UPPER ATMOSPHERE PHYSICS DATA OBTAINED AT SYOWA STATION IN 1993

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1. Introduction

This data book summarizes upper atmosphere physics data acquired by the 34th Japanese Antarctic Research Expedition (JARE-34) with the "Upper Atmosphere Physics Monitoring (UAPM) System" at Syowa Station in 1993. Observation items are as follows:

1) Geomagnetism :
- H-, D- and Z-components of magnetic variations
- Total force of the geomagnetic field
- H-, D- and Z-components of magnetic pulsations

2) ELF-VLF wave :
- Intensities at 0.35, 0.75, 1.2, 2, 4, 8, 30, 60 and 95 kHz
- Wide-band (0-10 kHz) signal of ELF-VLF emissions

3) Ionosphere :
- Cosmic noise absorption at 30 MHz observed with a broad-beam riometer.

4) Aurora :
- All-sky camera :
  Panchromatic auroral images recorded on black and white films and color films.
- Scanning photometers :
  Meridian-scanning record at the following three wavelengths.
  427.8 nm (N_2^+ 1NG), 630.0 nm (OI) and 486.1 nm (Hβ)

An outline of the observation system is given in Section 2. Section 3 describes specifications of the observation instruments and the data acquisition systems. Observation periods are also listed in Section 3. Format of the compiled digital data is shown in Section 4. Summary plots in the period of January 1-December 31, 1993 are given in Appendix.

All sky camera film data, magnetograms and summary plots of the monitoring data are available to users on request. The request should be addressed to:

World Data Center C2 for Aurora
National Institute of Polar Research
9-10, Kaga 1-chome, Itabashi-ku,
Tokyo 173, Japan.

Digital and analog data described here are available to researchers who will do collaborative studies with the upper atmosphere physics group of NIPR. The request should be addressed to:

Upper Atmosphere Physics Research Division
National Institute of Polar Research
9-10, Kaga 1-chome, Itabashi-ku,
Tokyo 173, Japan.

2. Upper Atmosphere Physics Monitoring (UAPM) System

A real-time digital data acquisition system for upper atmosphere physics observation was constructed at Syowa Station in January 1981 (Sato *et al.*, 1984). Data obtained from the system have been collected and published annually in the JARE Data Reports (Upper Atmosphere Physics) (Sato *et al.*, 1984, 1991; Fujii *et al.*, 1985, 1994; Sakurai *et al.*, 1985; Ono *et al.*, 1986,1993; Yamagishi *et al.*, 1987; Kikuchi *et al.*, 1988; Miyaoka *et al.*, 1990; Kadokura *et al.*, 1992; Yamazaki *et al.*, 1995). This report is the 13th of this series.

A block diagram of the system, including other ground observations, is shown in Fig. 1. The sensors for measuring weak natural electromagnetic waves such as ELF-VLF emissions, the three components of ULF magnetic pulsations and cosmic radio noise absorption (CNA) have been placed at a remote station on West Ongul Island, located about 5 km from Syowa Station in order to avoid man-made electromagnetic interference. Data of the magnetic pulsations and CNA are transmitted continuously to Syowa Station by a PCM telemeter in VHF band. Wide-band signals of ELF-VLF emissions are transmitted to Syowa Station through an FM telemeter in UHF band.

At the remote station, the electric power which drives all the instruments has been supplied by a solar battery system with maximum output power of 530 W since February 1985. An additional solar battery system with maximum power of 365 W was installed in January 1987 to reinforce the original battery system. The solar battery system consists of eighteen rechargeable car batteries (200 Ah each), five solar panels and three controllers in total. During winter when no sunlight is available, these batteries are charged manually about once a month by using a 10 kVA diesel-engine dynamo, which was installed in 1992 instead of the previous 16 kVA one.

The fluxgate and proton magnetometer sensors are placed at Syowa Station on East Ongul Island, about 150 m apart from the Data Processing Building. All the auroral photometric

instruments are placed on the roof of the building, and the data acquisition facilities are installed inside the building. All the outputs obtained from the observation instruments except the auroral photometric ones are transferred to the matrix terminal board and then recorded with pen recorders, analog data recorders and a computer system. These data have been recorded simultaneously with two sets of the TEAC DR-200 digital data logger systems since January 1987. An 8 mm video tape recorder is used to record wide-band VLF emissions, and 24-hour data can be stored on one volume of 8 mm video tape.

Universal time (UT) is supplied from a precise time-keeping system. This system consists of an NNSS satellite timing receiver, a quartz frequency standard with a stability of 2×10^{-11}/day, and time code generators. The time code generators supply the IRIG-A, -B and slow codes for analog data recorders and the 36-bit BCD code for the digital recording systems, respectively. The absolute accuracy of this system is estimated to be about 1 ms.

3. Specifications of Instruments

3.1. Geomagnetism

(1) *Magnetogram*

Magnetic variations were measured by a three-axis fluxgate magnetometer. Full scale ranges were +1250 to -3750 nT for H-component and ±2500 nT for D- and Z- components, respectively, with the frequency response of DC–2 Hz and noise levels less than 0.5 nT. The magnetometer data were recorded in digital form at the sampling rate of 1 Hz. The H-component data were also recorded on a chart recorder and an R-950L long-term analog data recorder.

(2) *Total force of the geomagnetic field*

Due to the pro-longed trouble with the proton magnetometer since January 1991, the total force observations were made only about once per month in 1993, using the other portable proton magnetometer, which was unable to be linked with the UAPM system. The results are listed in Table 1.

(3) *ULF magnetic pulsations*

The H-, D-, and Z-components of ULF magnetic pulsations are detected by three sets of search coil magnetometers. The search coil sensors have copper wires (0.4 mmϕ, 40000 turns each) wound around permalloy cores (1 cm in diameter× 100 cm in length). Measurable intensity range of the magnetometer is 0.001–5 nT/s and the frequency response is 0.001–3 Hz. The search coil magnetometers are installed at the remote station on West Ongul Island. The output signals transmitted by the PCM telemeter are recorded on an R-950L long-term analog data recorder, a chart recorder and a digital data recorder. The sampling frequency of the digital data is 1 Hz for each component.

(4) *Base line of the magnetic field and K-index*

Base line values of the magnetic field were observed about once per month during a magnetically quiet day. K-indices are calculated for every 3-hour interval measuring the maximum deviations of the H- and D-component magnetic fields from the quiet-day baselines. The definition of the K-indices at Syowa Station is as follows:

K-index		Deviation	K-index		Deviation
0	:	0 - 25 nT	5	:	350 – 600 nT
1	:	25 – 50	6	:	600 – 1000
2	:	50 – 100	7	:	1000 – 1660
3	:	100 – 200	8	:	1660 – 2500
4	:	200 – 350	9	:	2500 and more

The ordinary magnetogram is also available on chart papers with a recording speed of 5 cm/hr. The sensitivity of each component on the chart papers is about 100 nT/cm. Tables 1 and 2 give the baseline values and K-indices at Syowa Station in February 1993 – January 1994. Inquiries or requests for the data copies of the magnetic field measurements should be addressed to World Data Center C2 for Aurora in NIPR.

3.2. ELF-VLF waves

The natural ELF-VLF wave receiving system at the remote station has consisted of a triangle-shaped three turn loop antenna (10 m in height, 20 m in the bottom side), a pre-amplifier and a main amplifier with gains of 60 and 40 dB, respectively. The ELF-VLF wave intensities at the frequency bands of 0.35, 0.75, 1.2, 2, 4, 8, 30, 60, 95 kHz were obtained from wide band waveforms using a 9-channel filter bank and detectors. The ELF-VLF emissions within the intensity range of 10^{-17} to 10^{-13} W/m^2 Hz were detectable with this system. These data were recorded continuously in digital form at the sampling rate of 1 Hz. Some of the wide-band ELF-VLF signals up to 10 kHz were recorded on 8 mm video tape recorders. The wide-band recording was usually executed during 0900 - 1300 UT on Sunday - Friday, and 24 hour recording was executed during September 14 - October 3 which was the conjugate observation period between Syowa and Iceland.

3.3. Ionosphere

Cosmic noise absorption at 30 MHz was observed with a broad-beam riometer, which has been installed at the remote station on West Ongul Island since 1981. Its beam half-width is 60°. Used receiver is made by La Jolla Science, which bandwidth and time constant are 150 kHz and 0.25 s, respectively. The riometer data were recorded in digital form at the sampling rate of 1 Hz in the UAPM system.

Data of ionospheric vertical sounders, broad-beam riometers (20, 30 and 45 MHz), HF field strength receivers (8 and 10 MHz) and the VHF auroral radar (50 MHz) were recorded with other

observation systems at Syowa Station, and the observational results have been published in another JARE Data Report (Ionosphere). Inquiries and requests for the data copies are to be addressed to:

World Data Center C2 for Ionosphere
Communications Research Laboratory
Ministry of Posts and Telecommunications
2-1, Nukui-Kitamachi 4-chome, Koganei-shi,
Tokyo 184, Japan.

3.4. Aurora

(1) *All-sky camera*

Black-and-white and color all-sky auroral images were observed by using a 35 mm cine-pulse camera with a fish-eye lens of f/1.4 and an exposure time of 7 s. The observations were carried out during clear nights in 1993, as given in Table 3. Inquiries or requests for the all-sky data copies should be addressed to World Data Center C2 for Aurora in NIPR.

(2) *Meridian-scanning photometer*

Auroral emissions at the wavelengths of 427.8 nm (N_2^+ 1NG), 630.0 nm (OI) and 486.1 nm (Hβ) were observed by a meridian-scanning photometer installed in 1987. The interference filter for Hβ was tilted with 1 s period, measuring the Doppler effect of the auroral Hβ emission. The field of view of the photometer was 3° for 427.8 nm and 630.0 nm, and 5° for Hβ emissions. The scanning from the poleward to the equatorward horizon required 30 s. The meridian-scanning photometer data were recorded with a sampling frequency of 25 Hz.

4. Compiled Digital Tape Format

Data have been digitally recorded continuously since 1981. A similar recording system has been used in Iceland for the geomagnetic conjugate observations. The specifications of the compiled digital tapes are as follows:

Tracks	: 9
Record density	: 6250 BPI
Record format	: FB
Block length	: 28848 bytes
Logical record length	: 48 bytes
Label	: Non-label
Filing	: Multi-file (1 file/day)

24 kinds of upper atmospheric data are recorded every 1 s in the following sequence:

Word No.	Observation item	Word No.	Observation item
1	H-component of magn. field	13	VLF 8 kHz
2	D-component of magn. field	14	VLF 30 kHz
3	Z-component of magn. field	15	VLF 60 kHz
4	H-component of ULF waves	16	VLF 95 kHz
5	D-component of ULF waves	17	NA
6	Z-component of ULF waves	18	NA
7	CNA (30 MHz)	19	NA
8	VLF 350 Hz	20	NA
9	VLF 750 Hz	21	NA
10	VLF 1.2 kHz	22	NA
11	VLF 2 kHz	23	NA
12	VLF 4 kHz	24	NA

Words 17-24 are dummy words. Each word, 12 bit A/D converted value, is recorded in the 2 byte binary form of signed 2's complement. A set of these 24 words makes a logical record of 48 bytes; the 10-min data make a block of 28848 bytes. A file contains one day of data (144 blocks) and a volume contains one month of data (28-31 files), as shown in Fig. 2. At the beginning of each block, the starting time of the observation period is written in the following format (48 bytes):

Sequence	Item	
1	Year	(2 bytes)
2	Total day	(2 bytes)
3	Hour	(2 bytes)
4	Minute	(2 bytes)
5	Station code	(4 bytes)
6	Space	(36 bytes)

The magnetic field data recorded on a compiled tape can be transformed to physical quantities by the following relations:

H-component of the geomagnetic field variation (nT)	= DATA*2500/2048 – 1250
D- and Z-component of the geomagnetic field variation (nT)	= DATA*2500/2048
H-component of ULF waves (nT/s)	= DATA/141
D-component of ULF waves (nT/s)	= DATA/158
Z-component of ULF waves (nT/s)	= DATA/316

For CNA and VLF data, individual calibration values are required to obtain physical values

from the recorded data. Inquiries on these calibration values should be addressed to the Upper Atmosphere Physics Research Division of NIPR. For more detailed information on the compiled data, see Uchida *et al.* (1988). These compiled data are also recorded on an Optical Disk (OD) at the sampling rate of 0.5 Hz together with the data from three Icelandic stations for conjugate studies. One volume of the OD can store the data obtained at the four stations during one year. Softwares to handle the OD data are also available to researchers. Details of the OD conjugate data base are described in Yamagishi (1990).

A computer system of the Information Science Center is available to collaborative researchers of NIPR. The center has also been providing various kinds of software such as tape-to-tape copy, displays and spectrum analysis program to the researchers.

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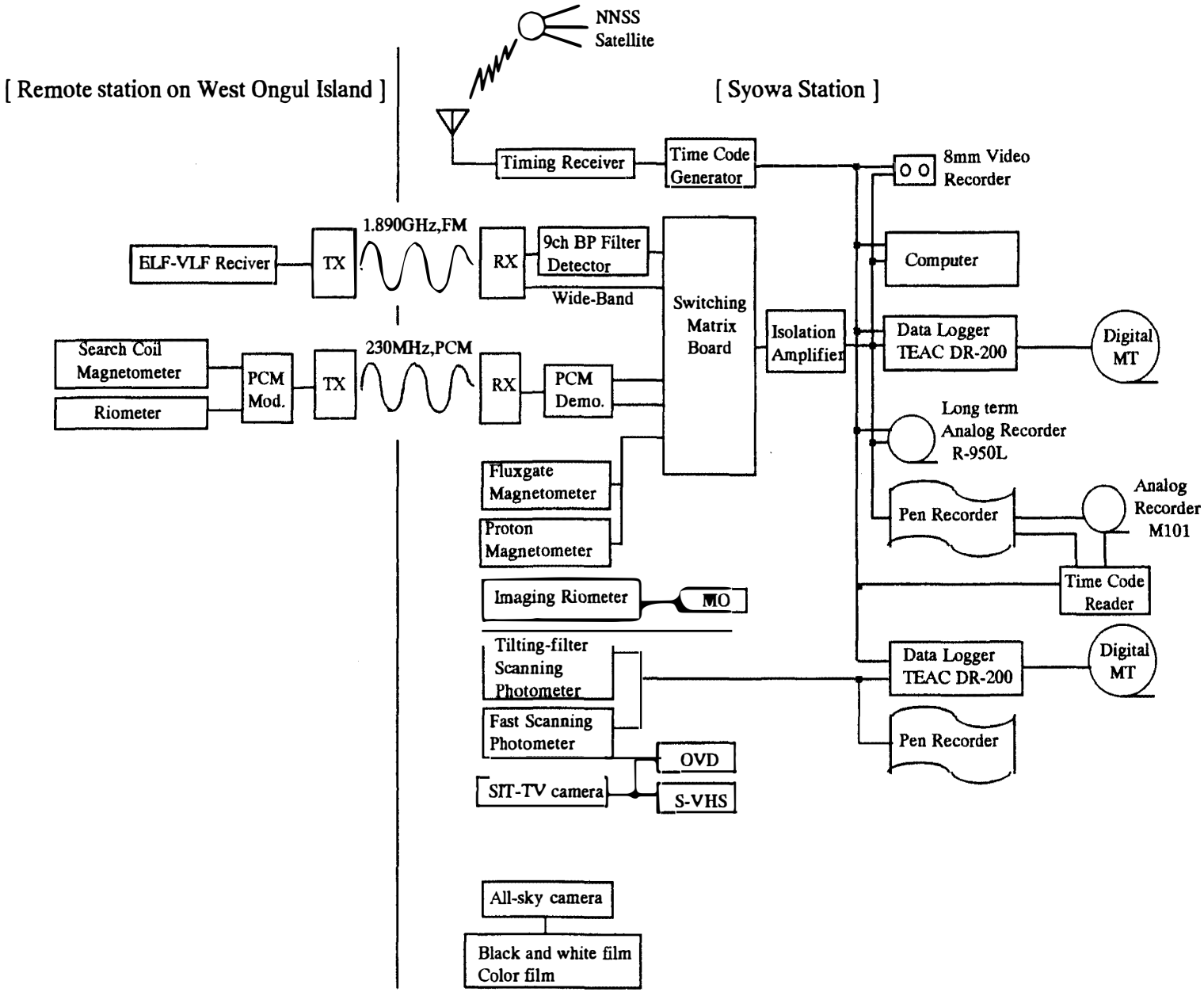


Fig. 1. Block diagram of the "Upper Atmosphere Physics" monitoring system at Syowa Station.

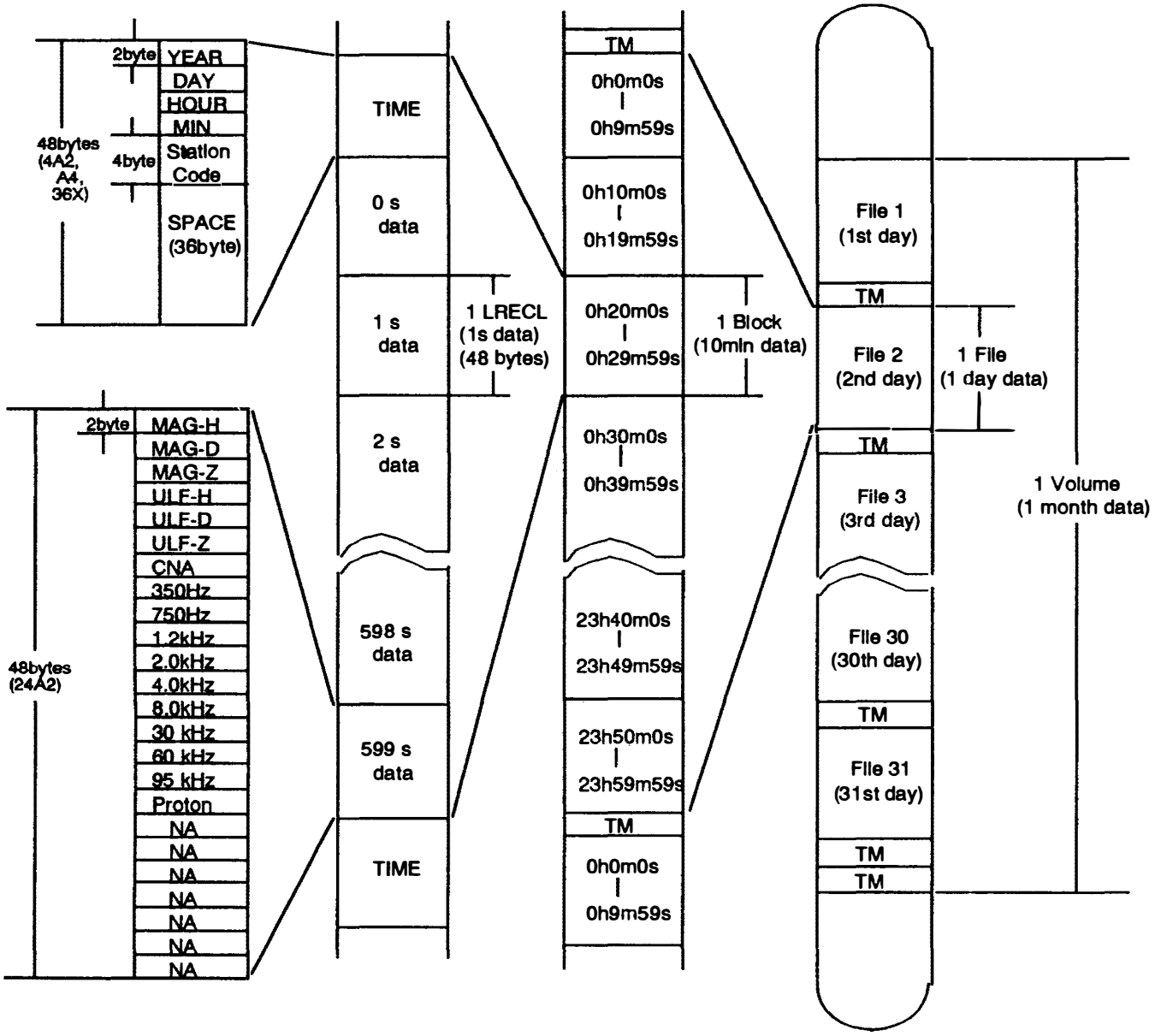


Fig. 2. The structure of the compiled digital tape format for Syowa Station.

Table 1. Baseline values of the geomagnetic field at Syowa Station in February 1993 - January 1994.

DATA	TIME (UT)	TOTAL INT. (nT)	HORI-ZONAL INT. (nT)	VERTICAL INT. (nT)	DECLINATION	DIP ANGLE
FEB. 24 1993	10h 50m	43767.4	19077.9	-39390.6	-47° 36.2′	-64° 9.5′
	11h 00m	43770.0	19093.1	-39386.2	-47° 36.9′	-64° 8.2′
	11h 12m	43759.8	19064.8	-39388.4	-47° 34.4′	-64° 10.3′
	11h 19m	43763.4	19070.7	-39389.7	-47° 34.3′	-64° 9.9′
	11h 05m	43765.2	19076.7	-39388.7	-47° 35.4′	-64° 9.5′
MAR. 29	10h 31m	43803.0	19112.8	-39413.3	-47° 35.5′	-64° 7.8′
	10h 39m	43804.1	19088.9	-39426.1	-47° 35.4′	-64° 9.9′
	10h 54m	43803.3	19094.8	-39422.3	-47° 35.6′	-64° 9.4′
	11h 03m	43806.6	19094.8	-39425.8	-47° 35.5′	-64° 9.5′
	10h 47m	43804.3	19097.9	-39421.9	-47° 35.5′	-64° 9.1′
APR. 24	11h 04m	43766.8	19085.5	-39386.3	-47° 40.6′	-64° 8.8′
	11h 13m	43767.8	19082.8	-39388.7	-47° 39.5′	-64° 9.1′
	11h 22m	43767.5	19078.9	-39390.2	-47° 39.4′	-64° 9.4′
	11h 30m	43768.6	19079.4	-39391.2	-47° 39.0′	-64° 9.4′
	11h 17m	43767.7	19081.7	-39389.1	-47° 39.6′	-64° 9.2′
MAY. 24	11h 08m	43761.1	19107.1	-39369.5	-47° 38.0′	-64° 6.7′
	11h 19m	43762.3	19095.6	-39376.4	-47° 38.6′	-64° 7.7′
	11h 36m	43764.1	19096.9	-39377.7	-47° 39.0′	-64° 7.7′
	11h 46m	43763.0	19098.2	-39375.9	-47° 38.2′	-64° 7.5′
	11h 27m	43762.6	19099.4	-39374.8	-47° 38.4′	-64° 7.4′
JUL. 7	10h 33m	43755.2	19120.2	-39356.5	-47° 40.5′	-64° 5.3′
	10h 48m	43756.7	19101.4	-39367.3	-47° 40.0′	-64° 7.0′
	11h 05m	43755.6	19100.4	-39366.6	-47° 40.5′	-64° 7.1′
	11h 14m	43756.4	19100.5	-39367.5	-47° 40.1′	-64° 7.1′
	10h 55m	43756.0	19105.6	-39364.5	-47° 40.3′	-64° 6.6′
AUG. 10	11h 21m	43762.9	19081.1	-39384.0	-47° 36.3′	-64° 9.0′
	11h 30m	43775.8	19093.9	-39392.2	-47° 35.5′	-64° 8.4′
	11h 42m	43791.8	19105.2	-39404.5	-47° 38.0′	-64° 8.0′
	11h 51m	43780.0	19099.2	-39394.3	-47° 37.1′	-64° 8.1′
	11h 36m	43777.6	19094.9	-39393.8	-47° 36.7′	-64° 8.4′

DATA	TIME (UT)	TOTAL INT. (nT)	HORI-ZONAL INT. (nT)	VERTICAL INT. (nT)	DECLINATION	DIP ANGLE
AUG. 28	10h 42m	43731.2	19098.1	-39340.6	-47° 39.5′	-64° 6.3′
	10h 50m	43734.3	19094.5	-39345.7	-47° 38.2′	-64° 6.8′
	11h 01m	43726.9	19090.7	-39339.4	-47° 37.0′	-64° 6.8′
	11h 08m	43727.4	19091.2	-39339.6	-47° 39.1′	-64° 6.8′
	10h 55m	43730.0	19093.6	-39341.3	-47° 38.4′	-64° 6.7′
SEP. 19	10h 41m	43746.6	19104.6	-39354.6	-47° 43.9′	-64° 6.3′
	10h 48m	43744.5	19104.3	-39352.3	-47° 44.8′	-64° 6.3′
	10h 59m	43745.1	19102.8	-39353.7	-47° 44.0′	-64° 6.4′
	11h 06m	43741.5	19103.0	-39349.6	-47° 44.5′	-64° 6.3′
	10h 54m	43744.4	19103.7	-39352.5	-47° 44.3′	-64° 6.3′
OCT. 19	11h 07m	43724.8	19079.9	-39342.3	-47° 39.7′	-64° 7.7′
	11h 14m	43723.3	19073.5	-39343.7	-47° 39.4′	-64° 8.2′
	11h 24m	43725.7	19075.1	-39345.6	-47° 39.1′	-64° 8.1′
	11h 30m	43723.6	19072.5	-39344.6	-47° 38.6′	-64° 8.3′
	11h 19m	43724.4	19075.2	-39344.0	-47° 39.2′	-64° 8.1′
NOV. 25	10h 30m	43697.4	19088.2	-39307.8	-47° 42.6′	-64° 5.9′
	10h 37m	43701.1	19091.5	-39310.3	-47° 42.2′	-64° 5.8′
	10h 48m	43701.6	19088.6	-39312.2	-47° 41.0′	-64° 6.0′
	10h 55m	43702.1	19087.4	-39313.4	-47° 41.6′	-64° 6.2′
	10h 43m	43700.5	19088.9	-39310.9	-47° 41.8′	-64° 6.0′
DEC. 30	10h 32m	43695.1	19093.3	-39304.2	-47° 40.3′	-64° 5.6′
	10h 39m	43695.7	19085.1	-39307.4	-47° 37.9′	-64° 6.1′
	10h 54m	43692.0	19084.1	-39303.8	-47° 39.3′	-64° 6.1′
	11h 00m	43701.7	19093.5	-39310.0	-47° 38.8′	-64° 5.6′
	10h 46m	43696.1	19088.3	-39306.4	-47° 39.1′	-64° 5.9′
JAN. 5 1994	10h 19m	43685.4	19084.1	-39296.5	-47° 41.4′	-64° 5.8′
	10h 31m	43686.8	19075.2	-39302.4	-47° 40.9′	-64° 6.4′
	10h 42m	43691.4	19078.6	-39305.7	-47° 40.3′	-64° 6.5′
	10h 48m	43692.2	19080.2	-39306.0	-47° 40.4′	-64° 6.4′
	10h 35m	43689.0	19079.5	-39302.6	-47° 40.8′	-64° 6.3′

Table 2. K-indices at Syowa Station in February 1993 - January 1994.

	1993																						1994	
	FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY	
1	5554	3445	2232	3444	4432	1245	5321	1000	2100	0111	5633	3136	3000	0010	2200	0001	6733	3343	4322	2333	3222	5536	4554	3432
2	5542	3332	2343	2464	2221	1223	1111	1133	3211	0121	4433	4457	0000	0002	2211	2133	2121	1133	4211	1111	5544	5456	4543	3443
3	3322	1256	5443	4475	3221	1123	3122	2112	4422	2233	6652	2224	2101	0012	4533	3457	1111	1143	1111	1346	5664	3333	4232	3343
4	5422	2335	6532	1333	2221	2557	2110	0102	5665	4366	4212	2101	1232	4446	5565	3335	1111	1143	5665	5456	3212	2343	3321	2122
5	3331	1325	5421	1124	7784	3453	3321	1001	5755	4345	3510	0011	5533	2332	5422	2224	3110	0235	4444	4466	3222	4434	1111	2123
6	2321	1233	4223	1343	3222	1125	4311	1334	5553	3455	0012	0002	2343	3332	5322	3244	6631	1125	5434	3345	3221	2234	5422	3335
7	2544	2455	5662	1265	3421	1344	3431	2357	5344	3326	4420	0000	5544	3256	4532	1224	2211	1001	5333	3456	4221	5446	1111	1233
8	6654	2476	4342	3445	2333	3465	7463	3355	5423	3243	4532	3322	3443	2201	5221	1125	4334	3233	5322	3354	6555	4642	3331	2122
9	5634	4445	6655	3336	4321	1547	7764	3366	5421	1102	5521	2333	5533	2232	3011	1022	4574	4455	4322	2335	2111	0112	2221	1221
10	4322	3353	6531	2224	5552	2335	7765	4234	1011	1237	4333	3244	2112	2234	2211	1103	6553	3345	5422	2332	3221	2343	1221	1111
11	6522	2346	3323	3566	3421	2124	3211	1112	4321	2123	5653	3321	4111	1003	5311	0133	5533	3436	3421	2111	4221	2222	1233	3555
12	4432	2224	7432	2475	6732	1222	2433	3366	3233	4225	3233	2112	2331	1103	3111	1456	6332	3235	3321	1111	3222	3224	5554	4435
13	6422	2234	6543	2545	2664	4444	6510	1154	4333	2214	4433	2213	3321	1103	5876	5556	5532	2143	2222	3333	3221	1213	6443	3445
14	4421	1232	5344	3466	6552	1335	3433	3312	2322	2325	2000	0010	2000	0000	6443	3336	5321	2113	3222	4544	2212	1122	4533	4445
15	4421	2122	5564	3447	5553	2256	1121	1234	3331	1000	1110	0012	0000	1245	5532	2344	3211	1112	4531	2255	3332	2222	6642	2466
16	2222	2122	5463	3445	5542	2245	4522	2225	0010	1001	2100	0003	5666	5677	2211	2120	2312	1223	5422	2344	3553	4445	4532	3454
17	2444	4423	6533	2266	4212	1432	4542	2255	1010	0023	1000	0002	7752	3423	1110	1113	5411	1124	3221	1143	5533	3364	6553	4336
18	3223	3366	6452	2224	6543	2332	1111	0125	1000	0000	2011	1212	4553	2345	2111	0002	4411	2333	2221	4565	4333	4345	5433	4554
19	4221	2223	3222	2333	4422	1423	3333	2133	0111	1123	2402	1002	4442	2154	3211	0012	4322	1234	4622	3446	5431	2335	6653	3335
20	6654	3445	5553	3335	6643	3344	2342	2111	2021	0011	2233	2345	4321	1113	1112	2456	3111	1233	6522	1223	5422	2334	4331	3243
21	3343	3544	4534	5435	6553	3445	1100	0001	0000	0001	4544	3333	3231	1112	6311	1344	3321	2123	3331	1123	4323	3444	4422	2344
22	5543	3446	5432	4455	6332	2445	1210	0001	3100	0004	5423	3223	3312	1004	4421	1102	5531	2234	4221	1123	4222	2134	4421	1124
23	4522	2222	4322	2235	3322	1246	0000	0001	4411	1054	4431	1101	3111	0100	1111	2234	3542	2133	3321	2223	3322	2335	4232	1233
24	3222	2223	5675	3445	5223	1222	0111	0001	4553	4335	2001	1110	0122	1113	5122	2443	5421	1232	2211	1223	3332	2344	4222	3012
25	2422	1122	4432	2333	4332	2225	1100	0000	4344	3324	3310	1002	3111	0003	2222	2124	2334	5544	2321	1223	3422	3233	3421	1123
26	2221	1122	2322	1233	2222	1112	0000	0011	4331	1103	2210	0101	3211	0123	4442	2013	2222	2545	3231	2446	3311	3334	5653	4444
27	2222	1124	4331	2445	2222	1114	2562	2223	4211	1111	2000	1122	4121	3445	5421	2244	5663	4445	5321	1223	3421	3322	5533	3445
28	5433	4322	4531	2447	2122	1111	5643	3456	1011	1000	4321	0025	3112	2334	2111	2344	4343	2136	1222	2222	3211	1222	6532	3234
29			5652	1123	1222	1245	5433	1213	0222	2212	5322	2234	5431	2105	2223	3464	4421	3324	5522	3334	2211	1113	1332	3222
30			4442	3444	5322	2234	1211	0000	4441	1313	5511	0011	3211	0003	5542	1136	4111	1102	4221	1212	3321	1111	4222	2434
31			5321	1245			1101	1101			4212	0011	4210	0023			1122	2343			4455	2444	4322	2224

Table 3. Observation periods of a 35 mm all-sky camera at Syowa Station in 1993.

Date	Hours (Universal Time)			K-Index	
	h m s	h m s	h m s		
MAR. 13			18 04 00	6543	2545
14	-00 59 37		18 01 00	5344	3466
15	-00 59 37	18 01 00	-20 40 07	5564	3447
16			18 05 00	5463	3445
17	-00 59 37	18 01 00	-20 35 37	6533	2266
21		20 02 00	-23 59 07	4534	5435
23			22 02 00	4322	2235
24	-00 59 37		17 31 00	5675	3445
25	-00 59 37		17 31 00	4432	2333
26	-01 29 37	17 31 00	-18 23 37	2322	1233
APR. 1			19 04 00	4432	1245
2	-01 29 37		17 16 00	2221	1223
3	-01 29 37		17 01 00	3221	1123
4	-01 59 37	17 01 00	-17 16 37	2221	2557
6			17 01 00	3222	1125
7	-01 59 37	16 31 00	-21 59 07	3421	1344
8			16 31 00	2333	3465
9	-01 59 37	16 31 00	-17 11 07	4321	1547
10		16 41 00	-21 27 07	5552	2335
APR. 15			16 32 00	5553	2256
16	-02 29 37		16 30 00	5542	2245
17	-02 29 37	16 31 00	-19 06 37	4212	1432
20			19 26 00	6643	3344
21	-02 29 07	16 00 00	-19 45 37	6553	3445
24			15 00 00	5223	1222
25	-03 59 37	15 01 00	-19 56 07	4332	2225
25			20 23 00	4332	2225
26	-03 59 37		15 01 00	2222	1112
27	-03 59 37		15 01 00	2222	1114
28	-03 59 37		15 01 00	2122	1111
29	-03 59 37	15 01 00	-21 17 07	1222	1245
30	01 34 00	-03 59 37	15 01 00	5322	2234
MAY 1	-03 59 37		15 01 00	5321	1000
2	-03 59 37		15 01 00	1111	1133
3	-03 59 37		15 01 00	3122	2112
4	-00 51 07			2110	0102
5			17 24 00	3321	1001
6	-03 59 37	15 01 00	-21 09 37	4311	1334
9			16 01 00	7764	3366
10	-03 59 37		14 31 00	7765	4234
11	-04 15 37			3211	1112
12			14 31 00	2433	3366
13	-01 20 07	02 30 00	-04 29 37	6510	1154
13			14 30 00	6510	1154
14	-03 44 07			3433	3312
18			15 24 00	1111	0125

Date	Hours (Universal Time) h m s	h m s	h m s	K-Index	
MAY 19	-04 29 37	14 31 00	-20 40 37	3333	2133
20		14 31 00	-21 12 07	2342	2111
21		14 31 00	-17 51 37	1100	0001
22			19 35 00	1210	0001
23	-04 29 37	14 29 00	-14 38 37	0000	0001
23			15 09 00	0000	0001
24	-01 57 07	14 31 00	-14 32 37	0111	0001
25			14 31 00	1100	0000
26	-02 44 37		14 10 00	0000	0011
27	-04 29 37			2562	2223
30			14 01 00	1211	0000
31	-04 59 37	14 01 00	-17 13 37	1101	1101
31			21 30 00	1101	1101
JUN. 1	-04 59 37		14 01 00	2100	0111
2	-04 59 37		14 01 00	3211	0121
3	-04 59 37		14 01 00	4422	2233
4	-04 59 37	14 01 00	-14 38 07	5665	4366
4			17 19 00	5665	4366
5	-04 59 37		14 01 00	5755	4345
6	-04 59 37		14 01 00	5553	3455
7	-04 59 37		14 01 00	5344	3326
8	-03 38 07		16 37 00	5423	3243
9	-04 59 37		16 11 00	5421	1102
10	-04 51 07		13 00 00	1011	1237
11	-04 59 37	13 01 00	-15 57 37	4321	2123
13		16 38 00	-17 46 07	4333	2214
14		14 18 00	-22 25 07	2322	2325
15			23 10 00	3331	1000
16	-02 02 07			0010	1001
18			14 01 00	1000	0000
19	-04 59 37		14 01 00	0111	1123
20	-04 59 37		14 01 00	2021	0011
21	-04 59 37	14 01 00	-19 14 37	0000	0001
21			21 28 00	0000	0001
22	-04 59 37		14 03 00	3100	0004
23	-04 59 37		14 03 00	4411	1054
24	-04 59 37		14 03 00	4553	4335
25	-04 59 37	14 01 00	-17 10 37	4344	3324
25			22 42 00	4344	3324
26	-04 59 37		14 01 00	4331	1103
27	-04 59 37		14 01 00	4211	1111
28	-04 59 37		14 01 00	1011	1000
29	-04 59 37	14 01 00	-15 51 37	0222	2212
JUL. 2			15 04 00	4433	4457
3	-04 59 37		14 05 00	6652	2224
4	-04 59 37		14 05 00	4212	2101
5	-04 59 37	14 05 00	-16 53 07	3510	0011

Date	Hours (Universal Time)			K-Index	
	h m s	h m s	h m s		
JUL. 8		14 17 00	-20 54 07	4532	3322
9	01 11 00	-04 59 37	14 45 00	5521	2333
10	-04 59 37		14 01 00	4333	3244
11	-04 59 37		14 01 00	5653	3321
12	-04 59 07			3233	2112
16		14 35 00	-19 51 07	2100	0003
17			16 35 00	1000	0002
18	-04 59 37	15 53 00	-17 41 37	2011	1212
21		14 20 00	-19 12 07	4544	3333
23		14 01 00	-21 31 07	4431	1101
24		14 09 00	-18 11 07	2001	1110
26			18 44 00	2210	0101
27	-04 28 07		14 01 00	2000	1122
28	-04 59 37		14 01 00	4321	0025
29	-04 59 37	14 01 00	-17 16 37	5322	2234
31	00 55 00	-04 59 37	14 55 00	4212	0011
31	-20 57 37			4212	0011
AUG. 5	03 12 00	-04 59 37		5533	2332
7			16 03 00	5544	3256
8	-04 27 37		14 31 00	3443	2201
9	-04 29 37		14 31 00	5533	2232
10	-04 29 37		14 31 00	2112	2234
11	-01 21 07		16 56 00	4111	1003
12	-04 29 37		19 15 00	2331	1103
13	-03 01 37			3321	1103
17			15 06 00	7752	3423
18	-03 59 37		15 02 00	4553	2345
19	-03 59 37		15 02 00	4442	2154
20	-03 59 37		15 02 00	4321	1113
21	-03 29 37	16 16 00	-22 22 07	3231	1112
22		15 06 00	-16 50 07	3312	1004
23			21 36 00	3111	0100
24	-03 11 37		15 01 00	0122	1113
25	-02 59 37		15 01 00	3111	0003
26	-02 59 37		15 01 00	3211	0123
27	-02 59 37	19 16 00	-21 52 37	4121	3445
28			16 17 00	3112	2334
29	-01 05 07		15 05 00	5431	2105
30	-02 59 37		15 01 00	3211	0003
31	-02 59 37		15 01 00	4210	0023
SEP. 1	-02 58 37			2200	0001
2			22 56 00	2211	2133
3	-02 58 37			4533	3457
5		15 02 00	-20 21 37	5422	2224
7		16 02 00	-23 41 07	4532	1224
8	01 20 00	-01 55 37	16 02 00	5221	1125
9	-02 06 37		16 01 00	3011	1022

Date	Hours(Universal Time) h m s	h m s	h m s	K-Index	
SEP. 10	-01 55 07	16 32 00	-18 17 37	2211	1103
14			17 03 00	6443	3336
15	-01 59 37		17 00 00	5532	2344
16	-01 29 37		17 01 00	2211	2120
17	-01 02 07			1110	1113

Appendix

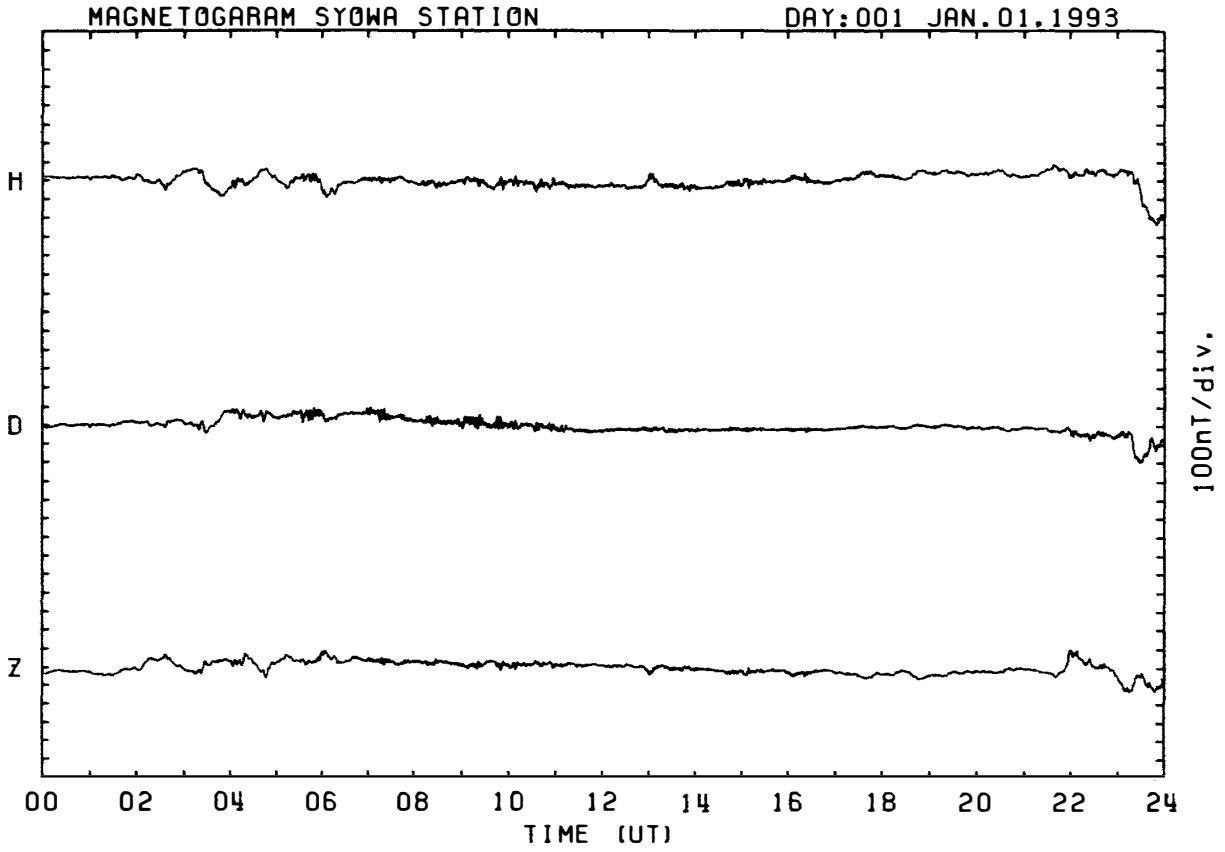
Summary plots of the Upper Atmosphere Physics Monitoring data in 1993

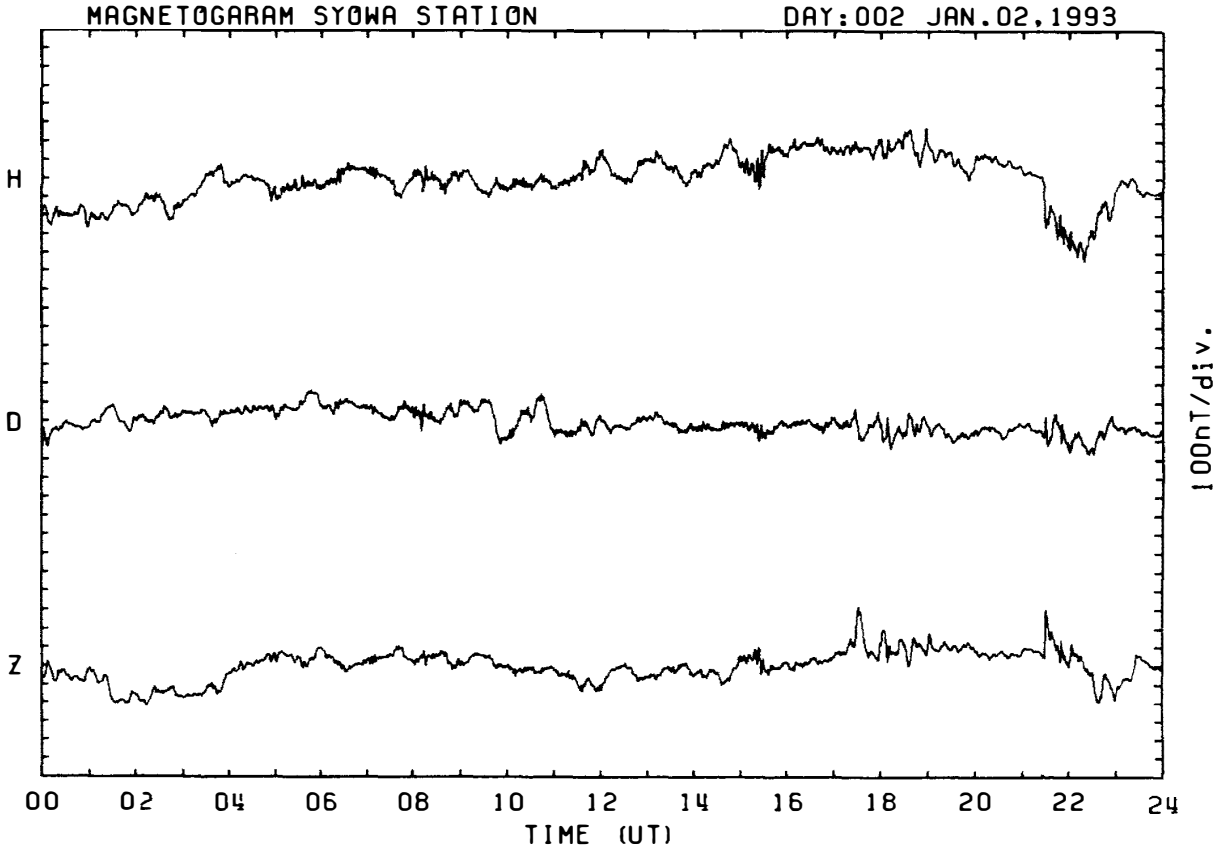
- Plotted data from top:

