi-component) & IV_{IP}, by Wind/*WAVES*					
Type IV	01/15 22:30	01/16 03:00D			500H-30L
Type II	01/15 22:36	01/15 23:00			200-30L
Coronal Type IV &II by CUL					
Type III	01/15 22:33	01/15 23:08			180-1L
Group (GG) by Wind/*WAVES & CUL*					
X2.6	01/15 22:25	0115 23:31	$6.30{\cdot}10^{-01}$	N15°W05°	
Peak at 23:02, in AR10720 by G12 & XFL					
CME	01/15 23:07		2861	323°Halo	
CME Lift-off:01/15 22:36					
CME(s)Preceding Main Ejection					
CME	01/15 06:30		2049	359°Halo	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 16/2005 January 15**					
Type IV	01/15 07:00	01/15 08:30			14-7.0
Type II	01/15 06:15	01/15 09:30			14-0.250
Type II (Chaotic) & IV_{IP}, by Wind/*WAVES*					
Type IV	01/15 06:00	01/15 10:00D		N11°E06°	630-20L
Coronal Type IV by ART-IV & NRH					
Type III	01/15 06:06	01/15 06:40			630-1L
Group by Wind/*WAVES, ART-4 & NRH*					
M8.6	01/15 05:54	01/15 07:17	$2.90{\cdot}10^{-1}$	N11°E06°	
Peak at 06:38, Br./Import. SF, in AR10720 by G12, XFL & LEA					
CME	01/15 06:30		2049	359°Halo	
CME Lift-off:01/15 05:57					
CME(s)Preceding Main Ejection					
CME	01/14 17:06		358	238°Halo	
Poor Event, Only C2					
CME	01/13 23:54		335	058°>250°	
Uncertain Width, Partial Halo					
***Compact Event*: 17/2004 November 09**					
Type IV	11/09 17:50	11/09 19:50			14-7.0
Type II	11/09 17:35	11/09 18:10			14-5.0
Type II (Intermittent Tone) & IV_{IP}, by Wind/*WAVES*					
Type II	11/09 17:24	11/09 17:30			40-25L
Type IV	11/09 17:06	11/09 20:30D			180H-25L
Coronal Type IV &II by SAG					
Type III	11/09 17:00	11/09 17:30			180H-1L
Group by Wind/*WAVES &SAG*					
M8.9	11/09 16:59	11/09 17:32	$9.40{\cdot}10^{-2}$	N08°W51°	
Peak at 17:19, Br./Import. 2N, in AR10696 by G12, XFL & HOL					
CME	11/09 17:26		2000	299°Halo	
CME Lift-off: 11/09 16:57					
CME(s)Preceding Main Ejection					
CME	11/09 01:28		282	295°(26°)	
CME	11/08 11:54		557	310°(27°)	
CME	11/08 14:54		605	307°(23°)	
CME	11/08 03:54		462	148°Halo	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 18/2004 November 07**					
Type IV	11/07 17:10	11/07 18:15			14-10
Type II	11/07 16:25	11/08 20:00			14-0.060
Type II (Chaotic with multiple tones) & IV_{IP}, by Wind/*WAVES*					
Type II	11/07 15:59	11/07 16:16			180H-25L
Type IV	11/07 16:00	11/07 19:00D			180H-25L
Coronal Type IV &II by SAG					
Type III	11/07 15:59	11/07 16:57			180H-1L
Group (GG) by Wind/*WAVES &SAG*					
X2.0	11/07 15:42	11/07 16:15	$2.00{\cdot}10^{-1}$	N09°W17°	
Peak at 16:06, in AR10696 by G12 & XFL					
CME	11/07 16:54		1759	00°Halo	
CME Lift-off: 11/07 16:16					
CME(s)Preceding Main Ejection					
CME	11/07 14:30		226	298°(100°)	
CME	11/06 02:06		1111	21°(>214°)	
Poor Event with Uncertain Width, Partial Halo					
CME	11/06 01:32		818	23°Halo	
***Compact Event*: 19/2004 November 06**					
Type IV	11/06 01:20	11/06 02:30			14-10
Type II	11/06 01:50	11/06 02:45			6-0.70
Type II & IV_{IP}, by Wind/*WAVES*					
Type IV	11/06 00:33	11/06 02:45			1000-18L
Type II	11/06 00:44	11/06 00:58			80-25
Coronal Type IV &II by LEA & CUL					
Type III	11/06 00:44	11/06 00:58			1000-1L
Type III	11/06 01:40	11/06 01:43			1000-1L
Two Groups by Wind/*WAVES& CUL*					
M9.3	11/06 00:11	11/06 00:42	$6.50{\cdot}10^{-2}$	N10°E08°	
Peak at 00:34 , Br./Import. 2N, in 10696 by G12, XFL & LEA					
M5.9	11/06 00:44	11/06 01:10	$8.50{\cdot}10^{-2}$	N10°E05°	
Peak at 00:57 , Br./Import. 1N, in 10696 by G12 & CUL					
M3.6	11/06 01:40	11/06 02:08	$5.50{\cdot}10^{-2}$	N07°E00°	
Peak at 01:57, Br./Import. 1N, in AR10696 by G12 & CUL					
CME	11/06 01:32		818	23°Halo	
CME Lift-off: 11/06 00:38					

