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LEIRVOGUR

MAGNETIC RESULTS

2009

REYKJAVíK 2010

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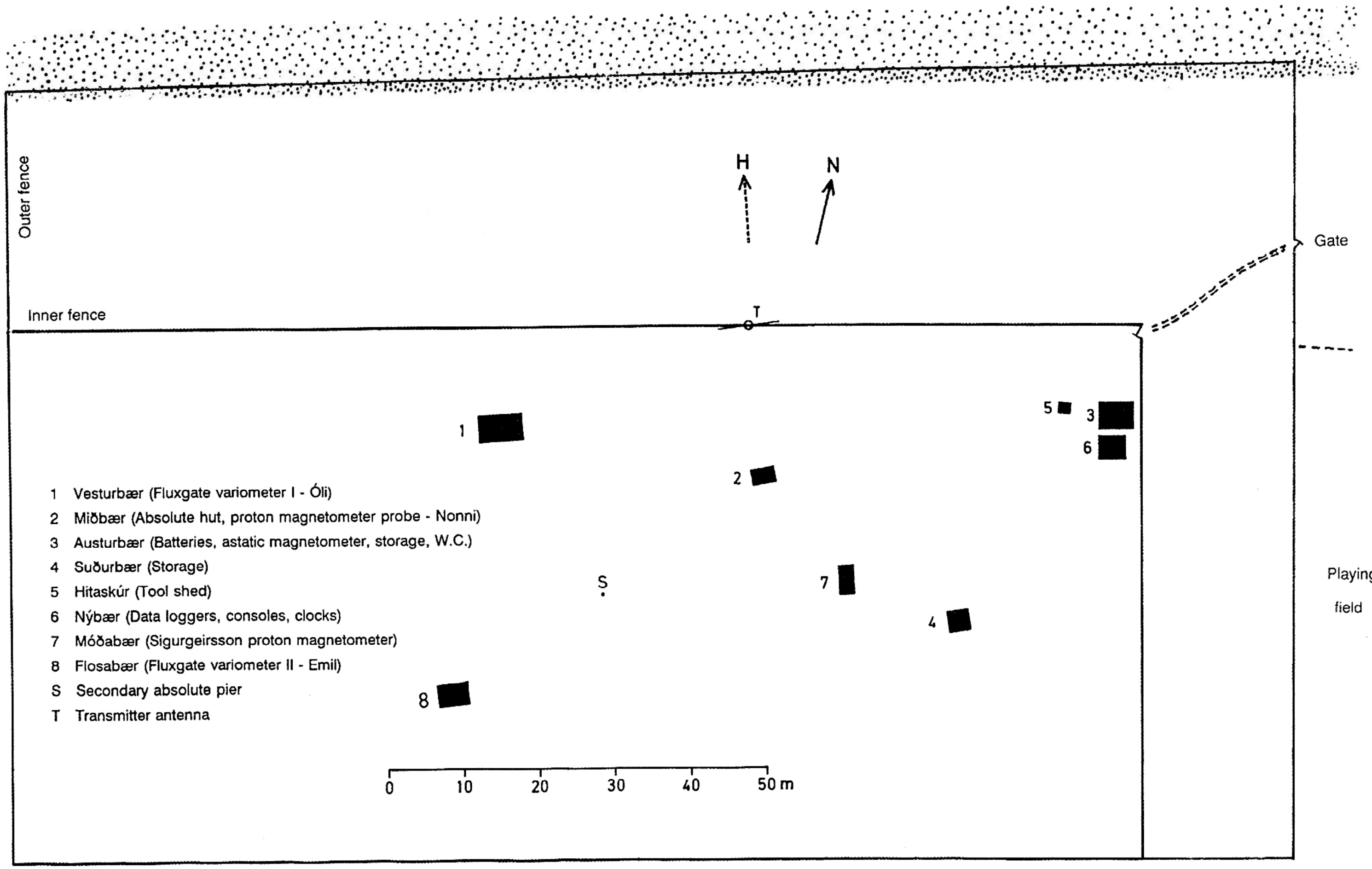

Outer fence
H
N
Gate
Inner fence
T
1
2
3
4
5
6
7
8
S
Playing
field
1 Vesturbær (Fluxgate variometer I - Óli)
2 Miðbær (Absolute hut, proton magnetometer probe - Nonni)
3 Austurbær (Batteries, astatic magnetometer, storage, W.C.)
4 Suðurbær (Storage)
5 Hitaskúr (Tool shed)
6 Nýbær (Data loggers, consoles, clocks)
7 Móðabær (Sigurgeirsson proton magnetometer)
8 Flosabær (Fluxgate variometer II - Emil)
S Secondary absolute pier
T Transmitter antenna
0
10
20
30
40
50 m

INTRODUCTION

This volume contains the results of geomagnetic measurements carried out at the Leirvogur Magnetic Observatory in Iceland during the year 2009. The observatory, which was established in 1957, is run by the Upper Atmosphere Section of the Science Institute, University of Iceland. A description of the observatory and its development up to 1968 may be found in a report published in 1969. More recent events are covered in the yearbooks.

The observatory is located on a river estuary, 5 m above mean sea level, 12 km ENE of Reykjavík (20 km by road). The geographic coordinates of the observatory's reference point are

$$64°10'\!.986\ \mathrm{N},\quad 21°41'\!.920\ \mathrm{W}\ \ (\mathrm{WGS84}).$$

The geomagnetic coordinates relative to a pole position of $79\overset{\circ}{.}4$ N, $71\overset{\circ}{.}7$ W are $69\overset{\circ}{.}4$ N, $71\overset{\circ}{.}8$ E. The McIlwain L-parameter of the observatory in 2009 was approximately 5.5 earth-radii, the corresponding corrected geomagnetic latitude being $64\overset{\circ}{.}7$. The geomagnetic conjugate point at 100 km altitude was at $69\overset{\circ}{.}1$ S, $29\overset{\circ}{.}7$ E geographic, about 390 km from the Japanese Antarctic station Syowa.

PERSONNEL

In 2009, the Upper Atmosphere Section had a staff of two: Gunnlaugur Björnsson, director and Pálmi Ingólfsson, research assistant. Former director, Þorsteinn Sæmundsson, continued to serve in an advisory capacity and made absolute measurements on occasions when Gunnlaugur was away.

Runólfur Valdimarsson, a retired technician of the Science Institute, overhauled the pump of the proton magnetometer Móði.

Helgi Freyr Rúnarsson, a physics student at the University of Iceland, was hired part-time to continue to develop data handling programs in Python.

Ingi Þ. Bjarnason from the Institute of Earth Sciences visited the observatory on June 3 and Óskar Ágústsson, a retired caretaker at the Science Institute, visited on June 10.

DEVELOPMENTS

The staff made 65 trips to the observatory in 2009, the lowest number of trips ever. This is a reflection of a very stable operation and there were no instrument problems throughout the year. A Skoda Fabia belonging to the Upper Atmosphere Section was used for transportation to and from Leirvogur.

The environment

Weather was mild most of the year with very little snow that did not cause any problems. The lowest temperature was $-12°$C in February, and the highest was $+24°$C in July. On December 30, the absolute measurements were made at $-11°$C, apparently the lowest at which measurements have been made at the observatory. It should be noted that the absolute hut is not heated.

Due to the continuing economic crisis, very little construction work took place in the nearby housing project. It remains unclear when this will continue. So far, no major problems have been caused by the new neighbours that have already moved in.

The electrical supply was interrupted once on December 16 for 10 minutes when a new electrical power meter was installed. No data was lost.

All in all, the year was strikingly quiet and uneventful.

Digital fluxgate systems I and II

Both the new and the old dataloggers with the new System II ran perfectly during the year. The data handling routines for the new logger were still being written, improved and tested. They are expected to be fully implemented in 2010 when the old datalogger is to be retierd.

An A/D converter with a laptop datalogger running linux, was connected to System I in April and operated in parallel with the old datalogger. After a couple of months of monitoring, a persistent difference was discovered between the results from the old and new A/D converters. An explanation is still being looked for. As with System II, the old datalogger for System I is expected to be retired in 2010.

On May 27, the thermostat in the variometer house Flosabær, where System II (Emil) is located, was adjusted from winter level ($13°$C) to summer level ($21°$C). Readjustment to winter level took place on November 18.

The thermostat in Vesturbær which houses System I (Óli) was adjusted from winter level ($13°$C) to summer level ($20°$C) on May 25. Readjustment took place on December 2.

Móði

The proton magnetometer Móði worked without problems for the entire year. The only data losses for Móði occurred when the pump was replaced in January and when the magnet and methanol in the system were renewed in May. In addition, 10 minutes of data were lost in December when the power meter for the observatory was replaced.

The new purpose-built electronics for Móði give slightly different results from the old counters. The reason for this has not been found conclusively, but appears to be in the timing signal.

Geó II

The conventional proton magnetometer Geó (G856-AX) was used in the absolute measurements. The setup has worked very well although on occasion it provided erroneous results. These were due to the cable connections in Miðbær, an old problem that seems to worsen in conditions of high humidity.

Backup computer

The PC-computer “Muninn”, which has been used at the Science Institute for receiving and storing 10-second data from Leirvogur, worked without problems throughout the year.

Real-time displays on the Web

The real-time display of the Leirvogur recordings on the World Wide Web were uninterrupted during the year. Transmissions at hourly intervals for display at the World Data Centre in Kyoto were occasionally affected due to temporary loss of network connection to the WDC.

Time control

A quartz clock of the type Omegaface is used for timing the data. Two clocks are maintained, a main clock and a backup unit. These are corrected by means of GPS signals once a week. This is generally sufficient for keeping the timings correct to within 1 second. The clocks are also compared with time signals from Rugby on 60 kHz. On several occasions did the GPS not correctly adjust the clocks, leaving them 1 second late. This was checked against the Network Time Protocol (*NTP*)-service as well as other time signals. On these occasions, the clocks were adjusted manually. The reason for these errors are not known.

ADSL connection

The ADSL-connection worked without major problems most of the year. Backup data are transferred to the Science Institute from System I every 10 minutes. A laptop computer reads and stores System II data every second and transfers each day's data to the Institute. An identical procedure was set up for System I in the spring.

Software development

Work continued on porting the various data handling routines from *Comal* to *Python*. A procedure to simplify the regular analysis and correction of the raw measurements to provide absolute data is being tested. This is a time-consuming work that must be carefully checked. Both systems are expected to be on-line with one second time resolution and semi-automatic data handling in the near future.

General maintenance and modifications

Trees and hedges were pruned and fertiliser applied in the spring. Because of the warm weather, tree growth was more vigorous than usual. During the summer and autumn, the grass around the observatory was cut from time to time with a lawnmower and a brush cutter.

MAGNETOMETERS

The observatory possesses the following instruments:

1. A triaxial fluxgate variometer, "Óli" (Óli II), of the type FGE, version E, from the Danish Meteorological Institute, with suspended sensors and a digital data logger designed and built at the Science Institute. This is the primary recording instrument at Leirvogur. The sensor elements are oriented in the approximate directions of Z (vertical), H (magnetic north) and D (magnetic east). The logger uses an Acorn BBC B+ microcomputer with two floppy drives, each able to store 12 days of data. The records contain 1-minute means of the elements and show the extreme departures from the mean during each minute. Hourly means are both stored and printed out. Momentary values at 10-second intervals are recorded by a PC laptop computer linked to BBC monitoring and display computers. A new A/D converter connected to a laptop running Linux was set up during the year and runs in parallel with the old datalogger. Data delivery from the new system to the Institute is automatic every morning at 02:05.

2. A triaxial fluxgate variometer “Emil” (Emil II), of the type FGE, version K, from the Danish Meteorological Institute, with suspended sensors. The data logger is an industrial A/D converter connected to a laptop computer running Linux which runs in parallel with the old data loggers and BBC computers. This will be continued while the data handling routines are being upgraded. This system serves as a backup for Óli. All the 1-minute data from this instrument are fully processed. Data delivery to the Institute is automatic every morning at 02:05.

3. A triaxial fluxgate variometer, Emil I, of the type FG84C with a BBC+ data logger identical to that of Óli. This instrument was replaced by Emil II on December 18, 2006, but will be kept in Flosabær as a reserve unit.

4. A triaxial fluxgate variometer, Óli I, of the same type as Emil I, superseded by Óli II in October 1998.

5. A Sigurgeirsson proton magnetometer (“Móði”) producing an uninterrupted record of the total force F. The precession cycles are counted and 1-minute averages recorded using the data loggers serving the fluxgate variometers Óli and Emil. Hourly means are also printed out. 10-second averages are recorded on a PC computer at Leirvogur and transmitted by radio to a backup computer and a display in Reykjavík.

6. A Geometrics G856-AX proton magnetometer (“Geó II”).

7. A Declination-Inclination fluxgate magnetometer (DI-flux, “Stefnir”) based on a Zeiss Jena Theo 010 B theodolite, with electronics from the Auroral Observatory, Tromsø.

8. A second, identical DI-flux instrument, “Stefnir-II”, also with electronics from Tromsø.

9. A portable fluxgate magnetometer (“Ferðaflosi”) made by Fjarskiptatækni for diverse applications.

In addition, the observatory has an astatic magnetometer and access to two portable proton magnetometers, a Barringer GM-122 (“Barri”) and a second Geometrics G856-AX (“Geó I”). These three instruments belong to Dr. Leó Kristjánsson of the Geophysics Division of the Science Institute.

The above list includes only those instruments that are in active use or are kept in reserve.

TIME CONTROL

The older digital fluxgate loggers are controlled by a quartz crystal clock which is adjusted using a signal from the Global Positioning System (GPS). The aim has been to keep the timing correct to within one second. This limit was exceeded twice in 2009. The *NTP* network service is used to correct the time on the laptop computers. It is typically accurate to within 10 milliseconds.

ABSOLUTE MEASUREMENTS

To determine the base-line values for the triaxial fluxgates Óli and Emil, absolute measurements were carried out by means of the proton magnetometers Geó and Móði and the DI-fluxgate magnetometer Stefnir. Traditionally, these measurements have been made once a week, on Wednesday afternoons, irrespective of the magnetic conditions.

The magnetometer Geó was used for measuring the total intensity (F) on the absolute pier. The crystal oscillator correction for Geó was checked regularly in 2009 and found quite stable, about -0.3 nT.

While measurements with Stefnir are in progress, the proton magnetometer probe must be removed from the absolute pier. Simultaneous measurements of the total field can be made, however, feeding the electronics with the signal from Móði. As the probe of Móði is situated some 15 meters from the absolute pier, a site correction must be applied. This correction is subject to changes whenever magnetic parts of the Móði system are moved or modified. Its value is checked by comparison measurements once a week. In 2009, the correction varied between -3.0 nT and -3.7 nT.

Stefnir measures the declination (D) and the inclination (I) of the geomagnetic field. The theory of the DI-fluxgate has been treated by Kring Lauridsen (Danish Meteorological Institute Geophysical Papers, R-71, 1985). For measurements of declination, the standard measuring scheme at Leirvogur involves four readings with the telescope facing west and four readings with the telescope facing east. For every reading with the telescope in an upright position (with the fluxgate sensor on top) there is a corresponding reading in an inverted position. From such a set of measurements the declination can be derived, along with the collimation angles of the sensor and the zero correction of the sensor output.

For the measurements of inclination, the adopted measuring scheme consists of eight measurements with the telescope oriented in the magnetic meridian and tilted at right angles to the total field vector. Four measurements are made with the telescope pointing south and four with the telescope pointing north. All readings are made with the telescope in the same (upright) position. In each case the total field is measured simultaneously. By combining the values of inclination and total intensity, both the vertical and horizontal intensities can be calculated.

BASE LINES

Digital Fluxgate I (Óli)

The base-line values derived from the absolute measurements are shown in graphic form on page 22. Individual measurements are indicated by squares. The solid lines which shift in steps are the adopted base-line values Z_0, H_0 and D_0, the definition of which will be given below.

The method used to derive Z, H, and D from the observed fluxgate readings will now be described. The first step occurs in the logging program where the raw values are multiplied by 0.16 to make the output unit correspond to 1 nT. Fixed constants are then added to give suitable base levels. For the electronics installed in 2002, these constants are 47802 nT for Z, 10164 nT for H and 2199 nT for D (see yearbook 2002, p. 14). The resulting outputs are the "observed" readings Z_1, H_1 and D_1. These readings are then corrected as follows (in units of nanotesla):

$$\begin{pmatrix} Z_2 \\ H_2 \\ D_2 \end{pmatrix} = \begin{pmatrix} 138 \\ 38 \\ -200 \end{pmatrix} + \begin{pmatrix} 1-3\epsilon & \epsilon & 0 \\ 0 & 1-3\epsilon & -\epsilon \\ 0 & 0 & 1-3\epsilon \end{pmatrix} \begin{pmatrix} Z_1 \\ H_1 \\ D_1 \end{pmatrix}$$

where $\epsilon = 0.001$. These corrections allow for the sensors' departure from orthogonality, found by rotating the instrument under controlled conditions. The fact that the scale values depart slightly from unity is also allowed for. The additive constants are adjusted to make the horizontal component similar to that in the absolute hut, Miðbær, both in size and direction.

The formulae giving the field in the absolute hut are then

$$
\begin{aligned}
Z &= Z_0 + Z_2 \\
H &= H_0 + \sqrt{H_2^2 + D_2^2} \\
D &= D_0 + \arctan\left(D_2/H_2\right)
\end{aligned}
$$

where Z_0, H_0, and D_0 are the base-line values. The adopted base-line values for 2009 were as follows:

Vertical intensity (Z_0):

		nT
Jan 1	– Jan 3	-1.0
Jan 4	– Feb 21	-1.5
Feb 22	– Mar 20	-1.0
Mar 21	– May 25 (16:40)	-1.5
May 25	– May 25 (20:20)	-1.0
May 25	– May 25 (24:00)	-0.5
May 26	– May 31	0.0
Jun 1	– Jun 12	0.5
Jun 13	– Oct 17	0.0
Oct 18	– Nov 13	0.5
Nov 14	– Nov 26	0.0
Nov 27	– Dec 2 (15:20)	0.5
Dec 2	– Dec 2 (16:40)	0.0
Dec 2	– Dec 2 (18:00)	-0.5
Dec 2	– Dec 12	-1.0
Dec 13	– Dec 31	-1.5

Horizontal intensity (H_0):

		nT
Jan 1	– Mar 7	-5.5
Mar 8	– Mar 20	-5.0
Mar 21	– May 25 (14:50)	-5.5
May 25	– May 25 (16:40)	-5.0
May 25	– May 25 (18:30)	-4.5
May 25	– May 25 (20:20)	-4.0
May 25	– May 25 (22:10)	-3.5
May 25	– May 25 (24:00)	-3.0
May 26	– May 31	-2.5

		nT
Jun 1	– Jun 12	-2.0
Jun 13	– Jul 3	-2.5
Jul 4	– Jul 18	-2.0
Jul 19	– Dec 2 (14:40)	-2.5
Dec 2	– Dec 2 (15:20)	-3.0
Dec 2	– Dec 2 (16:00)	-3.5
Dec 2	– Dec 2 (16:40)	-4.0
Dec 2	– Dec 2 (17:20)	-4.5
Dec 2	– Dec 2 (18:00)	-5.0
Dec 2	– Dec 31	-5.5

Declination (D_0):

Jan 1	– Feb 1	$345°\ 08\rlap{.}'8$
Feb 2	– Feb 28	$345°\ 09\rlap{.}'0$
Mar 1	– Mar 7	$345°\ 08\rlap{.}'9$
Mar 8	– Mar 20	$345°\ 08\rlap{.}'8$
Mar 21	– May 25 (16:40)	$345°\ 08\rlap{.}'9$
May 25	– May 25 (20:20)	$345°\ 08\rlap{.}'8$
May 25	– May 25 (24:00)	$345°\ 08\rlap{.}'7$
May 26	– May 31	$345°\ 08\rlap{.}'6$
Jun 1	– Jul 10	$345°\ 08\rlap{.}'5$
Jul 11	– Aug 15	$345°\ 08\rlap{.}'6$
Aug 16	– Oct 2	$345°\ 08\rlap{.}'5$
Oct 3	– Oct 17	$345°\ 08\rlap{.}'4$
Oct 18	– Nov 6	$345°\ 08\rlap{.}'5$
Nov 7	– Nov 21	$345°\ 08\rlap{.}'6$
Nov 22	– Dec 2 (15:00)	$345°\ 08\rlap{.}'5$
Dec 2	– Dec 2 (16:00)	$345°\ 08\rlap{.}'6$
Dec 2	– Dec 2 (17:00)	$345°\ 08\rlap{.}'7$
Dec 2	– Dec 2 (18:00)	$345°\ 08\rlap{.}'8$
Dec 2	– Dec 18	$345°\ 08\rlap{.}'9$
Dec 19	– Dec 31	$345°\ 09\rlap{.}'1$

The changes in base lines on May 25 and December 2 were caused by adjustments of the thermostat in the variometer building Vesturbær. The temperature coefficient is about 0.25 nT/°C for Z and 0.4 nT/°C for H and D.

Scale values. The scale values of Óli are close to unity (1 nT/unit). This was confirmed by indirect tests in 1998 (see yearbook p. 18). The tests have not been repeated since a new electronic unit was installed in October 2002. The intrinsic sensitivity of the instrument is actually higher by a factor of 6.25 but is reduced by inserting a suitable term in the program of the logging computer as explained above.

Digital fluxgate II (Emil)

The base-line values derived from the absolute measurements are shown graphically on page 23. With the new fluxgate being nearly identical to System I, the data are now handled in the same way as the data for that system. The constants added to the output values are determined in the same fashion as for System I. They are 50204 nT for Z, 12640 nT for H and 39 nT for D. The "observed" readings Z_1, H_1 and D_1, are corrected as follows (in units of nanotesla):

$$\begin{pmatrix} Z_2 \\ H_2 \\ D_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ -200 \end{pmatrix} + \begin{pmatrix} 1 & 0 & \epsilon \\ 0 & 1 & -\epsilon \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} Z_1 \\ H_1 \\ D_1 \end{pmatrix}$$

where $\epsilon = 0.001$. Note that due to better alignment of this instrument, most of the correction coefficients are zero. The adopted base-line values for 2009 were as follows:

Vertical intensity (Z_0):

		nT
Jan 1	– Mar 7	-0.5
Mar 8	– Mar 20	0.0
Mar 21	– May 27	-0.5
May 28	– Jun 19	-1.5
Jun 20	– Jul 3	-1.0
Jul 4	– Aug 21	-1.5
Aug 22	– Sep 5	-1.0
Sep 6	– Nov 2	-1.5
Nov 2	– Nov 18 (19:50)	-1.0
Nov 18	– Nov 26	-0.5
Nov 27	– Dec 31	-0.0

Horizontal intensity (H_0):

		nT
Jan 1	– Mar 7	-6.0
Mar 8	– Mar 20	-5.5
Mar 21	– Apr 30	-6.0
May 1	– May 27	-6.5
May 28	– Sep 5	-8.0
Sep 6	– Sep 26	-8.5
Sep 27	– Oct 2	-8.0
Oct 3	– Oct 15	-8.5
Oct 16	– Nov 2	-7.5
Nov 3	– Nov 18 (15:40)	-8.5
Nov 18	– Nov 18 (17:45)	-8.0
Nov 18	– Nov 18 (19:50)	-7.5
Nov 18	– Nov 18 (21:55)	-7.0
Nov 18	– Dec 4	-6.5
Dec 5	– Dec 18	-6.0
Dec 19	– Dec 31	-6.5

Declination (D_0):

Jan 1	– Feb 6	$345° 5\overset{'}{.}9$
Feb 6	– Feb 28	$345° 6\overset{'}{.}0$
Mar 1	– Mar 20	$345° 5\overset{'}{.}9$
Mar 21	– Apr 3	$345° 6\overset{'}{.}0$
Apr 4	– May 27	$345° 5\overset{'}{.}9$
May 28	– Oct 24	$345° 5\overset{'}{.}7$
Oct 25	– Nov 18 (19:50)	$345° 5\overset{'}{.}8$
Nov 18	– Dec 31	$345° 5\overset{'}{.}9$

The steps in the base lines on May 28 and November 18 were caused by adjustments of the thermostat in the variometer house. The temperature coefficients are approximately 0.1 nT/°C for Z, 0.2 nT/°C for H and less than 0.2 nT/°C for D.

ONE-MINUTE MEANS

Calculations of 1-minute means of Z, H, and D are based on measurements with the triaxial fluxgate variometers, chiefly system I (Óli). The magnetometers measure at 1-second intervals at, 02^{s} –

09^{s}, $12^{\mathrm{s}} - 19^{\mathrm{s}}$, $22^{\mathrm{s}} - 29^{\mathrm{s}}$, $32^{\mathrm{s}} - 39^{\mathrm{s}}$, $42^{\mathrm{s}} - 49^{\mathrm{s}}$and $52^{\mathrm{s}} - 59^{\mathrm{s}}$ past each minute mark, giving a total of 48 measurements per minute. An exception occurs during the first minute of each quarter-hour, when measurements from 02^{s} to 07^{s} past the minute are left out, resulting in 42 measurements per minute. During the first minute of each day, measurements at $12^{\mathrm{s}} - 17^{\mathrm{s}}$ are left out as well.

The 10-second momentary recordings, which are made at 08^{s}, 18^{s}, 28^{s}, 38^{s}, 48^{s} and 58^{s}, are used to compensate for the gaps at the quarter-hours and the larger gap at the beginning of each day.

The 1-minute means of F are calculated from the number of proton precession cycles of the continuous proton magnetometer Móði. From the number, N, of precession cycles per minute, the mean value of F is found:

$$F = 0.3914534 \cdot N + \delta F \ \ (\mathrm{in}\ \ \mathrm{nT}).$$

The numerical constant corresponds to $(2\pi/\gamma_{\mathrm{p}})/60$, where γ_{p} is the proton gyromagnetic ratio and δF is the sum of a site reduction and a clock correction. A site reduction is needed because the probe of Móði is some distance away from the observatory reference pier as mentioned earlier. A clock correction arises if the Móði reference clock runs too slowly or too fast; this correction is generally small (< 0.1 nT). The value of δF is found by comparing the signal from Móði with that from the proton magnetometer Geó, the probe of which is situated on the pier. This comparison is made once a week.

The adopted values of δF in 2009 were as follows:

		δF (nT)
Jan 1	– Feb 1	-3.7
Feb 2	– Feb 21	-3.6
Feb 22	– Mar 14	-3.5
Mar 15	– Apr 30	-3.7
May 1	– May 12	-3.6
May 13	– May 31	-3.4
Jun 1	– Jun 11	-3.2
Jun 12	– Jun 26	-3.0
Jun 27	– Jul 10	-3.2
Jul 11	– Jul 25	-3.0

		nT
Jul 26	– Aug 2	-3.2
Aug 3	– Sep 5	-3.3
Sep 6	– Nov 2	-3.4
Nov 3	– Nov 13	-3.3
Nov 14	– Dec 18	-3.4
Dec 19	– Dec 31	-3.2

On occasions when Móði was not functioning, F was calculated from the fluxgate components to fill the gaps in the records.

All 1-minute data were checked visually in graphic form on a computer screen. The 1-minute values of Z and H were also checked by comparing them with the 1-minute values of F. The expression

$$M = \sqrt{Z^2 + H^2} - F,$$

was evaluated for this purpose. The mean value of M over the year was -0.01 nT. Most of the values (99.98%) were in the range -1 to $+1$ nT, 0.02% reached ± 2 nT, and there were 4 cases of higher values.

Non-zero values of M may be explained by a combination of several factors. To begin with, the field values of Z and H are only recorded to the nearest nanotesla. The base-line values are rounded to the nearest 0.5 nT. Finally, the fluxgate sensors are sampled at discrete intervals which are not spaced evenly within the minute. All these factors can cause M to depart from zero, especially during magnetic storms.

In 2009, the 1-minute data for Z, H and D were complete. Gaps or errors in the 1-minute data from the proton magnetometer Móði were 168 or 0.03% of the total time. Most of this was due maintenance.

HOURLY MEANS

The hourly mean values of the magnetic elements Z, H, D and F were found by averaging the 1-minute means from the fluxgate variometers and the proton magnetometer Móði.

The hourly means of Z and H were checked by comparing them with the hourly means of F and tabulating the difference M

(see p. 17). In 2009, individual rounded values of the difference rarely exceeded 1 nT.

K-INDICES

K-indices were derived from the digital 1-minute values by a straightforward measurement of the 3-hour ranges of H and D, as explained in the yearbook for 1993.

MAGNETIC ACTIVITY

As measured by Ak, the magnetic activity in 2009 was by far the lowest ever recorded at Leirvogur and there were no highly disturbed days. The only significant disturbance was on July 22:

Date	*K-sum*	*C9*	*L9*
Jul 22	(36)	(5)	(5)

This and other disturbances are displayed in the graphical records on pages 35-126. The index L9 was explained in the yearbook for 1998.

The index K never reached the extreme value 9 in 2009, and it never even reached the value 8. The value of 7 was only seen four times during the year. The year was by far the quietest on record at Leirvogur as is evident from the tables on pages 30 and 31. The quietest time of the year was on December 14 when the field kept steady to the nearest nanotesla in all elements for 219 consecutive 10-second readings (36 minutes). December was in fact the least disturbed month of the year, K reaching the value of 4 only once during the entire month and the value of 3 only six times.

COMPUTER PROGRAMS

Approximately 100 programs are used for data handling and processing. Most are in Comal and Python, nine in Fortran, four in Turbo-Pascal, four in BBC-Basic with 6502 assembly language, one in C and ten in GNU-awk and Linux command scripts.

DATA DISTRIBUTION

Magnetic results from Leirvogur are sent to two data centres: WDC-C2 in Kyoto and WDC-A in Boulder. The data are transmitted over the Internet. Preliminary 10-second data are sent daily to Kyoto where they are displayed graphically on the World Wide Web. The address is:

http://wdc.kugi.kyoto-u.ac.jp/

Preliminary values of Z, H and D are sent every hour to Kyoto, to be displayed graphically on the World Wide Web, and also made available at the above address. The same preliminary data are also placed in graphical form on the Leirvogur website: *http://www.raunvis.hi.is/∼halo/leirvogur.html*. The data on this site cover the last 24 hours and are renewed every 10 minutes. Final 10-second values are sent to Kyoto after the end of each month along with the 1-minute means, hourly means, monthly means and K-indices. The 1-minute means and hourly means are converted from a special Leirvogur format to WDC format before transmission. Monthly transmissions to Boulder are restricted to 1-minute means and hourly means.

Both preliminary and final data are available over the Internet by ftp-transfer. The address is *ftp.raunvis.hi.is* logging in as "anonymous". The files are kept in the directory "pub/lrv". The annual means are sent to WDC-C2 in Kyoto, WDC-C1 in Edinburgh and the Analytical Centre on Secular Variations in Troitsk (IZMIRAN). The annual means are accessible by FTP at the above address under the file name ANNMEANS.LRV. Also kept in the same location is the file ADQMEANS.LRV which contains an extended list of annual means, including disturbed-day and quiet-day means.

FIELD STATION OBSERVATIONS

In 2009, observations were made at one field station, Patreksfjörður, at $65°33.'26$ N, $23°58.'29$ W. The above coordinates were measured with a GPS receiver and refer to WGS84. The observations were made on June 1 under magnetically quiet conditions. A considerable amount of sand had drifted over the site and a cylindrical hole about 70 cm in diameter and 40 cm deep had to be dug to get to the reference pin. A sample of the sand was taken to Reykjavík to measure its magnetization to estimate the effect of the hole on the local field. Dr. Leó Kristjánsson of the Science Institute measured the magnetization to be 0.046 A/m; hence the hole would reduce the measured F by 1-2 nT. The results given below are corrected for this.

The DI-flux instrument Stefnir II and the proton magnetometer Geó were used to measure the magnetic field components. Three series of measurements were made with Stefnir II, and four with Geó. However, after the first set of measurements visibility deteriorated rapidly and sight to the main markers were lost. The latter two measurements used easily identifiable buildings in the town of Patreksfjörður as marks, but as the angle between those and the main marks is not known at present, the results of the last 2 sets of D-measurements can only be calculated once this angle is known. The result of the first set are as follows:

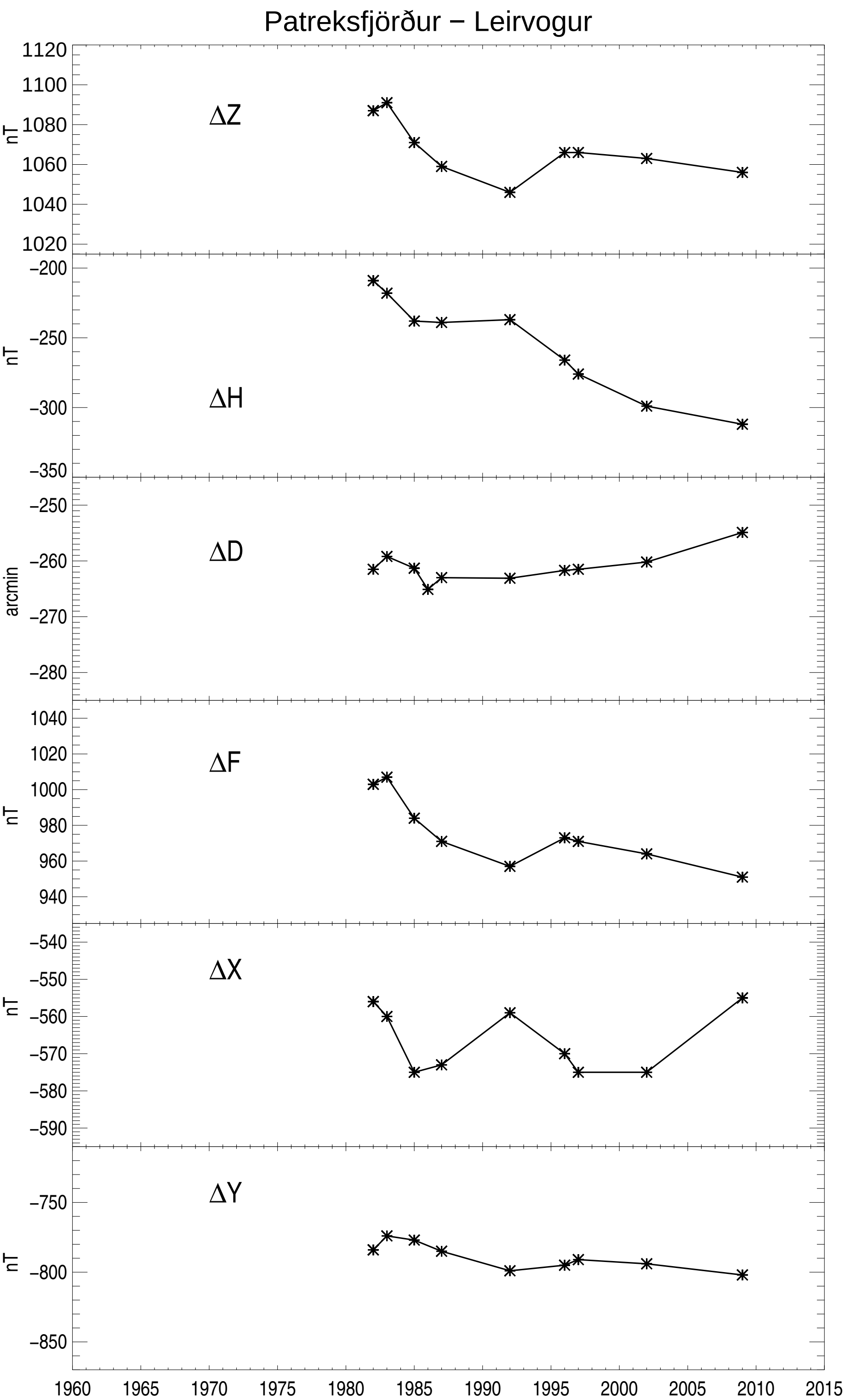
Patreksfjörður minus Leirvogur

	dF	dZ	dH	dD
2009	+951	+1056	–314	$-4°14.'9$
2002	+964	+1063	–299	$-4°20.'2$

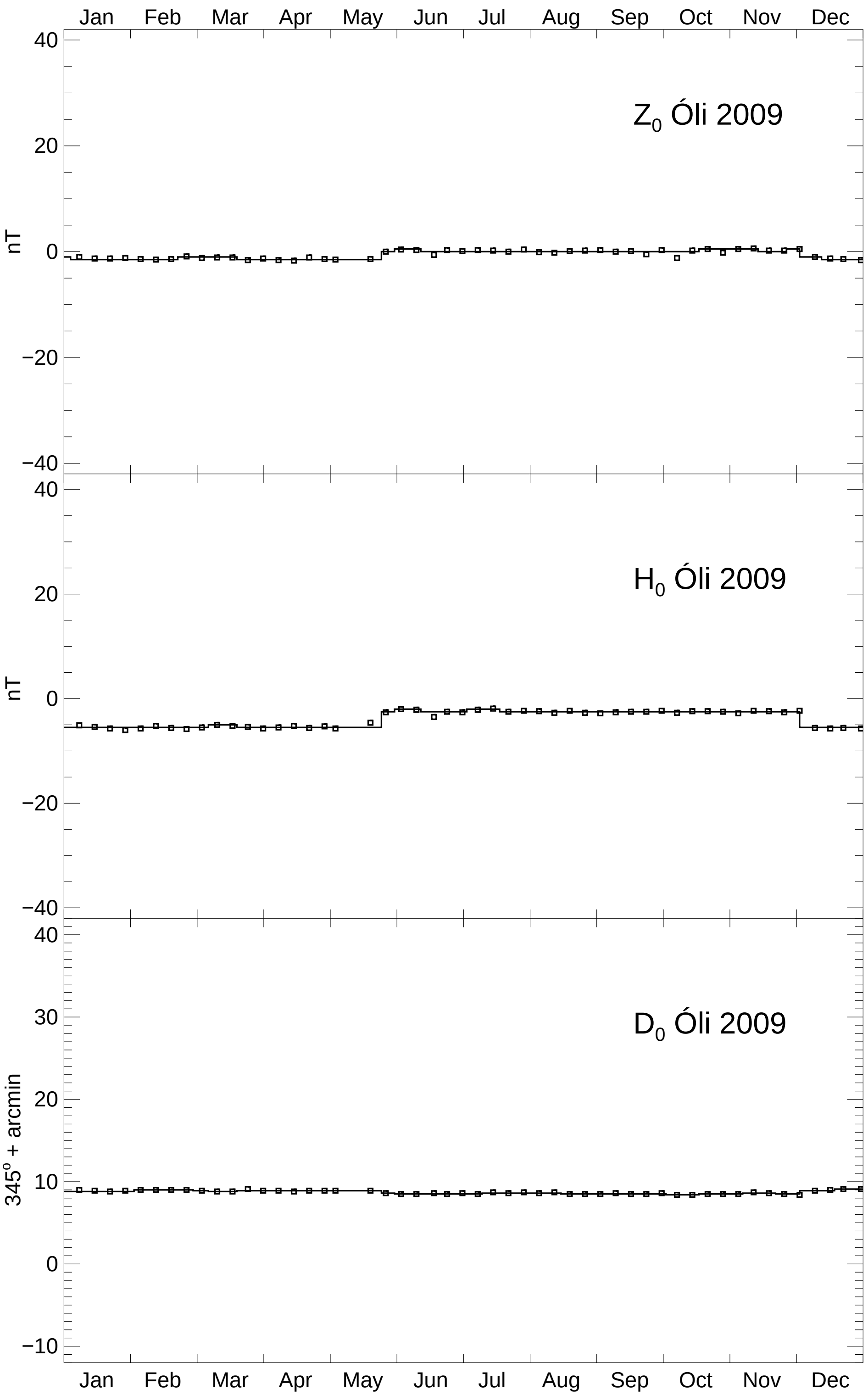
The units of F, Z and H are nanoteslas. As can be seen from the graph on page 21, the results are in conformity with a previously established trend.

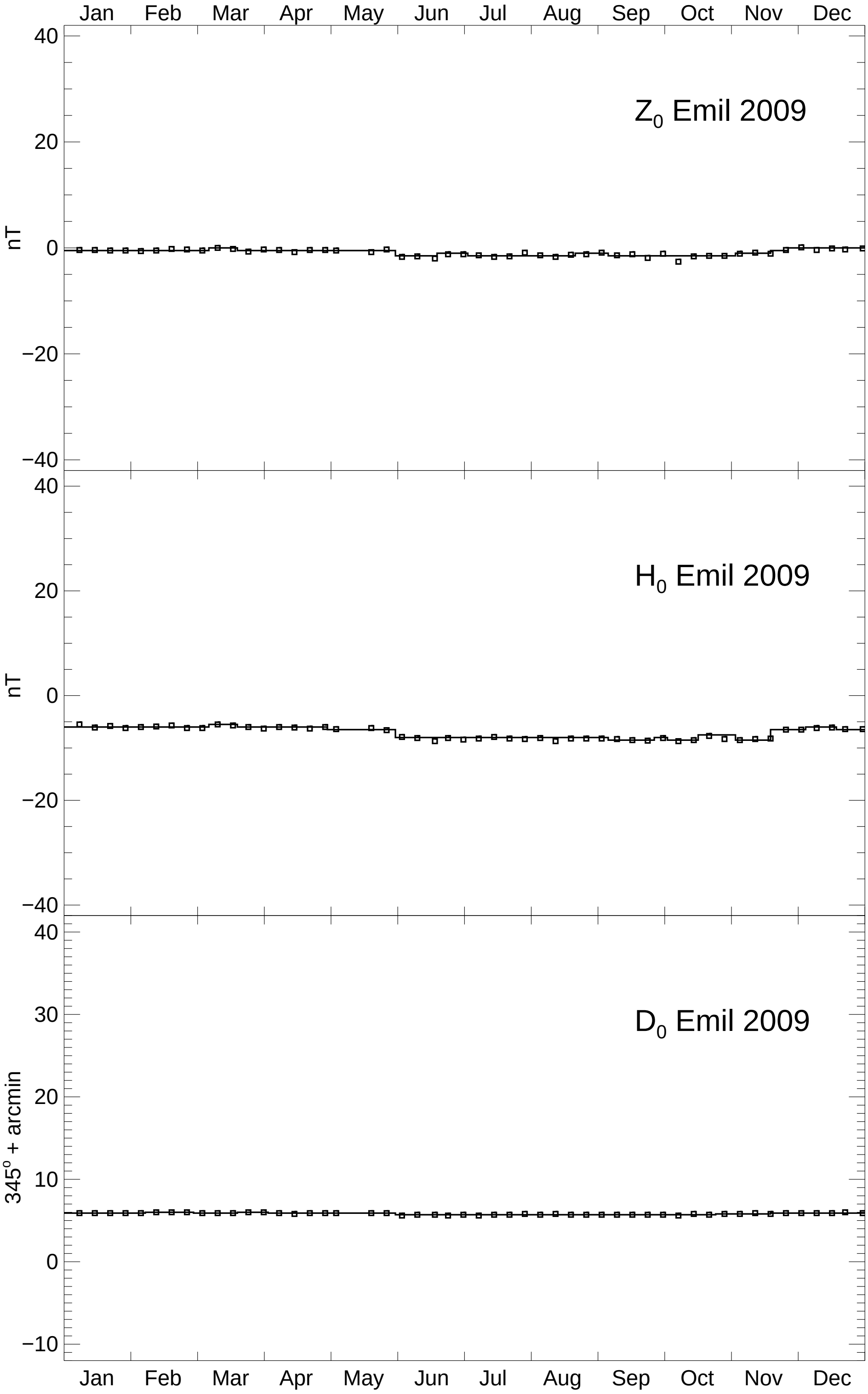
February 2010

Gunnlaugur Björnsson



Patreksfjörður − Leirvogur
ΔZ
ΔH
ΔD
ΔF
ΔX
ΔY
nT
arcmin
1120
1100
1080
1060
1040
1020
−200
−250
−300
−350
−260
−270
−280
1040
1020
1000
980
960
940
−540
−550
−560
−570
−580
−590
−750
−800
−850
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015


Z0 Óli 2009
H0 Óli 2009
D0 Óli 2009
nT
nT
345° + arcmin
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
40
20
0
−20
−40
30
10
−10


Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Z_0 Emil 2009
nT
40
20
0
−20
−40
H_0 Emil 2009
nT
40
20
0
−20
−40
D_0 Emil 2009
345° + arcmin
40
30
20
10
0
−10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

EXPLANATION OF TABLES

Monthly and annual means

In the table of monthly means on the following page, the declination is reckoned towards the east from 0 to 360 degrees. Thus $346°$ corresponds to $14°$ W. The letters Q and D mark the international quiet and disturbed days, respectively. The days were selected according to circulars from the International Service of Geomagnetic Indices in Potsdam.

Annual means (all days) since 1958 are given on pages 125-126.

Diurnal variations

The tables on pages 26-27 show the mean diurnal inequalities of the magnetic elements Z, H, D and F at Leirvogur in 2009. The units are nanoteslas (for Z, H and F) or tenths of a minute (for D). The top row in each group of four gives the mean of all months of the year, while the other rows show the mean for the winter months (W = January, February, November, December), the equinoctial months (E = March, April, September, and October) and summer months (S = May, June, July and August).

The averages for the international quiet and disturbed days are shown separately and are identified by Q or D as a second letter.

The last three columns give the positions of the minimum and the maximum values in each row, and the range. In cases where there are two or more extreme values of equal size, the number 99 is printed.

K-indices

The three-hourly K-indices, based on the components H and D, are shown in tabular from on page 28. The daily K-sums are shown on page 29 in runs of 27 days. The table on page 30 shows the distribution of K-indices for each month of the year. The columns give the number of cases when $K = 0$, $K = 1$ etc. The column marked "–" shows how many indices are missing owing to breaks in the record. The final columns give the average values of K and the equivalent amplitudes Ak. A summary for all years since 1958 is given on page 31.

LEIRVOGUR 2009
MEAN VALUES OF THE MAGNETIC ELEMENTS

VERTICAL INTENSITY (Z) IS 50000 PLUS TABULAR VALUES IN NANOTESLAS
HORIZONTAL INTENSITY (H) IS 12000 PLUS TABULAR VALUES IN NANOTESLAS
DECLINATION (D) IS 346 DEGREES PLUS TABULAR VALUES IN TENTH-MINUTES
TOTAL INTENSITY (F) IS 51000 PLUS TABULAR VALUES IN NANOTESLAS
Q=QUIET DAYS, D=DISTURBED DAYS

	Z	ZQ	ZD	H	HQ	HD	D	DQ	DD	F	FQ	FD
JAN	190	190	186	604	606	598	12	14	11	748	748	743
FEB	188	190	185	607	607	609	27	26	28	747	749	745
MAR	184	187	173	602	607	583	44	37	51	742	746	726
APR	184	188	175	607	610	598	58	54	59	743	747	732
MAY	185	187	179	612	614	602	78	77	82	745	748	737
JUN	185	187	182	619	618	615	88	85	95	747	748	744
JUL	189	190	190	613	617	592	107	101	130	750	752	746
AUG	189	191	189	614	616	613	121	123	123	749	752	750
SEP	189	192	178	612	611	602	133	139	143	750	752	737
OCT	190	190	183	613	615	602	149	148	155	750	752	740
NOV	193	193	195	619	618	621	166	165	170	755	754	758
DEC	191	191	190	621	621	623	181	179	181	753	753	753
MEAN	188	190	184	612	613	605	97	96	102	748	750	743

LEIRVOGUR 2009

MEAN DIURNAL INEQUALITIES

UT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	MIN	MAX	RANGE
Z		-16	-18	-17	-13	-9	-6	-5	-5	-5	-4	-3	-2	1	3	7	12	16	17	17	15	12	8	1	-7	2.	18.	35
ZW		-9	-13	-12	-8	-6	-3	-3	-4	-4	-3	-3	-2	0	1	3	6	9	10	11	11	11	9	4	-2	2.	21.	24
ZE		-18	-22	-22	-17	-9	-7	-7	-6	-4	-2	-2	0	3	5	9	13	17	19	19	17	13	9	1	-8	2.	99.	41
ZS		-20	-19	-17	-15	-13	-8	-5	-6	-6	-6	-4	-3	0	3	10	17	22	23	21	18	12	8	-1	-12	1.	18.	44
ZQ		-6	-7	-5	-3	-1	0	0	-1	-2	-3	-3	-3	-2	0	3	5	7	7	6	5	2	1	0	-1	2.	18.	14
ZQW		0	-2	-3	-2	0	1	0	0	0	-1	-2	-2	-2	-1	0	2	2	3	2	2	1	1	1	0	3.	18.	5
ZQE		-8	-11	-6	-2	-1	0	-1	-1	-2	-3	-3	-3	-1	1	4	7	9	9	8	6	3	1	0	-2	2.	99.	19
ZQS		-10	-8	-6	-5	-3	-2	0	-1	-2	-3	-4	-3	-2	1	4	7	9	10	9	6	3	2	0	-2	1.	18.	21
ZD		-30	-33	-37	-34	-20	-12	-11	-13	-10	-6	0	2	6	10	18	28	34	35	34	31	24	13	-5	-22	3.	18.	72
ZDW		-16	-16	-29	-26	-21	-11	-9	-13	-12	-8	-3	0	4	8	12	20	24	23	24	24	23	15	-1	-11	3.	99.	54
ZDE		-38	-54	-58	-47	-16	-17	-20	-15	-5	1	7	9	14	17	23	29	36	40	39	37	27	11	-2	-20	3.	18.	98
ZDS		-35	-28	-23	-28	-24	-8	-5	-12	-11	-12	-5	-4	-1	5	18	34	42	42	39	34	21	13	-13	-36	24.	18.	78
H		-11	-16	-15	-12	-8	-4	0	1	-2	-5	-9	-12	-11	-7	0	7	14	17	19	20	18	13	5	-4	2.	20.	36
HW		-6	-11	-10	-8	-5	-1	2	3	2	0	-1	-3	-4	-3	0	4	7	7	7	6	7	5	3	-2	2.	17.	18
HE		-14	-19	-17	-9	-2	0	3	4	2	-3	-8	-13	-14	-9	-2	4	11	16	18	18	18	14	6	-2	2.	99.	38
HS		-13	-17	-18	-19	-15	-10	-4	-4	-9	-13	-17	-19	-16	-8	2	13	23	30	33	35	30	20	6	-8	99.	20.	54
HQ		0	1	0	0	0	1	1	-1	-3	-7	-11	-14	-14	-10	-5	0	4	8	10	11	10	8	6	5	13.	20.	25
HQW		-1	-2	-3	-3	-2	0	1	2	1	0	-2	-3	-4	-4	-1	1	1	2	3	3	4	3	2	1	13.	21.	8
HQE		3	2	4	3	3	3	3	2	-1	-6	-11	-17	-19	-16	-9	-2	2	5	8	10	9	9	8	7	13.	20.	29
HQS		-2	1	0	-1	-1	0	-1	-5	-10	-15	-20	-22	-19	-12	-4	2	10	17	19	19	17	12	9	8	12.	19.	41
HD		-42	-59	-61	-48	-26	-13	-2	5	2	0	0	-2	-2	4	13	26	41	43	43	46	41	23	-4	-30	3.	20.	107
HDW		-18	-18	-35	-30	-18	0	3	3	2	-3	0	-2	-6	-1	3	15	29	25	24	17	14	9	-3	-11	3.	17.	65
HDE		-68	-91	-82	-40	-7	-2	6	11	10	7	4	3	4	7	17	23	32	42	40	42	44	26	-2	-25	2.	21.	135
HDS		-41	-67	-66	-75	-52	-35	-13	1	-5	-5	-2	-6	-5	5	18	41	62	63	65	79	64	34	-6	-54	4.	20.	154

LEIRVOGUR 2009

MEAN DIURNAL INEQUALITIES

UT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	MIN	MAX	RANGE
D		14	15	17	18	28	34	37	36	31	24	12	-6	-26	-43	-52	-49	-40	-30	-20	-14	-6	1	7	11	15.	7.	89
DW		17	16	11	12	14	14	14	11	7	2	-2	-10	-19	-27	-30	-26	-21	-18	-11	-6	2	10	21	19	15.	23.	51
DE		17	17	21	20	29	34	33	31	26	22	11	-8	-29	-47	-55	-52	-39	-27	-16	-9	-2	5	9	14	15.	6.	89
DS		10	11	17	23	40	56	65	66	60	47	27	0	-29	-55	-70	-69	-58	-46	-34	-25	-18	-10	-8	0	15.	8.	135
DQ		6	7	7	10	15	20	26	28	29	27	18	2	-17	-33	-40	-37	-29	-19	-11	-6	-2	-1	0	2	15.	9.	70
DQW		7	7	5	5	6	5	6	6	7	8	5	-3	-12	-19	-20	-16	-9	-6	-3	-1	1	3	7	8	15.	10.	29
DQE		8	10	10	11	16	19	22	25	27	26	17	2	-17	-33	-42	-39	-29	-16	-8	-4	-2	-2	-1	2	15.	9.	70
DQS		3	4	6	12	21	36	49	52	54	47	31	5	-23	-47	-58	-56	-48	-35	-23	-13	-5	-3	-5	-4	15.	9.	112
DD		31	33	44	42	62	64	60	43	22	7	-6	-23	-39	-58	-70	-68	-59	-51	-35	-30	-10	7	14	19	15.	6.	134
DDW		28	31	26	31	38	28	28	12	-2	-14	-21	-26	-29	-38	-47	-50	-42	-37	-13	-17	8	31	46	29	16.	23.	96
DDE		36	46	62	45	60	63	49	31	6	-6	-16	-30	-43	-59	-71	-68	-54	-44	-30	-18	0	11	8	22	15.	6.	134
DDS		28	24	44	51	89	103	103	87	64	42	18	-13	-46	-78	-92	-88	-79	-73	-63	-55	-38	-23	-12	7	15.	99.	194
F		-18	-21	-20	-16	-11	-7	-5	-5	-5	-5	-5	-4	-2	1	7	13	18	21	21	20	16	11	3	-8	2.	99.	42
FW		-10	-15	-14	-10	-6	-3	-3	-3	-3	-3	-3	-2	-2	0	3	7	10	11	12	12	12	10	4	-3	2.	99.	27
FE		-21	-27	-25	-19	-10	-7	-6	-5	-3	-3	-4	-3	-1	3	8	13	19	22	23	21	17	12	3	-8	2.	19.	49
FS		-23	-22	-21	-19	-16	-10	-6	-6	-8	-9	-8	-7	-4	1	10	19	26	30	28	26	19	13	1	-13	1.	18.	53
FQ		-6	-6	-5	-3	-1	0	0	-1	-2	-4	-6	-6	-5	-3	1	5	7	9	9	7	5	3	2	0	2.	19.	15
FQW		0	-2	-4	-2	0	1	0	0	0	-1	-2	-3	-3	-2	0	2	2	3	3	2	3	2	1	0	3.	19.	7
FQE		-7	-10	-5	-1	0	0	-1	-1	-2	-4	-6	-7	-5	-3	1	6	9	9	10	8	5	3	2	0	2.	19.	19
FQS		-10	-7	-6	-5	-3	-1	-1	-2	-5	-7	-8	-8	-6	-2	2	7	12	14	13	11	7	6	3	1	1.	18.	24
FD		-39	-46	-50	-44	-26	-15	-12	-12	-9	-7	0	1	5	11	20	34	43	44	44	42	33	18	-6	-29	3.	18.	95
FDW		-20	-20	-37	-33	-25	-11	-9	-11	-12	-8	-3	-1	2	8	13	24	31	28	30	27	25	17	-1	-13	3.	17.	68
FDE		-53	-75	-76	-55	-17	-17	-18	-12	-3	2	8	10	14	18	27	34	42	49	48	46	37	18	-2	-26	3.	18.	125
FDS		-44	-43	-38	-46	-36	-16	-8	-11	-12	-14	-6	-6	-3	6	21	43	55	56	54	52	35	21	-14	-48	24.	18.	104