H	: northward component of the magnetic variation
D	: westward component of the magnetic variation
Z	: downward component of the magnetic variation

- Plotting vertical scale:

H, D, Z : 100 nT/div


MAGNETOGARAM SYOWA STATION
DAY:001 JAN.01.1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)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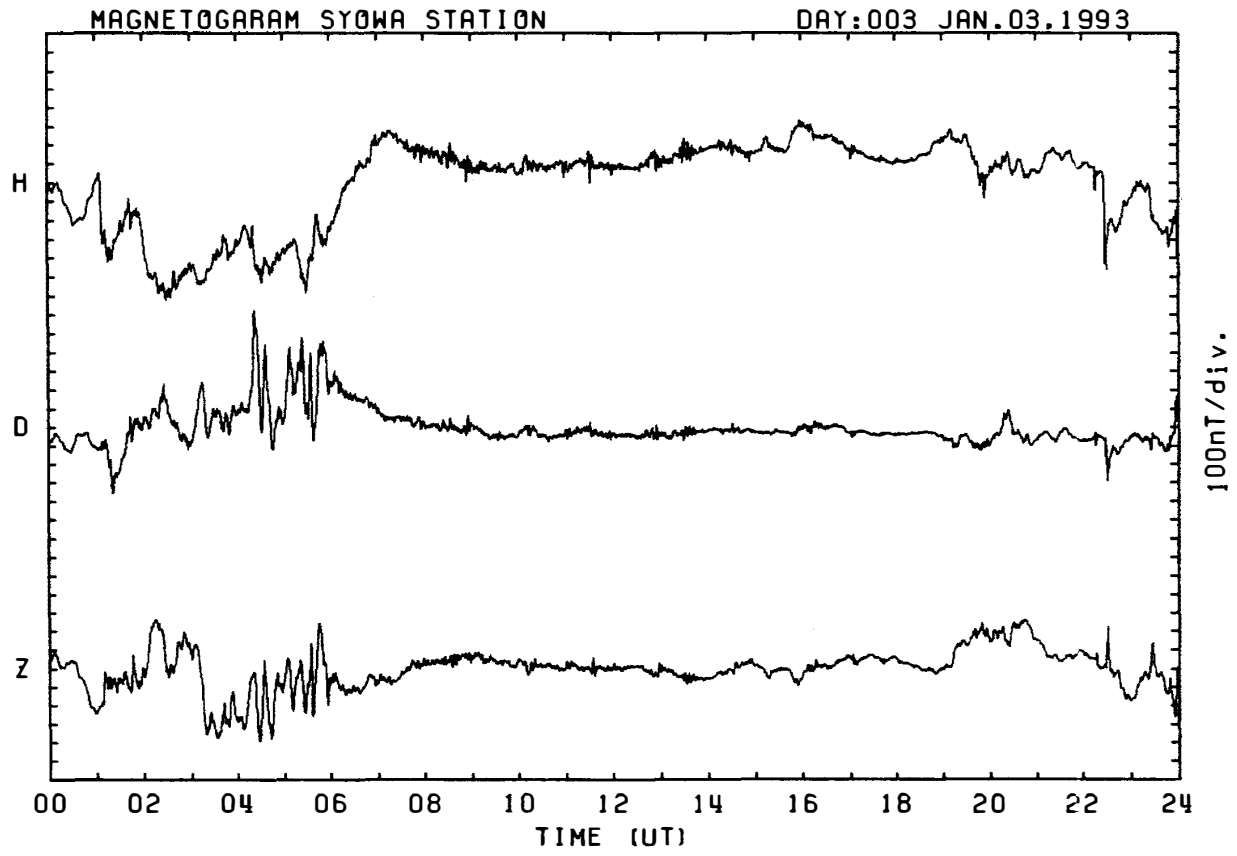
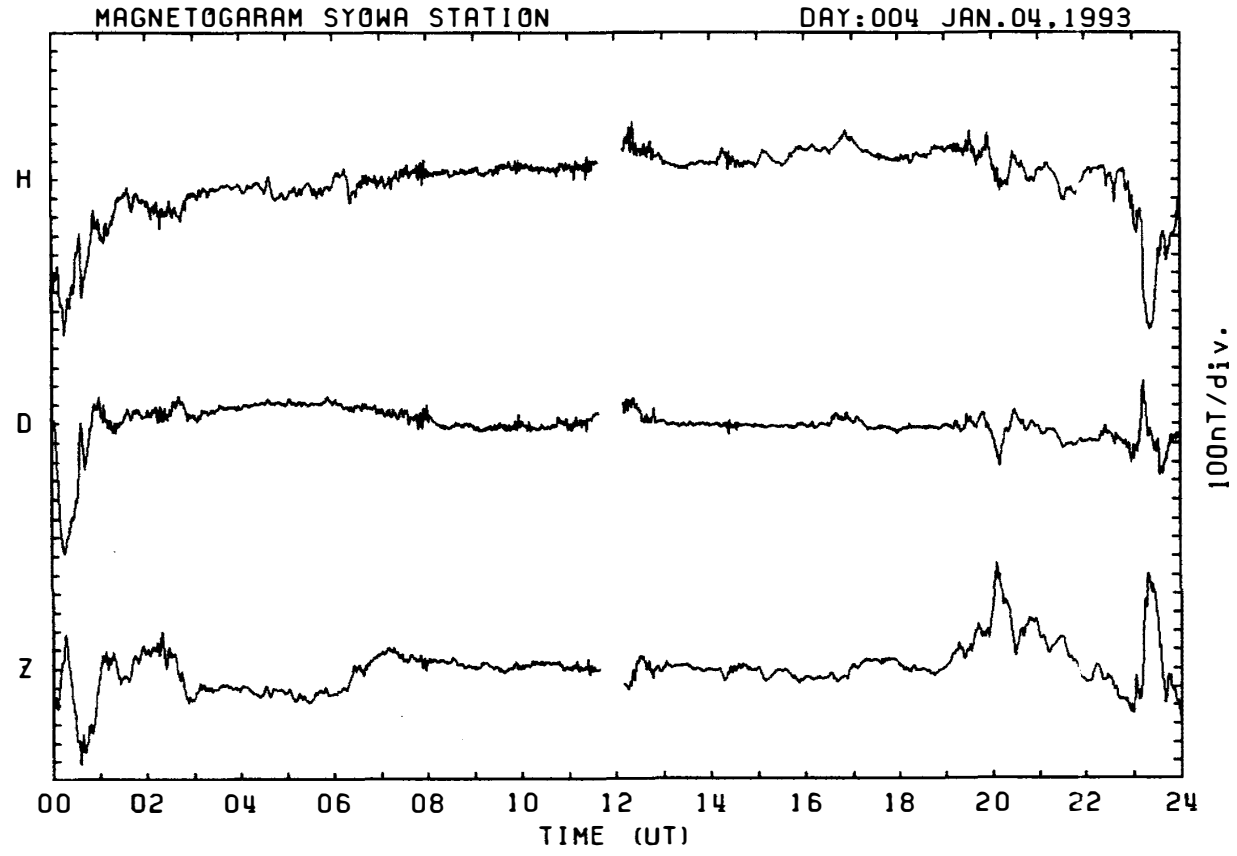
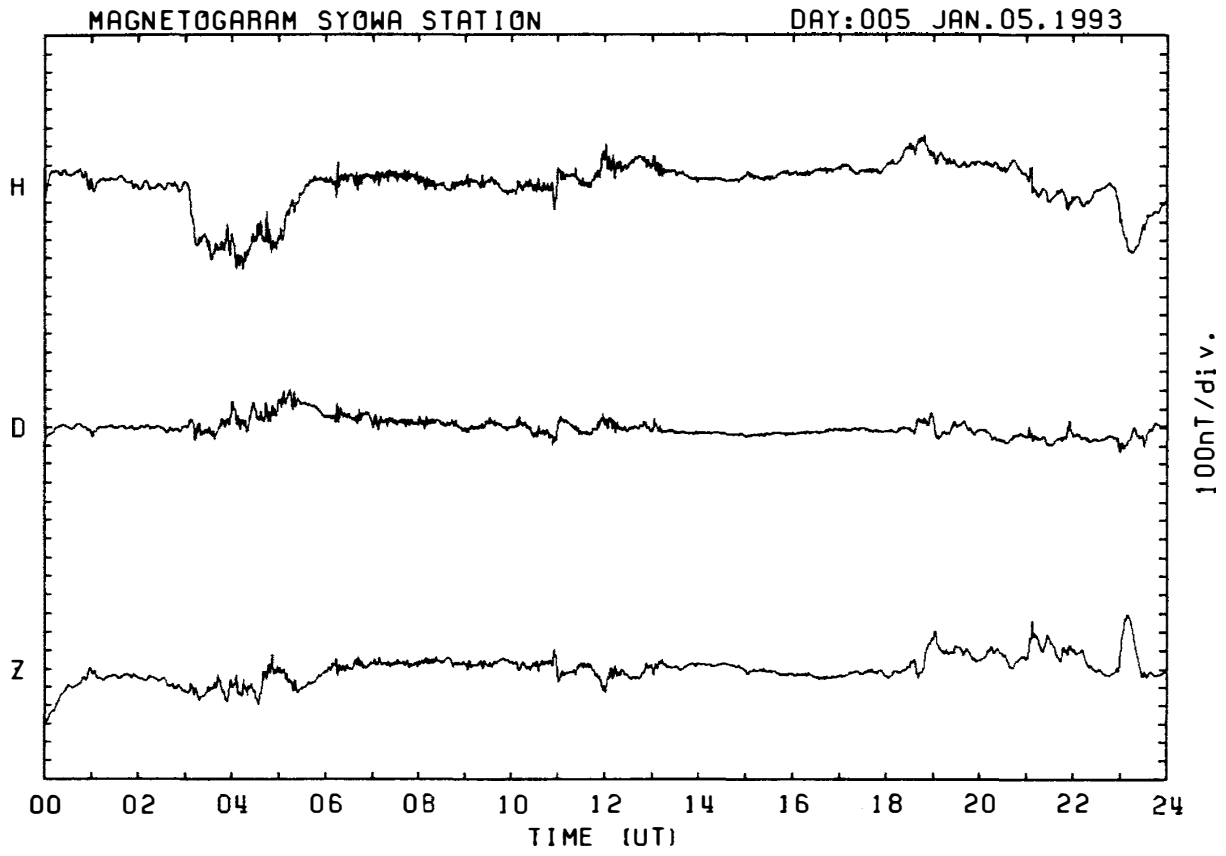
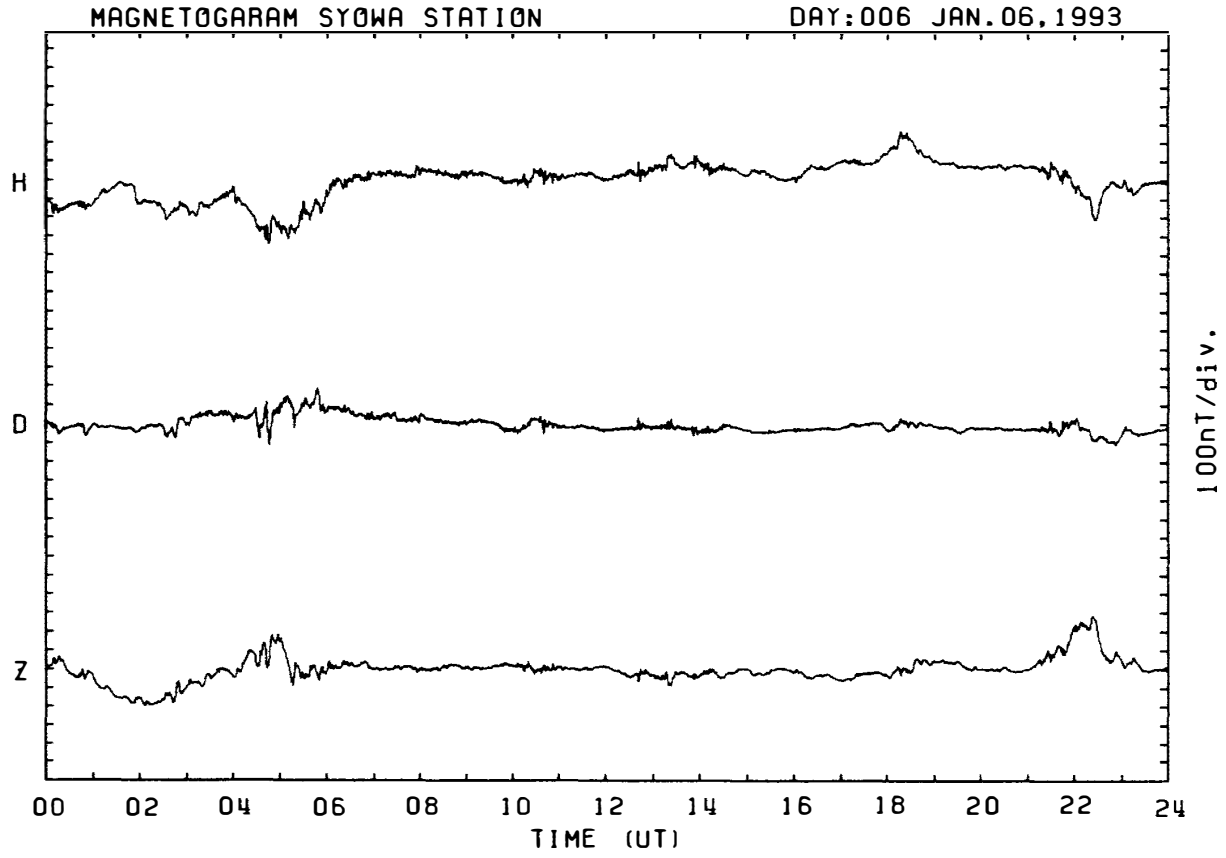
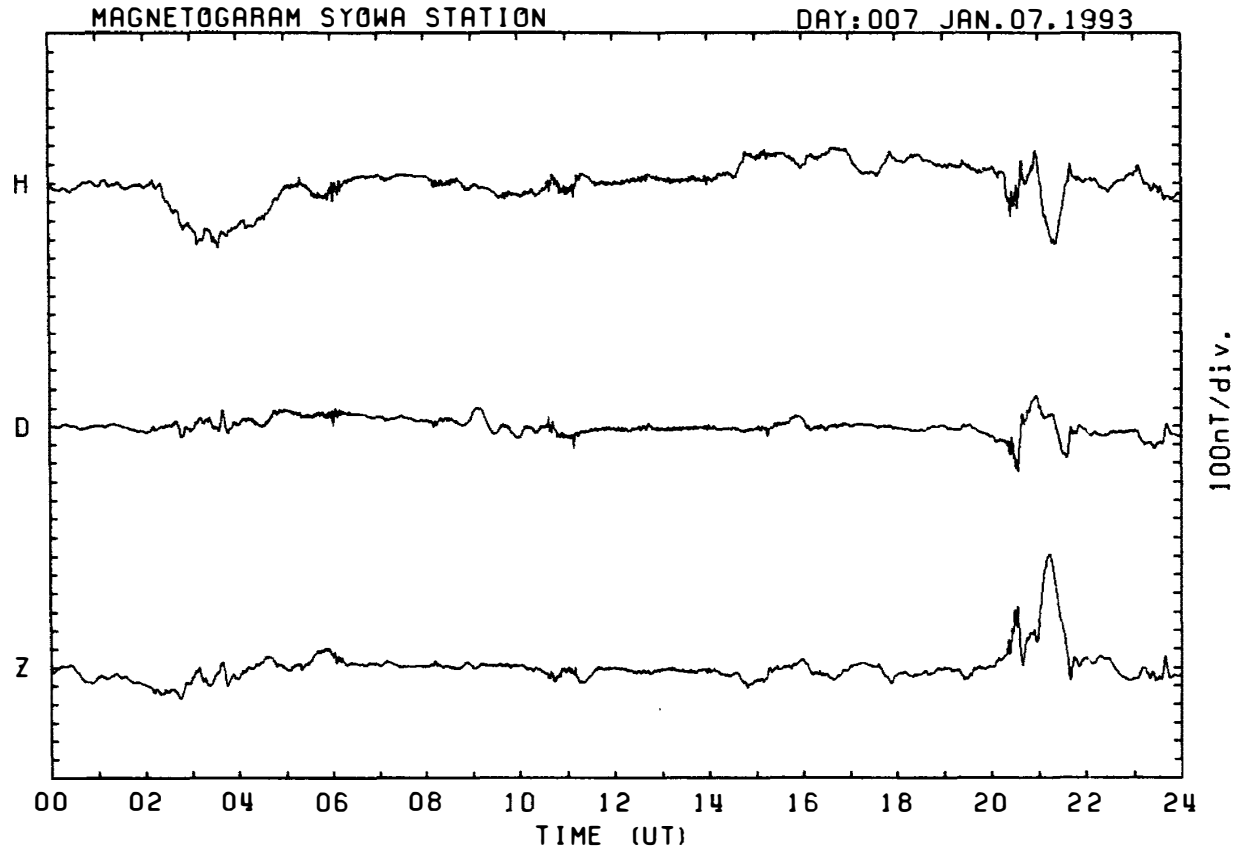
DAY:002 JAN.02.1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:003 JAN.03.1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:004 JAN.04.1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:005 JAN.05.1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:006 JAN.06,1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:007 JAN.07,1993
H
D
Z
100nT/div.
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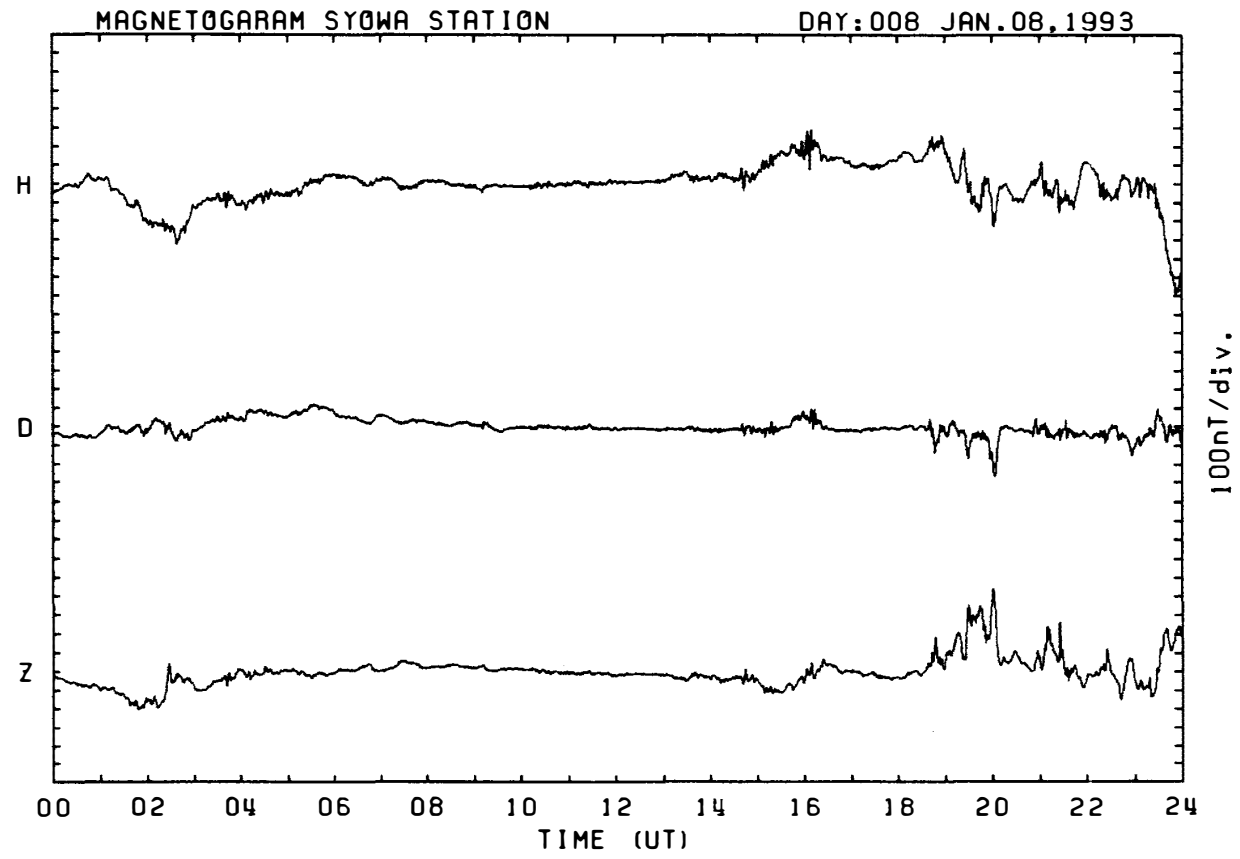
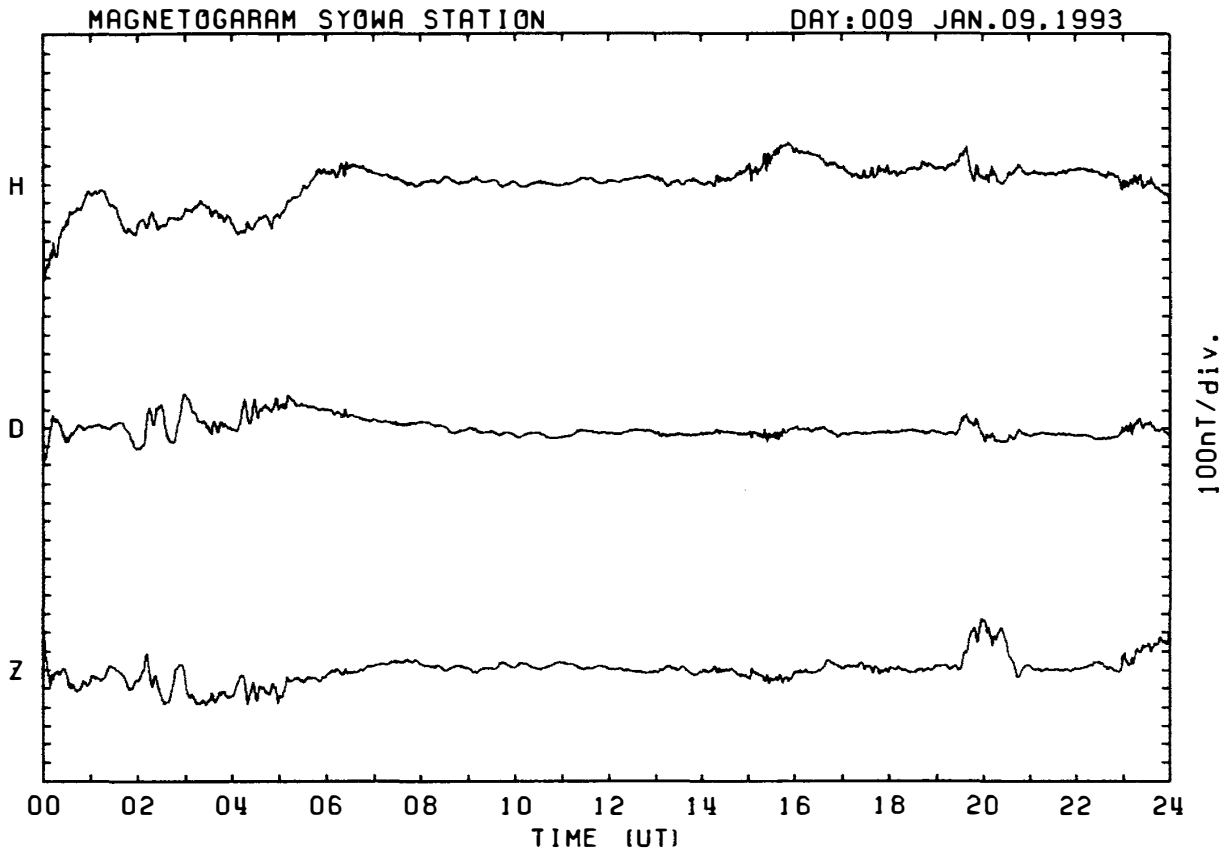
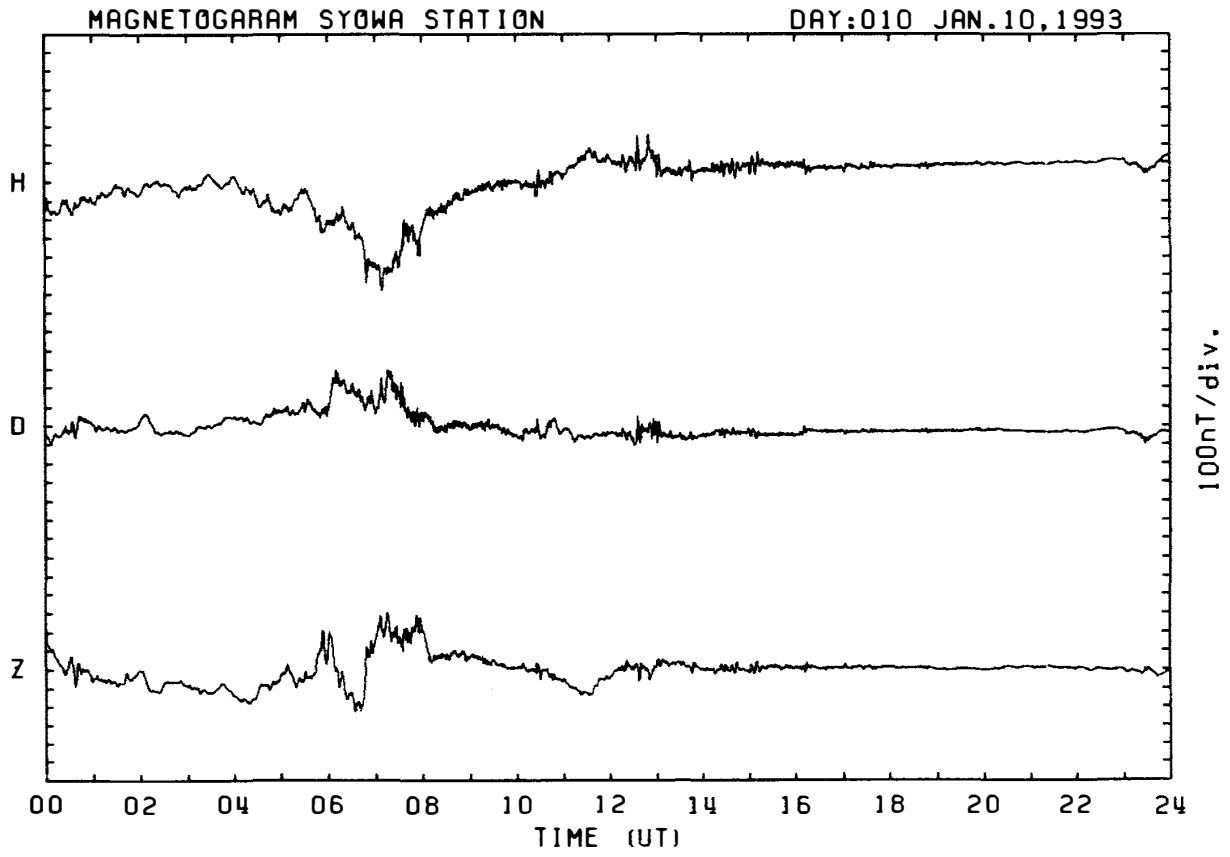
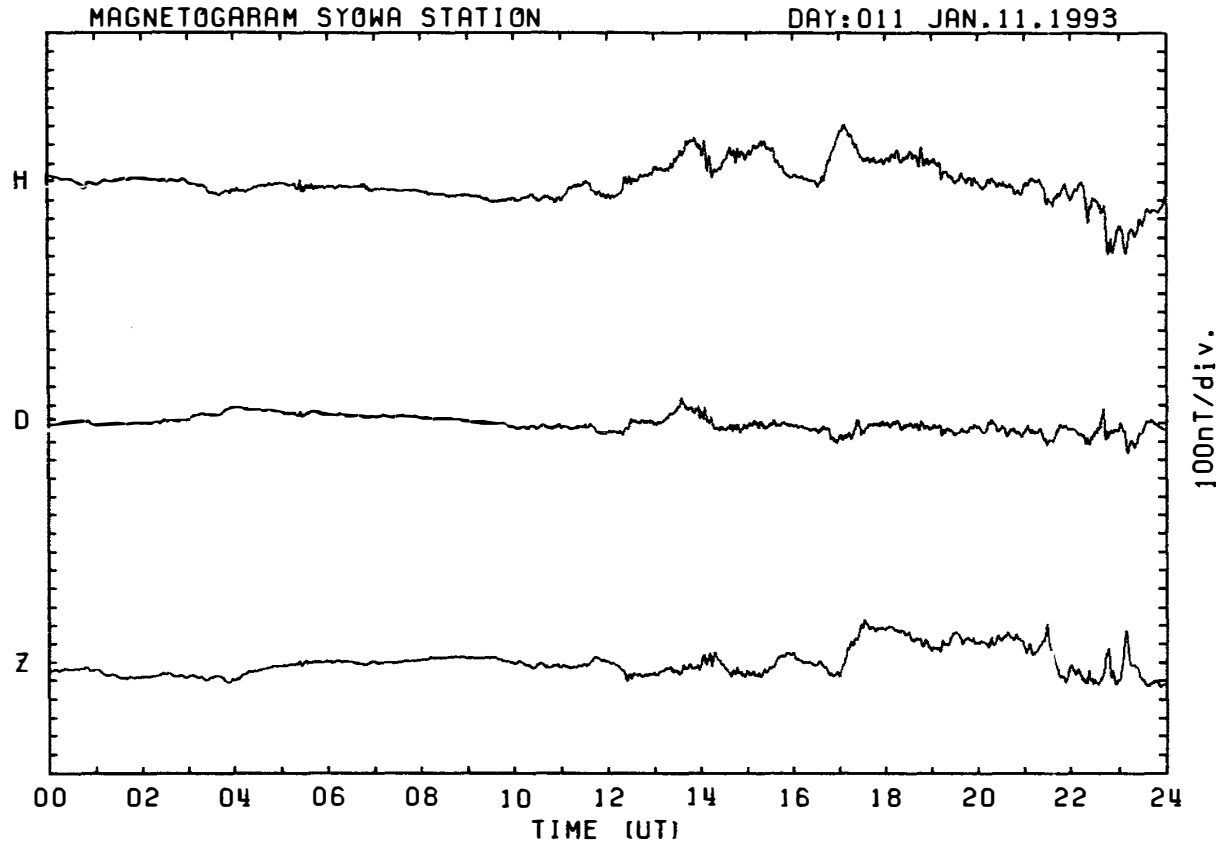
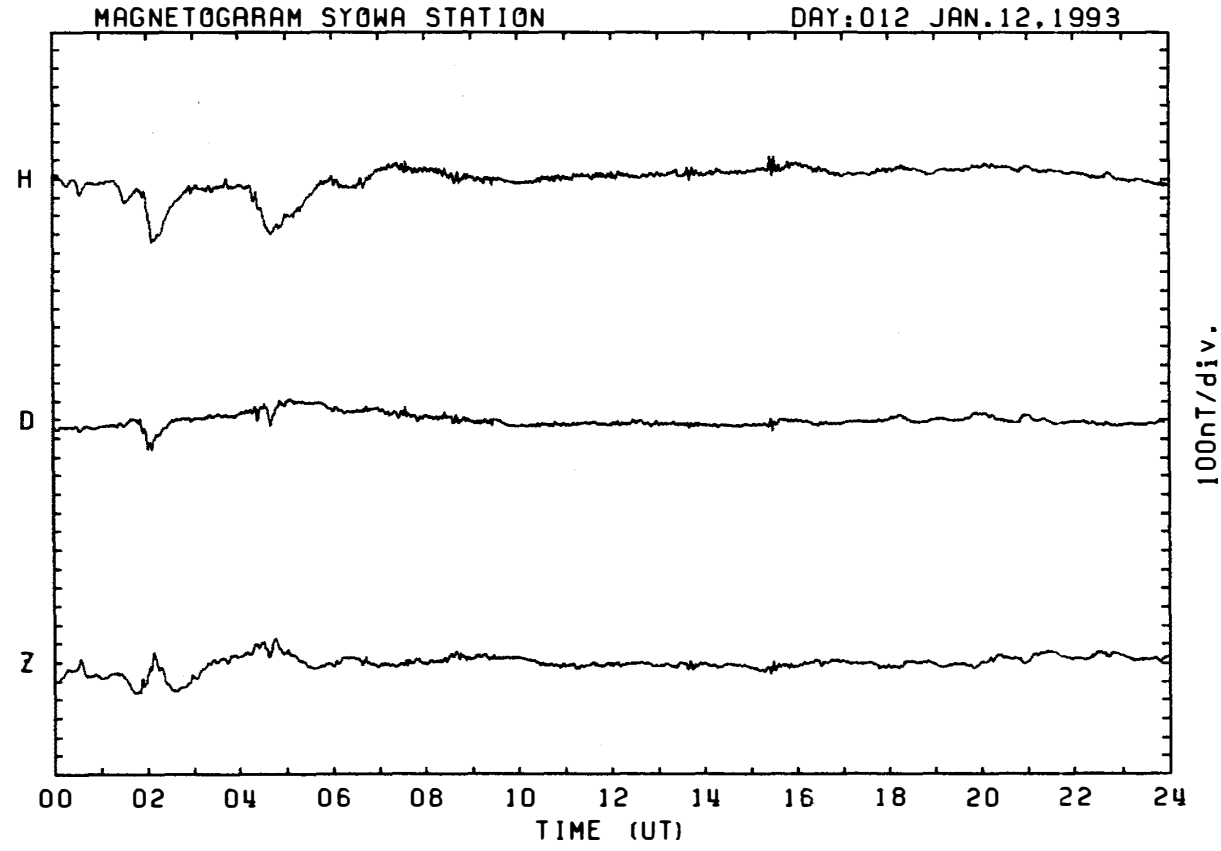
TIME (UT)

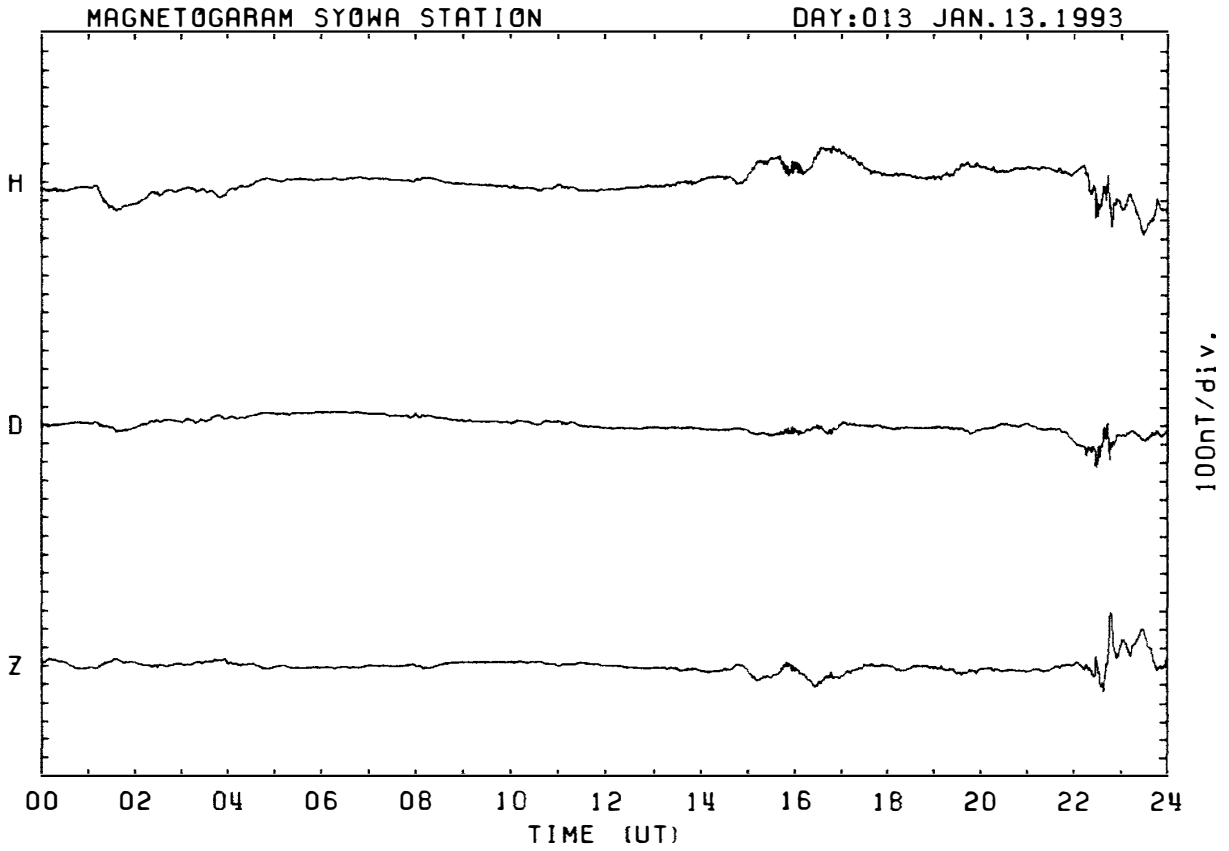

MAGNETOGARAM SYOWA STATION
DAY:008 JAN.08,1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)

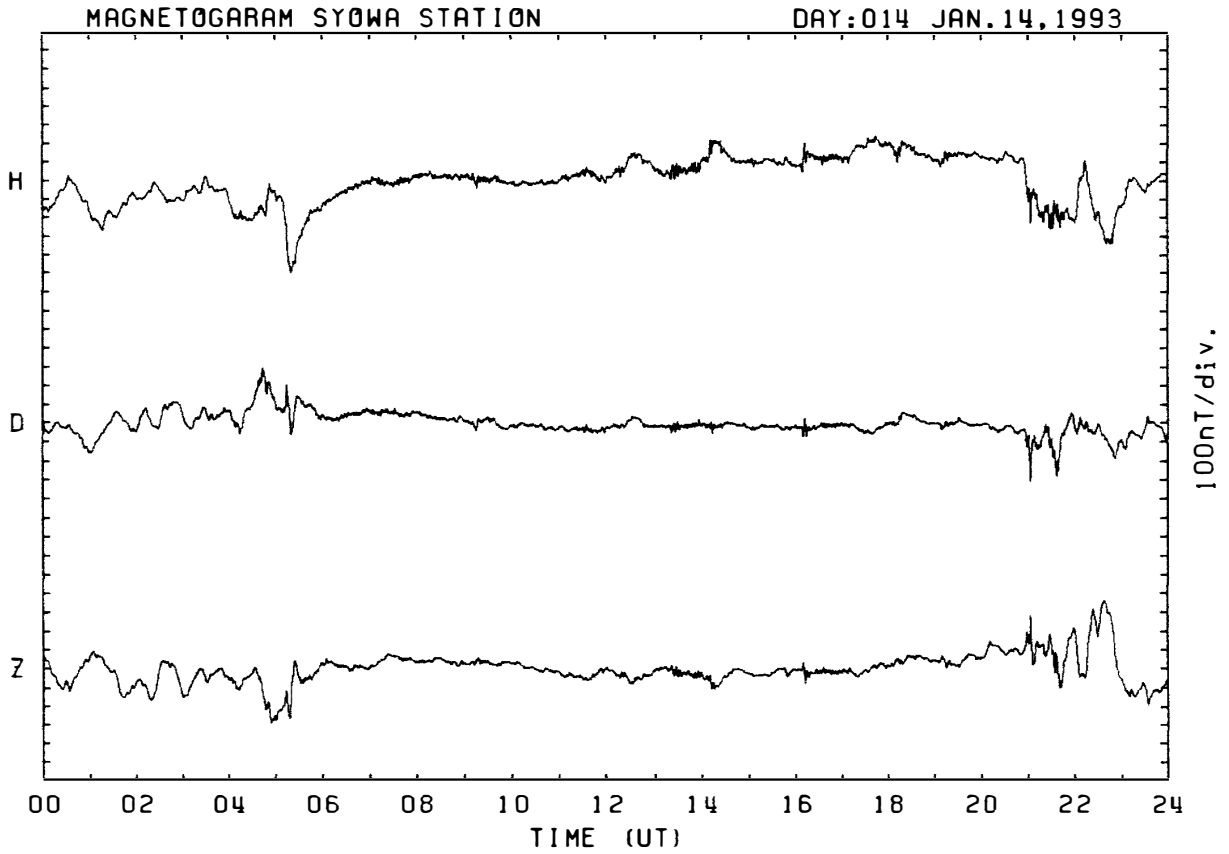

MAGNETOGARAM SYOWA STATION
DAY:009 JAN.09,1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)

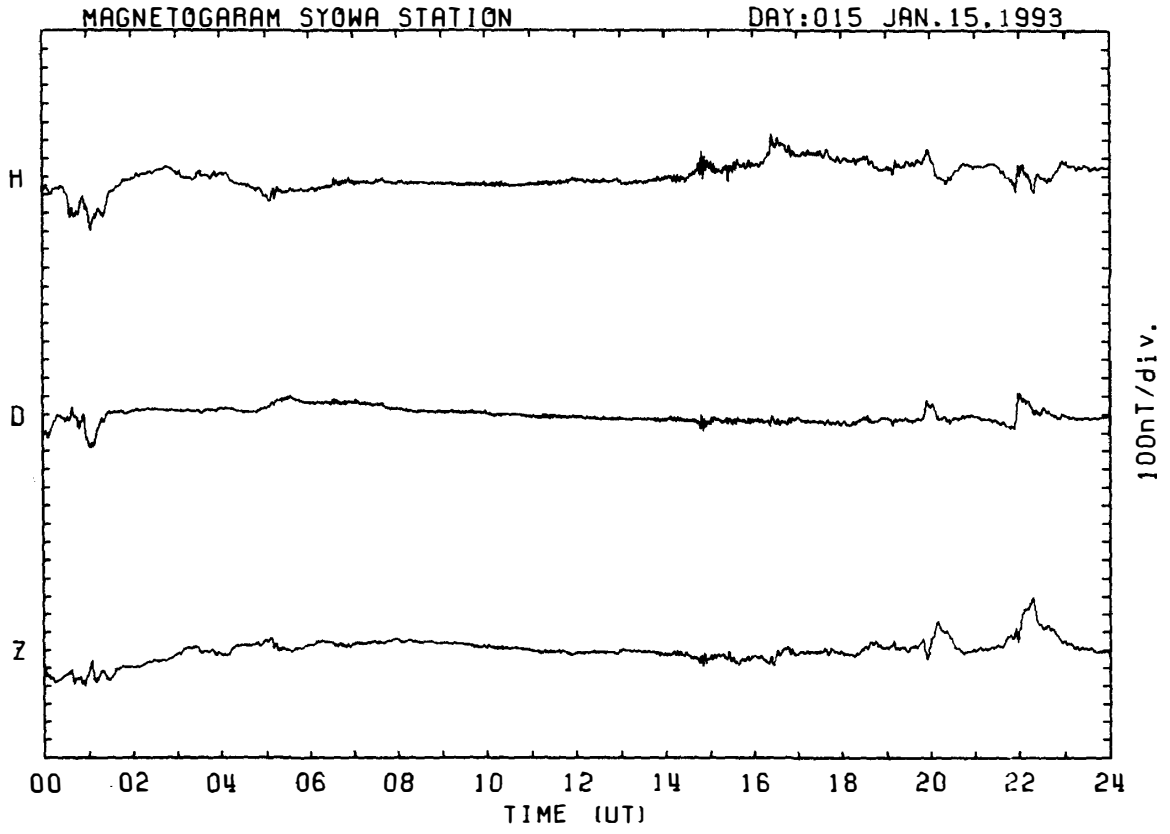

MAGNETOGARAM SYOWA STATION
DAY:010 JAN.10,1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)