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start	End	F_{SXR}^{tot}	Position	Freq.
	Universal Time		(J/m^2)	PA	MHz
			V_{CME}	(Width)	
			(Km/s)		
CME(s)Preceding Main Ejection					
CME	11/06 02:06		1111	21°(>214°)	
Poor Event with Uncertain Width, Partial Halo					
CME	11/06 23:30		1055	31°(>293°)	
Uncertain Width; Partial Halo					
***Compact Event*: 20/2004 July 29**					
Type IV	07/29 12:40	07/29 14:30			14-3.0
Type II	07/29 13:20	07/29 20:30			1.0-0.05
Type II (Continuous tone with structure) & IV_{IP}, by Wind/*WAVES*					
Type IV	07/29 11:30	07/29 13:30		S00°W90°	180H-25L
Coronal Type IV by SVI					
Type III	07/29 10:57	07/29 12:26			180H-1L
Several Grours (GG & G) by Wind/*WAVES &SVI*					
C2.1	07/29 11:42	07/29 14:02	$1.20{\cdot}10^{-2}$		
Peak at 13:04, in AR10652 by G12					
CME	07/29 12:06		1180	245°Halo	
CME Lift-off: 07/29 11:51					
CME(s)Preceding Main Ejection					
CME	07/29 09:30		275	241°(48°)	
CME	07/28 03:30		754	284°(>201°)	
Uncertain Width, Partial Halo					
***Compact Event*: 21/2004 July 25**					
Type IV	07/25 15:10	07/25 20:30			14-2.0
Type II	07/25 15:00	07/26 22:25			1.0-0.028
Type II (Complex with many bands) & IV_{IP}, by Wind/*WAVES*					
Type IV	07/25 14:15	07/25 17:31		N04°W30°	180H-25L
Coronal Type IV by SVI & NRH					
Type III	07/24 13:18	07/24 15:10			180H-1L
Type III Groups by Wind/*WAVES &SVI*					
C2.1	07/24 13:18	07/24 13:32	$1.50{\cdot}10^{-3}$	N04°W29°	
Peak at 13:25, in AR10652 by G12 & XFL					
M2.2	07/24 13:37	07/24 13:55	$1.30{\cdot}10^{-2}$	N04°W30°	
Peak at 13:49, in AR10652 by G12 & XFL					
M1.1	07/25 14:19	07/25 16:43	$6.50{\cdot}10^{-2}$	N08°W33°	
Peak at 15:14, Br./Import. 1F, in AR10652 by G12 & HOL					
CME	07/25 14:54		1333	204°Halo	
CME Lift-off: 07/25 14:32					

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
CME(s)Preceding Main Ejection					
CME	07/25 14:30		450	229°(45°)	
CME	07/25 13:32		556	242°(16°)	
CME	07/25 06:54		299	296°(31°)	
CME	07/24 23:54		555	215°(78°)	
***Compact Event*: 22/2004 July 23**					
Type IV	07/23 19:30	07/23 20:30			14-7.0
Type II	07/23 19:00	07/23 19:35			1-2.5
Type II & IV_{IP}, by Wind/*WAVES*					
Type IV	07/23 18:30	07/23 21:30			180H-25L
Coronal Type IV by PAL					
Type III	07/23 17:30	07/23 18:30			180H-1L
Type III Group (GG) by Wind/*WAVES &PAL*					
M2.2	07/23 17:07	07/23 17:35	$1.50{\cdot}10^{-2}$	N04°W08°	
Peak at 17:28, in AR10652 by G12 & XFL					
C4.1	07/23 18:02	07/23 18:11	$1.70{\cdot}10^{-3}$	N05°W05°	
Peak at 18:07, in AR10652 by G12 & XFL					
M1.7	07/23 21:15	07/23 21:30	$9.00{\cdot}10^{-3}$	N05°W07°	
Peak at 21:23, in AR10652 by G12 & XFL					
CME	07/23 19:32		874	187°(100°)	
CME Lift-off: 07/23 18:47					
CME(s)Preceding Main Ejection					
CME	07/23 16:06		824	278°Halo	
CME	07/23 17:54		569	256°(142°)	
CME	07/23 07:32		459	218°(138°)	
Two Partial Haloes					
***Compact Event*: 23/2003 November 04**					
Type IV	11/04 20:20	11/04 21:00			14-10
Type II	11/04 20:00	11/04 24:00			10-0.20
Type II & IV_{IP}, by Wind/*WAVES*					
Type IV	11/04 19:35	11/04 21:00			300H-25L
Coronal Type IV by HOL & CUL (after 20:00)					
Type III	11/04 19:35	11/04 20:38			180H-1L
Type III Groups by Wind/*WAVES &HOL*					
X17.4	11/04 19:29	11/04 20:06	2.30	S19°W83°	
Peak at 19:53, Br./Import. 3B, in AR10486 by G12 & HOL					
CME	11/04 19:54		2657	260°Halo	
CME Lift-off: 11/04 19:38, 3 Points					

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
CME(s)Preceding Main Ejection					
CME	11/04 19:32		327	187°(52°)	
CME	11/04 12:54		605	263°(72°)	
CME	11/04 12:06		1208	84°Halo	
***Compact Event*: 24/2003 November 03**					
Type IV	11/03 10:15	11/03 11:15			14-6.0
Type II	11/03 10:00	11/03 12:30			6-0.40
Type II (Complex F-H) & IV_{IP} (with drifting features), by Wind/*WAVES*					
Type IV	11/03 09:50	11/03 11:40		N08°W77°	500-20L
Type II	11/03 09:51	11/03 10:12			200-20L
Coronal Type IV & II by ART-IV & NRH					
Type III	11/03 09:49	11/03 10:05			500H-1L
Groups (GG) by Wind/*WAVES, ART-IV & NRH*					
X3.9	11/03 09:43	11/03 10:19	$5.60 \cdot 10^{-1}$	N08°W77°	
Peak at 09:55, Br./Import. 2F, in AR10488 by G12 & LEA					
CME	11/03 10:06		1420	301°(103°)	
CME Lift-off:11/03 09:45					
CME(s)Preceding Main Ejection					
CME	11/03 01:59		827	324°(65°)	
***Compact Event*: 25/2003 November 03**					
Type IV	11/03 02:10	11/03 03:05			14-9.0
Type II	11/03 01:15	11/03 01:25			3.0-1.5
TypeII (Multiple brief tones) & IV_{IP}, by Wind/*WAVES*					
Type IV	11/03 01:31	11/03 04:00			500H-18L
Type II	11/03 01:24	11/03 01:30			200-18L
Coronal Type IV & II by CUL & LEA					
Type III	11/03 00:58	11/03 01:34			250-1L
Group (GG) by Wind/*WAVES& CUL*					
X2.7	11/03 01:09	11/03 01:45	$3.60 \cdot 10^{-1}$	N10°W83°	
Peak at 01:30, Br./Import. 2B, in AR10488 by G12 & LEA					
CME	11/03 01:59		827	324°(65°)	
CME Lift-off:11/03 00:52					
CME(s)Preceding Main Ejection					
CME	11/01 21:30		413	320°(>143°)	
Uncertain Width, Partial Halo					