LEIRVOGUR MAGNETIC OBSERVATORY 2009
K-INDICES FOR THREE HOUR INTERVALS IN U.T.
LOWER LIMIT FOR K-9 = 1500 NANOTESLAS IN H

DAYS	K-INDICES						
1- 7	23321112	11000125	55232213	20110111	12111122	32100101	11000001
8- 14	10001102	31102210	42010002	20000000	00000000	22101022	22022113
15- 21	31211134	31001100	00110121	10010000	64201135	41010021	00010232
22- 28	00000000	00011001	11000001	20000003	52223420	00010121	00011000
29- 35	02211010	11110101	12212213	13100001	00000000	10000015	42233664
36- 42	52112103	41010001	02110001	00000002	20000002	00000001	30000110
43- 49	00011111	00000111	22344316	55223333	31001210	10000001	31101013
50- 56	00000100	01111133	00010110	00111100	00012324	45211100	42111111
57- 63	12121100	22243223	44211013	21101100	00011010	10121234	34222134
64- 70	34111102	30011000	10011103	32323211	10011100	10012320	10001124
71- 77	54011117	65533333	42321335	54312314	40131220	20011232	10011121
78- 84	21111212	10011220	00133244	35021113	31011120	14222324	66221222
85- 91	34312312	00012443	20011231	10212201	21122220	10111110	00111122
92- 98	00012211	10011210	00011101	12111211	10022200	00111110	00123232
99-105	44322545	43222354	63222336	53211234	32112212	21011113	51111222
106-112	22222313	31121212	35512222	33112223	31121210	01221111	22112112
113-119	00111110	11123210	01121223	21121102	43111110	01122111	00121221
120-126	20011101	01112202	11121113	31112201	02121200	01211200	32122326
127-133	54222225	75422233	01222213	32112112	41112211	10112112	21122211
134-140	12132344	31122211	11122223	31111110	21111113	23212110	11122131
141-147	11221211	00222211	01121323	33121222	00112201	01112211	01012111
148-154	02232210	21122323	23111220	01222312	12121110	01111211	11122221
155-161	24122125	32222222	12211122	01122322	21111211	10012211	01222111
162-168	11012211	00011211	01112212	10022222	12121201	00122110	11111100
169-175	01012211	11121110	01223221	35222112	11121110	01122105	53322255
176-182	41113235	31111112	10112322	21112455	66222321	13221321	33121211
183-189	11111200	11112212	21112212	22111223	22112212	11112311	01212112
190-196	30111333	32122223	21112212	11021201	21123434	76222223	32212101
197-203	21111111	00011100	01102010	01011210	01223311	11122223	57662343
204-210	22323333	42223312	55122211	10121210	11122122	33112211	32112110
211-217	10022321	01312223	11122222	11111013	54212221	01102222	32222100
218-224	15632334	34122436	32122121	25222123	51122210	00121212	11112225
225-231	32111212	12122112	10112010	10110101	01111211	11112112	10123336
232-238	66222224	31223325	25222122	23322221	11112100	01121111	32212100
239-245	11122433	21111111	00121100	11324546	32222220	00112212	21122101
246-252	00122322	23322221	21121111	12121120	00122212	10122212	30011111
253-259	00012220	01022222	02111101	32112333	51111222	02212314	32212210
260-266	43211121	42121100	00011110	00121123	62233210	10112101	10001000
267-273	00011110	01011110	00012215	36222125	52211224	00111101	11112123
274-280	22111101	10111110	20011110	12022101	11011201	01111101	00011101
281-287	10011102	01011112	10011100	11222212	00011110	10011101	00011000
288-294	00112331	42011100	00011000	00010110	00012100	20010000	00011100
295-301	43322156	54132111	10122255	51122100	10111122	21021120	01111100
302-308	22112224	54332101	10011112	21010110	00111100	00011000	00011100
309-315	00011000	00011000	00000002	11022354	21111101	10000001	20010000
316-322	00000002	00000001	10121124	31111321	00000001	10000000	00010001
323-329	01110103	20001000	61121133	41201110	10001000	00012334	44221112
330-336	20121342	11000000	00020000	00000001	10010000	00000000	00000000
337-343	00000001	00000000	00000033	43100000	20001011	00000001	00000000
344-350	00000000	00000000	00000000	00000012	23211100	00100001	32011101
351-357	10011100	00011100	20010002	20001000	20000010	11000012	11110002
358-364	21100000	00011113	21110100	00011100	00010101	10000000	00000000
365	00000000						

LEIRVOGUR MAGNETIC OBSERVATORY 2009

K-SUMS IN 27-DAY RUNS

DAYS	K-SUMS																										
1- 27	15	10	23	7	11	8	3	5	10	9	2	0	10	13	16	6	6	2	22	9	8	0	3	3	5	20	5
28- 54	2	7	6	14	6	0	7	30	15	7	5	2	4	1	5	5	3	25	26	8	2	10	1	11	3	4	12
55- 81	14	12	8	20	16	6	3	14	21	13	5	7	17	4	9	9	20	31	23	23	13	11	7	11	7	17	16
82-108	9	20	23	19	14	10	9	12	6	8	7	6	4	10	7	5	13	29	25	27	21	14	10	15	17	13	22
109-135	17	11	9	12	5	11	12	10	12	9	9	6	9	11	11	8	7	21	24	28	13	13	13	9	12	20	13
136-162	14	9	11	12	12	11	10	13	16	7	9	7	12	16	12	13	9	8	12	19	17	12	13	10	8	10	9
163-189	6	10	11	10	7	6	8	8	13	18	8	12	27	20	11	12	21	24	15	14	7	11	12	14	13	11	10
190-216	15	17	12	8	20	26	12	9	3	5	6	13	14	36	21	19	19	8	12	14	11	11	14	13	9	19	10
217-243	12	27	25	14	19	14	9	15	13	12	6	5	8	10	19	26	21	18	17	7	8	11	17	9	5	26	15
244-270	9	10	12	17	10	10	10	11	8	7	11	7	18	15	15	13	15	11	4	10	19	7	2	4	5	11	23
271-297	19	5	12	9	6	6	9	7	6	4	6	7	4	13	4	5	2	11	9	2	3	4	3	3	26	18	18
298-324	12	9	9	5	16	19	7	6	4	2	3	2	2	2	18	8	2	3	2	1	12	13	1	1	2	7	3
325-351	18	10	2	13	17	15	2	2	1	2	0	0	1	0	6	8	5	1	0	0	0	0	3	10	2	9	4
352-365	3	5	3	3	5	6	4	7	6	3	3	1	0	0													

LEIRVOGUR MAGNETIC OBSERVATORY 2009

DISTRIBUTION OF K-INDICES AND AVERAGES OF K AND Ak

	K=0	K=1	K=2	K=3	K=4	K=5	K=6	K=7	K=8	K=9	-	$\bar{K}$	$\overline{Ak}$
JAN	102	76	44	15	5	5	1	0	0	0	0	1.0	5
FEB	95	65	25	20	11	5	3	0	0	0	0	1.2	6
MAR	53	83	52	33	17	6	3	1	0	0	0	1.6	9
APR	37	96	68	23	7	7	2	0	0	0	0	1.6	7
MAY	26	101	86	25	5	3	1	1	0	0	0	1.6	7
JUN	27	106	80	13	3	9	2	0	0	0	0	1.6	7
JUL	26	98	80	32	4	3	3	2	0	0	0	1.7	8
AUG	26	92	85	23	8	8	6	0	0	0	0	1.8	9
SEP	51	92	71	16	4	4	2	0	0	0	0	1.4	6
OCT	82	109	38	7	5	6	1	0	0	0	0	1.1	5
NOV	133	68	21	9	7	1	1	0	0	0	0	0.7	3
DEC	178	50	13	6	1	0	0	0	0	0	0	0.4	1
YEAR	836	1036	663	222	77	57	25	4	0	0	0	1.3	6
%	28.6	35.5	22.7	7.6	2.6	2.0	0.9	0.1	0.0	0.0			

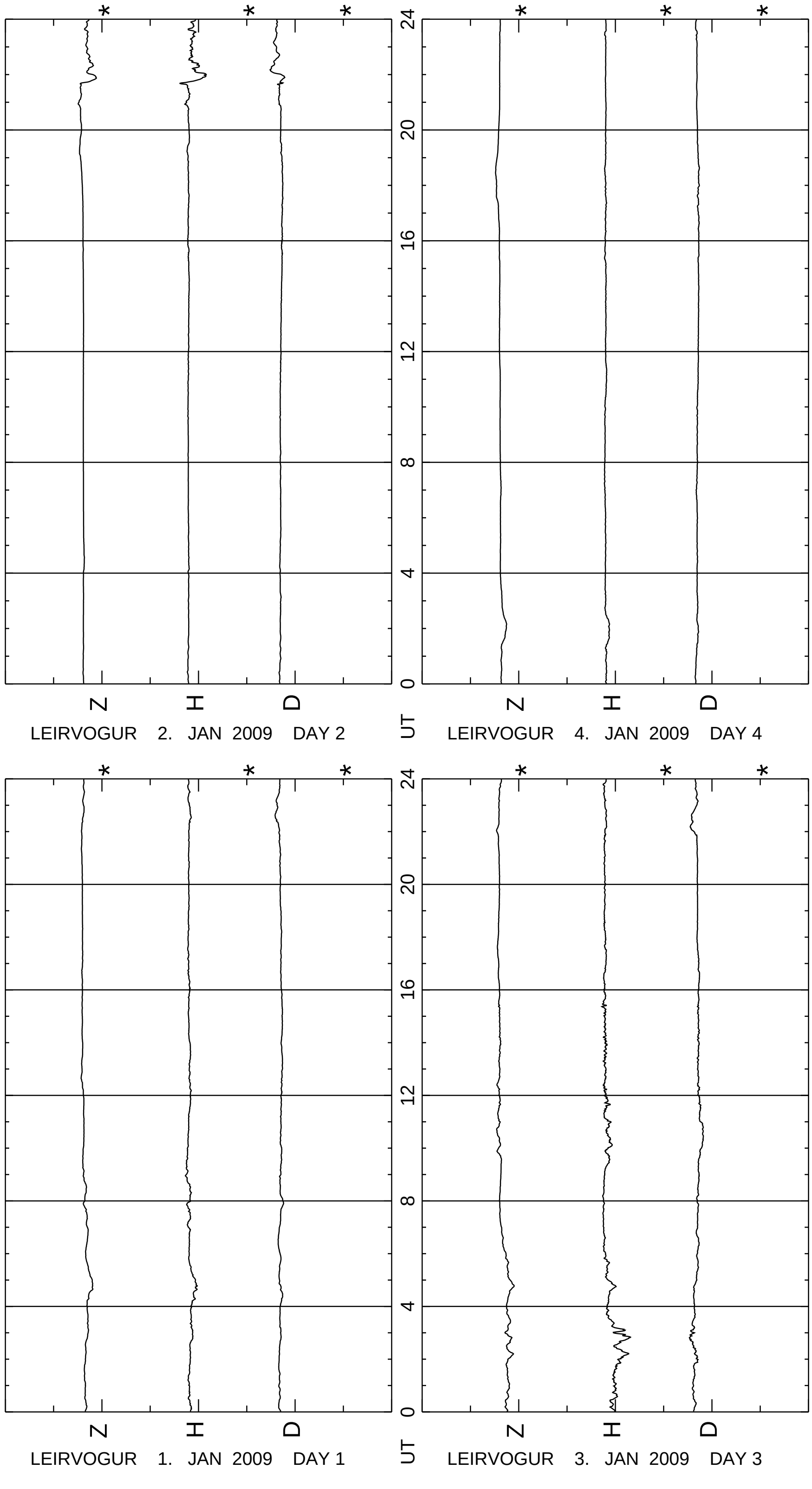
	K=0	K=1	K=2	K=3	K=4	K=5	K=6	K=7	K=8	K=9	-	$\bar{K}$	$\overline{Ak}$
1958	76	267	459	591	510	488	328	87	12	2	100	3.6	33
1959	46	260	360	567	562	547	388	138	33	8	11	3.9	39
1960	75	275	399	539	468	492	304	165	32	4	175	3.7	38
1961	224	477	475	518	482	351	222	87	19	1	64	3.1	27
1962	17	346	592	569	444	412	259	94	10	0	177	3.4	30
1963	181	494	543	550	371	353	259	99	10	0	60	3.1	27
1964	328	699	573	451	325	238	159	54	3	0	98	2.5	19
1965	416	799	567	455	247	199	111	35	0	0	91	2.2	15
1966	247	644	648	535	309	299	158	48	8	1	23	2.6	20
1967	178	561	685	523	386	294	189	58	7	3	36	2.8	23
1968	114	411	569	596	489	387	256	75	9	0	22	3.2	27
1969	174	469	619	610	418	351	195	52	4	2	26	3.0	23
1970	48	388	676	640	478	378	209	58	11	4	30	3.2	26
1971	13	316	768	684	448	367	215	81	8	0	20	3.3	26
1972	20	321	812	682	453	356	172	73	24	4	11	3.2	27
1973	55	213	603	586	484	459	326	171	17	0	6	3.7	35
1974	41	237	400	563	509	533	392	209	24	1	11	3.9	41
1975	81	364	621	603	432	425	260	111	19	3	1	3.4	30
1976	109	413	701	589	417	377	223	84	12	3	0	3.1	27
1977	131	460	757	547	396	337	189	91	10	2	0	3.0	25
1978	135	352	601	569	458	392	270	122	17	4	0	3.3	31
1979	87	270	644	680	492	441	227	70	9	0	0	3.3	27
1980	142	448	826	612	400	303	160	35	2	0	0	2.8	20
1981	33	301	573	663	585	440	241	67	15	2	0	3.4	29
1982	20	182	366	648	566	554	389	156	29	10	0	4.0	41
1983	10	150	494	595	596	585	330	137	17	6	0	3.9	37
1984	9	117	516	676	568	497	367	151	24	3	0	3.9	38
1985	2	231	806	695	454	386	237	85	23	1	0	3.4	29
1986	14	300	927	645	399	322	194	96	20	3	0	3.2	27
1987	17	371	931	687	385	314	143	55	5	1	11	3.0	22
1988	14	249	814	694	495	374	182	63	10	0	25	3.3	26
1989	3	122	601	711	520	475	346	111	19	4	8	3.8	35
1990	16	230	665	661	527	444	246	98	12	2	19	3.5	30
1991	10	186	531	620	505	497	375	134	37	5	20	3.8	38
1992	98	293	669	655	469	402	242	77	23	0	0	3.3	28
1993	92	372	712	598	437	361	234	95	19	0	0	3.2	28
1994	100	368	546	546	445	409	322	157	26	1	0	3.5	34
1995	200	547	638	493	389	339	212	82	12	1	7	2.9	25
1996	206	557	845	578	304	231	148	52	7	0	0	2.6	19
1997	398	659	737	482	265	214	124	33	8	0	0	2.3	17
1998	228	516	729	525	361	295	186	61	13	5	1	2.8	23
1999	163	440	687	583	397	355	213	71	7	0	4	3.0	24
2000	157	321	673	616	446	399	219	75	13	5	4	3.2	27
2001	182	479	747	591	408	275	165	59	9	5	0	2.8	22
2002	133	356	720	647	420	367	198	60	8	0	11	3.1	24
2003	43	197	406	588	530	519	414	186	30	7	0	4.0	41
2004	154	431	706	599	415	323	212	71	11	6	0	3.0	25
2005	218	463	676	557	366	305	232	75	20	8	0	3.0	26
2006	389	768	703	413	290	185	120	44	5	3	0	2.3	17
2007	469	722	724	454	240	158	112	40	1	0	0	2.1	15
2008	524	734	713	463	223	154	84	29	4	0	0	2.0	13
2009	836	1036	663	222	77	57	25	4	0	0	0	1.3	6

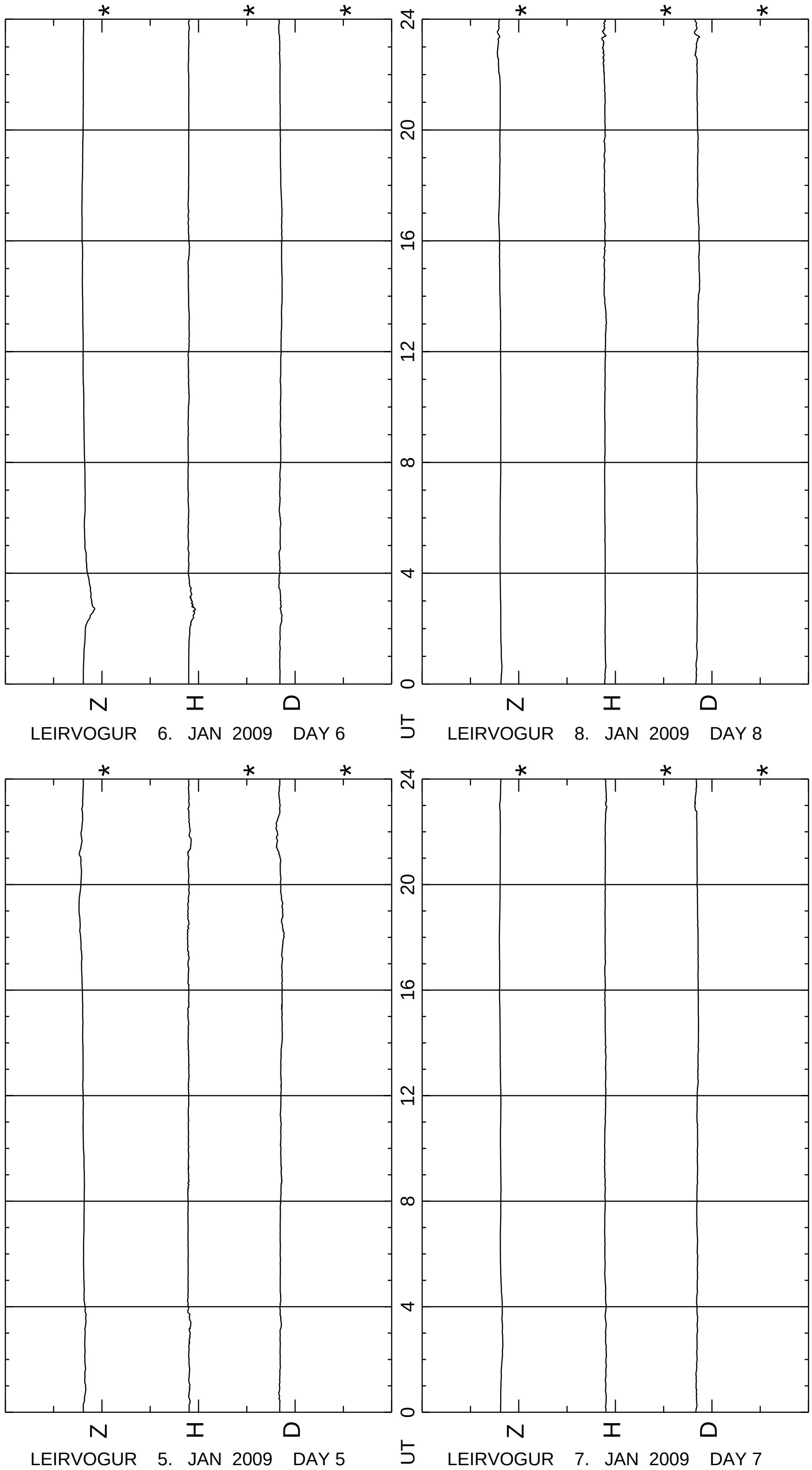
EXPLANATION OF DAILY GRAPHS

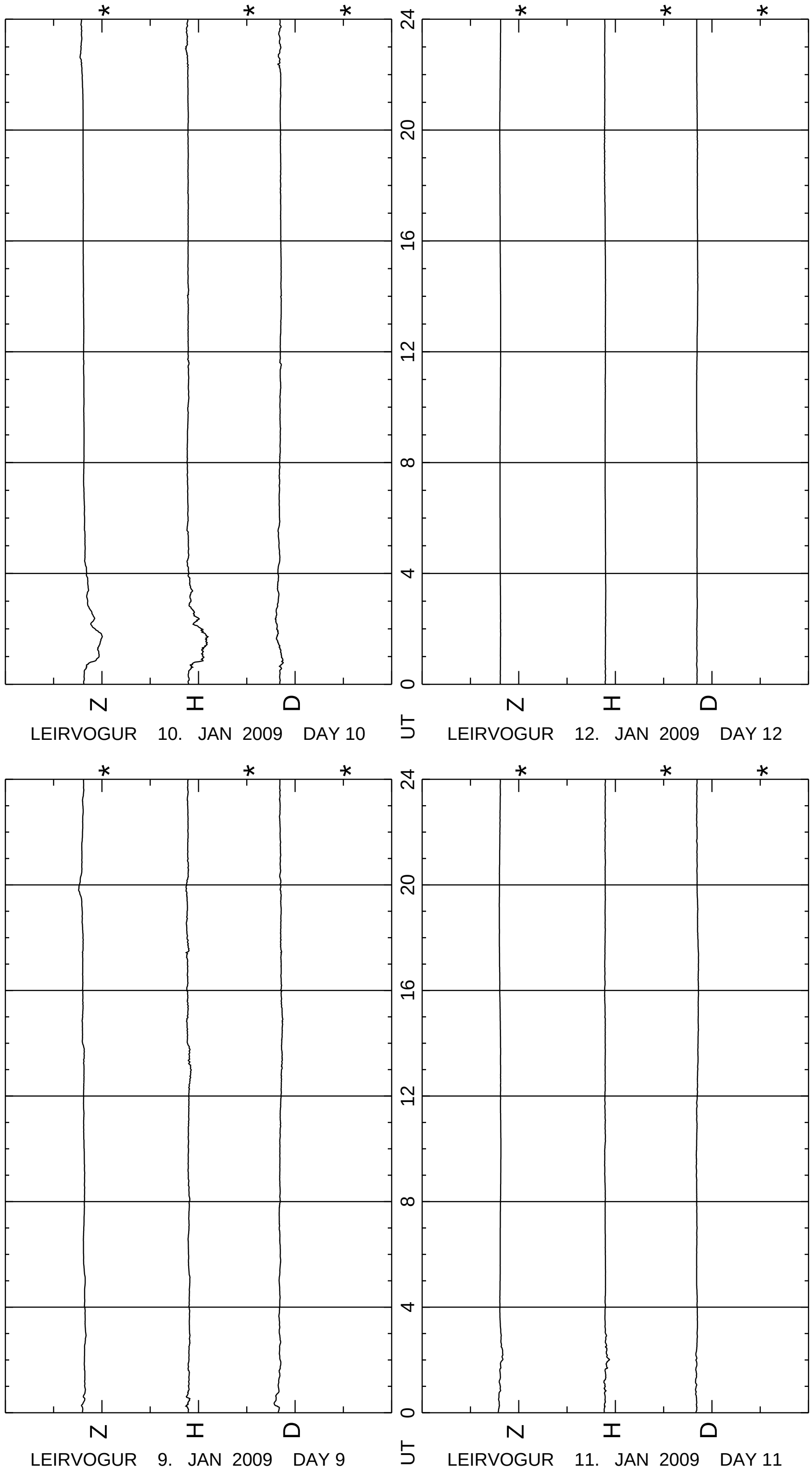
The graphs on pages 33–124 show the 1-minute means of the magnetic elements Z, H, and D at Leirvogur in 2009. Vertical divisions are spaced at intervals of 500 nT in Z and H and $2.^\circ 31$ in D. The last figure is equivalent to 500 nT in the direction of magnetic east for average values of H at Leirvogur.

Levels marked with asterisk (*) are as follows:
Z: 50000 nT
H: 12000 nT
D: 343° E

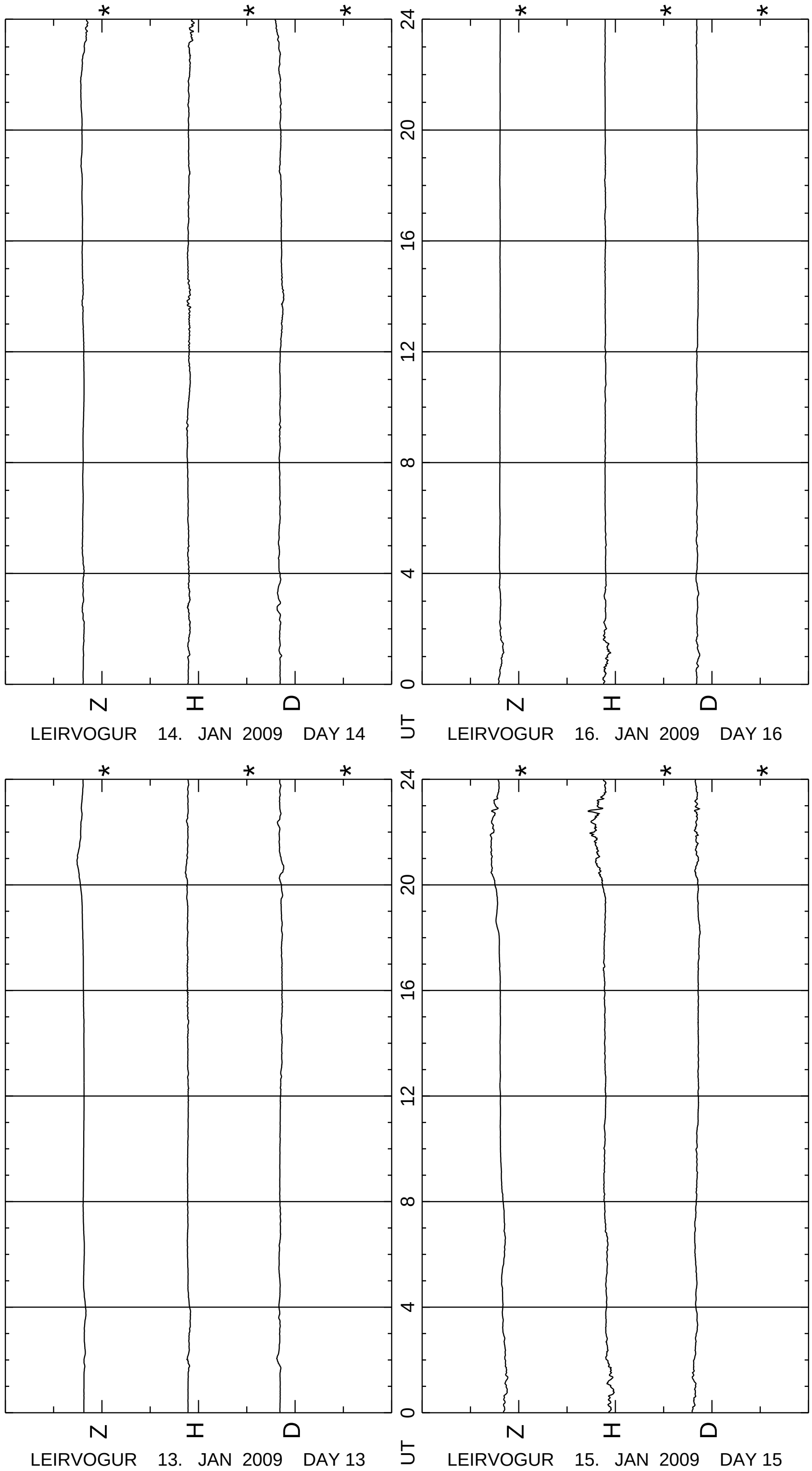
In several cases the H and D components had to be shifted upwards or downwards by one interval (500 nT) to disentangle the lines or prevent them from disappearing off scale.

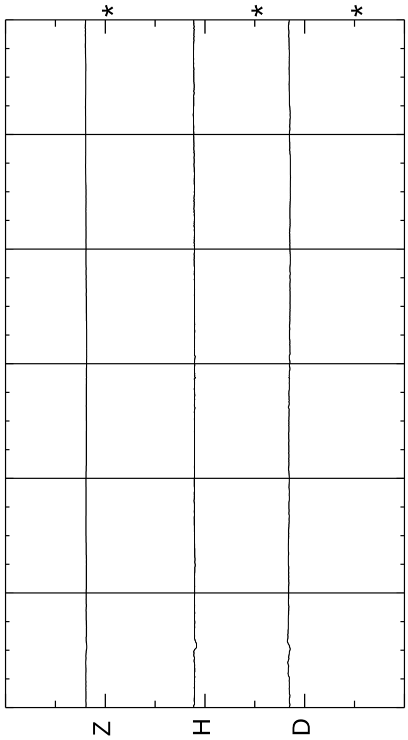

LEIRVOGUR 2. JAN 2009 DAY 2
LEIRVOGUR 4. JAN 2009 DAY 4
LEIRVOGUR 1. JAN 2009 DAY 1
LEIRVOGUR 3. JAN 2009 DAY 3
Z
H
D
UT
0
4
8
12
16
20
24


LEIRVOGUR 6. JAN 2009 DAY 6
LEIRVOGUR 8. JAN 2009 DAY 8
LEIRVOGUR 5. JAN 2009 DAY 5
LEIRVOGUR 7. JAN 2009 DAY 7
Z
H
D
UT
0
4
8
12
16
20
24

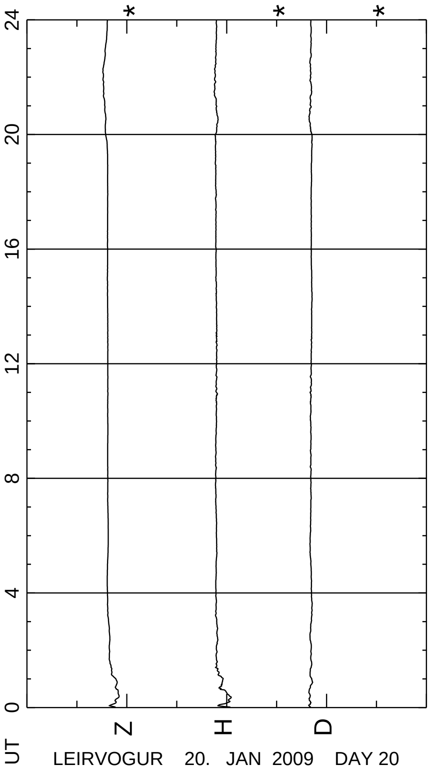


Z H D
LEIRVOGUR 10. JAN 2009 DAY 10
UT
Z H D
LEIRVOGUR 12. JAN 2009 DAY 12
Z H D
LEIRVOGUR 9. JAN 2009 DAY 9
UT
Z H D
LEIRVOGUR 11. JAN 2009 DAY 11
0 4 8 12 16 20 24

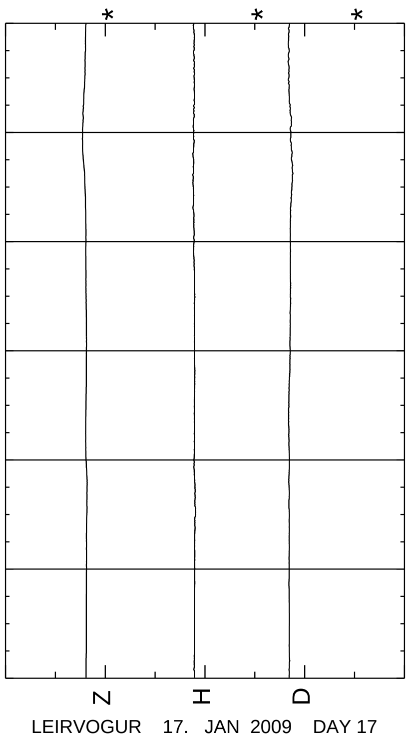

LEIRVOGUR 14. JAN 2009 DAY 14
LEIRVOGUR 16. JAN 2009 DAY 16
LEIRVOGUR 13. JAN 2009 DAY 13
LEIRVOGUR 15. JAN 2009 DAY 15
Z
H
D
UT
0
4
8
12
16
20
24



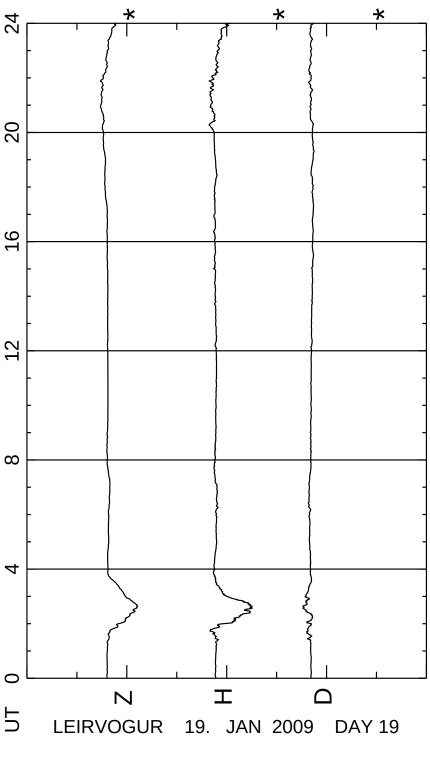
LEIRVOGUR 18. JAN 2009 DAY 18



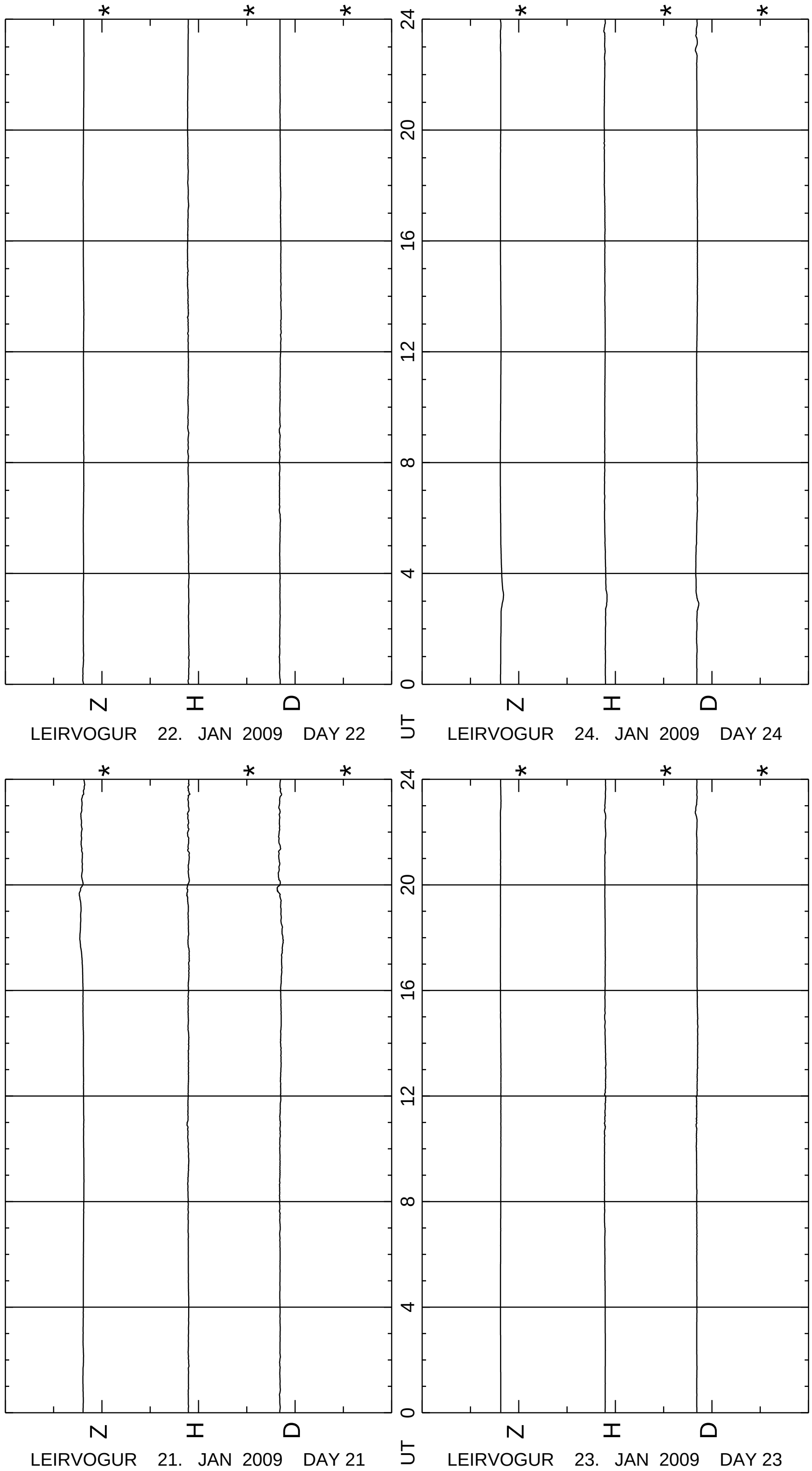
LEIRVOGUR 20. JAN 2009 DAY 20

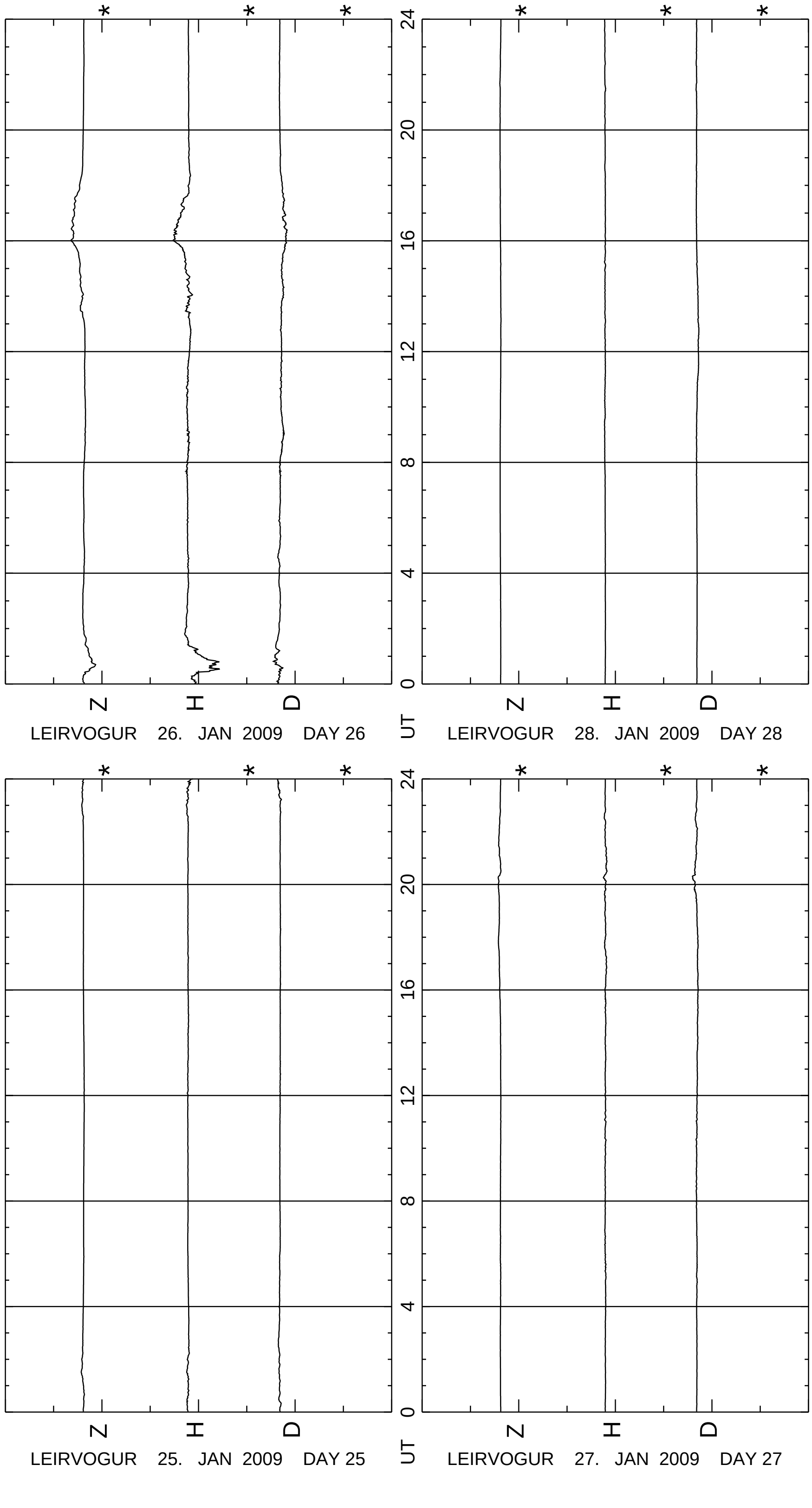


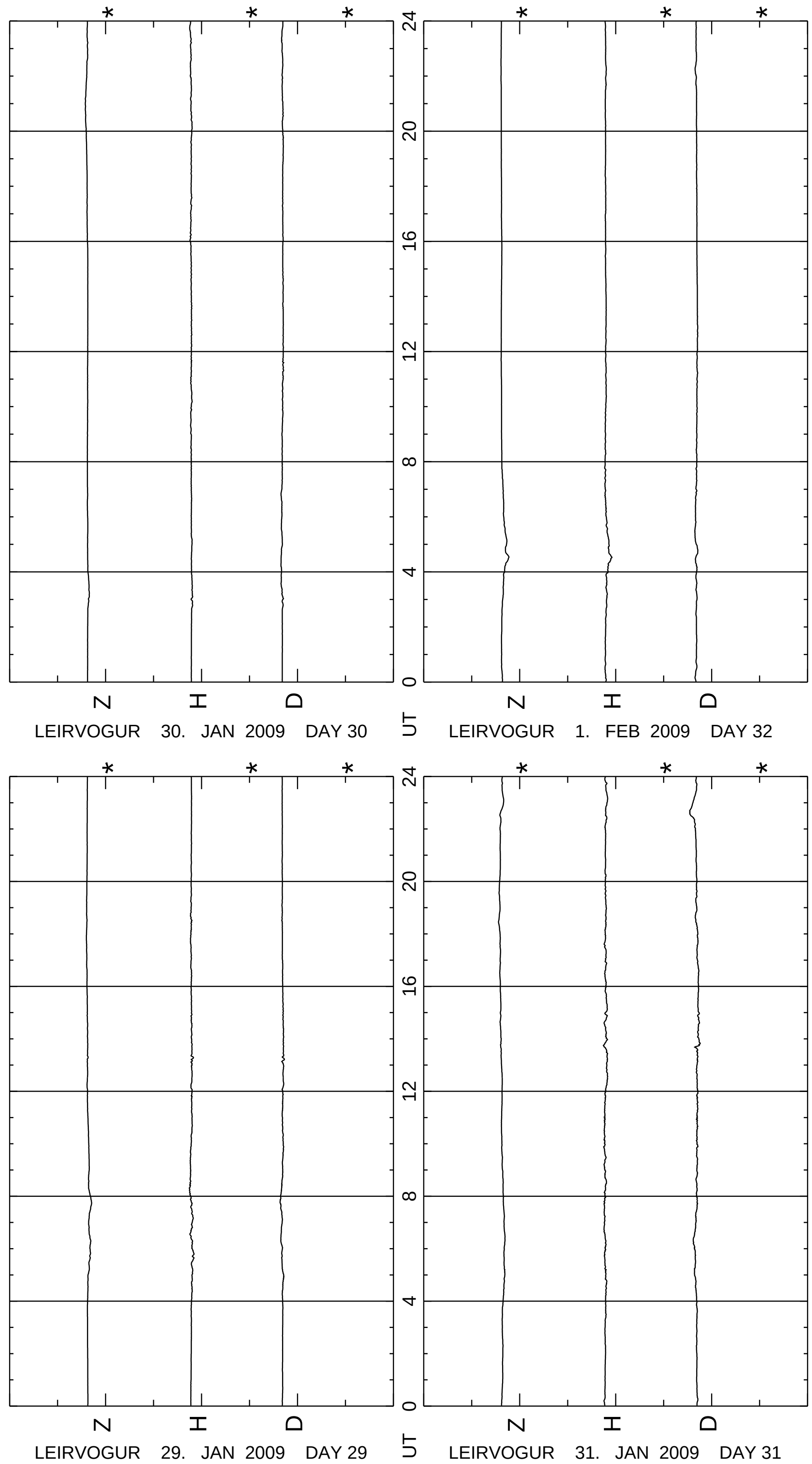
LEIRVOGUR 17. JAN 2009 DAY 17

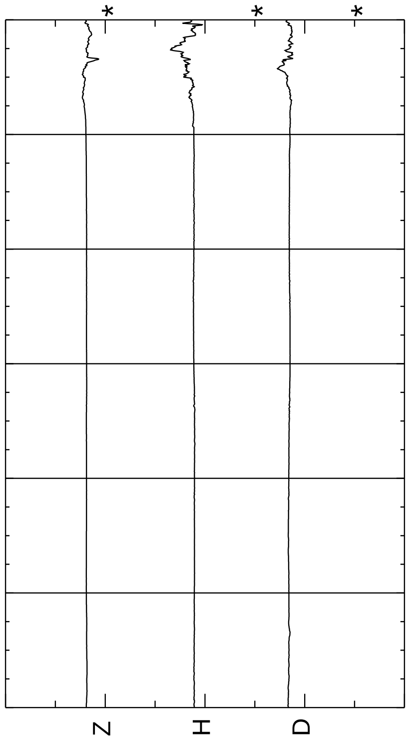


LEIRVOGUR 19. JAN 2009 DAY 19

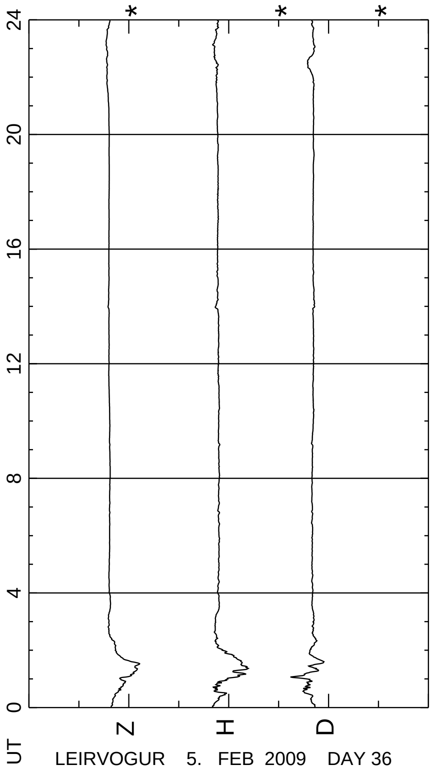

LEIRVOGUR 22. JAN 2009 DAY 22
LEIRVOGUR 24. JAN 2009 DAY 24
LEIRVOGUR 21. JAN 2009 DAY 21
LEIRVOGUR 23. JAN 2009 DAY 23
Z
H
D
UT
0
4
8
12
16
20
24


Z
H
D
UT
0
4
8
12
16
20
24
LEIRVOGUR 26. JAN 2009 DAY 26
LEIRVOGUR 28. JAN 2009 DAY 28
LEIRVOGUR 25. JAN 2009 DAY 25
LEIRVOGUR 27. JAN 2009 DAY 27

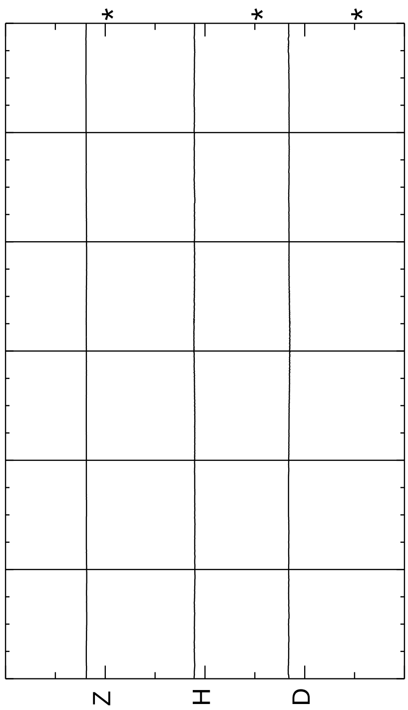

LEIRVOGUR 30. JAN 2009 DAY 30
LEIRVOGUR 1. FEB 2009 DAY 32
LEIRVOGUR 29. JAN 2009 DAY 29
LEIRVOGUR 31. JAN 2009 DAY 31
Z
H
D
UT
0
4
8
12
16
20
24