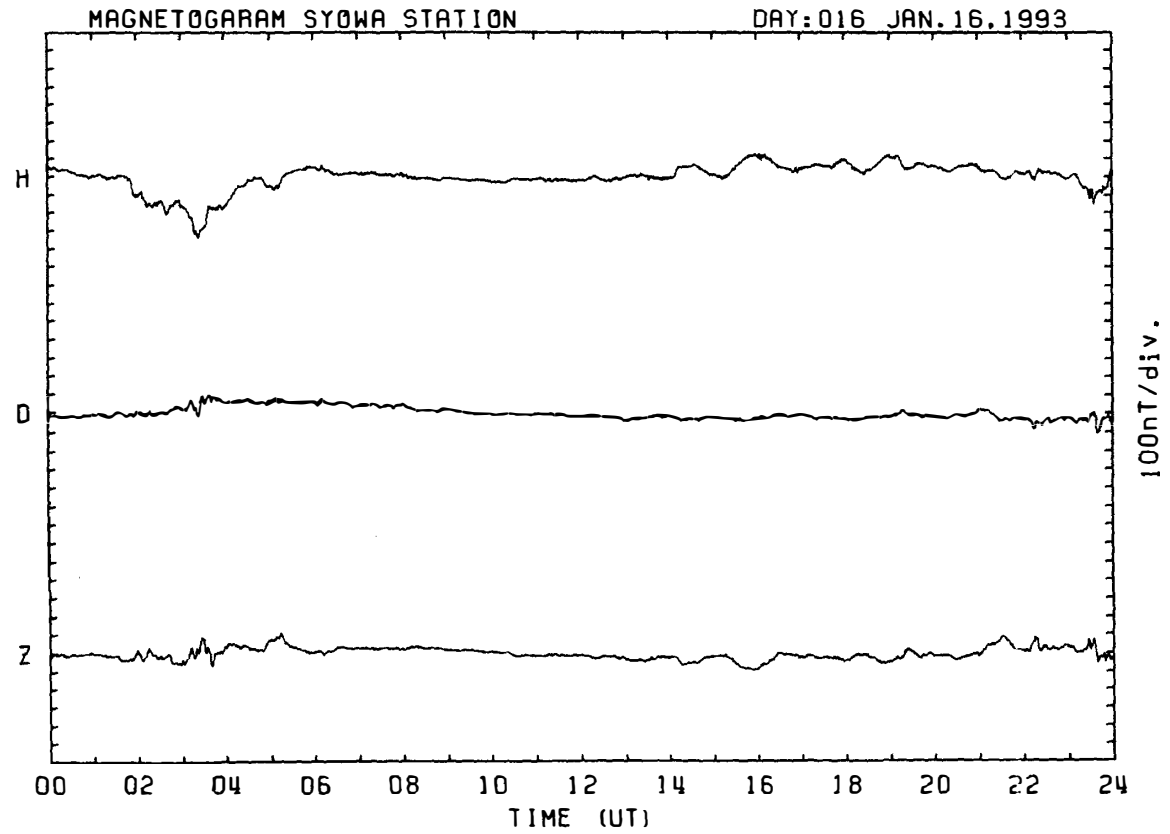

MAGNETOGARAM SYOWA STATION
DAY:011 JAN.11.1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:012 JAN.12,1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:013 JAN.13.1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:014 JAN.14,1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:015 JAN.15.1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:016 JAN.16.1993
H
D
Z
100nT/div.
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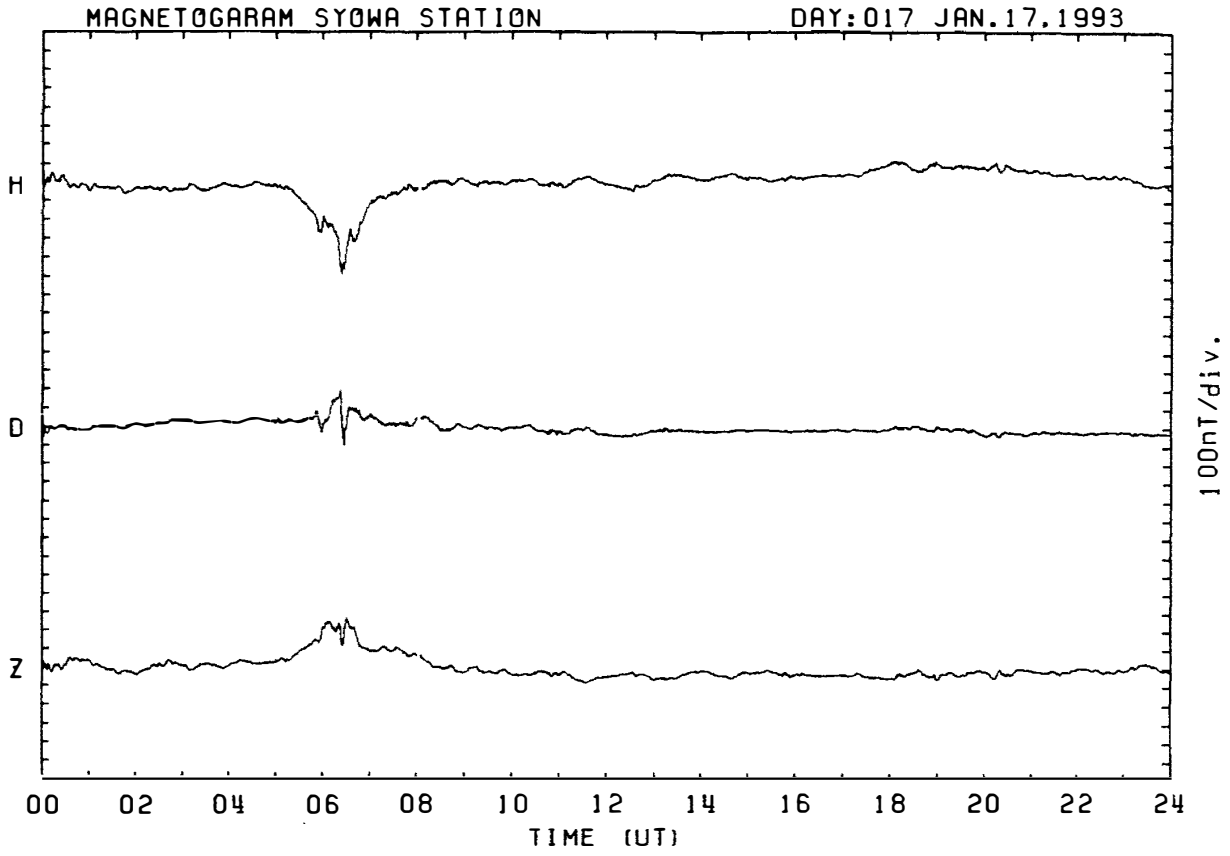
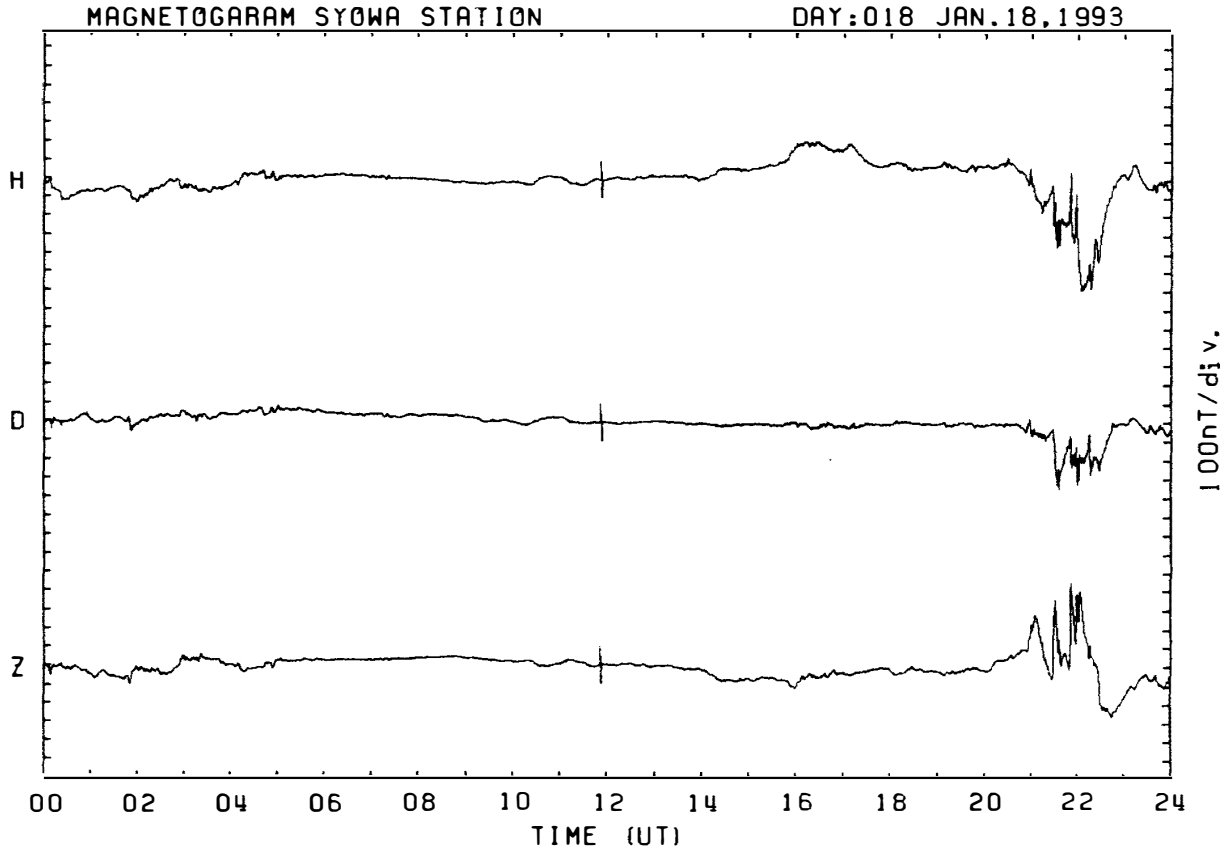
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:017 JAN.17,1993
H
D
Z
100nT/div.
00 02 04 06 08 10 12 14 16 18 20 22 24
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:018 JAN.18,1993
H
D
Z
100nT/div.
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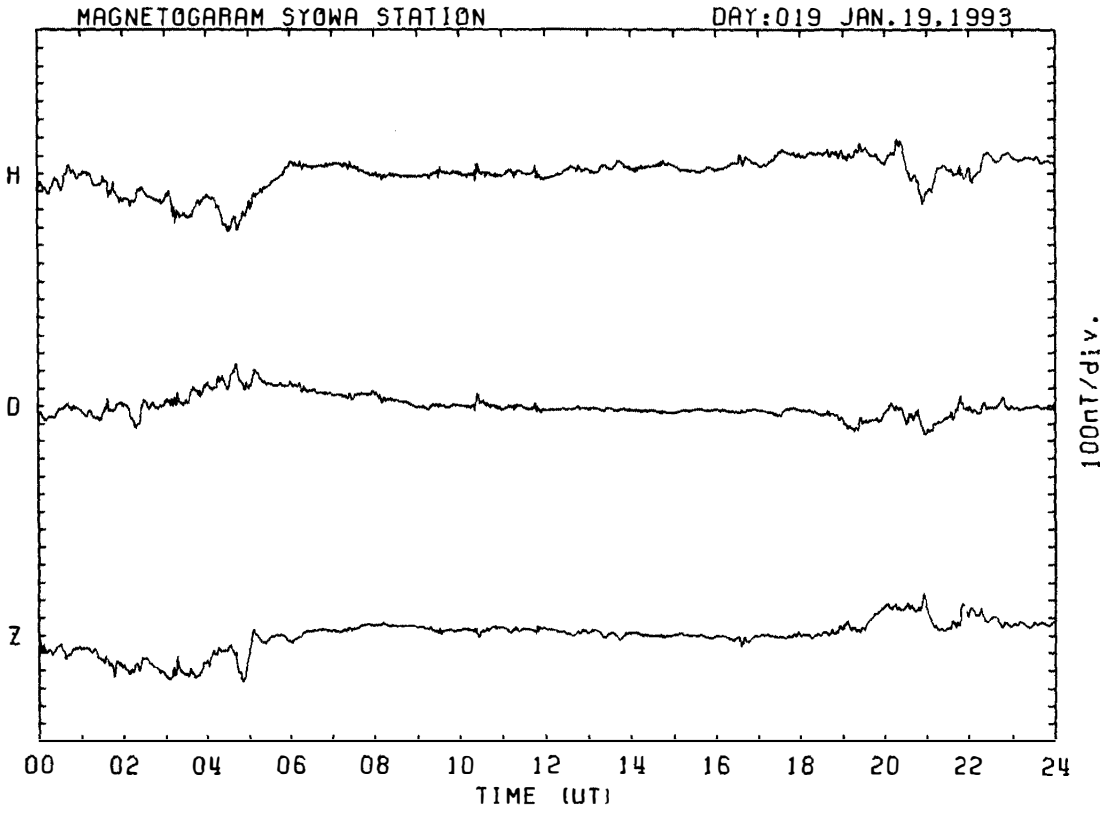
TIME (UT)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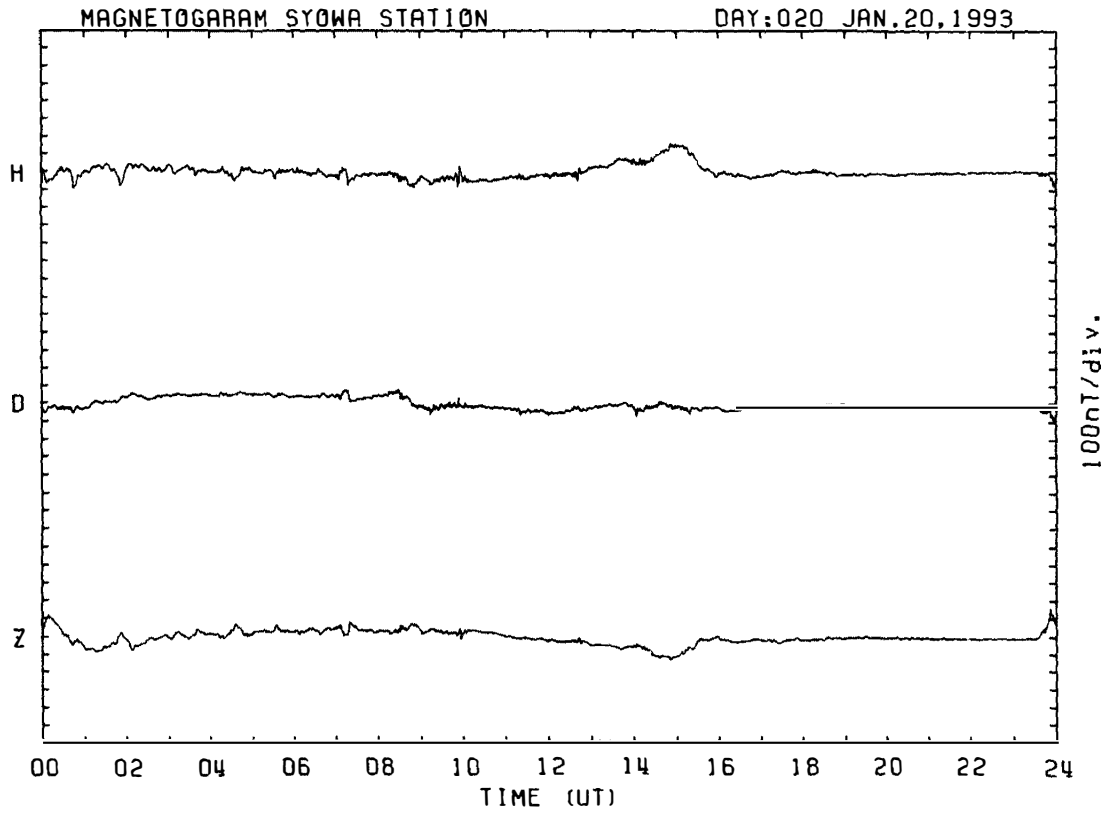
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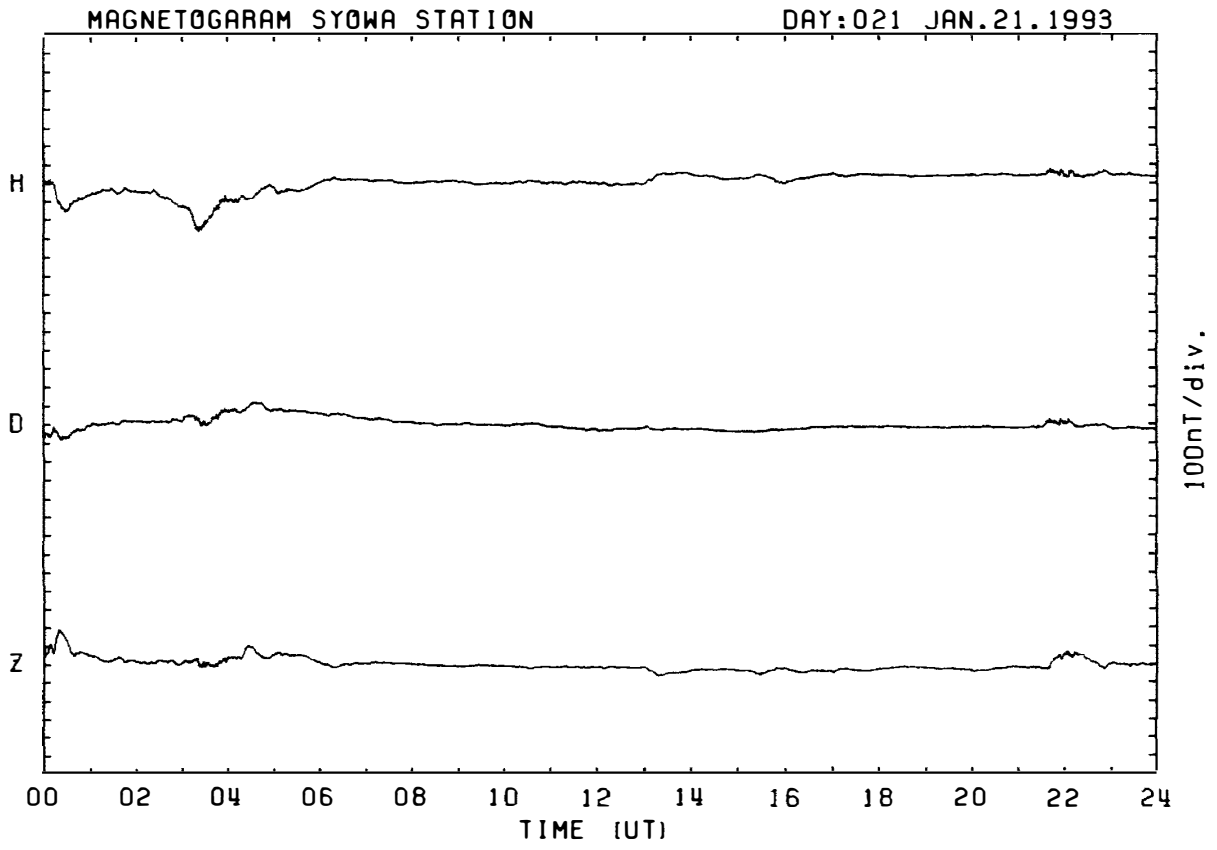
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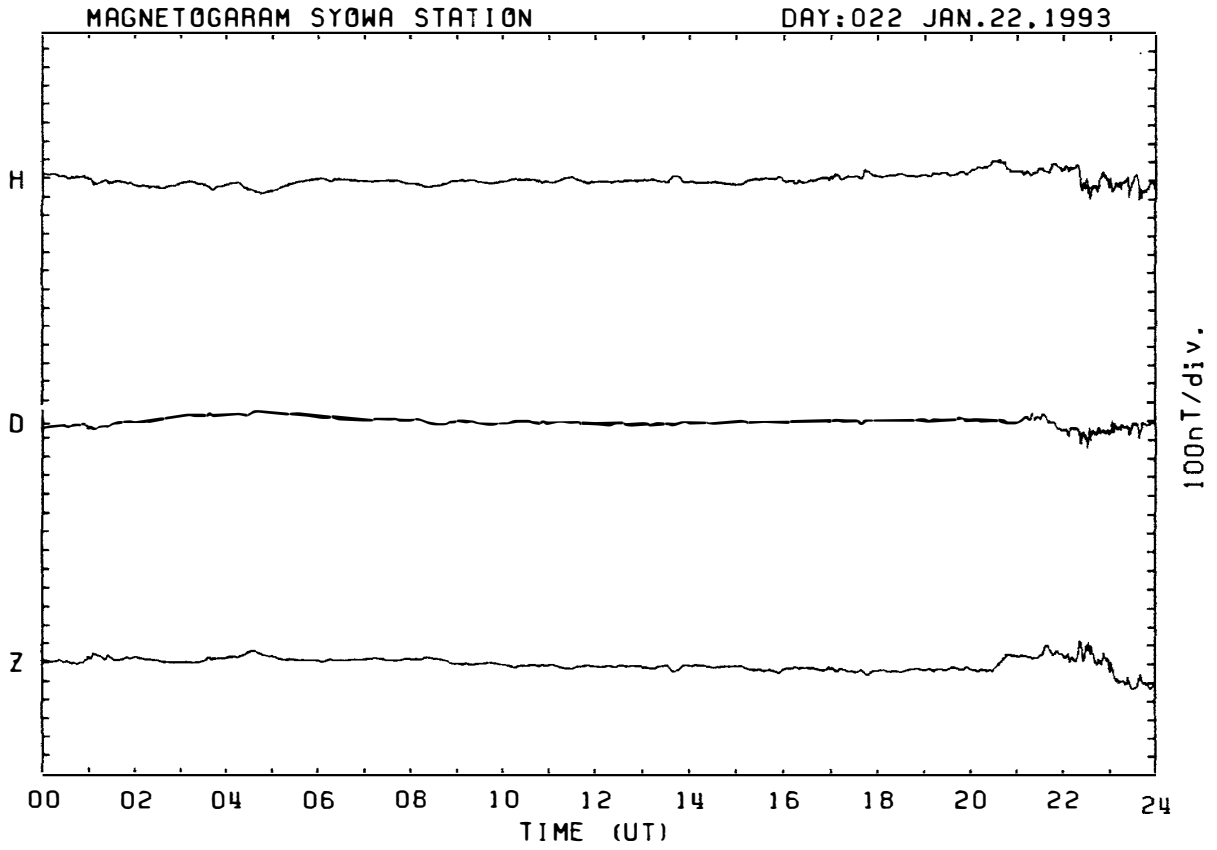
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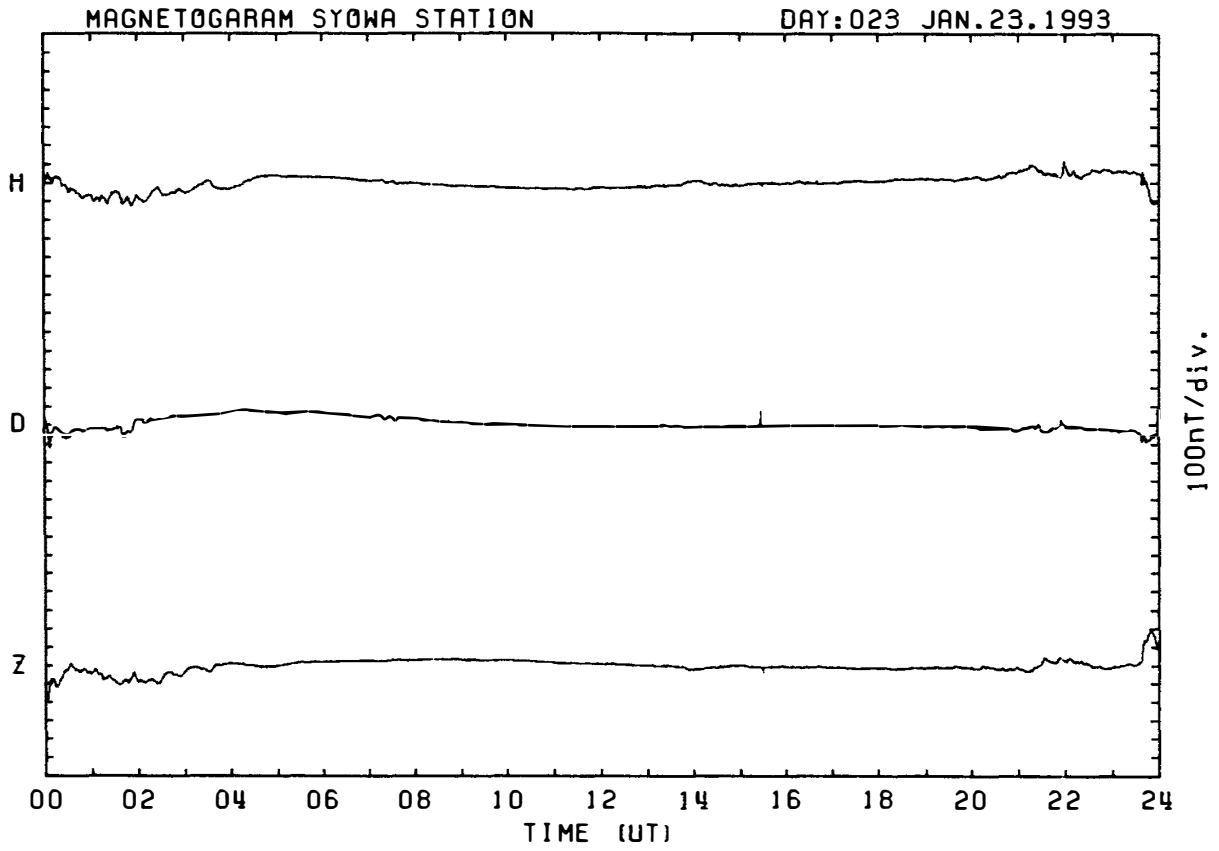
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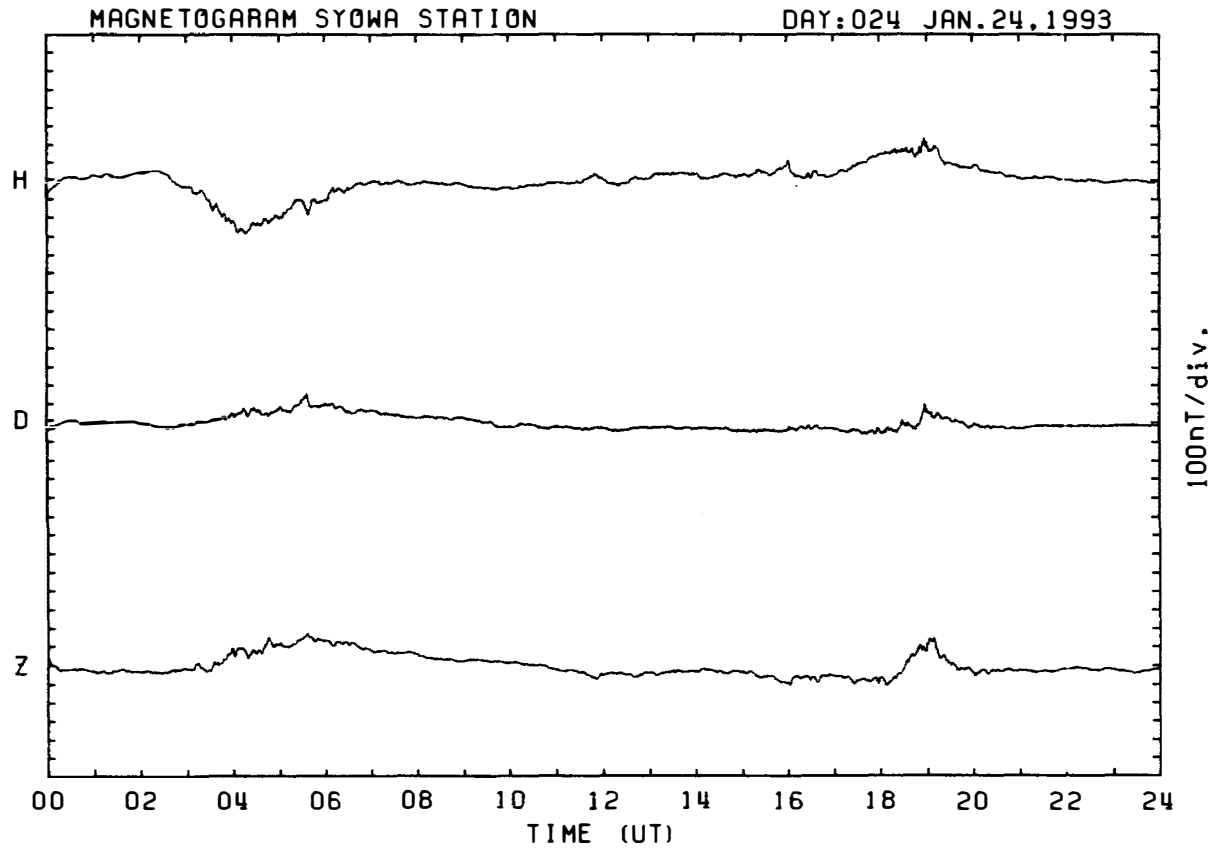
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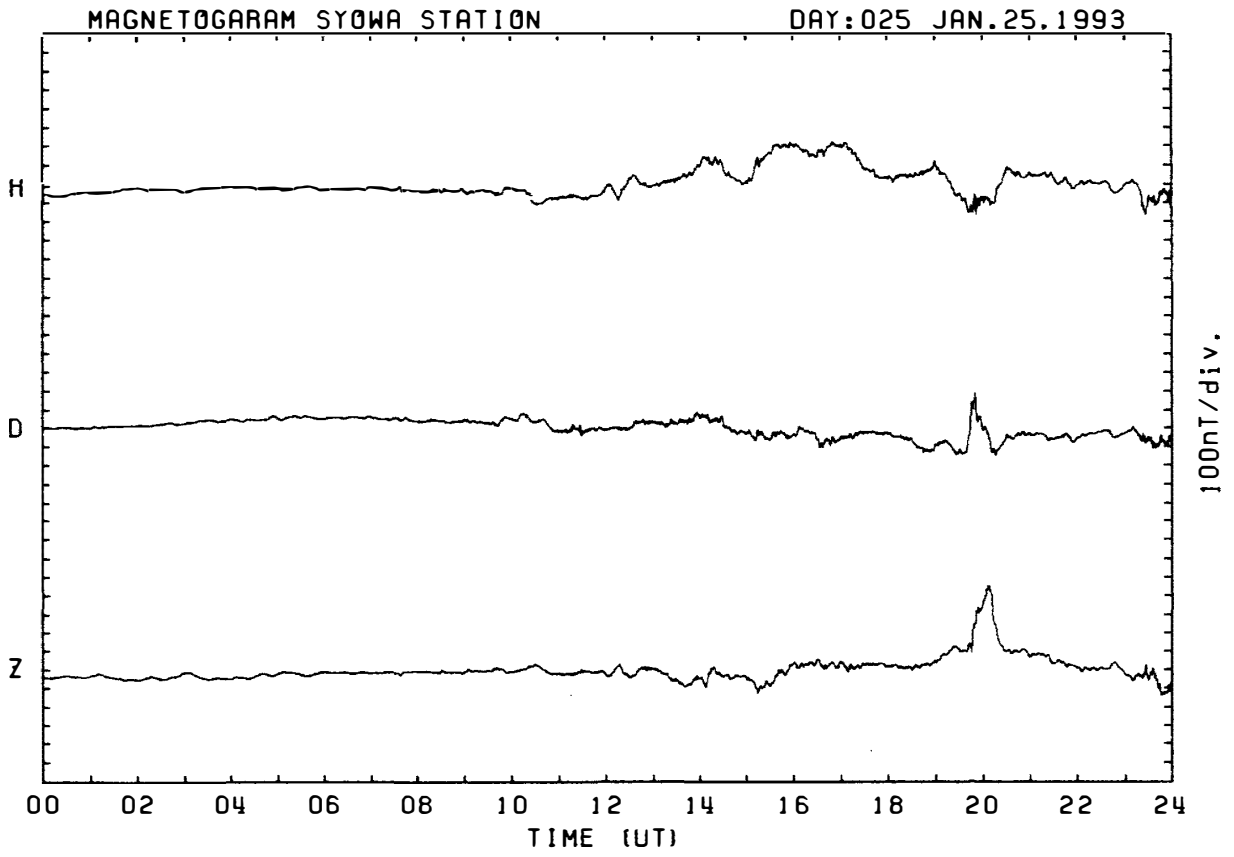