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 26/2003 November 02**					
Type IV	11/02 17:55	11/02 18:50			14-8.0
Type II	11/02 17:30	11/03 01:00			12-0.25
	Type II (Chaotic and intense) & IV_{IP}, by Wind/*WAVES*				
Type IV	11/02 17:14	11/02 18:24			80-25L
Type II	11/02 17:14	11/02 17:37			180-25L
	Coronal Type IV & II by HOL				
Type III	11/02 17:14	11/02 17:48			180-1L
	Group (GG) by Wind/*WAVES& HOL*				
X8.3	11/02 17:03	11/02 17:39	$9.10 \cdot 10^{-1}$	S14°W56°	
	Peak at 17:25, Br./Import. 2B, in AR10486 by G12 & HOL				
CME	11/02 17:30		2598	265°Halo	
	CME Lift-off:11/02 17:16				
CME(s)Preceding Main Ejection					
CME	11/02 11:30		826	226°(33°)	
CME	11/02 09:30		2036	195°Halo	
***Compact Event*: 27/2003 October 29**					
Type IV	10/29 21:15	10/29 22:30			14-5.0
Type II	10/29 20:55	10/29 24:00			11-0.50
	Type II (Difficult to observe) & IV_{IP}, by Wind/*WAVES*				
Type IV	10/29 20:39	10/29 21:00D			500H-20L
Type II	10/29 20:42	10/29 20:55			18-430
	Coronal Type IV & II by CUL				
Type III	10/29 20:49	10/29 21:00			500H-1L
	Group (GG) by Wind/*WAVES& CUL*				
X10.0	10/29 20:37	10/29 21:01	$8.70 \cdot 10^{-1}$	S15°W02°	
	Peak at 20:49, Br./Import. 2B, in AR10486 by G12 & HOL				
CME	10/29 20:54		2029	190°Halo	
	CME Lift-off:10/29 20:36				
CME(s)Preceding Main Ejection					
CME	10/29 10:17		922	182°(114°)	
	Very Poor Event, C2 Only.				