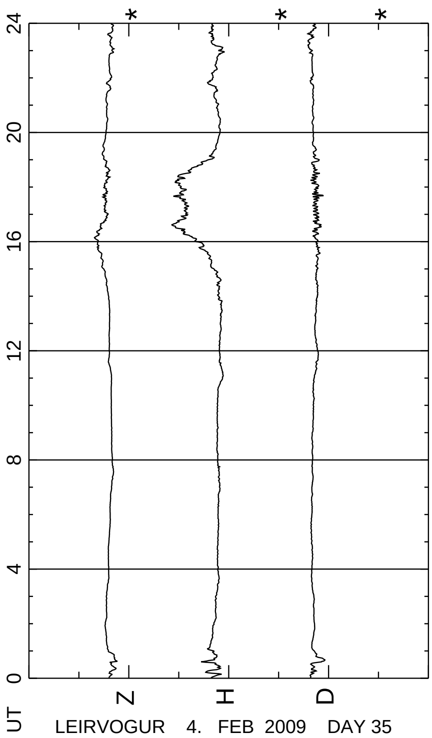
LEIRVOGUR 3. FEB 2009 DAY 34



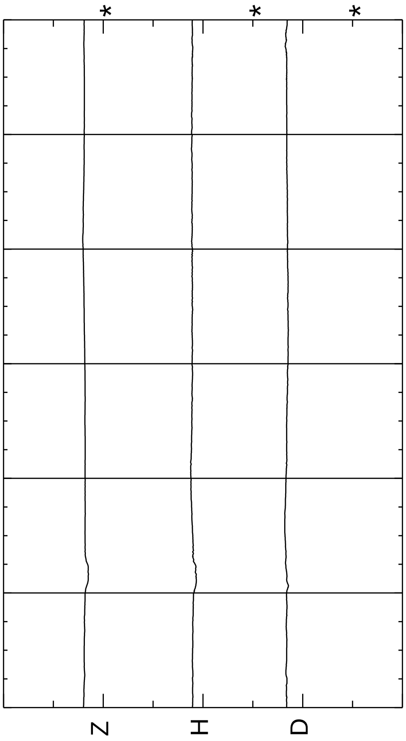
LEIRVOGUR 5. FEB 2009 DAY 36



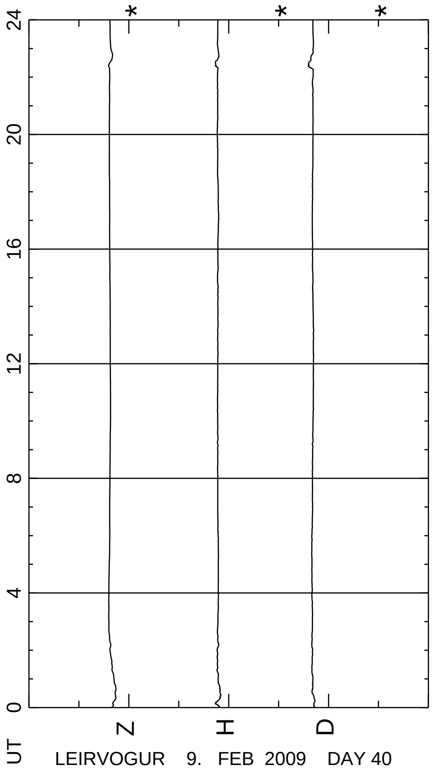
LEIRVOGUR 2. FEB 2009 DAY 33



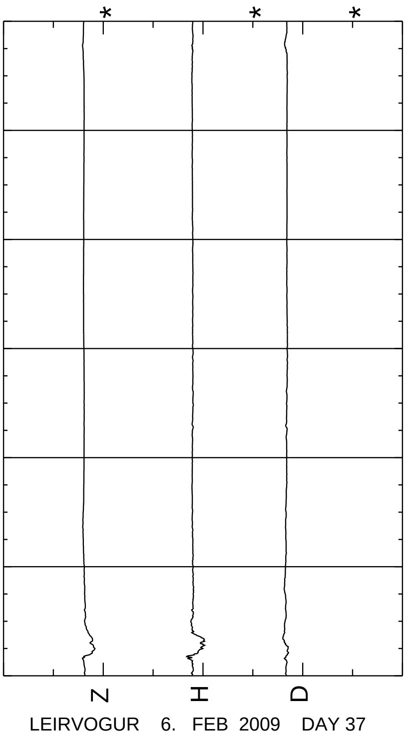
LEIRVOGUR 4. FEB 2009 DAY 35



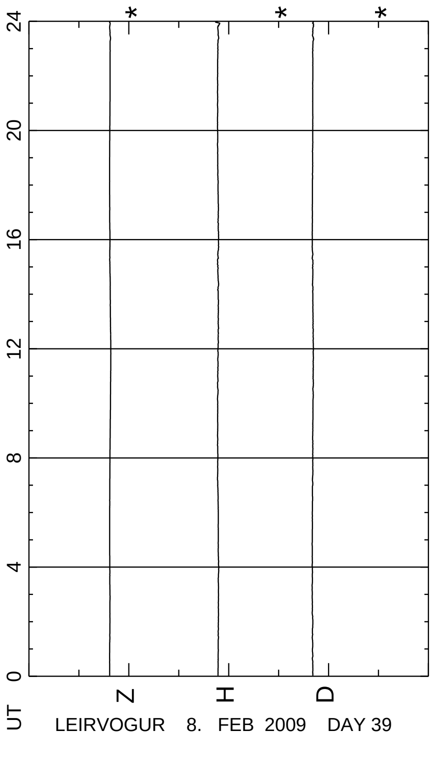
LEIRVOGUR 7. FEB 2009 DAY 38



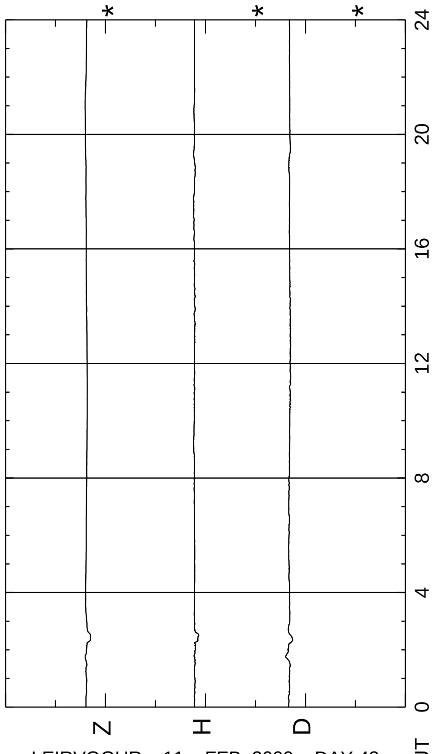
LEIRVOGUR 9. FEB 2009 DAY 40



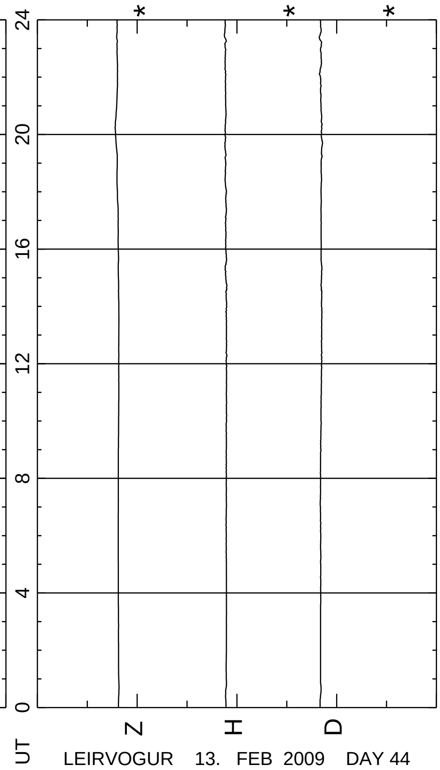
LEIRVOGUR 6. FEB 2009 DAY 37



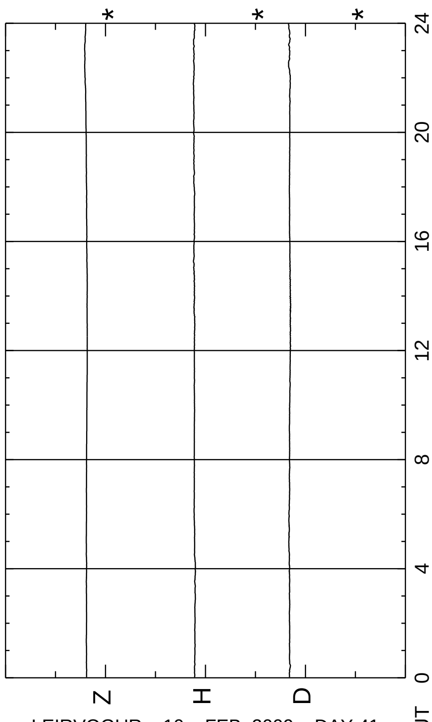
LEIRVOGUR 8. FEB 2009 DAY 39



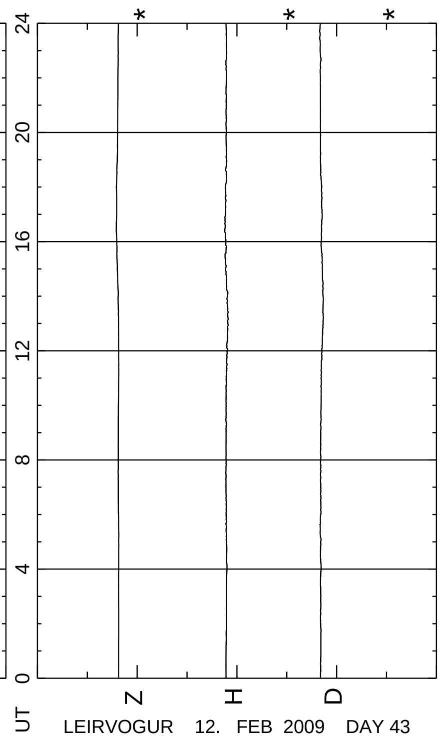
LEIRVOGUR 11. FEB 2009 DAY 42



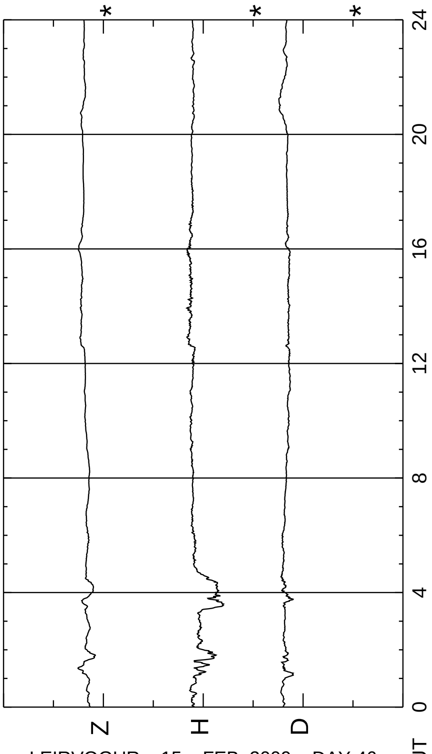
LEIRVOGUR 13. FEB 2009 DAY 44



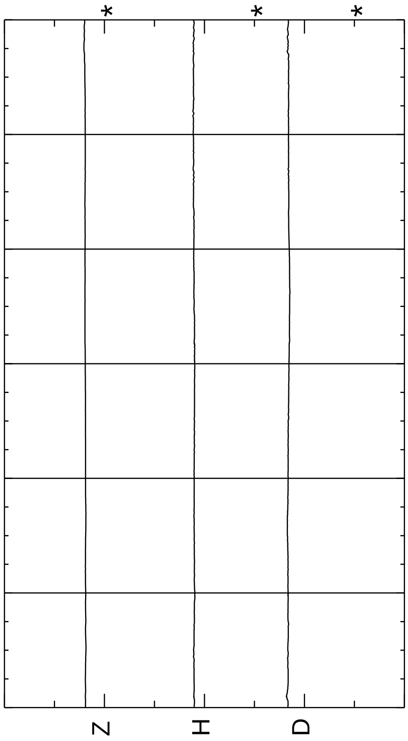
LEIRVOGUR 10. FEB 2009 DAY 41



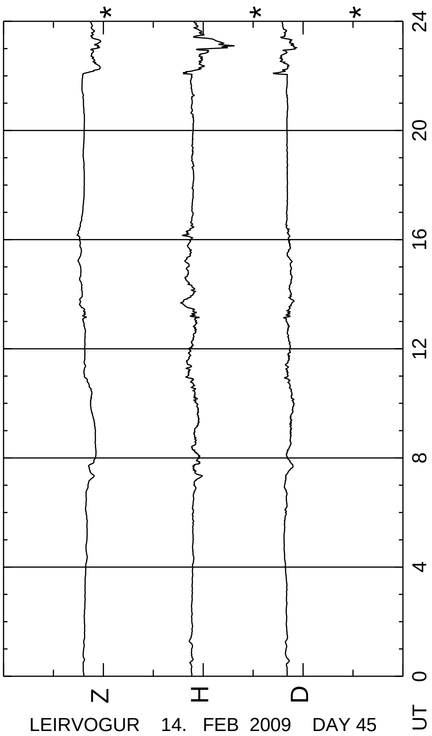
LEIRVOGUR 12. FEB 2009 DAY 43



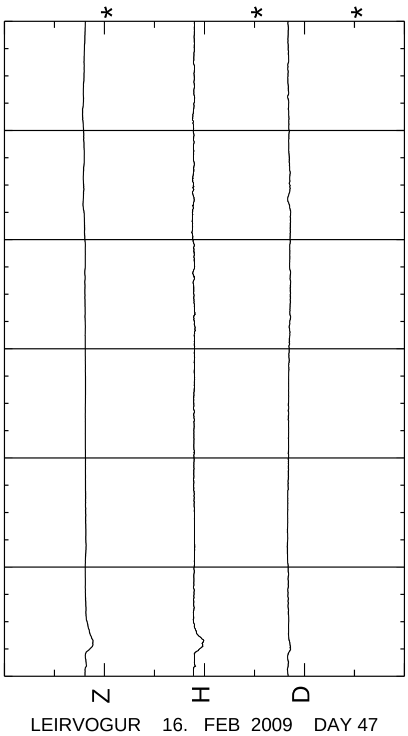
LEIRVOGUR 15. FEB 2009 DAY 46



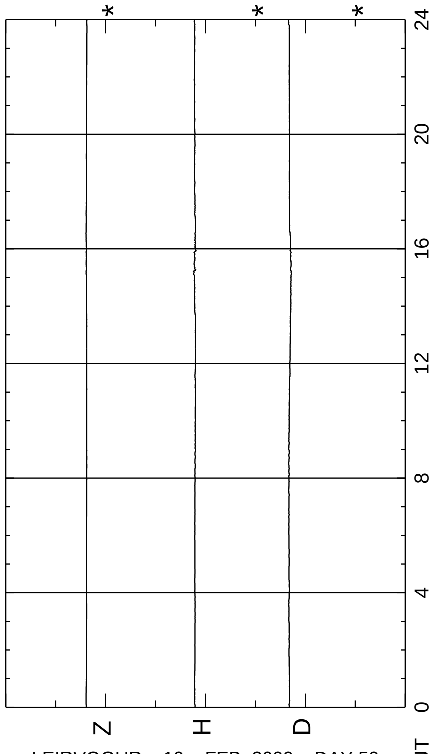
LEIRVOGUR 17. FEB 2009 DAY 48



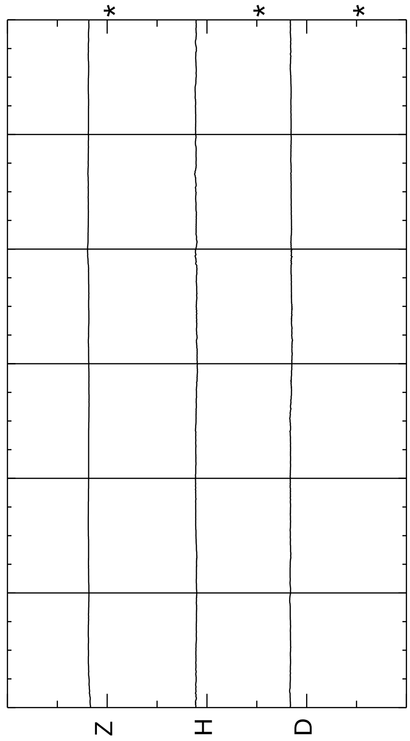
LEIRVOGUR 14. FEB 2009 DAY 45



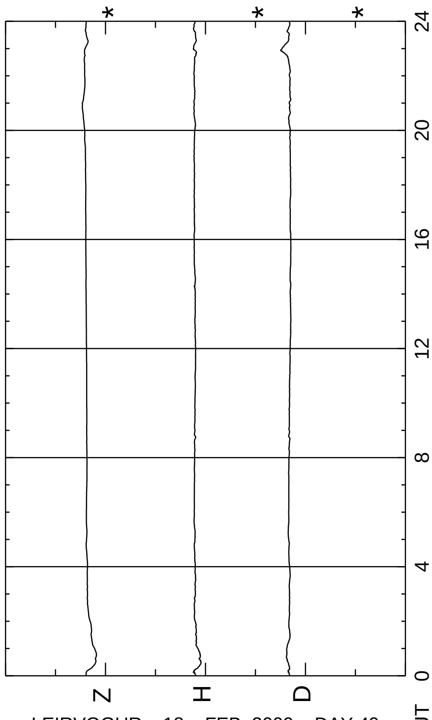
LEIRVOGUR 16. FEB 2009 DAY 47



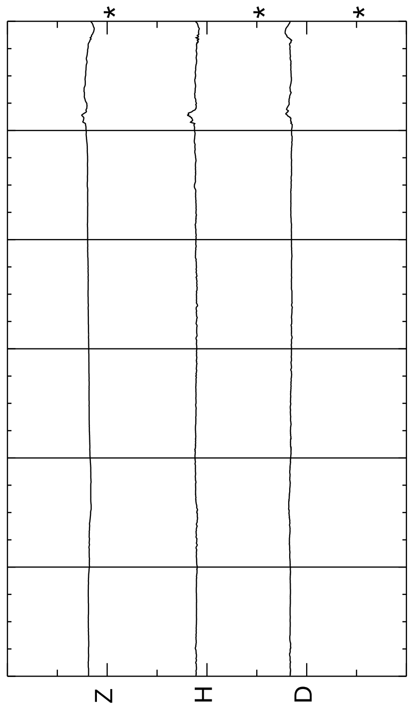
LEIRVOGUR 19. FEB 2009 DAY 50



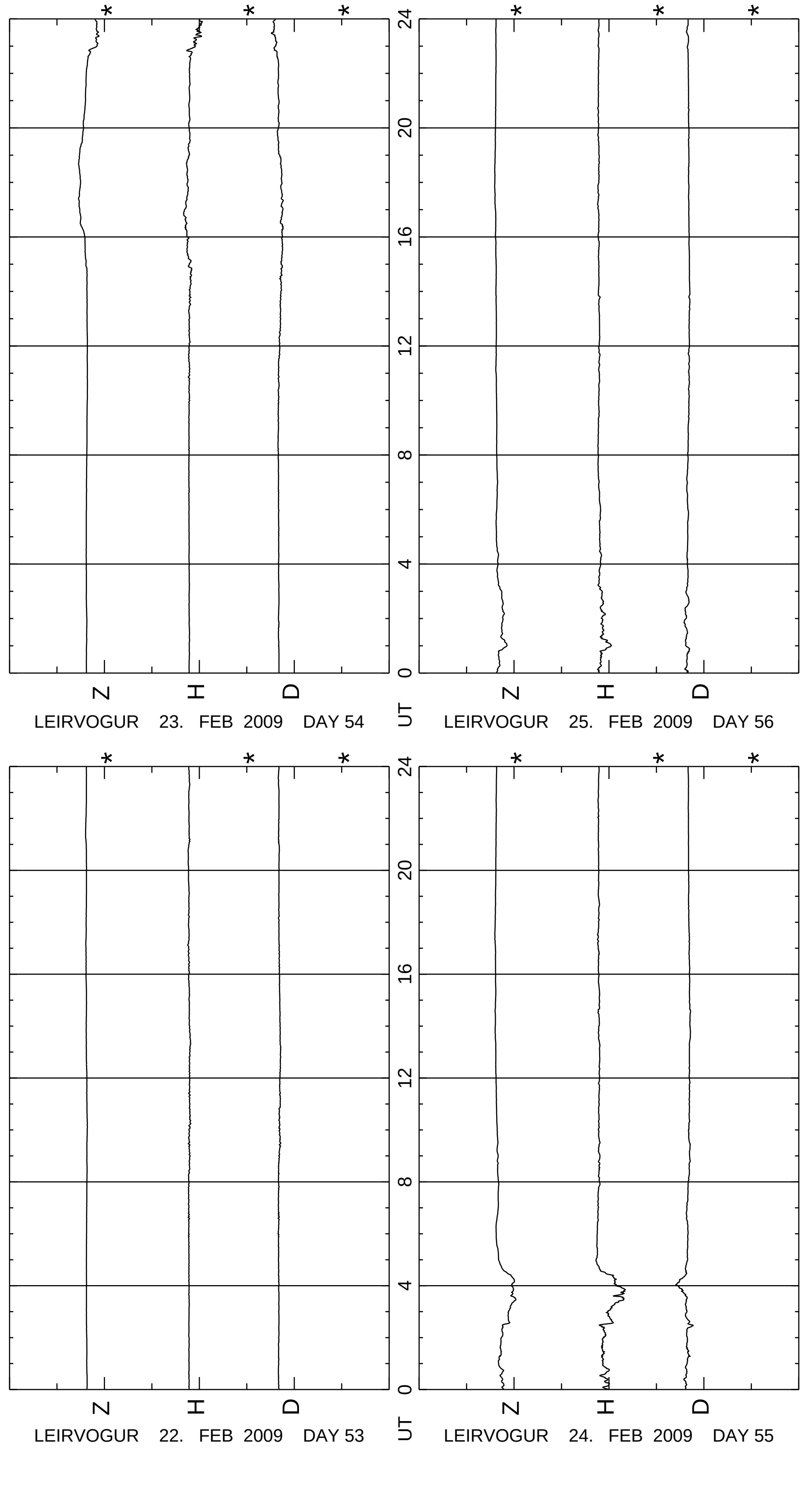
LEIRVOGUR 21. FEB 2009 DAY 52

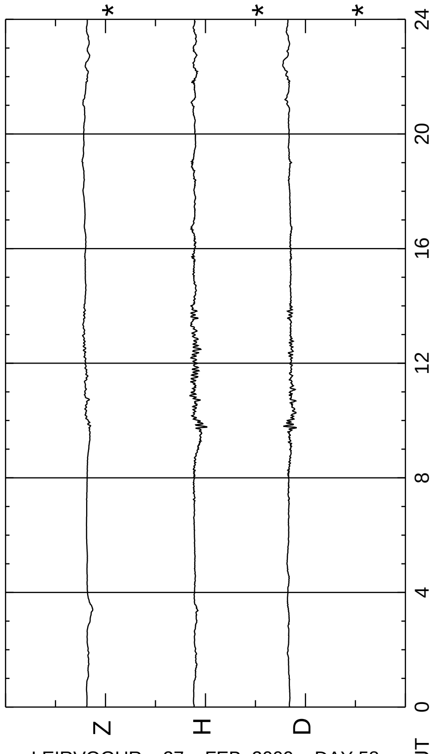


LEIRVOGUR 18. FEB 2009 DAY 49

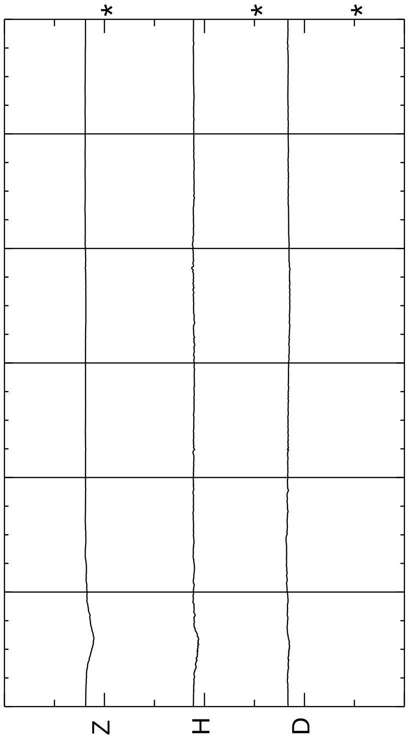


LEIRVOGUR 20. FEB 2009 DAY 51

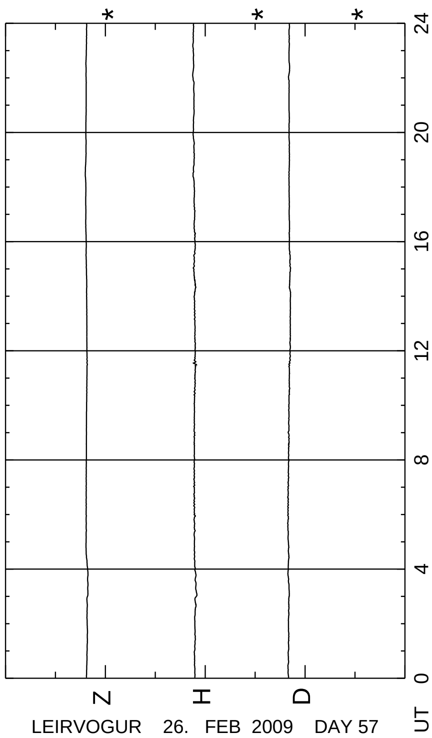

LEIRVOGUR 23. FEB 2009 DAY 54
LEIRVOGUR 25. FEB 2009 DAY 56
LEIRVOGUR 22. FEB 2009 DAY 53
LEIRVOGUR 24. FEB 2009 DAY 55
Z
H
D
UT
0
4
8
12
16
20
24



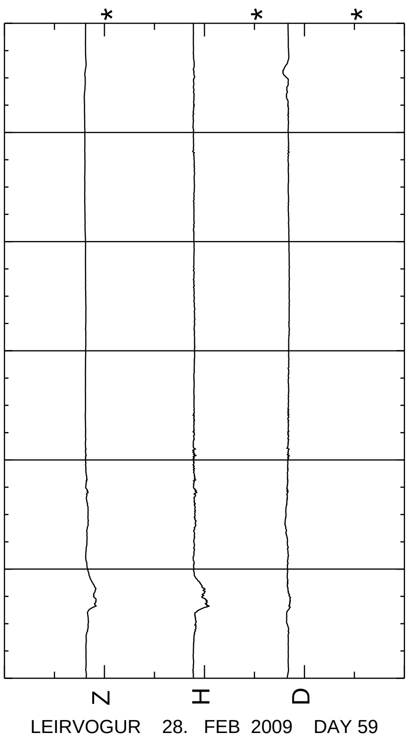
LEIRVOGUR 27. FEB 2009 DAY 58



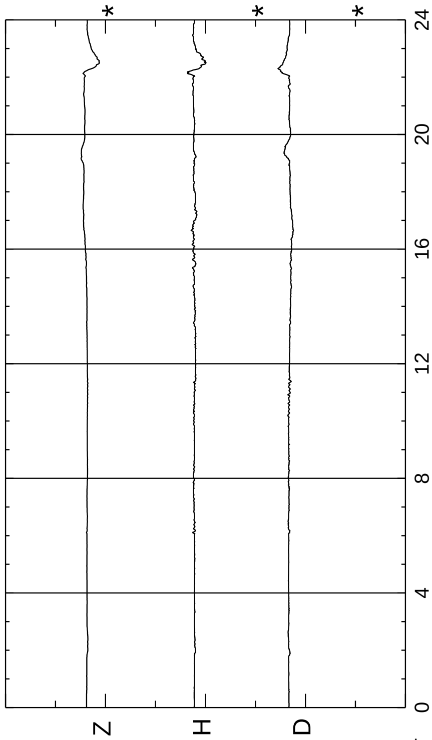
LEIRVOGUR 1. MAR 2009 DAY 60



LEIRVOGUR 26. FEB 2009 DAY 57

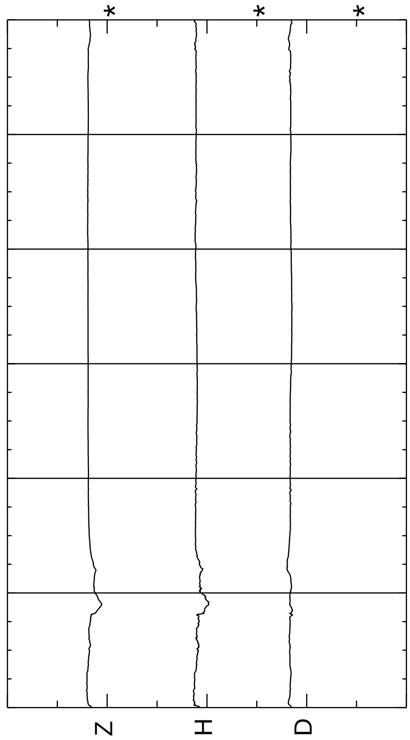


LEIRVOGUR 28. FEB 2009 DAY 59

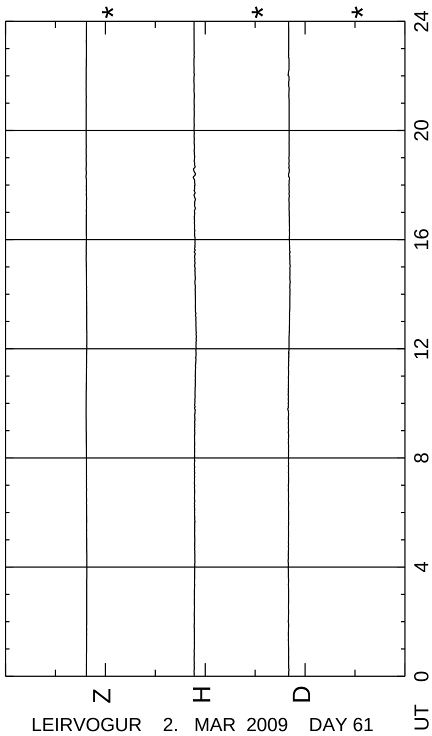


UT

LEIRVOGUR 3. MAR 2009 DAY 62



LEIRVOGUR 5. MAR 2009 DAY 64



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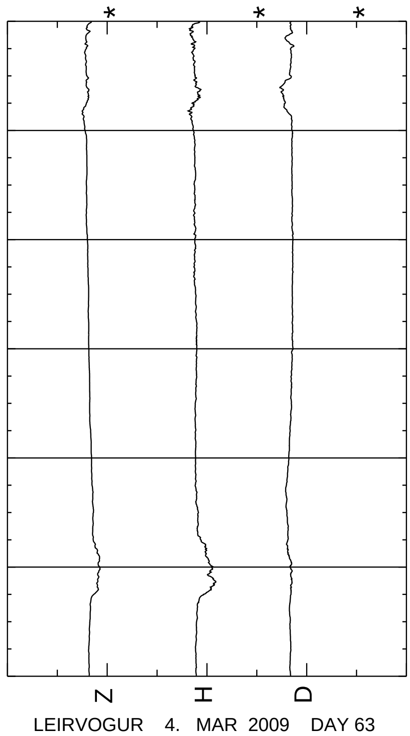
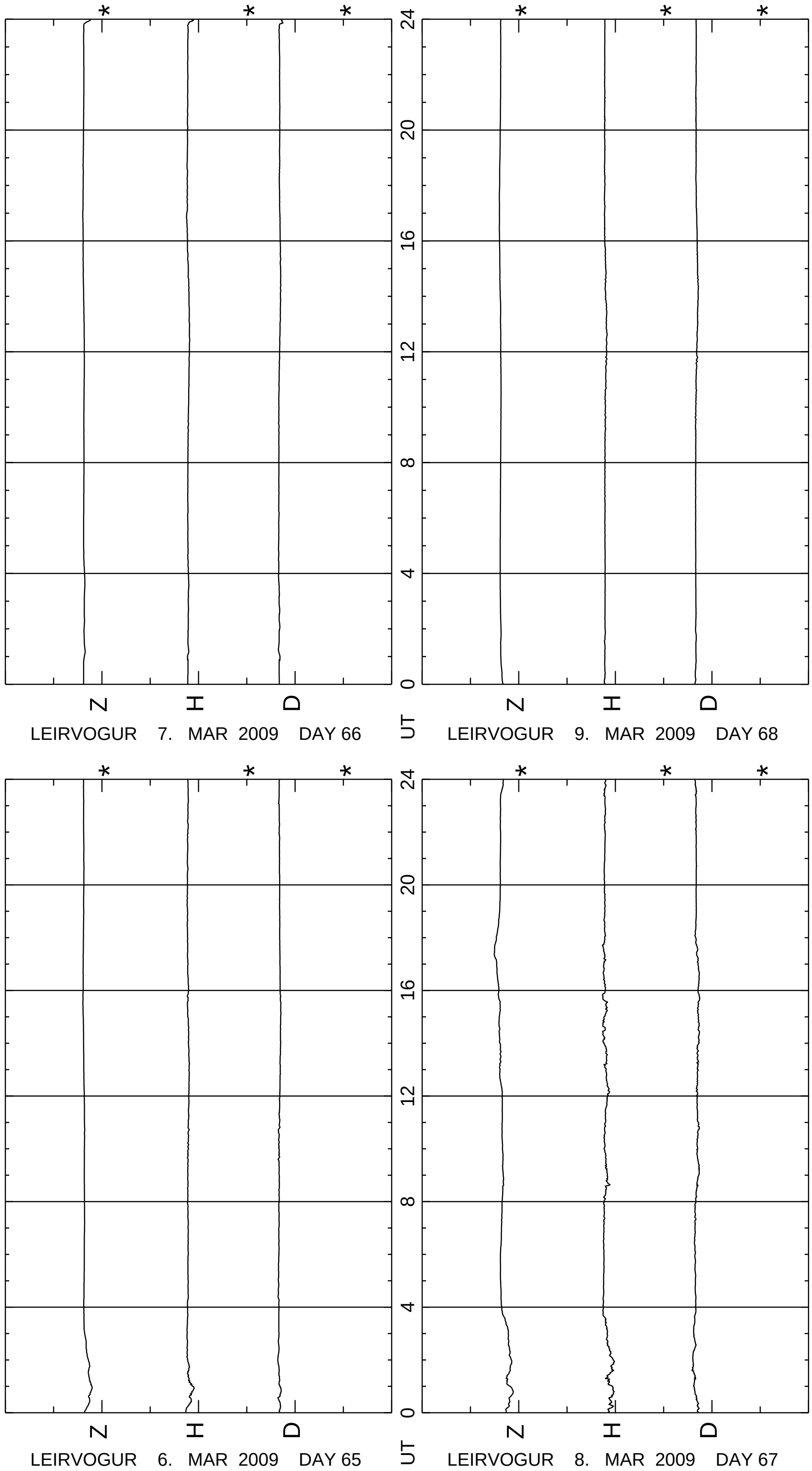
LEIRVOGUR 2. MAR 2009 DAY 61



LEIRVOGUR 4. MAR 2009 DAY 63



LEIRVOGUR 7. MAR 2009 DAY 66
LEIRVOGUR 9. MAR 2009 DAY 68
LEIRVOGUR 6. MAR 2009 DAY 65
LEIRVOGUR 8. MAR 2009 DAY 67
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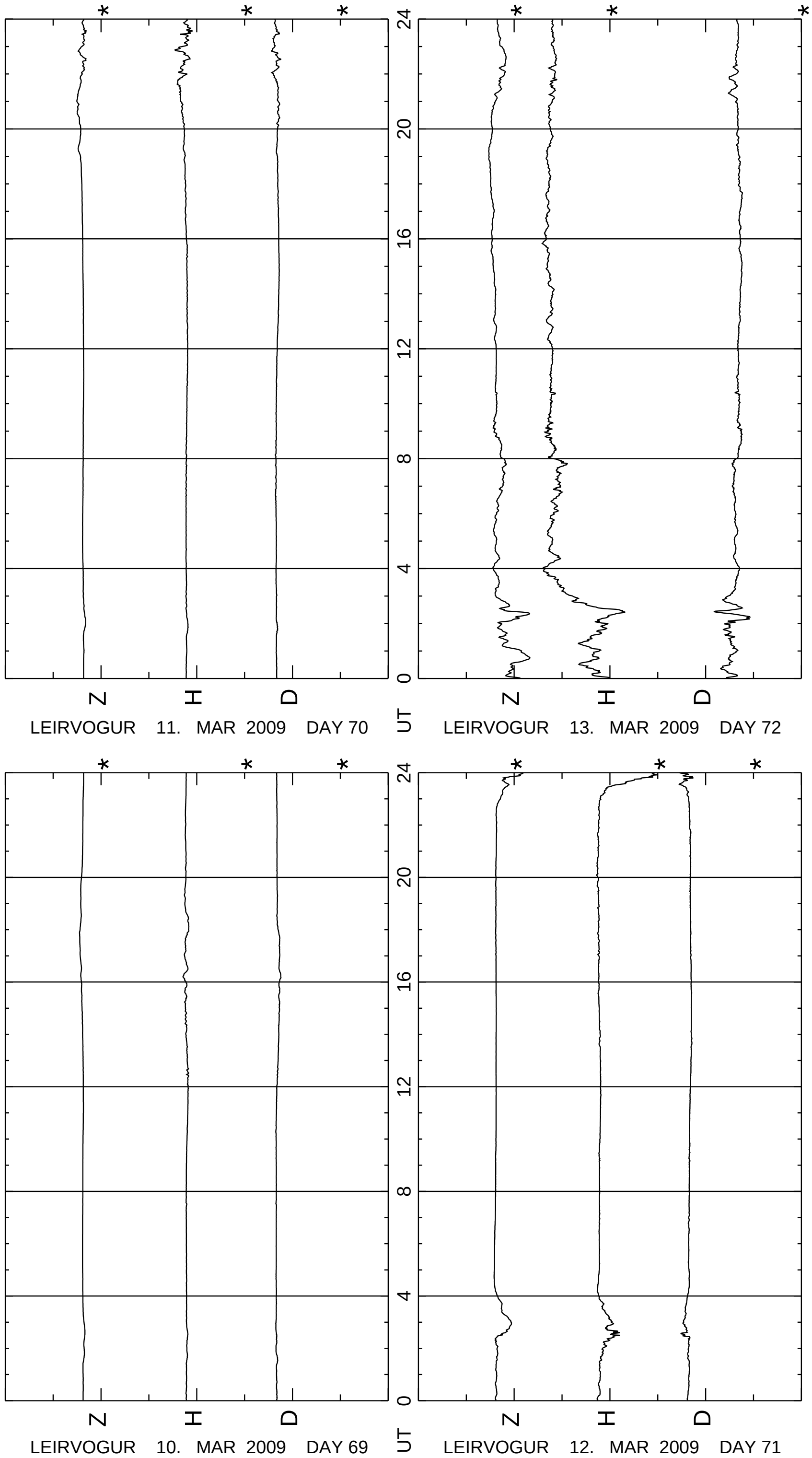
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LEIRVOGUR 12. MAR 2009 DAY 71
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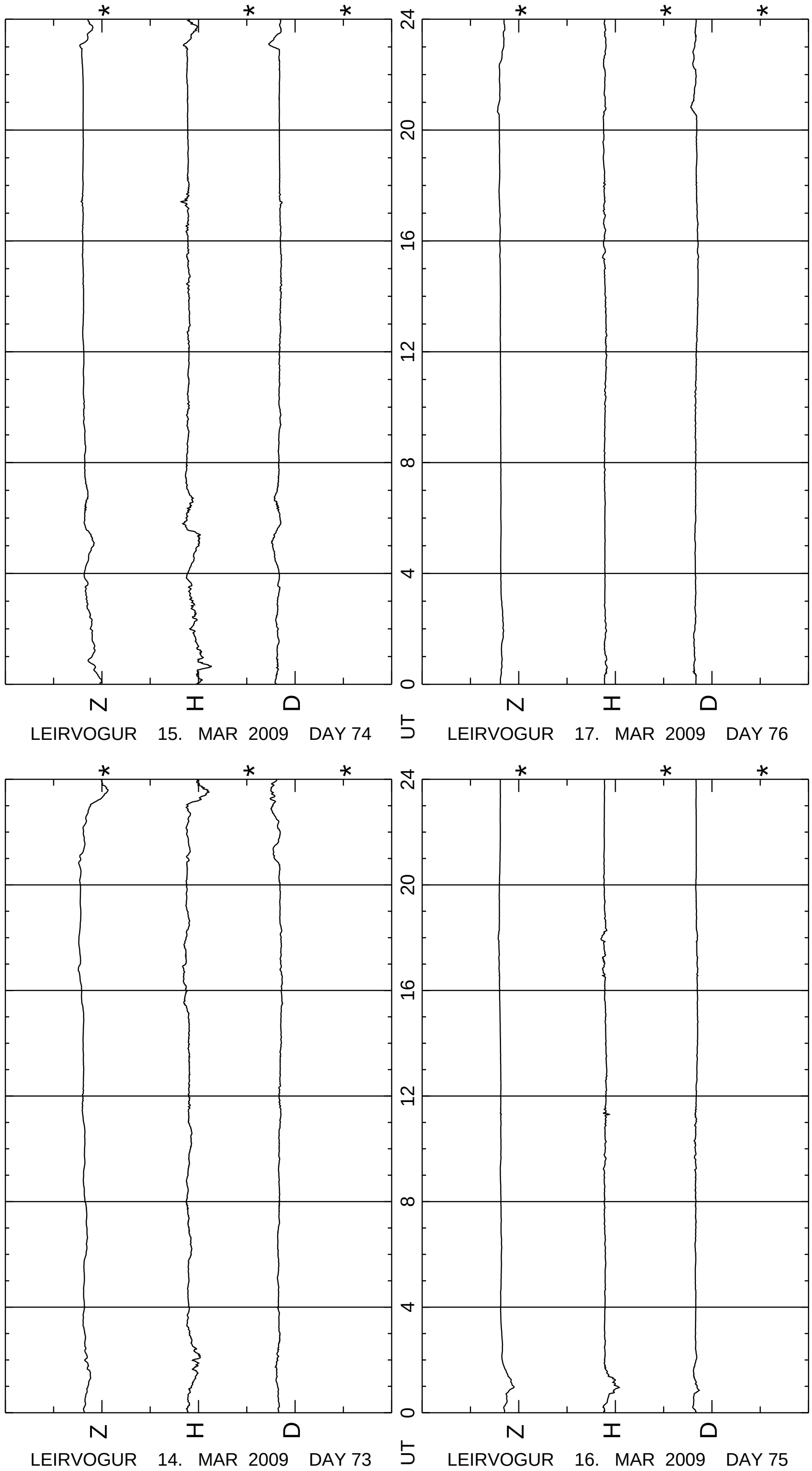
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LEIRVOGUR 17. MAR 2009 DAY 76
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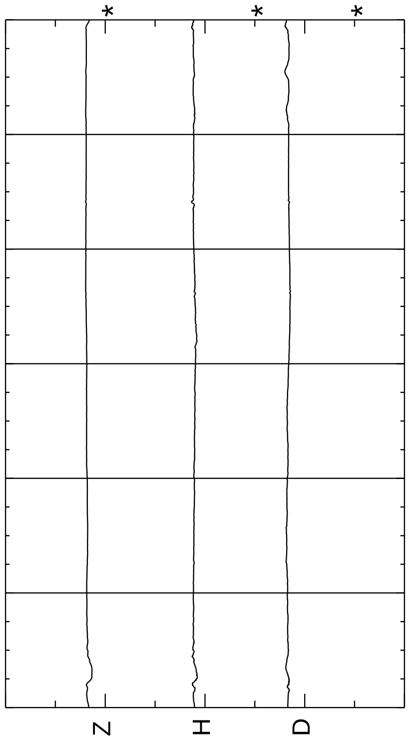
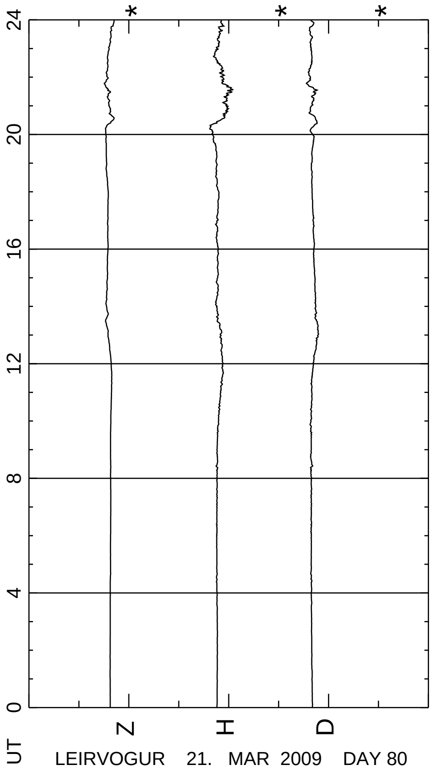
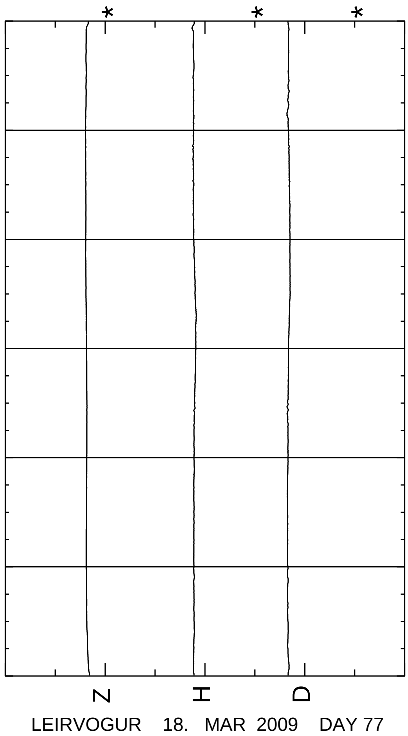


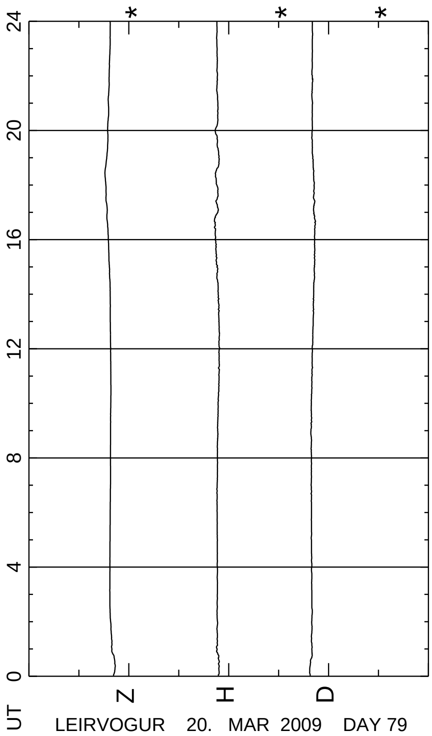
LEIRVOGUR 19. MAR 2009 DAY 78



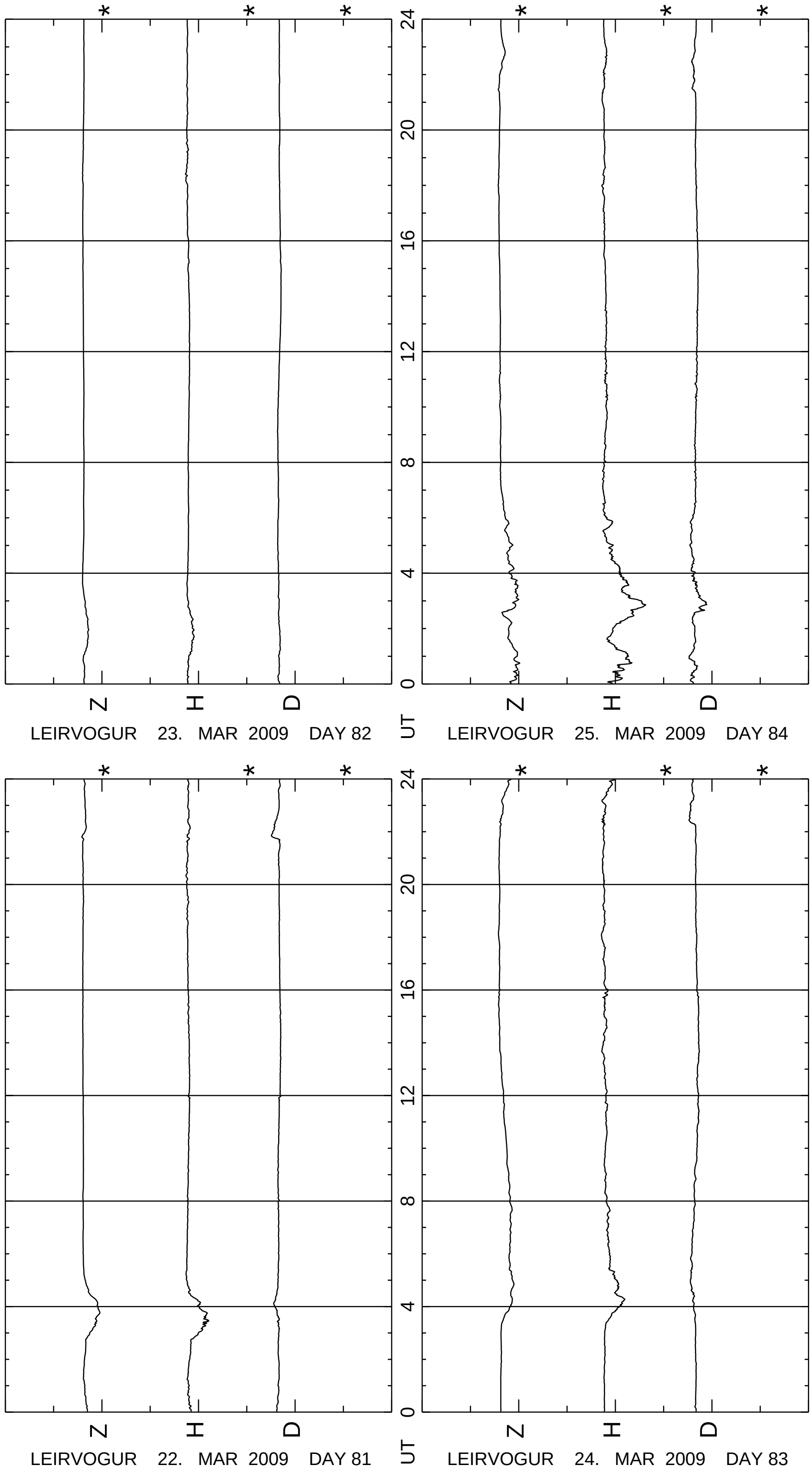
LEIRVOGUR 21. MAR 2009 DAY 80



LEIRVOGUR 18. MAR 2009 DAY 77



LEIRVOGUR 20. MAR 2009 DAY 79


LEIRVOGUR 23. MAR 2009 DAY 82
LEIRVOGUR 25. MAR 2009 DAY 84
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LEIRVOGUR 24. MAR 2009 DAY 83
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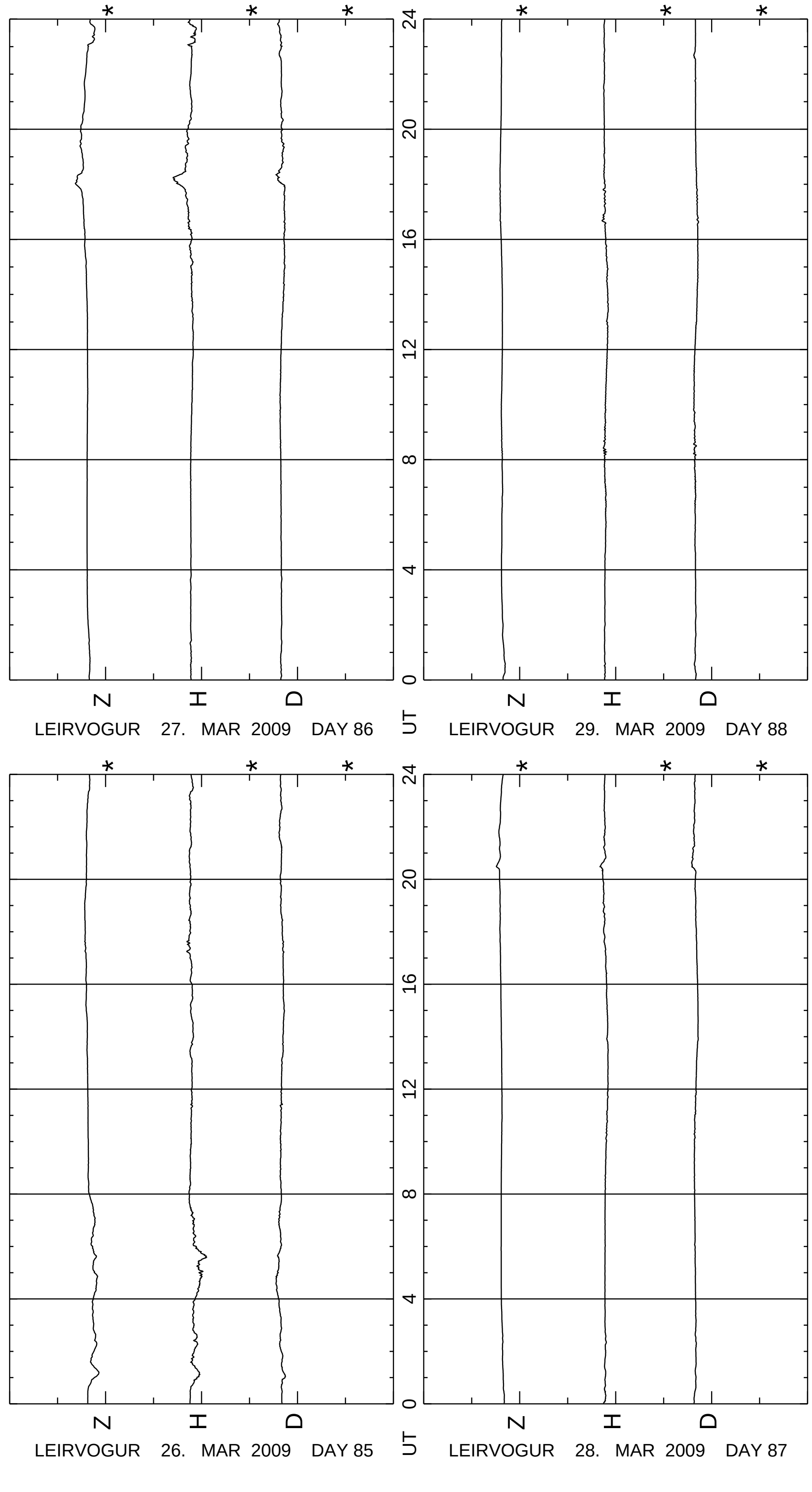

LEIRVOGUR 27. MAR 2009 DAY 86
LEIRVOGUR 29. MAR 2009 DAY 88
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LEIRVOGUR 28. MAR 2009 DAY 87
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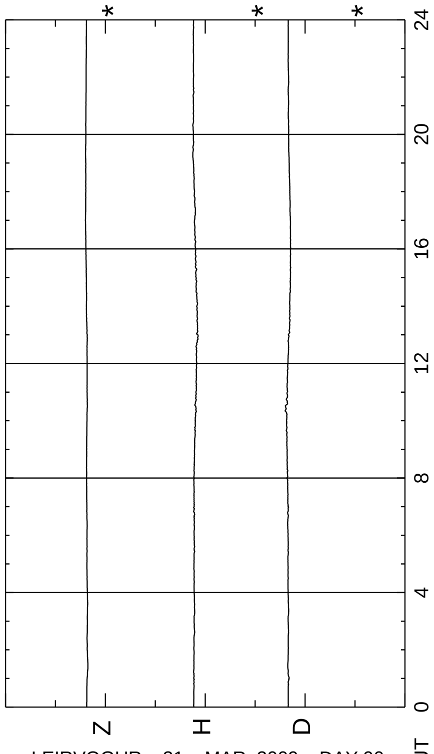
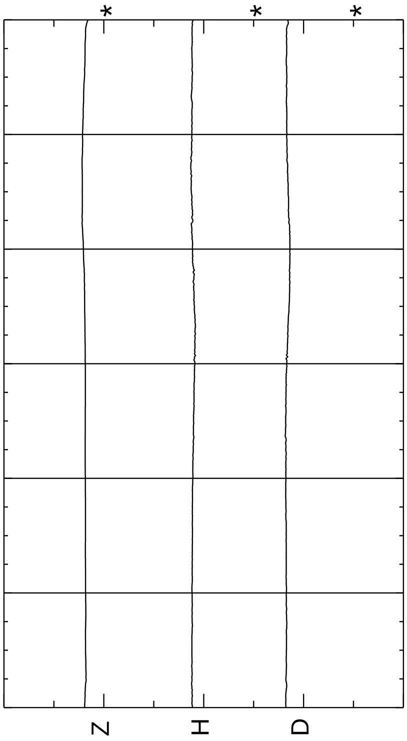
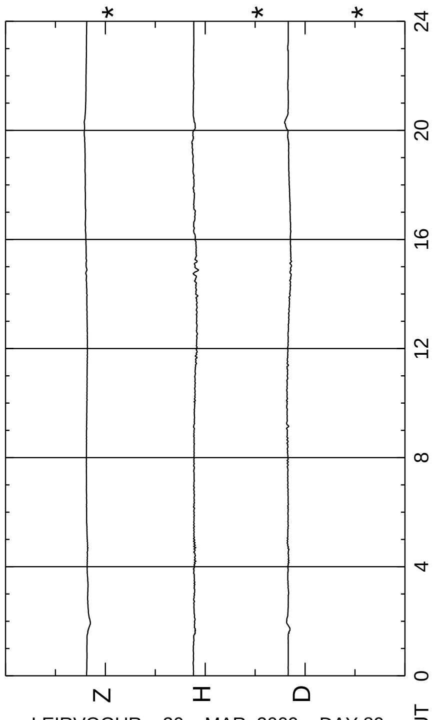


LEIRVOGUR 31. MAR 2009 DAY 90



LEIRVOGUR 2. APR 2009 DAY 92



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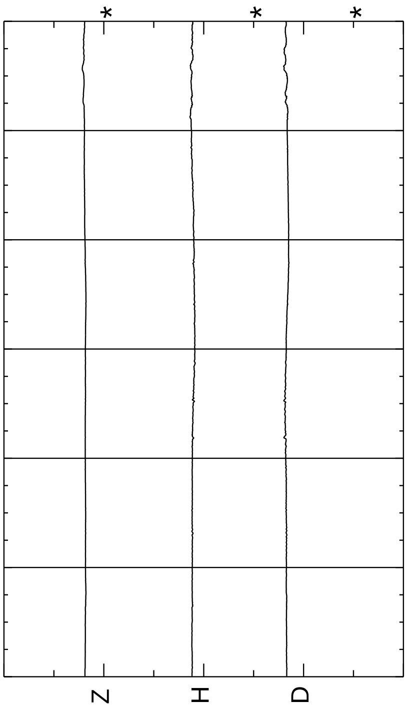
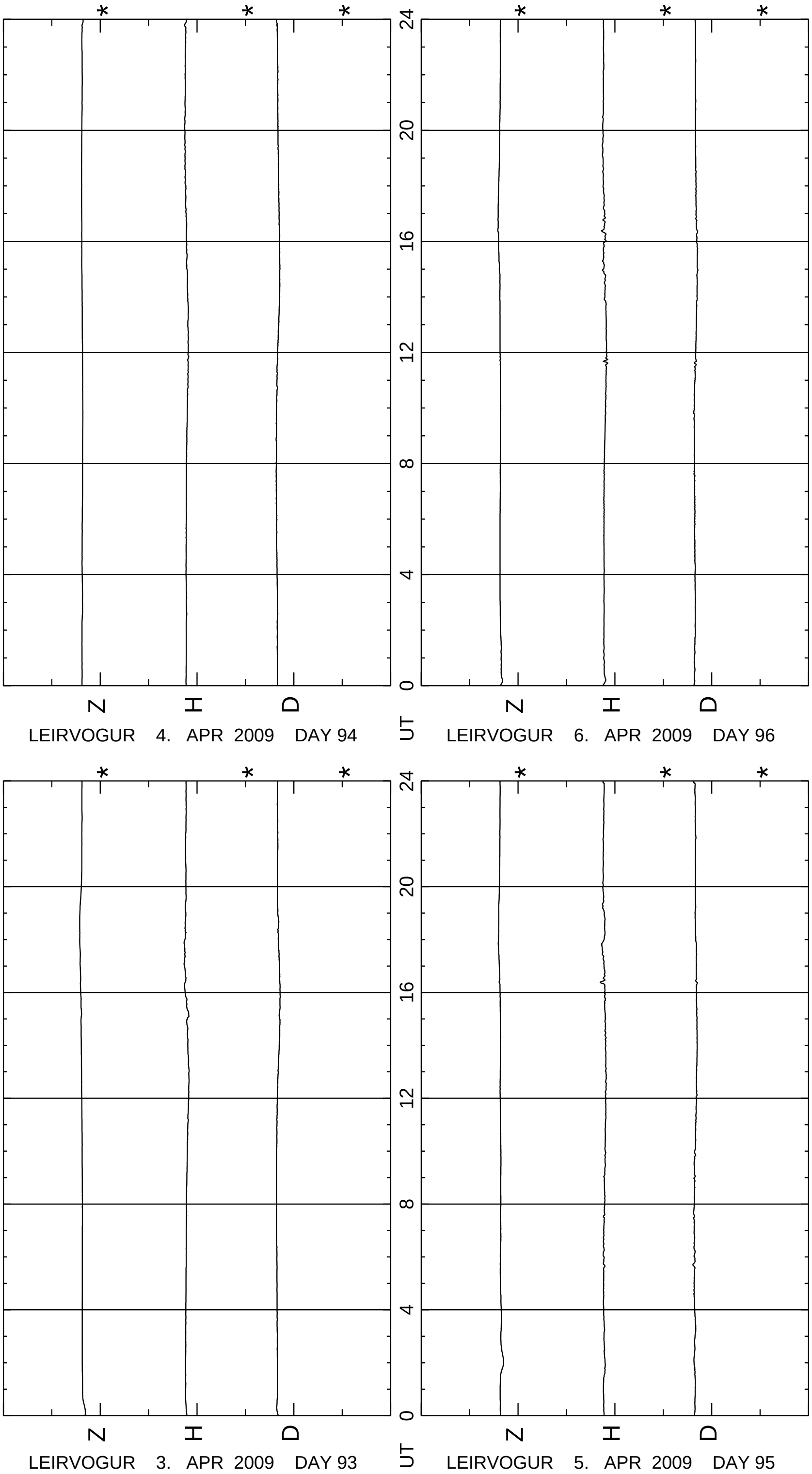