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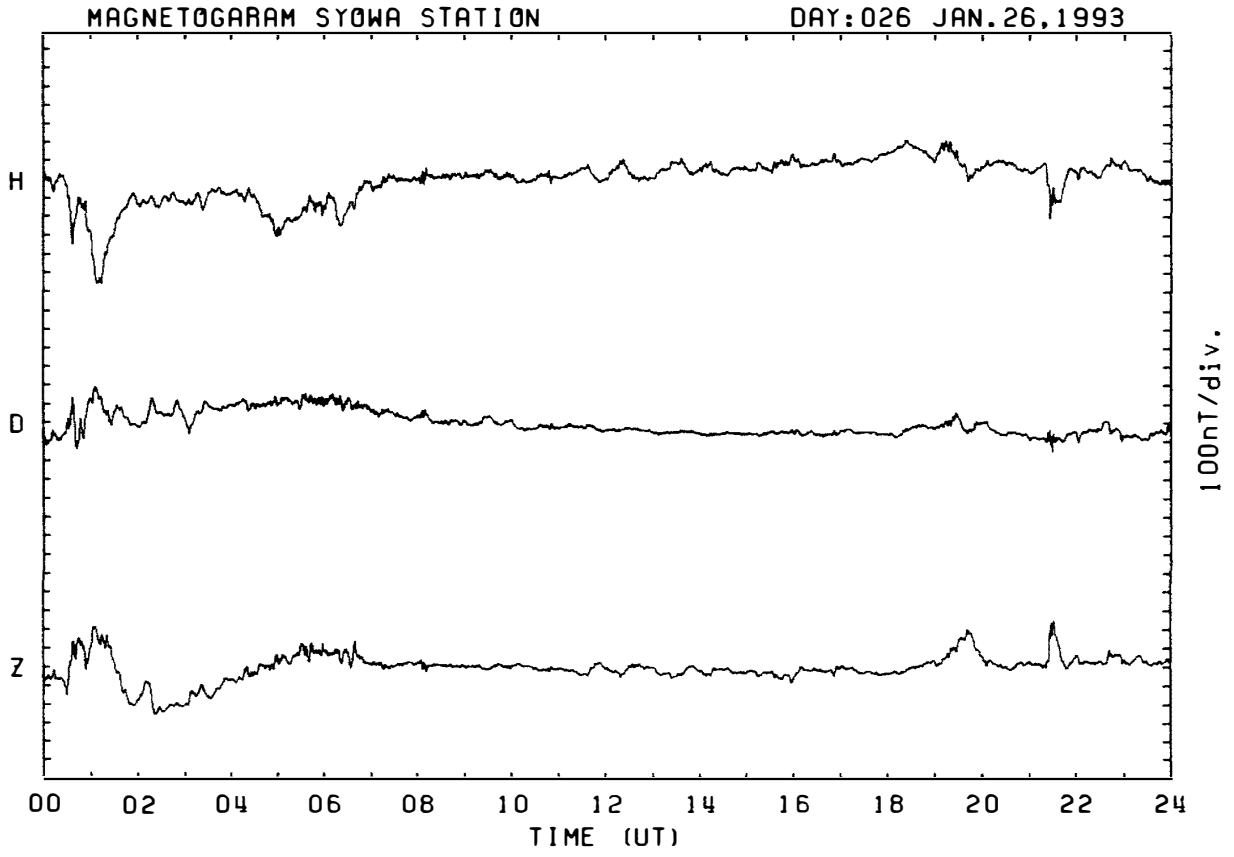
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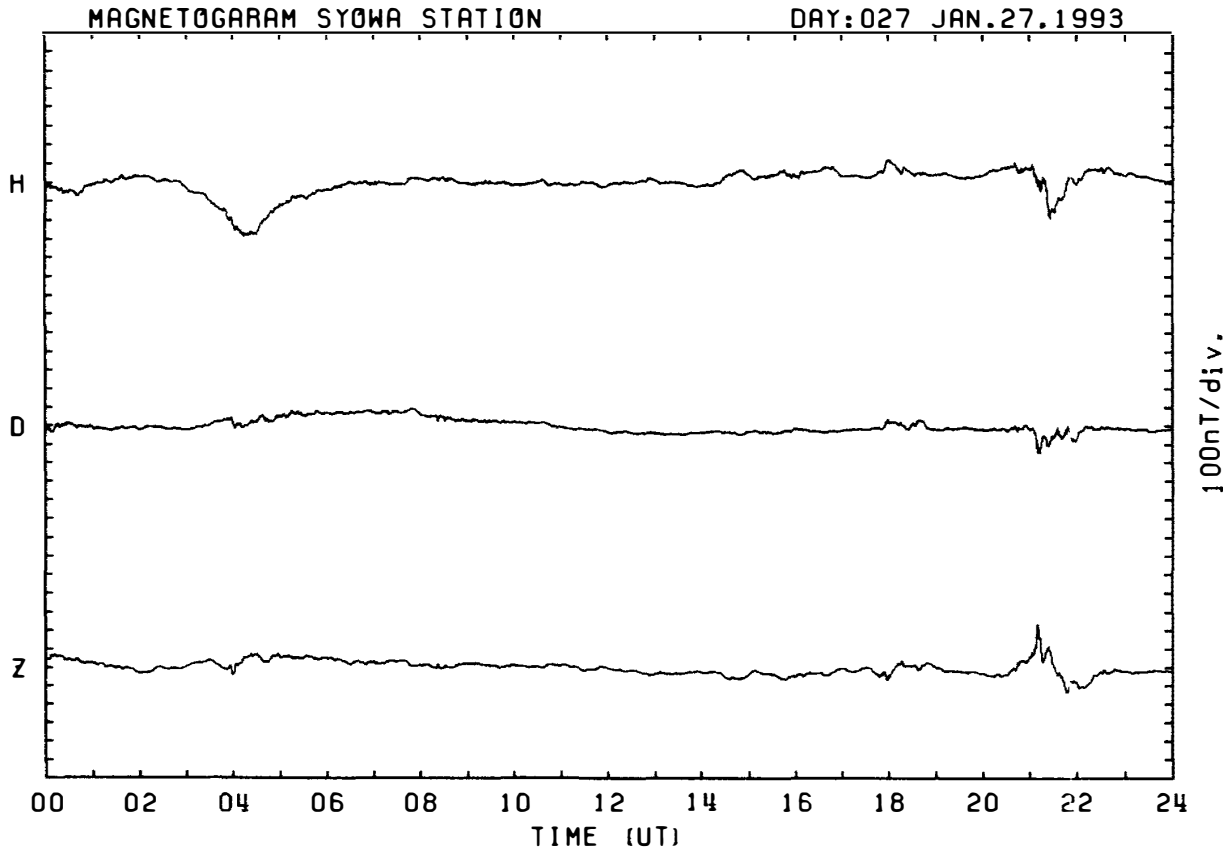
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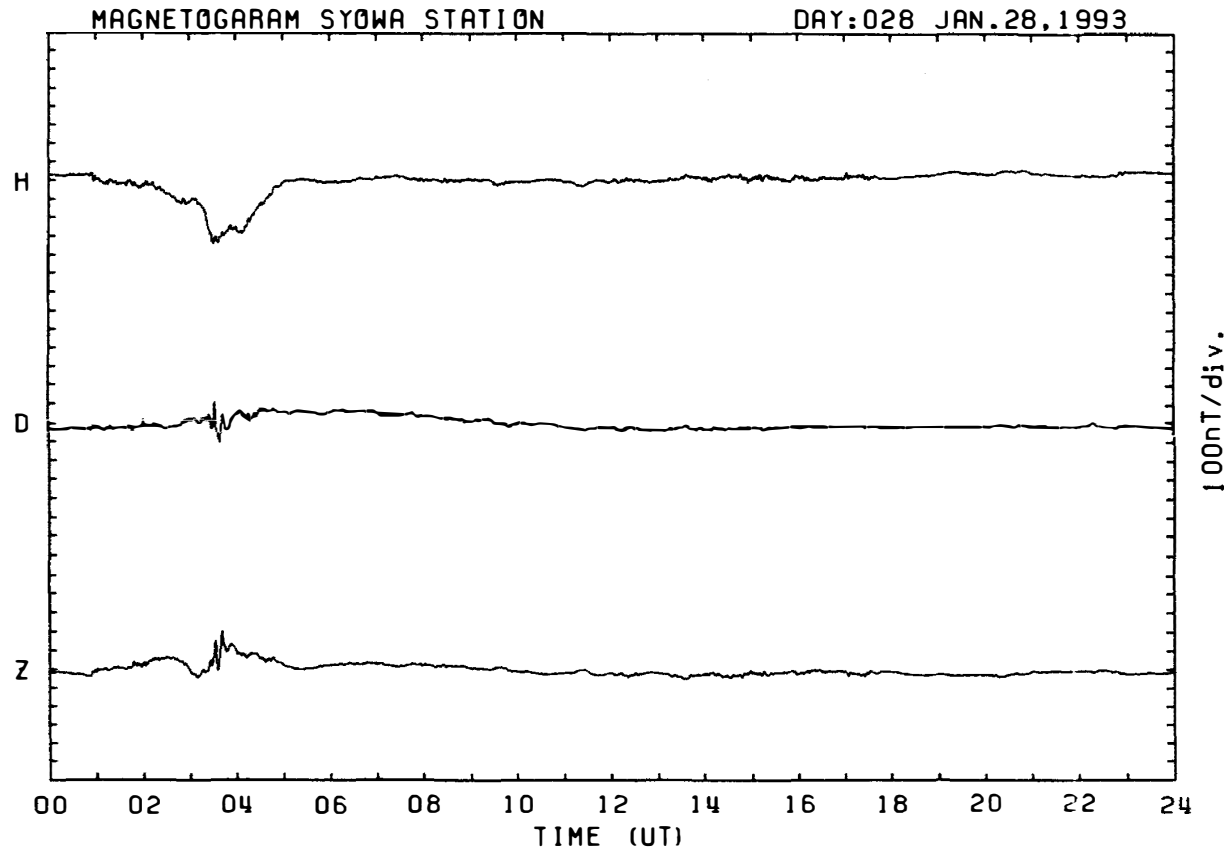
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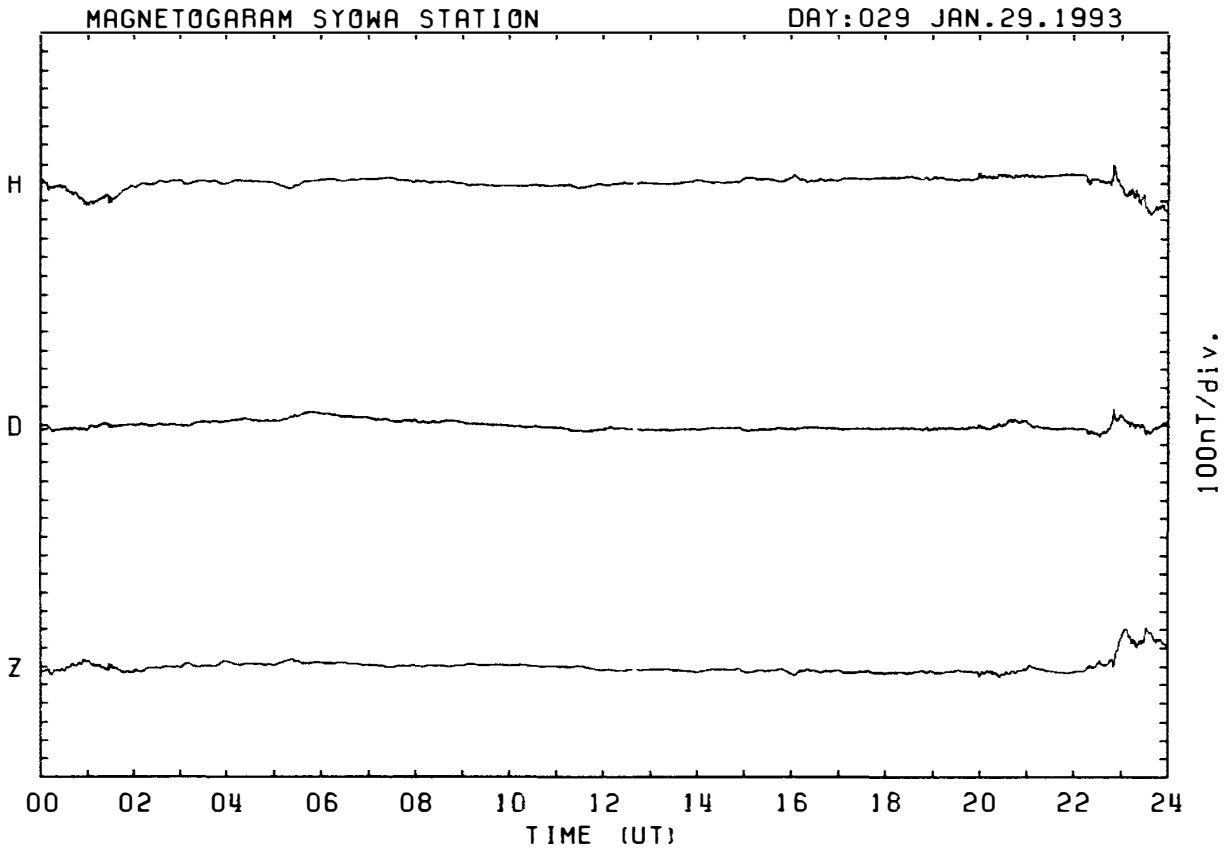
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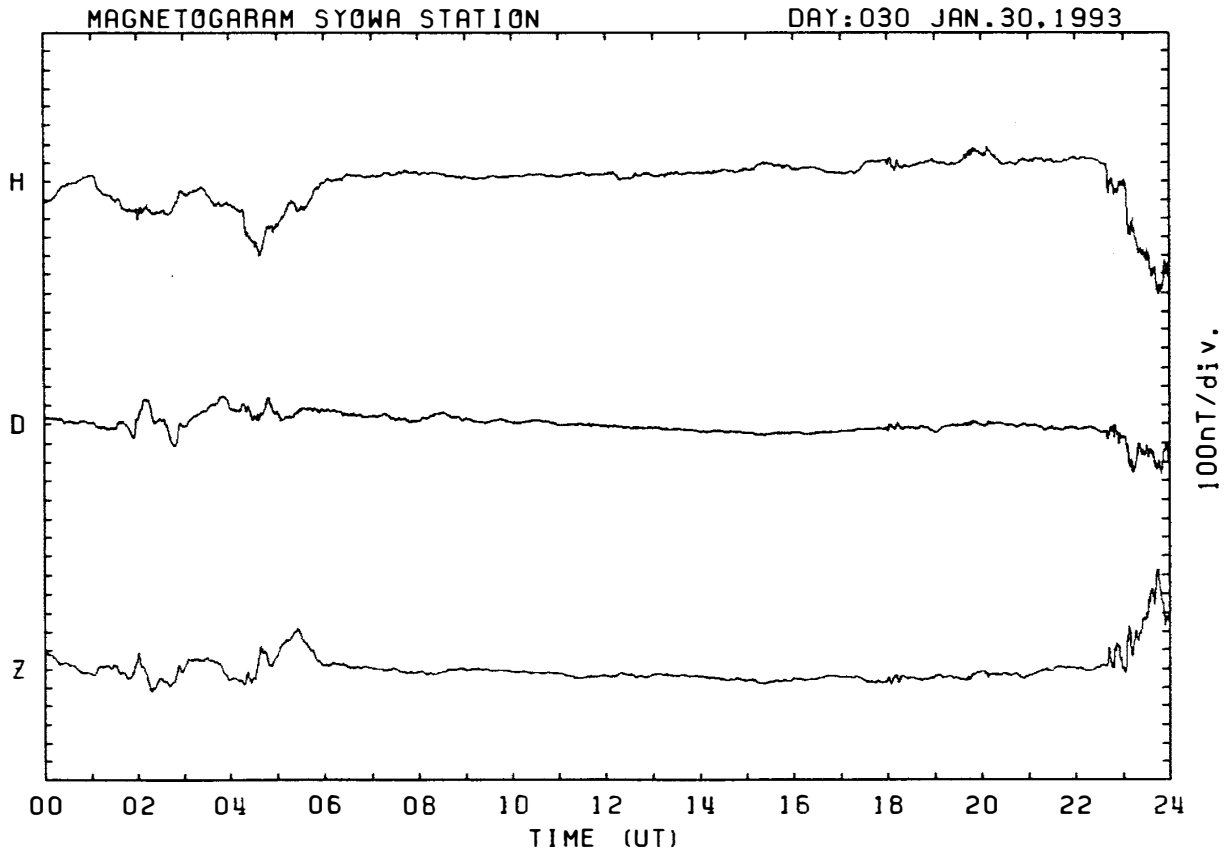
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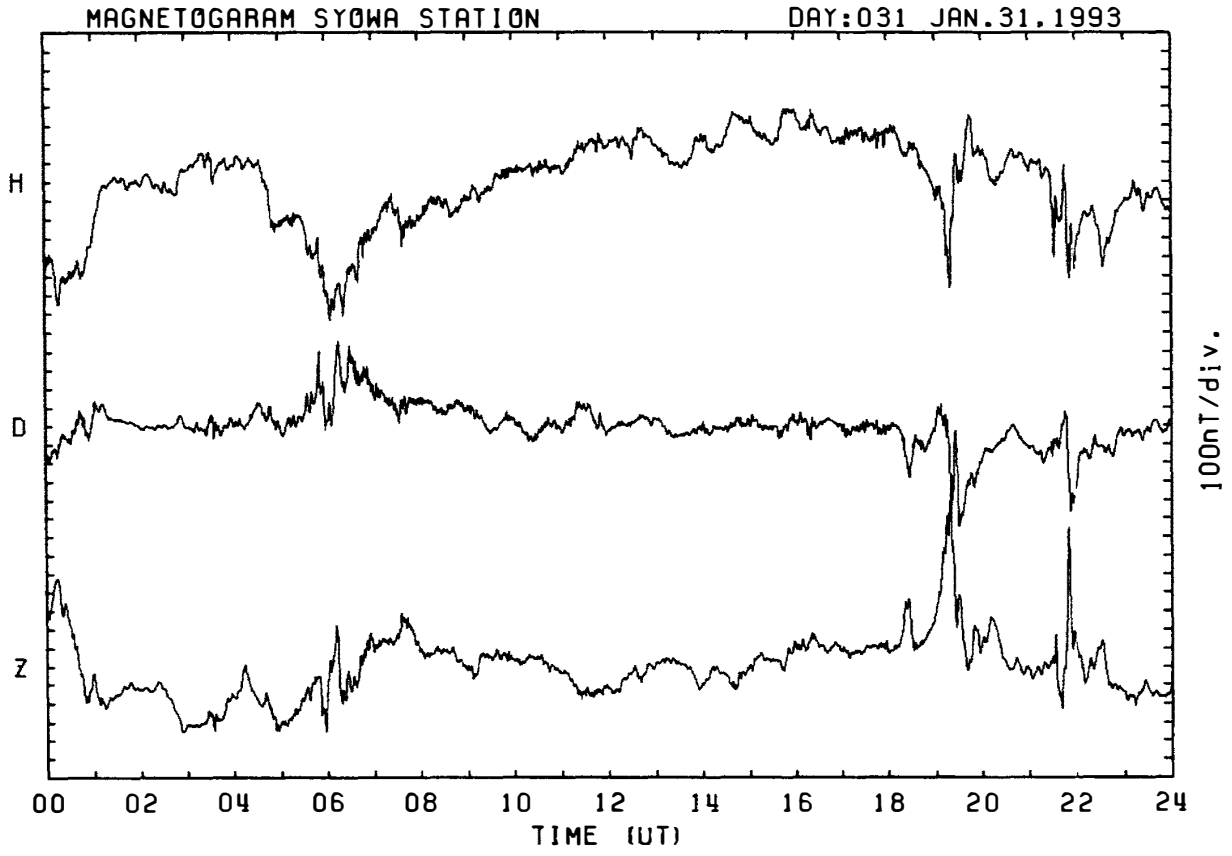
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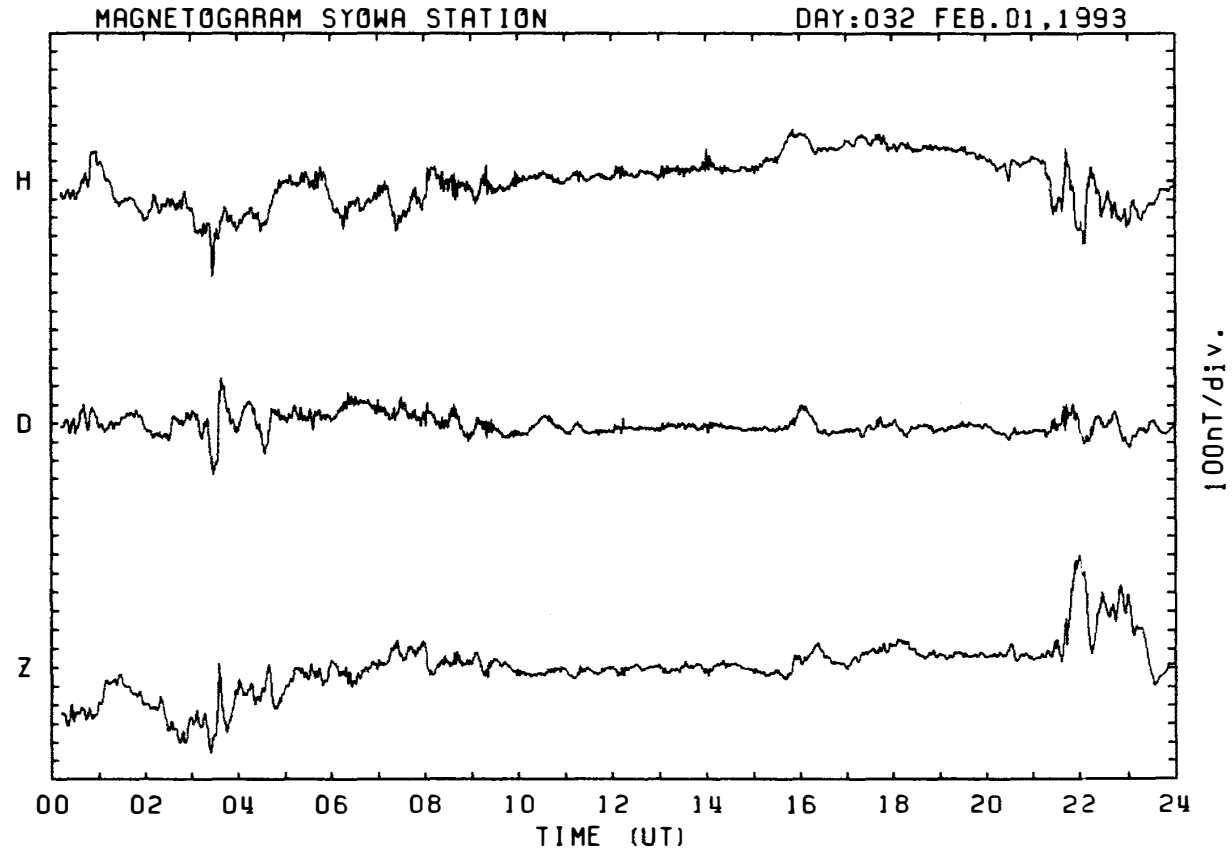
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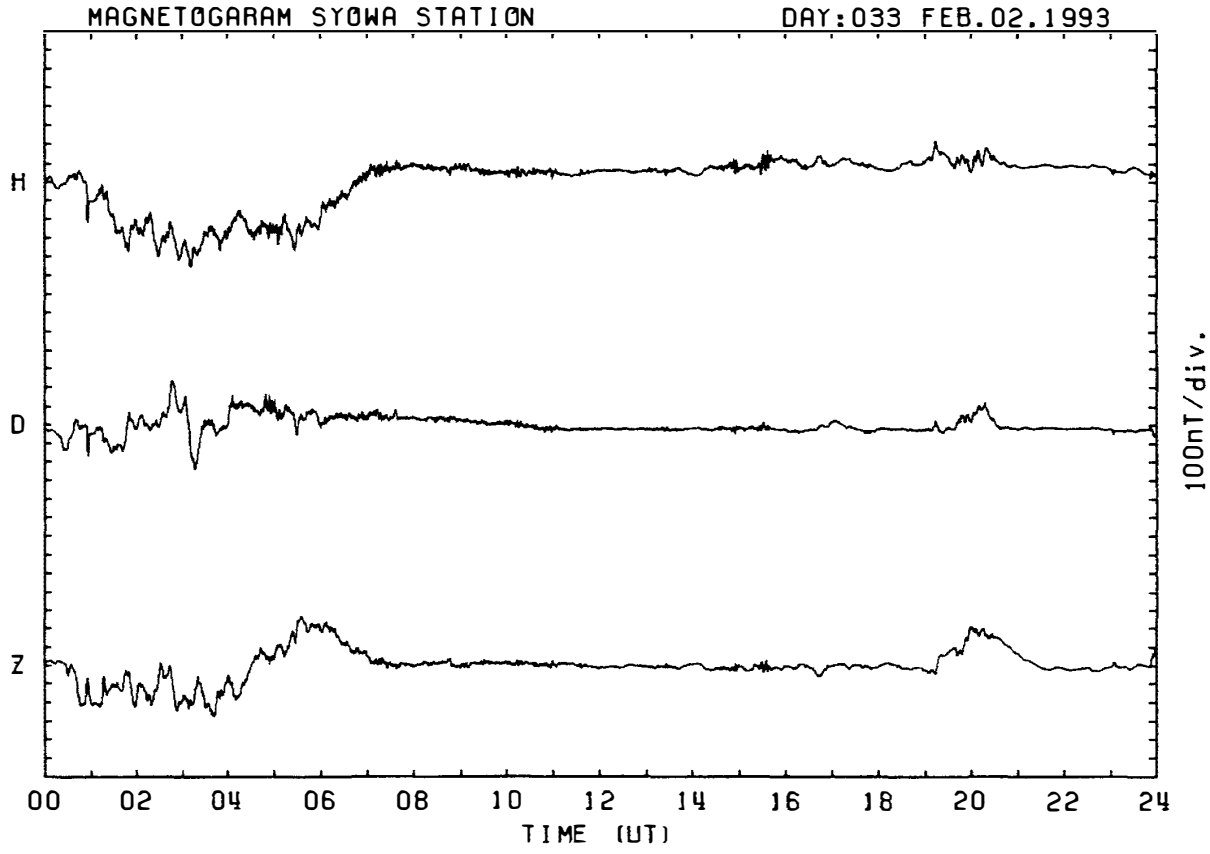
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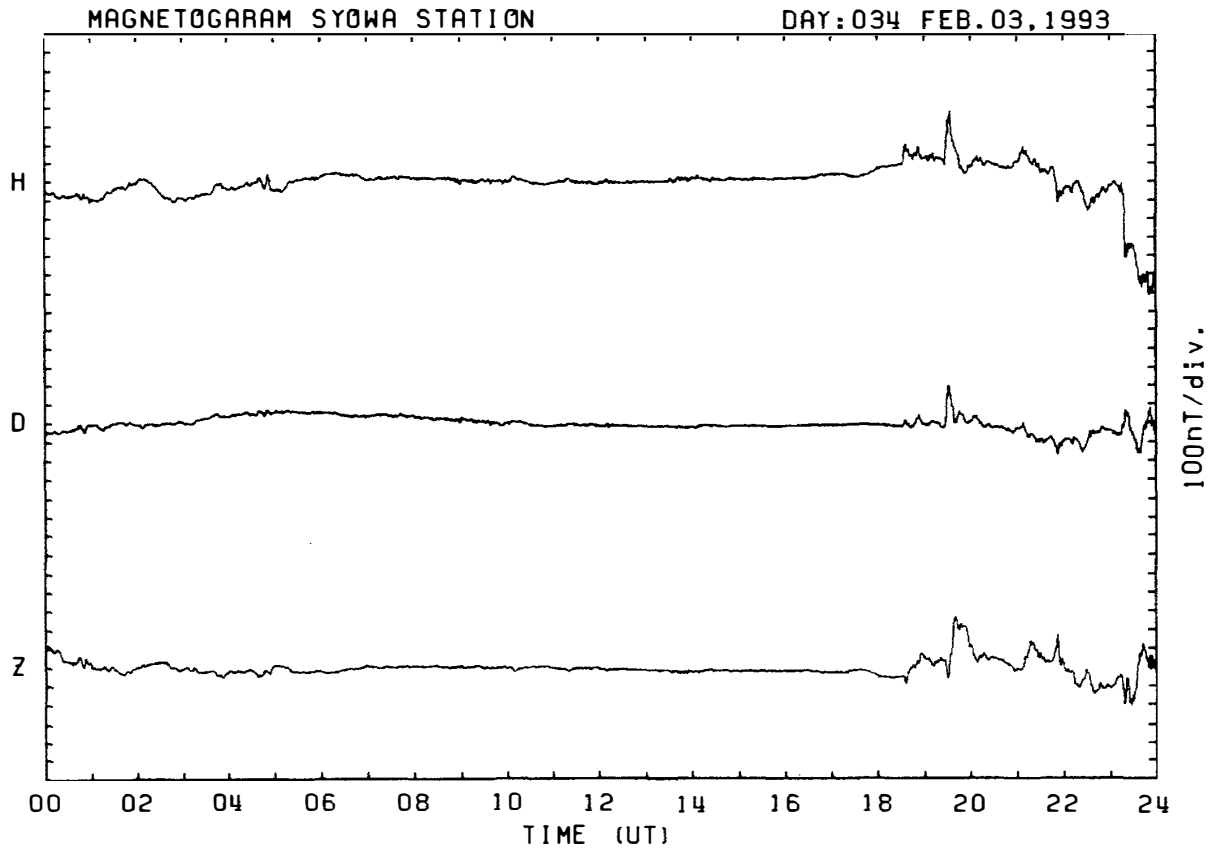
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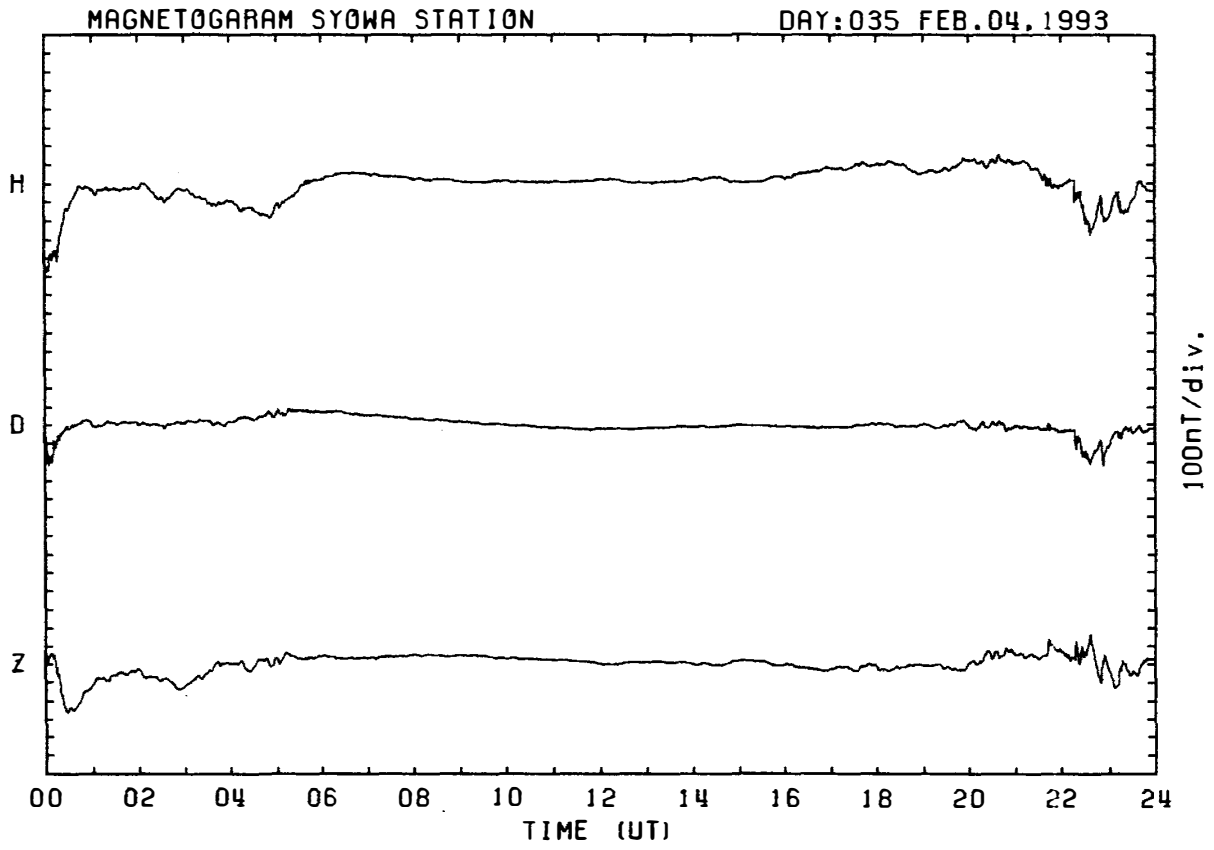
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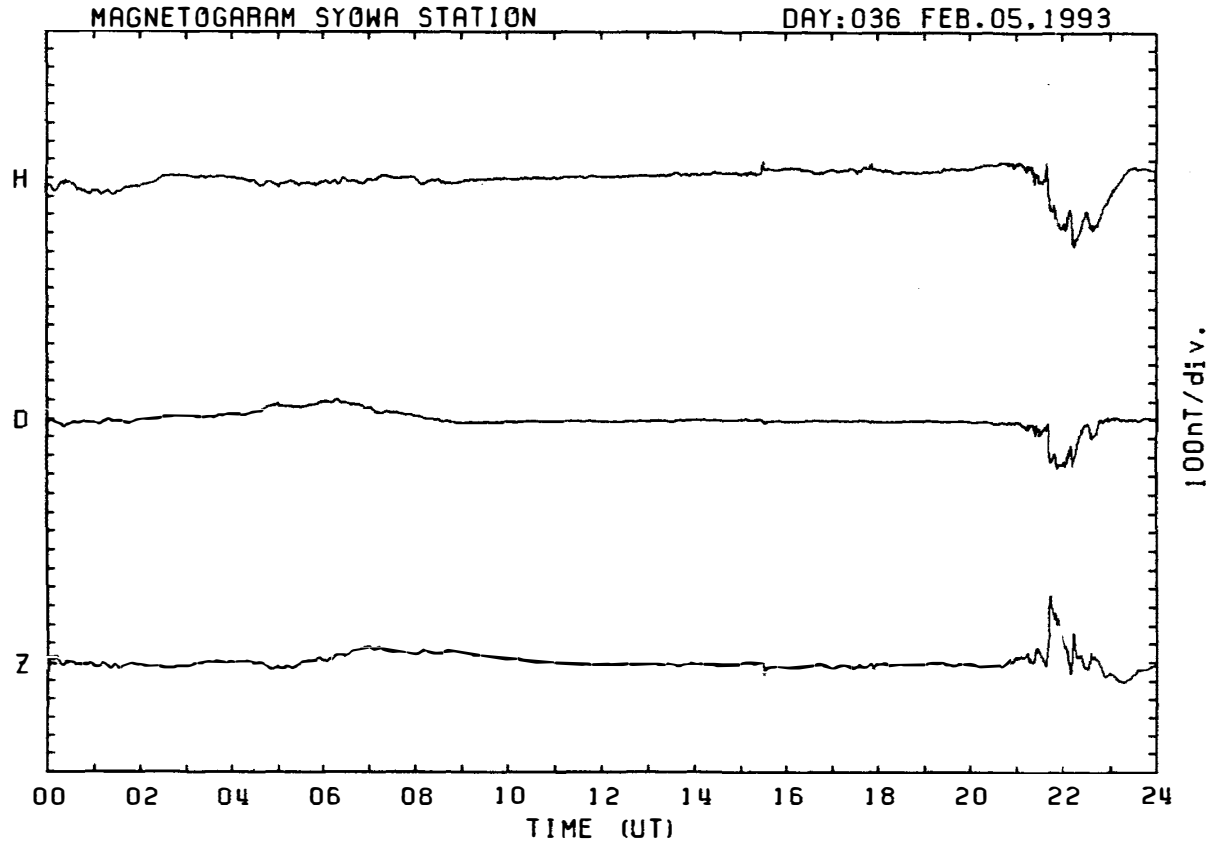
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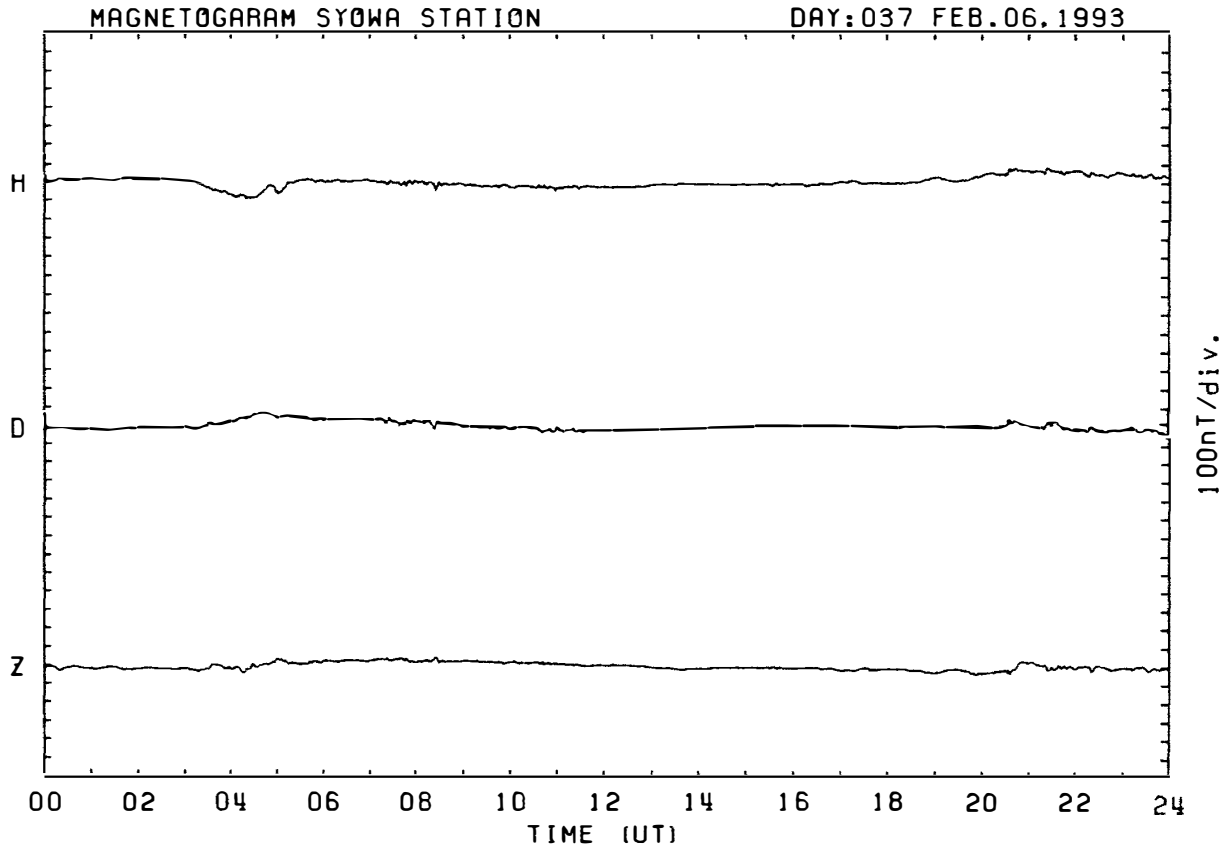
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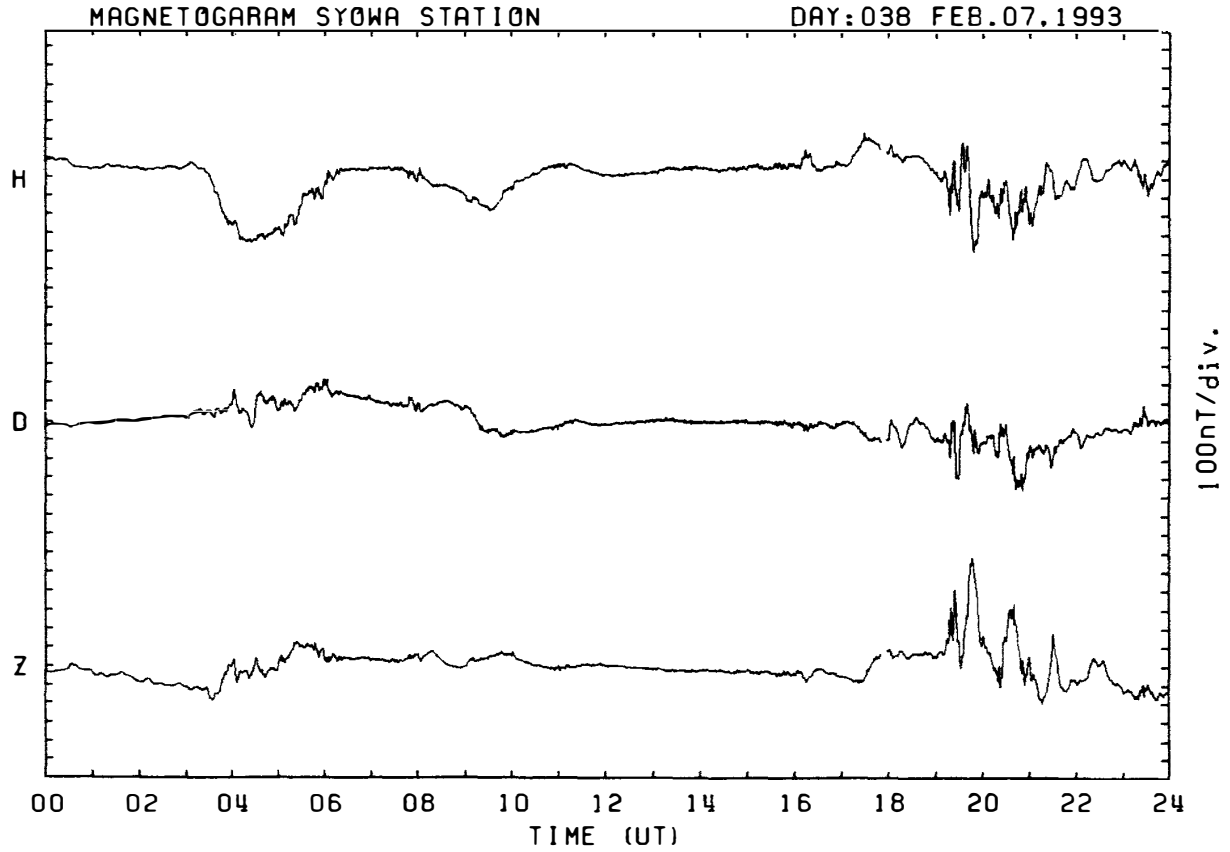
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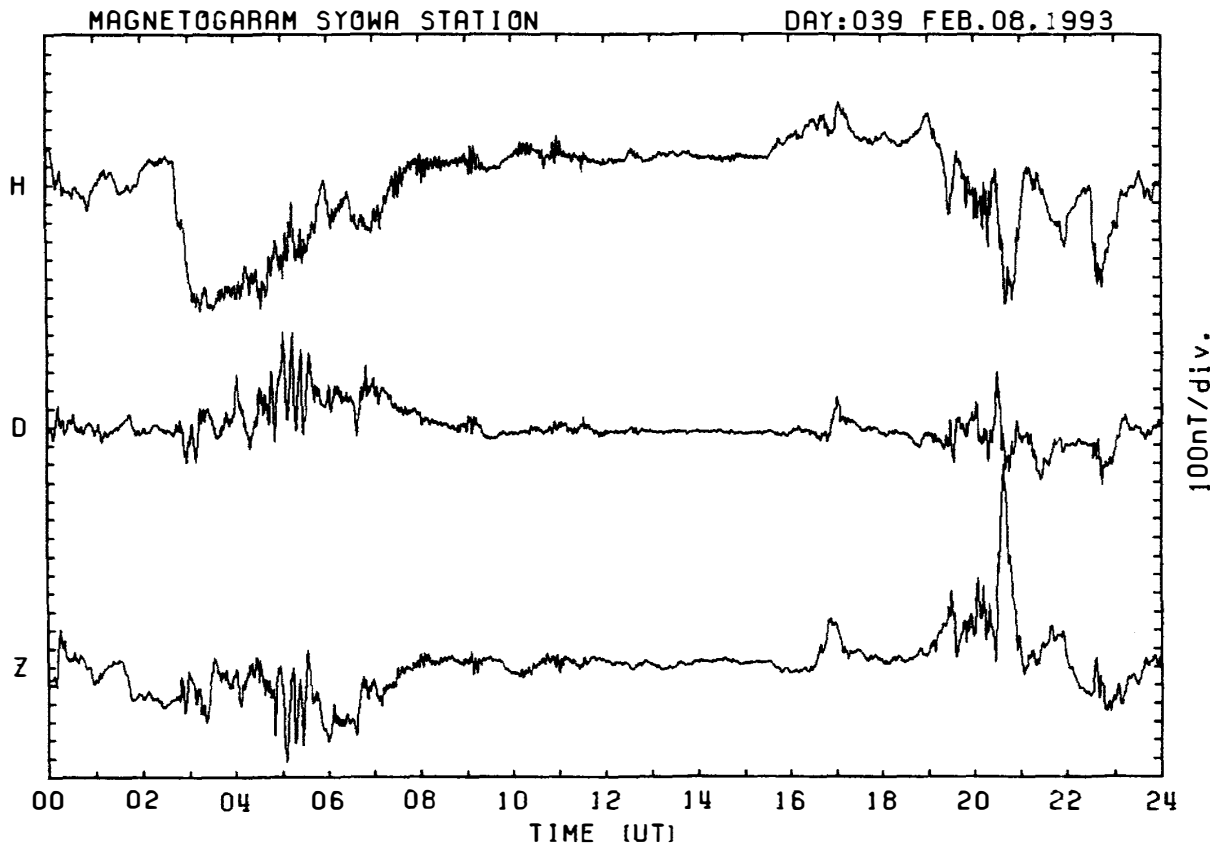