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start	End	F^{tot}_{SXR}	Position	Freq.
	Universal Time		(J/m^2)	PA	MHz
			V_{CME}	(Width)	
			(Km/s)		
***Compact Event*: 28/2003 October 29**					
Type IV	10/29 06:00	10/29 11:00			14-9.0
Type IV_{IP}, by Wind/*WAVES*					
Type IV	10/29 05:35	10/29 13:00D		S20°W08°	200-20L
Coronal Type IV & II by ART-IV, SVI, HOL & NRH (after 10:00)					
Type III	10/29 04:27	10/29 10:00			180H-1L
Groups (GG) by Wind/*WAVES, ART-4 &SVI*					
M3.5	10/29 04:08	10/29 05:54	$1.20{\cdot}10^{-1}$	S17°E06°	
Peak at 05:11, Br./Import. SN, in AR10486 by G12 & LEA					
CME	10/29 10:17		922	200°(114°)	
CME Lift-off:10/29 09:00, Very Poor Event, C3 Only					
NO LASCO CMEs recorded from 28 October 11:30 to 29 October 10:17 UT.					
***Compact Event*: 29/2003 October 29**					
Type IV	10/29 01:30	10/29 04:00			14-7.0
Type IV_{IP}, by Wind/*WAVES*					
Type IV	10/29 00:37	10/29 03:55D			180H-25L
Coronal Type IV & II by LEA					
Type III	10/29 00:21	10/29 01:29			180H-1L
by Wind/*WAVES& LEA*					
M1.1	10/29 00:26	10/29 02:08	$5.20{\cdot}10^{-02}$	S18°E08°	
Peak at 01:51, Br./Import. 1F, in AR10486 by G12 & LEA					
NO LASCO CMEs recorded from 28 October 11:30 to 29 October 10:17 UT.					
***Compact Event*: 30/2003 October 28**					
Type IV	10/28 11:30	10/28 15:00			14-5.0
Type II	10/28 11:10	10/29 24:00			14-0.04
Strongest type II & IV_{IP} observed by Wind/*WAVES*					
Type IV	10/28 10:38	10/28 14:00D		S16°E08°	550-20L
Type II	10/28 11:05	10/28 11:17			550-20L
Coronal Type IV & II by ART-IV & NRH (after 10:00)					
Type III	10/28 10:58		10/28 11:22		550-1L
Group (GG) by Wind/*WAVES & ART-IV*					
X17.2	10/28 09:51	1028 11:24	1.80	S16°E08°	
Peak at 11:10, Br./Import. 4B, in AR10486 by G12 & SVI					
CME	10/28 11:30		2459	15° Halo	
CME Lift-off: 10/28 11:01					
CME(s)Preceding Main Ejection					
CME	10/28 09:30		853	86°(22°)	
CME	10/27 20:30		990	322°(43°)	
CME	10/27 13:32		1005	326°(45°)	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 31/2003 May 28**					
Type IV	05/28 01:00	05/28 03:00			14-10
Type IV_{IP}, by Wind/*WAVES*					
Type IV	05/28 00:23	05/28 02:41			500H-40
Coronal Type IV by CUL					
Type III	05/28 00:23	05/28 01:14			500H-1L
Two Groups (GG) by Wind/*WAVES& CUL*					
X3.6	05/28 00:17	05/28 00:39	$2.80{\cdot}10^{-1}$	S08°W22°	
Peak at 00:27, Br./Import. 1B, in AR10365 by G12 & MIT					
CME	05/28 00:50		1366	292°Halo	
CME Lift-off: 05/28 00:13					
CME(s)Preceding Main Ejection					
CME	05/27 23:50		964	67°Halo	
CME	05/27 22:06		1122	225°(123°)	
CME Lift-off: 04/25 05:04, Partial Halo					
***Compact Event*: 32/2003 April 25**					
Type IV	04/25 05:55	04/25 06:10			14-9.0
Type IV_{IP}, by Wind/*WAVES*					
Type IV	04/25 05:31	04/25 05:46			124-25L
Type II	04/25 05:41	04/25 05:55			180-25L
Coronal Type IV & II (F-M) by CUL & LEA					
Type III	04/25 05:24	04/25 05:56			360-1L
Three Goups (GG) by Wind/*WAVES, CUL & LEA*					
M1.2	04/25 05:23	04/25 05:58	$1.80{\cdot}10^{-2}$	N14°E79°	
Peak at 05:40, Br./Import. SF, in AR10346 by G10 & LEA					
CME	04/25 05:50		806	54°(235°)	
CME Lift-off: 04/25 05:04, Partial Halo					
CME(s)Preceding Main Ejection					
CME	04/24 02:50	459	51°(138°)		
Poor Event.					
CME	04/24 22:26		347	59°(47°)	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 33/2002 August 16**					
Type IV	08/16 12:20	08/16 16:30			14-4.0
Type II	08/16 12:20	08/17 21:00			14-0.060
	Type IV_{IP} & II (Multiple bands), by Wind/*WAVES*				
Type IV	08/16 12:05	08/16 17:56D		S14°E20°	180H-25L
	Coronal Type IV by SVI & NRH				
Type III	08/16 11:32	08/16 13:00			180H-1L
	Several Groups (G–GG) by Wind/*WAVES, SVI & NRH*				
M5.2	08/16 11:32	08/16 13:07	$1.60 \cdot 10^{-1}$	S14°E20°	
	Peak at 12:32, Br./Import. 2N, in AR10069 by G08 & SVI				
CME	08/16 12:30		1585	121°Halo	
	CME Lift-off: 08/16 12:01				
CME(s)Preceding Main Ejection					
CME	08/14 10:54		809	142°(52°)	
CME	08/14 16:54		1049	100°(16°)	
	3 points only.				

***Extended Event*: 34/2002 May 18-23**					
Type IV	05/18 09:00	05/23 04:00			9-0.400
	Possible movingType IV_{IP}, by Wind/*WAVES. Very intense*				
CME	05/18 08:06		841	90°(6°)	
	CME Lift-off: 5/18 07:00, Only 2 points				
CME	05/18 09:26		707	226°(78°)	
	CME Lift-off: 05/18 08:27				
C2.6	05/18 09:18	05/18 09:35	$2.00 \cdot 10^{-3}$	N12°E61°	
	Peak at 09:25, Br./Import. SF, in AR9957 by G08 & SVI				
C3.0	05/18 10:42	05/18 12:09	$1.10 \cdot 10^{-2}$	S14°E36°	
	Peak at 11:39, Br./Import. SF, in AR9955 by G08 & RAM				
CME	05/18 11:50		614	163°(46°)	
	CME Lift-off: 05/18 10:56				
CME	05/18 13:27		415	222°(144°)	
	CME Lift-off: 05/18 12:18				
C2.5	05/18 12:36	05/18 12:42	$8.30 \cdot 10^{-4}$	N12°E80°	
	Peak at 12:39, Br./Import. SF, in AR9960? by G10 & SVI				
CME	05/18 16:06		789	103°(4°)	
	CME Lift-off: 05/18 15:21, Only 3 points				
C3.4	05/18 15:40	05/18 15:48	$1.40 \cdot 10^{-3}$	N11°E54°	
	Peak at 15:44, Br./Import. SF, in AR9957 by G08 &HOL				
C2.2	05/18 18:24	05/18 18:33	$1.00 \cdot 10^{-3}$	N11°E53°	
	Peak at 18:29, Br./Import. SF, in AR9957 by G08 &RAM				