LEIRVOGUR 1. APR 2009 DAY 91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LEIRVOGUR 4. APR 2009 DAY 94
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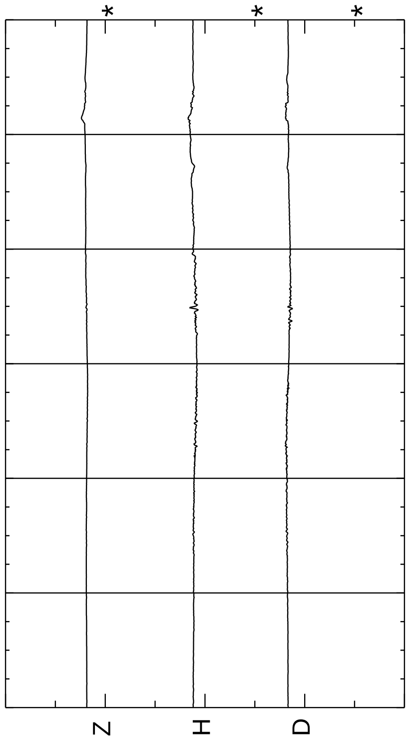
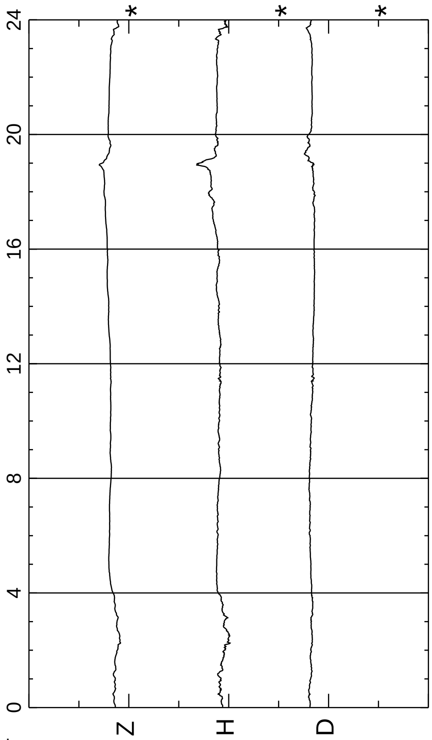
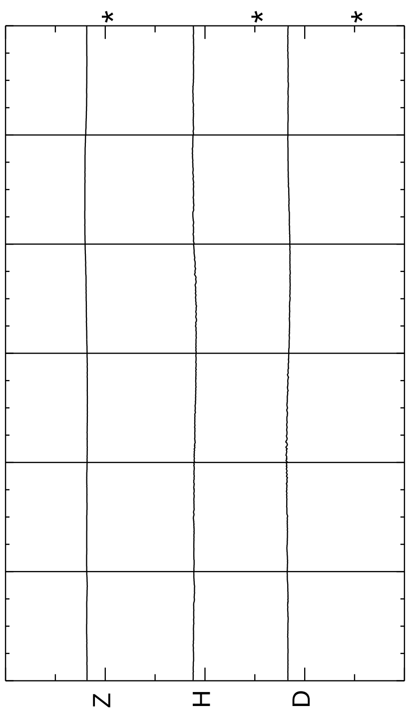


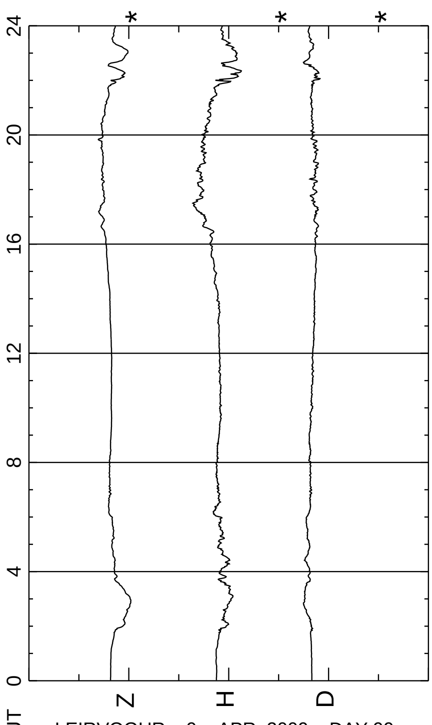
LEIRVOGUR 8. APR 2009 DAY 98



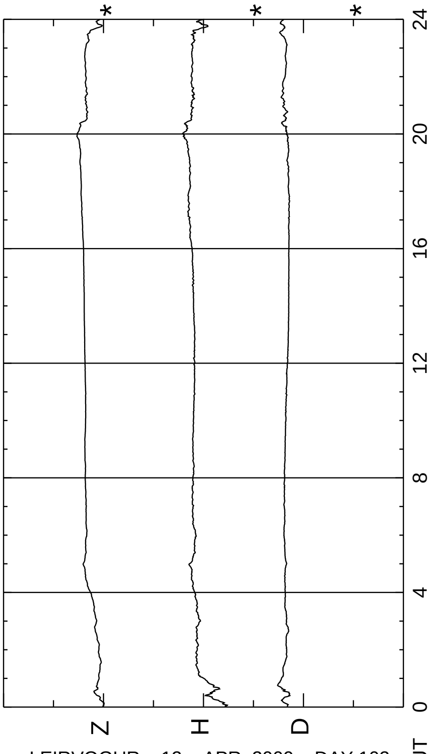
LEIRVOGUR 10. APR 2009 DAY 100



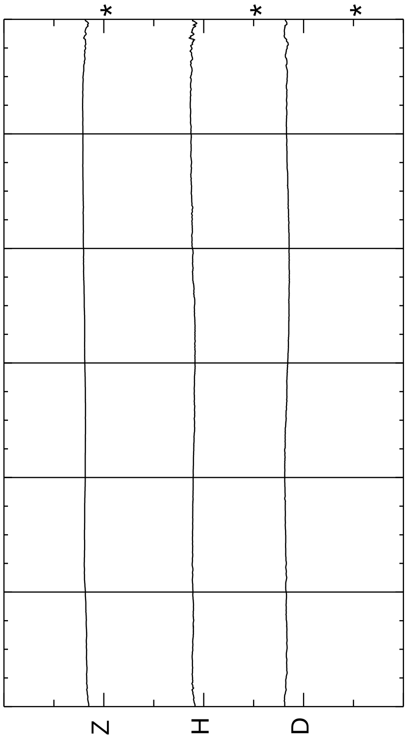
LEIRVOGUR 7. APR 2009 DAY 97



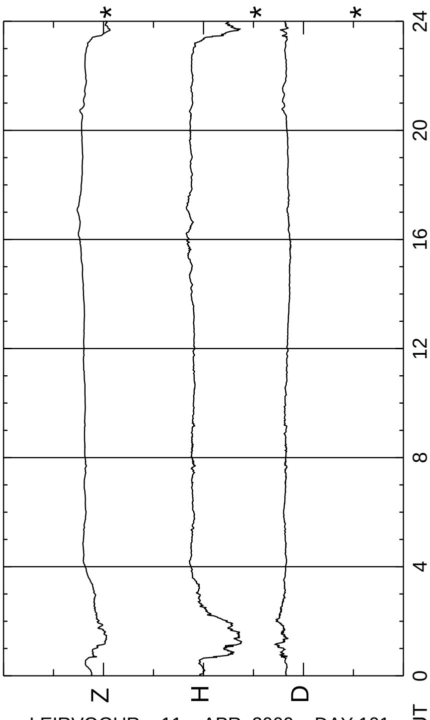
LEIRVOGUR 9. APR 2009 DAY 99



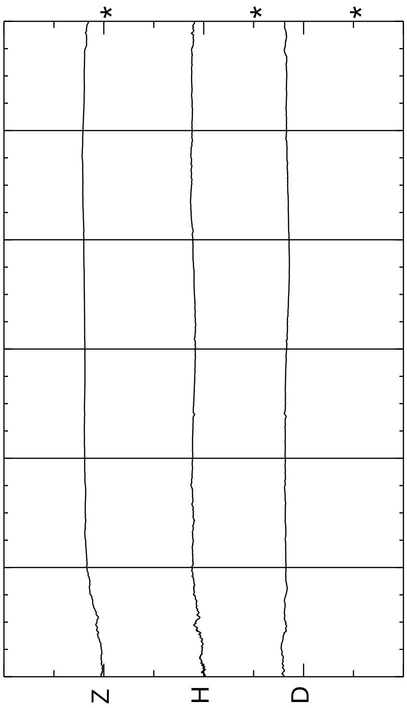
LEIRVOGUR 12. APR 2009 DAY 102



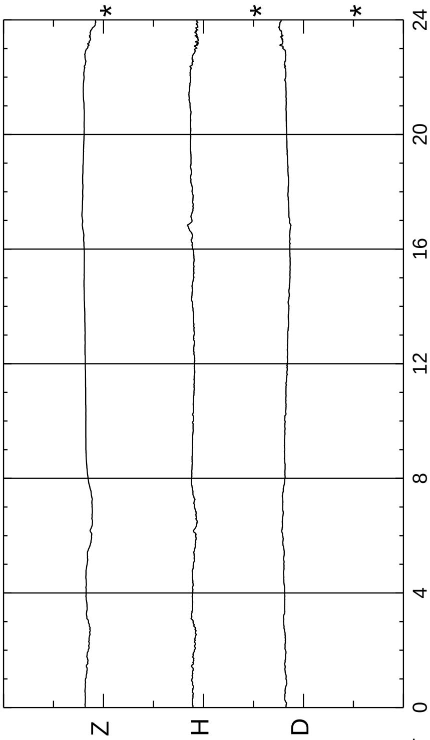
LEIRVOGUR 14. APR 2009 DAY 104



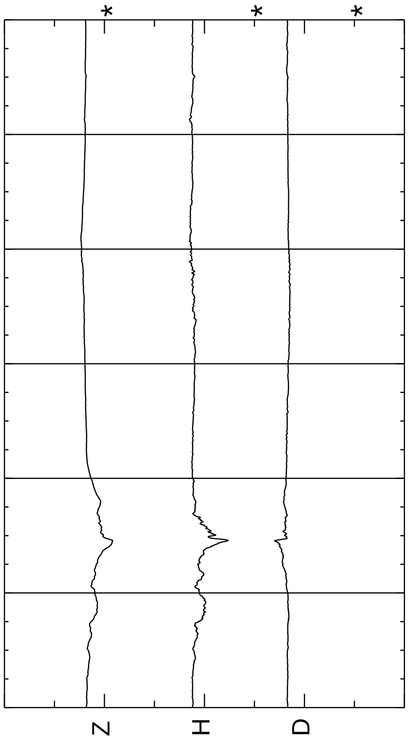
LEIRVOGUR 11. APR 2009 DAY 101



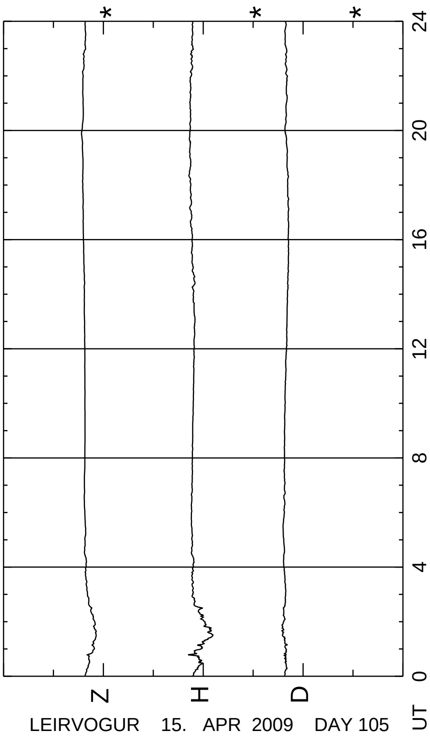
LEIRVOGUR 13. APR 2009 DAY 103



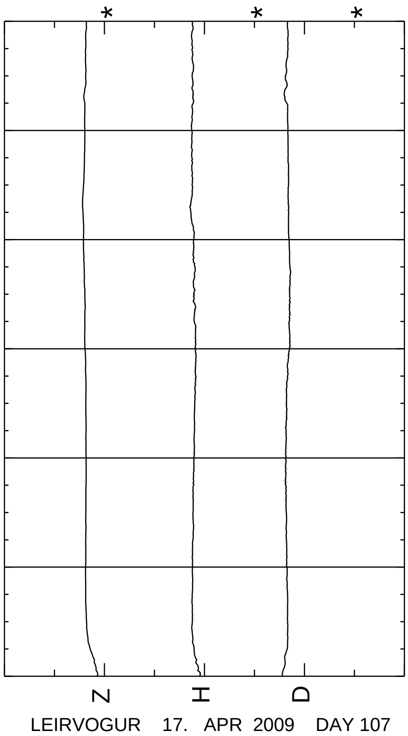
LEIRVOGUR 16. APR 2009 DAY 106



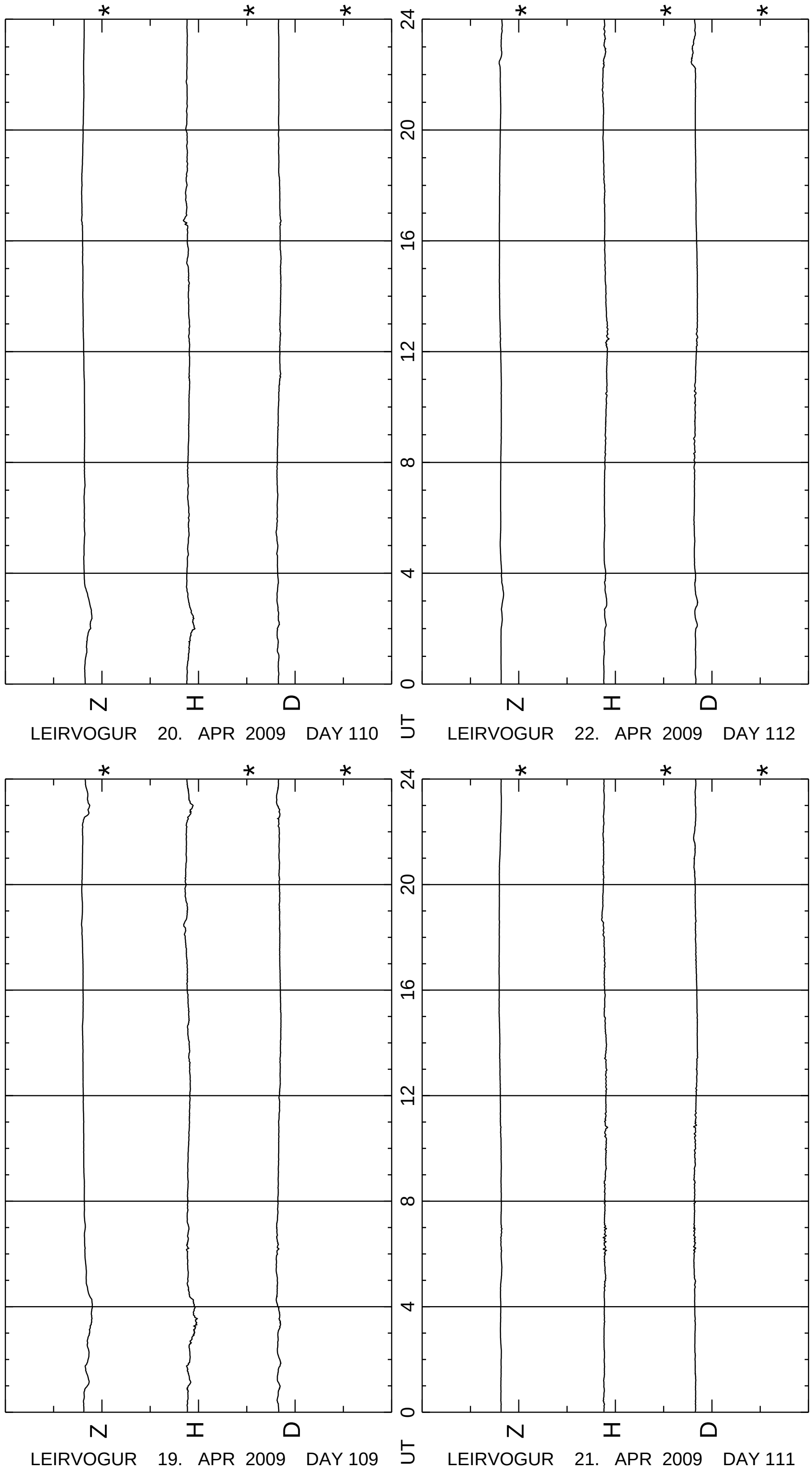
LEIRVOGUR 18. APR 2009 DAY 108



LEIRVOGUR 15. APR 2009 DAY 105



LEIRVOGUR 17. APR 2009 DAY 107


LEIRVOGUR 20. APR 2009 DAY 110
LEIRVOGUR 22. APR 2009 DAY 112
LEIRVOGUR 19. APR 2009 DAY 109
LEIRVOGUR 21. APR 2009 DAY 111
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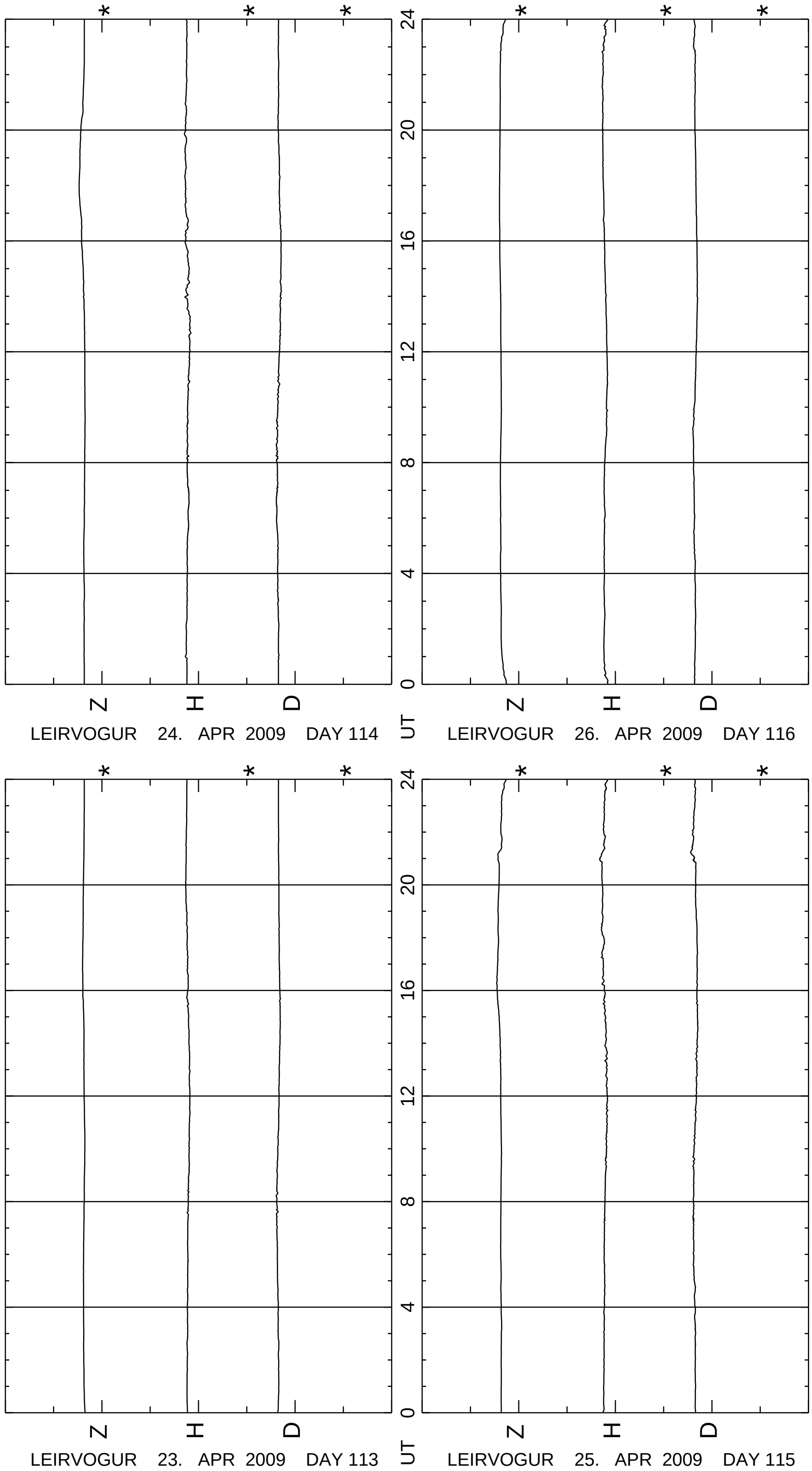
LEIRVOGUR 24. APR 2009 DAY 114
LEIRVOGUR 26. APR 2009 DAY 116
LEIRVOGUR 23. APR 2009 DAY 113
LEIRVOGUR 25. APR 2009 DAY 115
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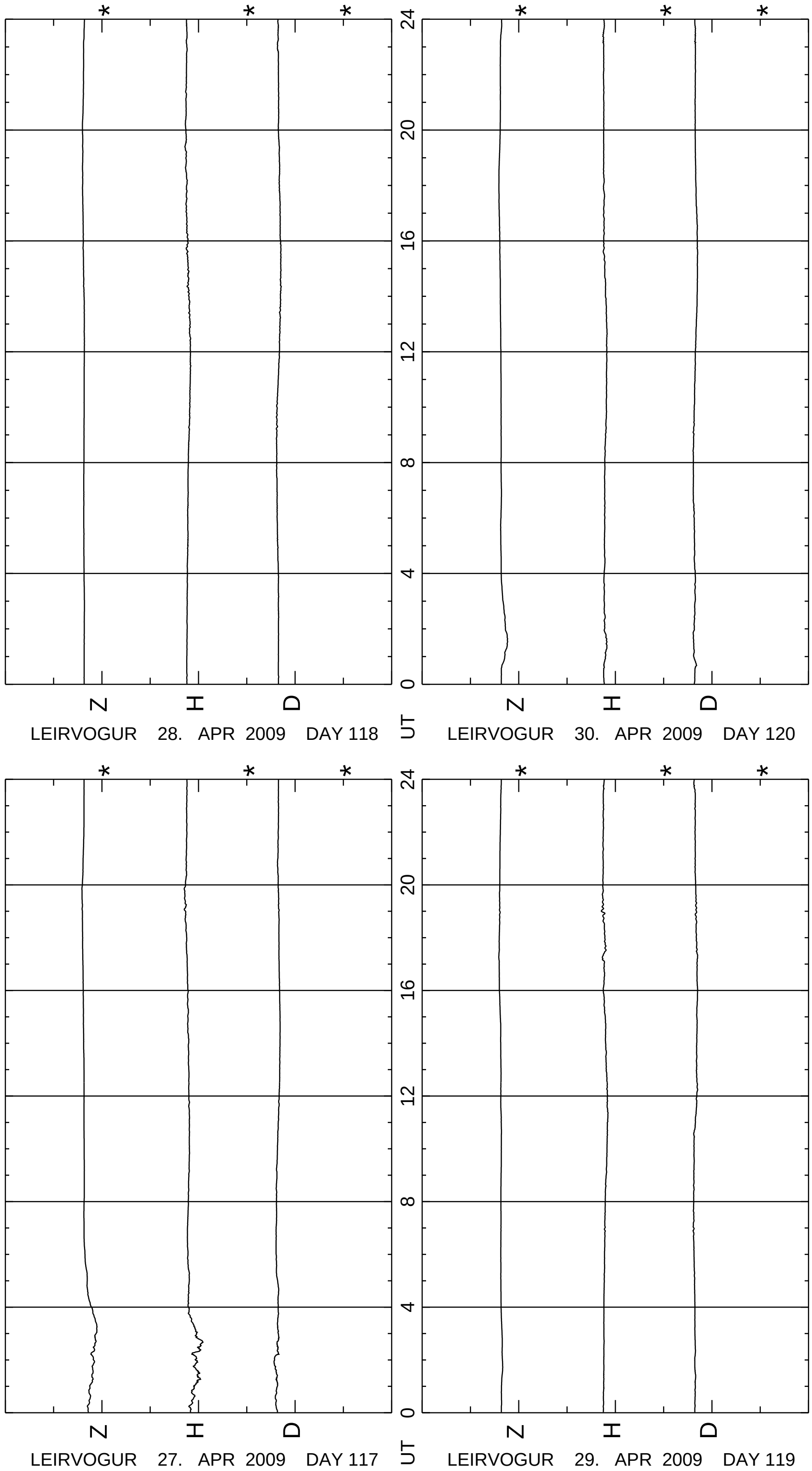
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LEIRVOGUR 28. APR 2009 DAY 118
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LEIRVOGUR 30. APR 2009 DAY 120
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LEIRVOGUR 27. APR 2009 DAY 117
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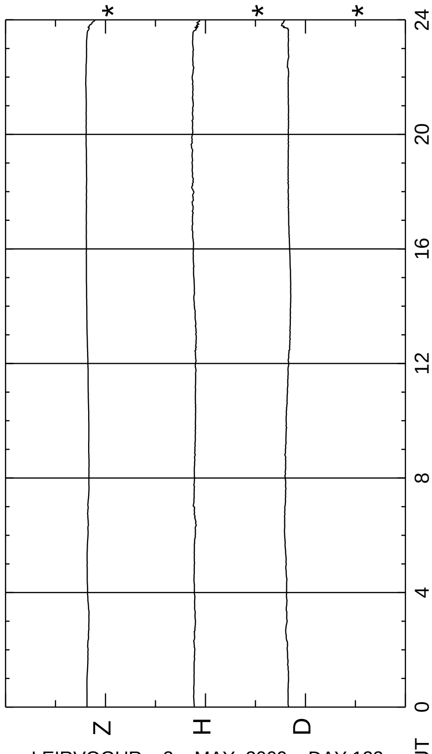

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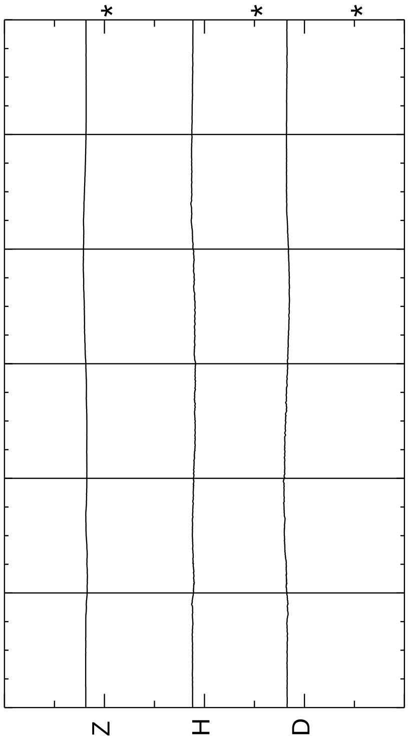

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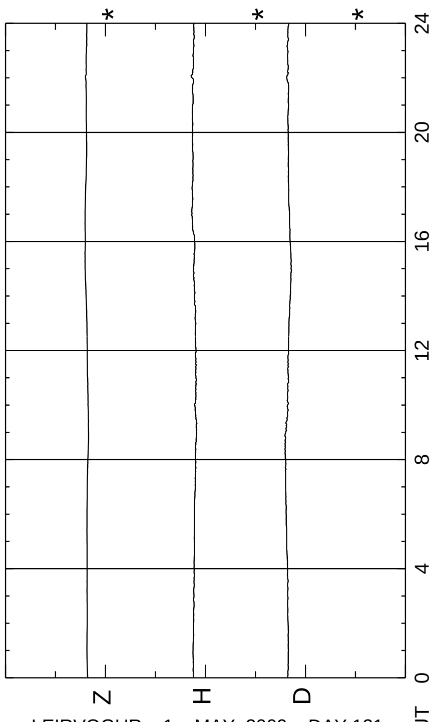
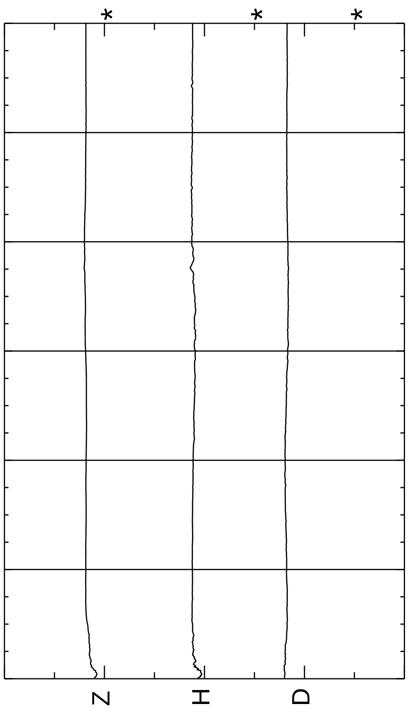
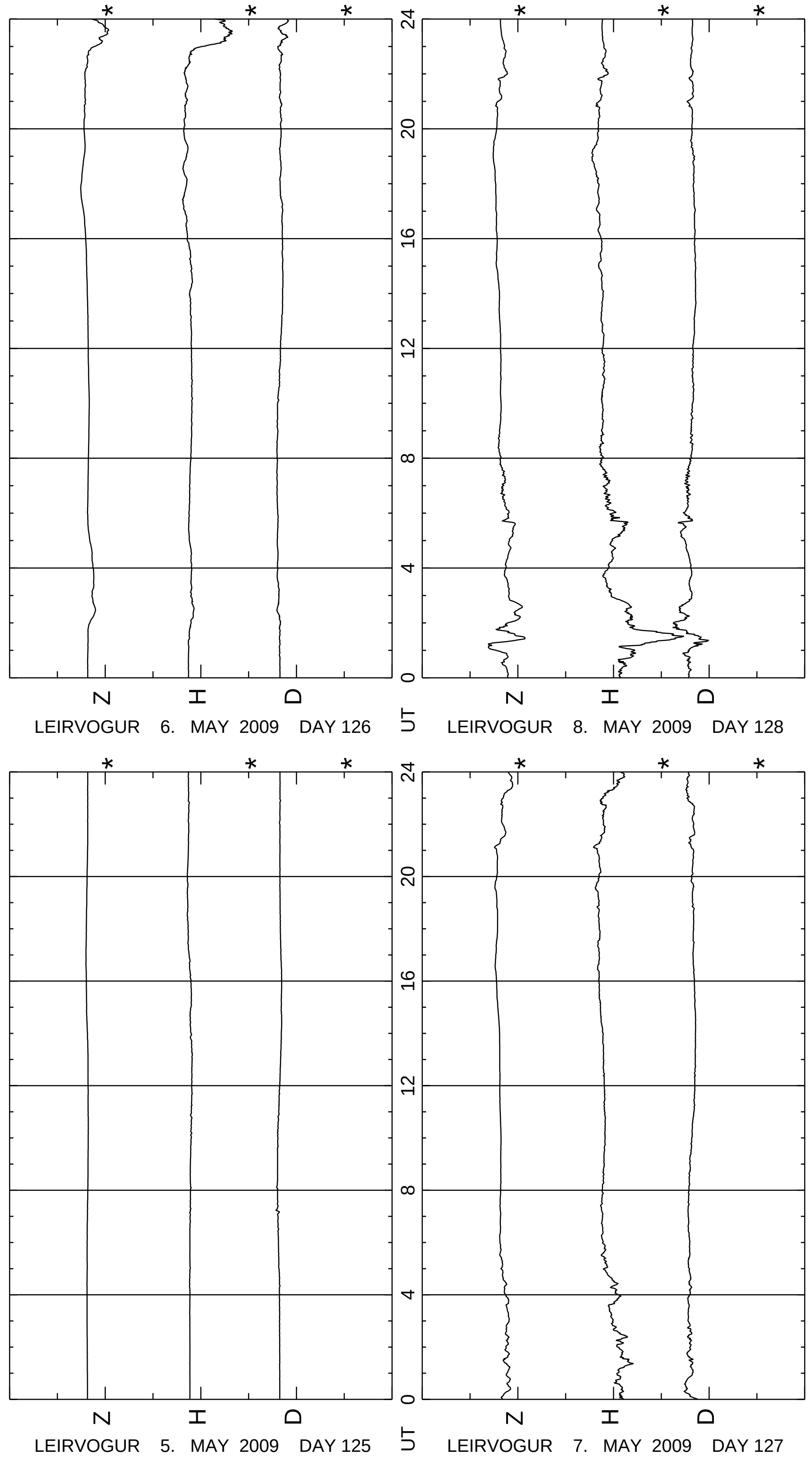


LEIRVOGUR 1. MAY 2009 DAY 121



LEIRVOGUR 3. MAY 2009 DAY 123


LEIRVOGUR 6. MAY 2009 DAY 126
LEIRVOGUR 8. MAY 2009 DAY 128
LEIRVOGUR 5. MAY 2009 DAY 125
LEIRVOGUR 7. MAY 2009 DAY 127
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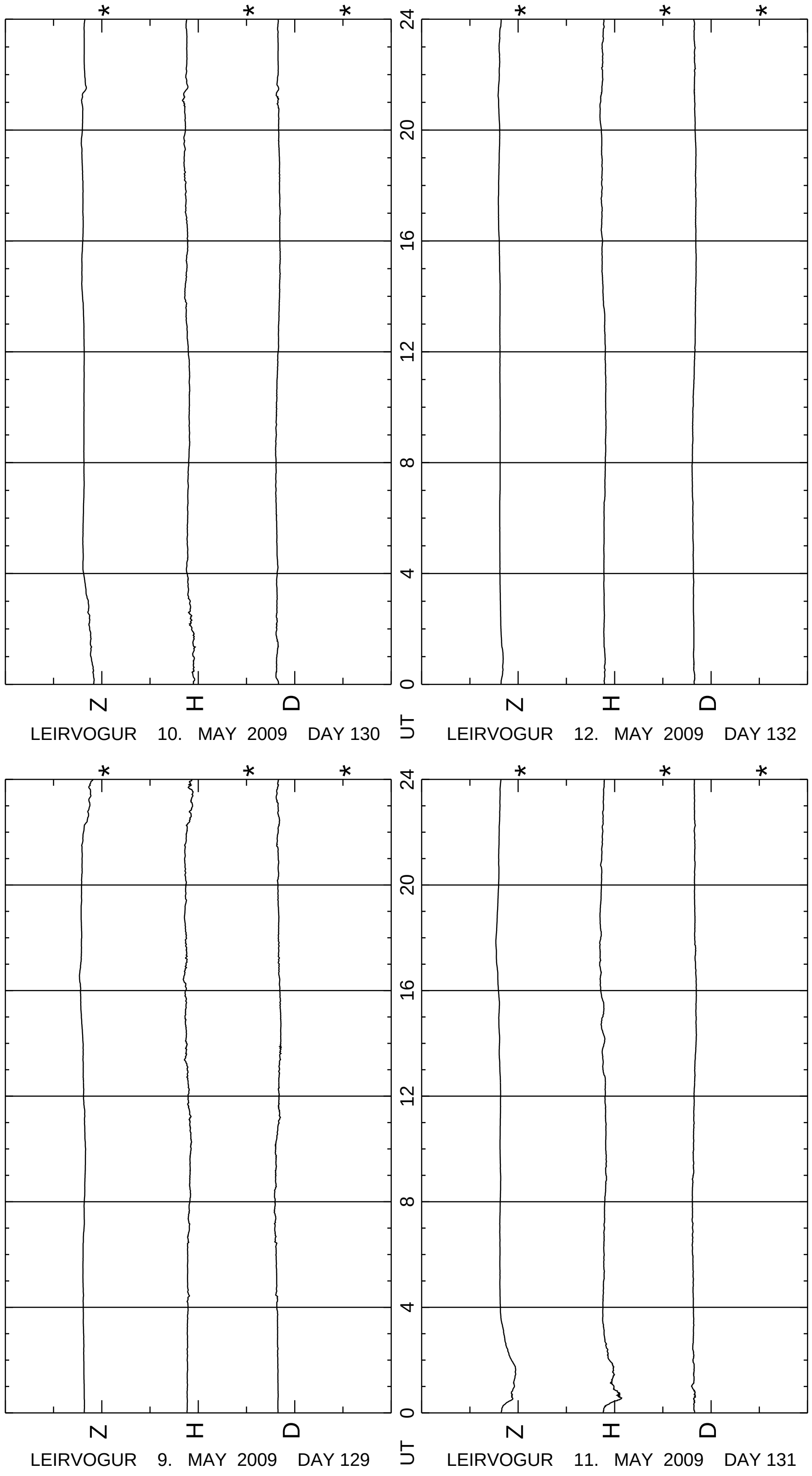
LEIRVOGUR 10. MAY 2009 DAY 130
LEIRVOGUR 12. MAY 2009 DAY 132
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LEIRVOGUR 11. MAY 2009 DAY 131
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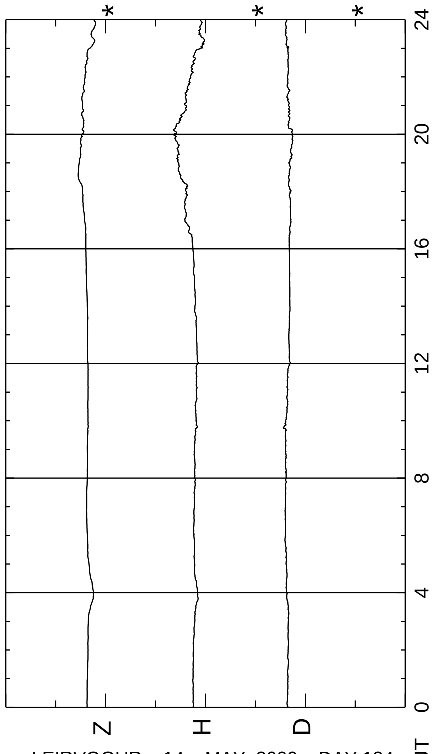
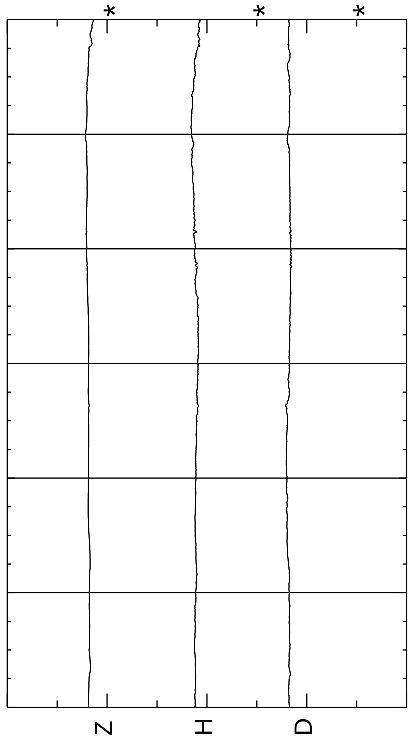
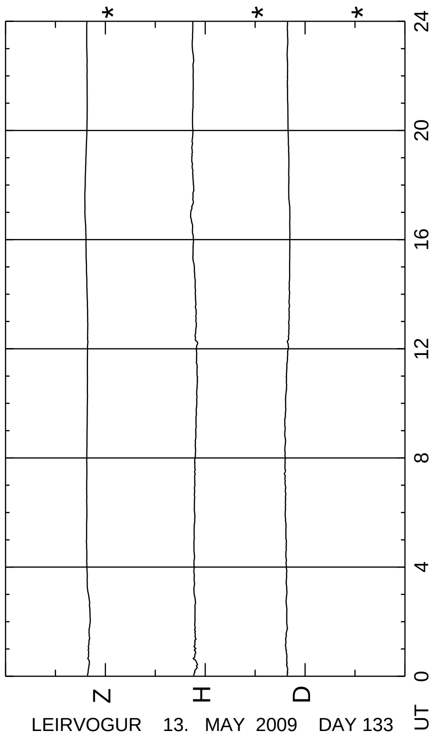


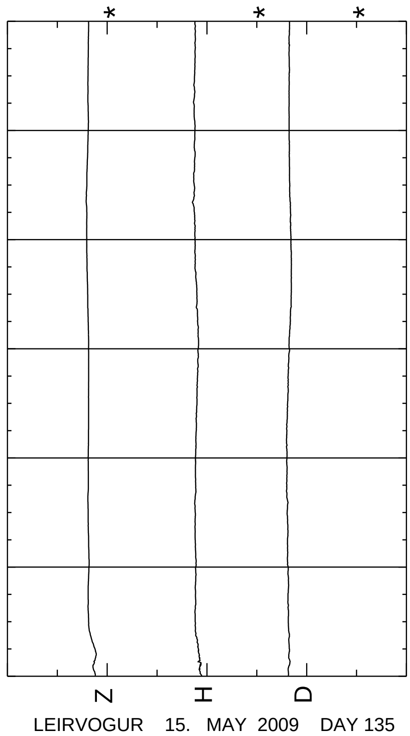
LEIRVOGUR 14. MAY 2009 DAY 134



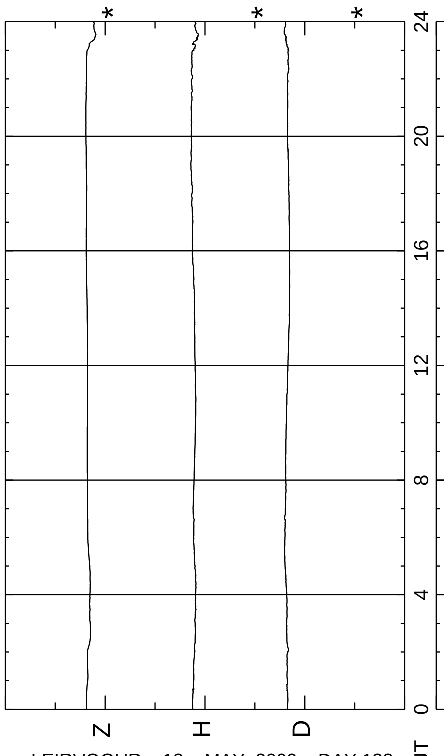
LEIRVOGUR 16. MAY 2009 DAY 136



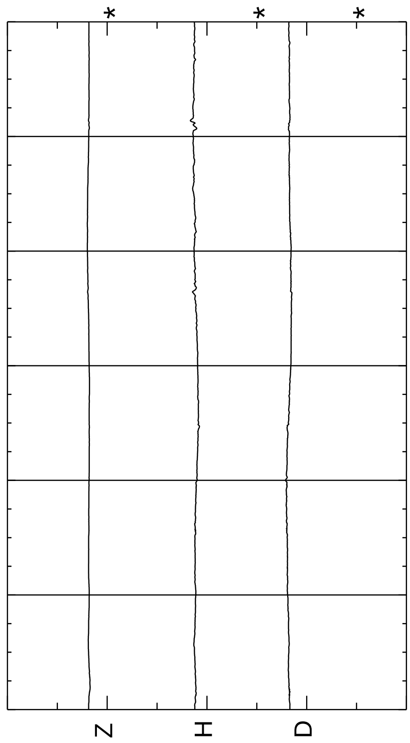
LEIRVOGUR 13. MAY 2009 DAY 133



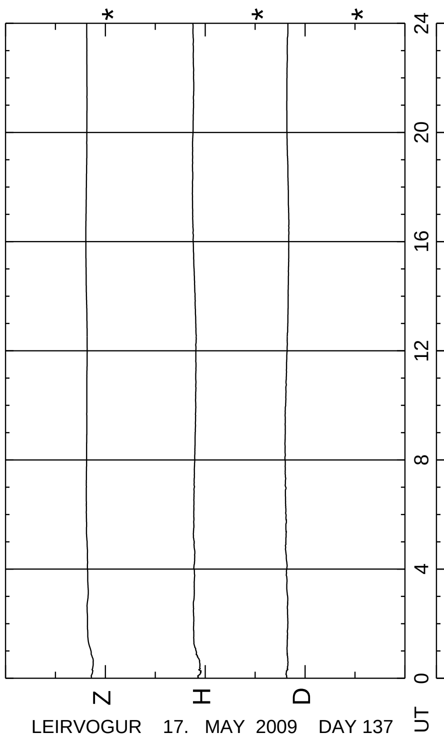
LEIRVOGUR 15. MAY 2009 DAY 135



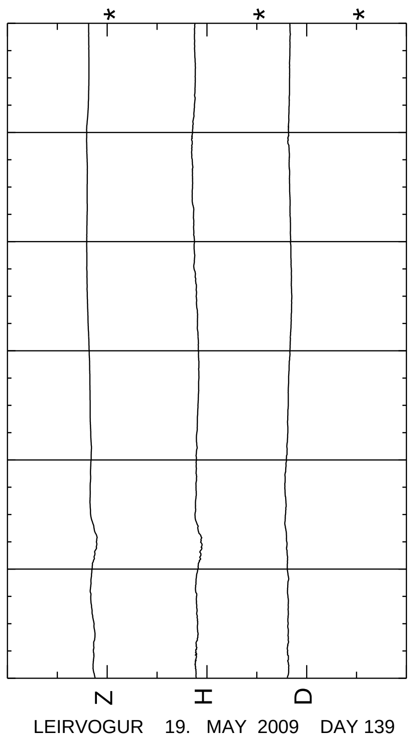
LEIRVOGUR 18. MAY 2009 DAY 138



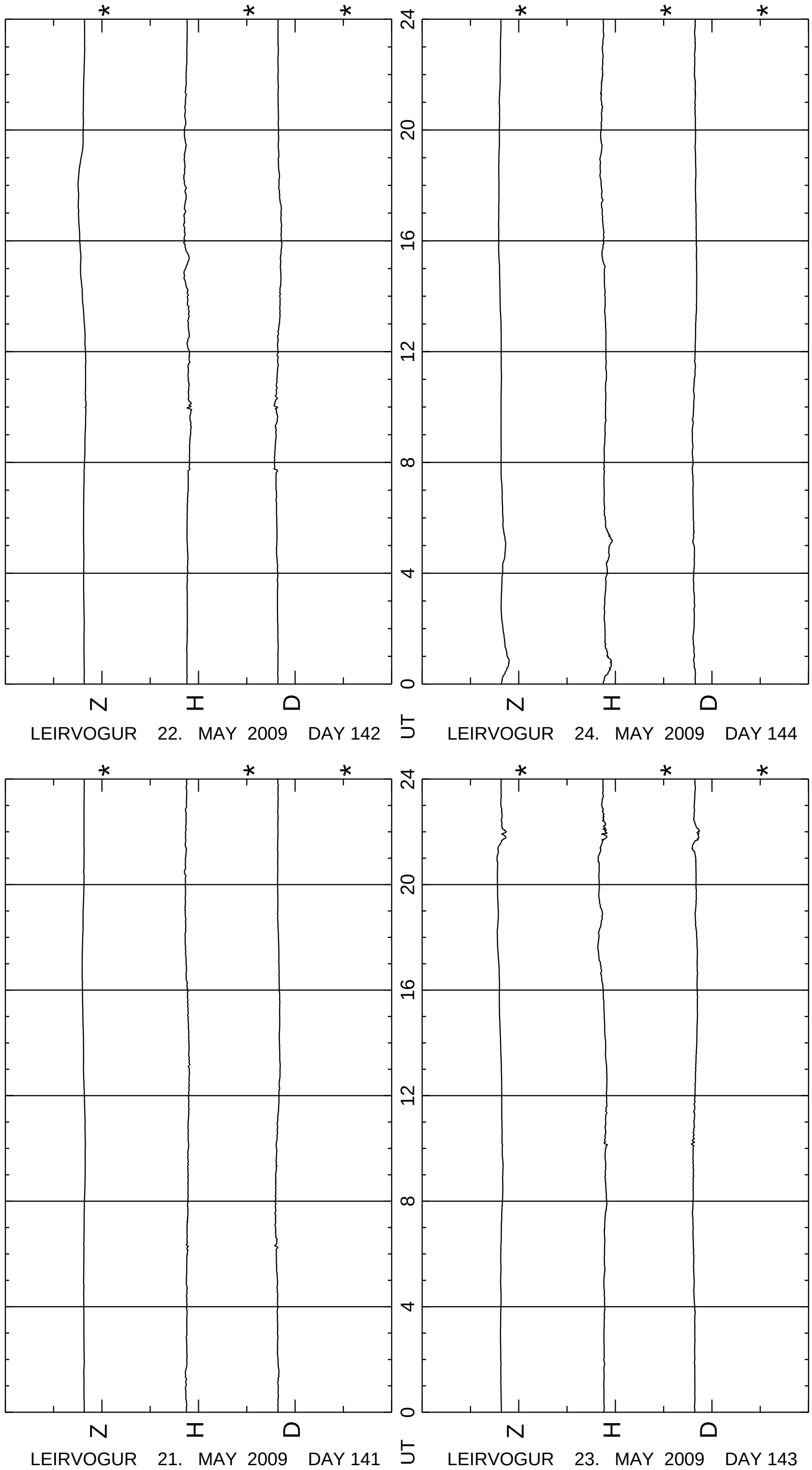
LEIRVOGUR 20. MAY 2009 DAY 140



LEIRVOGUR 17. MAY 2009 DAY 137



LEIRVOGUR 19. MAY 2009 DAY 139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LEIRVOGUR 24. MAY 2009 DAY 144
LEIRVOGUR 21. MAY 2009 DAY 141
LEIRVOGUR 23. MAY 2009 DAY 143
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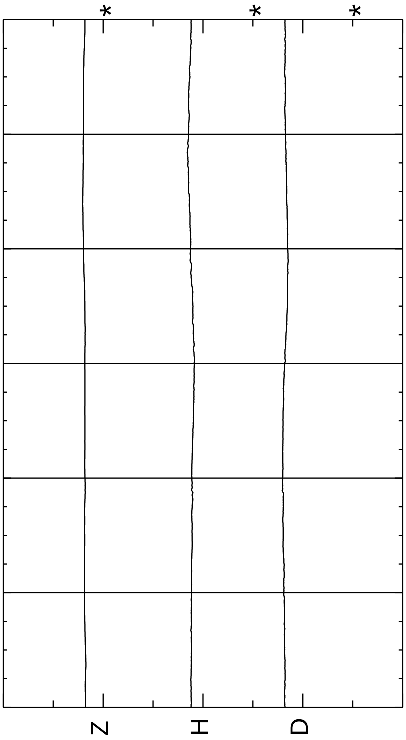
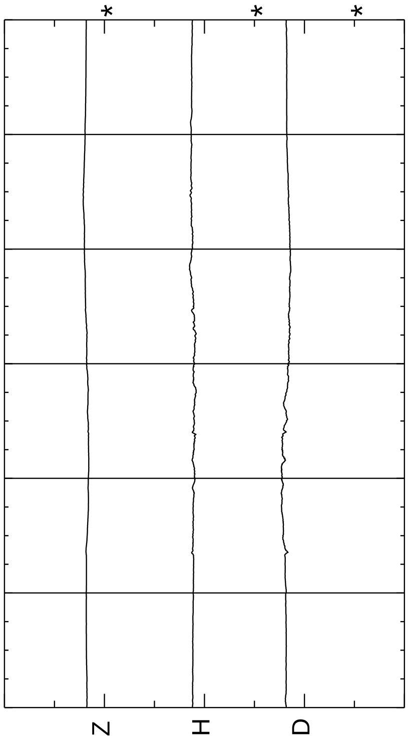
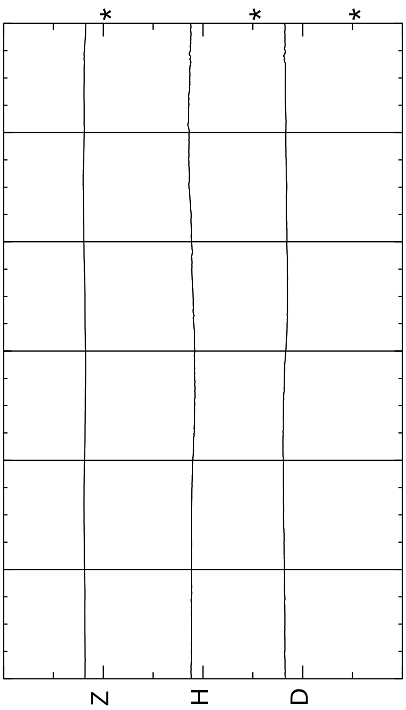


LEIRVOGUR 26. MAY 2009 DAY 146



LEIRVOGUR 28. MAY 2009 DAY 148



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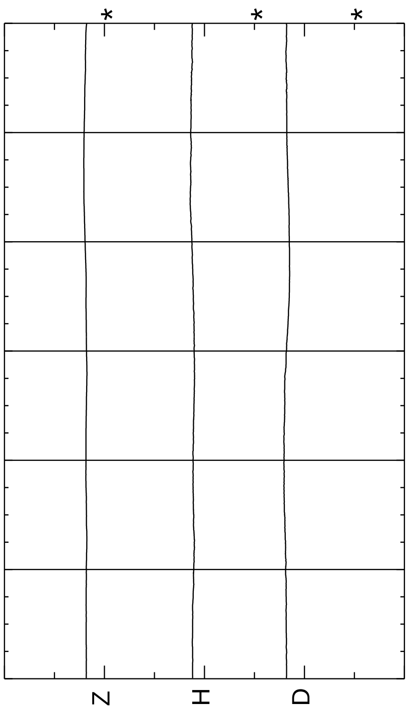
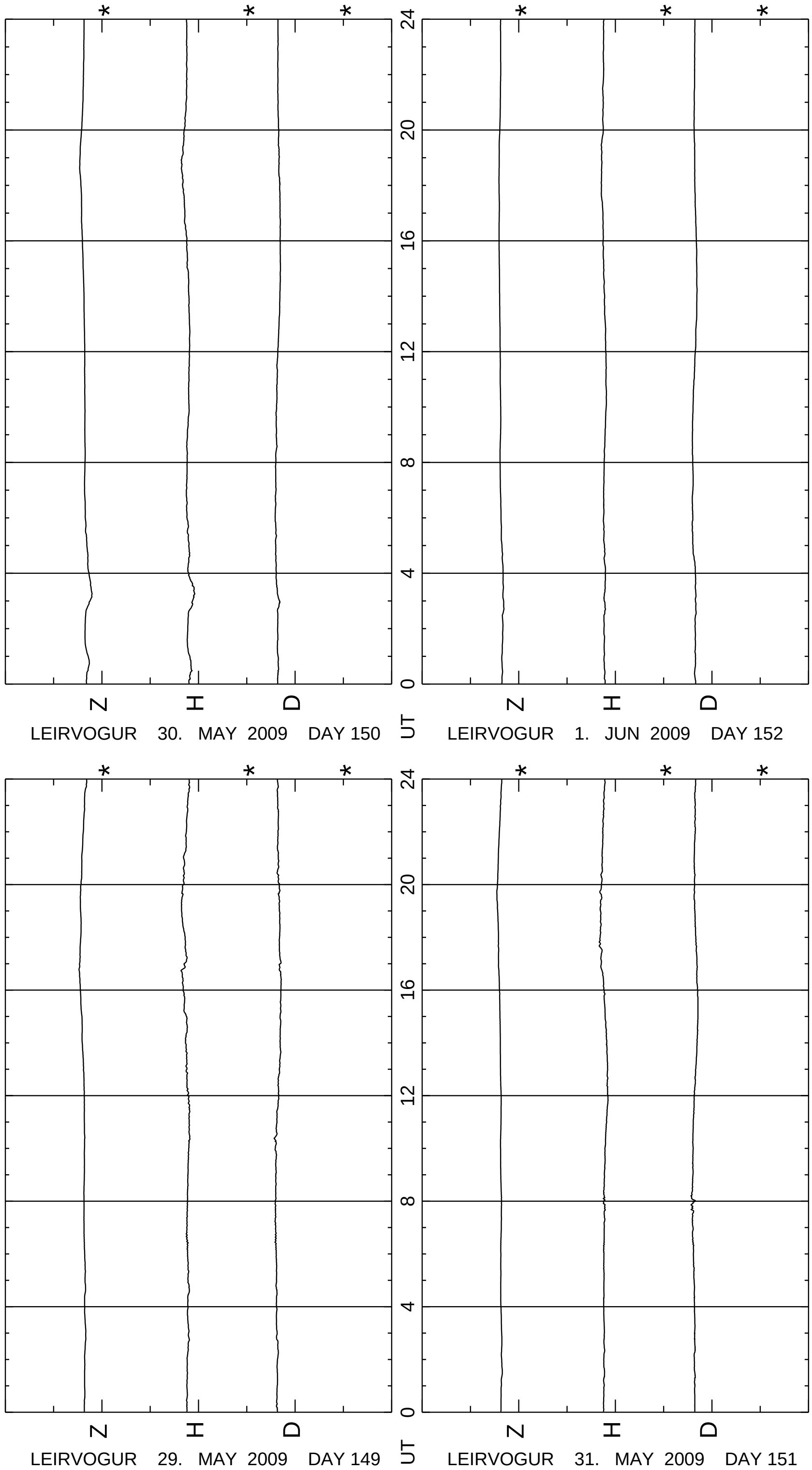