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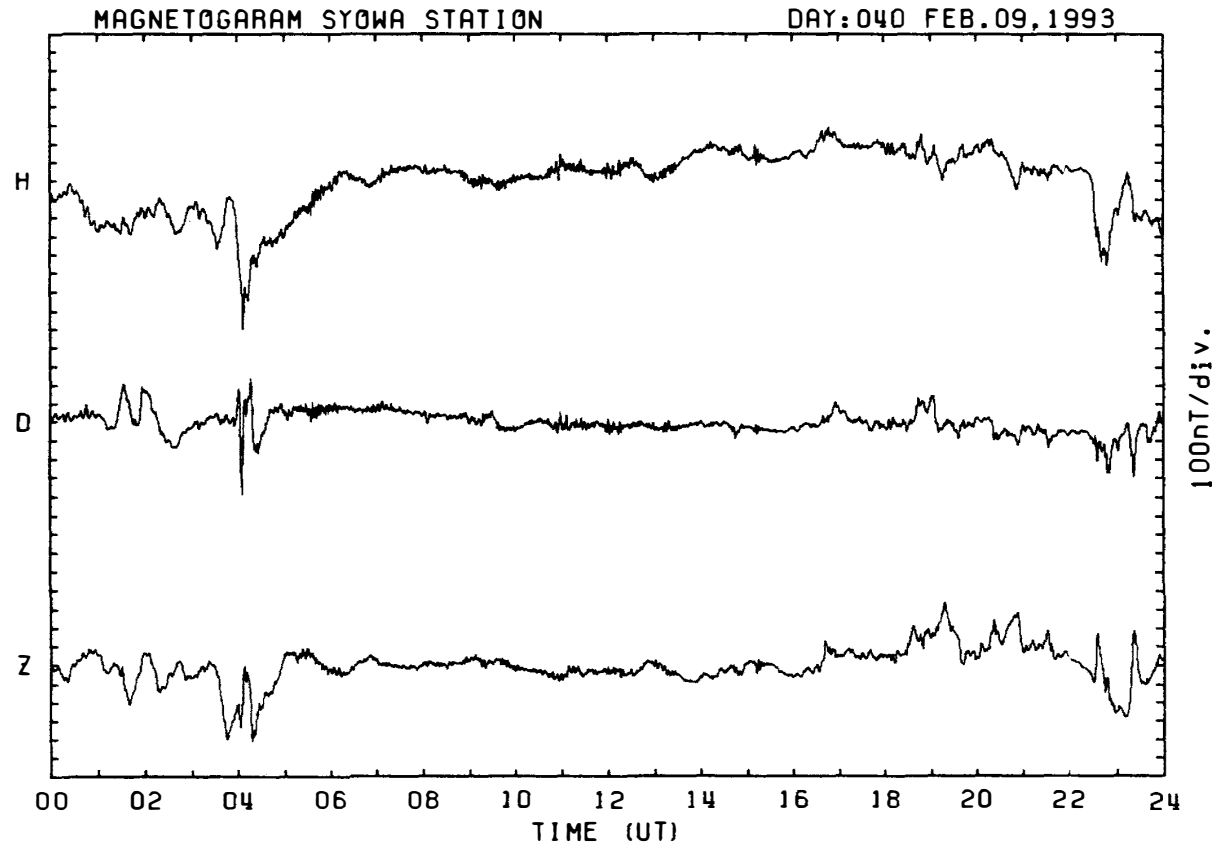
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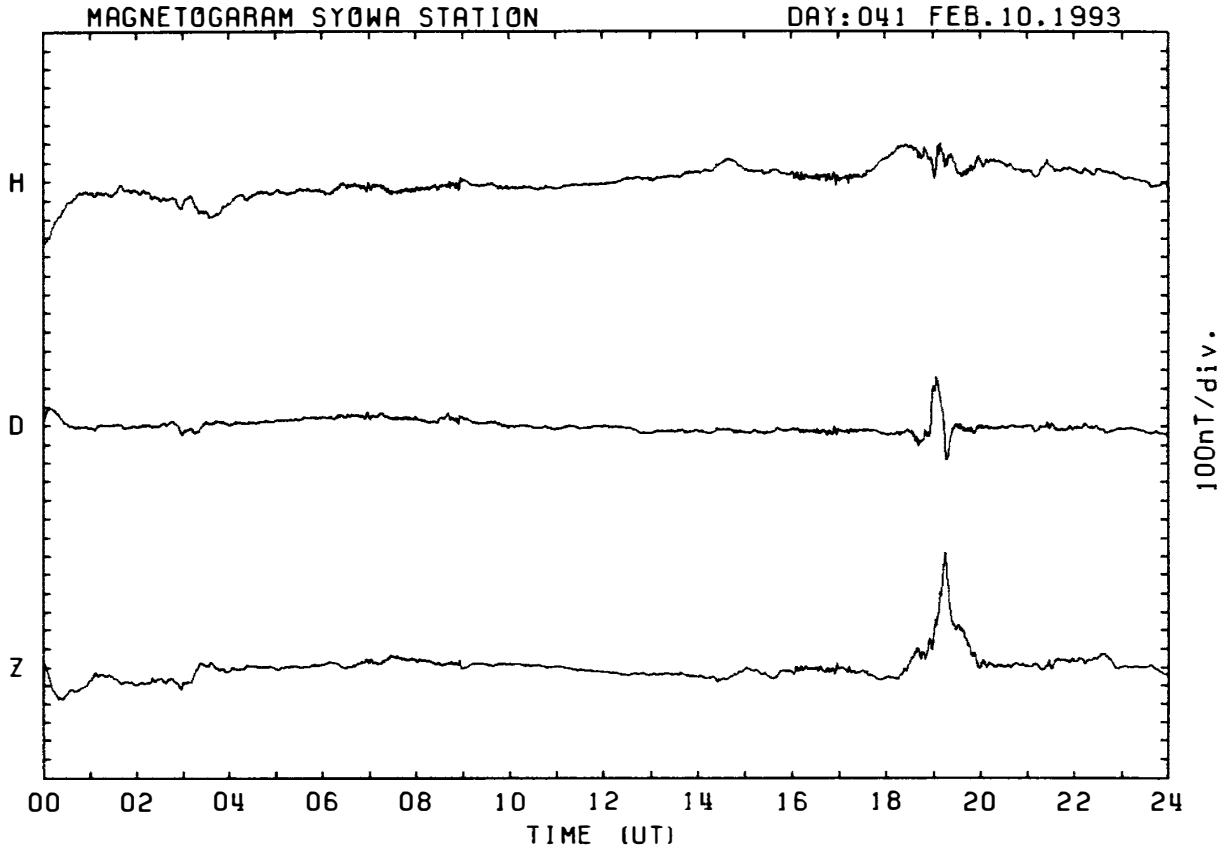
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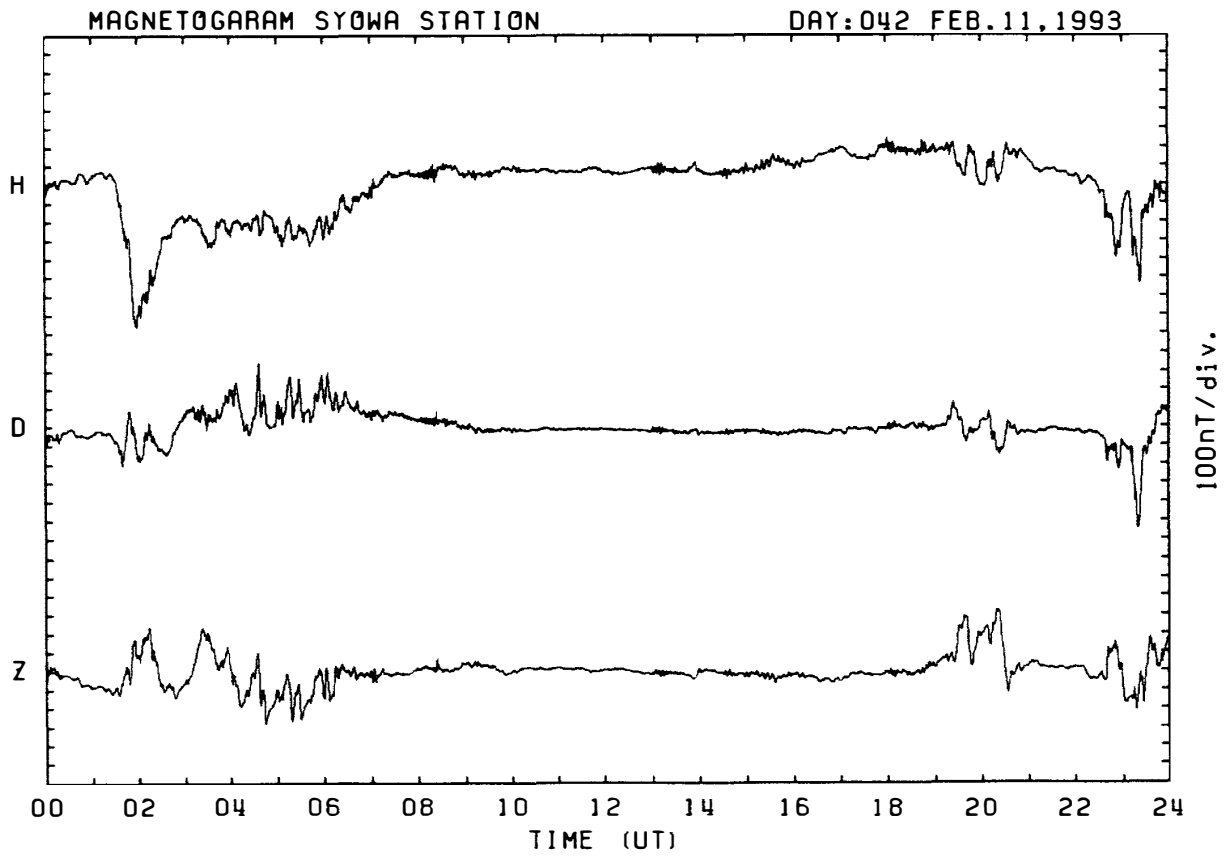
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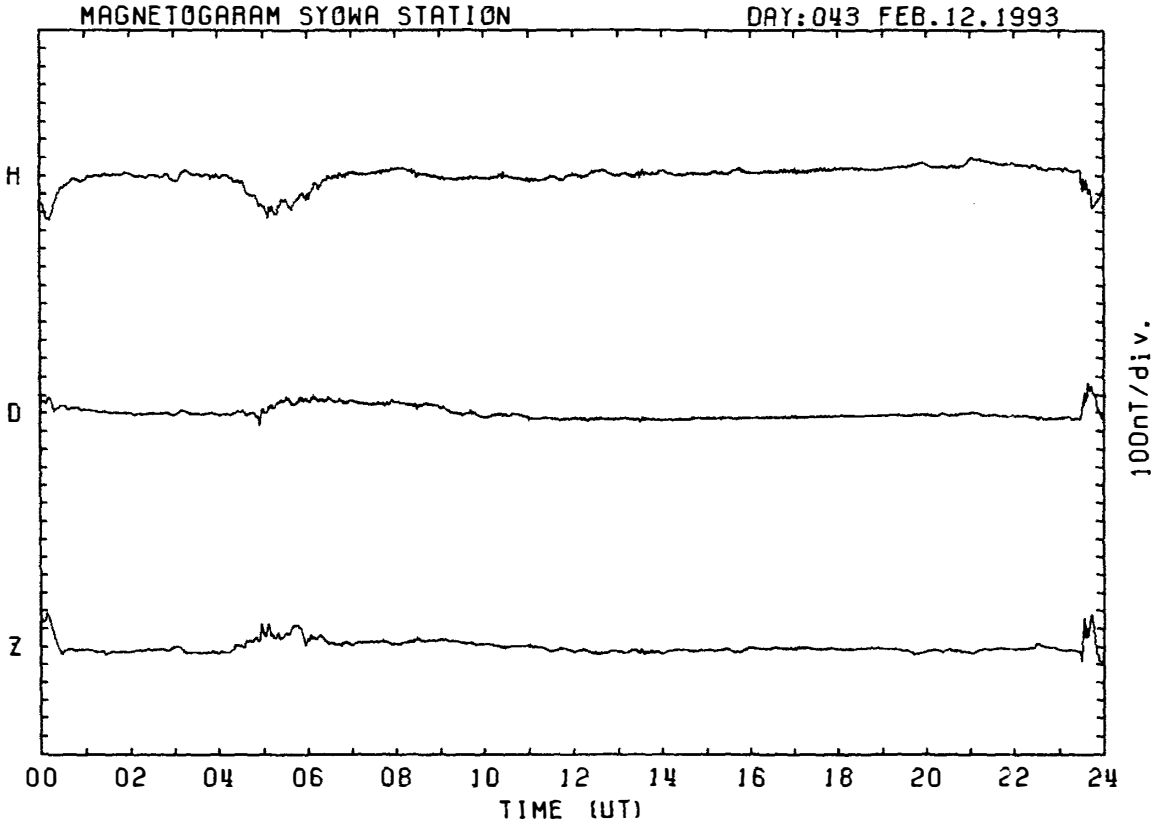
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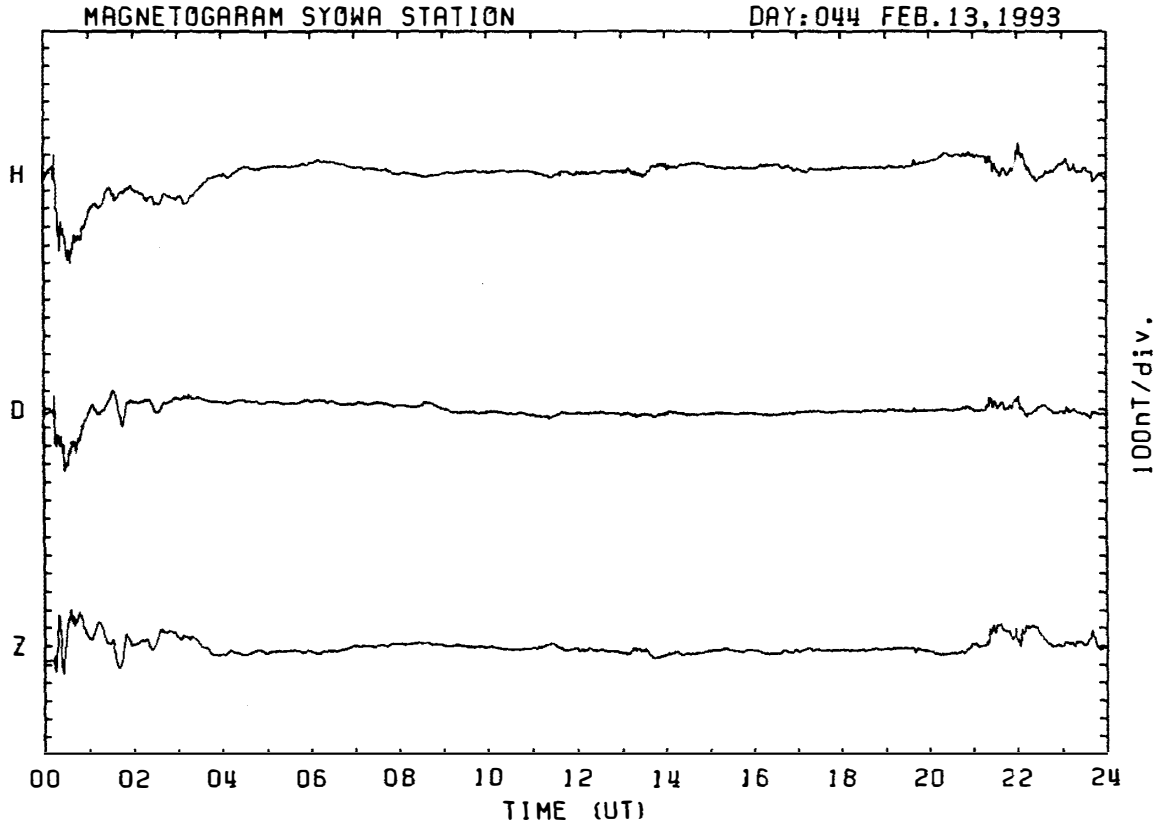
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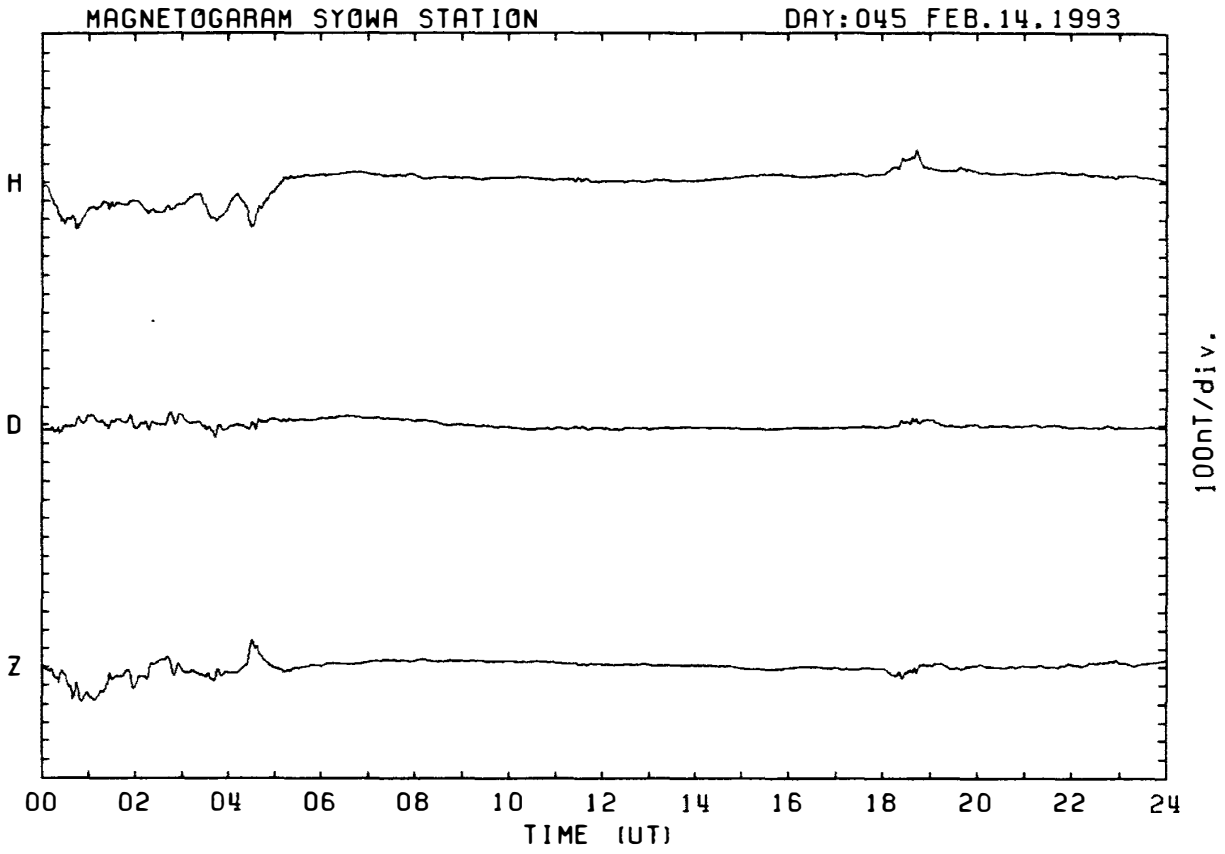
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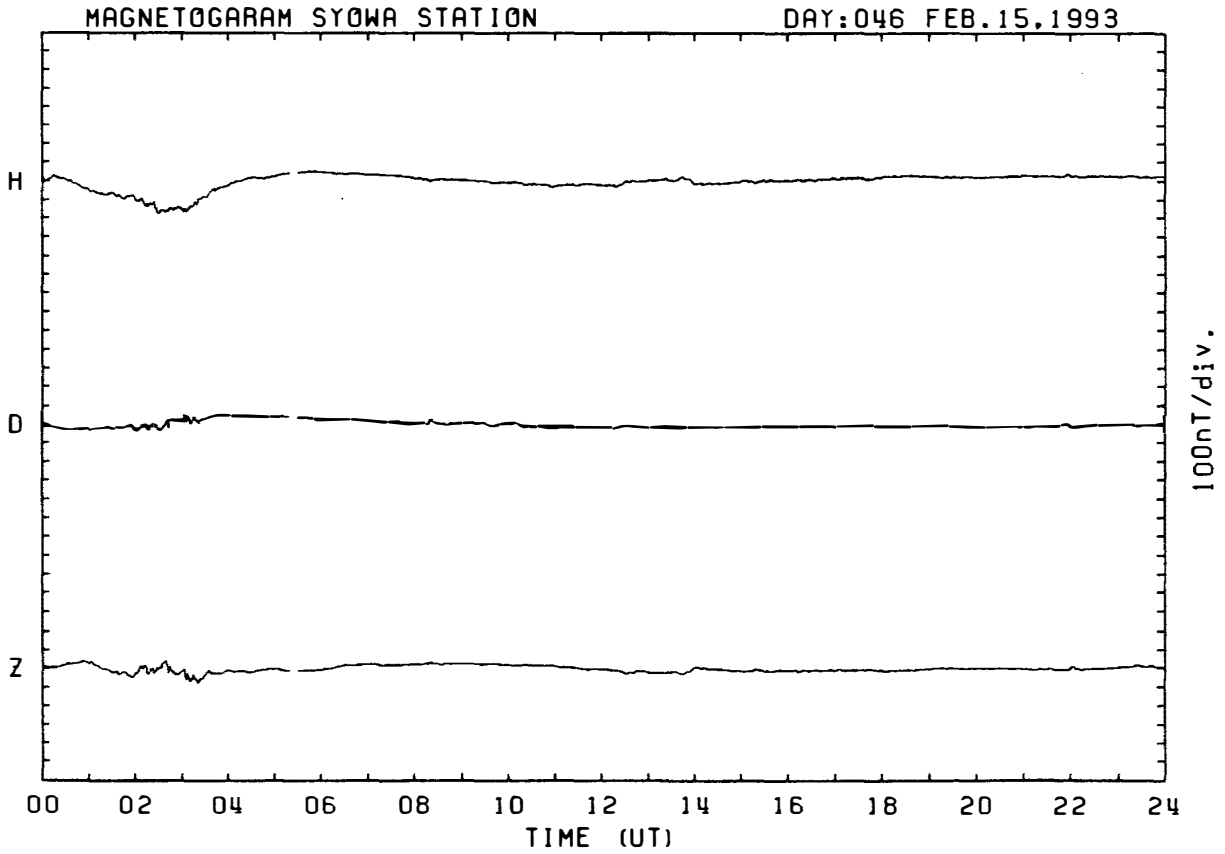
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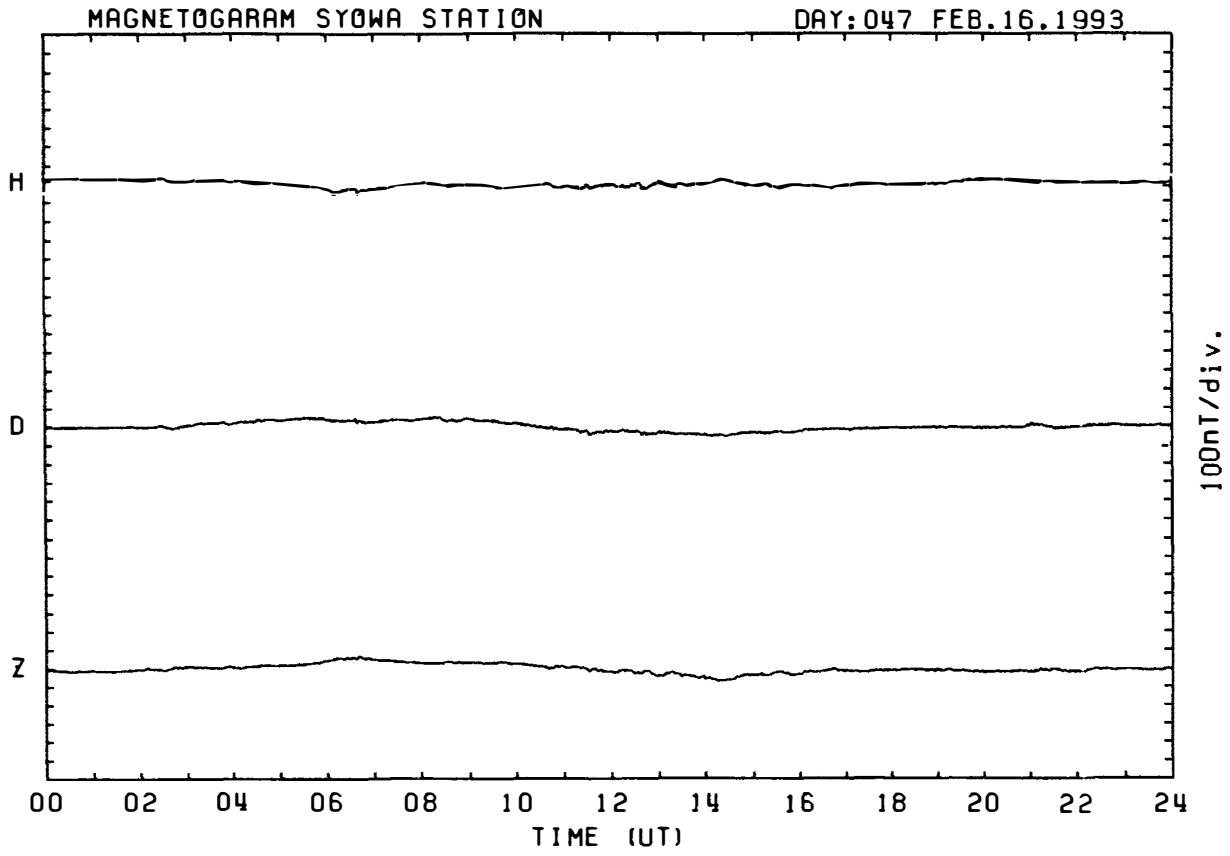
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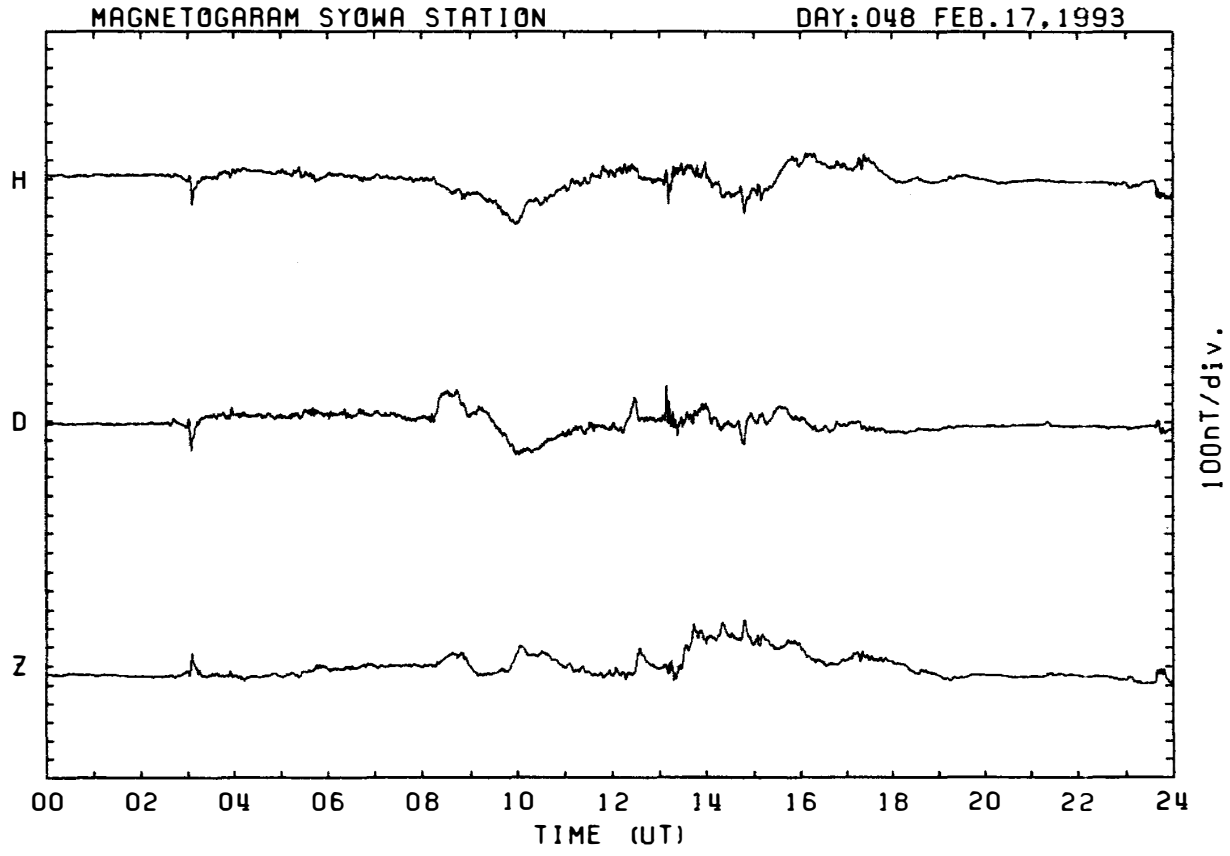
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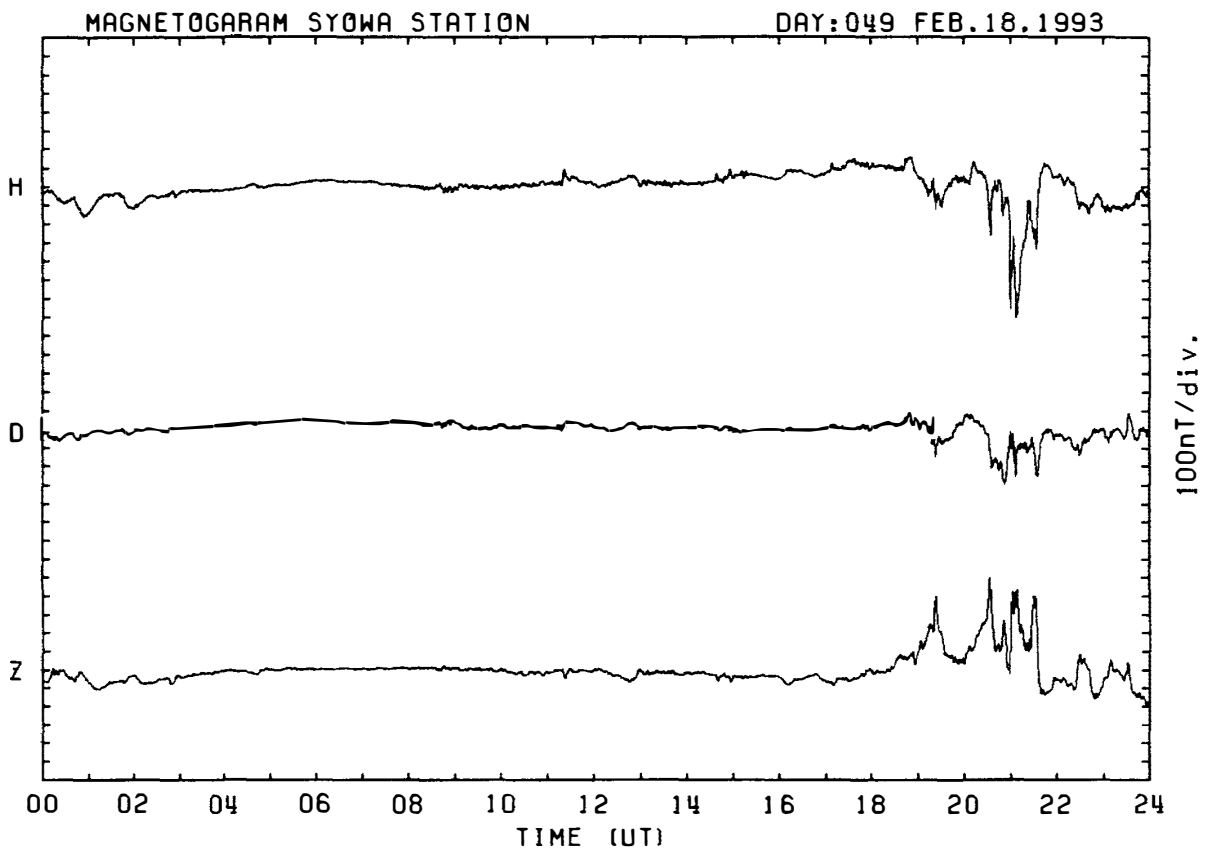
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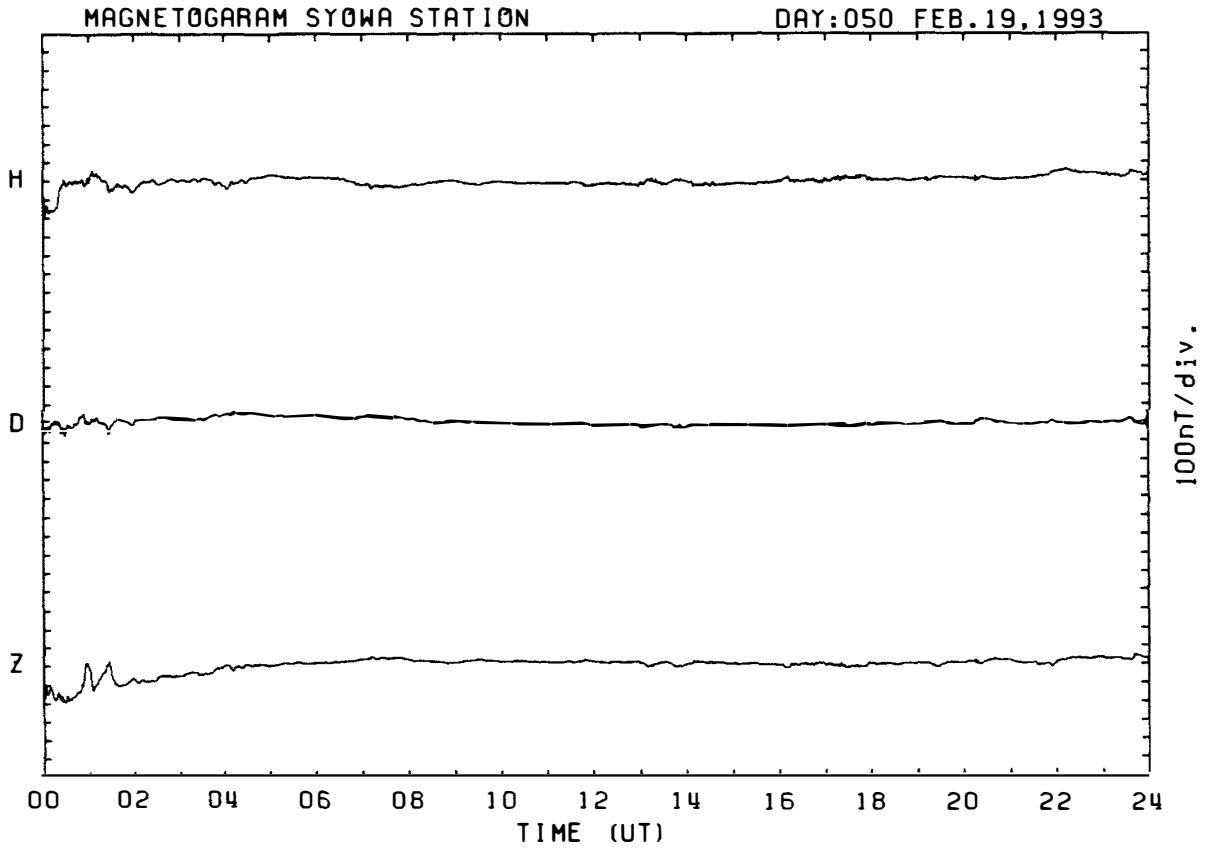
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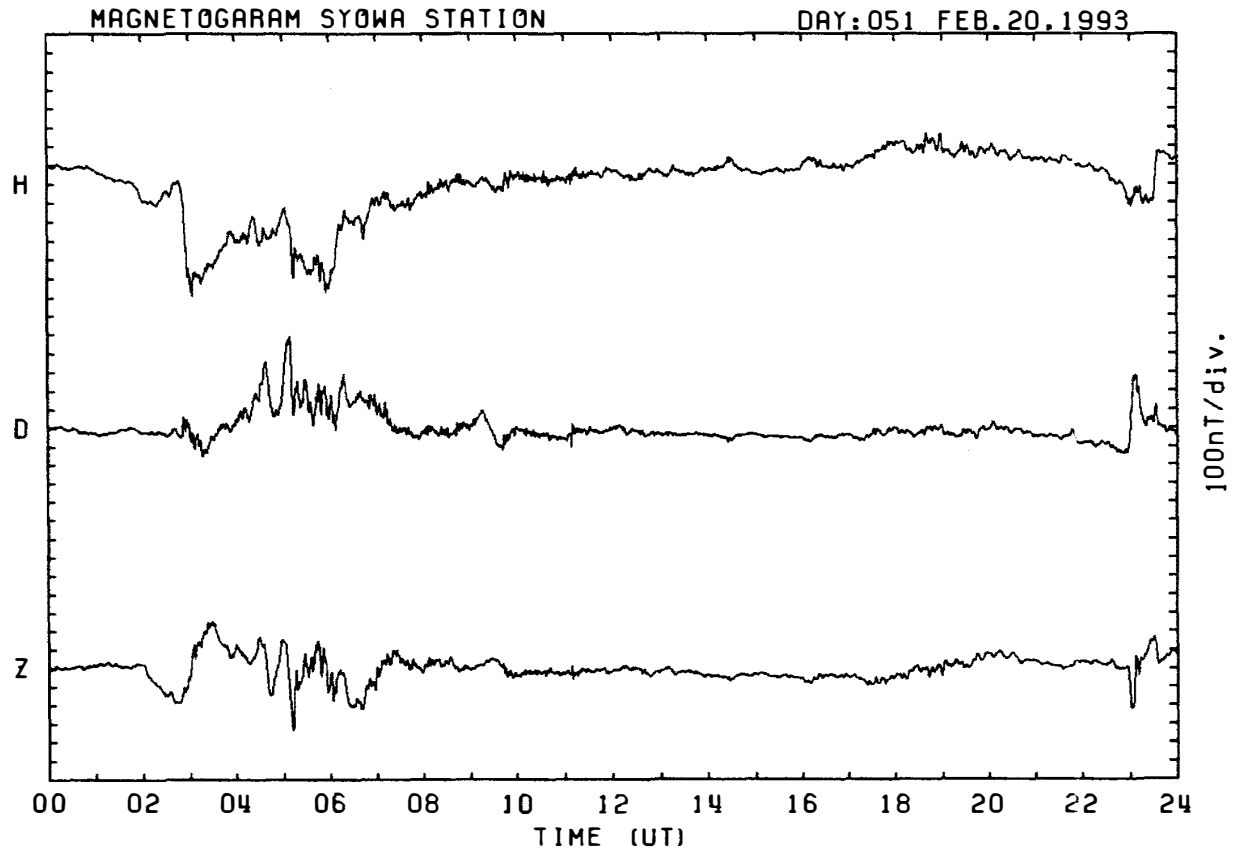
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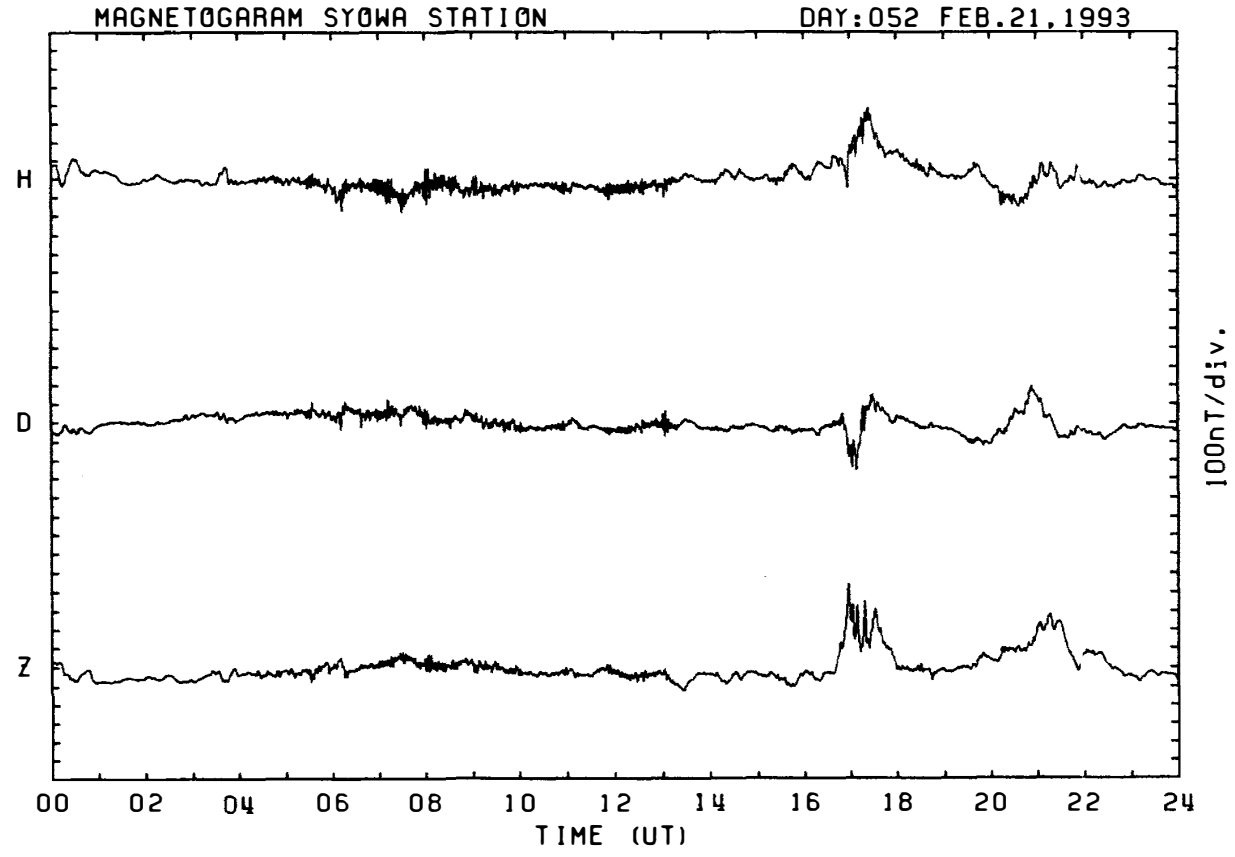
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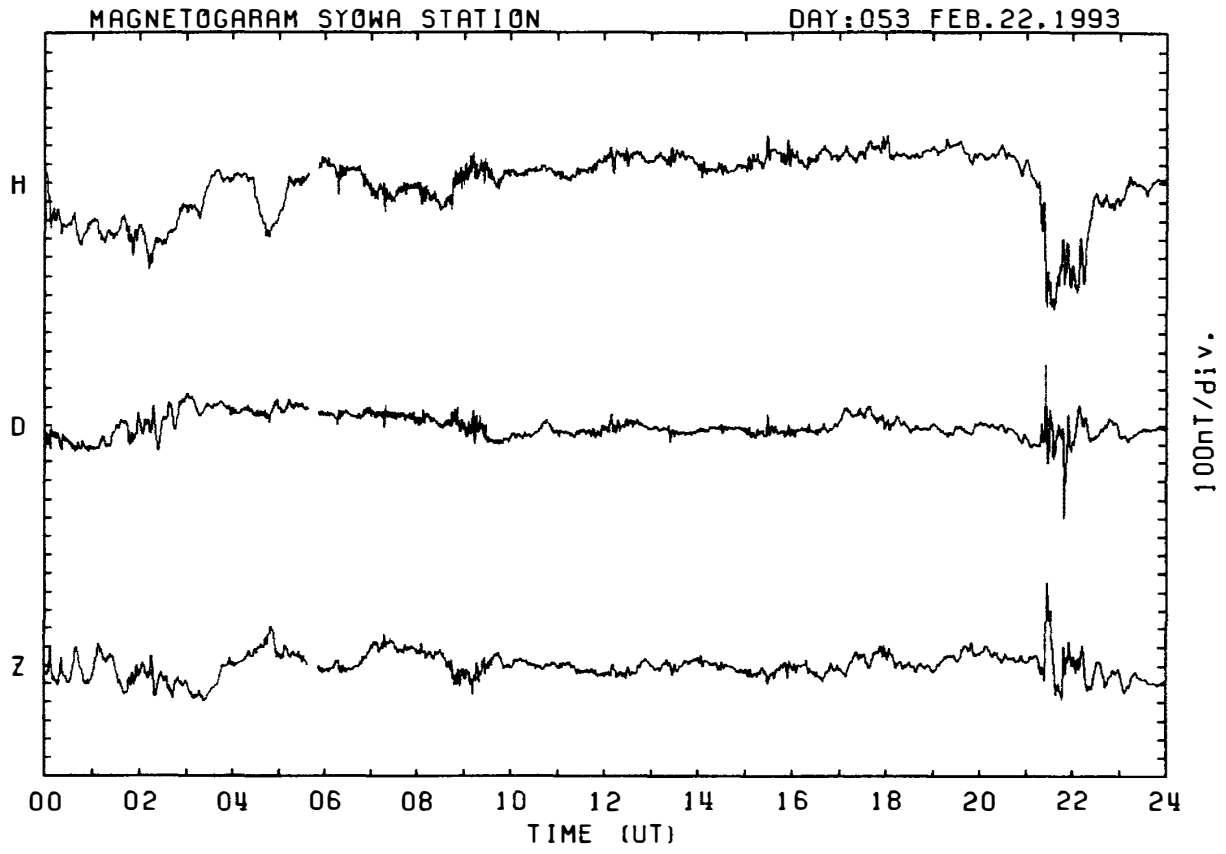
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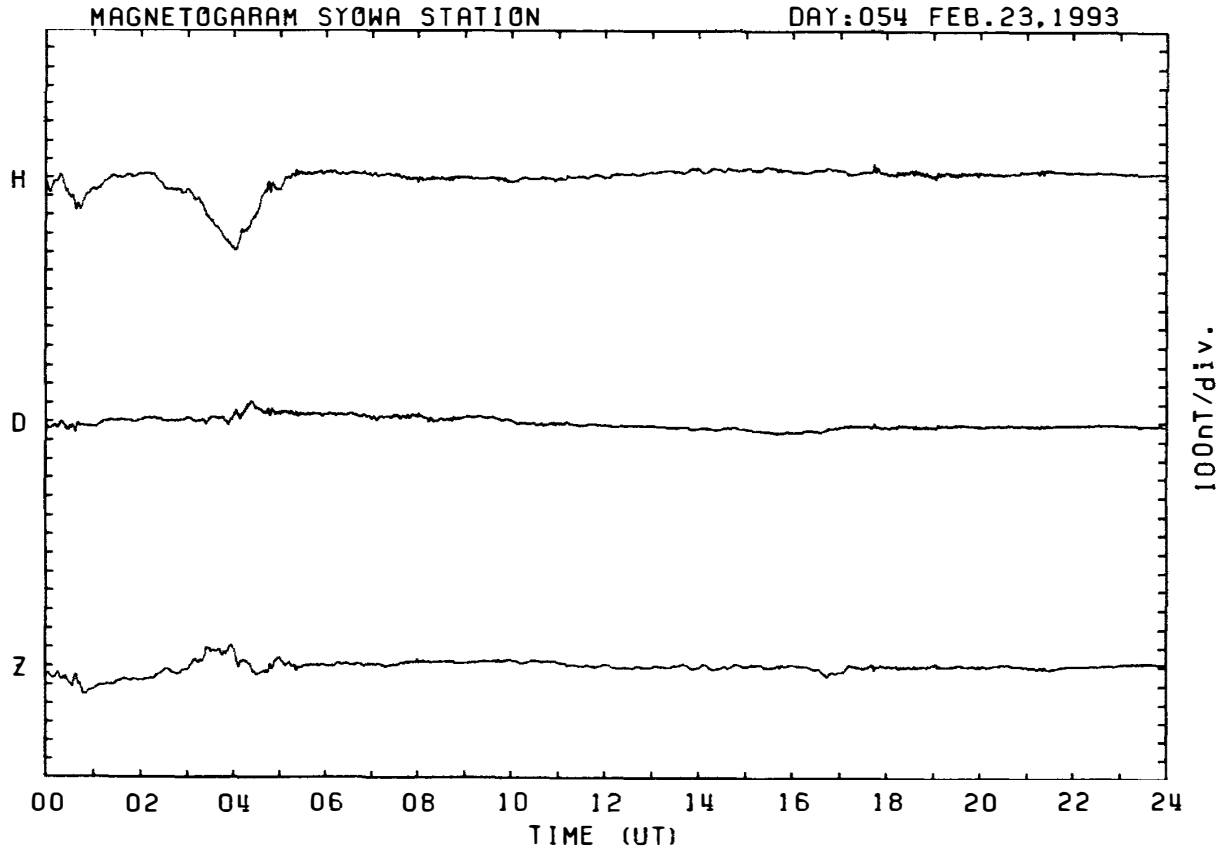