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
C1.4	05/18 21:22	05/18 21:31	$6.30{\cdot}10^{-4}$	—	
	Peak at 21:26, by G08				
C1.3	05/19 00:17	05/19 00:23	$3.90{\cdot}10^{-4}$	—	
	Peak at 00:20, by G08				
C1.4	05/19 01:38	05/19 01:49	$8.00{\cdot}10^{-4}$	—	
	Peak at 01:43, by G08				
CME	05/19 02:50			82°(8°)	
	Very Poor Event				
C1.1	05/19 06:46	05/19 06:59	$8.00{\cdot}10^{-4}$	N14°E45°	
	Peak at 06:49, Br./Import. SF, in AR9957 by G08 &LEA				
C2.5	05/19 08:08	05/19 09:02	$6.10{\cdot}10^{-3}$	—	
	Peak at 08:34, by G08				
CME	05/19 08:50			90°(72°)	
	Very Poor Event				
C1.4	05/19 14:07	05/19 14:12	$3.80{\cdot}10^{-4}$	—	
	Peak at 14:10, by G08				
C1.4	05/19 15:54	05/19 16:03	$6.80{\cdot}10^{-4}$	—	
	Peak at 15:58, by G08				
C2.3	05/19 16:18	05/19 16:24	$6.10{\cdot}10^{-4}$	N08°E37°	
	Peak at 16:22, Br./Import. SF, in AR9961 by G08 &HOL				
CME	05/19 18:06		448	156°(7°)	
	CME Lift-off: 05/19 16:49				
C2.2	05/19 05:19	05/19 17:16	$1.30{\cdot}10^{-3}$	S22°E76°	
	Peak at 17:11, Br./Import. SF, in AR9961 by G08 & HOL				
C2.7	05/19 18:41	05/19 18:49	$1.10{\cdot}10^{-03}$	—	
	Peak at 18:46, by G08				
C3.1	05/19 19:09	05/19 19:19	$1.30{\cdot}10^{-03}$	—	
	Peak at 19:14, by G08				
CME	05/19 20:26		541	225°(125°)	
	CME Lift-off: 05/19 19:45, Partial Halo				
C2.1	05/19 19:46	05/19 19:54	$9.20{\cdot}10^{-4}$	—	
	Peak at 19:50 by G08				
C2.8	05/19 20:01	05/19 20:27	$3.00{\cdot}10^{-3}$	—	
	Peak at 20:23 by G08				
C4.7	05/19 21:43	05/19 21:52	$1.90{\cdot}10^{-3}$	—	
	Peak at 21:48 by G08				
CME	05/20 00:50		192	41°(93°)	
	CME Lift-off: 05/19 21:43				
C2.2	05/20 07:19	05/20 07:34	$1.10{\cdot}10^{-3}$	—	
	Peak at 07:33 by G08				

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
C3.9	05/20 07:29	05/20 08:14	$7.60{\cdot}10^{-3}$	S23°E74°	
Peak at 08:05, Br./Import. SF, in AR9961 by G08 & LEA					
CME	05/20 11:06		658	134°(38°)	
CME Lift-off: 05/20 10:13					
M4.7	05/20 10:14	05/20 10:34		S22°E76°	
Peak at 10:29, in AR9961 by G08					
M5.0	05/20 10:49	05/20 10:56		S22°E76°	
Peak at 10:53, in AR9961 by G08					
CME	05/20 16:50		196	35°(91°)	
CME Lift-off:05/20 14:12, Poor Event, C2 Only					
CME	05/20 15:50		553	143°(69°)	
CME Lift-off: 05/20 14:45					
X2.1,	05/20 15:21	05/20 15:31	$6.50{\cdot}10^{-2}$	S21°E65°	
Peak at 15:27, Br./Import. 2N, in AR9961 by G08 & HOL					
C4.1	05/20 18:15	05/20 18:25	$2.10{\cdot}10^{-3}$	S23°E67°	
Peak at 18:20, Br./Import. 1F, in AR9961 by G08 & HOL					
C1.8	05/20 19:46	05/20 19:56	$9.80{\cdot}10^{-4}$	S24°E70°	
Peak at 19:51, Br./Import. SF, in AR9961 by G08 & HOL					
C3.0	05/20 20:17	05/20 20:37	$3.00{\cdot}10^{-3}$	S21°E62°	
Peak at 20:24, Br./Import. SF, in AR9961 by G08 & HOL					
C2.0	05/20 21:16	05/20 21:24	$7.90{\cdot}10^{-4}$	—	
Peak at 21:20, by G08					
CME	05/21 02:50		319	307°(26°)	
CME Lift-off: 05/21 01:06					
C2.2	05/21 01:39	0521 01:48	$9.30{\cdot}10^{-4}$	S24°E58°	
Peak at 01:44, Br./Import. SF, in AR9961 by G08 & LEA					
CME	05/21 04:26		294	314°(37°)	
CME Lift-off: 05/21 02:50					
C4.8	05/21 04:58	05/21 05:10	$2.20{\cdot}10^{-3}$	N15°E44°	
Peak at 05:03, Br./Import. SF, in AR9960 by G08 & LEA					
CME	05/21 10:50		283	251°(73°)	
CME Lift-off: 05/21 09:04					
C1.9	05/21 10:15	05/21 10:29	$1.30{\cdot}10^{-3}$	N12°E29°	
Peak at 10:21, Br./Import. SF, in AR9960 by G08 & SVI					
C3.2	05/21 17:17	05/21 17:30	$1.80{\cdot}10^{-3}$	N11°E69°	
Peak at 17:23, Br./Import. SF, in AR9963 by G08 & RAM					
CME	05/21 21:50		853	54°(135°)	
CME Lift-off: 05/21 21:11, Partial Halo					
M1.5	05/21 21:20	05/21 22:00	$2.40{\cdot}10^{-2}$	N17°E38°	
Peak at 21:39, Br./Import. 2F, in AR9960 by G08 & HOL					