LEIRVOGUR 27. MAY 2009 DAY 147


LEIRVOGUR 30. MAY 2009 DAY 150
LEIRVOGUR 1. JUN 2009 DAY 152
LEIRVOGUR 29. MAY 2009 DAY 149
LEIRVOGUR 31. MAY 2009 DAY 151
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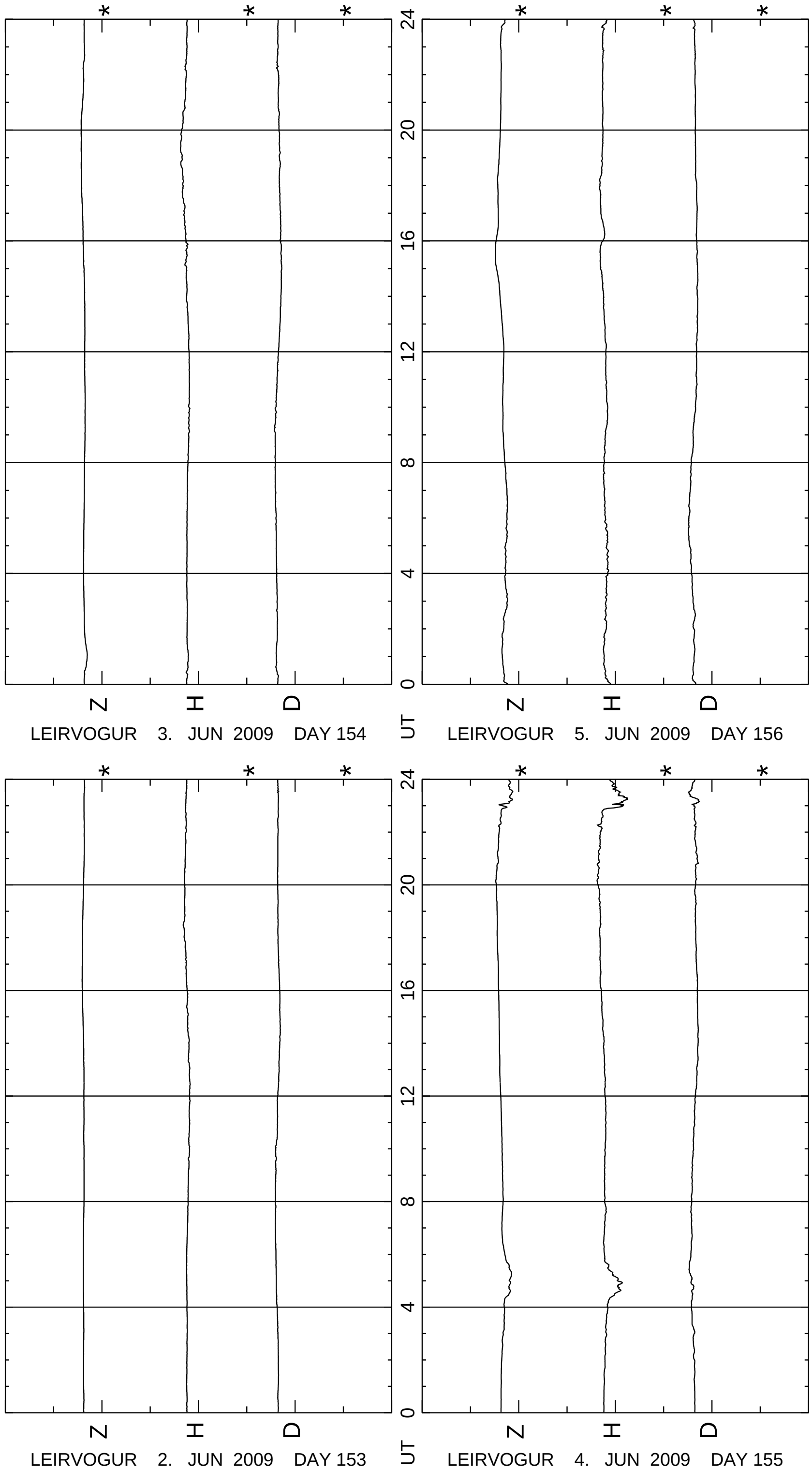
LEIRVOGUR 3. JUN 2009 DAY 154
LEIRVOGUR 5. JUN 2009 DAY 156
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LEIRVOGUR 4. JUN 2009 DAY 155
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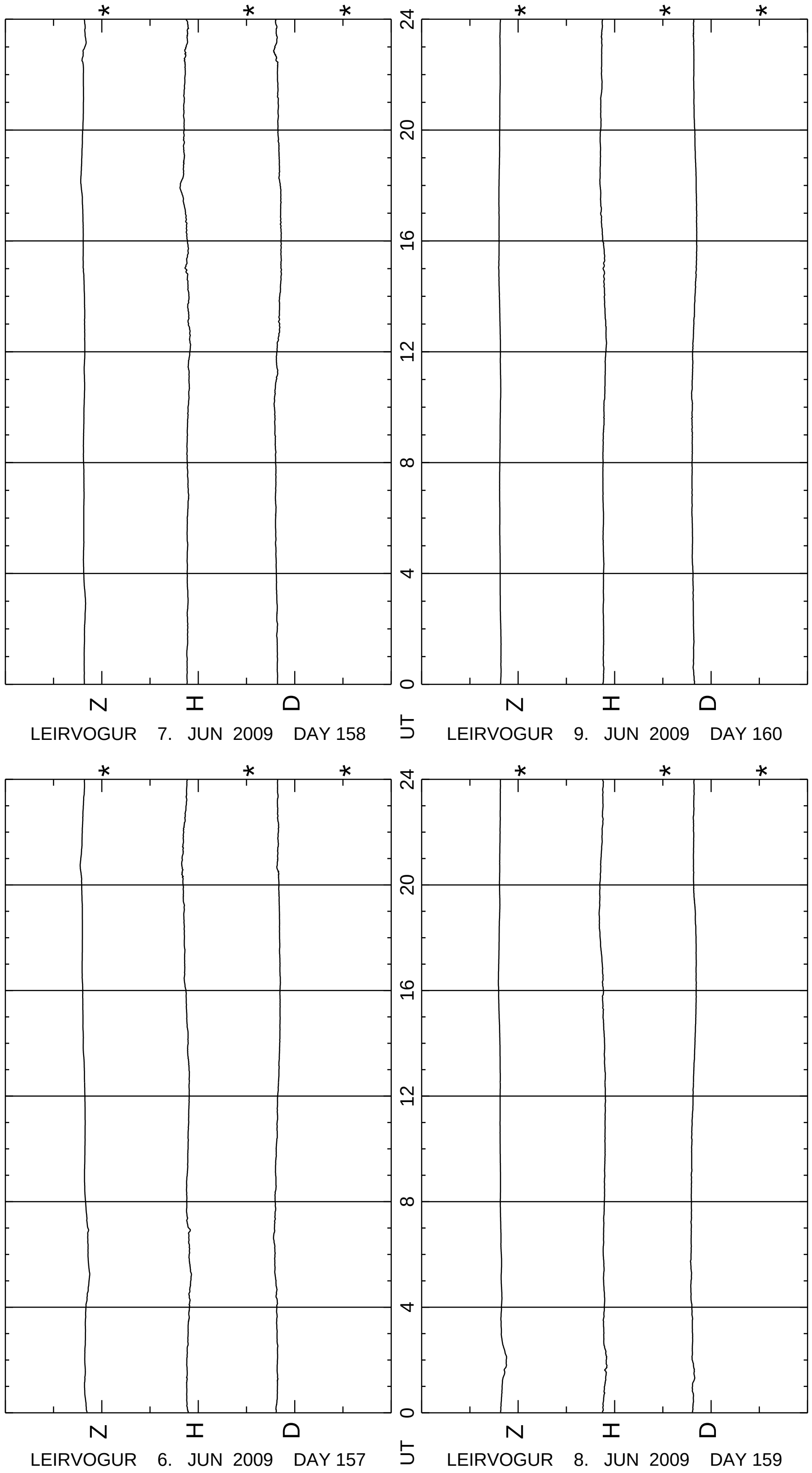
LEIRVOGUR 7. JUN 2009 DAY 158
LEIRVOGUR 9. JUN 2009 DAY 160
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LEIRVOGUR 8. JUN 2009 DAY 159
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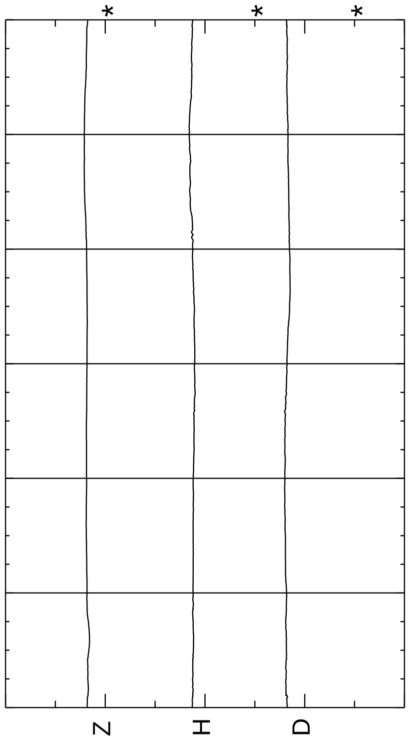
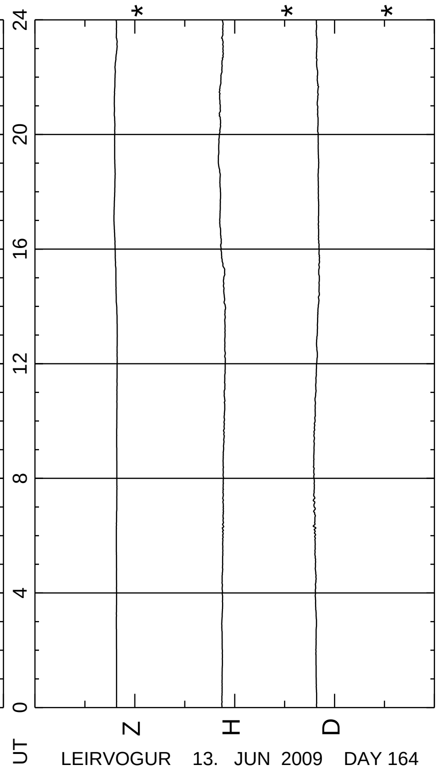
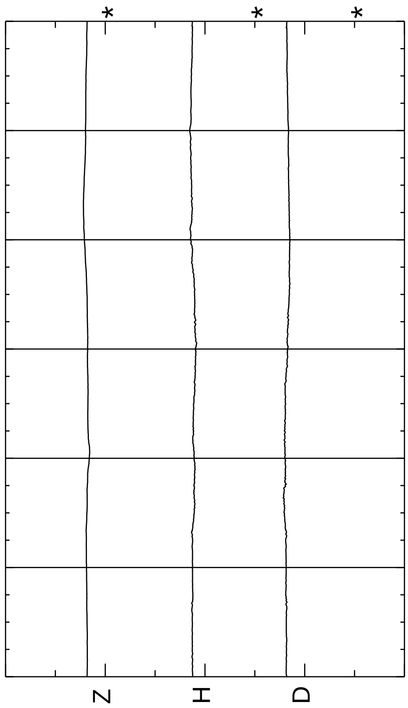


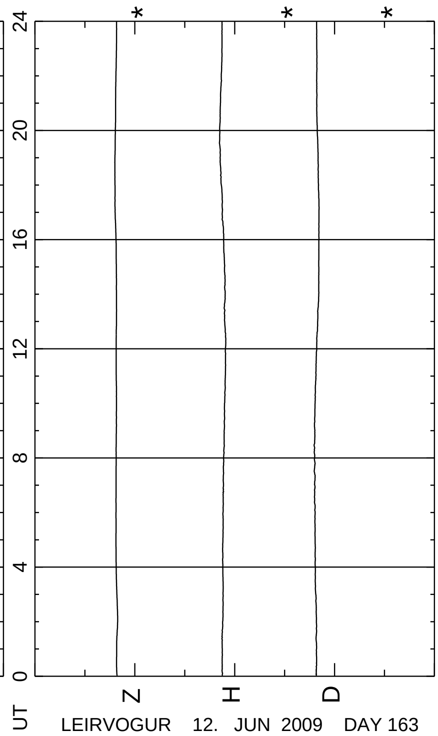
LEIRVOGUR 11. JUN 2009 DAY 162



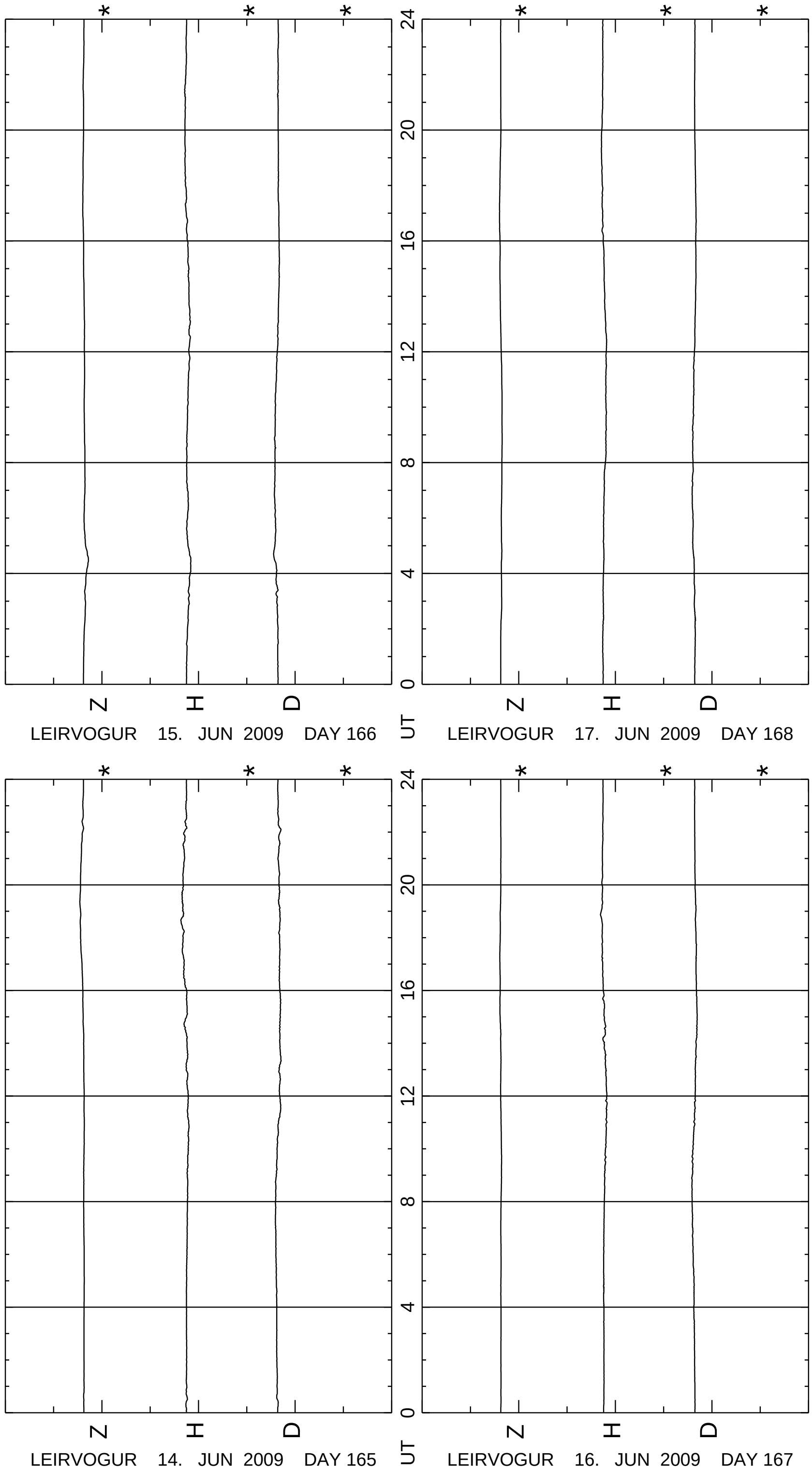
LEIRVOGUR 13. JUN 2009 DAY 164



LEIRVOGUR 10. JUN 2009 DAY 161



LEIRVOGUR 12. JUN 2009 DAY 163


LEIRVOGUR 15. JUN 2009 DAY 166
LEIRVOGUR 17. JUN 2009 DAY 168
LEIRVOGUR 14. JUN 2009 DAY 165
LEIRVOGUR 16. JUN 2009 DAY 167
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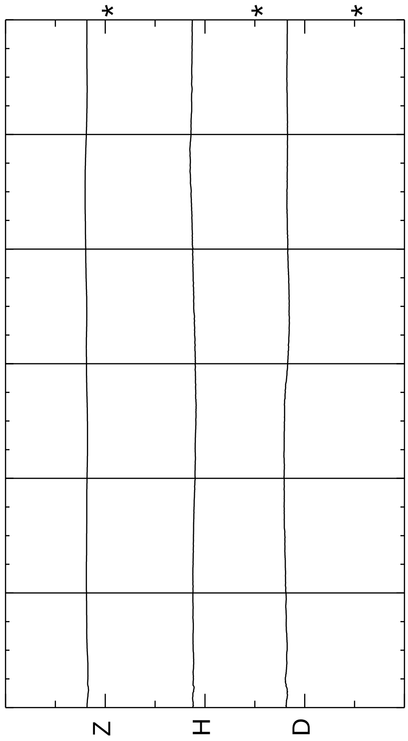
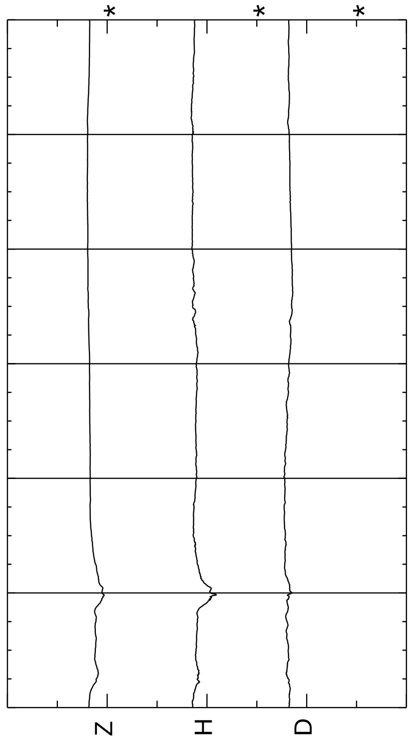
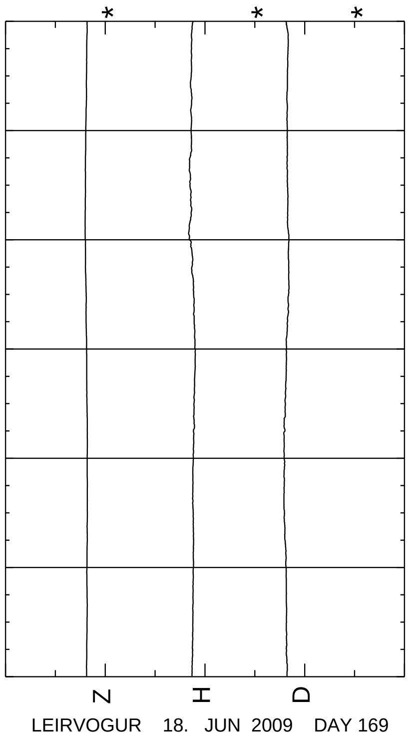


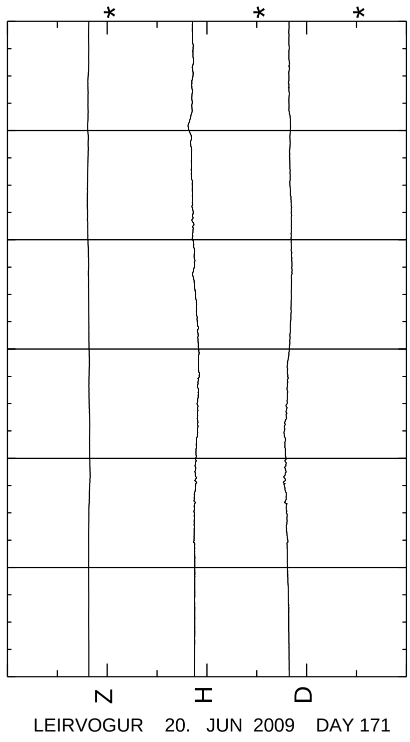
LEIRVOGUR 19. JUN 2009 DAY 170



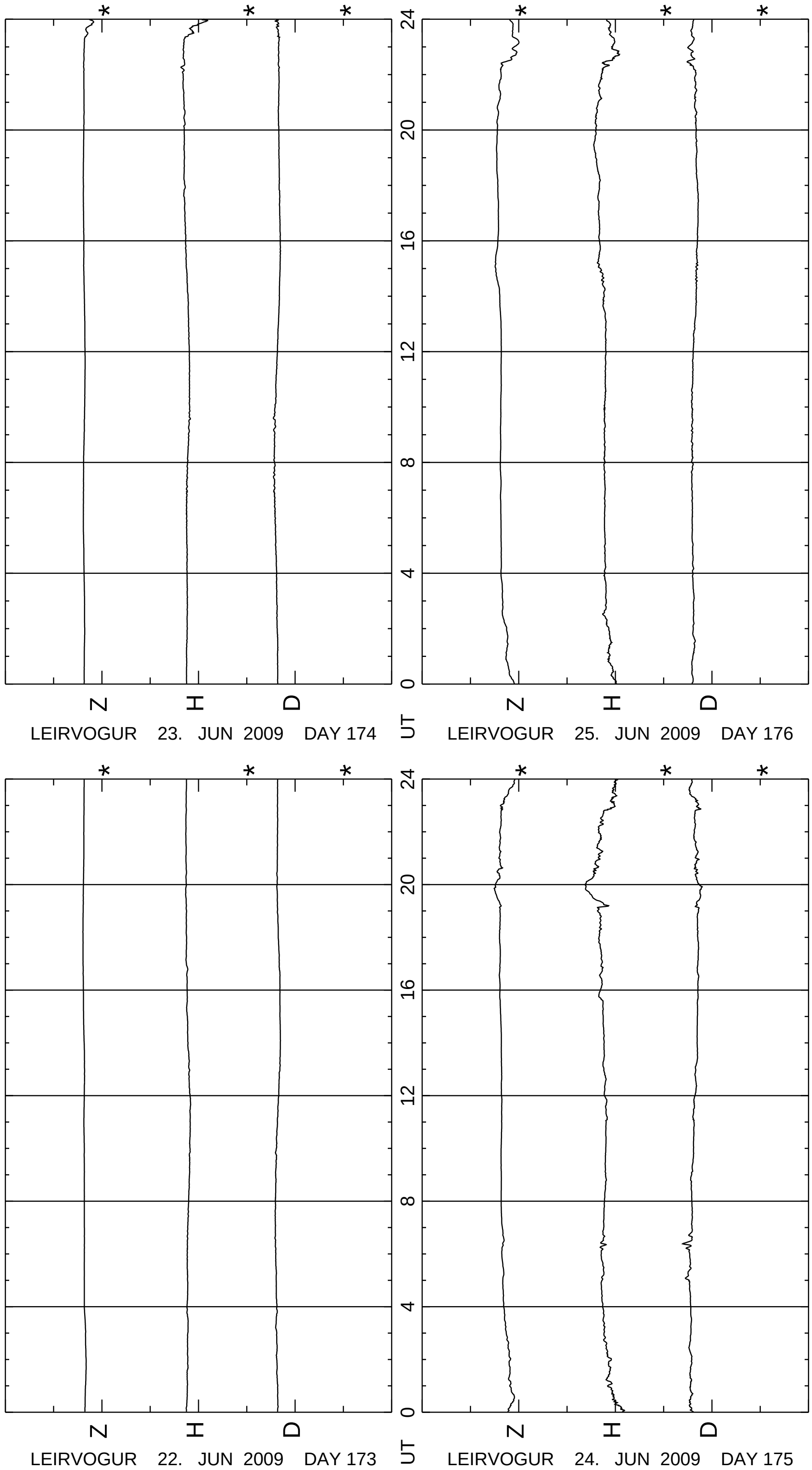
LEIRVOGUR 21. JUN 2009 DAY 172



LEIRVOGUR 18. JUN 2009 DAY 169



LEIRVOGUR 20. JUN 2009 DAY 171


LEIRVOGUR 23. JUN 2009 DAY 174
LEIRVOGUR 25. JUN 2009 DAY 176
LEIRVOGUR 22. JUN 2009 DAY 173
LEIRVOGUR 24. JUN 2009 DAY 175
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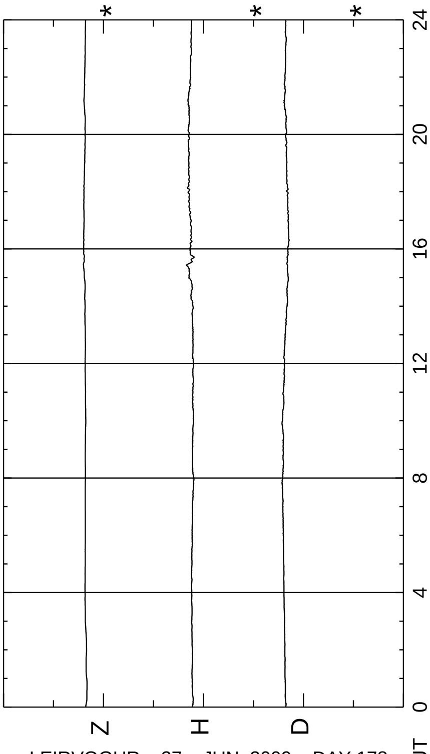
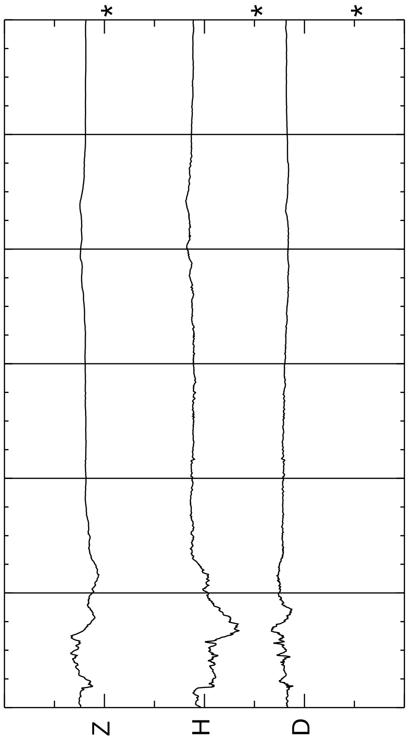
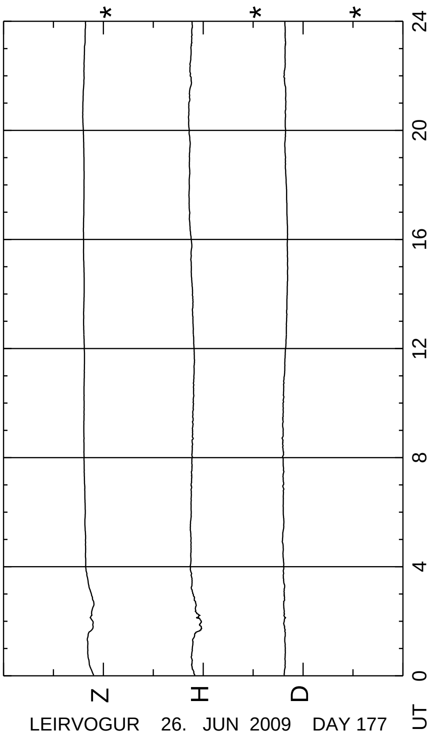


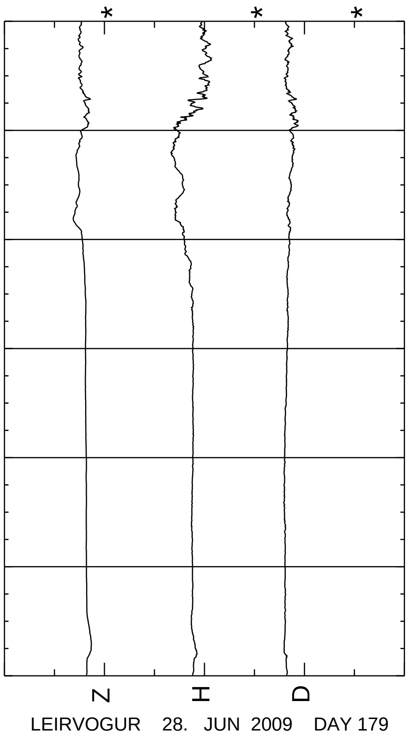
LEIRVOGUR 27. JUN 2009 DAY 178



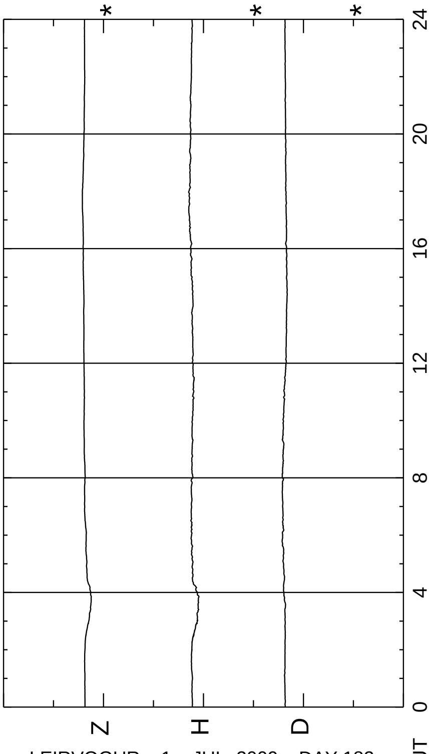
LEIRVOGUR 29. JUN 2009 DAY 180



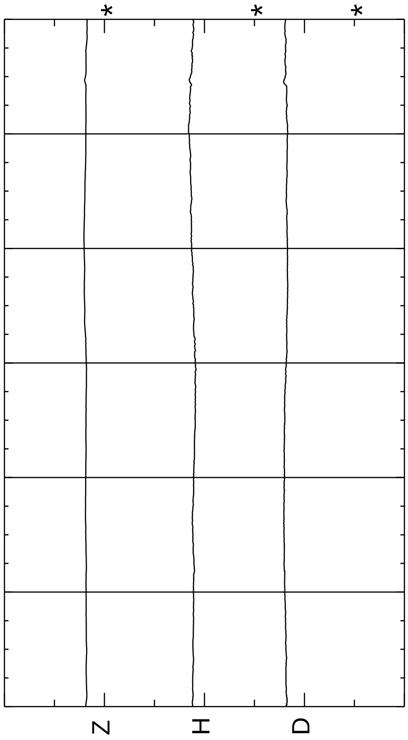
LEIRVOGUR 26. JUN 2009 DAY 177



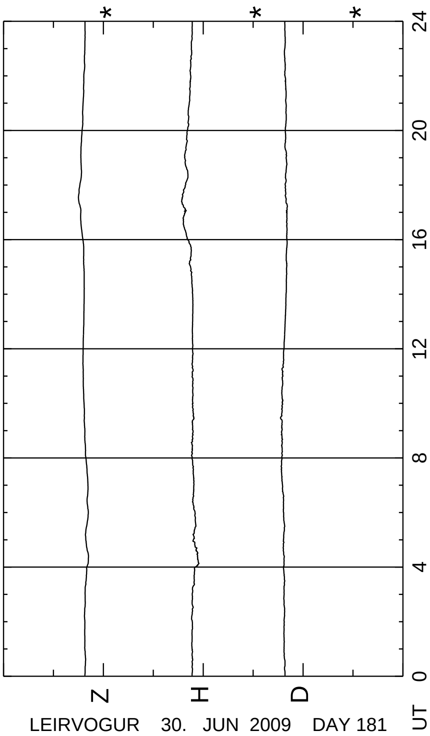
LEIRVOGUR 28. JUN 2009 DAY 179



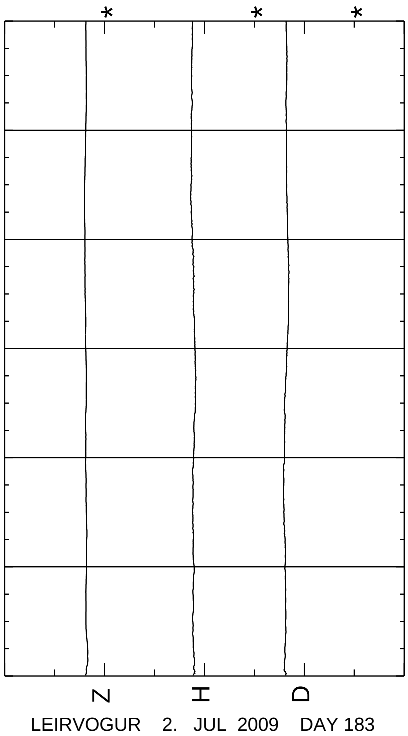
LEIRVOGUR 1. JUL 2009 DAY 182



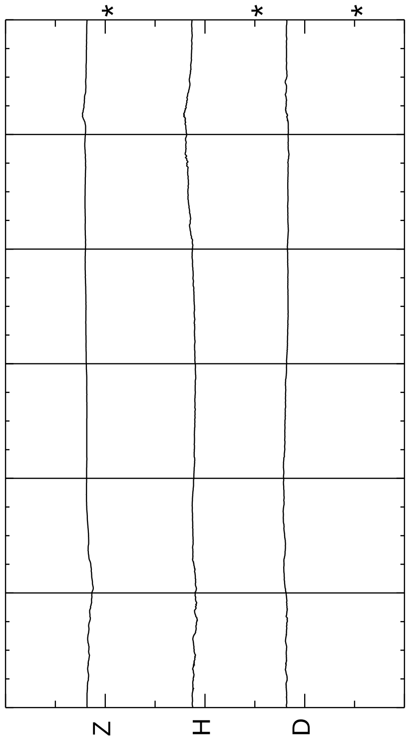
LEIRVOGUR 3. JUL 2009 DAY 184



LEIRVOGUR 30. JUN 2009 DAY 181



LEIRVOGUR 2. JUL 2009 DAY 183



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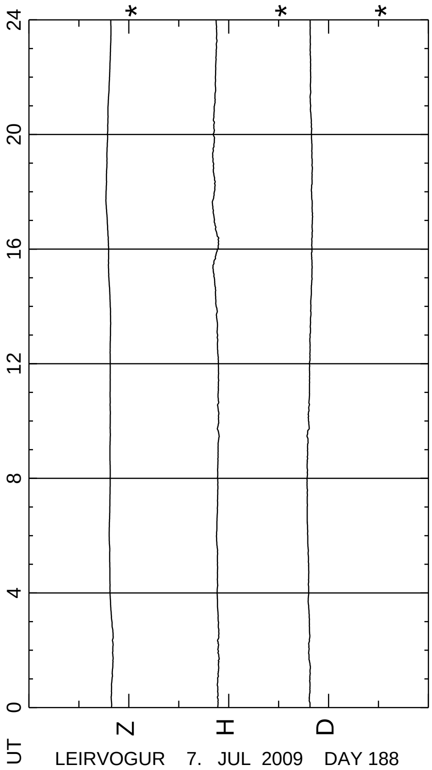
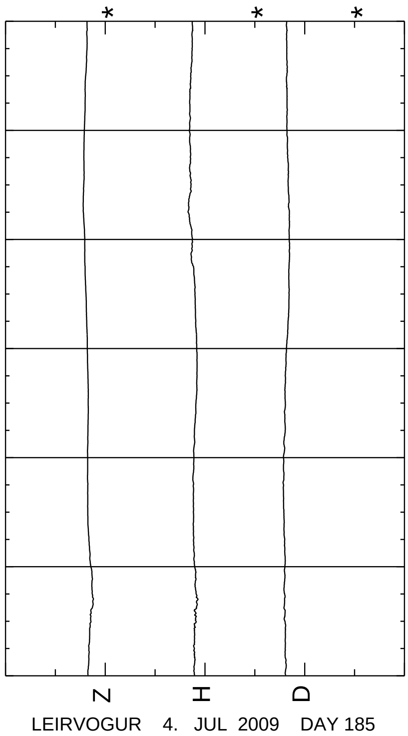


LEIRVOGUR 7. JUL 2009 DAY 188



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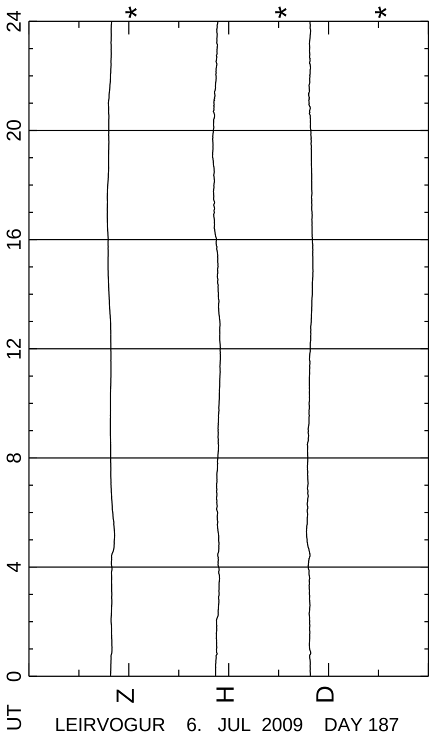

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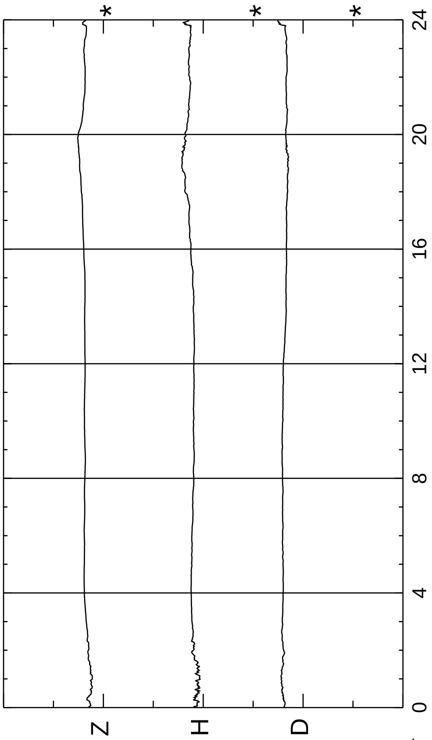
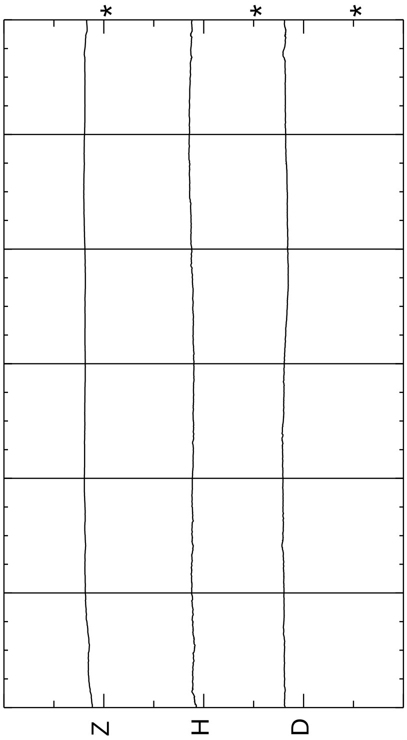
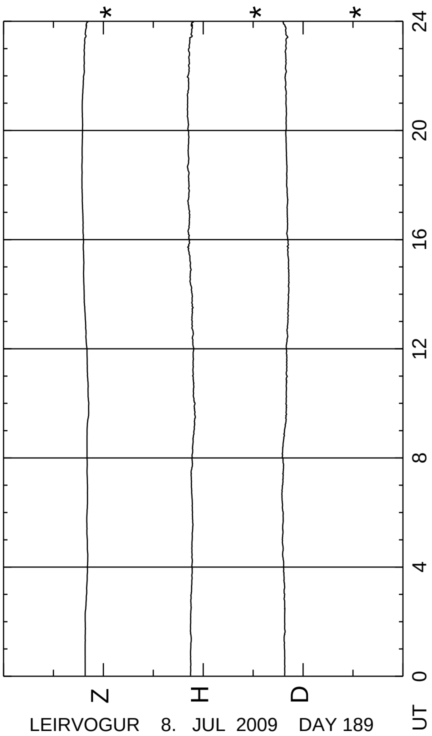


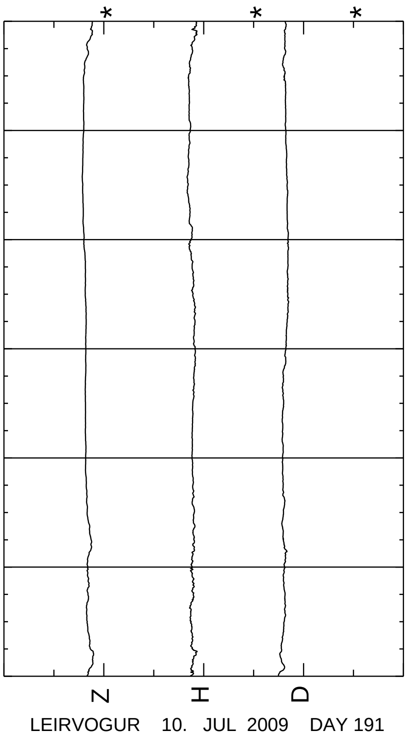
LEIRVOGUR 9. JUL 2009 DAY 190



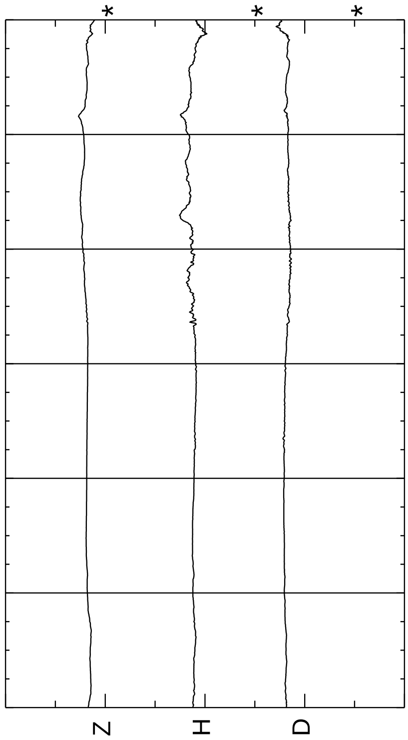
LEIRVOGUR 11. JUL 2009 DAY 192



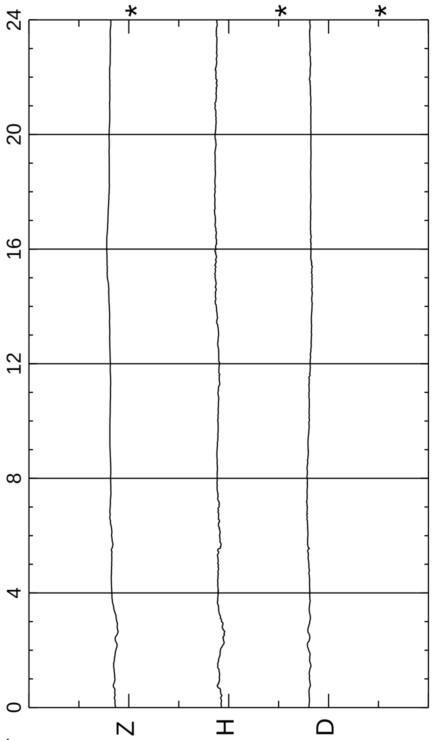
LEIRVOGUR 8. JUL 2009 DAY 189



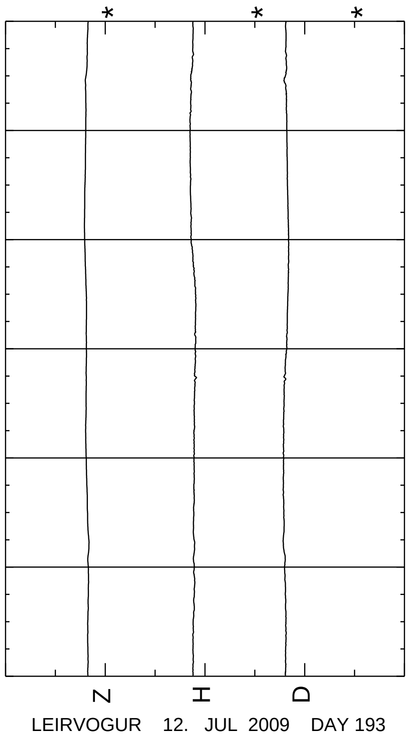
LEIRVOGUR 10. JUL 2009 DAY 191



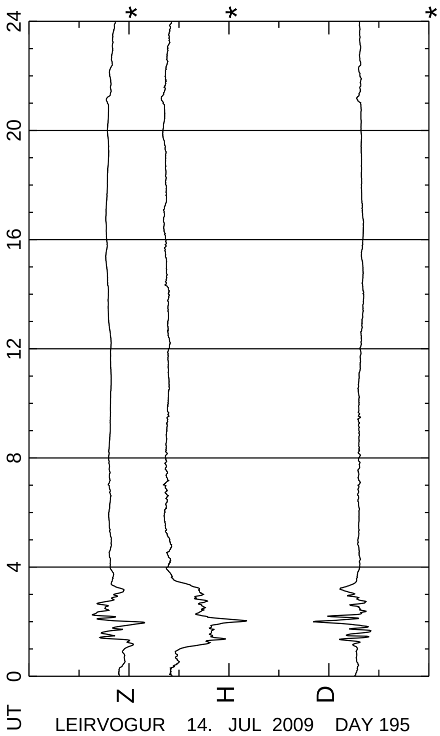
LEIRVOGUR 13. JUL 2009 DAY 194



LEIRVOGUR 15. JUL 2009 DAY 196



LEIRVOGUR 12. JUL 2009 DAY 193



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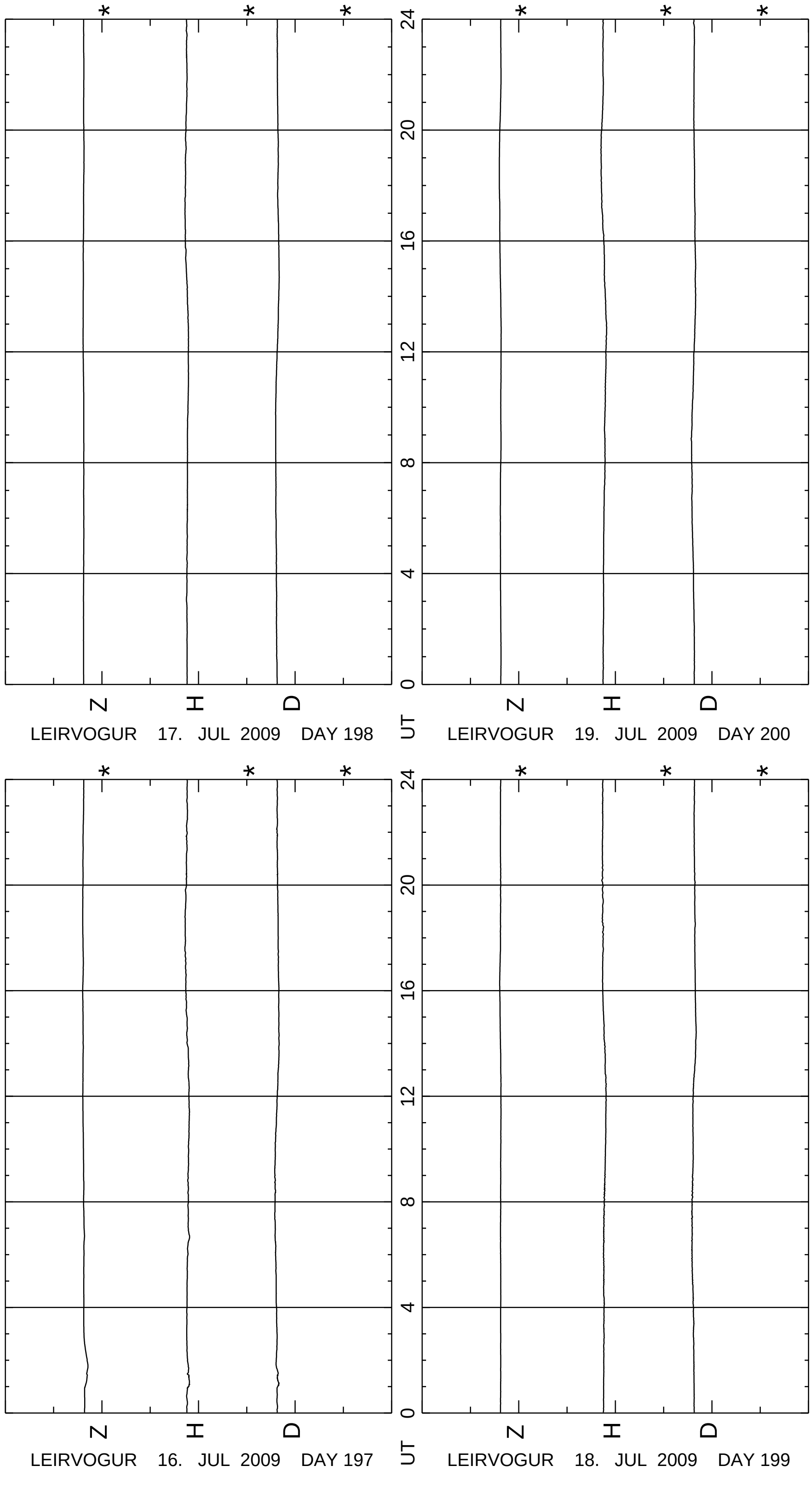
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LEIRVOGUR 19. JUL 2009 DAY 200
LEIRVOGUR 16. JUL 2009 DAY 197
LEIRVOGUR 18. JUL 2009 DAY 199
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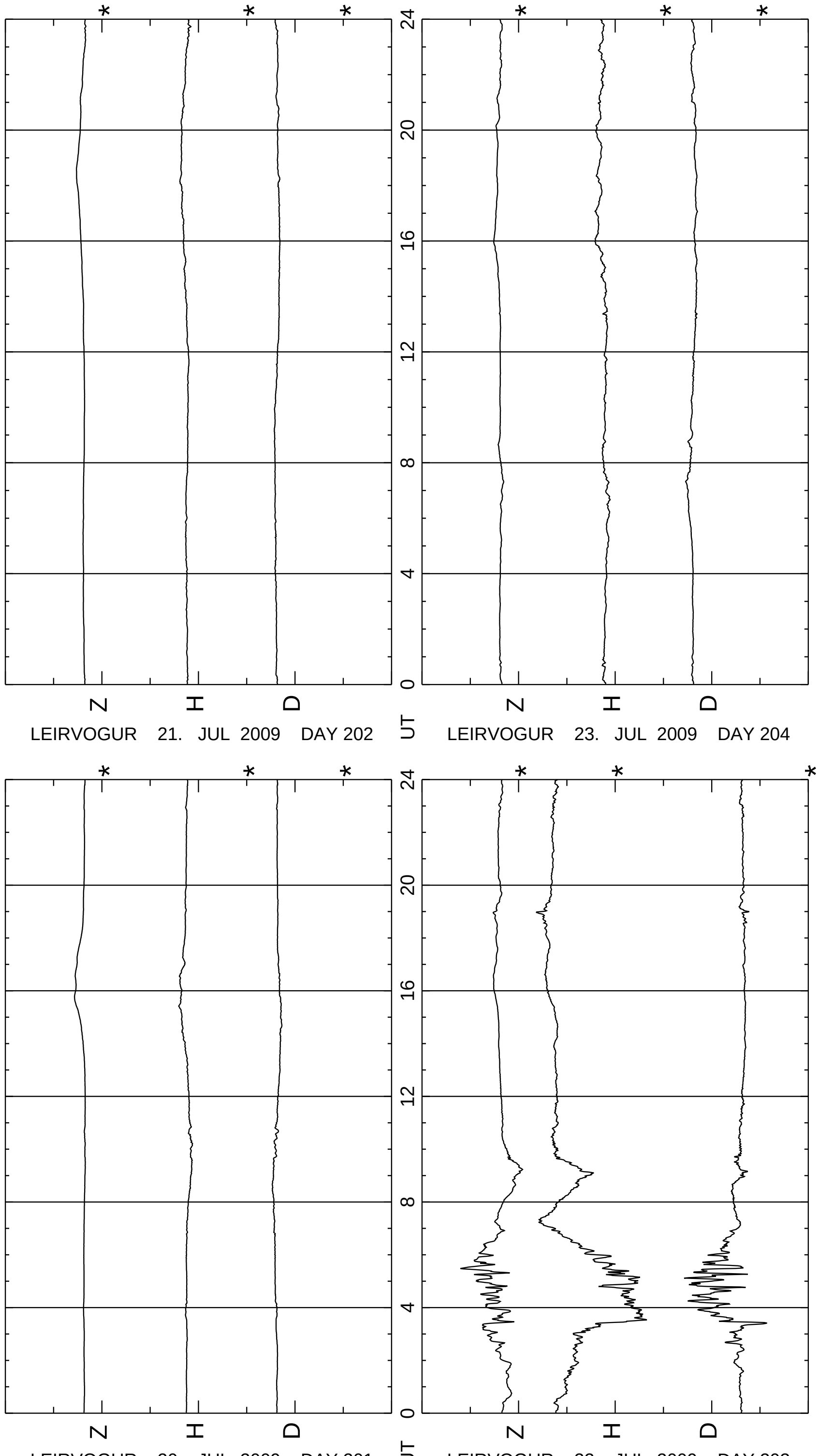