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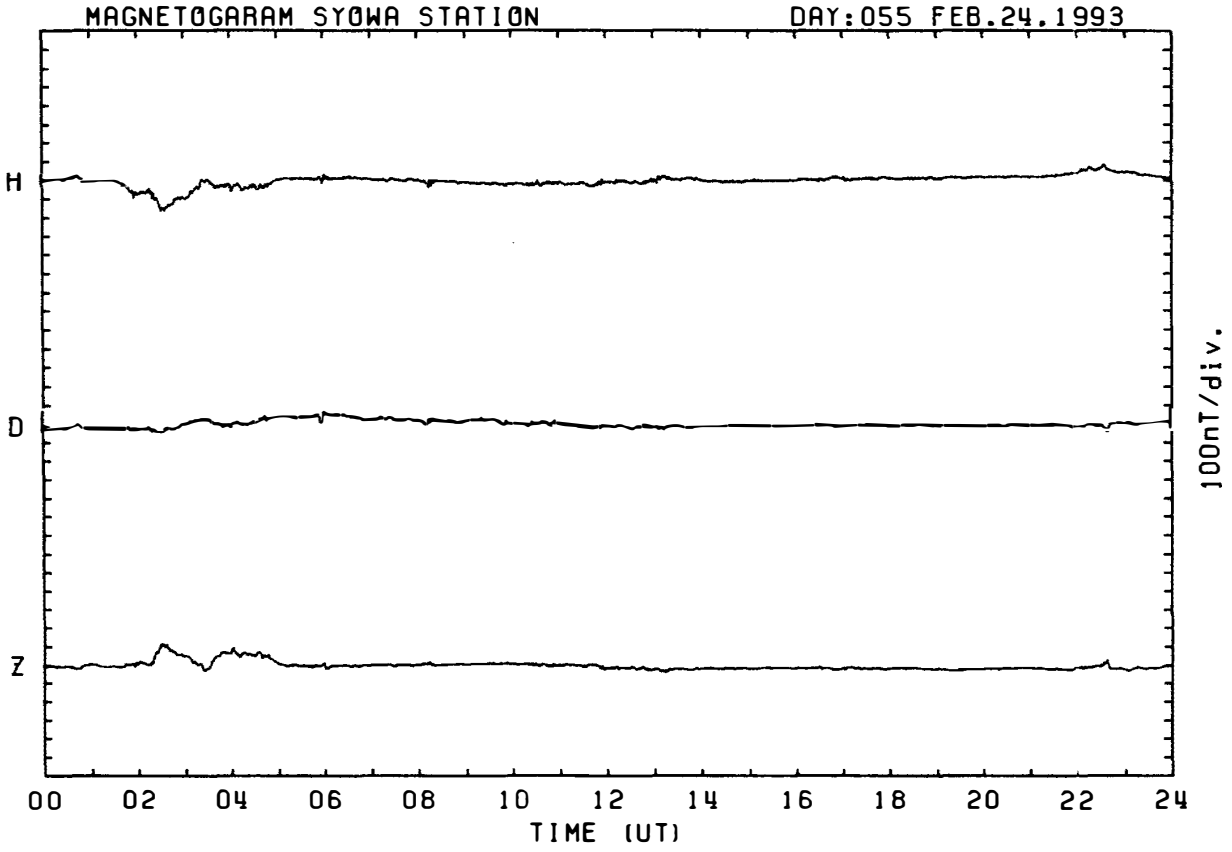
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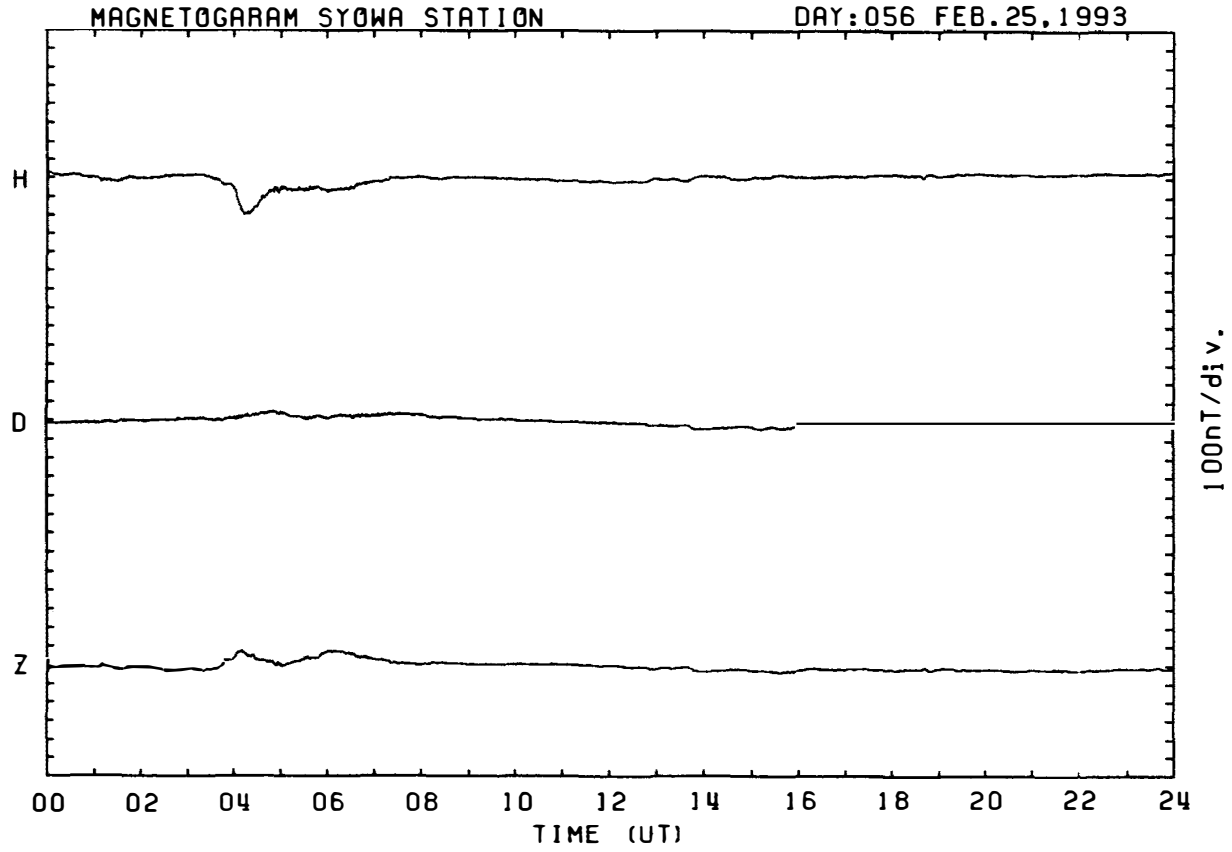
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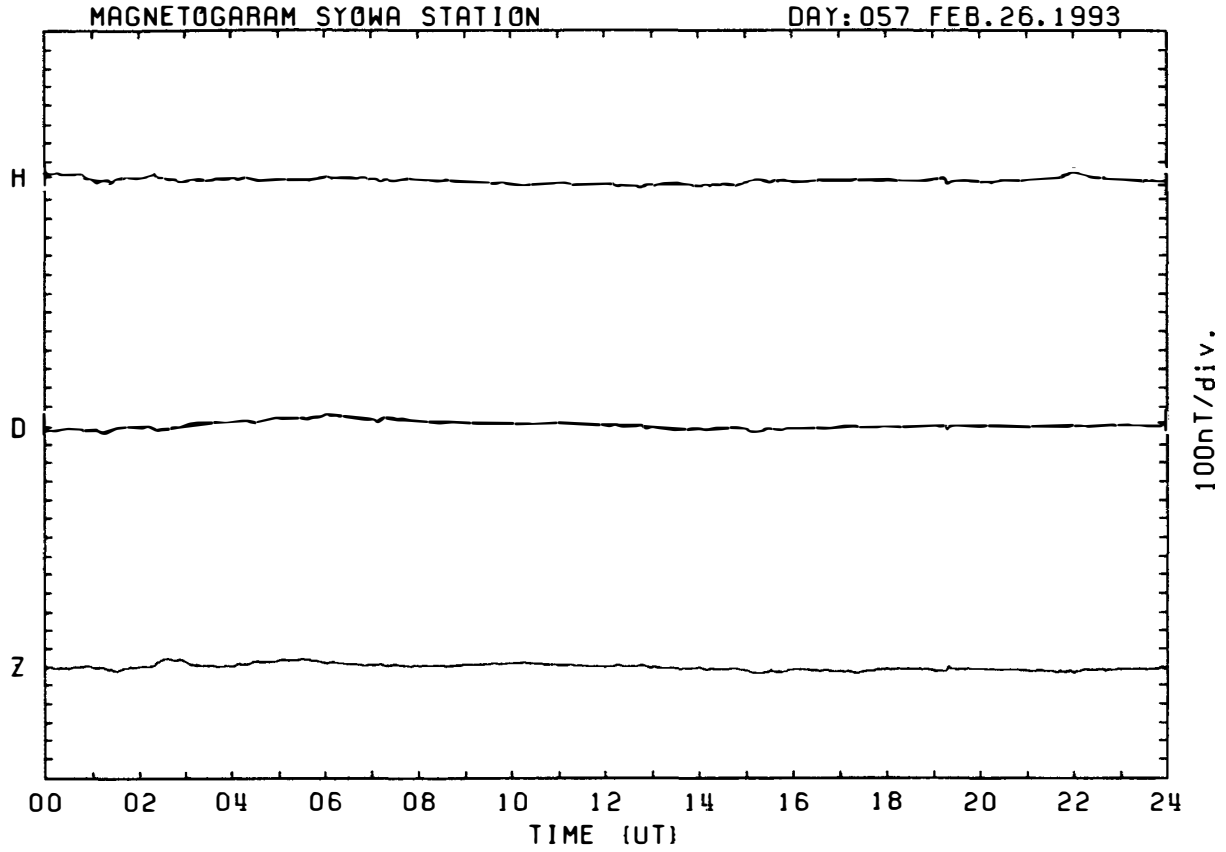
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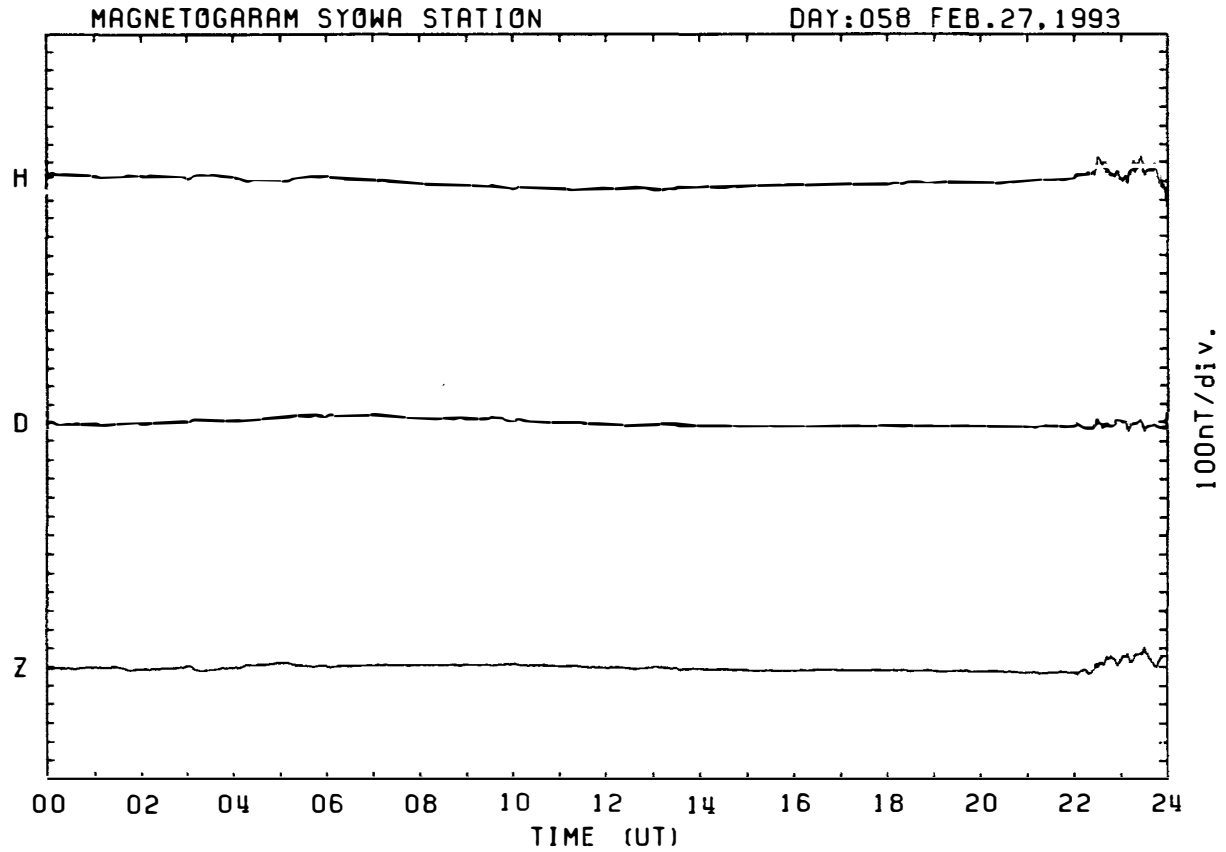
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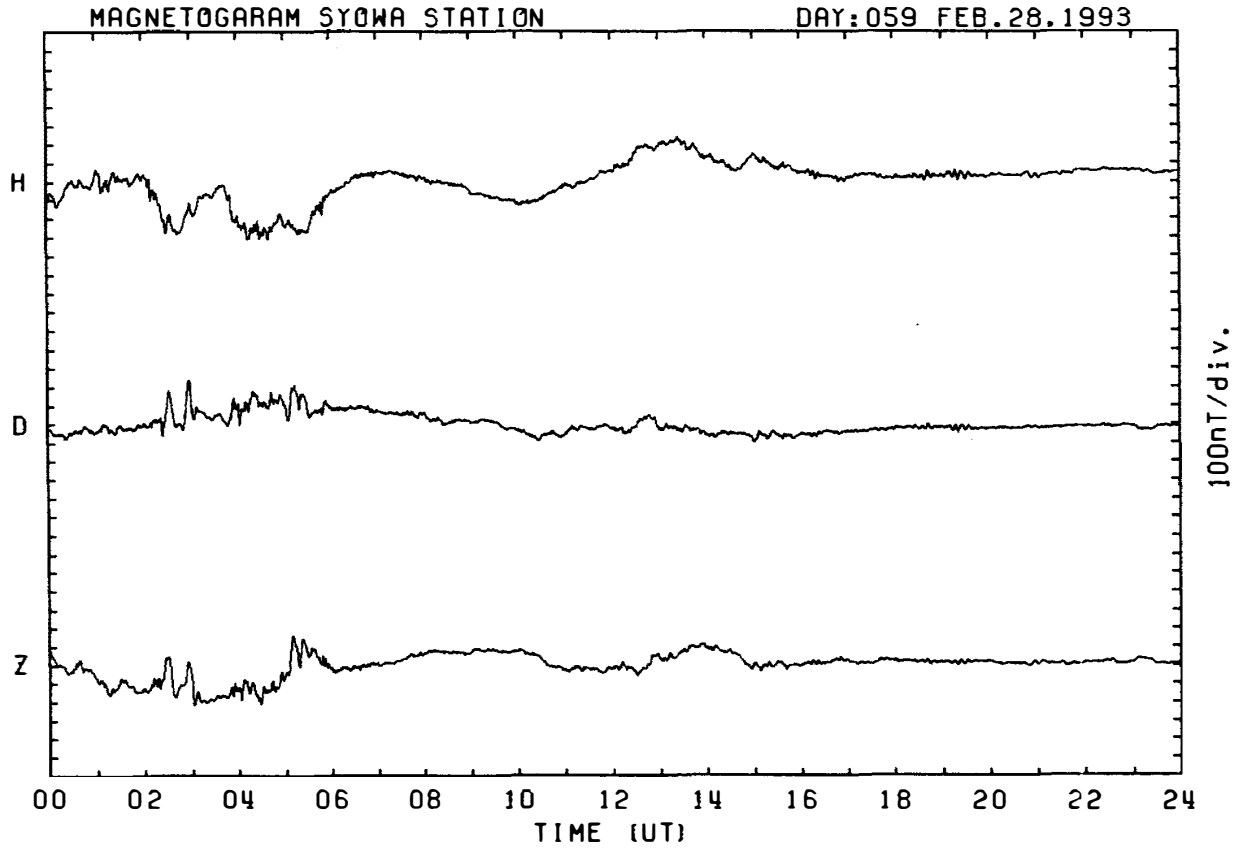
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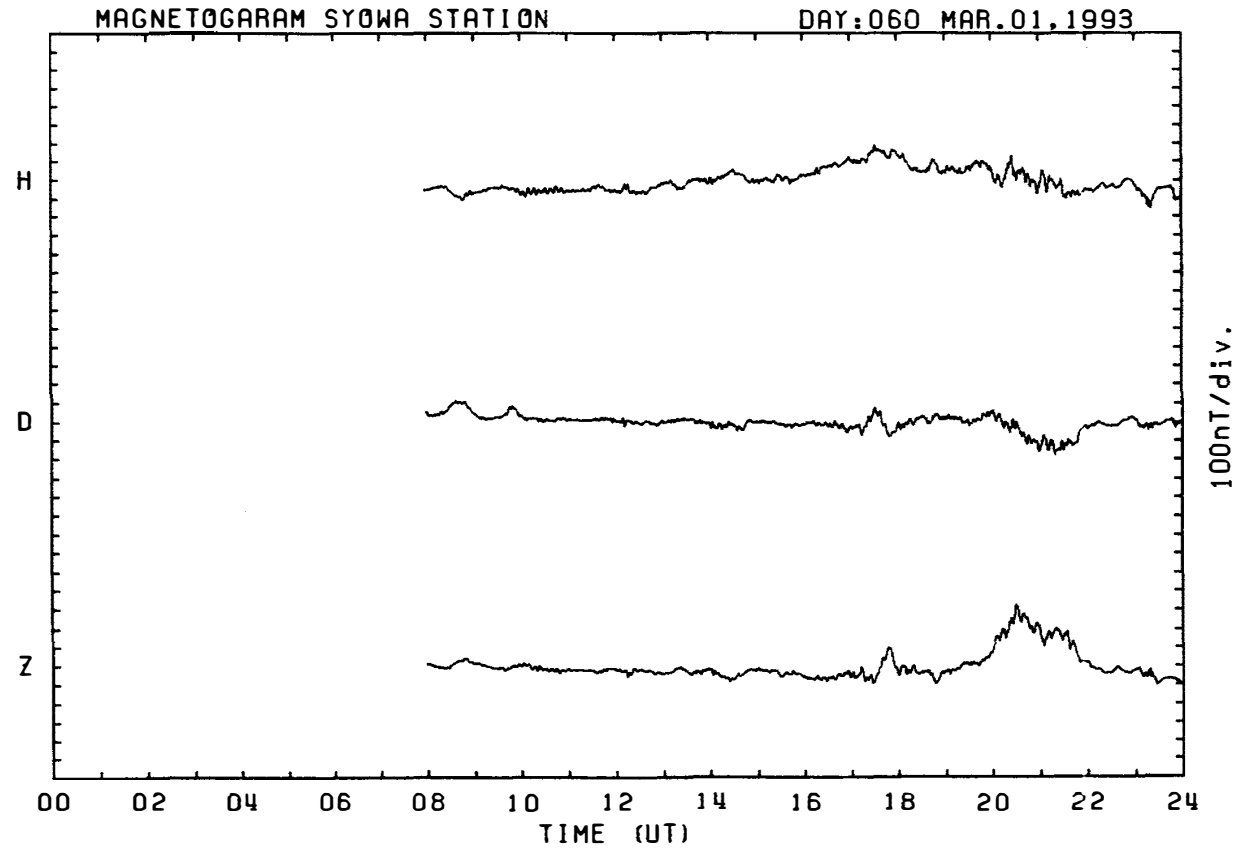
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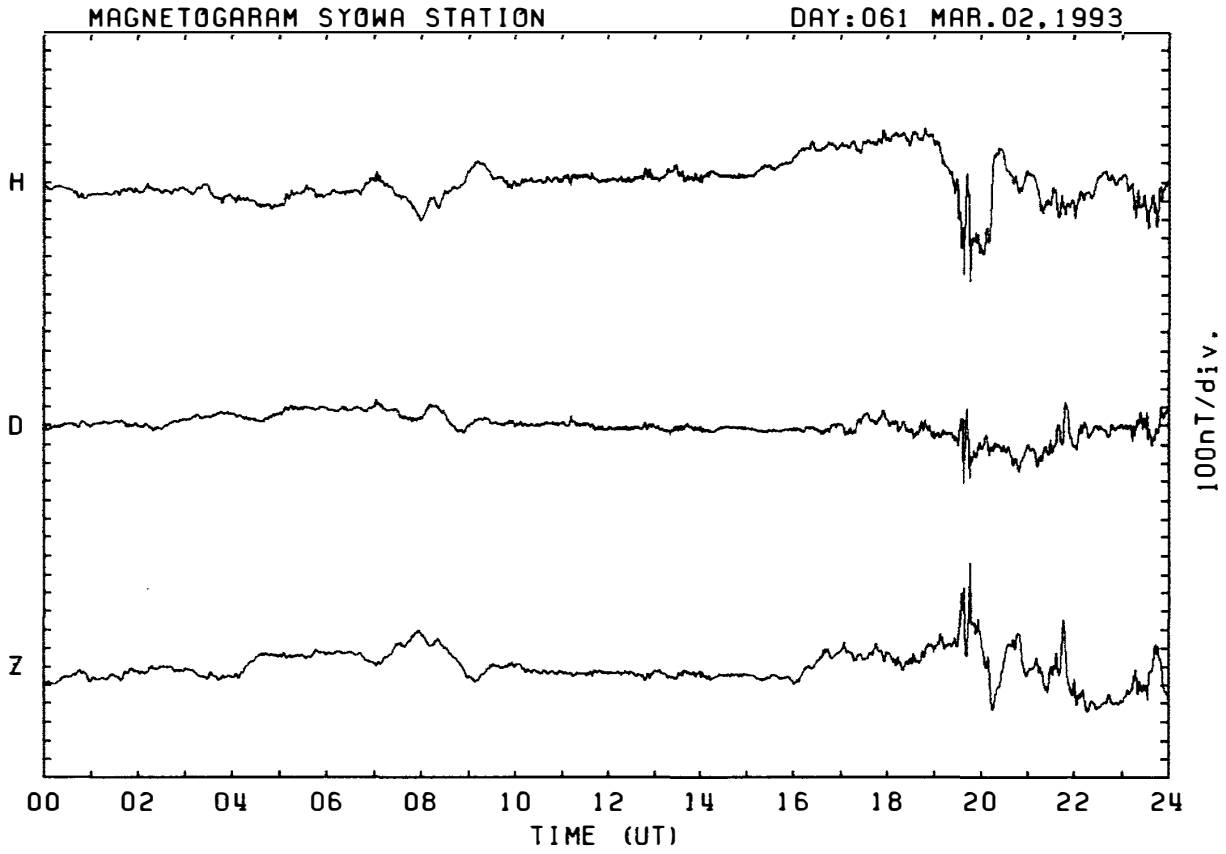
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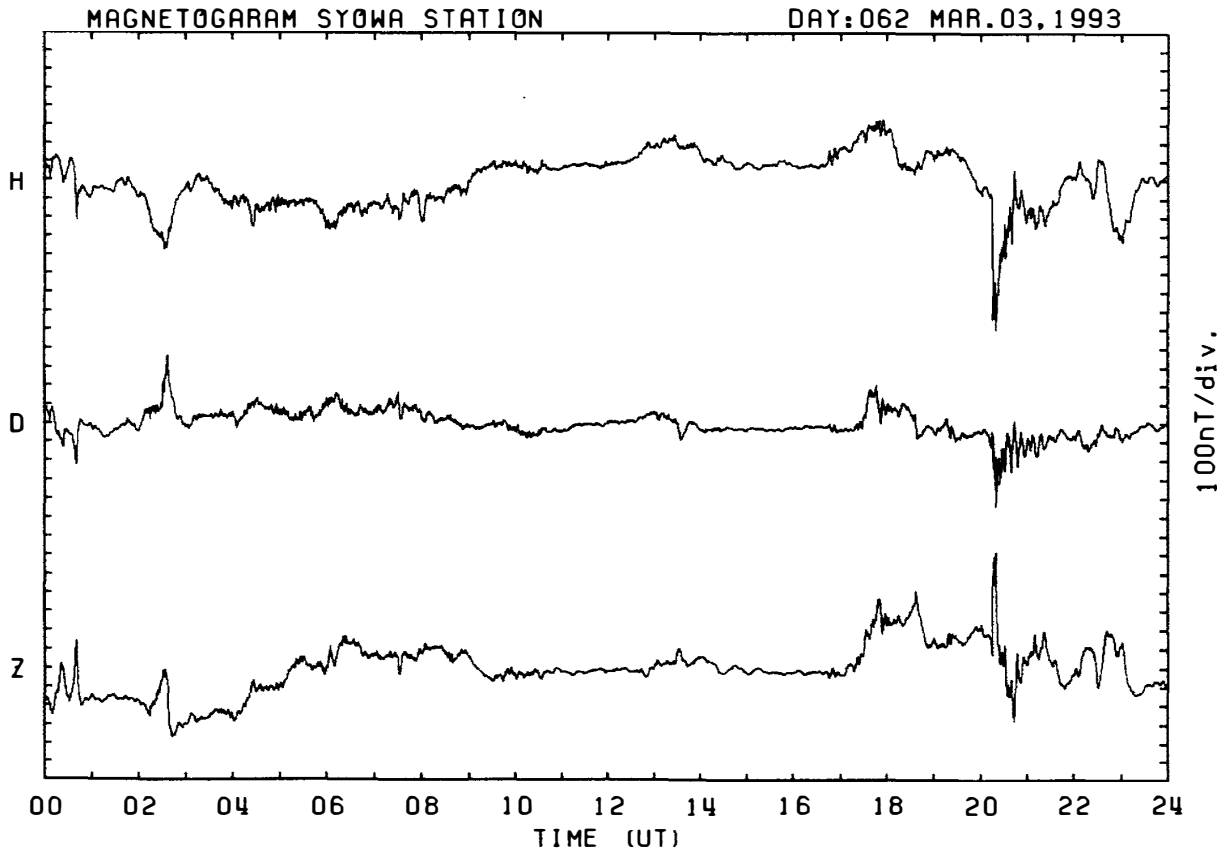
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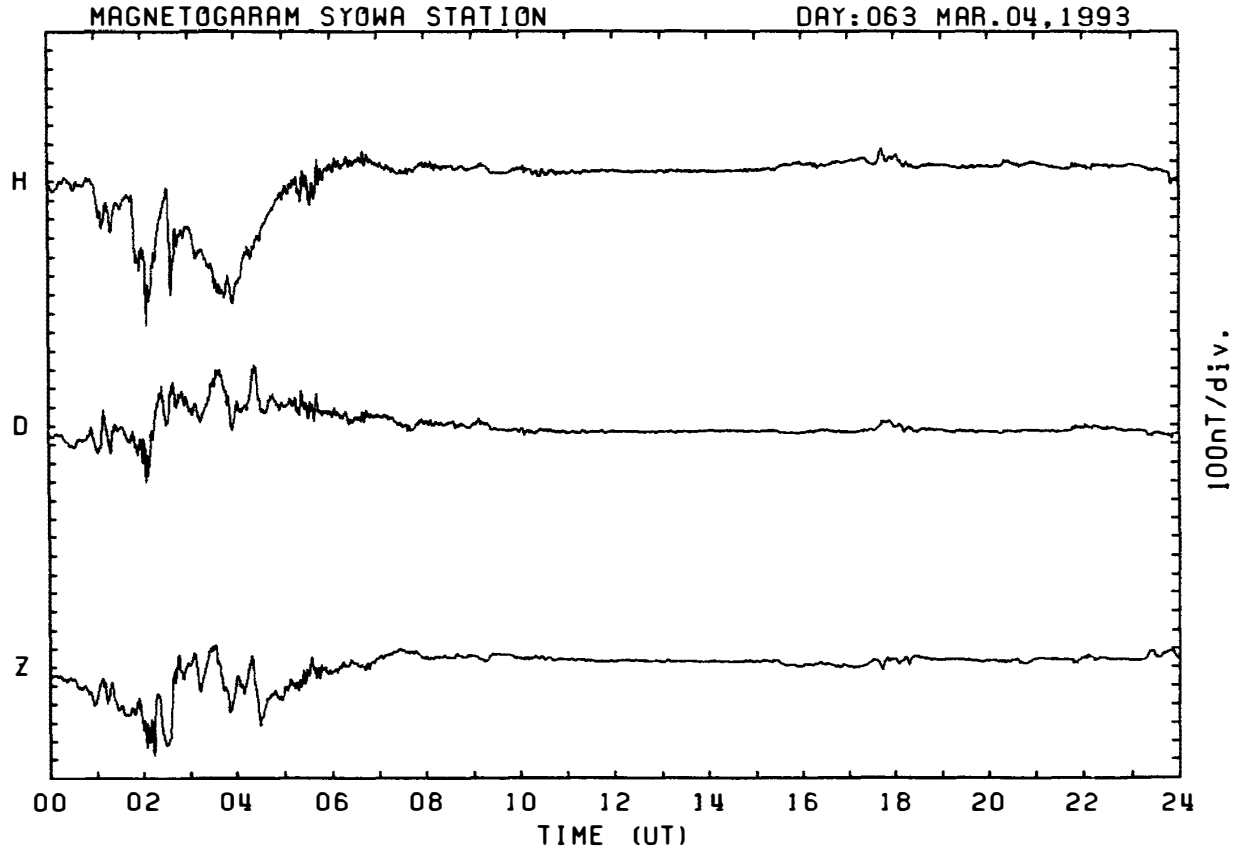
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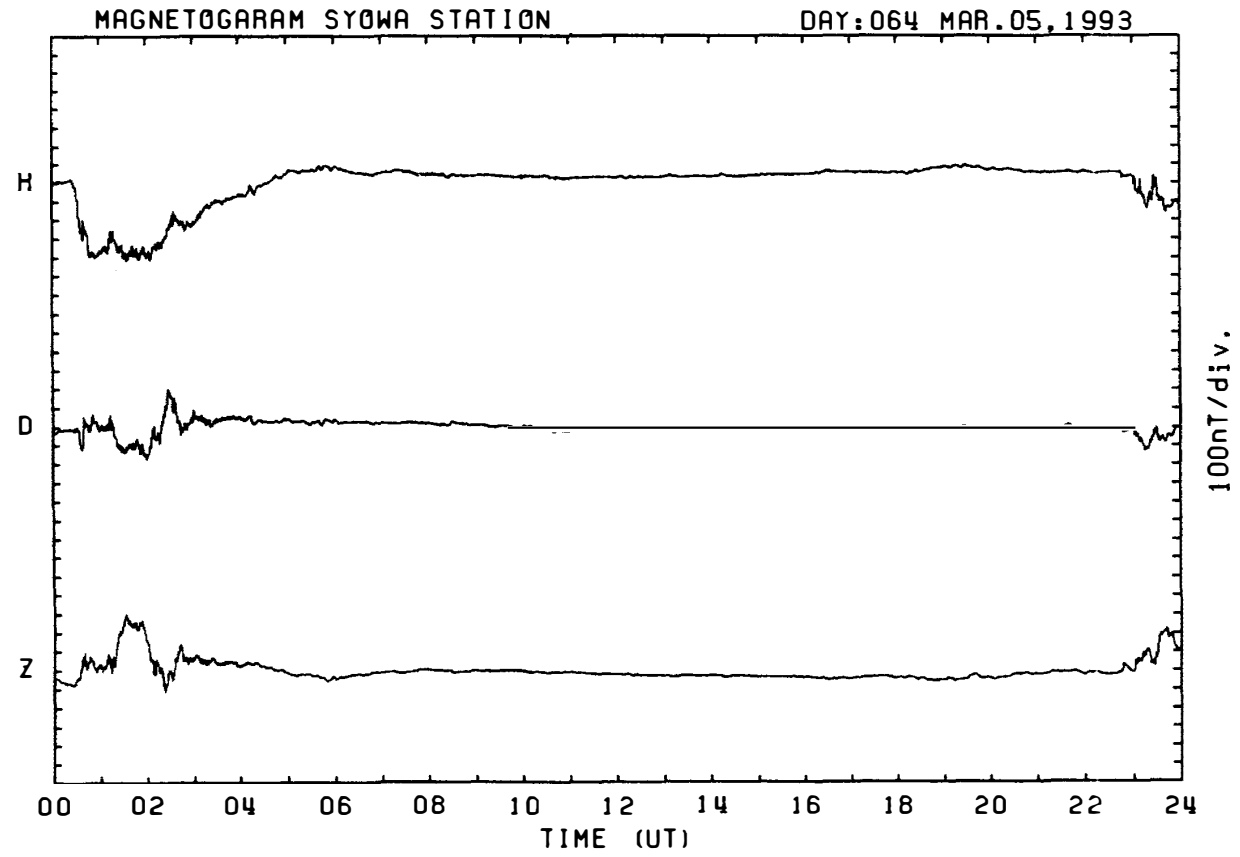
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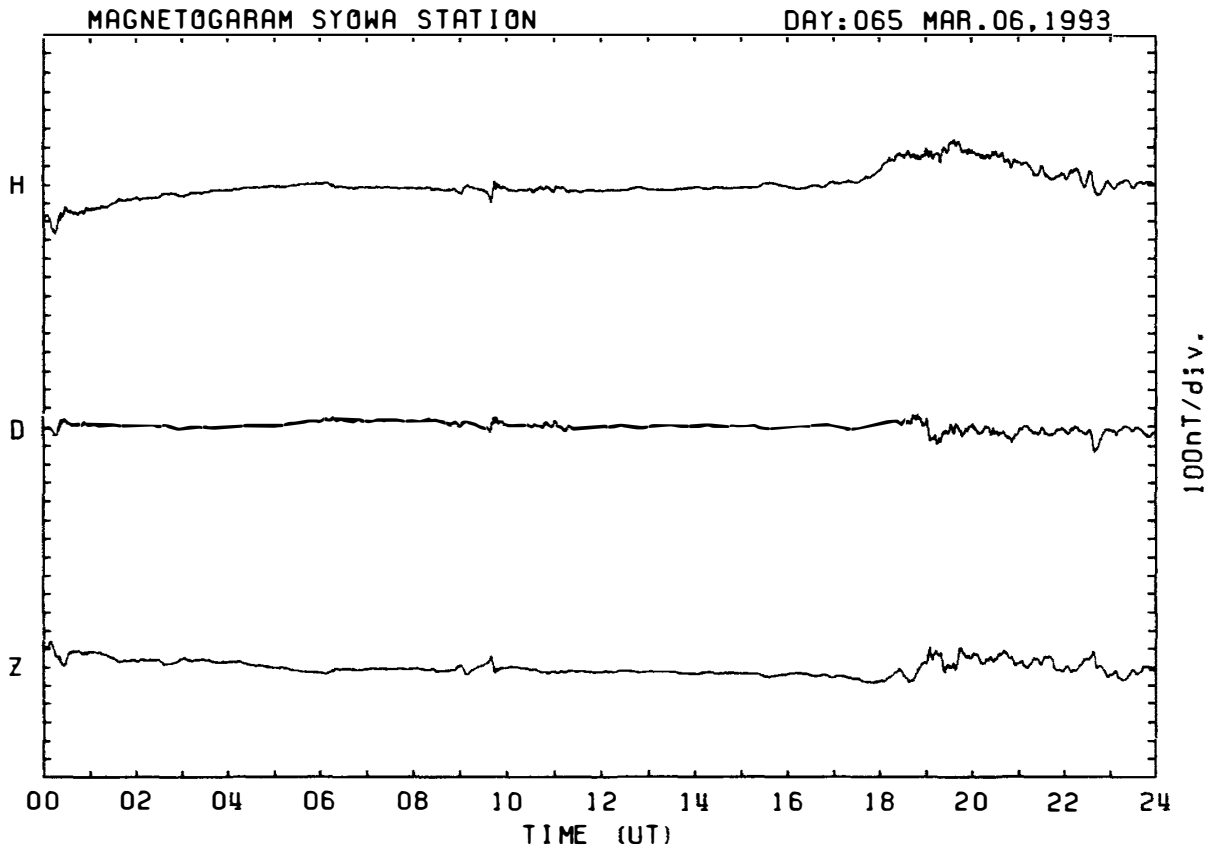
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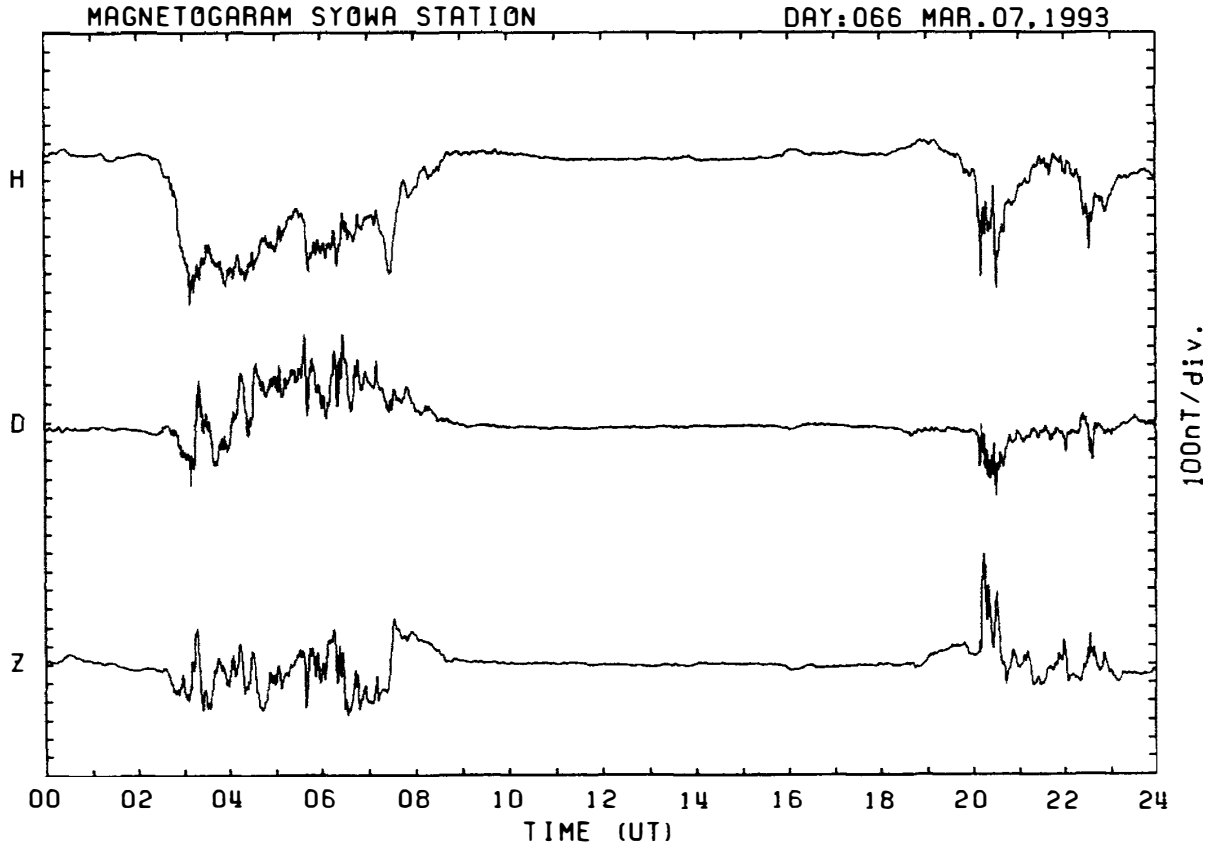
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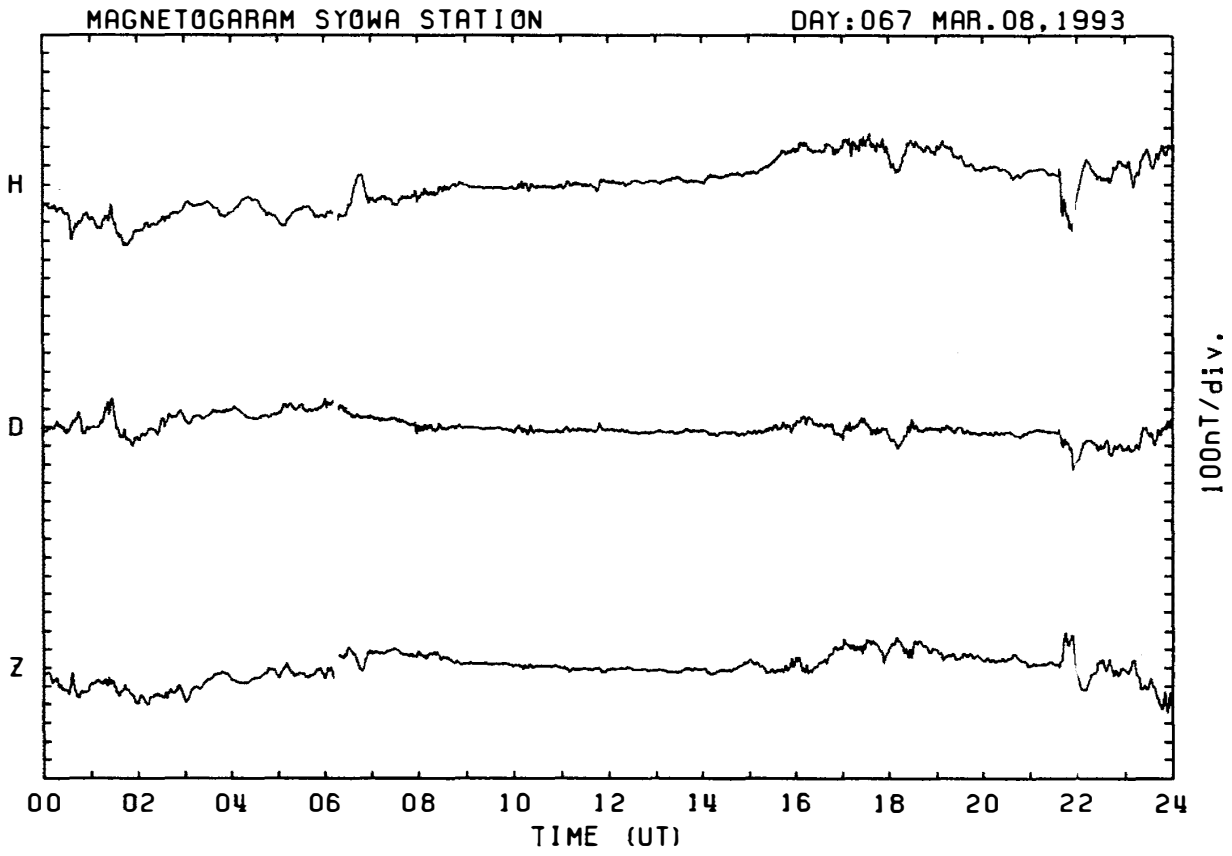
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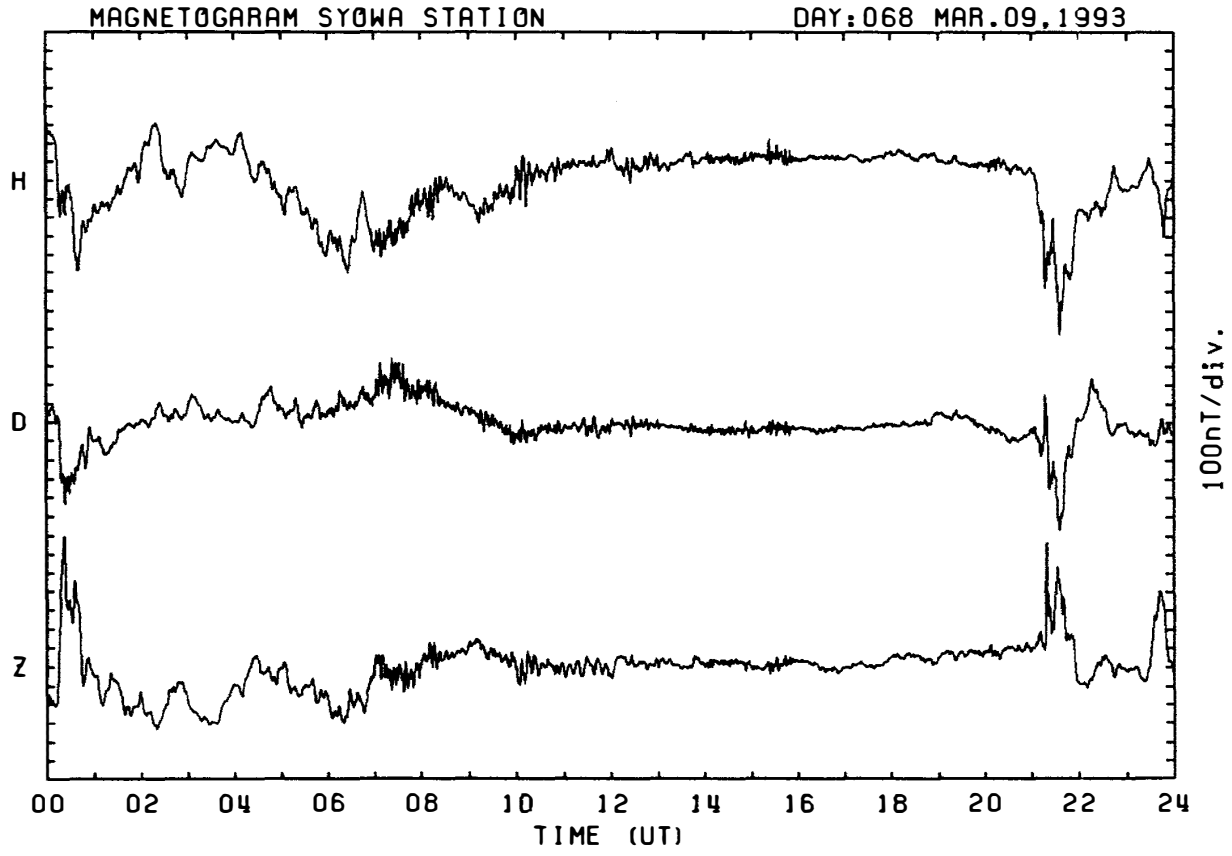
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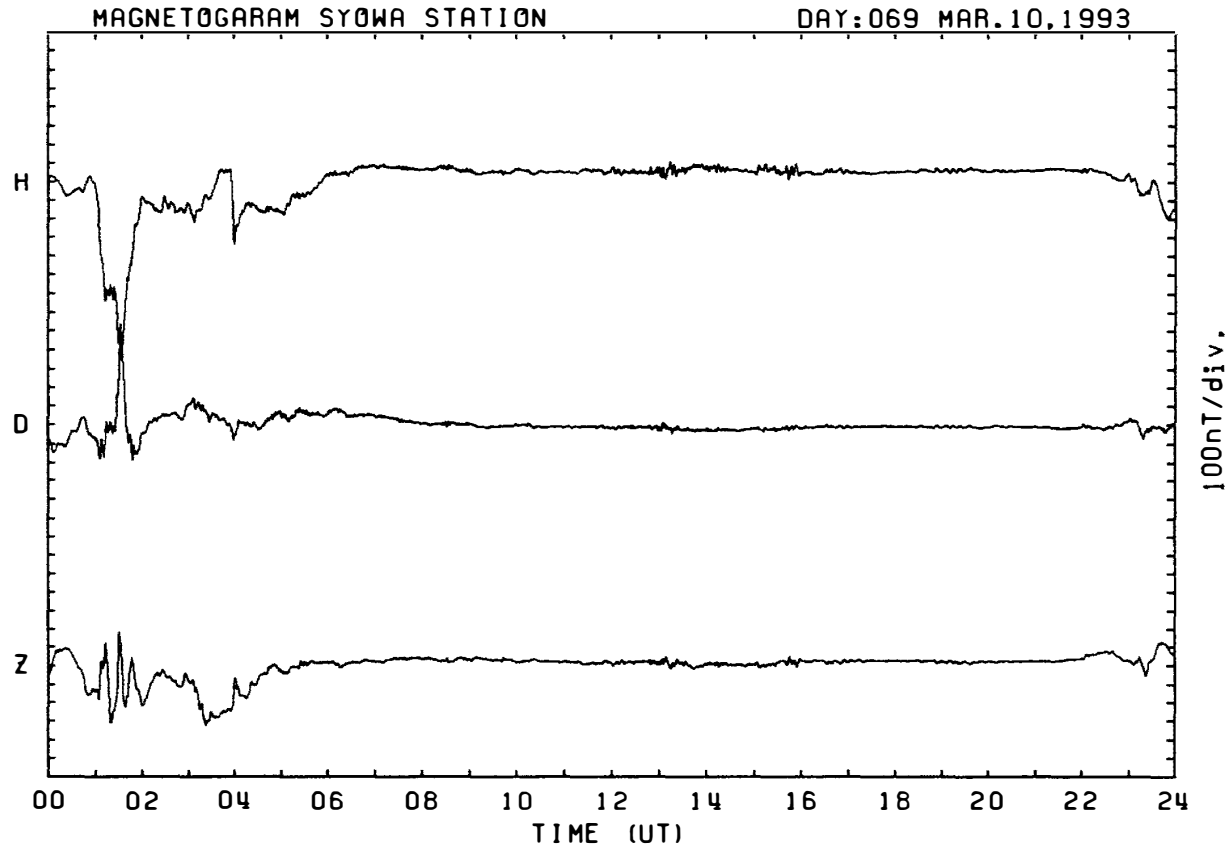