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
C9.7	05/21 23:14	05/22 01:28	$5.00{\cdot}10^{-2}$	—	
Peak at 05/22 00:30 by G08					
CME	05/22 00:06		1246	272°(186°)	
CME Lift-off: 05/21 23:38, partial Halo					
CME	05/22 03:50		1557	250°Halo	
CME Lift-off: 05/21 03:15					
C5.0	05/22 03:18	05/22 05:02	$2.50{\cdot}10^{-2}$	S22°W53°	
Peak at 03:54, Br./Import. SF by G08 & SVI					
Type II	05/22 04:10	05/23 10:40			0.50-0.03
FastType II by Wind/*WAVES*					
CME	05/22 06:26		831	258°(60°)	
CME Lift-off: 05/22 05:29					
C1.7	05/22 08:24	05/22 08:48	$2.20{\cdot}10^{-3}$		
Peak at 08:31, by G08					
CME	05/22 09:50		559	213°(37°)	
CME Lift-off:05/22 09:14					
CME	05/22 12:06		444	118°(30°)	
CME Lift-off:05/22 10:53					
C2.5	05/22 15:39	05/22 15:55	$1.80{\cdot}10^{-3}$	S23°E44°	
Peak at 15:47, Br./Import. SF, in AR9961 by G08 & RAM					
CME	05/22 20:26		305	16°(46°)	
CME Lift-off:05/22 18:52					
C2.4	05/22 20:48	05/22 20:59	$1.20{\cdot}10^{-3}$	S23°E40°	
Peak at 20:54, Br./Import. SF, in AR9961 by G08 & HOL					
CME	05/22 22:06		212	285°(66°)	
CME Lift-off:Uncertain					
B9.5	05/23 01:01	05/23 01:14	$6.60{\cdot}10^{-4}$	—	
Peak at 01:06 by G08					
C1.1	05/23 02:30	05/23 02:43	$7.70{\cdot}10^{-4}$	—	
Peak at 02:35 by G08					
CME	05/23 09:50		318	228°(17°)	
CME Lift-off:05/23 08:46					

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
	Universal Time				
***Compact Event*: 35/2002 May 16**					
Type II	05/16 01:13	05/16 03:30			40-2.0
Type IV	05/16 00:46	05/16 05:45			600-7.0
Type II (Intermittent tone) & IV_{IP} with coronal extension by Wind/*WAVES, CUL &LEA*					
Type III	05/16 01:35	05/16 05:30			400-1L
Intermittent Activity, by Wind/*WAVES, CUL &LEA with Largest Type III Group 0320-0500*					
C 4.5	05/16 00:11	05/16 01:18	$1.50{\cdot}10^{-2}$		
Peak at 00:35 by G08					
CME	05/16 00:50		600	158°Halo	
CME Lift-off:05/15 23:45					
CME(s)Preceding Main Ejection					
CME	05/15 23:06		698	88°(93°)	
CME	05/15 12:54		919	89°(95°)	
***Compact Event*: 36/2002 April 17**					
Type II	04/17 08:30	04/19 04:00			5-0.040
Type IV	04/17 08:03	04/17 11:50		S14°W34°	243-8.0
Type II (Intermittent bands) by Wind/*WAVES& IV_{IP} with coronal extension by ART-4, LEA & NRH*					
Type III	04/17 07:51	04/17 09:03			10-1L
Type III Group (GG), by Wind/*WAVES, ART-4, LEA & NRH*					
M2.6	04/17 07:4	04/17 09:57	$1.50{\cdot}10^{-1}$	S14°W34°	
Peak at 08:24, Br./Import. 2N, in AR9906 by G08 & SVI					
CME	04/17 08:26		1240	292°Halo	
CME Lift-off:04/17 07:50					
CME(s)Preceding Main Ejection					
CME	04/16 13:50		166	290°(50°)	
CME	04/16 11:06		496	262°(56°)	
CME	04/15 18:06		566	240°(98°)	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F^{tot}_{SXR} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 37/2001 October 05**					
Type II	10/05 10:12	10/05 11:45		S20°W90°	80-1.2
Type IV	10/05 10:10	10/05 13:00		S20°W90°	100-7.0
Type II (F-H) by Wind/*WAVES, DAM, NRH & IV_{IP} with coronal extension by* Wind/*WAVES, DAM, NRH*					
Type III	10/05 10:26	10/05 10:30			80-10L
Group (GG), by Wind/*WAVES, DAM, NRH*					
C 2.5	10/05 08:13	10/05 08:30	$2.10{\cdot}10^{-3}$		
Peak at 08:20 by G08					
C1.9	10/05 11:31	10/05 11:39	$8.30{\cdot}10^{-4}$	S12°W26°	
Peak at 11:35, Br./Import. SF, in AR9641 by G08 & SVI					
CME	10/05 10:30		1537	222°Halo	
CME Lift-off: 10/05 09:56					
CME(s)Preceding Main Ejection					
CME	10/05 09:30		219	235°(54°)	