LEIRVOGUR 21. JUL 2009 DAY 202
LEIRVOGUR 23. JUL 2009 DAY 204
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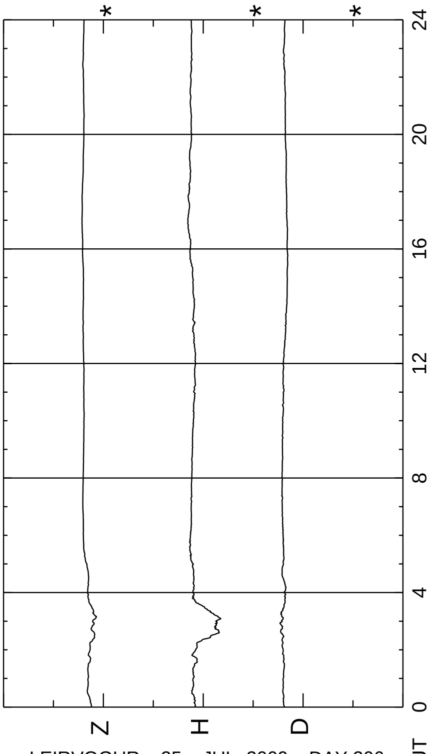

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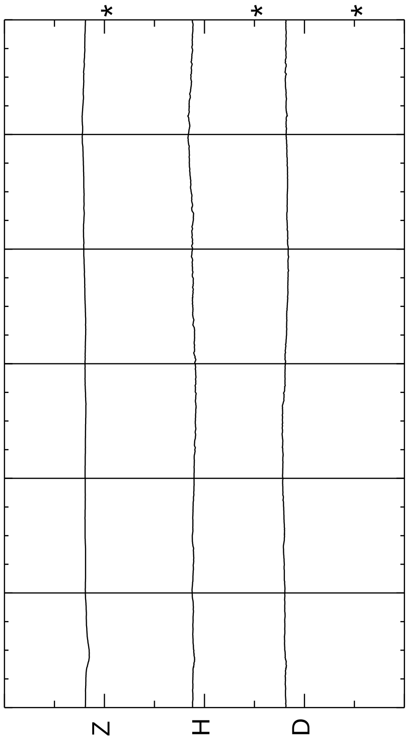

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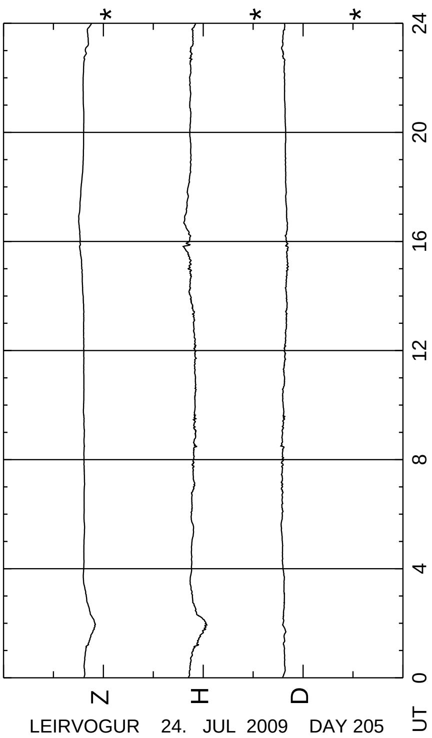

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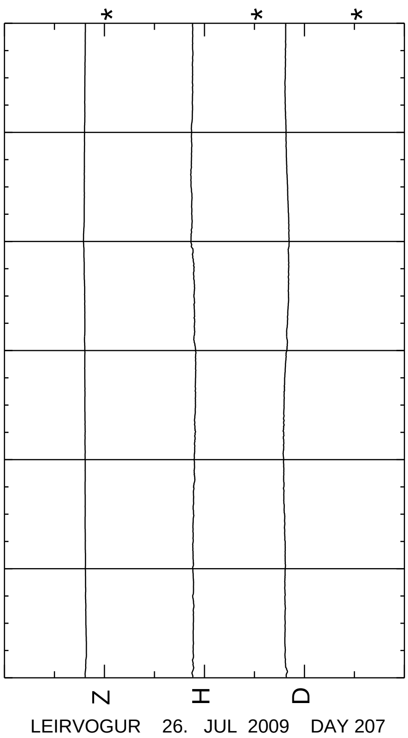

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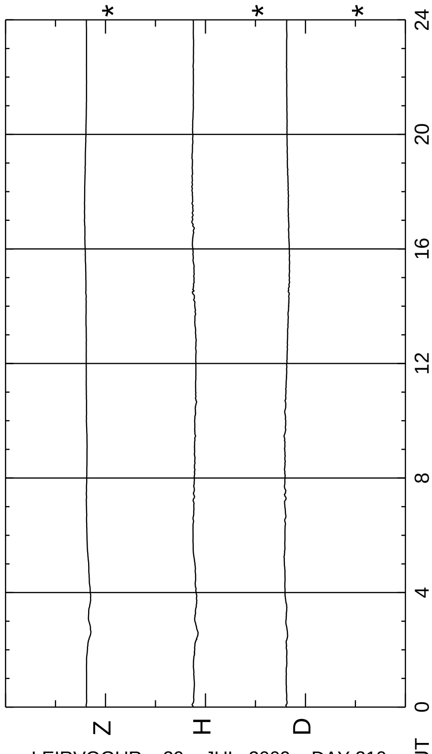

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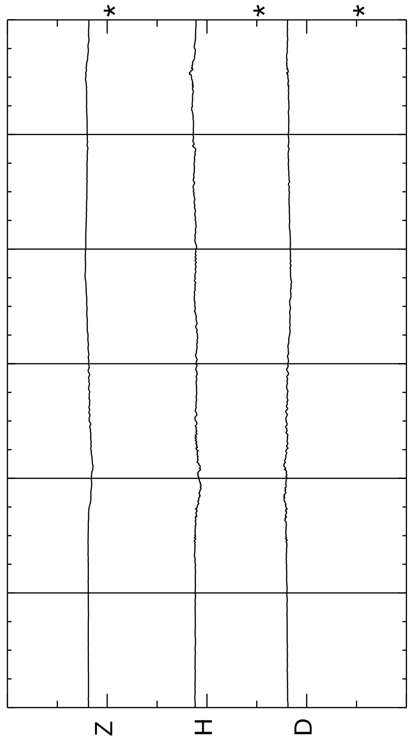
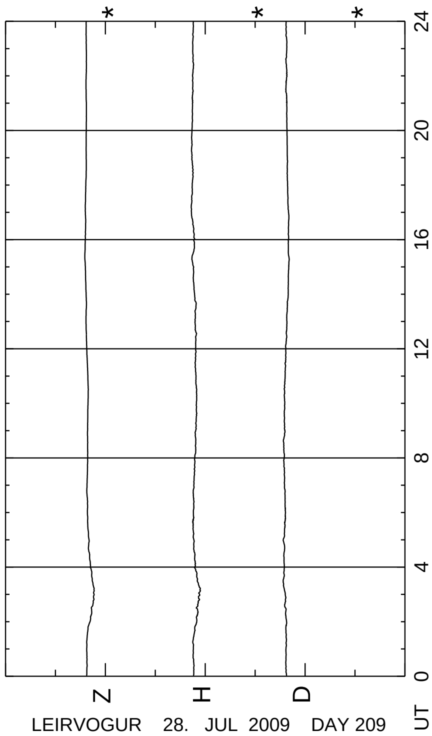
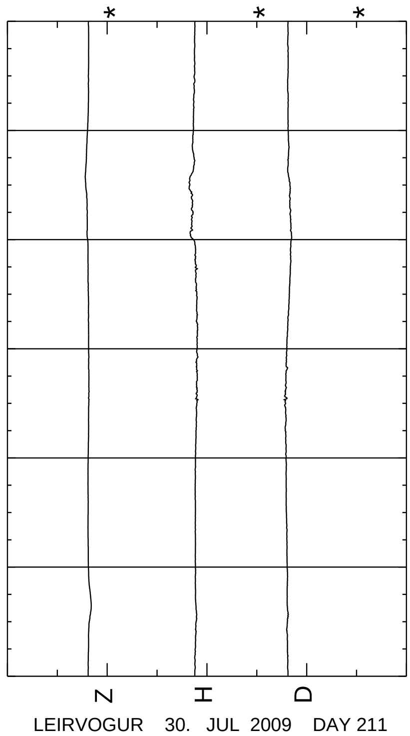


LEIRVOGUR 31. JUL 2009 DAY 212



LEIRVOGUR 28. JUL 2009 DAY 209



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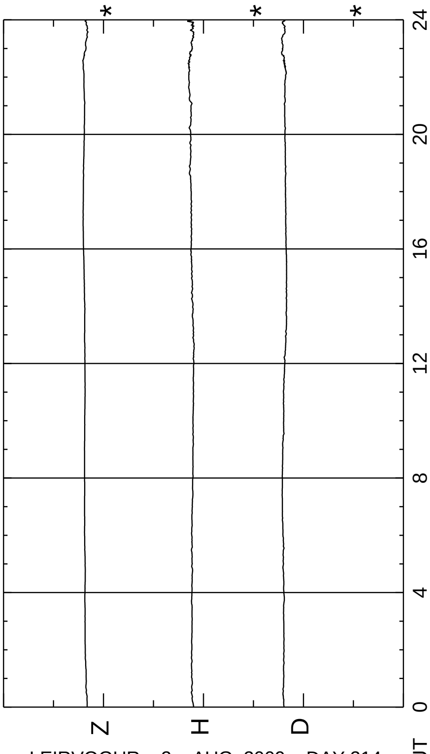

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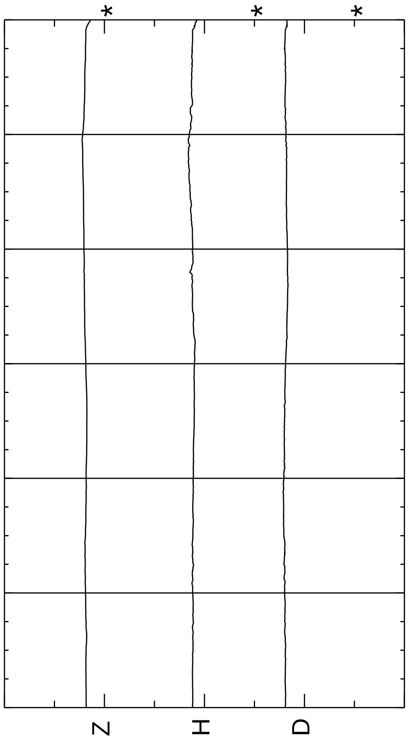
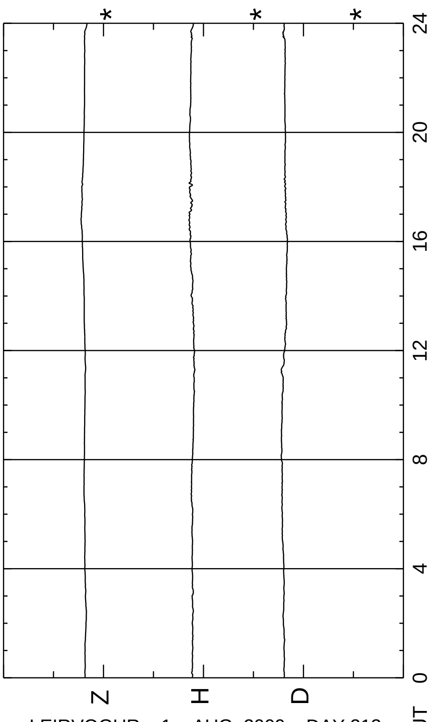
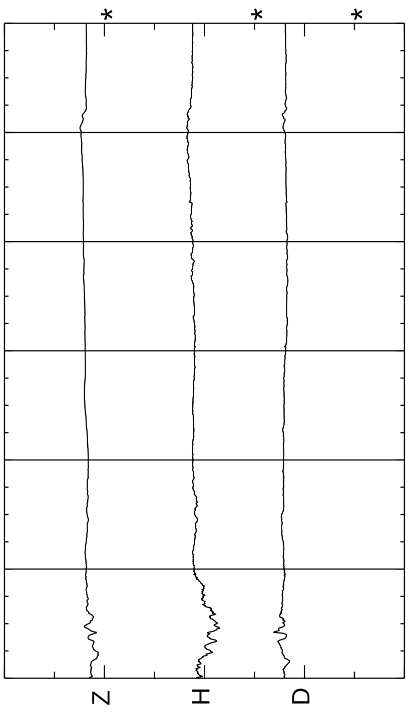


LEIRVOGUR 4. AUG 2009 DAY 216



LEIRVOGUR 1. AUG 2009 DAY 213



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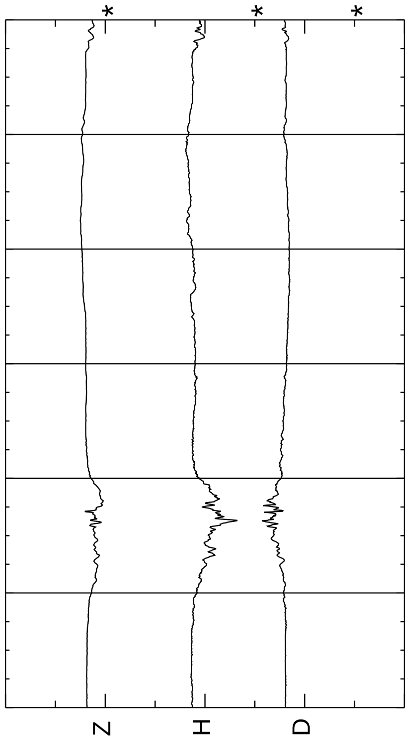
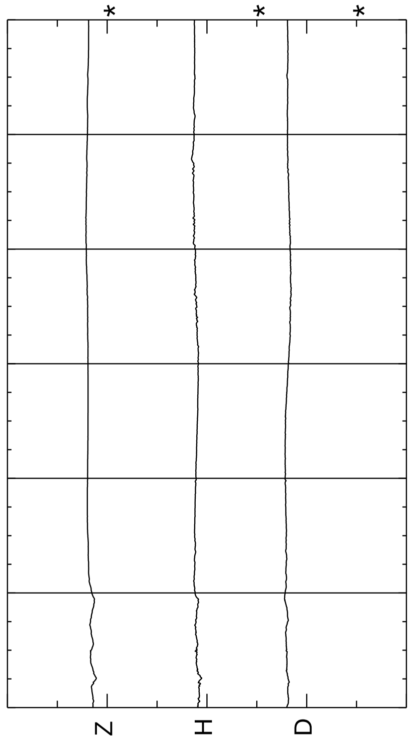
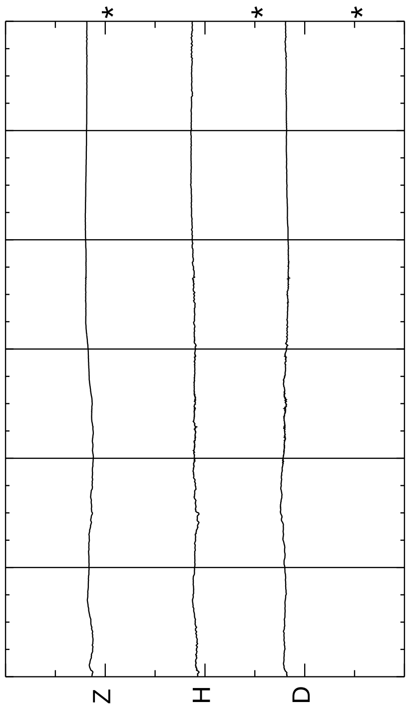


LEIRVOGUR 6. AUG 2009 DAY 218



LEIRVOGUR 8. AUG 2009 DAY 220



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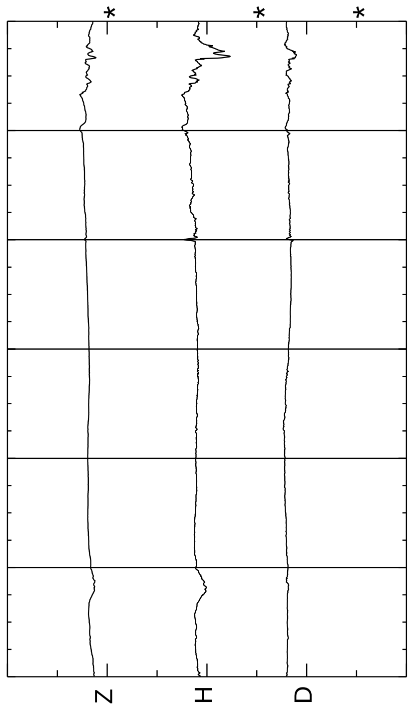
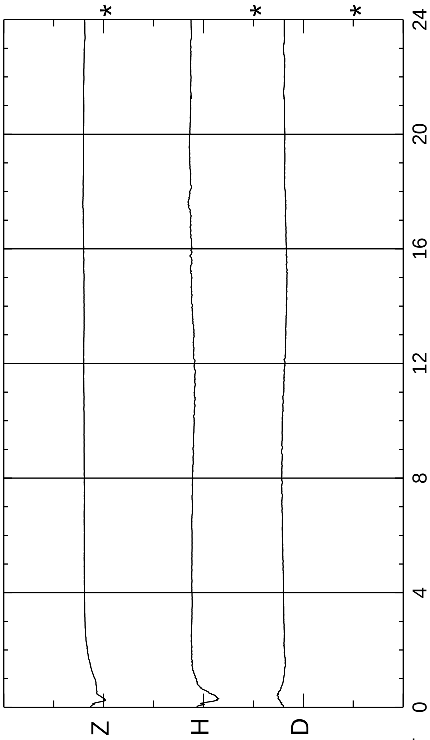
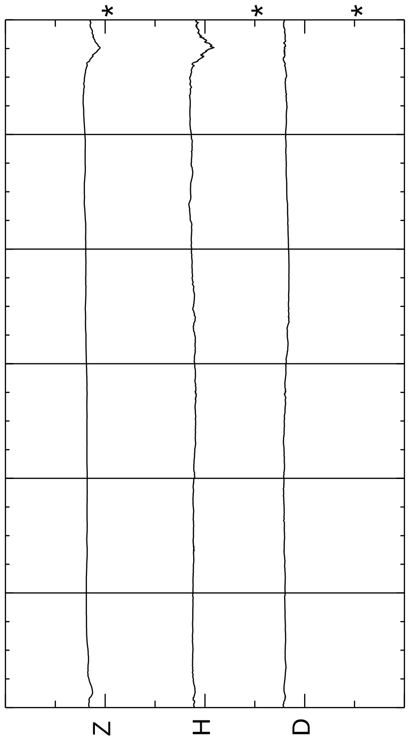


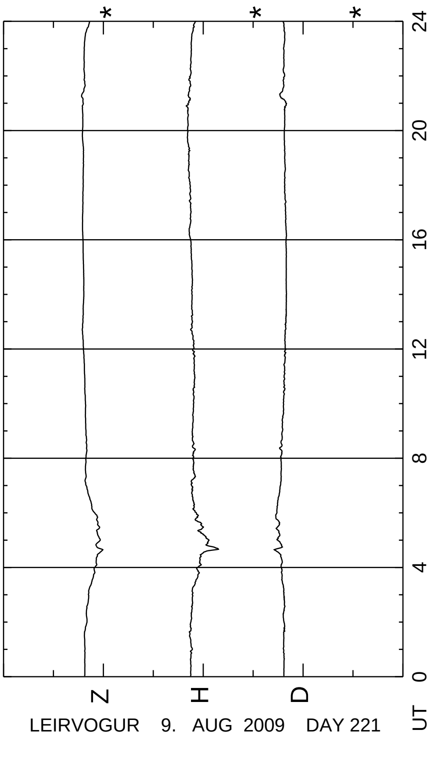
LEIRVOGUR 7. AUG 2009 DAY 219



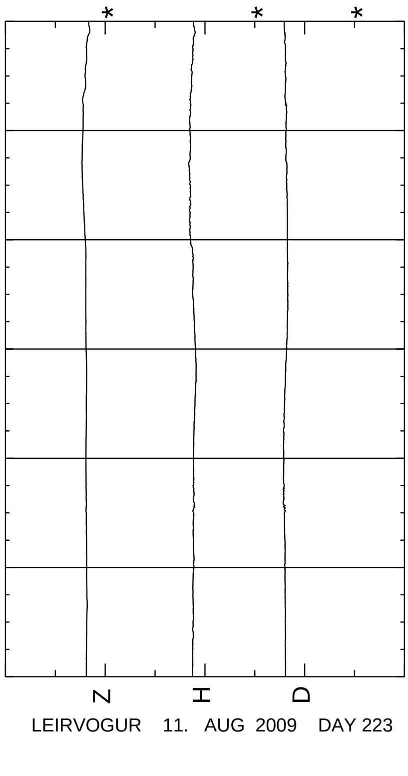
LEIRVOGUR 10. AUG 2009 DAY 222



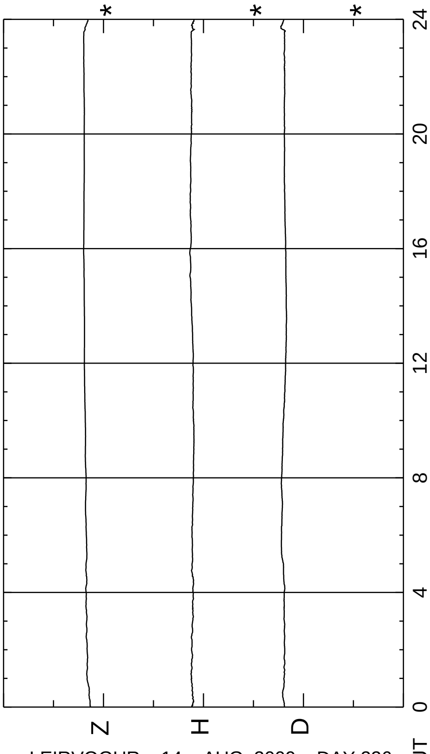
LEIRVOGUR 12. AUG 2009 DAY 224



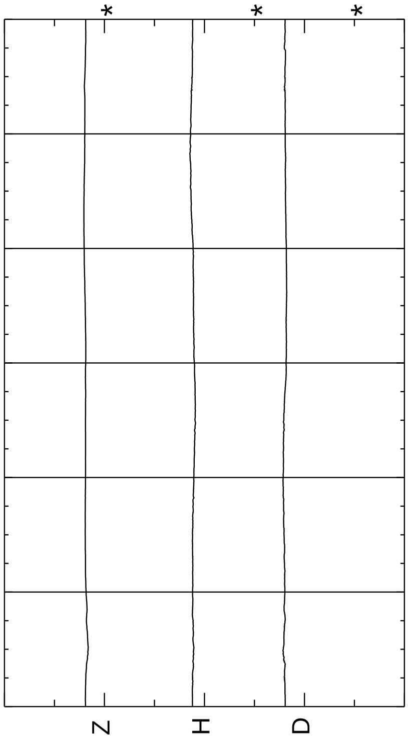
LEIRVOGUR 9. AUG 2009 DAY 221



LEIRVOGUR 11. AUG 2009 DAY 223



LEIRVOGUR 14. AUG 2009 DAY 226



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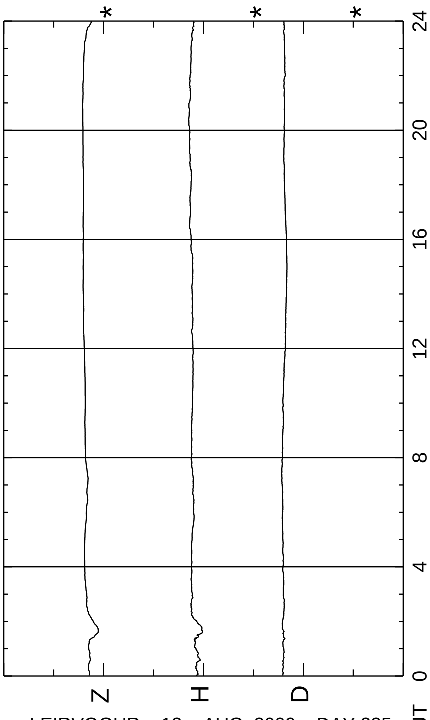

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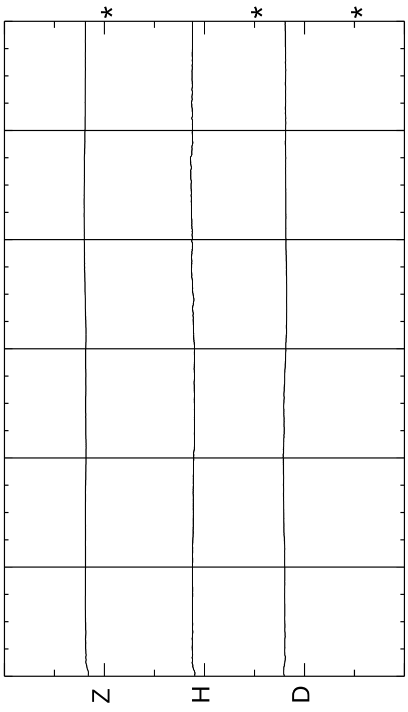
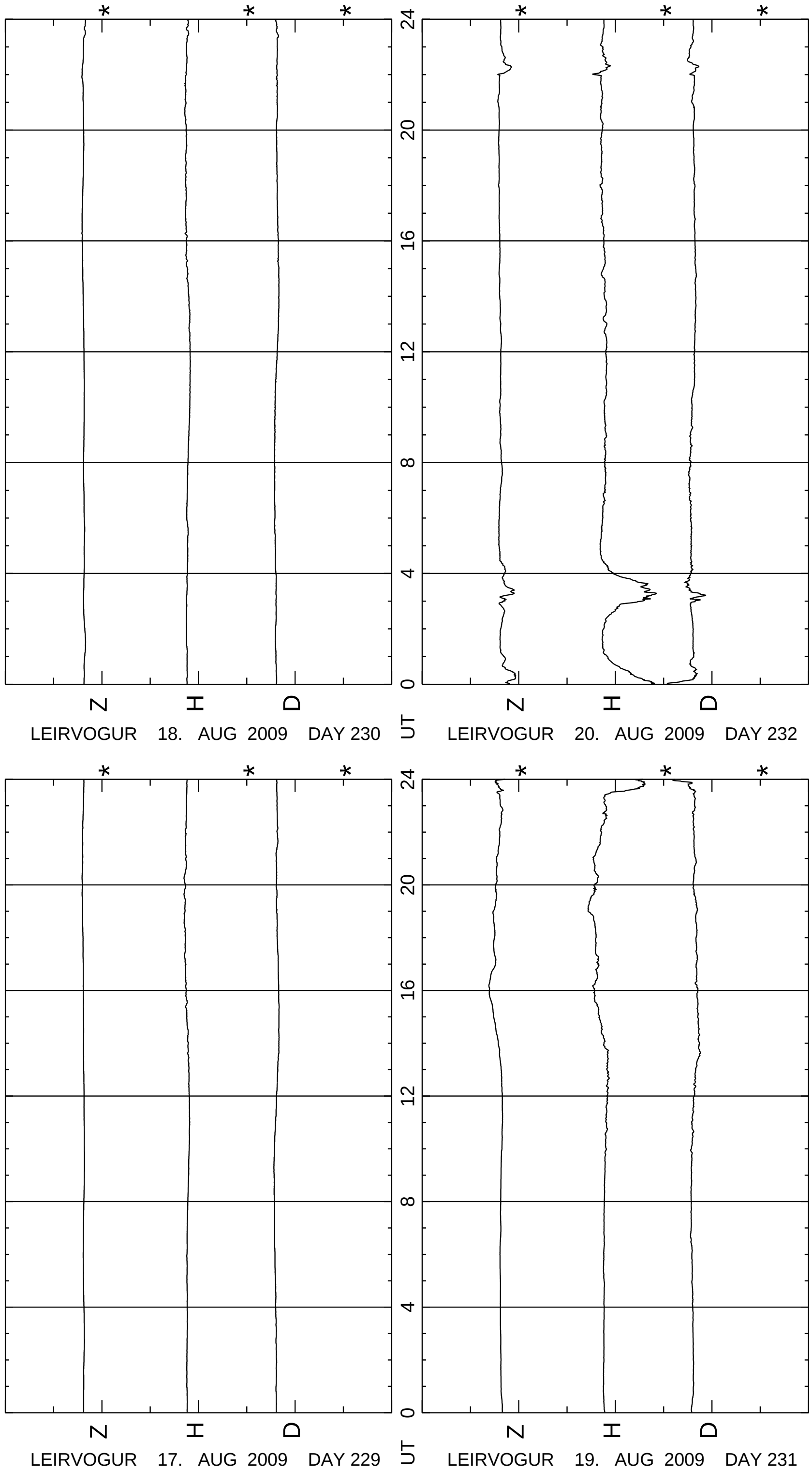


LEIRVOGUR 15. AUG 2009 DAY 227


LEIRVOGUR 18. AUG 2009 DAY 230
LEIRVOGUR 20. AUG 2009 DAY 232
LEIRVOGUR 17. AUG 2009 DAY 229
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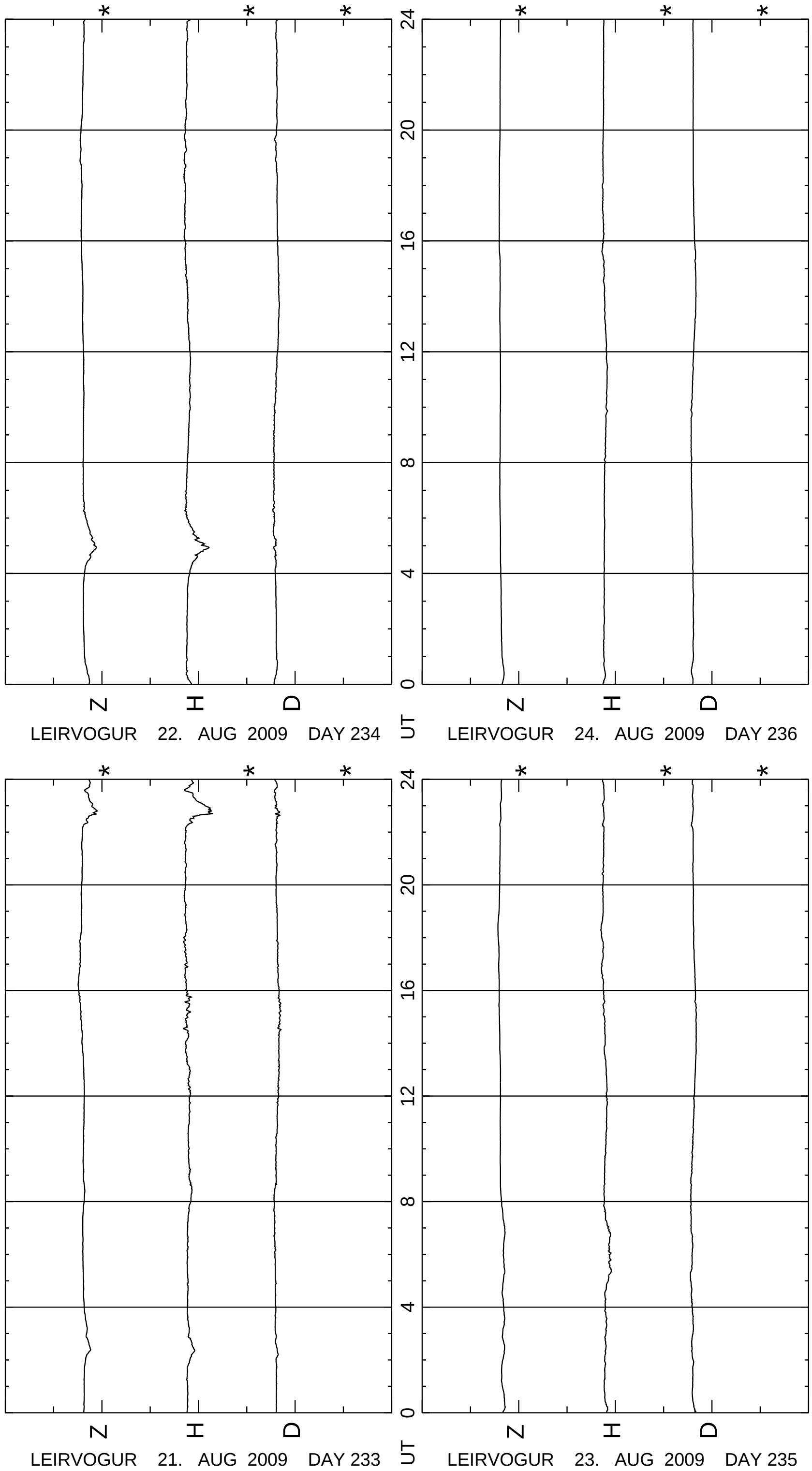
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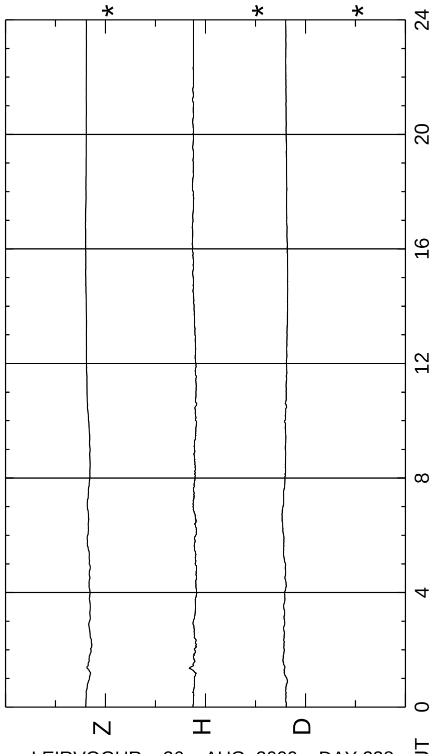
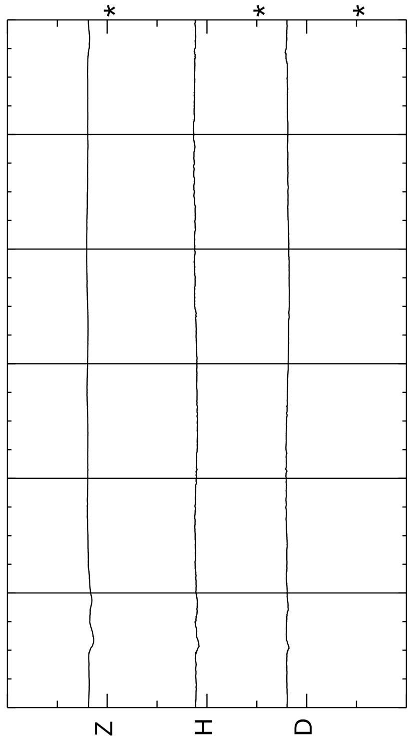
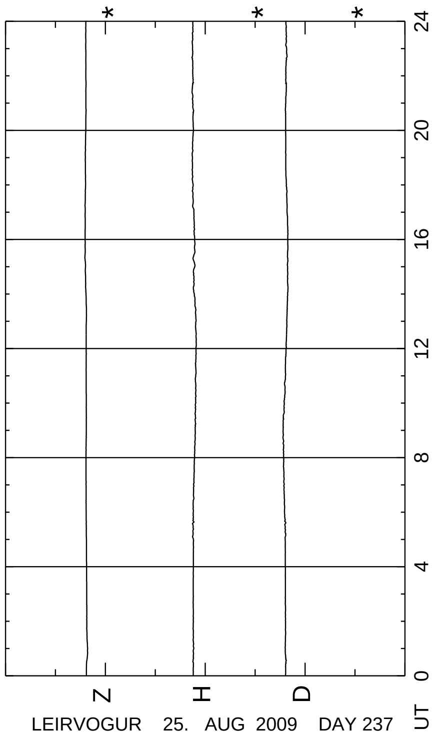


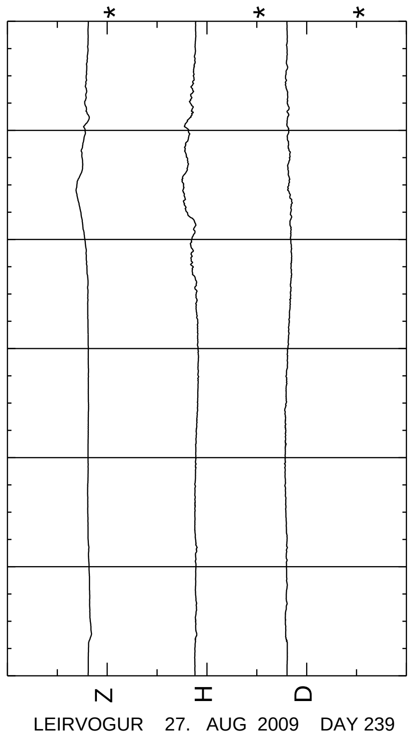
LEIRVOGUR 26. AUG 2009 DAY 238



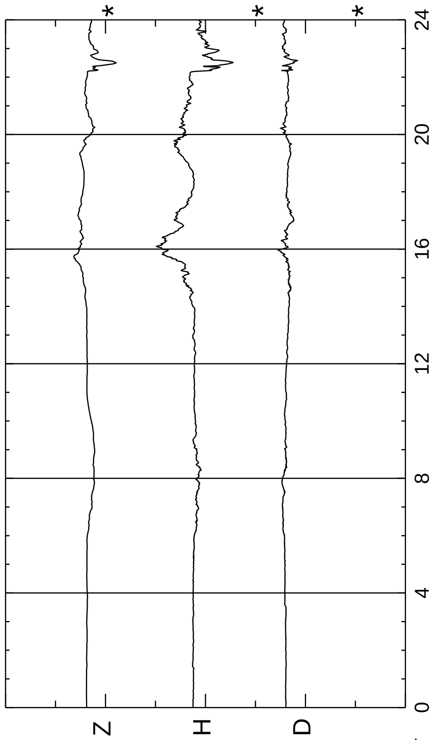
LEIRVOGUR 28. AUG 2009 DAY 240



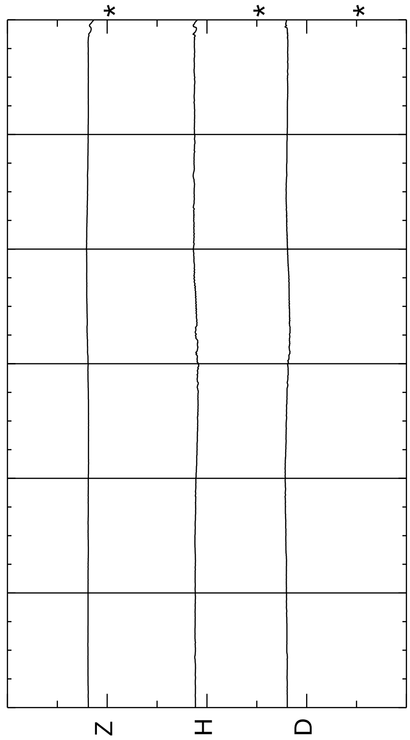
LEIRVOGUR 25. AUG 2009 DAY 237



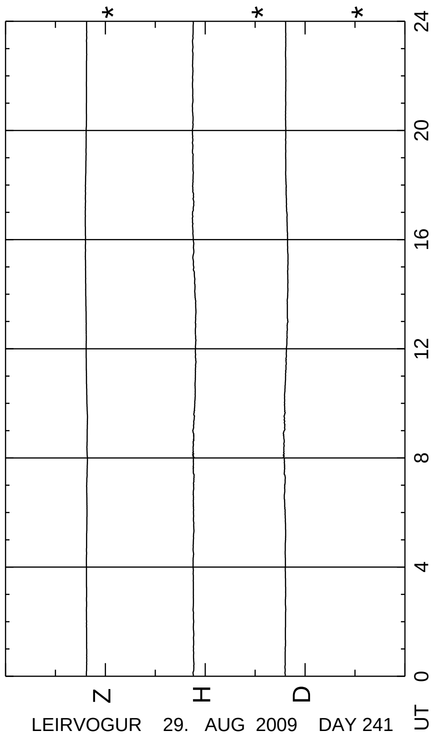
LEIRVOGUR 27. AUG 2009 DAY 239



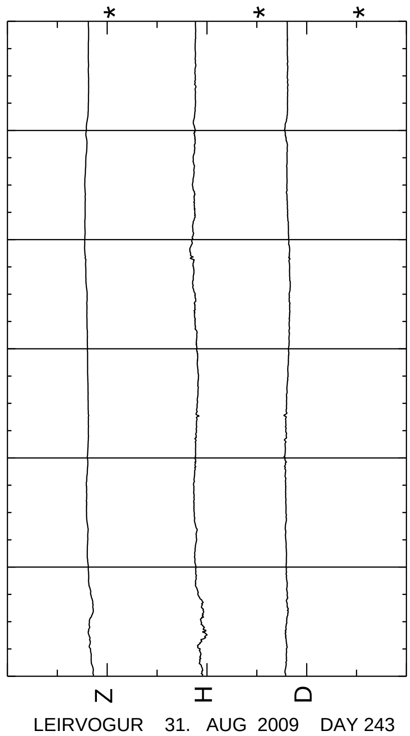
LEIRVOGUR 30. AUG 2009 DAY 242



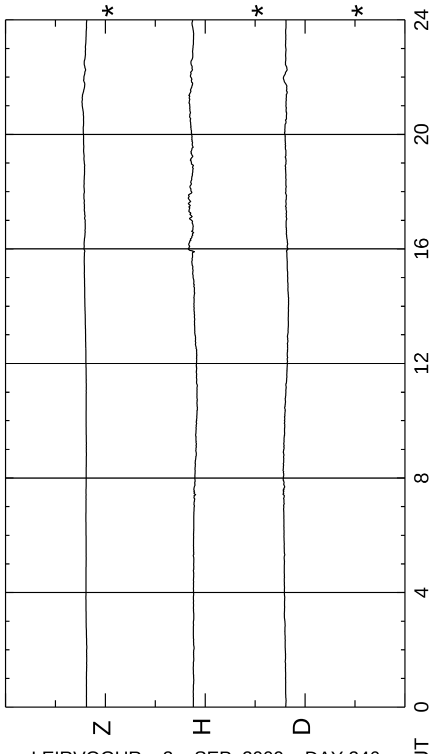
LEIRVOGUR 1. SEP 2009 DAY 244



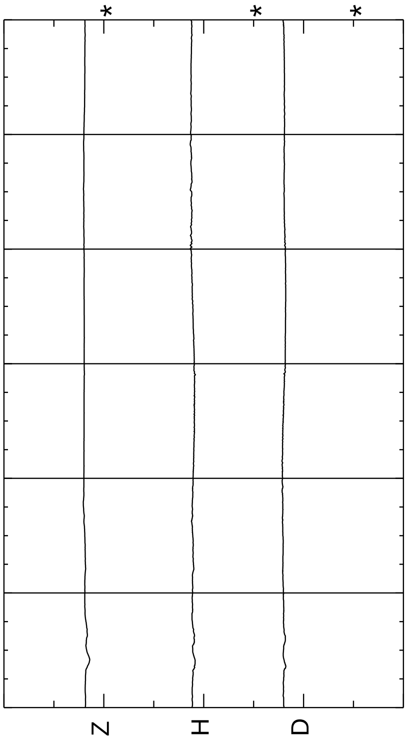
LEIRVOGUR 29. AUG 2009 DAY 241



LEIRVOGUR 31. AUG 2009 DAY 243



LEIRVOGUR 3. SEP 2009 DAY 246



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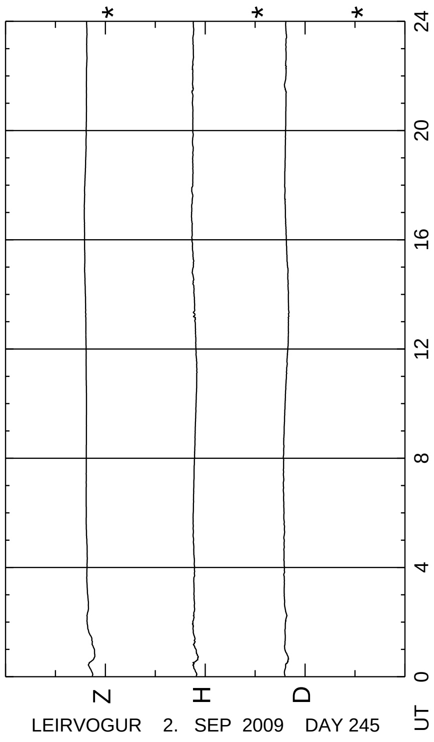
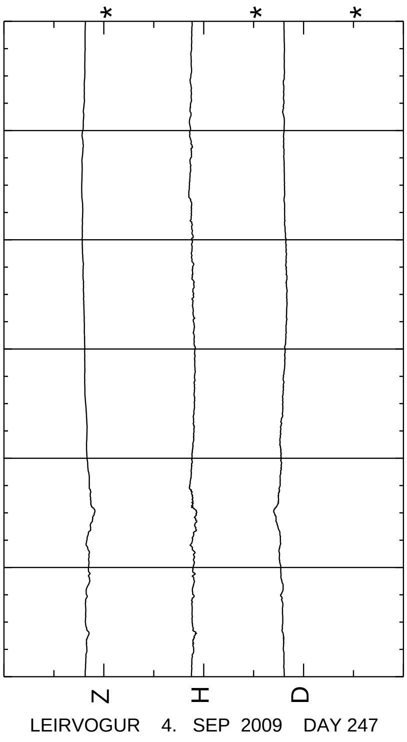
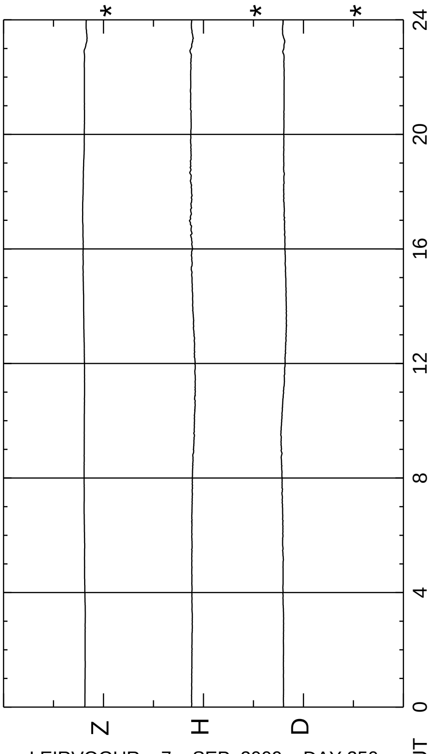


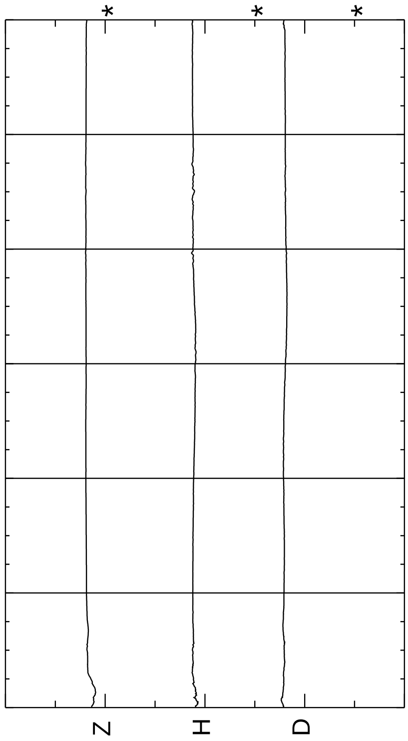
LEIRVOGUR 2. SEP 2009 DAY 245



LEIRVOGUR 4. SEP 2009 DAY 247



LEIRVOGUR 7. SEP 2009 DAY 250



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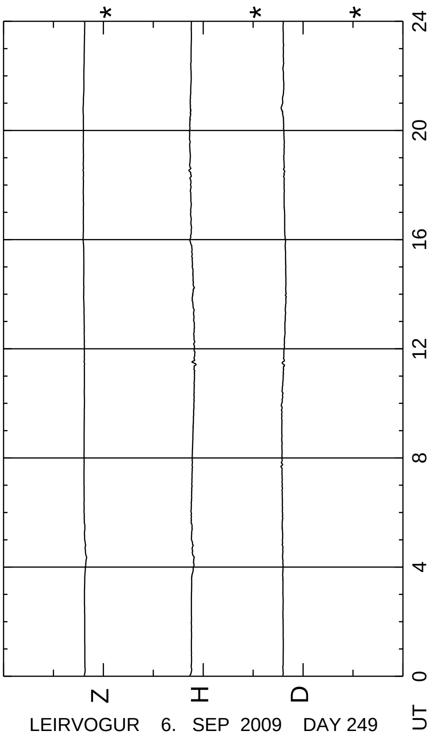

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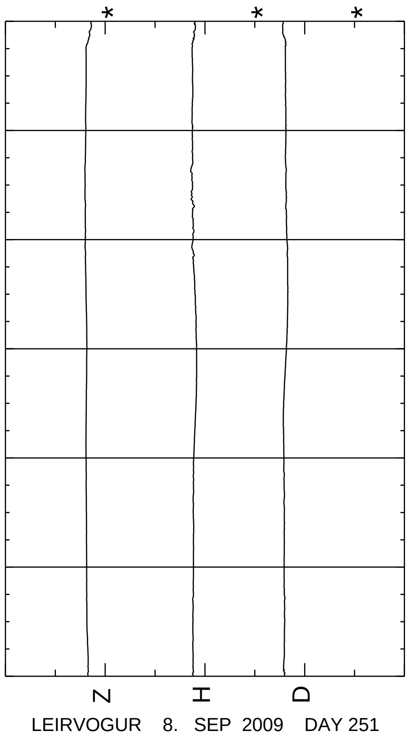

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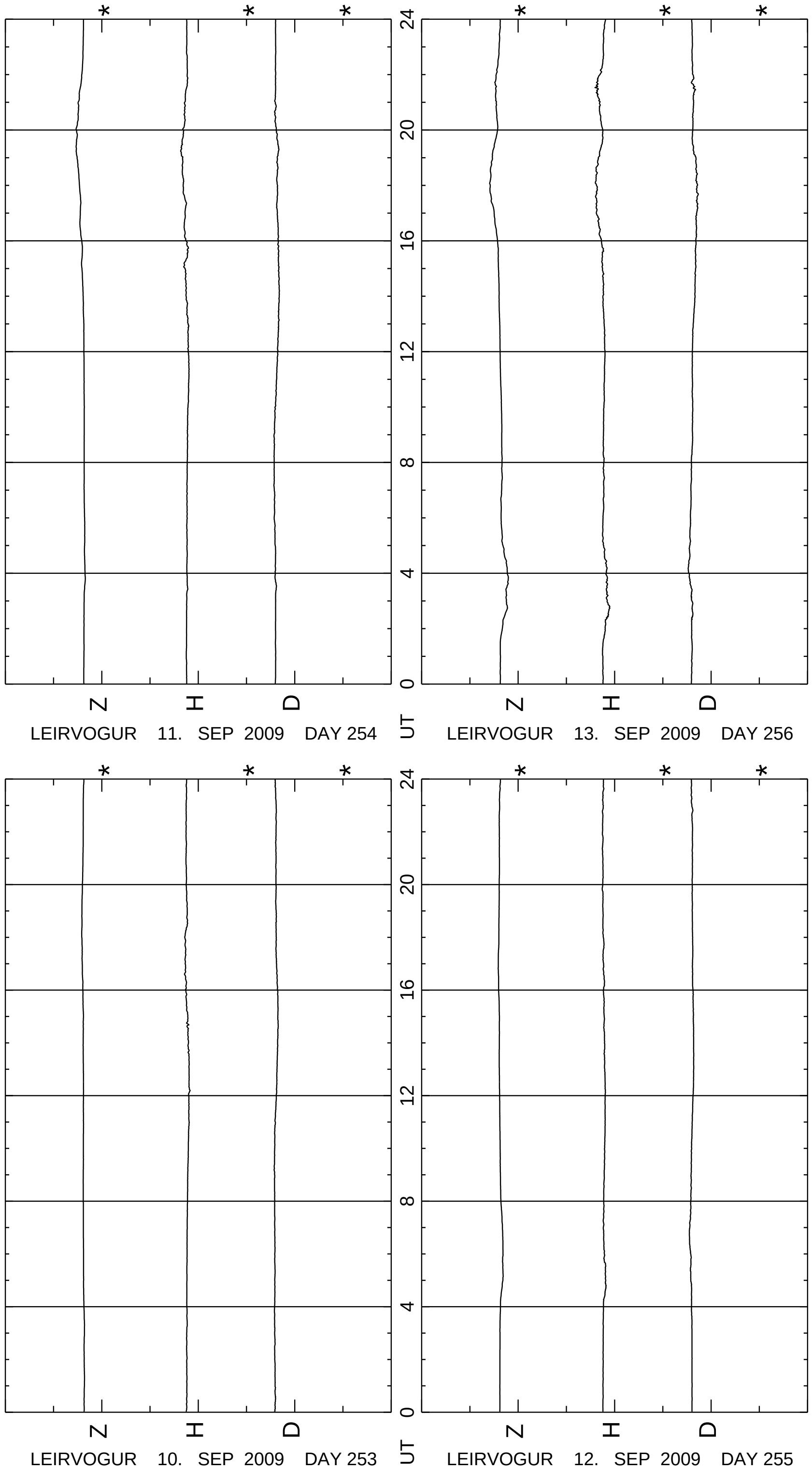
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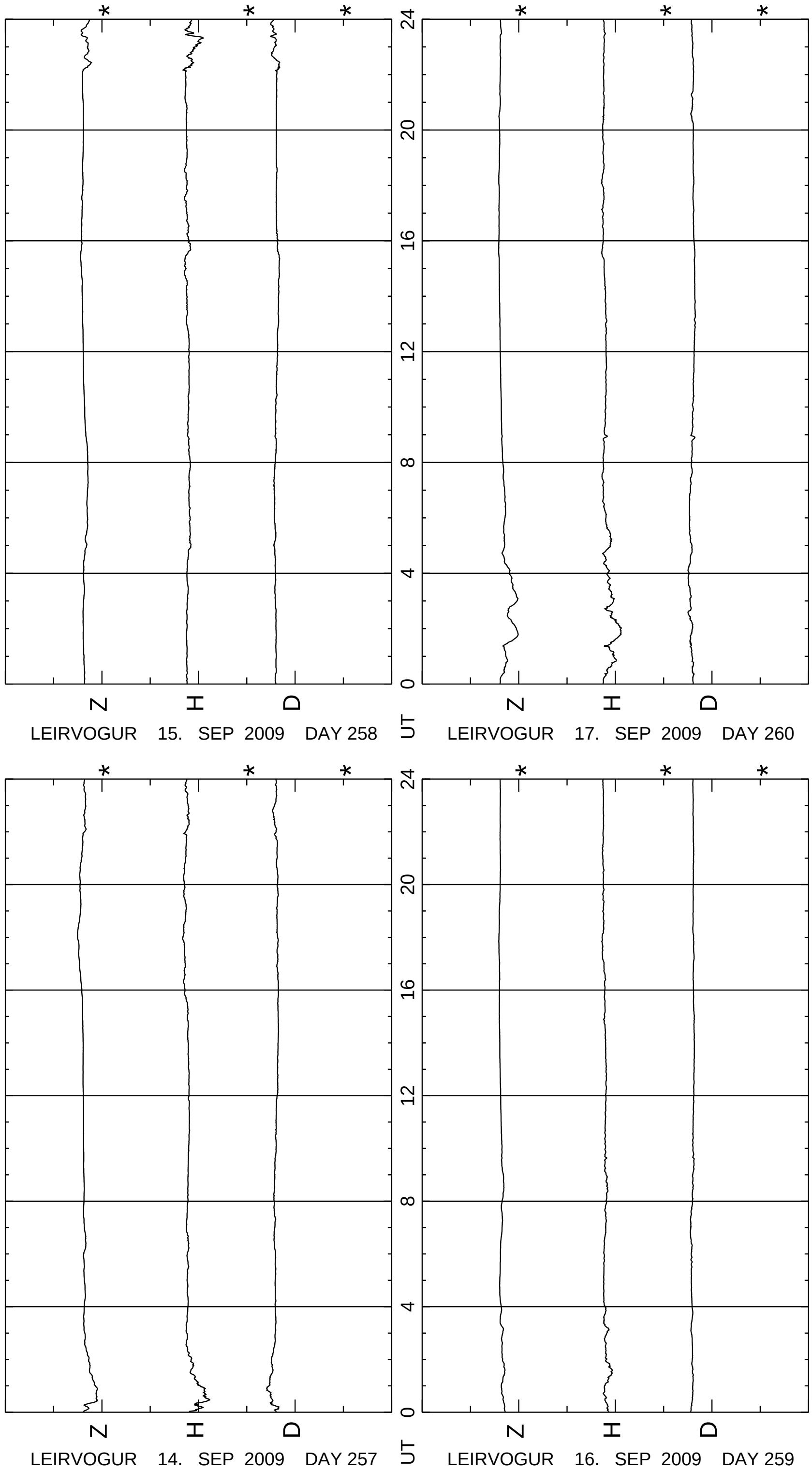
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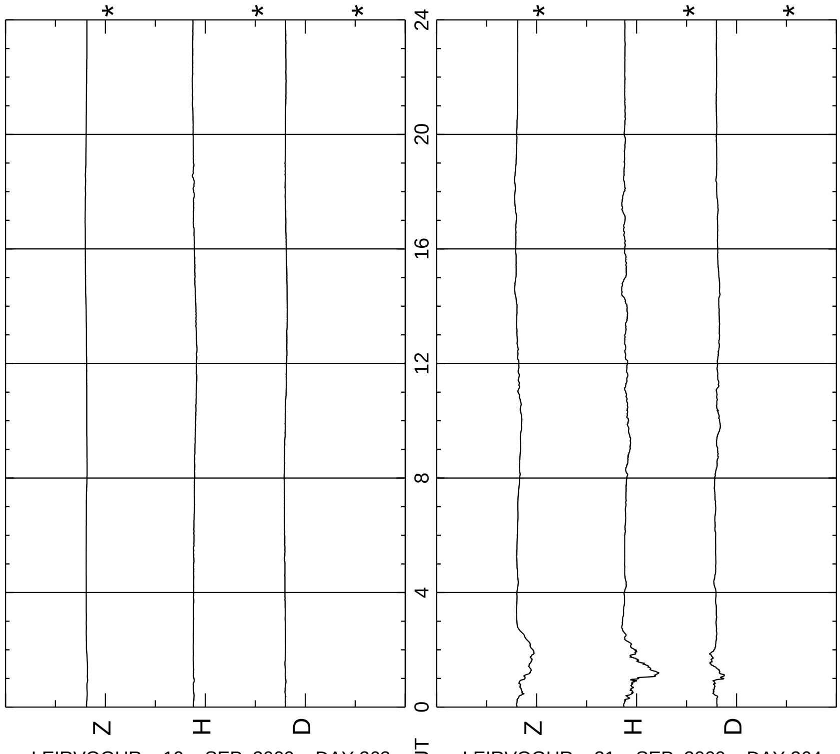