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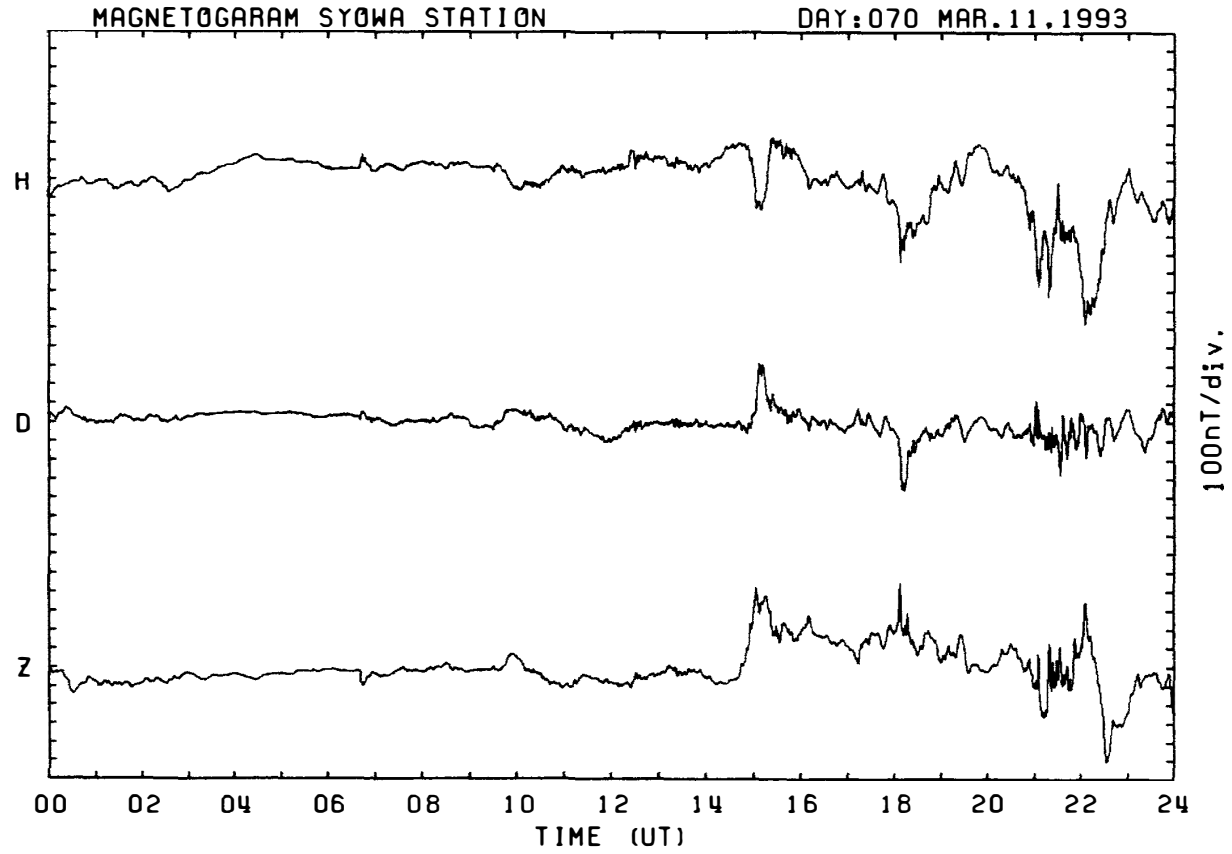
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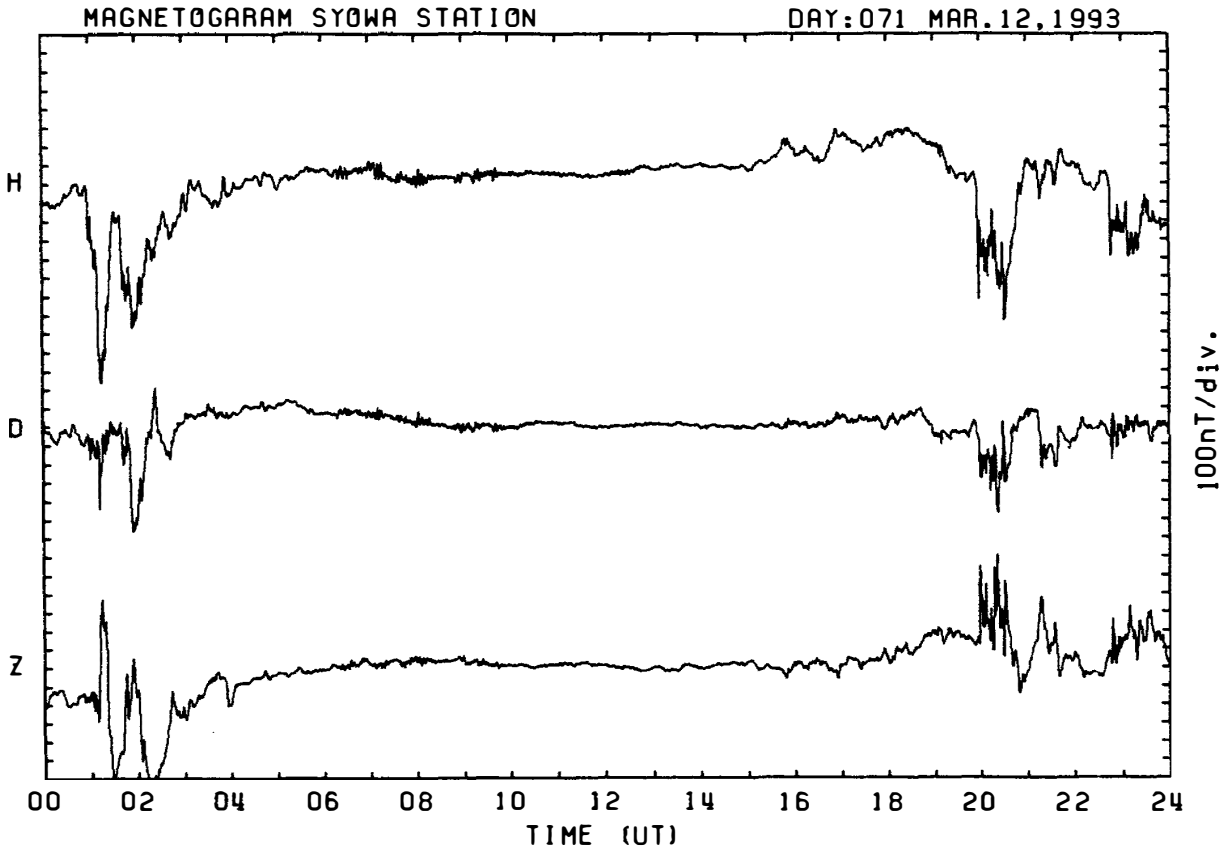
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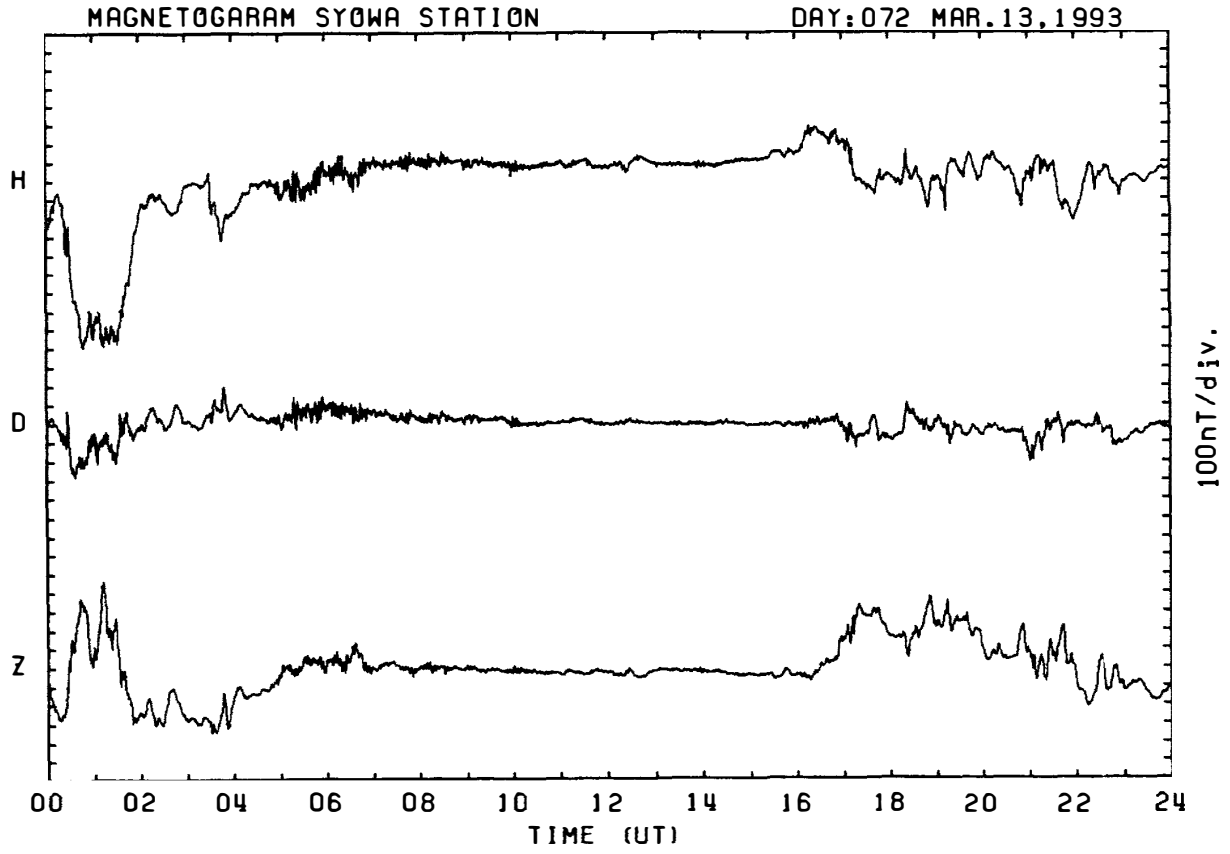
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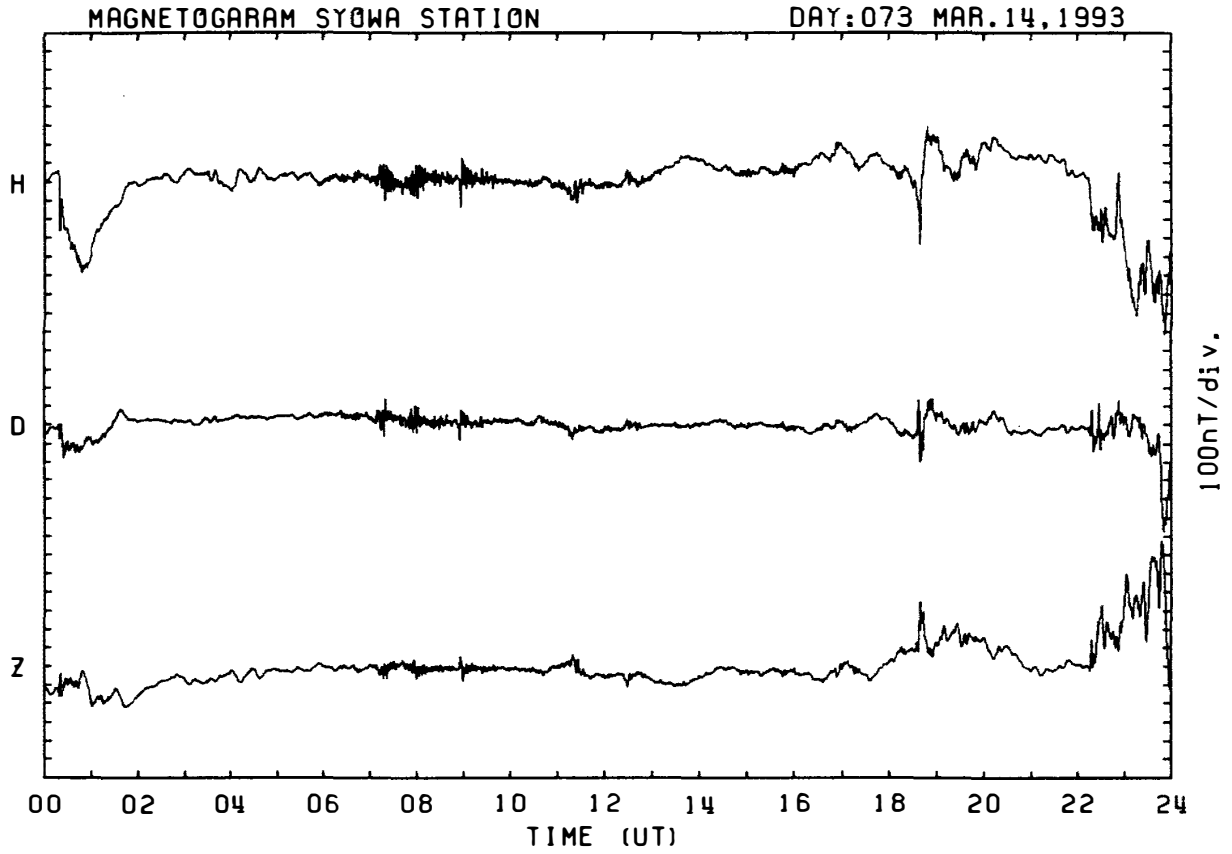
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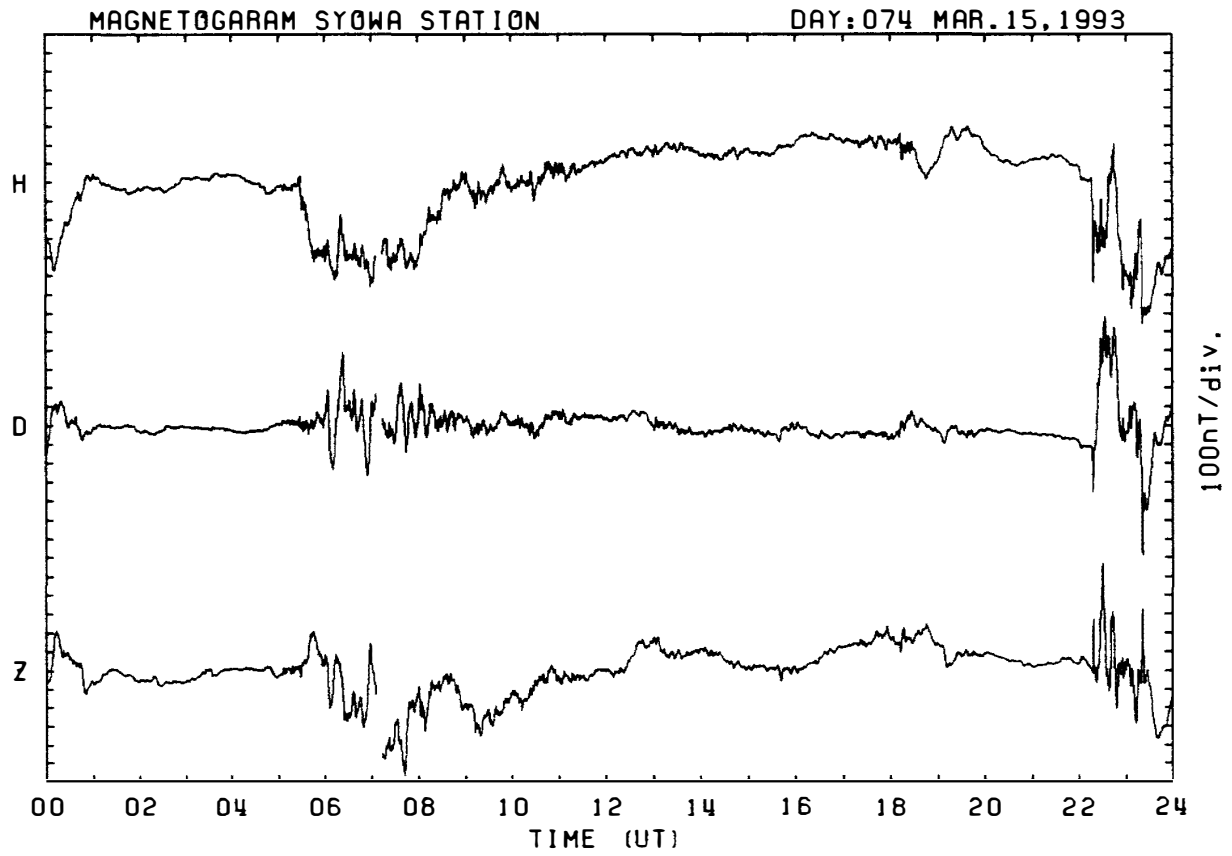
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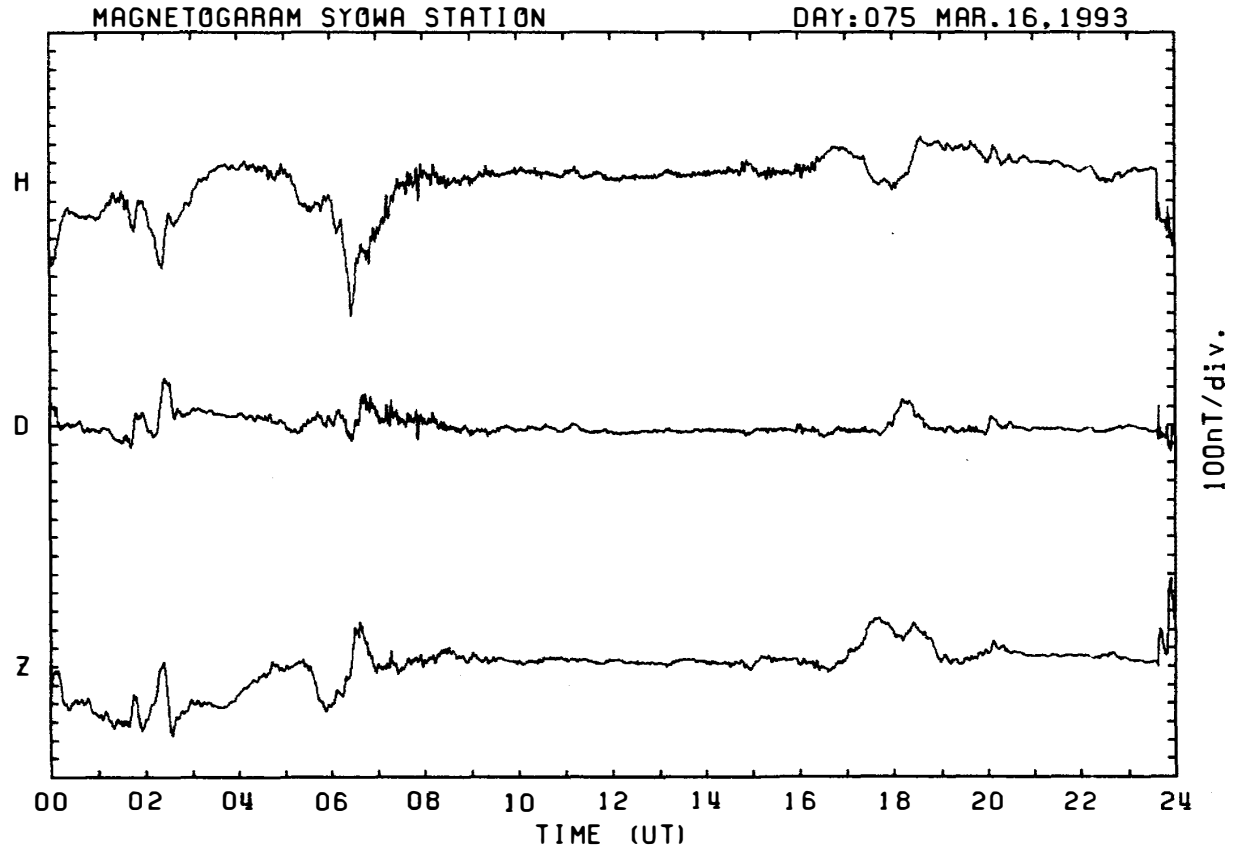
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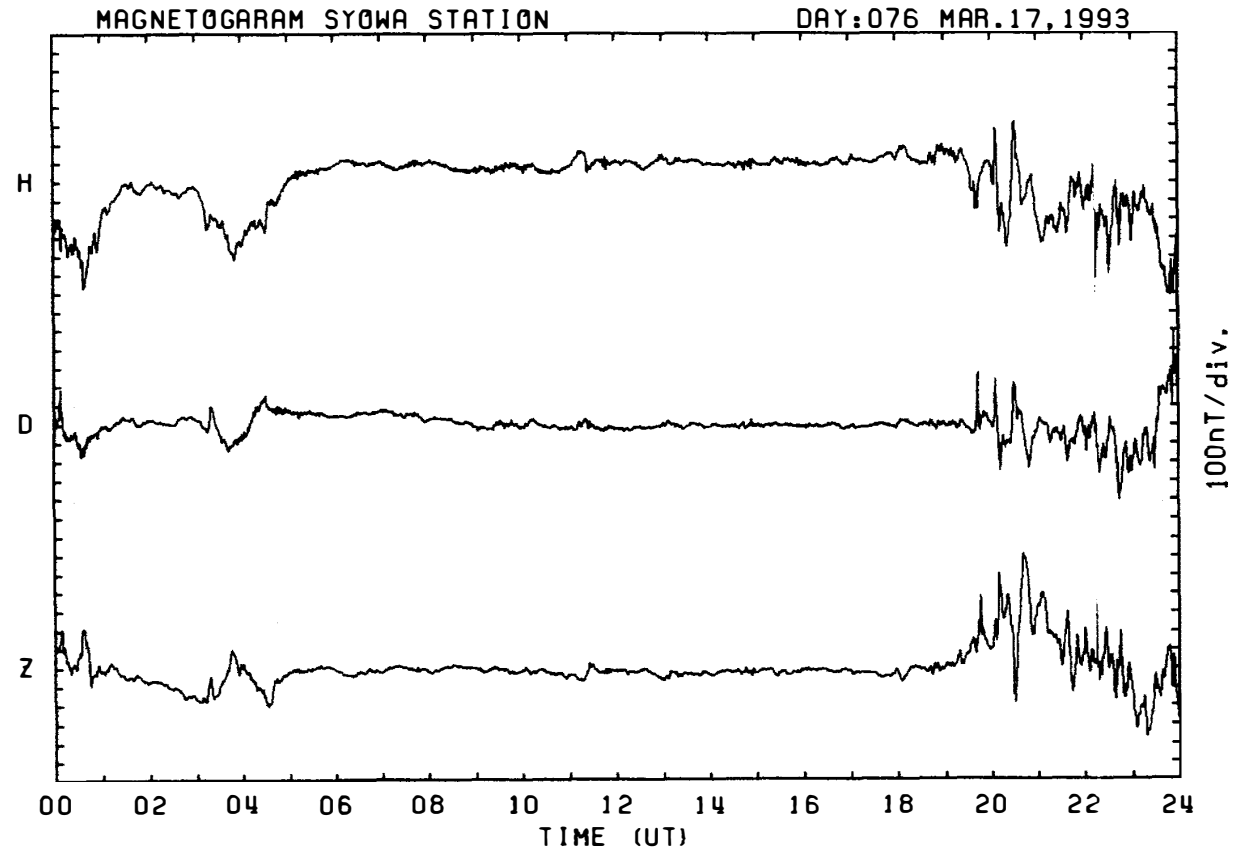
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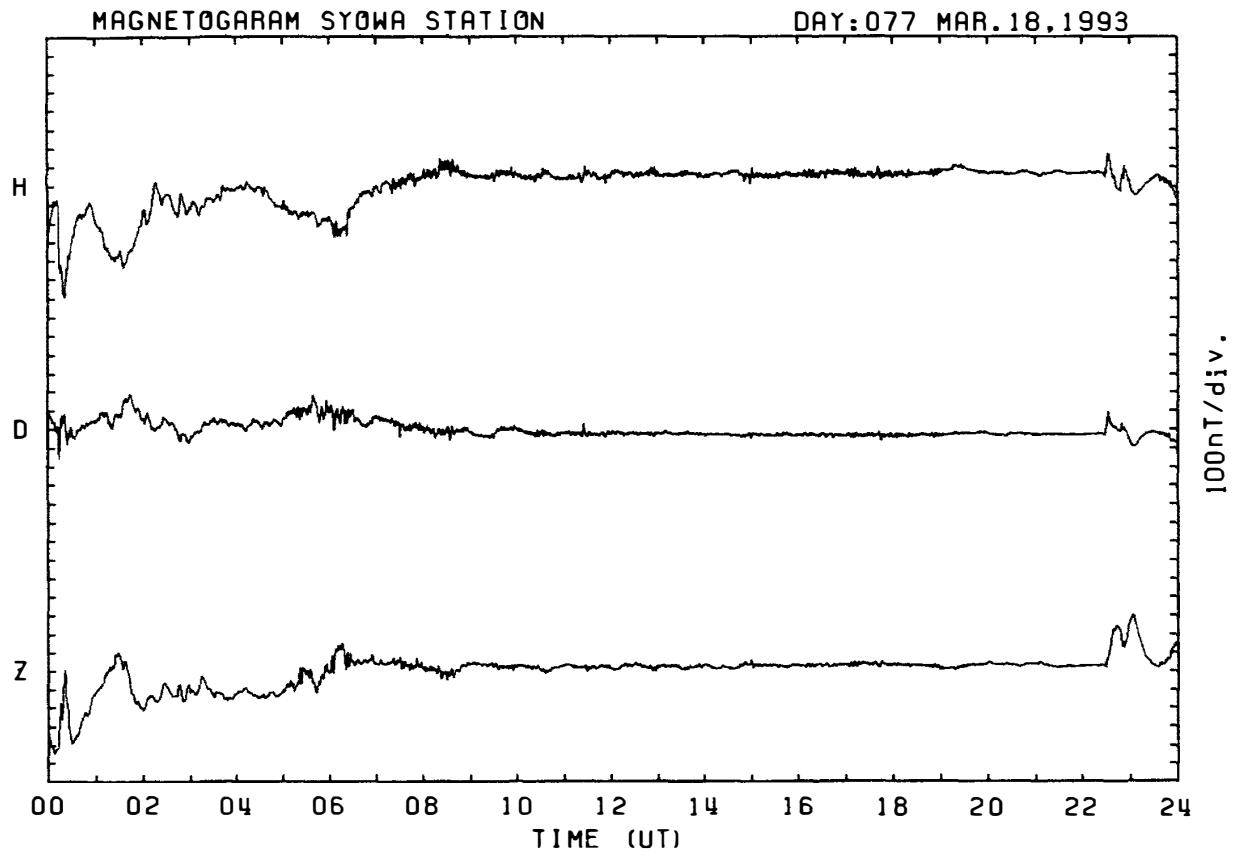
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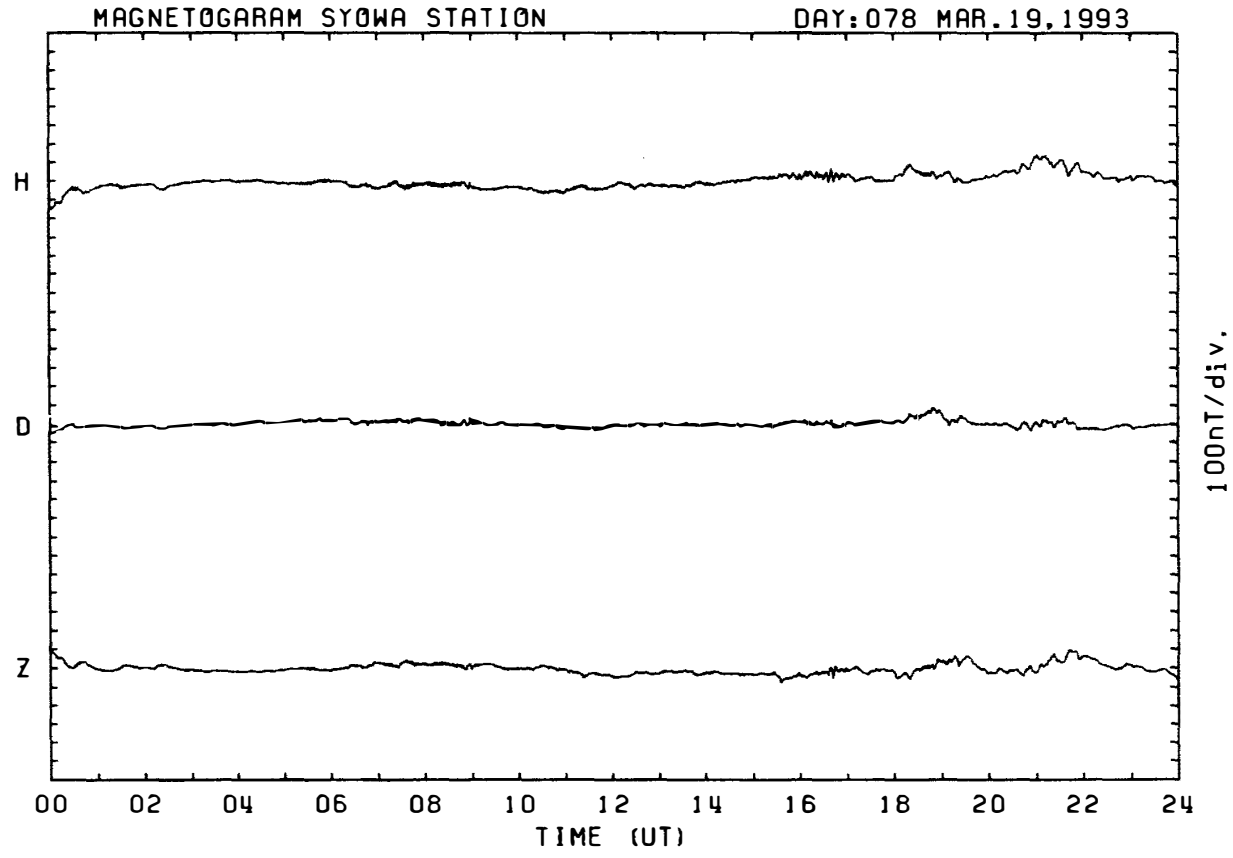
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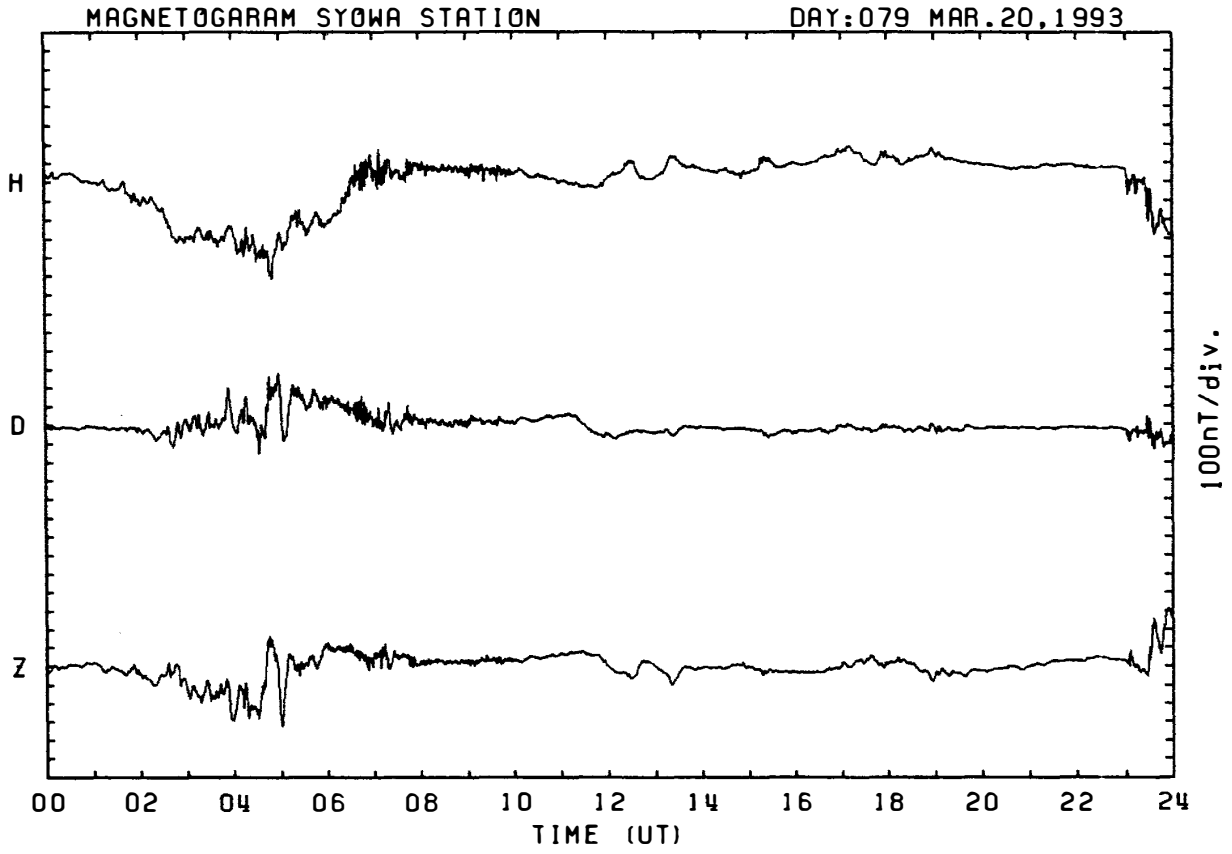
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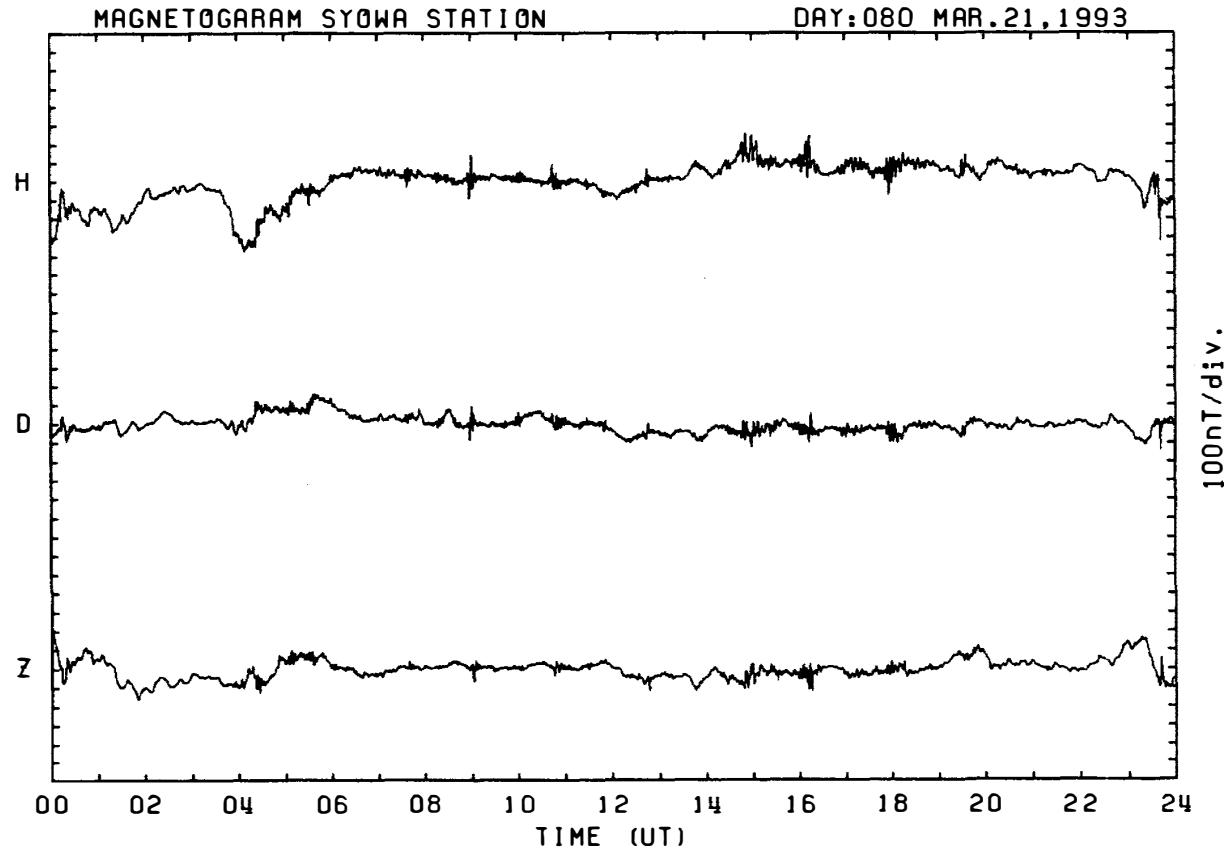
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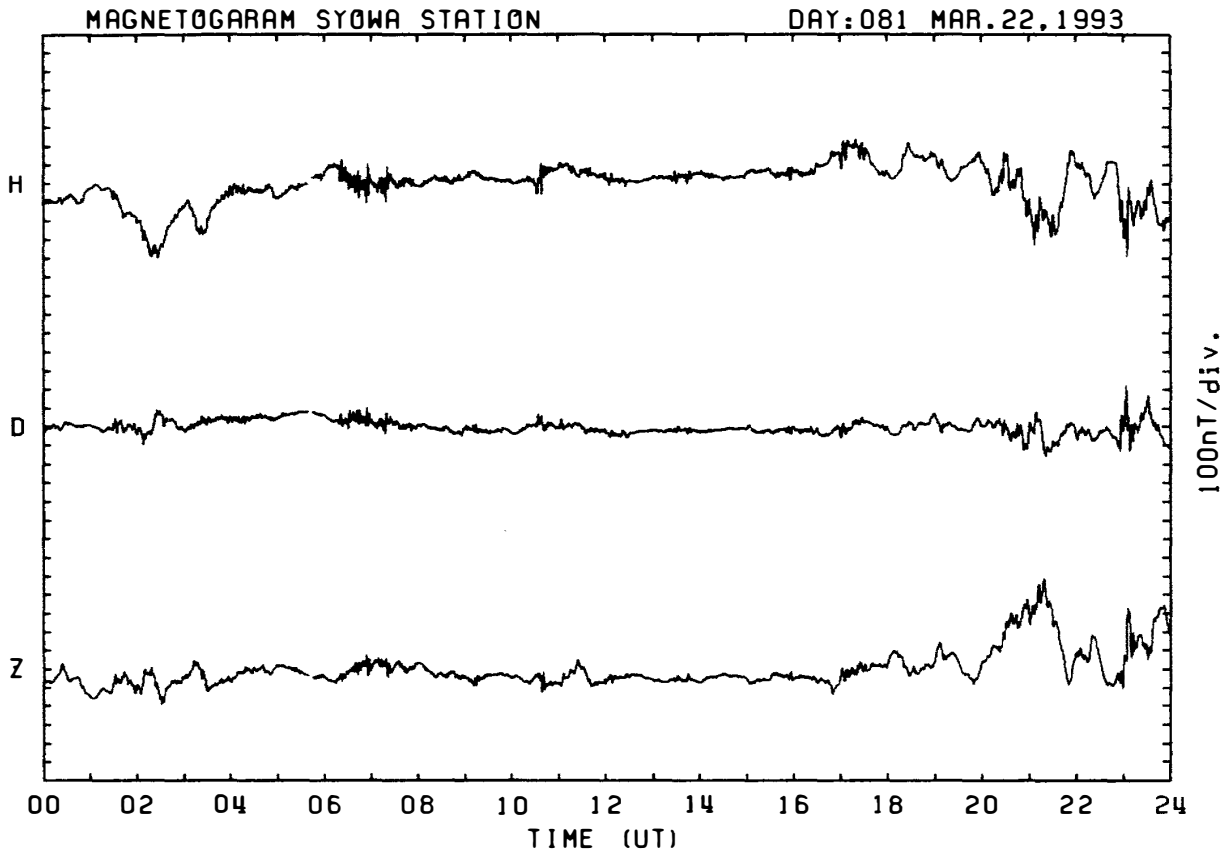
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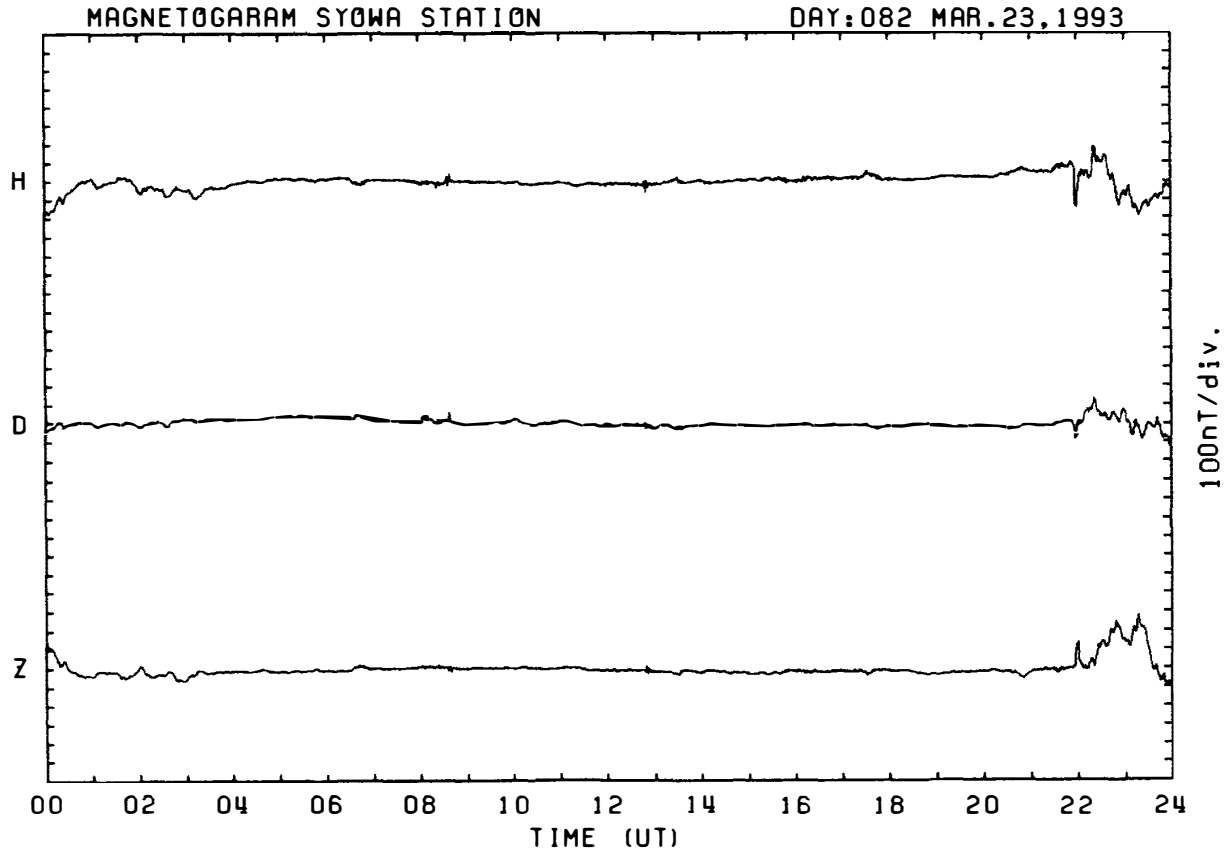
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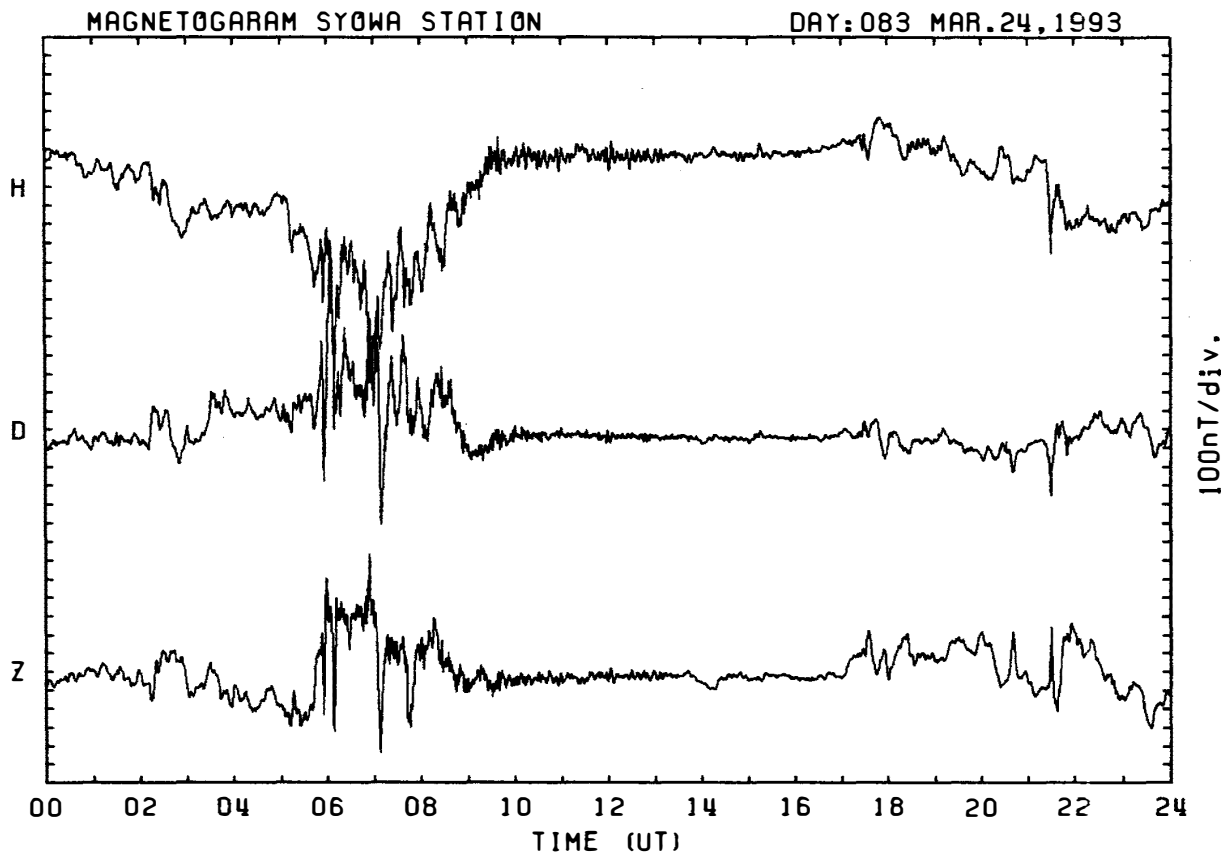
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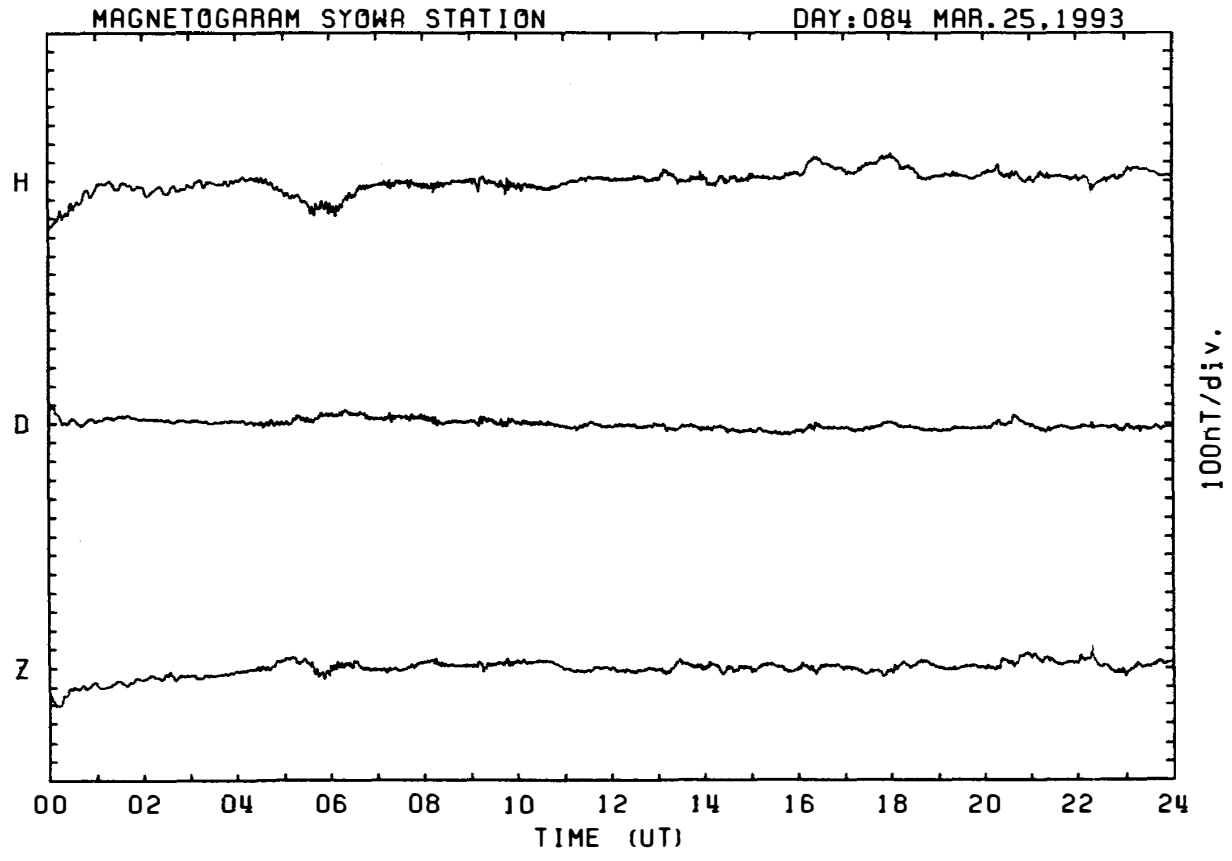