***Compact Event*: 38/2001 October 01**					
Type IV	10/01 06:30	10/01 07:00			4-10
Type II	10/01 07:00	10/01 18:30			1-0.15
Type IV_{IP} & Strong II (F-H) by Wind/*WAVES*					
Type II	10/01 06:07	10/01 07:08			90-30
Type IV	10/01 05:34	10/01 08:30		S29°W76°	210-10
Coronal Type II/IV by HiRAS, LEA & NRH					
Type III	10/01 04:46	10/01 05:20			144-1L
Type III Group (GG), by Wind/*WAVES, HiRAS, NRH*					
M 9.1	10/01 04:41	10/01 05:23	$8.60{\cdot}10^{-2}$	S29°W76°	
Peak at 05:15, in AR9628? by G10					
CME	10/01 05:30		1405	225°Halo	
CME Lift-off: 10/01 05:21					
CME(s)Preceding Main Ejection					
CME	10/01 01:54			220°(68°)	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 39/2001 April 11**					
Type II	04/11 13:15	04/11 14:15			14-1.50
Type IV	04/11 13:15	04/11 16:00			14-9.0
	Type II (F-H) & IV_{IP} by Wind/*WAVES*				
Type II	04/11 13:09				34-25L
Type IV	04/11 13:08	04/11 15:19		S22°W27°	180H-25L
	Coronal Type II by SVI &IV by SVI, NRH				
Type III	04/11 13:01	04/11 13:28			180H-1L
	Type III Group (GG), by Wind/*WAVES, SVI, NRH*				
M2.3	04/11 12:56	04/11 13:49	$4.80{\cdot}10^{-2}$	S22°W27°	
	Peak at 13:26, Br./Import. 1F, in AR9415 by G08 & RAM				
CME	04/11 13:32		1103	224°Halo	
	CME Lift-off: 04/11 12:52				
CME(s)Preceding Main Ejection					
CME	04/11 06:3		858	238°(72°)	
CME	04/11 00:54		939	247°(69°)	
***Compact Event*: 40/2000 July 10**					
Type II	07/10 22:00	07/10 23:30			14-1.0
Type IV	07/10 22:00	07/10 23:00			14-5.0
	ComplexType II & IV_{IP} by Wind/*WAVES*				
Type II/IV	07/10 21:27	07/10 23:05			500H-18
	Coronal Type II(F-H)/IV by CUL, HiRAS				
Type III	07/10 21:27	07/10 22:53			500H-1L
	SeveralType III Groups (G–GG), by Wind/*WAVES, CUL, HiRAS*				
M5.7	07/10 21:05	07/10 22:27	$2.20{\cdot}10^{-1}$	N18°E49°	
	Peak at 21:42, Peak 21:11, Br./Import. 2B, in AR9077 by G08 & HOL				
CME	07/10 21:50		1352	94°(289°)	
	CME Lift-off:07/10 21:12, partial Halo				
CME(s)Preceding Main Ejection					
CME	07/10 04:50		623	99°(59°)	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 41/2000 June 17**					
Type II	06/17 03:00	06/17 04:15			14-1.0
Type IV	06/17 03:20	06/17 03:35			14-7.0
Type II & IV_{IP}(Complex IV including U-bursts.), by Wind/*WAVES*					
Type IV	06/17 02:47	06/17 04:43			200H-20L
Coronal Type IV by CUL					
Type III	06/17 02:34	06/17 04:39			200H-1L
Type III Storm (S) by Wind/*WAVES& CUL*					
M3.5	06/17 02:25	06/17 02:44	$2.40 \cdot 10^{-2}$	N22°W72°	
Peak at 02:37, Br./Import. 2B, in AR9033 by G08 & LEA					
CME	06/17 03:28		857	301°(133°)	
CME Lift-off: 06/17 02:27, partial Halo					
CME(s)Preceding Main Ejection					
CME	06/15 22:06		362	348°(102°)	
Poor Event					

***Compact Event*: 42/2000 May 22**					
Type IV	05/22 01:30	05/22 03:30			14-6.0
Type IV_{IP}, by Wind/*WAVES*					
Type IV	05/22 01:16	05/22 04:00D			200H-20L
Coronal Type IV, by CUL					
Type III	05/22 01:16	05/22 01:46			200H-1L
Group (GG), by Wind/*WAVES, CUL*					
C6.3	05/22 01:20	05/22 02:54	$2.90 \cdot 10^{-2}$		
Peak at 02:01 by G08					
CME	05/22 01:50		649	245°Halo	
CME Lift-off: 05/22 00:55					
CME(s)Preceding Main Ejection					
CME	05/22 01:27		689	203°(119°)	

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Compact Event*: 43/2000 April 27**					
Type IV	04/27 14:40	04/27 14:55			14-5.0
PossibleType IV_{IP}, by Wind/*WAVES*					
Type IV	04/27 09:00	04/27 15:00D		E00°N40°	100-400
Coronal Type IV by ART-IV & NRH (Frequency GAP 100-14 MHz)					
B9.4	04/27 13:52	04/27 13:59	$3.10{\cdot}10^{-4}$		
Peak at 13:57 by G08					
B9.8	04/27 14:04	04/27 14:56	$2.40{\cdot}10^{-3}$		
Peak at 14:40 by G08					
CME	04/27 12:30		764	123°(122°)	
CME Lift-off: 04/27 11:42, Uncertain Width, Partial Halo					
CME	04/27 14:30		1110	301°(138°)	
CME Lift-off: 04/27 13:50, Partial Halo					
CME(s)Preceding Main Ejection					
CME	04/26 16:19		212	153°(31°)	
CME	04/25 16:06		672	296°(34°)	
CME	04/25 14:06		189	263°(49°)	
***Compact Event*: 44/1999 June 11**					
Type II	06/11 11:45	06/11 17:00			14-0.40
Type IV	06/11 11:30	06/11 12:20			14-7.0
Type IV_{IP}& II, by Wind/*WAVES*					
Type II/IV	06/11 11:16	06/11 11:45		N30°E90°	35L-300
Coronal Type II/IV by IZM, ART-IV & NRH					
Type III	06/11 11:12	06/11 12:11			500-1L
Four Groups (G–GG), by Wind/*WAVES, IZM & ART-IV*					
C8.8	06/11 11:07	06/11 12:31	$3.10{\cdot}10^{-2}$		
Peak at 11:57 by G10					
CME	06/11 11:26		1569	38°(181°)	
CME Lift-off: 06/11 11:05, Uncertain Width, Partial Halo					
CME(s)Preceding Main Ejection					
CME	06/10 14:50		412	87°(115°)	
CME	06/10 11:50		215	78°(55°)	
Poor Event					