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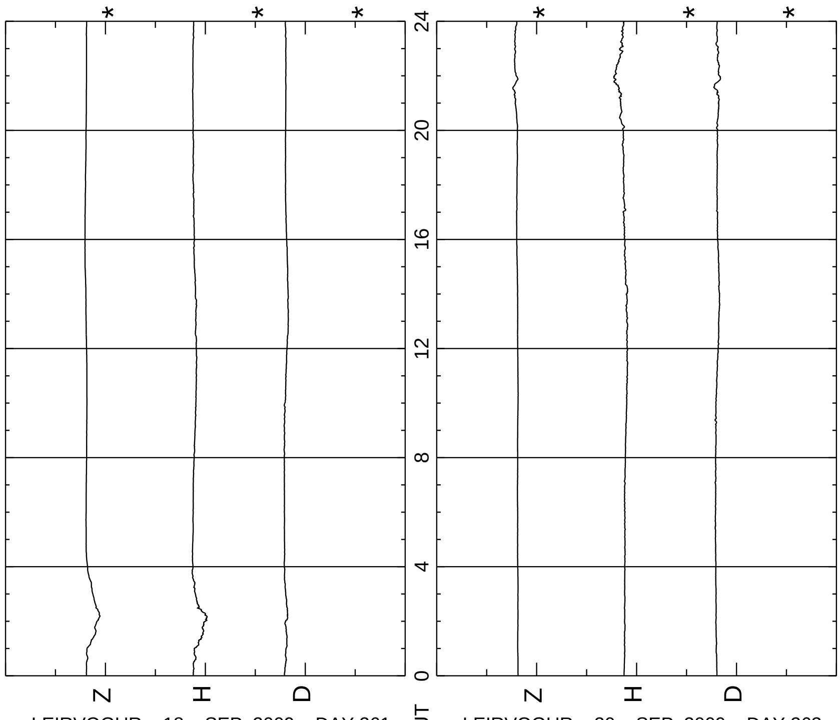

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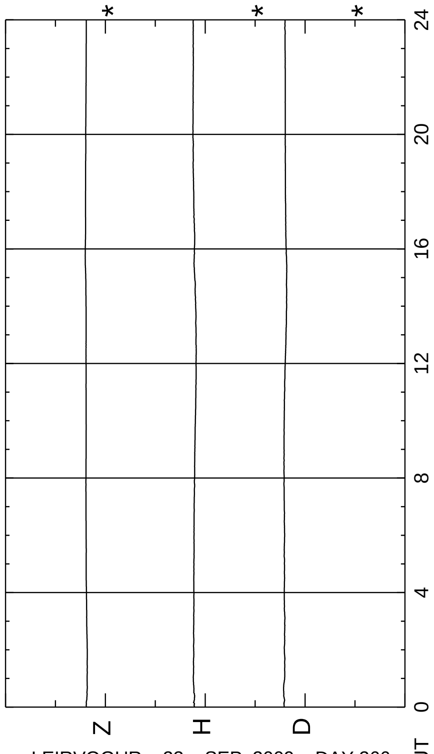

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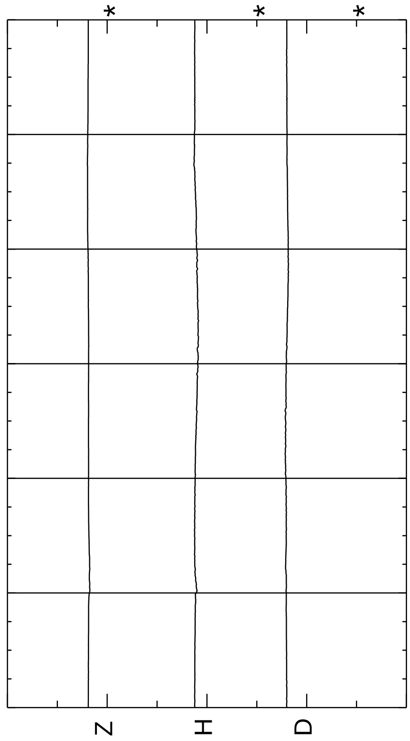

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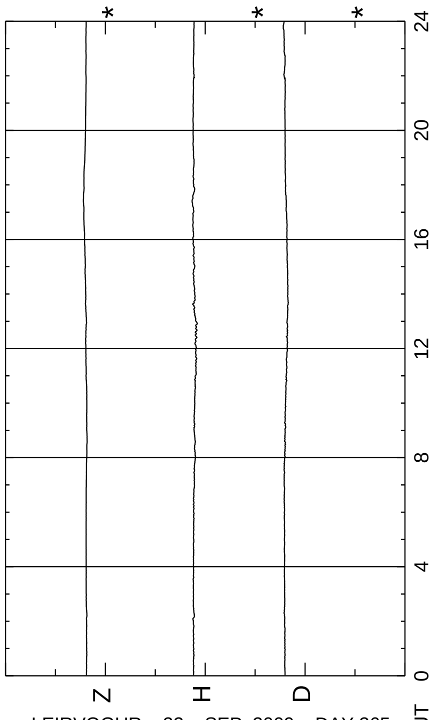

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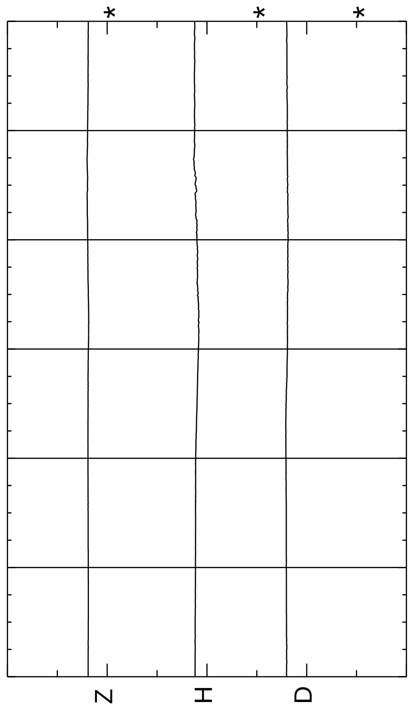

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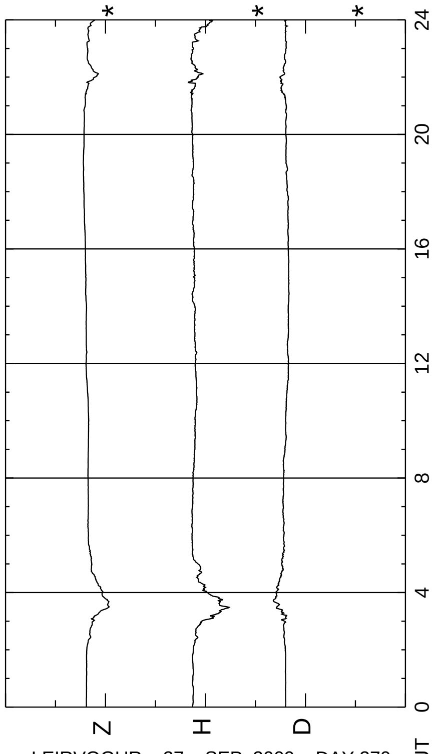

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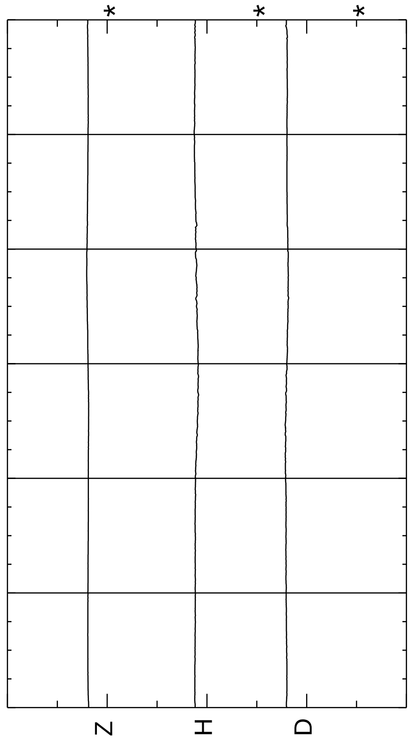

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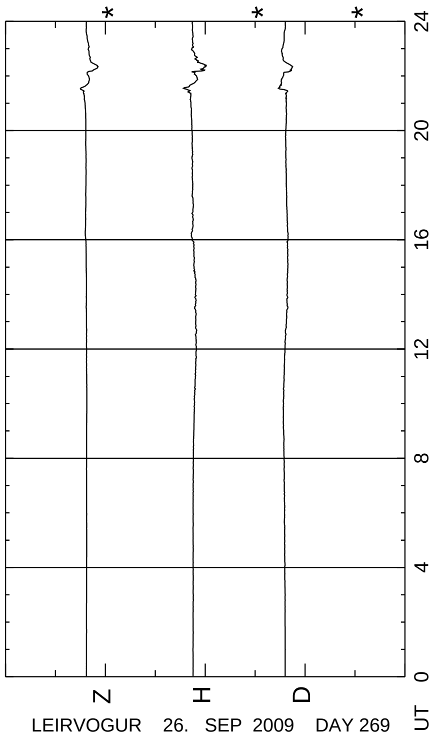

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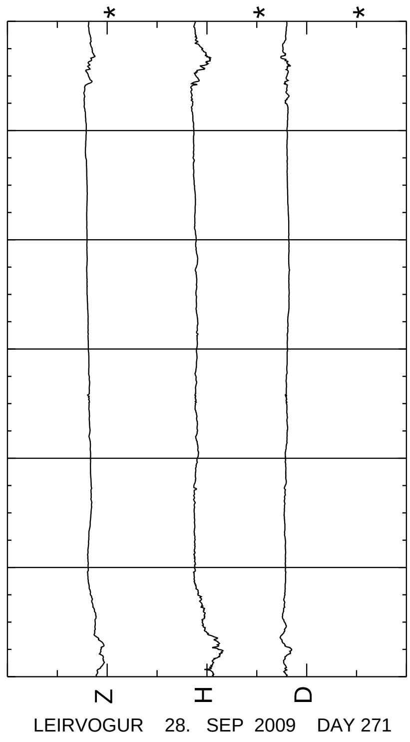

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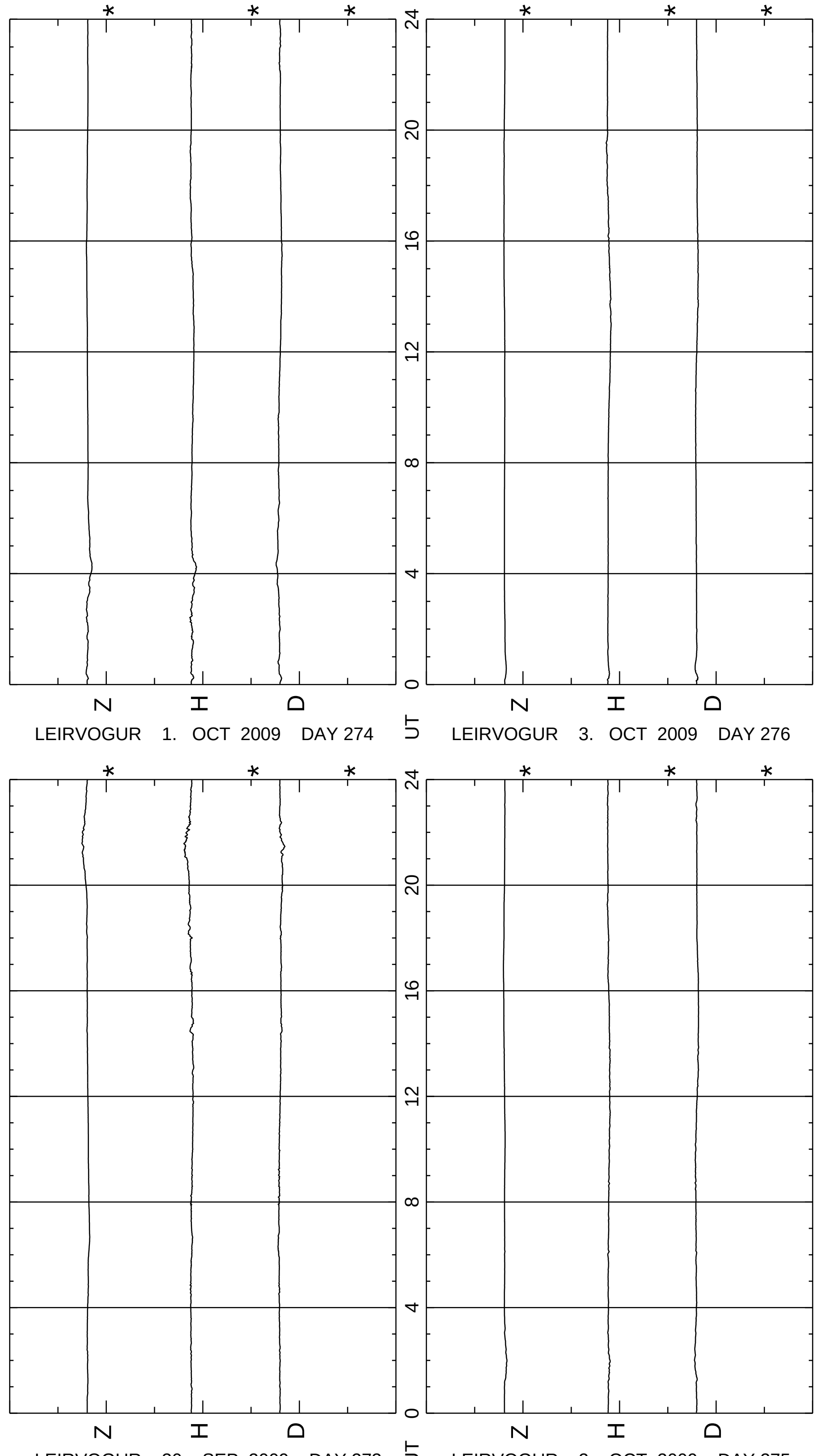

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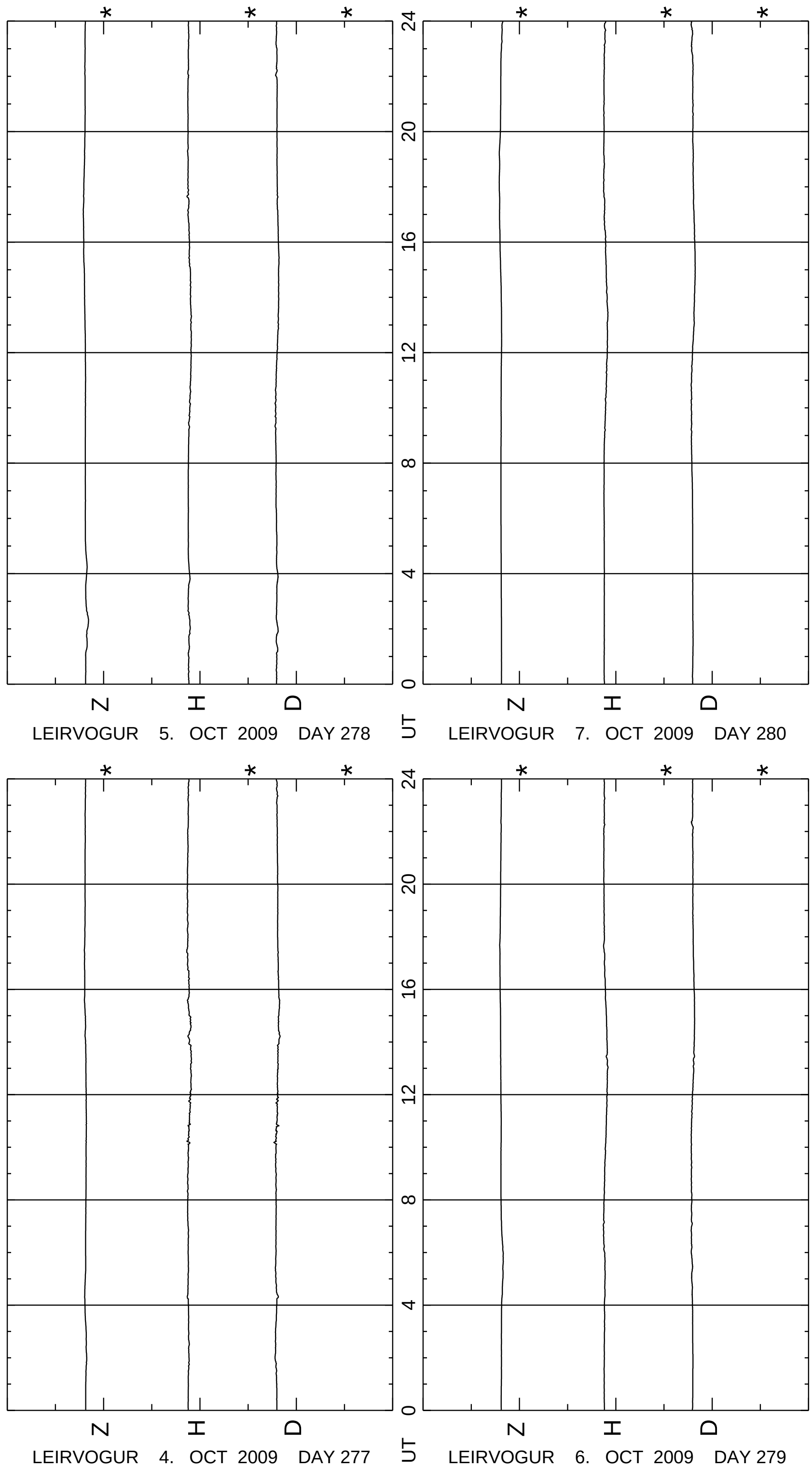
LEIRVOGUR 3. OCT 2009 DAY 276

LEIRVOGUR 30. SEP 2009 DAY 273

LEIRVOGUR 2. OCT 2009 DAY 275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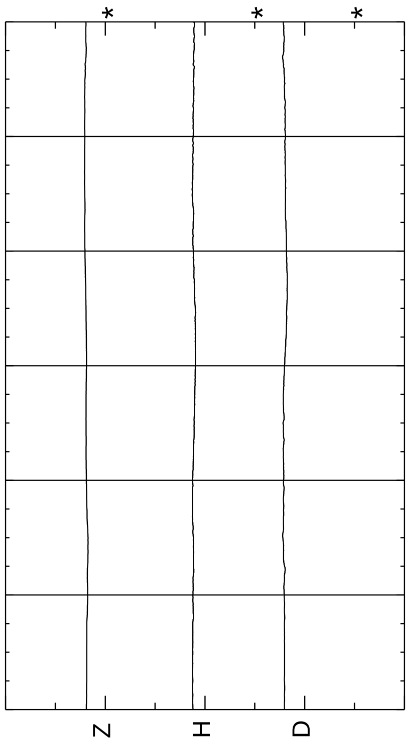
LEIRVOGUR 6. OCT 2009 DAY 279



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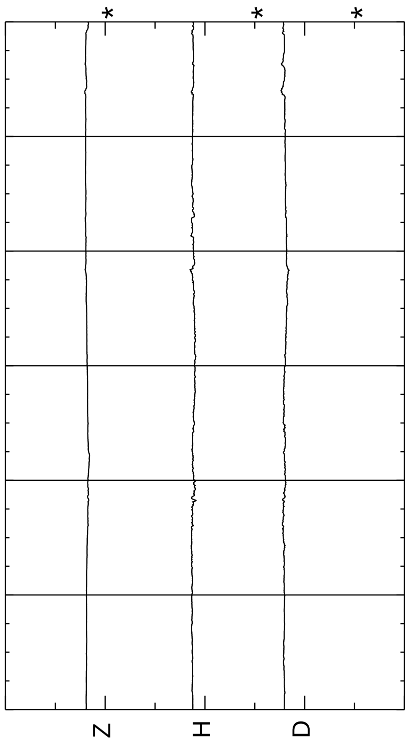

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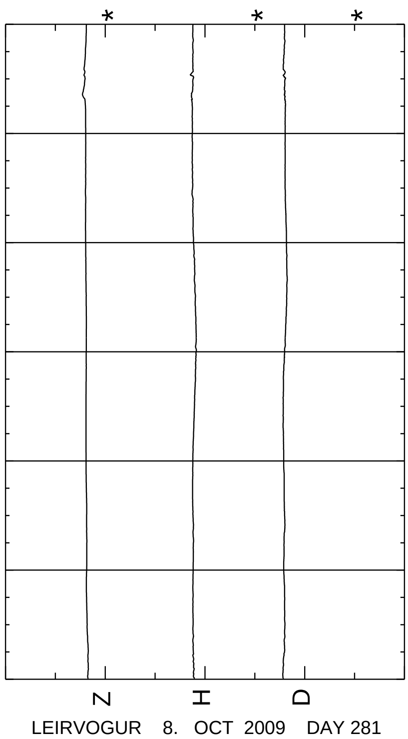

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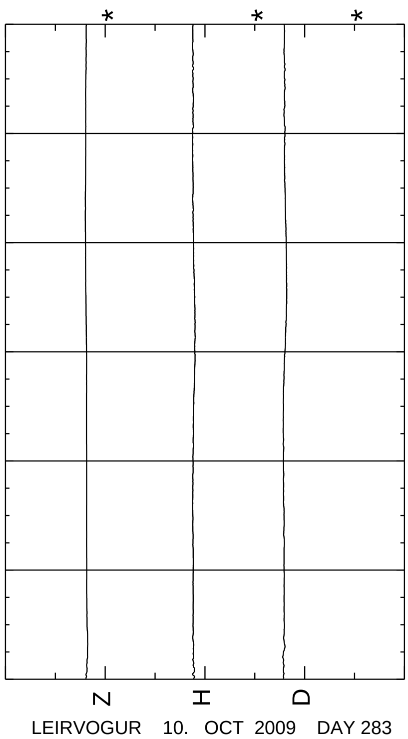

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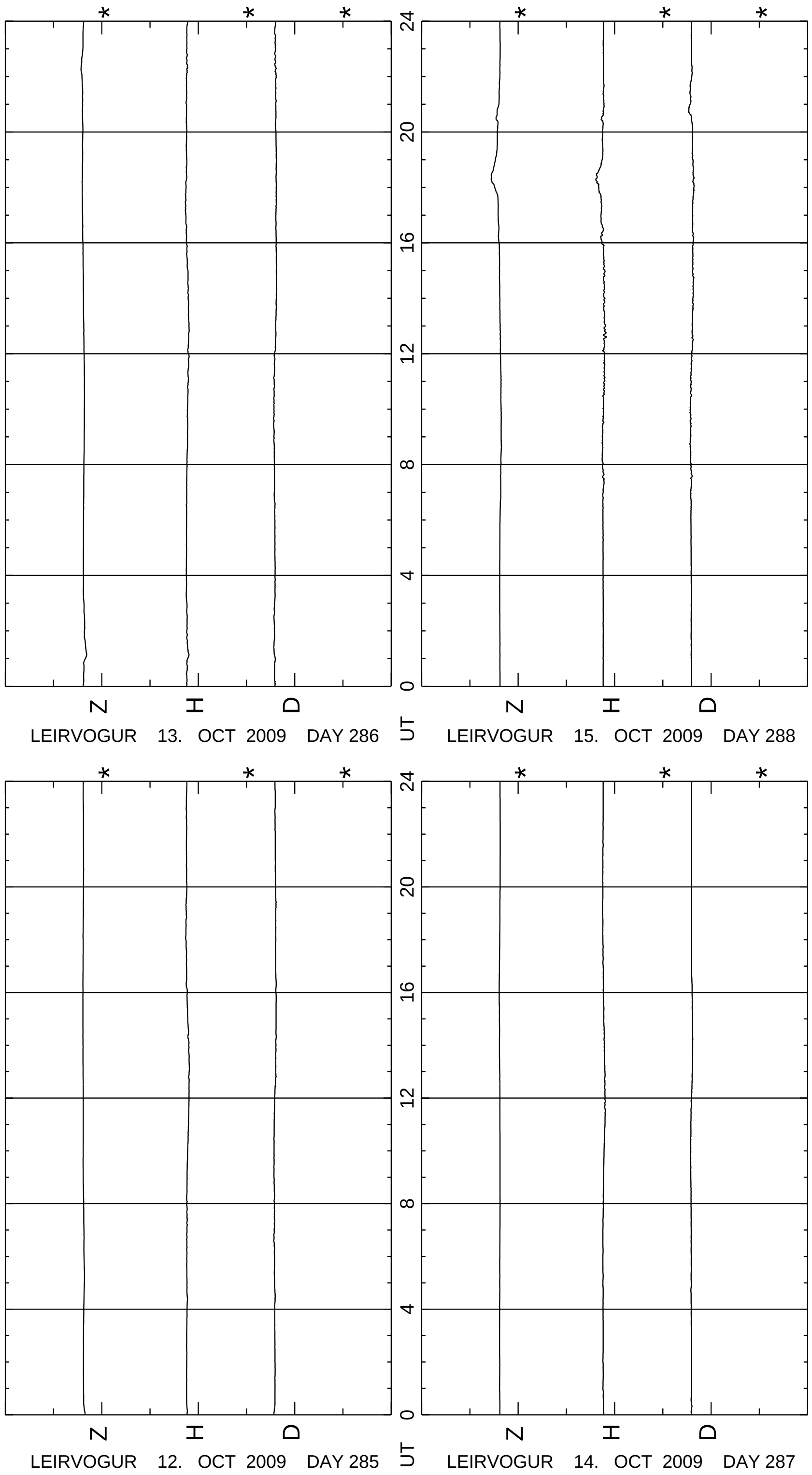
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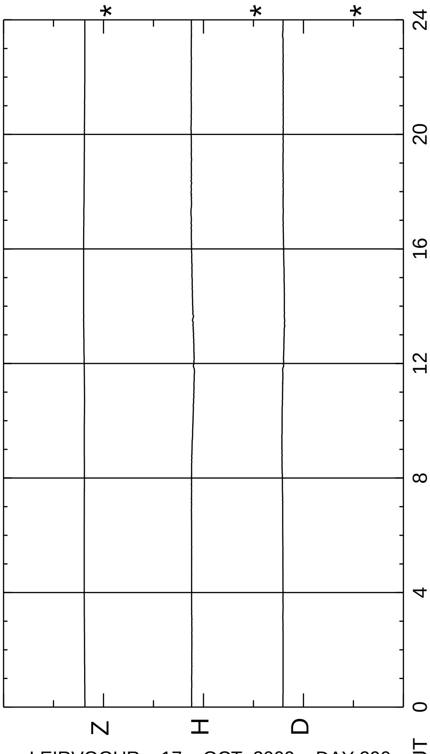

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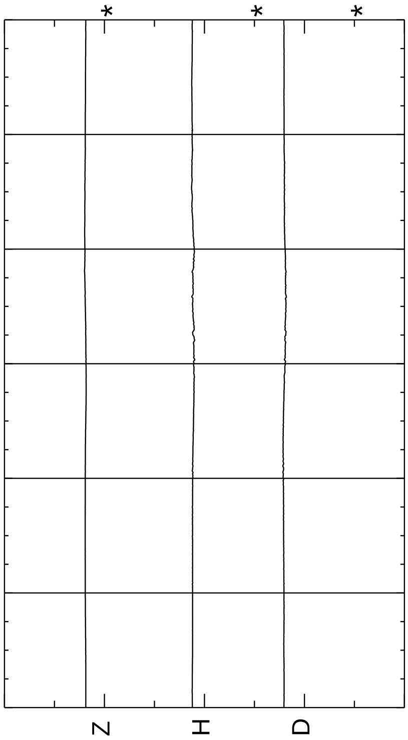

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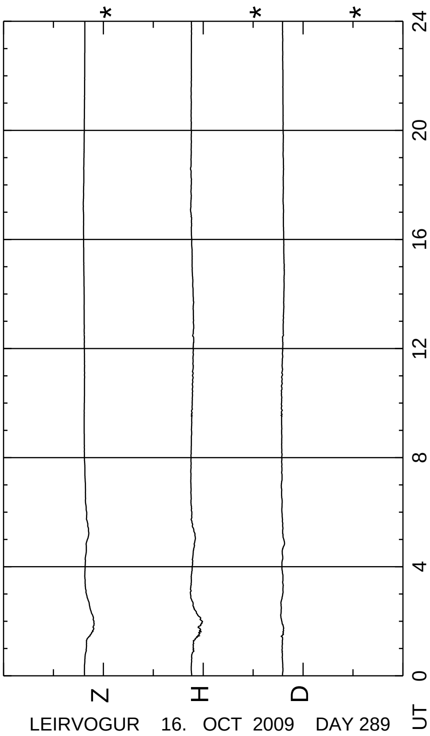

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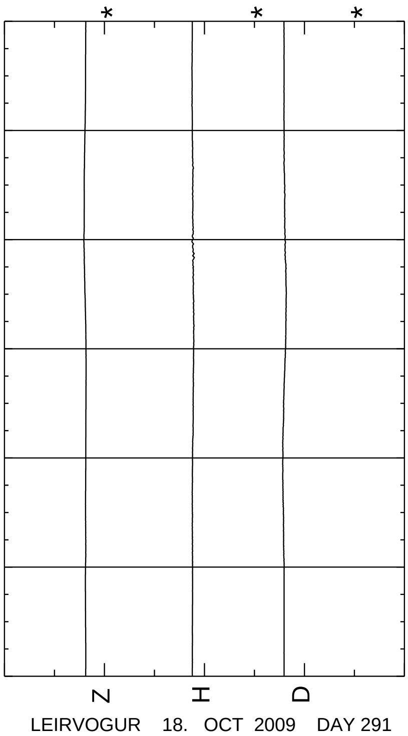

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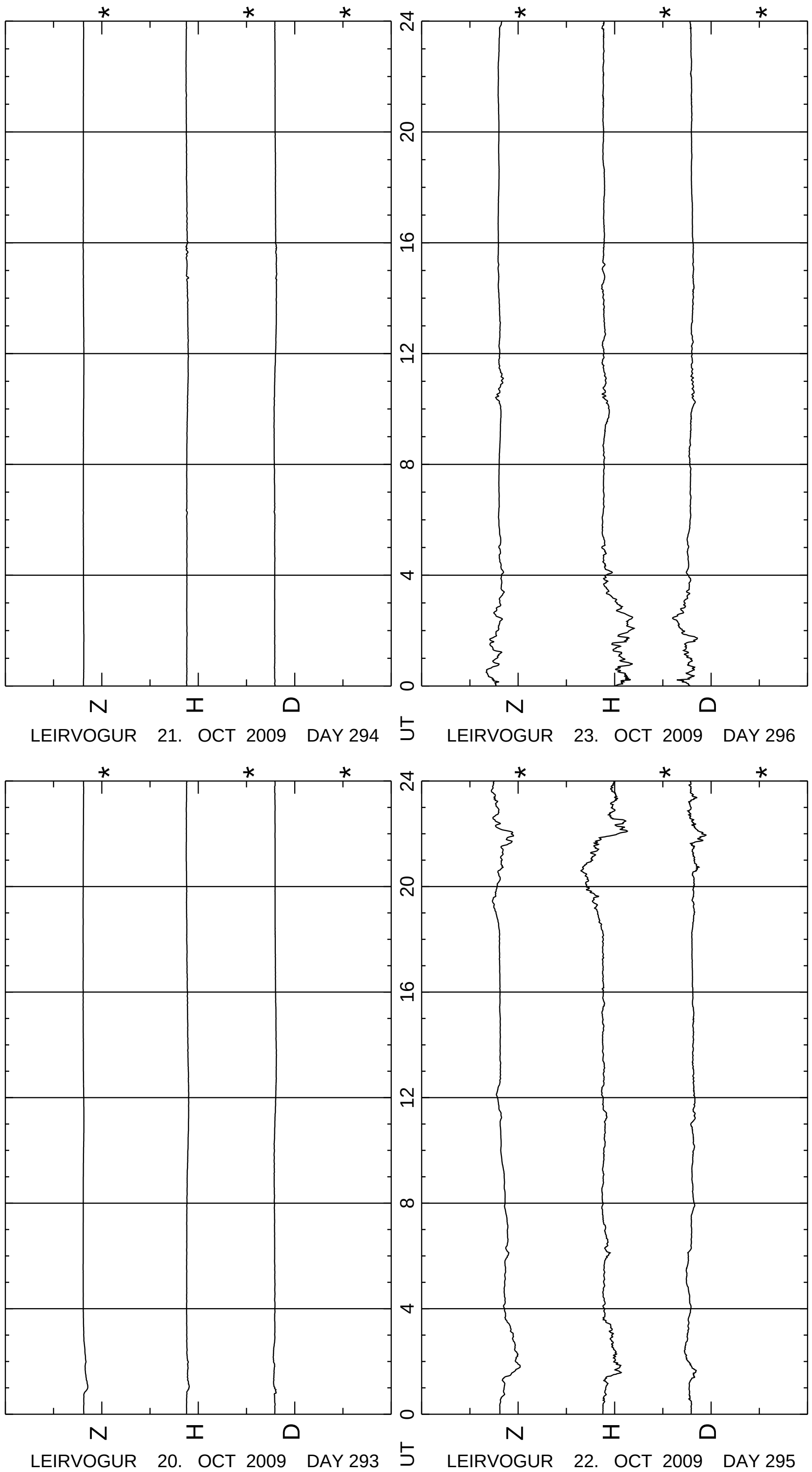
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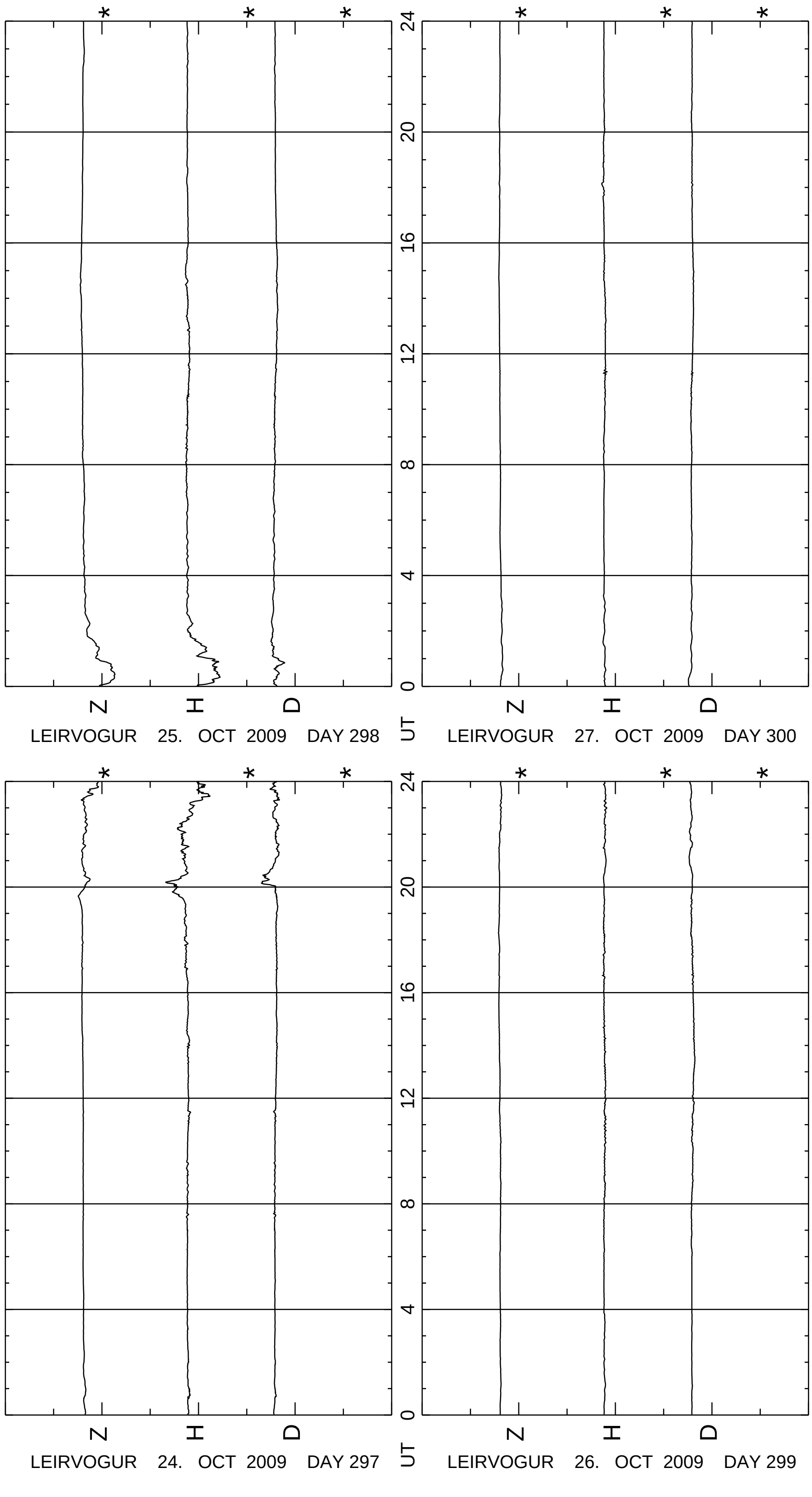
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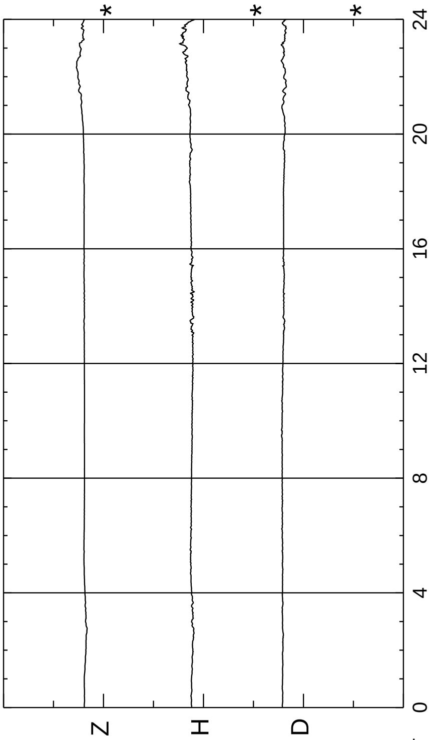

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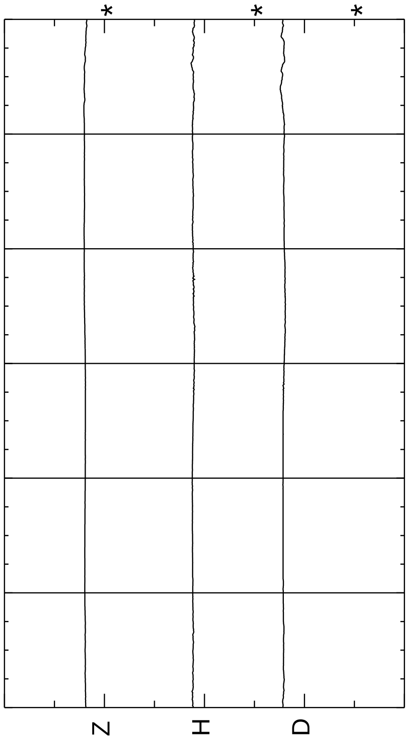

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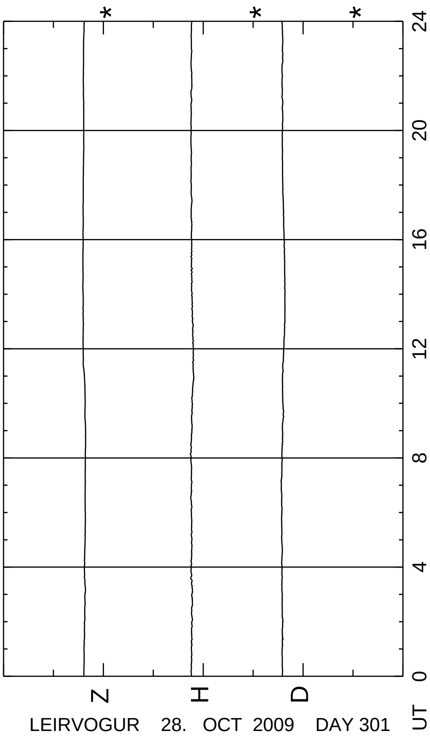

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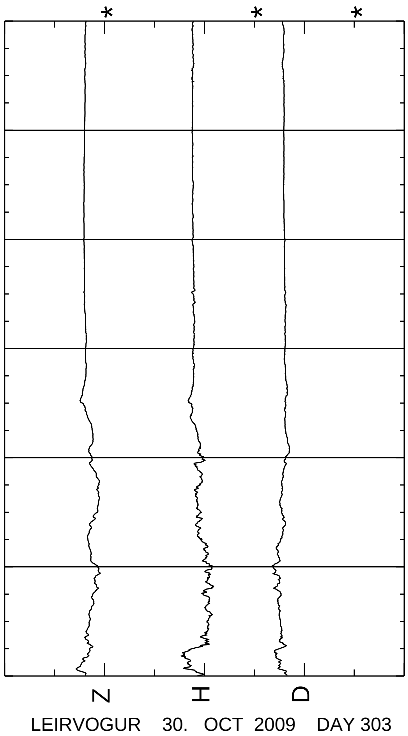

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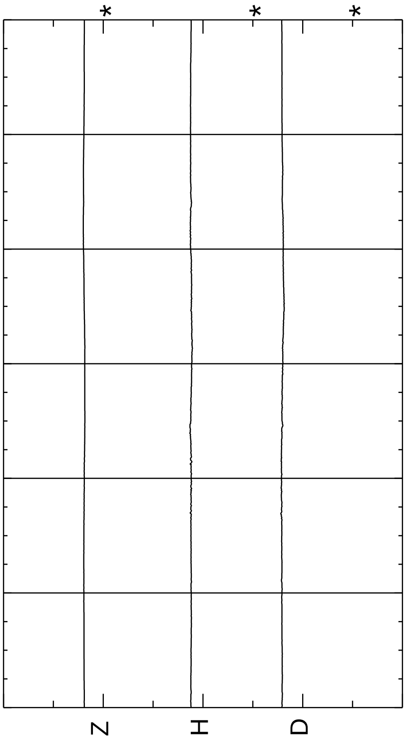

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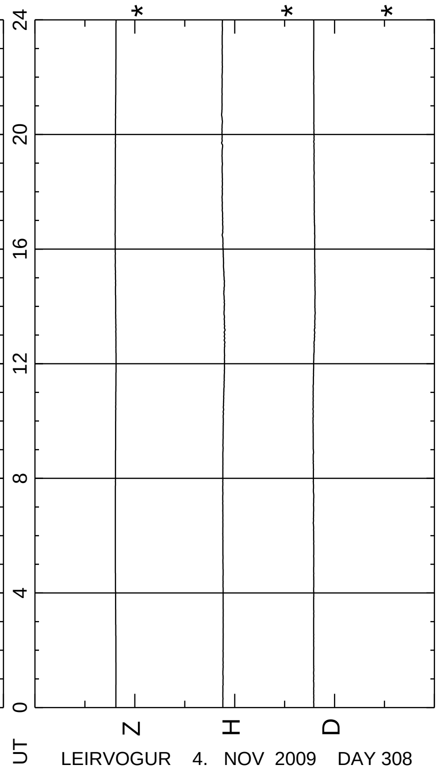

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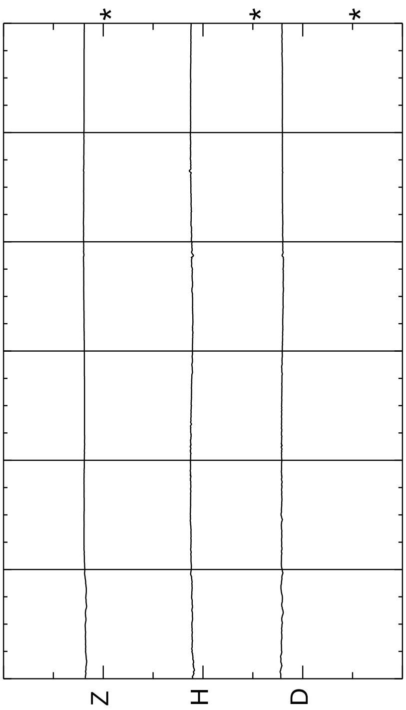

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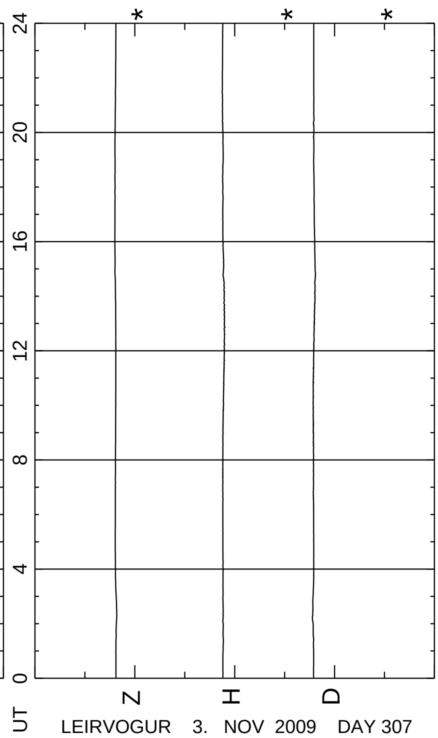

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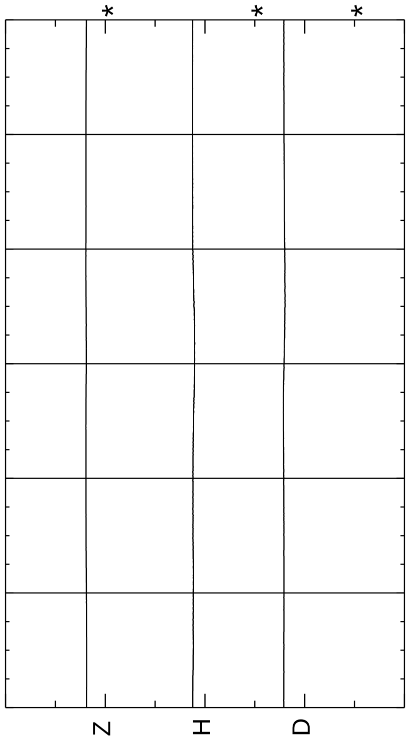

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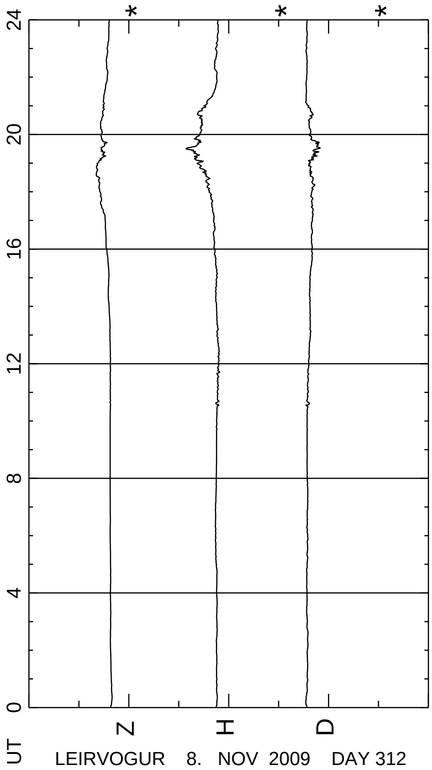

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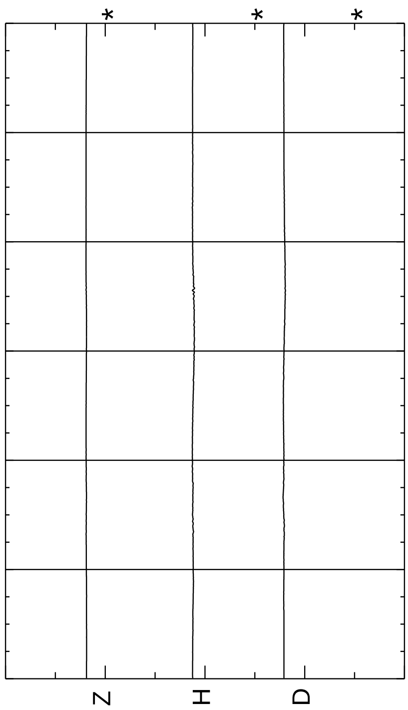

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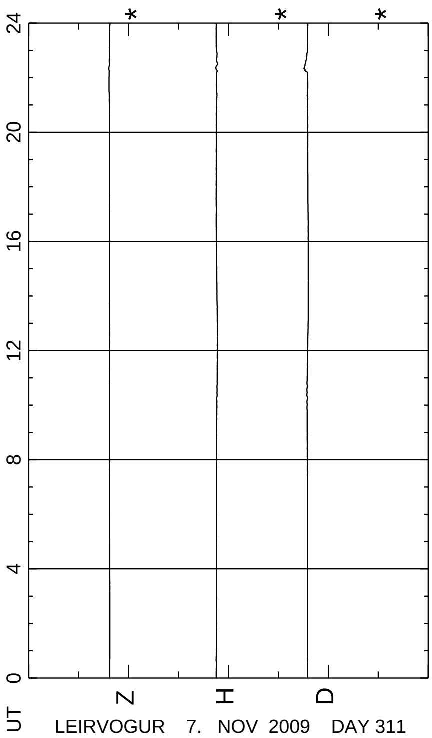

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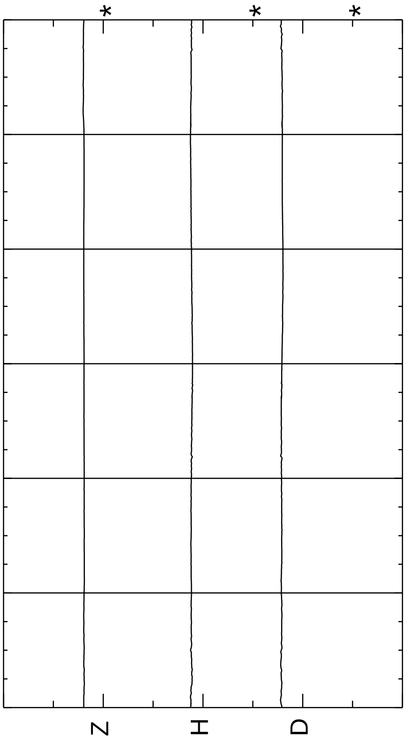

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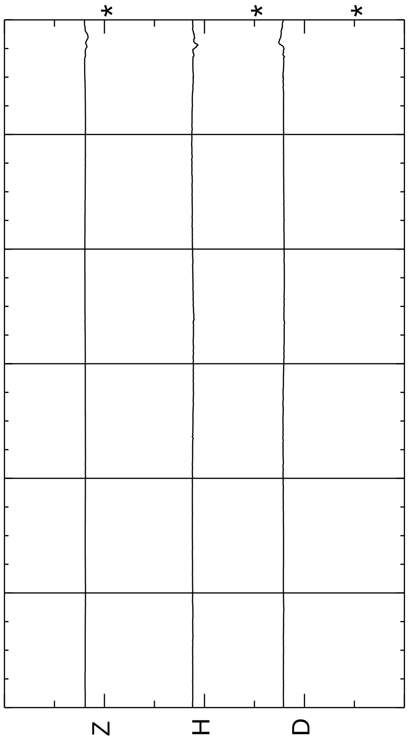

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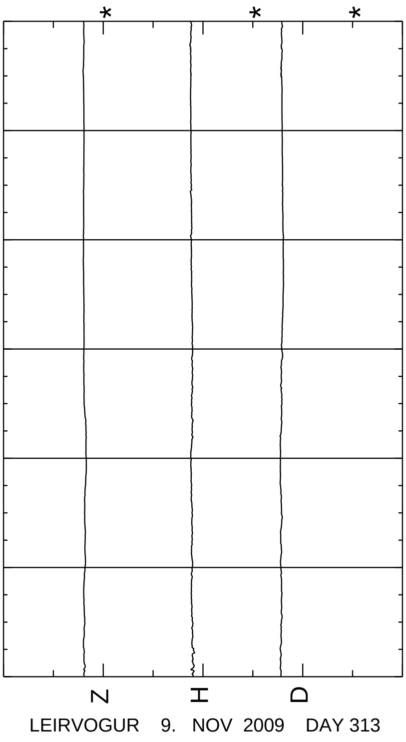

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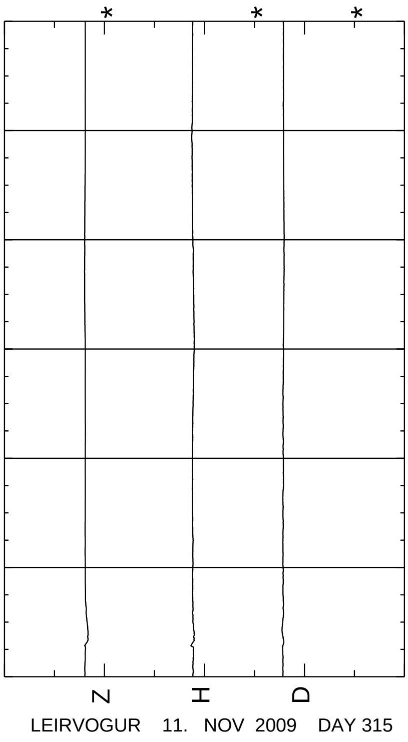

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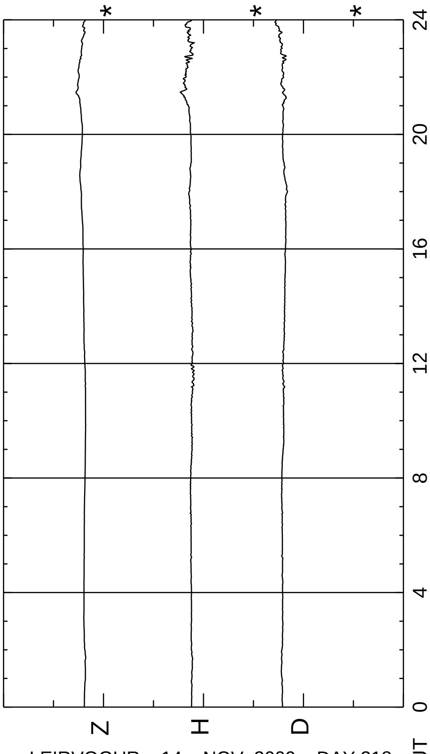

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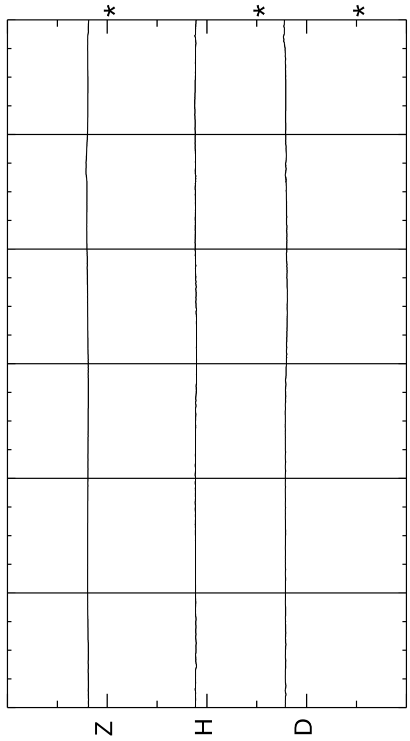

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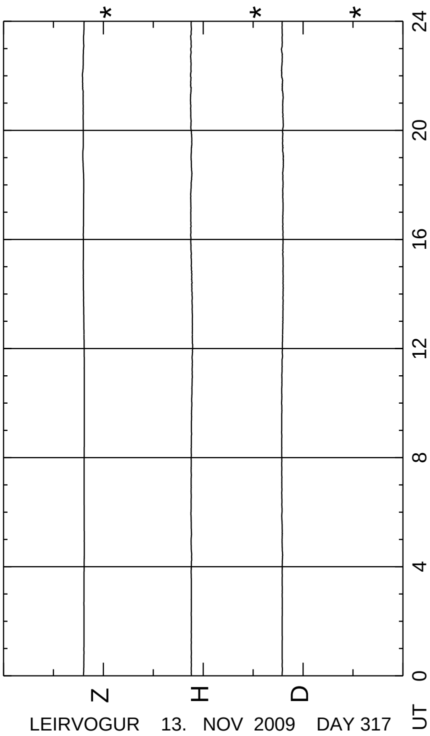

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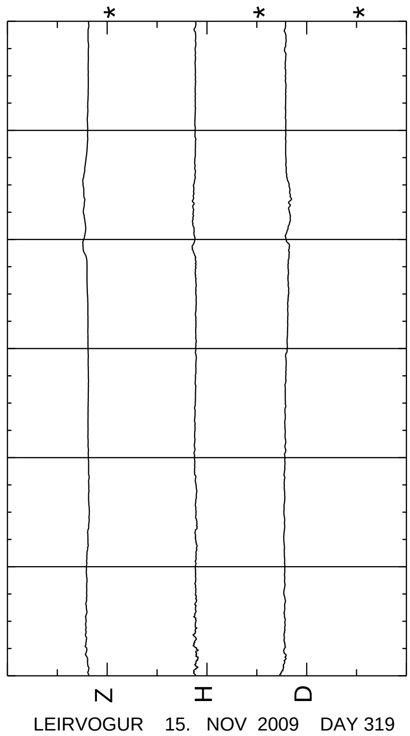

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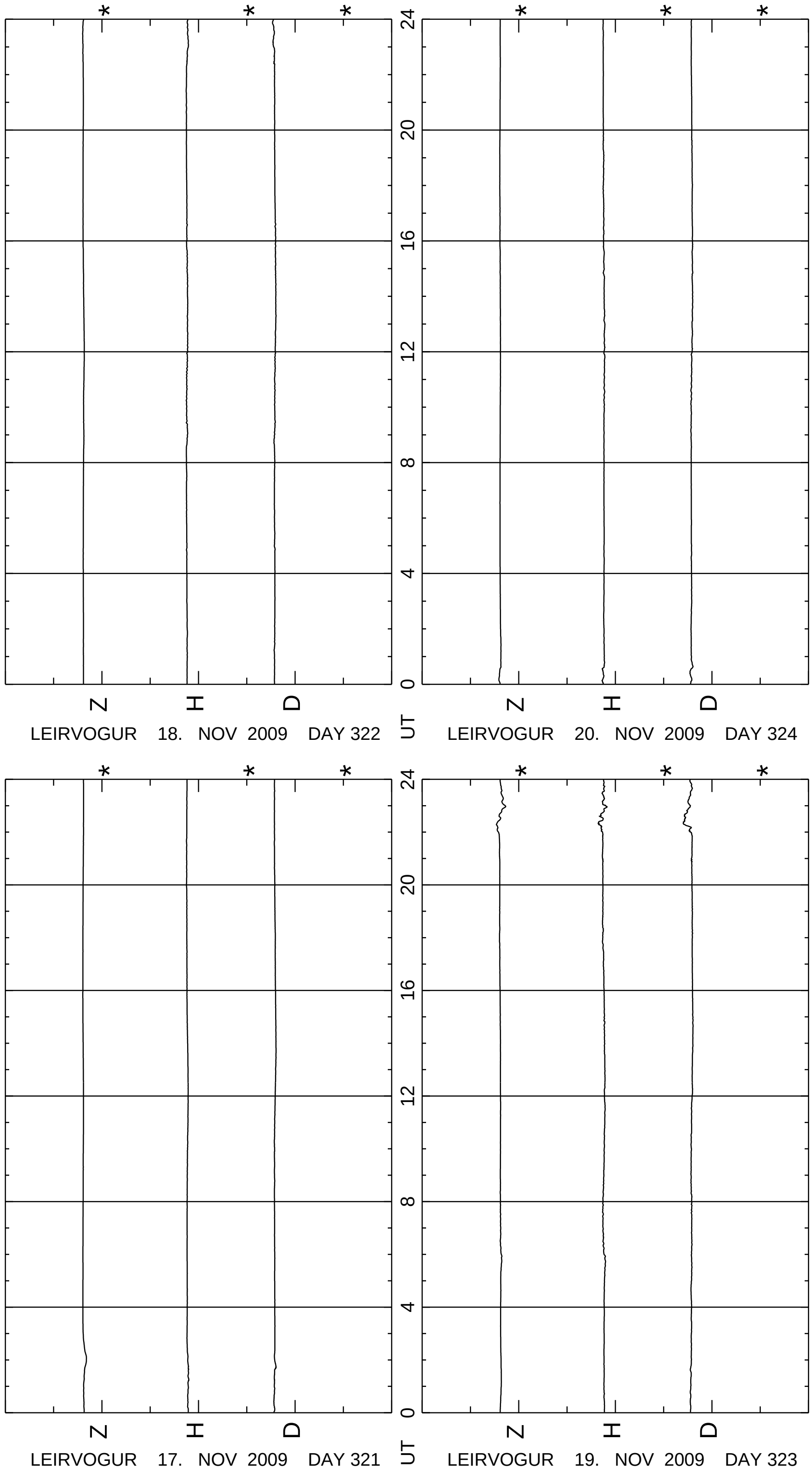
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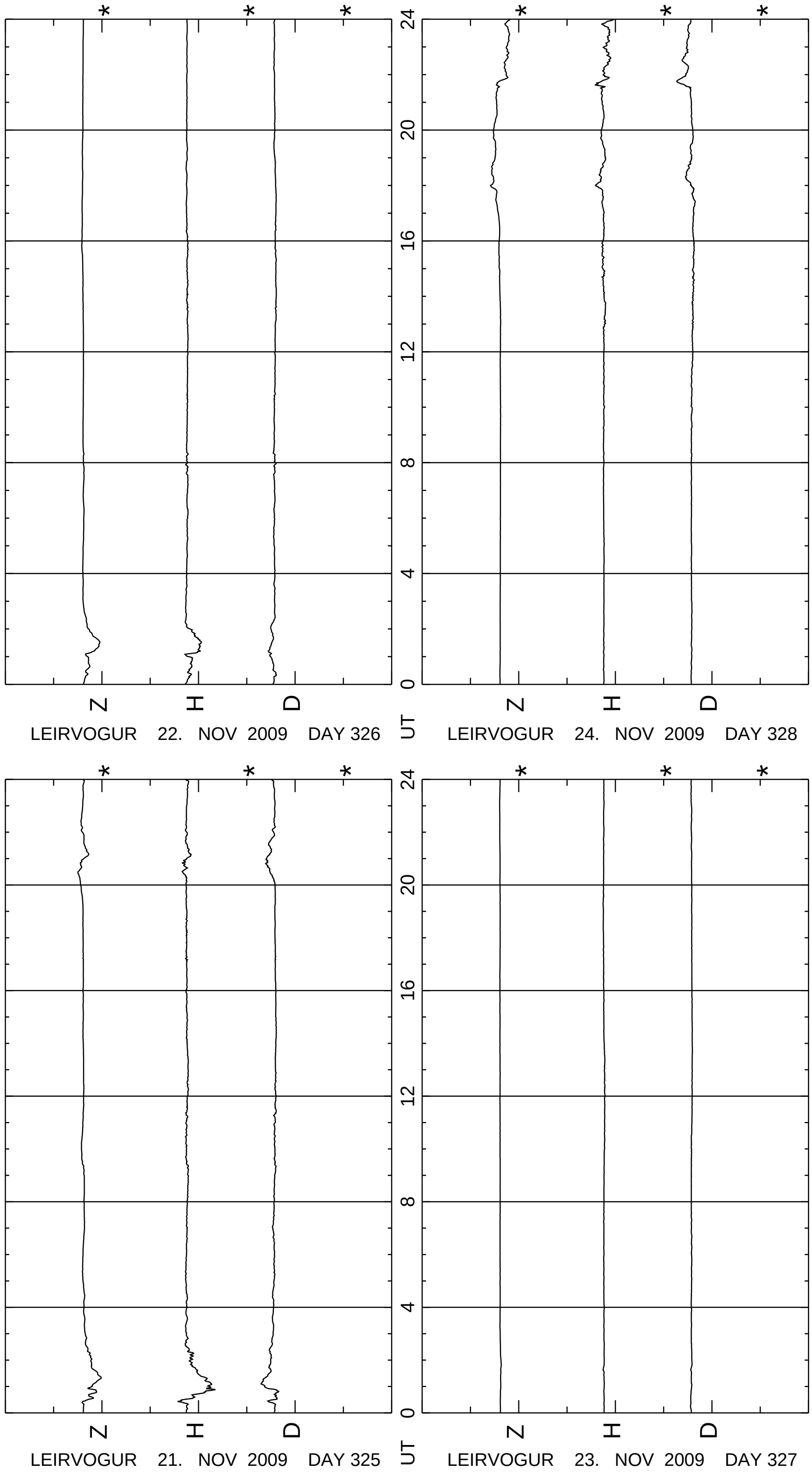
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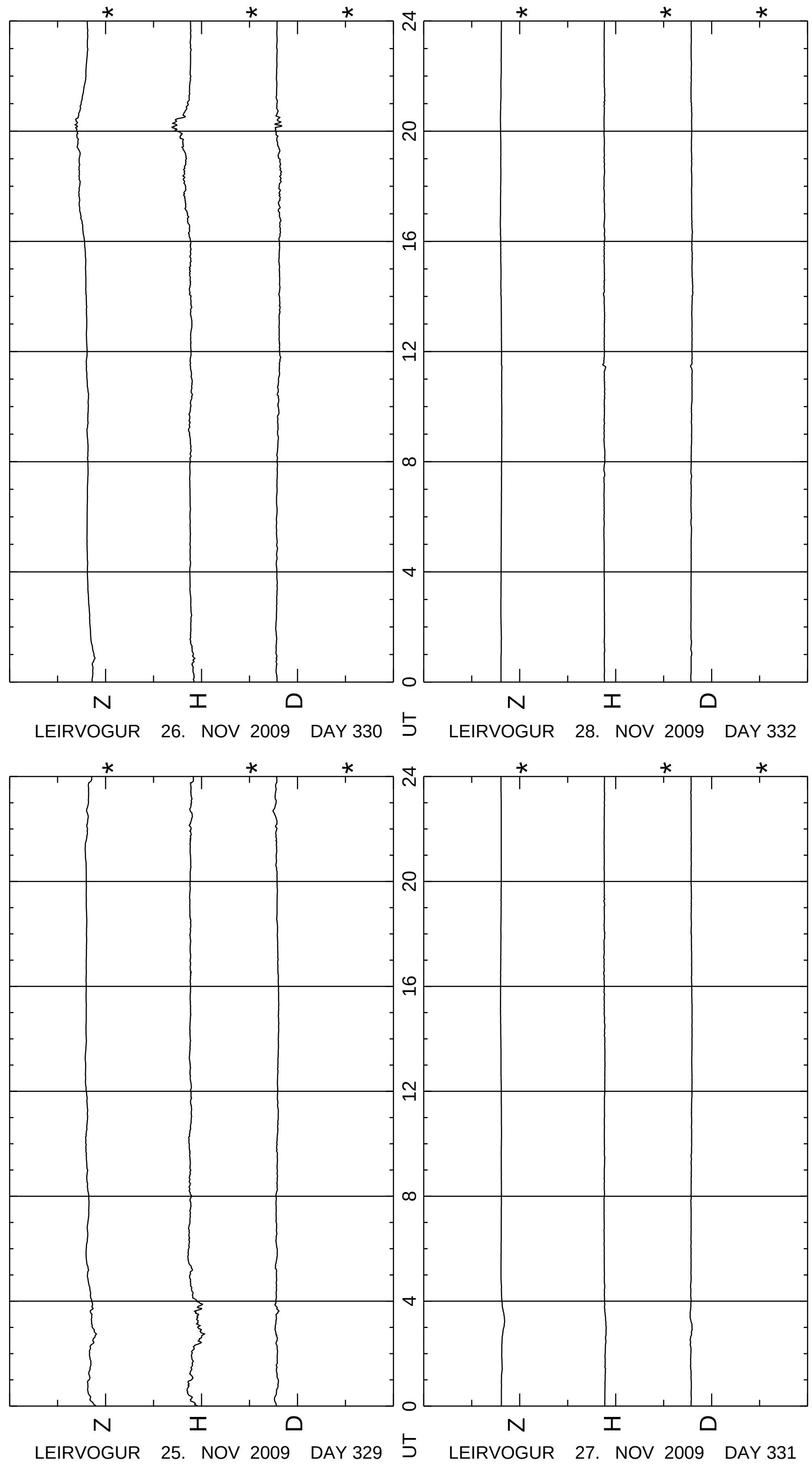
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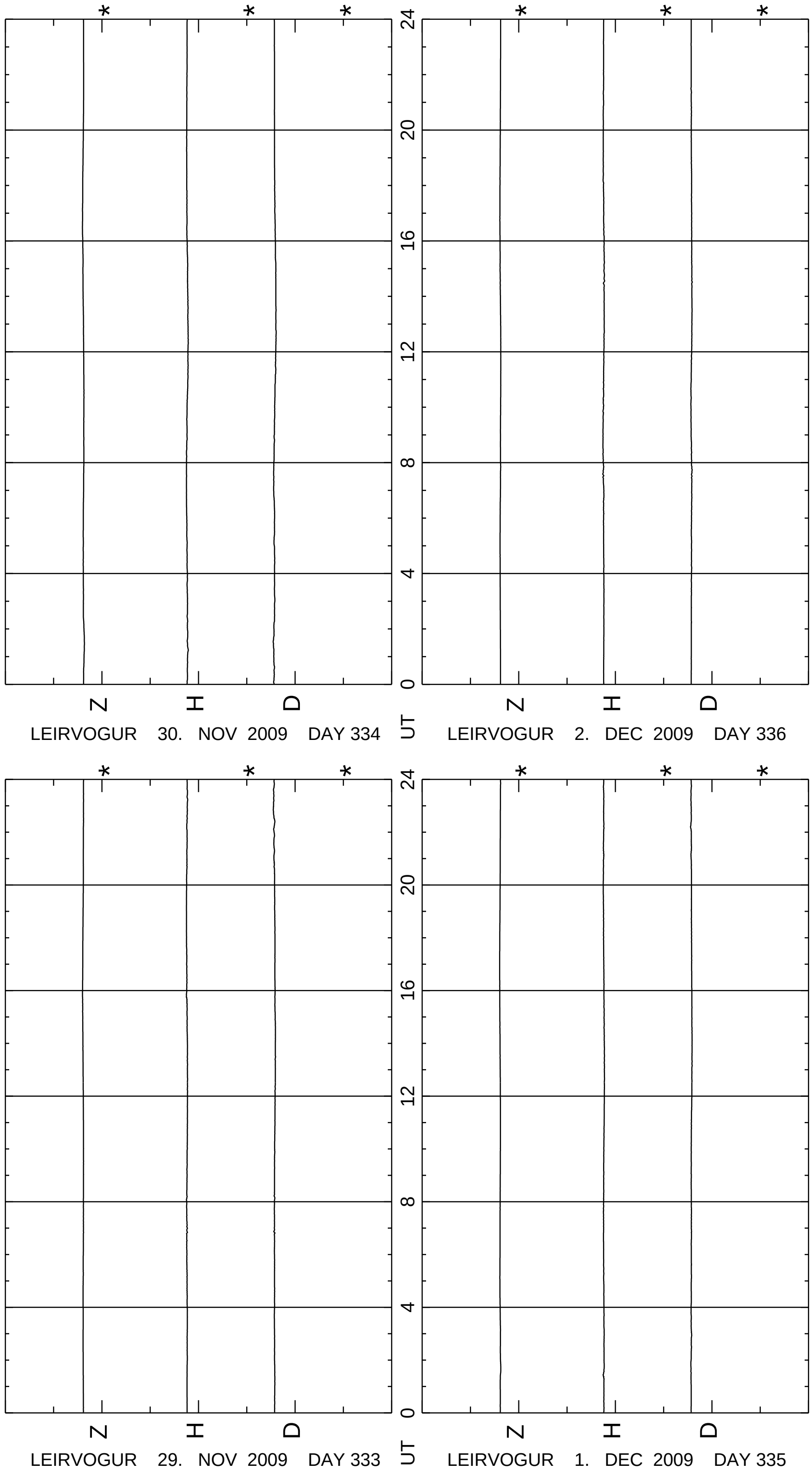
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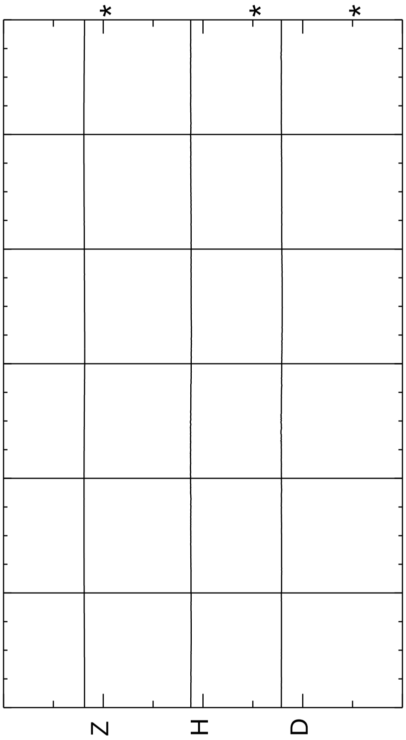

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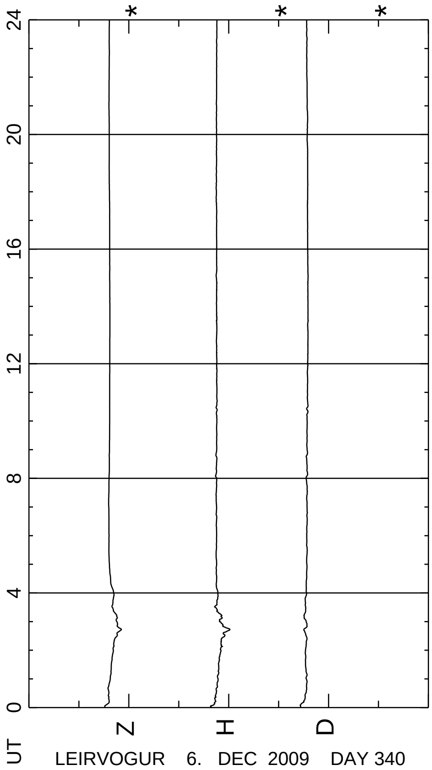

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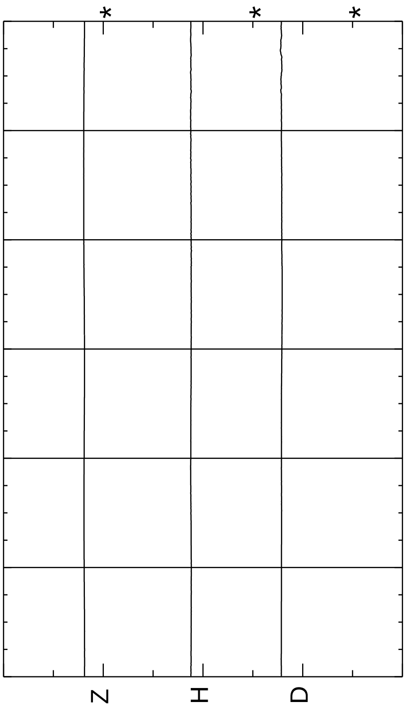

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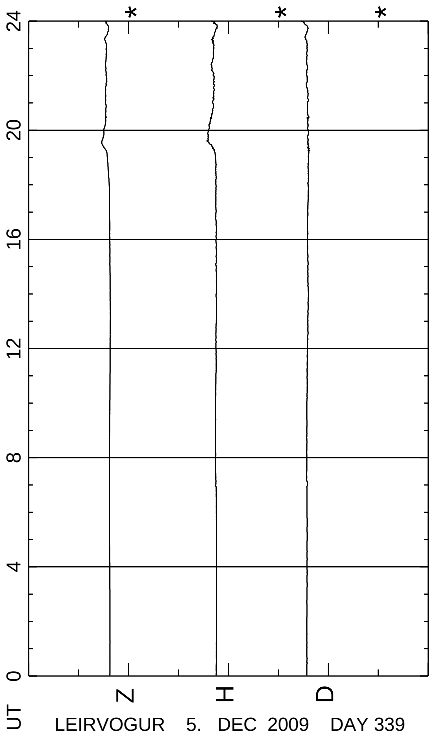

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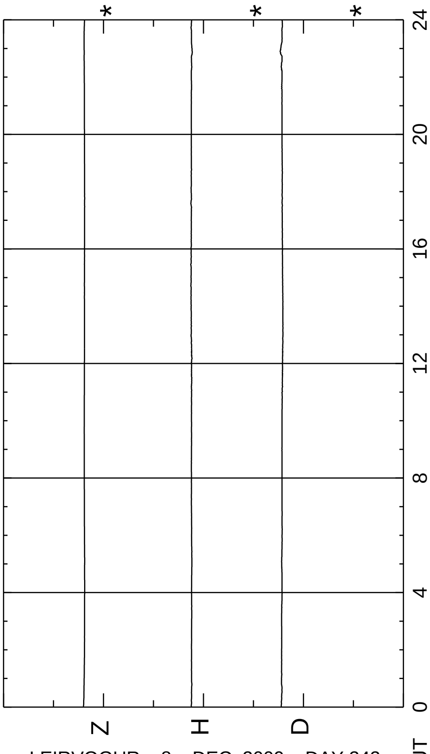

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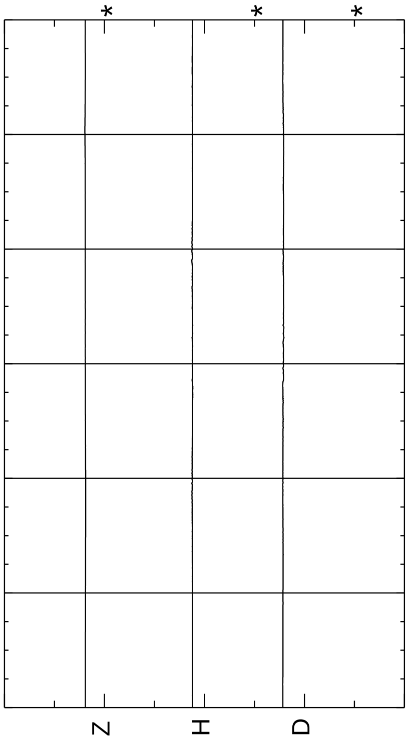

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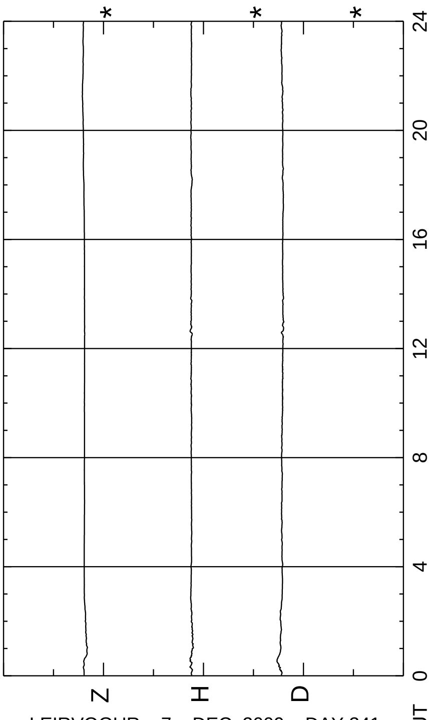

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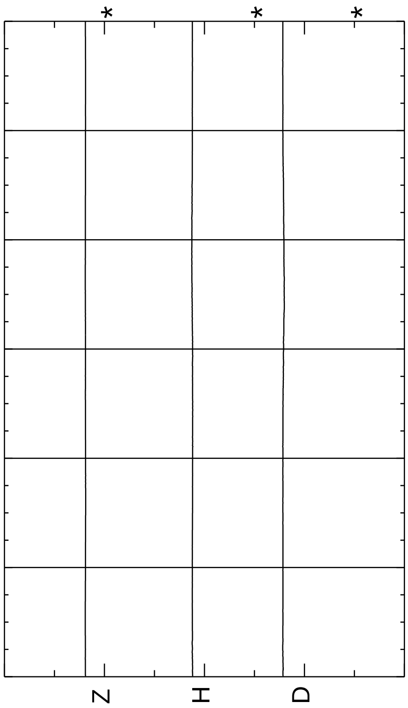

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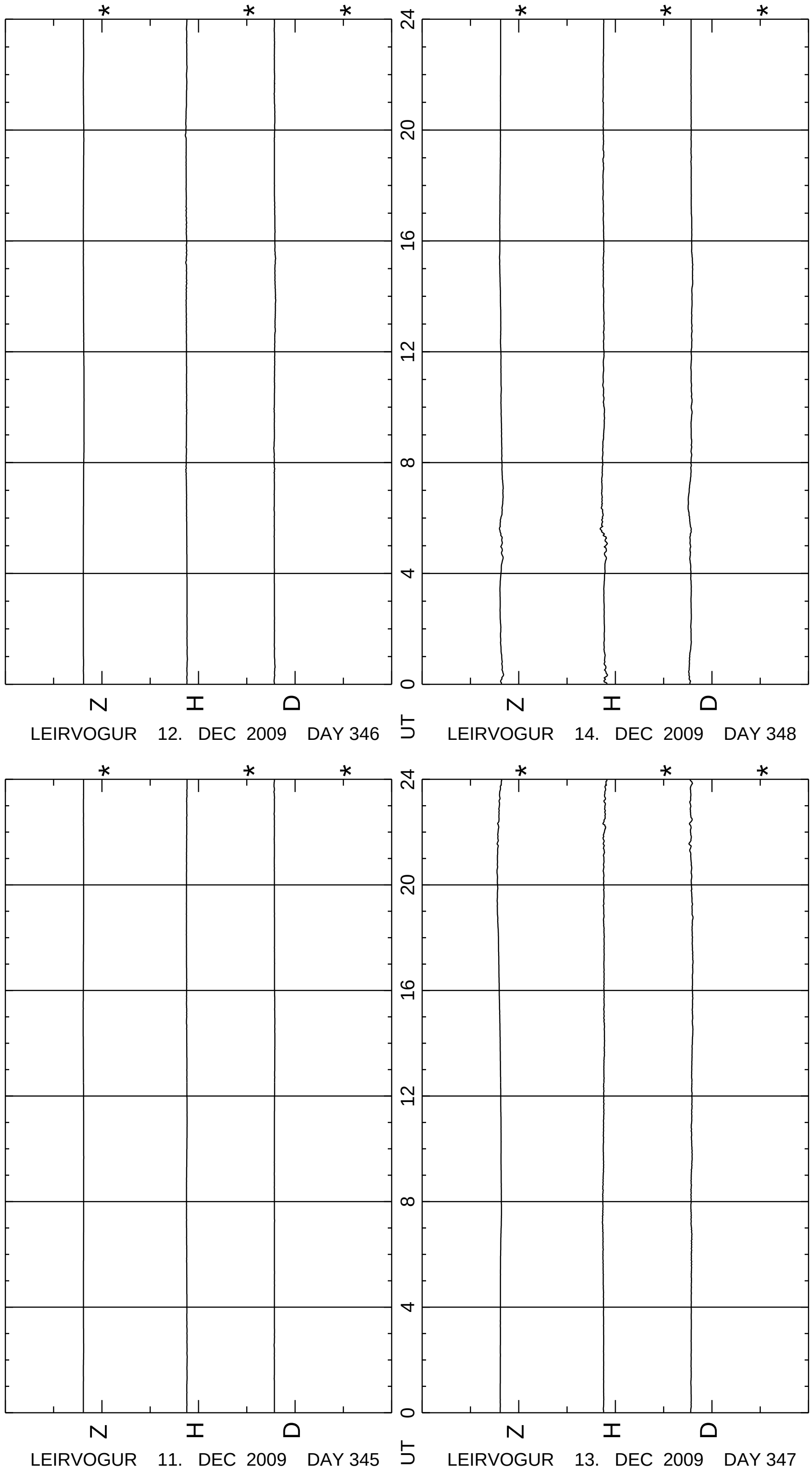
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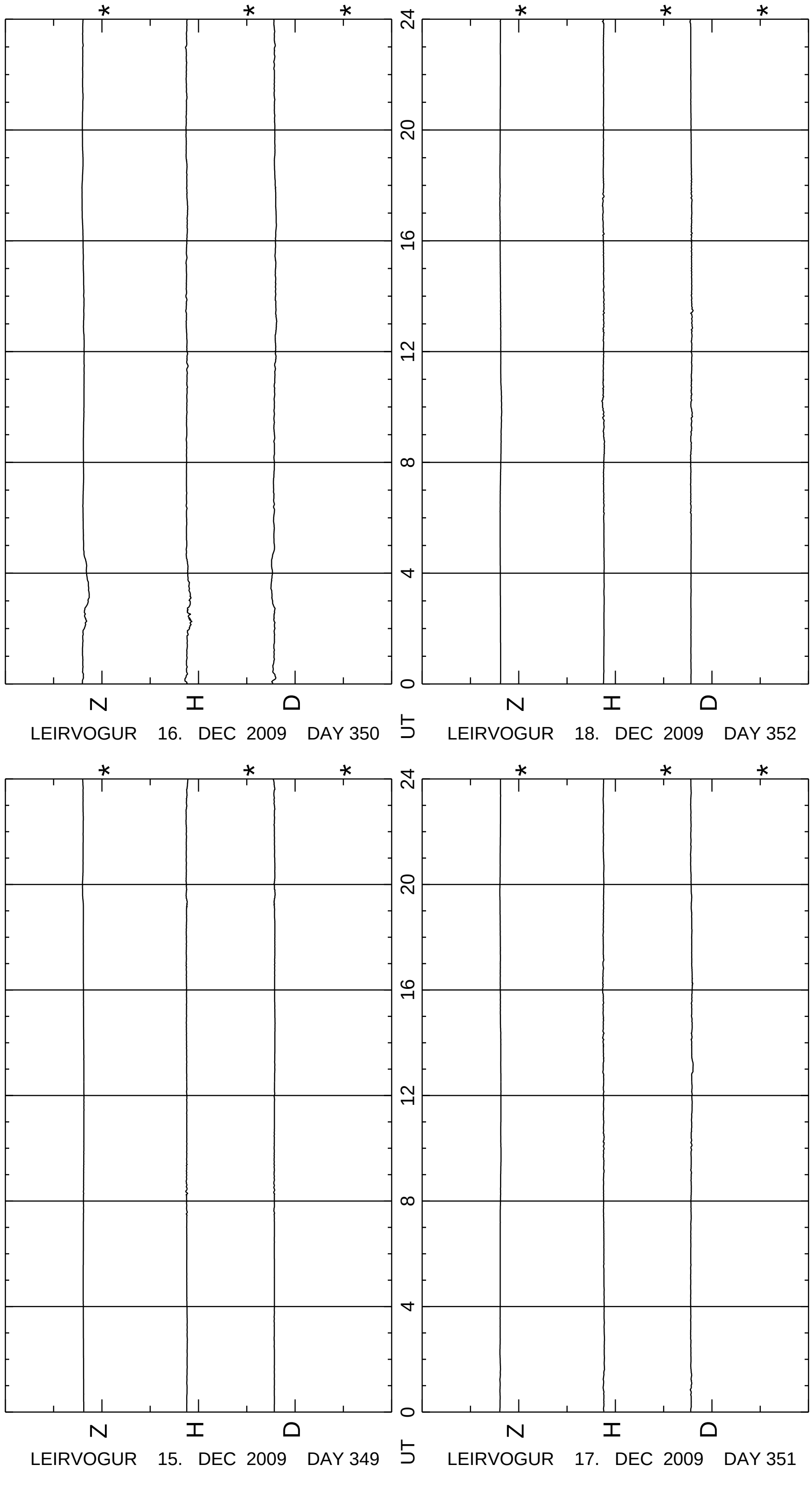
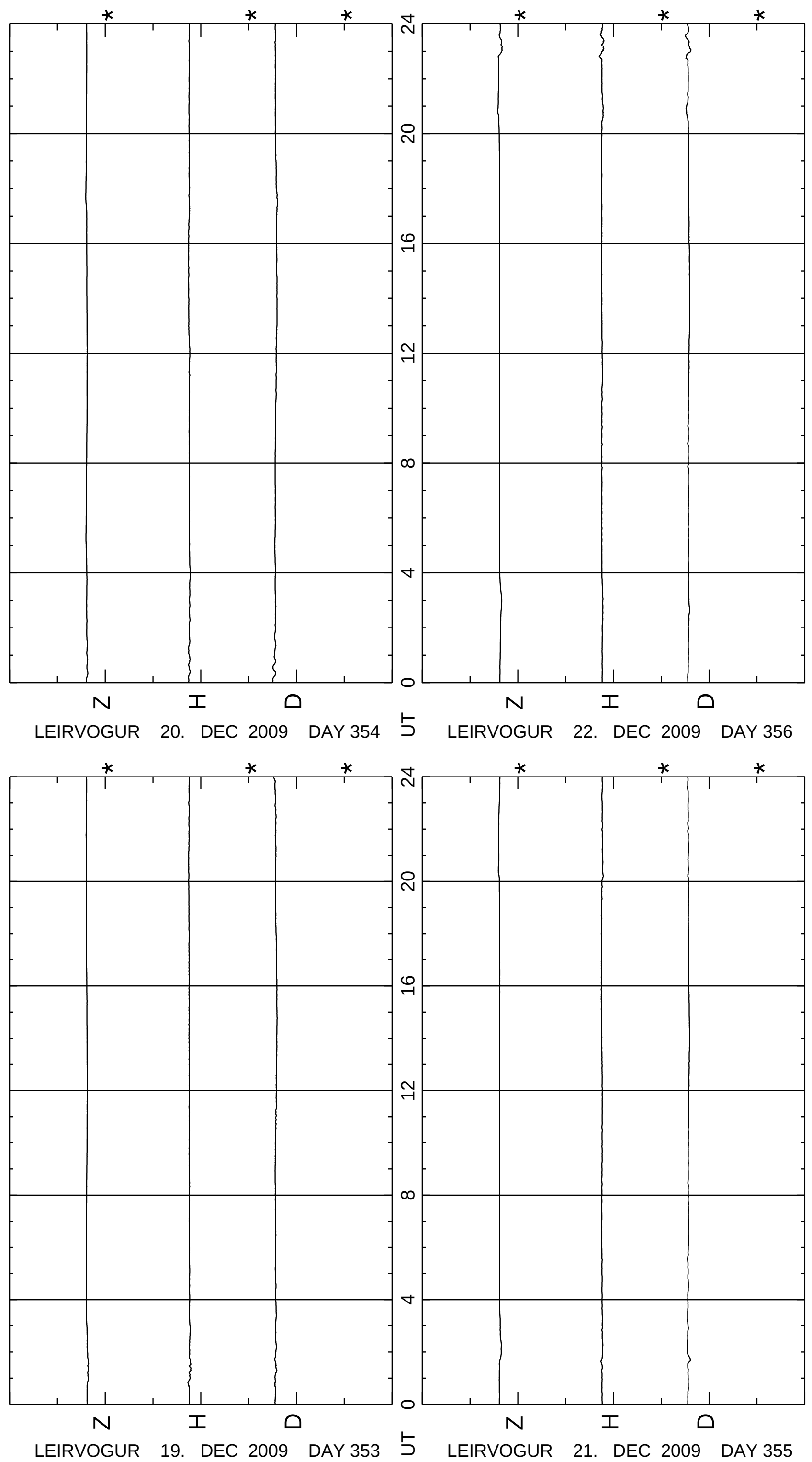
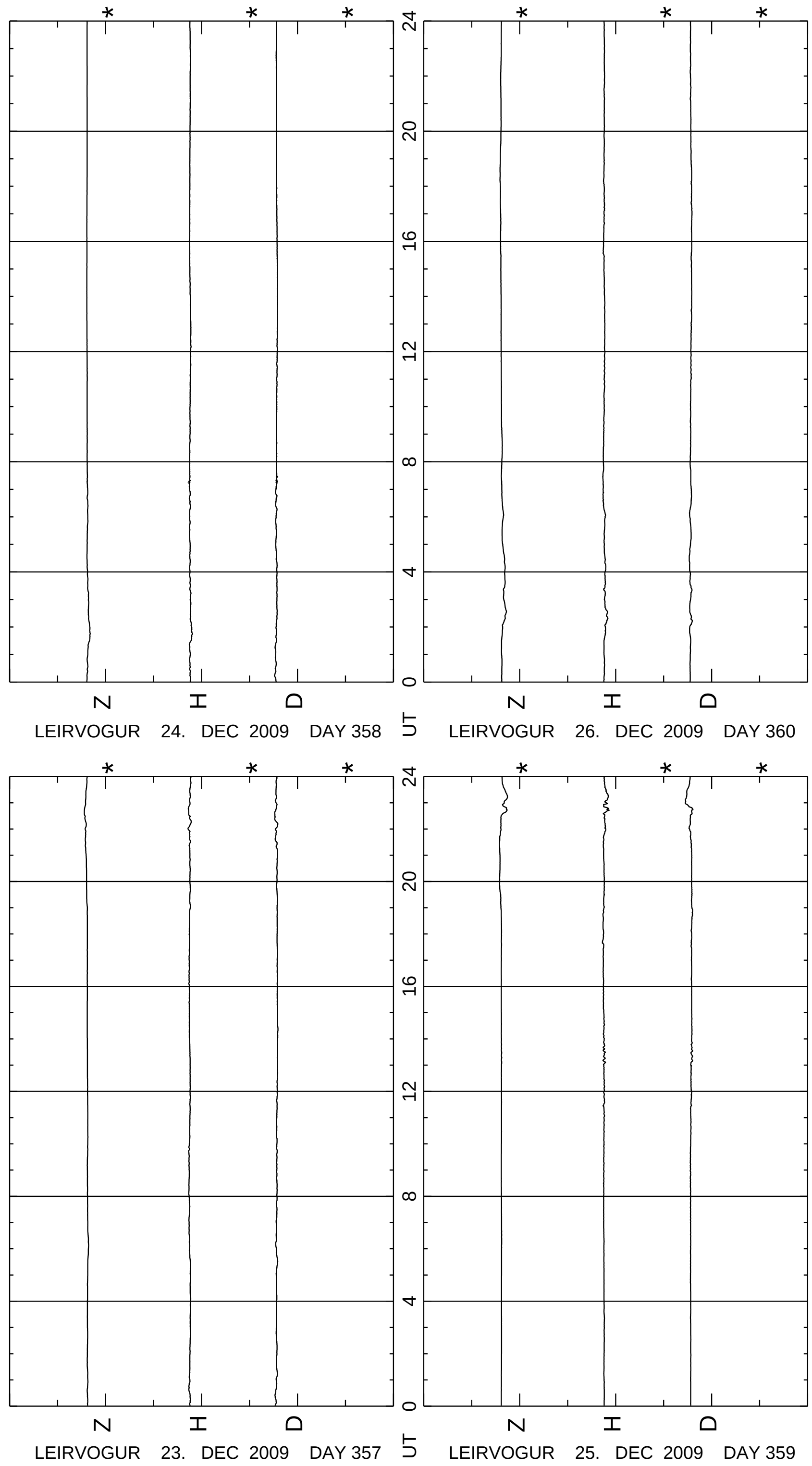
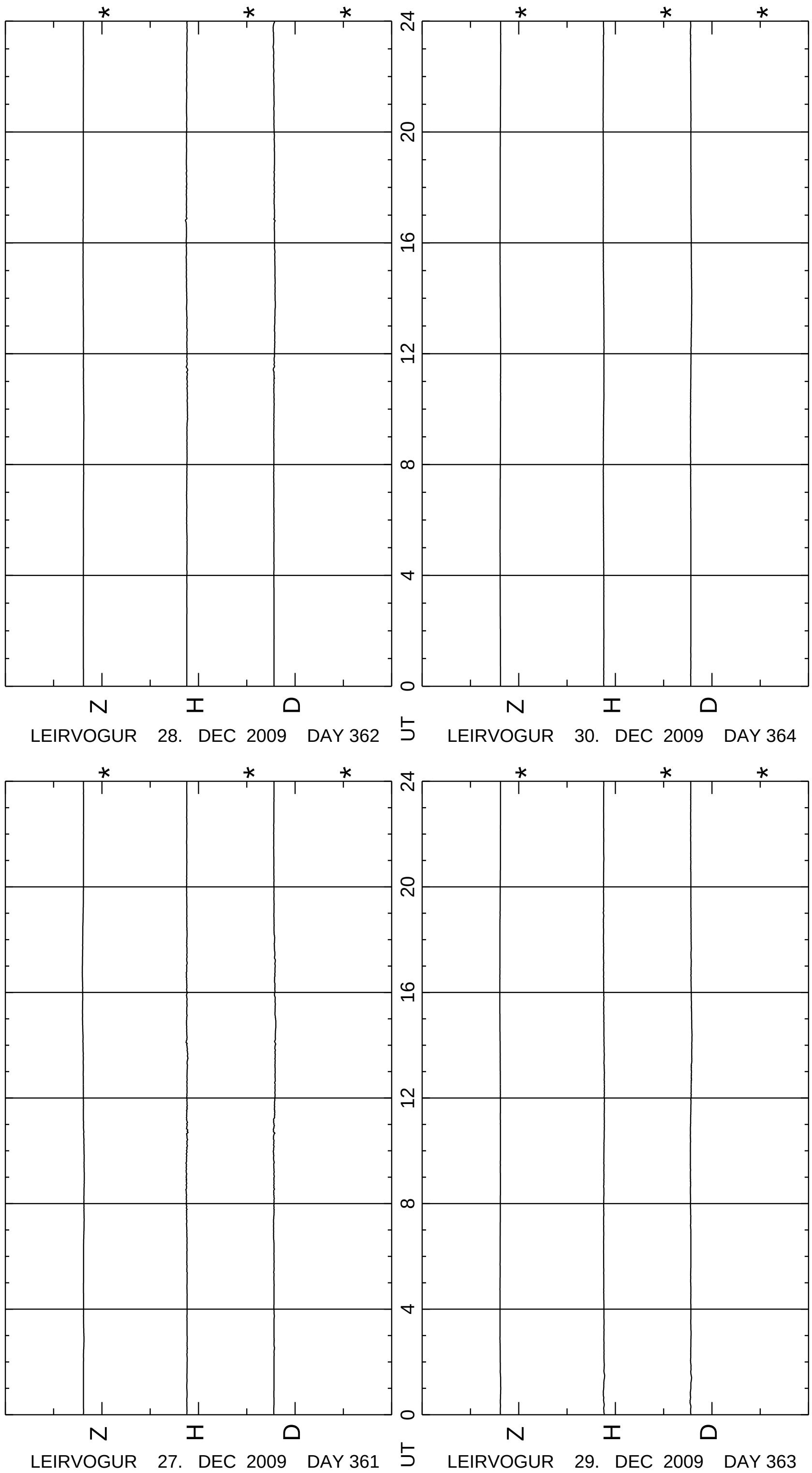
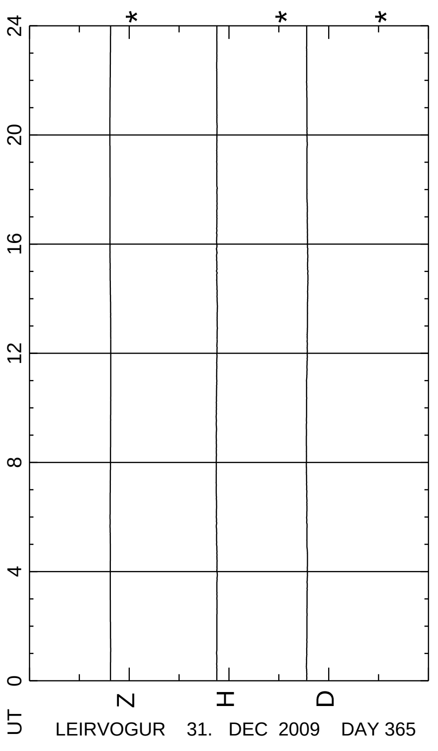
Z H D
LEIRVOGUR 13. DEC 2009 DAY 347


Z H D
LEIRVOGUR 16. DEC 2009 DAY 350
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 18. DEC 2009 DAY 352
Z H D
LEIRVOGUR 15. DEC 2009 DAY 349
UT
0 4 8 12 16 20 24
Z H D
LEIRVOGUR 17. DEC 2009 DAY 351


LEIRVOGUR 20. DEC 2009 DAY 354
LEIRVOGUR 22. DEC 2009 DAY 356
LEIRVOGUR 19. DEC 2009 DAY 353
LEIRVOGUR 21. DEC 2009 DAY 355
Z
H
D
UT
0
4
8
12
16
20
24


LEIRVOGUR 24. DEC 2009 DAY 358
LEIRVOGUR 26. DEC 2009 DAY 360
LEIRVOGUR 23. DEC 2009 DAY 357
LEIRVOGUR 25. DEC 2009 DAY 359
Z
H
D
UT
0
4
8
12
16
20
24


Z H D
UT 0 4 8 12 16 20 24
LEIRVOGUR 28. DEC 2009 DAY 362
LEIRVOGUR 30. DEC 2009 DAY 364
LEIRVOGUR 27. DEC 2009 DAY 361
LEIRVOGUR 29. DEC 2009 DAY 363



UT
0
4
8
12
16
20
24
Z
H
D
LEIRVOGUR 31. DEC 2009 DAY 365

ANNUAL MEANS AT LEIRVOGUR

In the table below, D and I are given in degrees and minutes of arc. Other values are in nanoteslas. Z, H and D are measured values, as are the values of F since 1963.

	Z	H	D		F	X	Y	I	
1958	49322	11872	336	15.3	50731	10867	-4780	76	28.0
	30	14		5.5	32	20	11		-0.5
1959	49352	11886	336	20.8	50763	10887	-4769	76	27.5
	51	11		5.3	52	18	13		0.1
1960	49403	11897	336	26.1	50815	10905	-4756	76	27.6
	26	32		6.9	33	39	9		-1.7
1961	49429	11929	336	33.0	50848	10944	-4747	76	25.9
	20	33		5.6	27	38	5		-1.8
1962	49449	11962	336	38.6	50875	10982	-4742	76	24.1
	31	18		5.0	37	23	8		-0.7
1963	49480	11980	336	43.6	50912	11005	-4734	76	23.4
	24	35		5.0	31	39	3		-1.9
1964	49504	12015	336	48.6	50943	11044	-4731	76	21.5
	26	27		3.7	33	30	1		-1.3
1965	49530	12042	336	52.3	50976	11074	-4730	76	20.2
	33	22		3.3	36	25	2		-1.0
1966	49563	12064	336	55.6	51012	11099	-4728	76	19.2
	50	21		3.6	51	24	3		-0.6
1967	49613	12085	336	59.2	51063	11123	-4725	76	18.6
	44	27		4.3	47	31	4		-1.1
1968	49657	12112	337	3.5	51110	11154	-4721	76	17.5
	44	28		2.6	53	29	-3		-1.1
1969	49701	12140	337	6.1	51163	11183	-4724	76	16.4
	53	29		3.6	58	32	1		-1.0
1970	49754	12169	337	9.7	51221	11215	-4723	76	15.4
	41	29		5.1	47	34	5		-1.3
1971	49795	12198	337	14.8	51268	11249	-4718	76	14.1
	46	31		6.8	51	38	11		-1.3
1972	49841	12229	337	21.6	51319	11287	-4707	76	12.8
	40	18		8.9	43	28	22		-0.5
1973	49881	12247	337	30.5	51362	11315	-4685	76	12.3
	41	24		10.5	45	37	25		-0.9
1974	49922	12271	337	41.0	51407	11352	-4660	76	11.4
	22	33		11.4	30	46	26		-1.8
1975	49944	12304	337	52.4	51437	11398	-4634	76	9.6
	23	28		13.3	29	44	33		-1.4
1976	49967	12332	338	5.7	51466	11442	-4601	76	8.2
	13	23		13.7	18	39	37		-1.3
1977	49980	12355	338	19.4	51484	11481	-4564	76	6.9
	23	11		14.7	25	30	46		-0.4
1978	50003	12366	338	34.1	51509	11511	-4518	76	6.5
	1	22		14.0	7	39	39		-1.4
1979	50004	12388	338	48.1	51516	11550	-4479	76	5.1
	-11	13		13.1	-7	29	39		-1.0
1980	49993	12401	339	1.2	51509	11579	-4440	76	4.1
	9	4		12.6	9	20	41		-0.1
1981	50002	12405	339	13.8	51518	11599	-4399	76	4.0
	2	-6		11.8	1	9	42		0.4
1982	50004	12399	339	25.6	51519	11608	-4357	76	4.4

ANNUAL MEANS AT LEIRVOGUR
(Continued)

1983	49994	12407	339	38.3	51511	11632	-4317	76	3.8
	-3	-1		12.1	-3	14	41		0.0
1984	49991	12406	339	50.4	51508	11646	-4276	76	3.8
	-9	4		11.1	-8	17	37		-0.4
1985	49982	12410	340	1.5	51500	11663	-4239	76	3.4
	0	-4		12.0	0	11	42		0.2
1986	49982	12406	340	13.5	51500	11674	-4197	76	3.6
	-2	7		11.9	-2	21	38		-0.5
1987	49980	12413	340	25.4	51498	11695	-4159	76	3.1
	12	-5		11.7	10	10	41		0.5
1988	49992	12408	340	37.1	51508	11705	-4118	76	3.6
	20	-3		11.6	20	11	41		0.6
1989	50012	12405	340	48.7	51528	11716	-4077	76	4.2
	5	1		11.3	5	14	38		0.0
1990	50017	12406	341	0.0	51533	11730	-4039	76	4.2
	11	-1		11.4	11	12	39		0.2
1991	50028	12405	341	11.4	51544	11742	-4000	76	4.4
	-3	6		12.0	-3	20	39		-0.4
1992	50025	12411	341	23.4	51541	11762	-3961	76	4.0
	-2	6		13.0	0	21	43		-0.4
1993	50023	12417	341	36.4	51541	11783	-3918	76	3.6
	7	-4		14.4	6	12	51		0.3
1994	50030	12413	341	50.8	51547	11795	-3867	76	3.9
	0	18		14.8	4	34	45		-1.1
1995	50030	12431	342	5.6	51551	11829	-3822	76	2.8
	-1	14		16.2	3	31	51		-0.9
1996	50029	12445	342	21.8	51554	11860	-3771	76	1.9
	9	12		16.9	12	30	55		-0.7
1997	50038	12457	342	38.7	51566	11890	-3716	76	1.2
	19	5		17.8	19	24	60		0.0
1998	50057	12462	342	56.5	51585	11914	-3656	76	1.2
	12	11		17.6	14	29	58		-0.5
1999	50069	12473	343	14.1	51599	11943	-3598	76	0.7
	20	8		17.8	22	26	60		-0.2
2000	50089	12481	343	31.9	51621	11969	-3538	76	0.5
	10	16		17.8	13	34	57		-0.9
2001	50099	12497	343	49.7	51634	12003	-3481	75	59.6
	18	11		18.3	20	28	61		-0.4
2002	50117	12508	344	8.0	51654	12031	-3420	75	59.2
	23	-4		18.7	22	15	67		0.6
2003	50140	12504	344	26.7	51676	12046	-3353	75	59.8
	6	23		17.7	12	39	56		-1.3
2004	50146	12527	344	44.4	51688	12085	-3297	75	58.5
	12	10		17.4	13	27	59		-0.5
2005	50158	12537	345	1.8	51701	12112	-3238	75	58.0
	6	21		16.4	11	35	52		-1.3
2006	50164	12558	345	18.2	51712	12147	-3186	75	56.7
	14	17		16.8	17	32	55		-0.9
2007	50178	12575	345	35.0	51729	12179	-3131	75	55.8
	7	15		17.1	11	30	57		-0.8
2008	50185	12590	345	52.1	51740	12209	-3074	75	55.0
	3	22		17.6	8	37	57		-1.4
2009	50188	12612	346	9.7	51748	12246	-3017	75	53.6