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start Universal Time	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
***Extended Event*: 45/1999 May 27–28**					
Type II/IV	05/27 10:55	05/28 15:00			14-0.070
Type IV_{IP} followed by II, by Wind/*WAVES*					
Type IV	05/27 10:55	05/27 15:00D		N18°E31°	25L-70H
Type IV	05/28 11:30	05/28 15:00D		N18°E31°	25L-70H
Two Coronal Type IV, by SVI, DAM & NRH					
Type II	05/27 10:48	05/27 10:55			20-55
Type II, by DAM					
Type III	05/27 10:55	05/27 11:08			20-70
Type III Group (GG) , by DAM					
C1.2	05/27 09:13	05/27 09:20	$4.00{\cdot}10^{-4}$	N31°W07°	
Peak at 09:17, Br./Import. SF, in AR8551 by G08 & SVI					
C4.5	05/27 11:36	05/27 11:54	$3.40{\cdot}10^{-3}$	S30°E78°	
Peak at 11:43, Br./Import. SF, in AR8557 by G08 & RAM					
C3.4	05/27 12:59	05/27 13:09	$1.60{\cdot}10^{-3}$	N18°E31°	
Peak at 13:04, Br./Import. 1F, in AR8552 by G08 & HOL					
C2.7	05/27 14:23	05/27 15:05	$5.90{\cdot}10^{-3}$	S22°W76°	
Peak at 14:40, Br./Import. SF, in AR8548 by G08 & RAM					
C6.2	05/27 15:15	05/27 16:03	$1.40{\cdot}10^{-2}$	S26°E81°	
Peak at 15:35, Br./Import. SF, in AR8557 by G08 & HOL					
C7.4	05/27 16:49	05/27 17:08	$7.60{\cdot}10^{-3}$	N38°W76°	
Peak at 16:59, Br./Import. SF, in AR8545 by G08 & RAM					
C2.3	05/27 18:3	05/27 19:13	$5.00{\cdot}10^{-3}$	N17°E29°	
Peak at 18:59, Br./Import. SF, in AR8552 by G08 & COM					
C2.3	05/28 05:49	05/28 05:58	$8.90{\cdot}10^{-4}$	N12°E81°	
Peak at 05:53, Br./Import. SF, in AR8558 by G08 & COM					
C1.2	05/28 08:23	05/28 08:40	$1.10{\cdot}10^{-3}$		
Peak at 08:31 by G10					
CME	05/27 11:06		1691	341°Halo	
CME Lift-off:05/27 10:33					
CME	05/27 14:50		646	61°(140°)	
CME Lift-off: 05/27 13:36, Partial Halo					
CME	05/27 16:26		798	116°(94°)	
CME Lift-off: 05/27 15:23					
CME	05/27 19:27		595	46°(122°)	
CME Lift-off: 05/27 17:41, Partial Halo, 3 points					
CME	05/28 09:50		411	110°(75°)	
CME Lift-off: 05/28 09:06					
CME	05/28 10:26		206	12°(104°)	
CME Lift-off: 05/28 07:48					

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start	End	F^{tot}_{SXR}	Position	Freq.
	Universal Time		(J/m^2)	PA	MHz
			V_{CME}	(Width)	
			(Km/s)		
***Compact Event*: 46/1998 May 03**					
Type IV	05/03 22:30	05/03 23:00			14-8.0
Type IV_{IP}, by Wind/*WAVES*					
M1.4	05/03 21:12	05/03 21:49	$2.10{\cdot}10^{-2}$	N25°E26°	
Peak at 21:29, in AR8214 by G09					
CME	05/03 22:03		649	302°(194°)	
CME Lift-off: 05/03 20:58					
CME(s)Preceding Main Ejection					
CME	05/03 03:17		399	296°(22°)	
CME	05/02 14:06		938	331°Halo	
***Compact Event*: 47/1998 May 02**					
Type II	05/02 14:25	05/02 14:50			5.0-3.0
Type IV	05/02 14:10	05/02 15:40			14-8.0
PossibleType II (Narrowband wisps) & Broadband IV_{IP}, by Wind/*WAVES*					
Type II	05/02 13:30	05/02 13:46			400-6.0
Type II (Multiple Bands), by Wind/*WAVES, ART-IV & DAM*					
Type III	05/02 13:34	05/02 14:00			600H-1L
Group (GG) by Wind/*WAVES, ART-IV & DAM*					
Type IV	05/02 13:30	05/02 15:36		S15°W15°	600H-20
Coronal Type IV by NRH, ART-IV & DAM					
X1.1	05/02 13:31	05/02 13:51	$6.70{\cdot}10^{-2}$	S15°W15°	
Peak at 13:42, Br./Import. 3B, in AR8210 by G09 & RAM					
CME	05/02 14:06		938	331°Halo	
CME Lift-off: 05/02 13:07					
CME(s)Preceding Main Ejection					
CME	05/02 05:32		542	154°Halo	
CME	05/01 23:40		585	126°Halo	
Only C3					
***Compact Event*: 48/1998 April 29**					
Type IV	04/29 17:00	04/29 18:15			14-8.0
Type II	04/29 16:30	04/29 17:00			10-2.0
PossibleType IV_{IP}& Broadband II, by Wind/*WAVES*					
M6.8	04/29 16:06	04/29 16:59	$1.00{\cdot}10^{-1}$	S18°E20°	
Peak at 16:37, Br./Import. 3B, in AR8210 by G09 & HOL					
Type III	04/29 16:06	04/29 17:15			14H-1L
Group (GG) by Wind/*WAVES, No Data above 14 MHz*					
CME	04/29 16:59		1374	336°Halo	
CME Lift-off: 04/29 16:22					

Table A1.:Type IV_{IP} Radio Bursts and Associated Activity-Continued

Obs.	Start	End	F_{SXR}^{tot} (J/m^2) V_{CME} (Km/s)	Position PA (Width)	Freq. MHz
CME(s)Preceding Main Ejection					
CME	04/27 08:56		1385	79°Halo	