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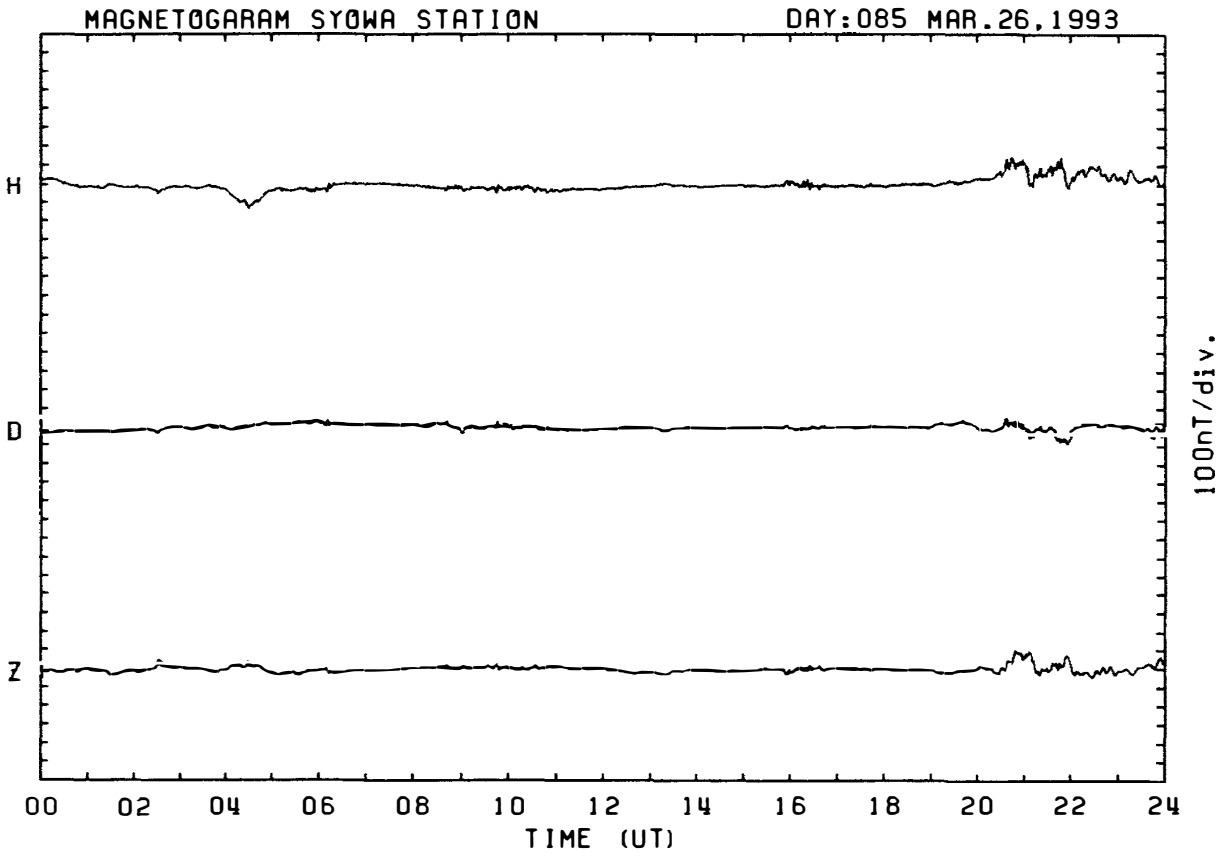
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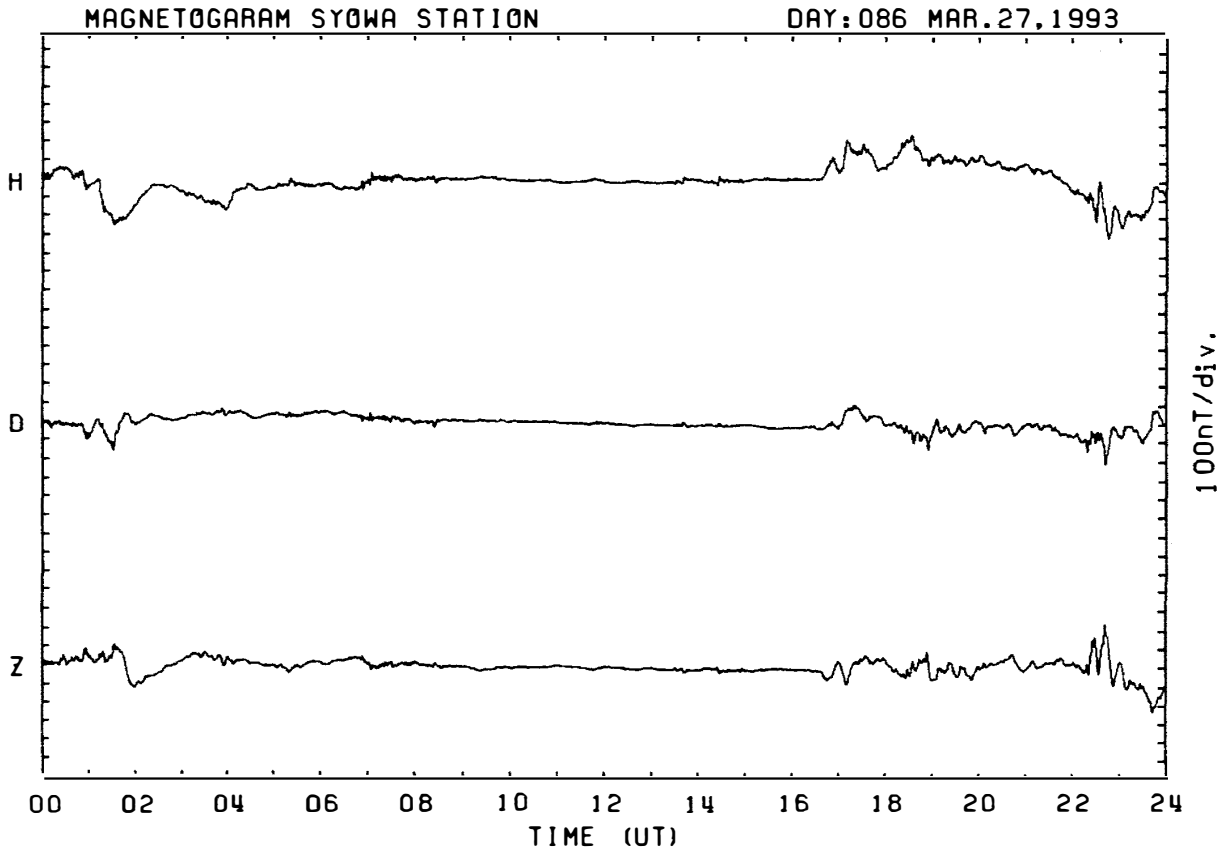
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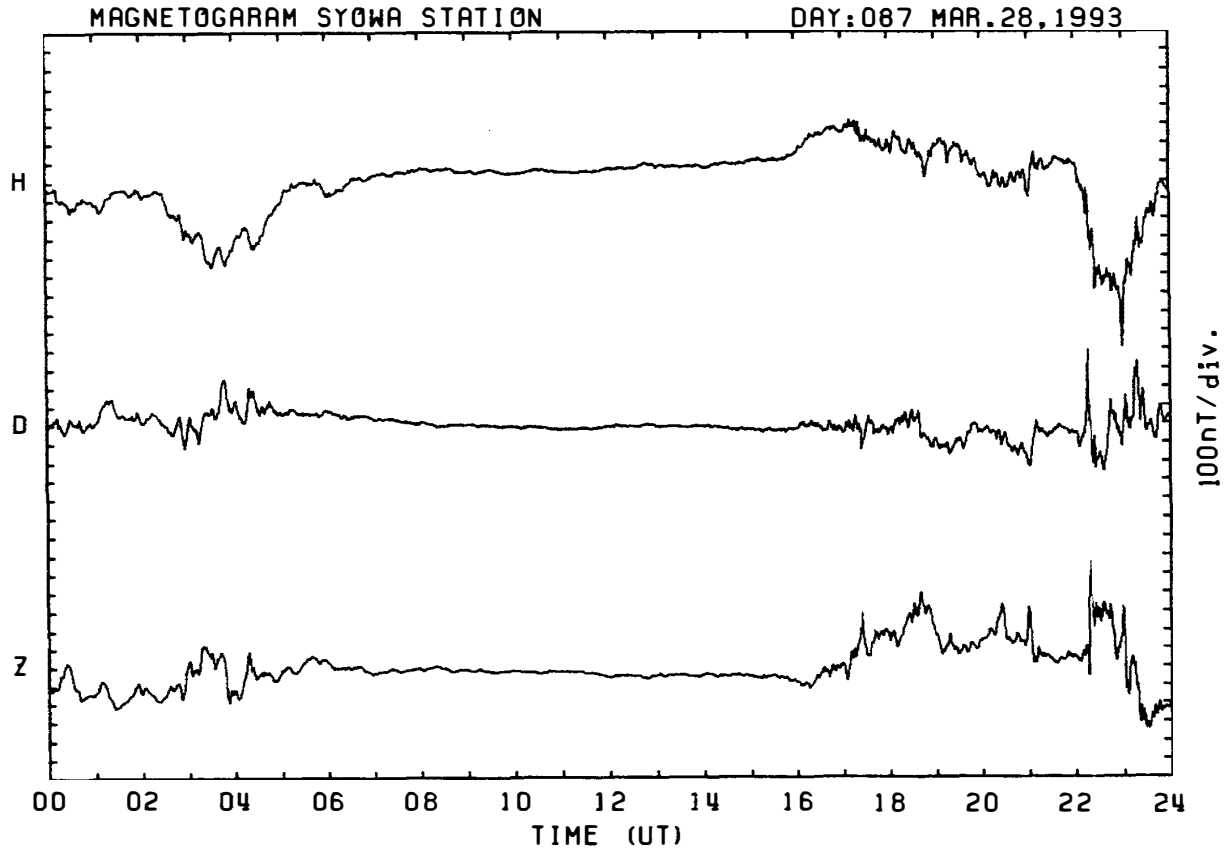
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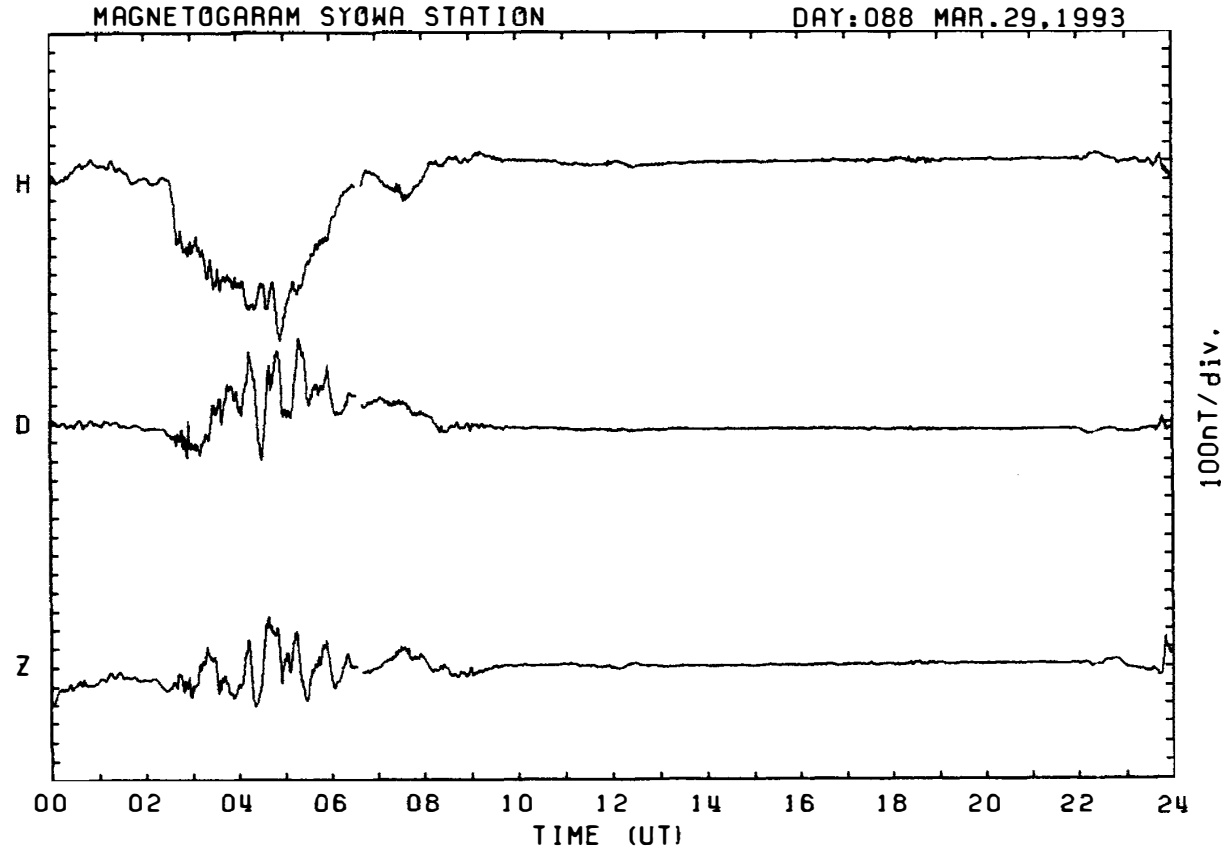
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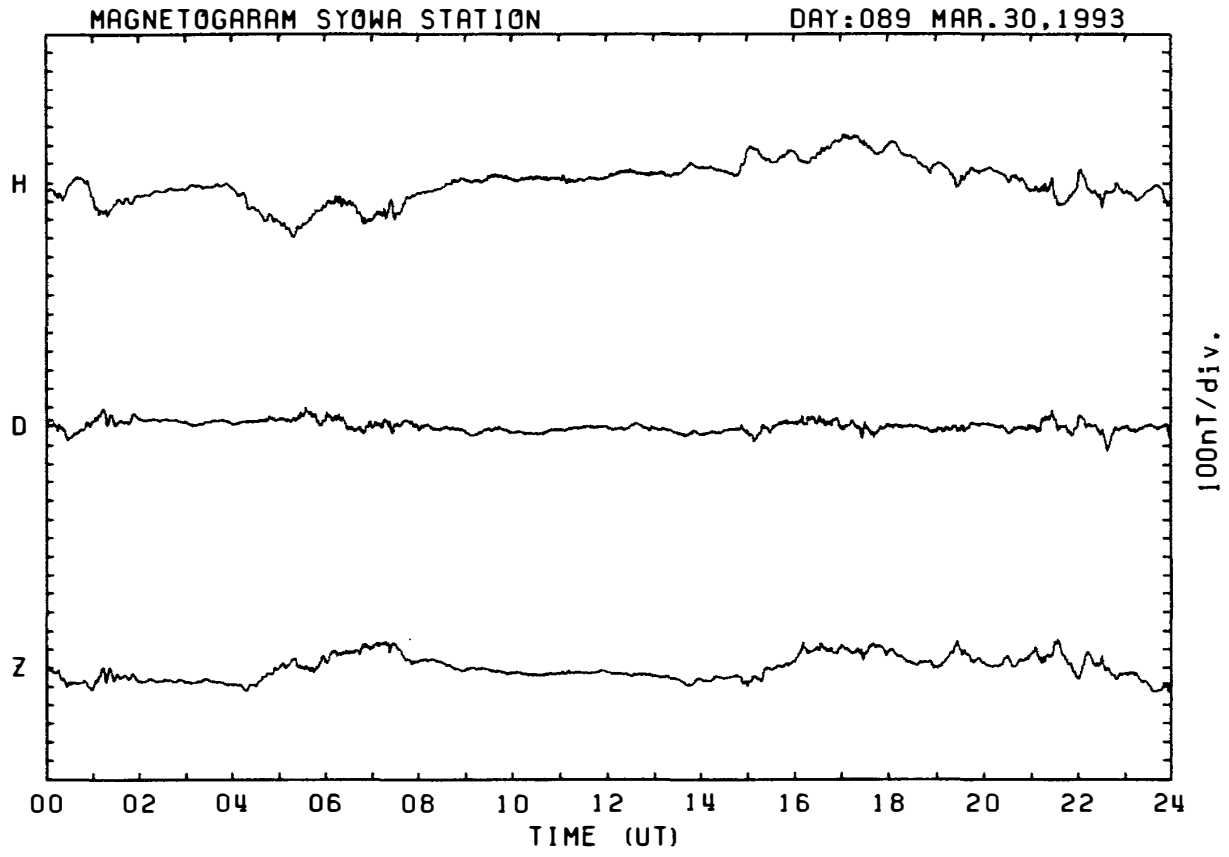
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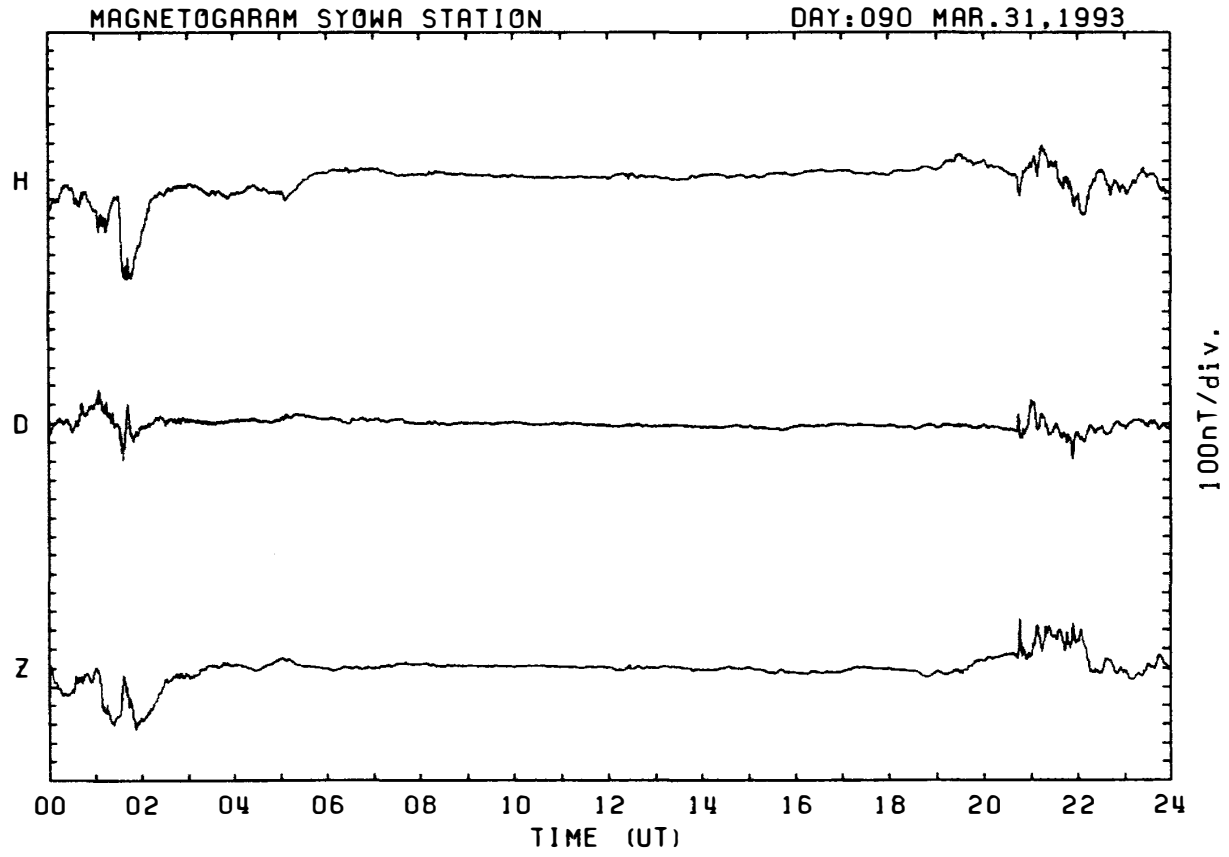
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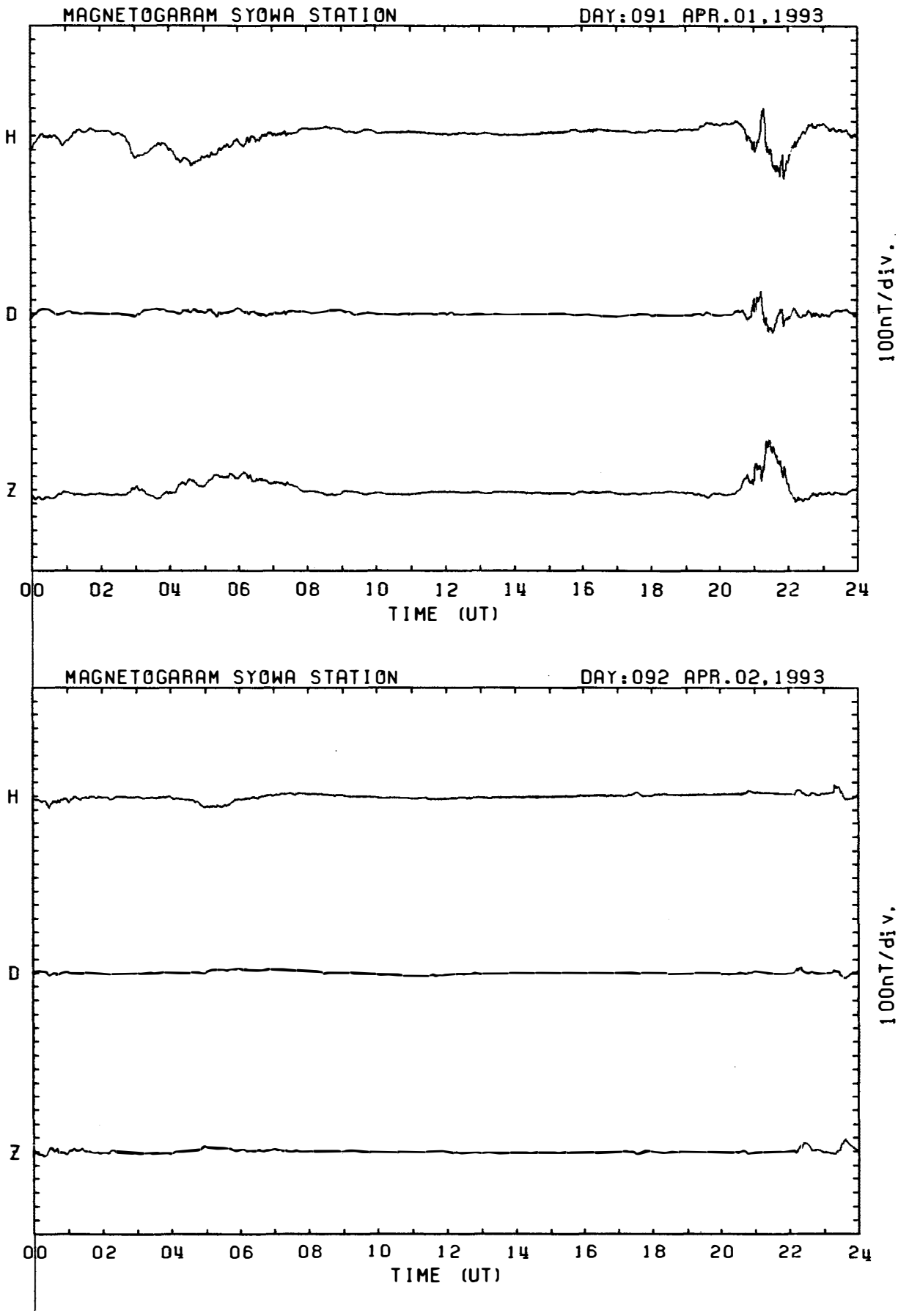
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TIME (UT)
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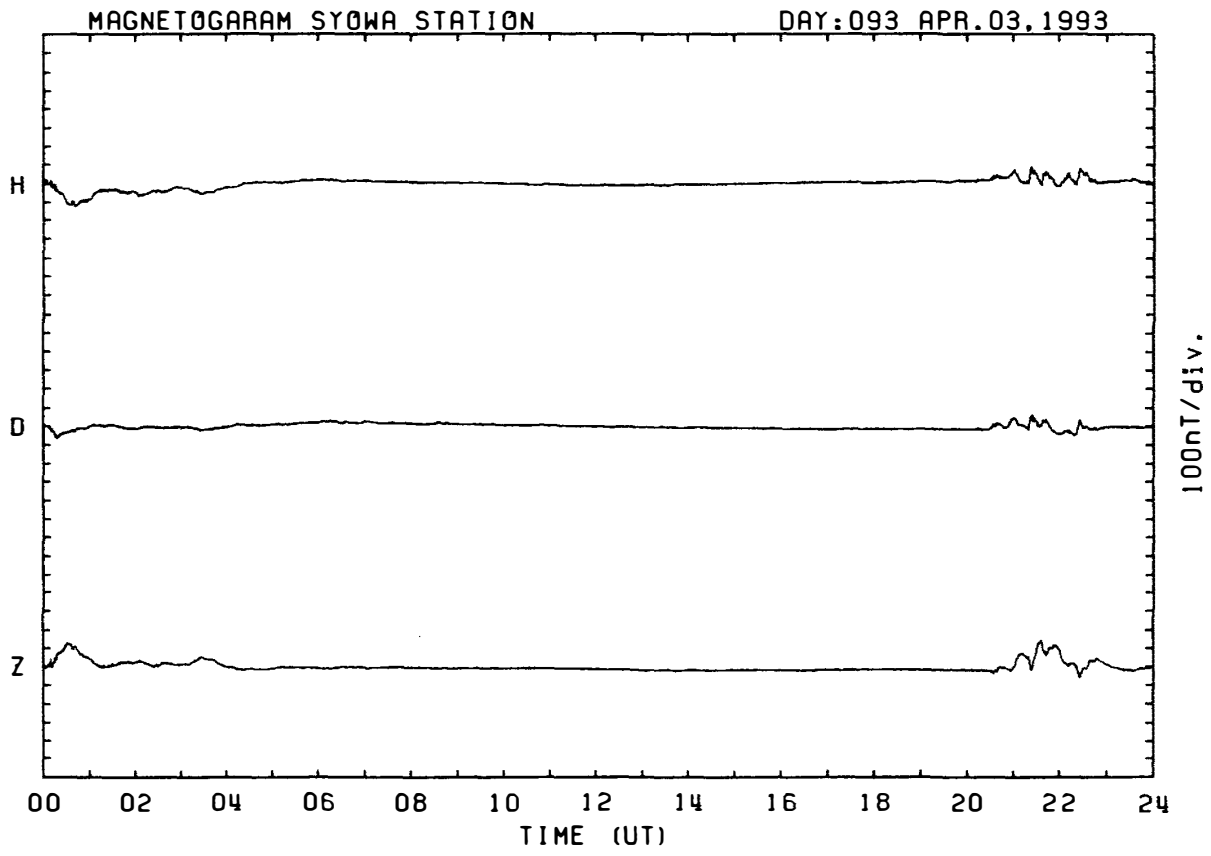
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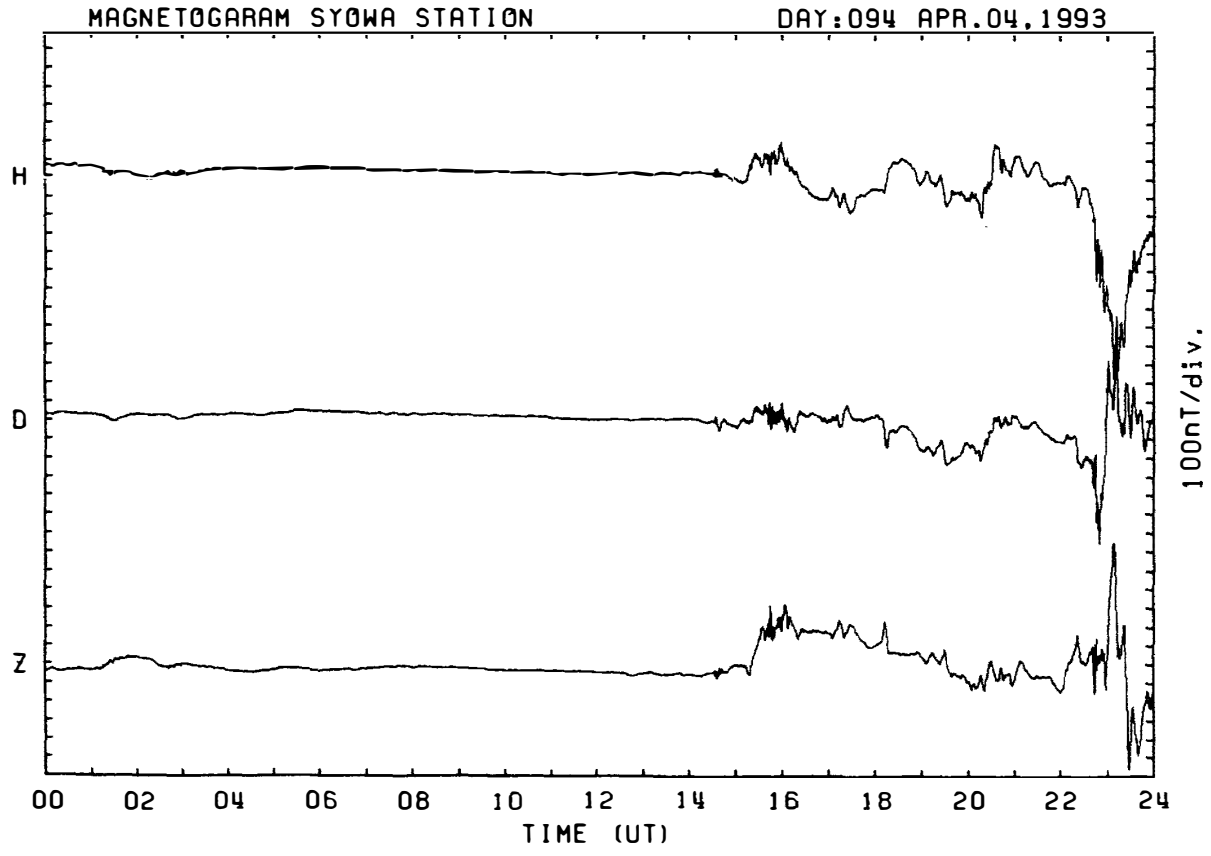
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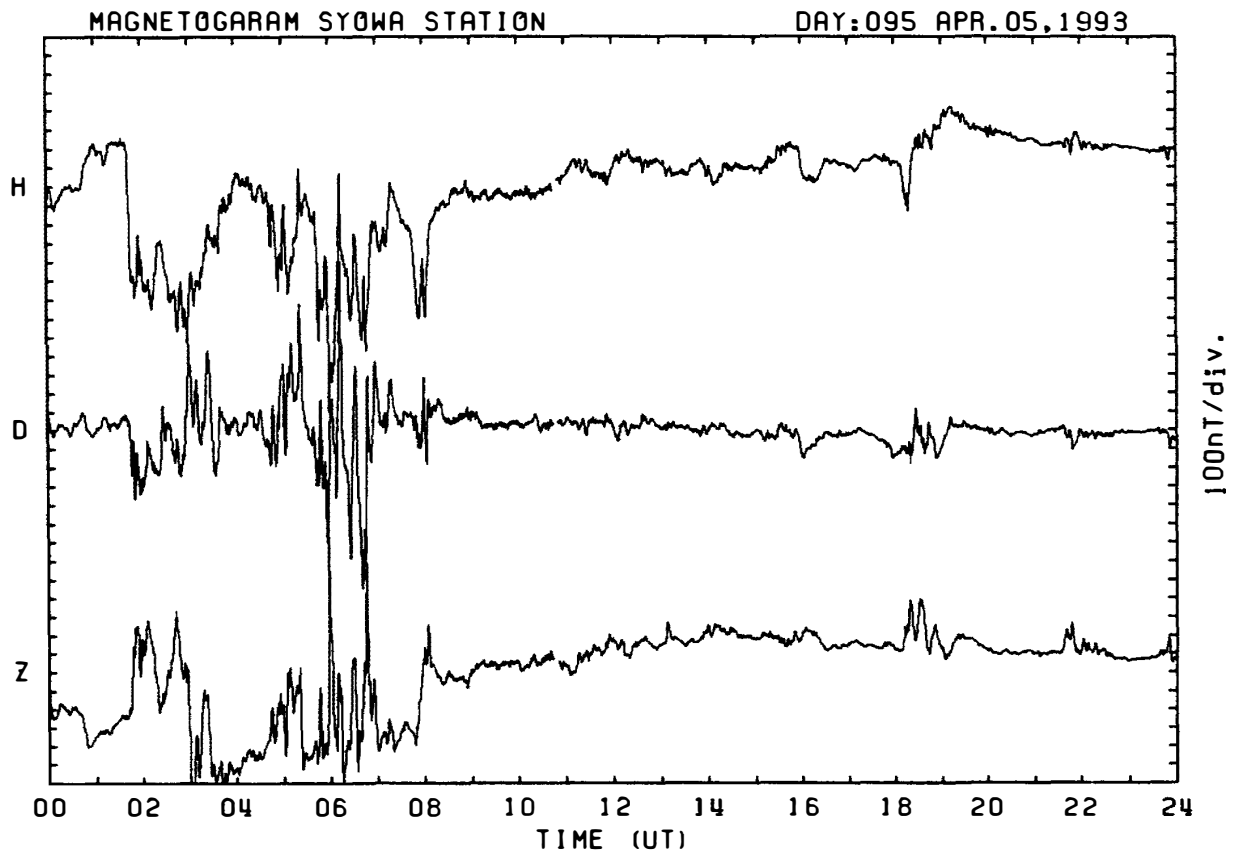
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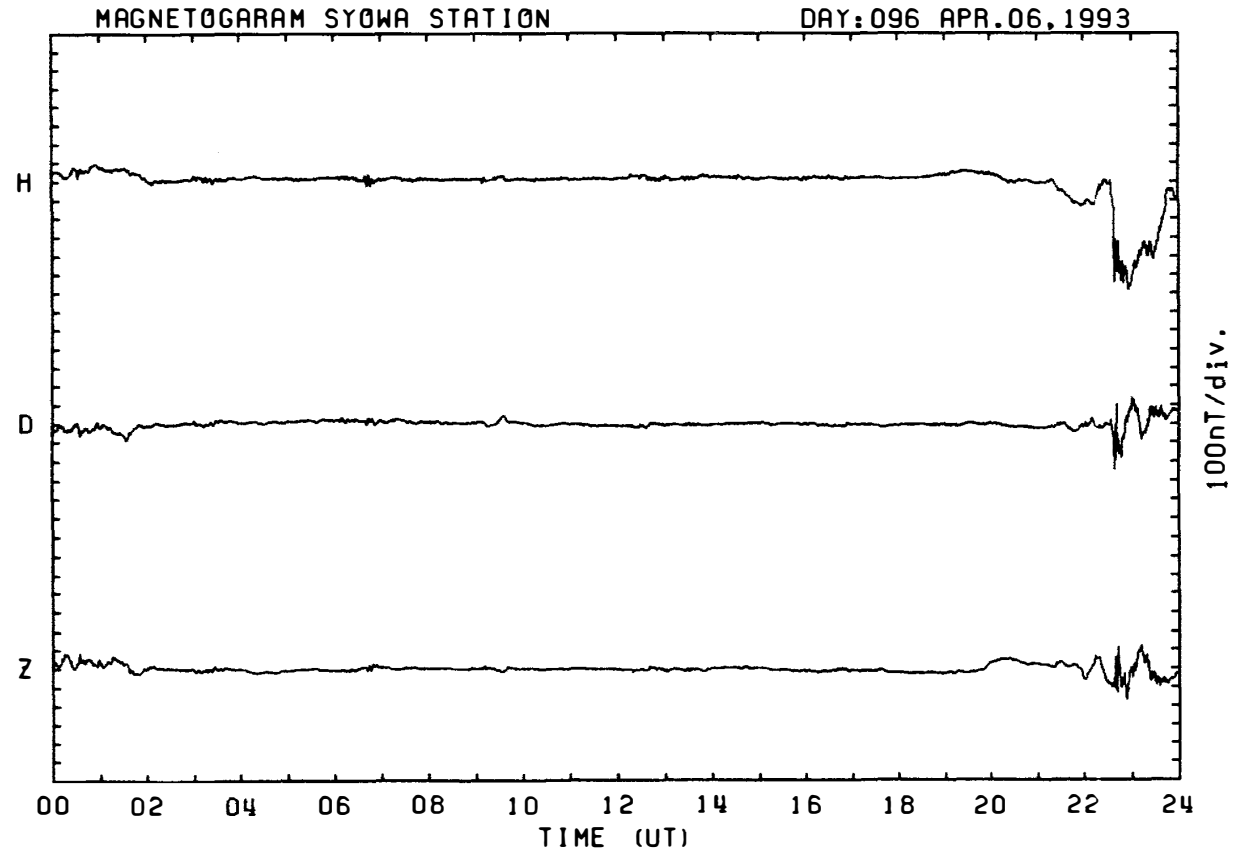
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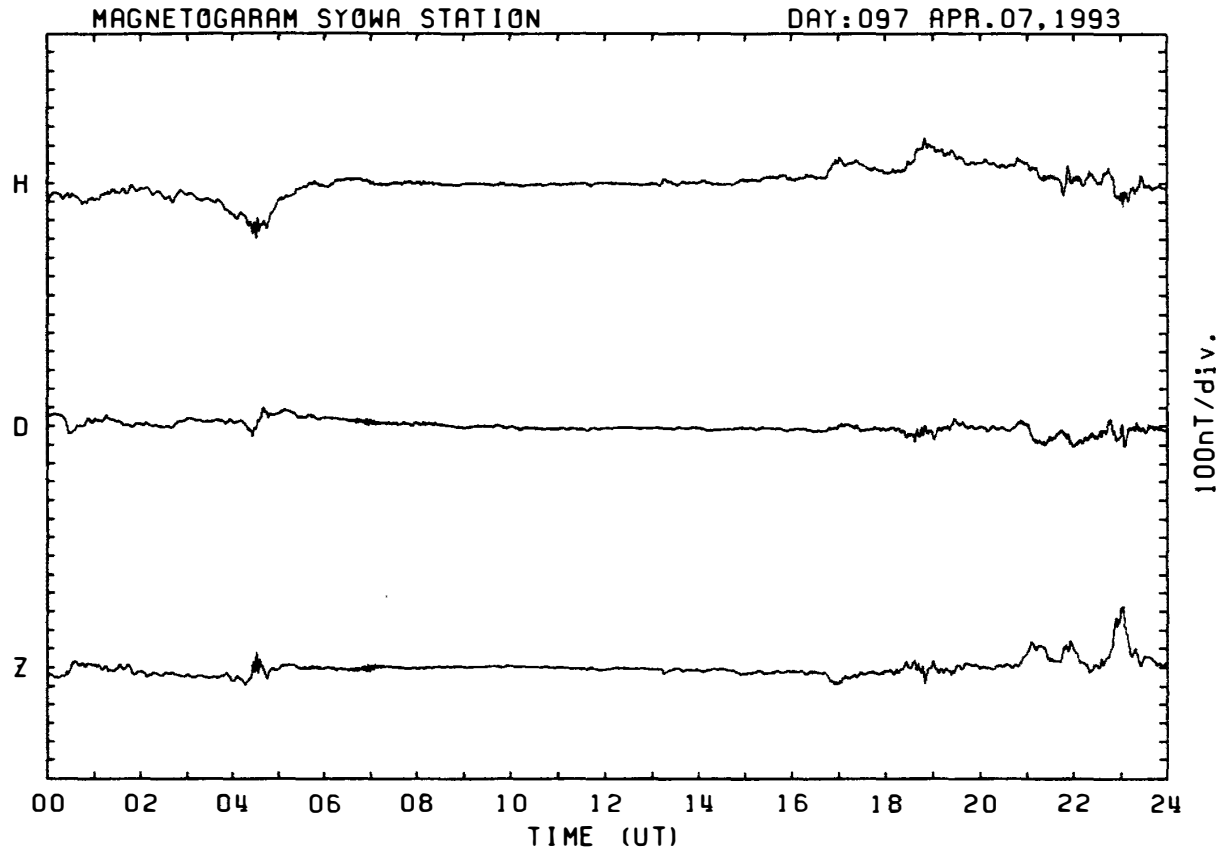
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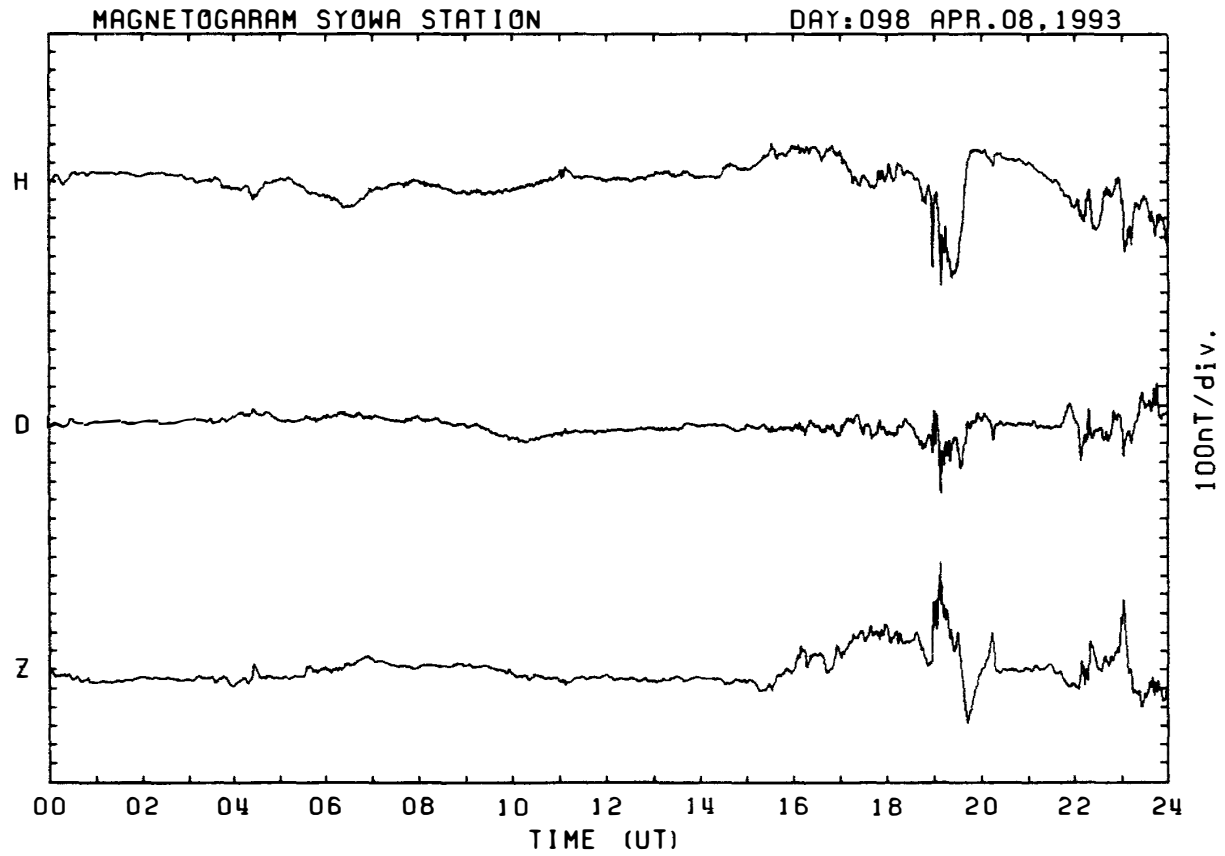
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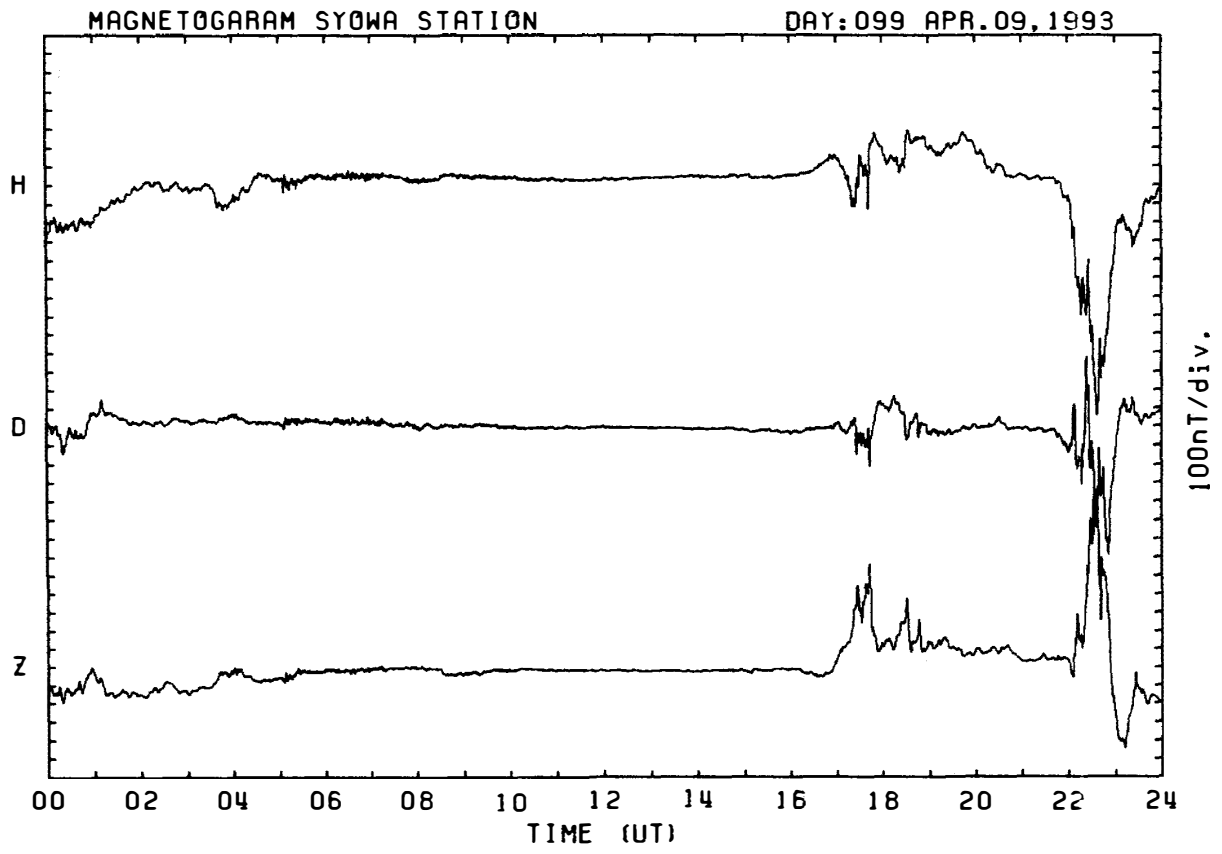
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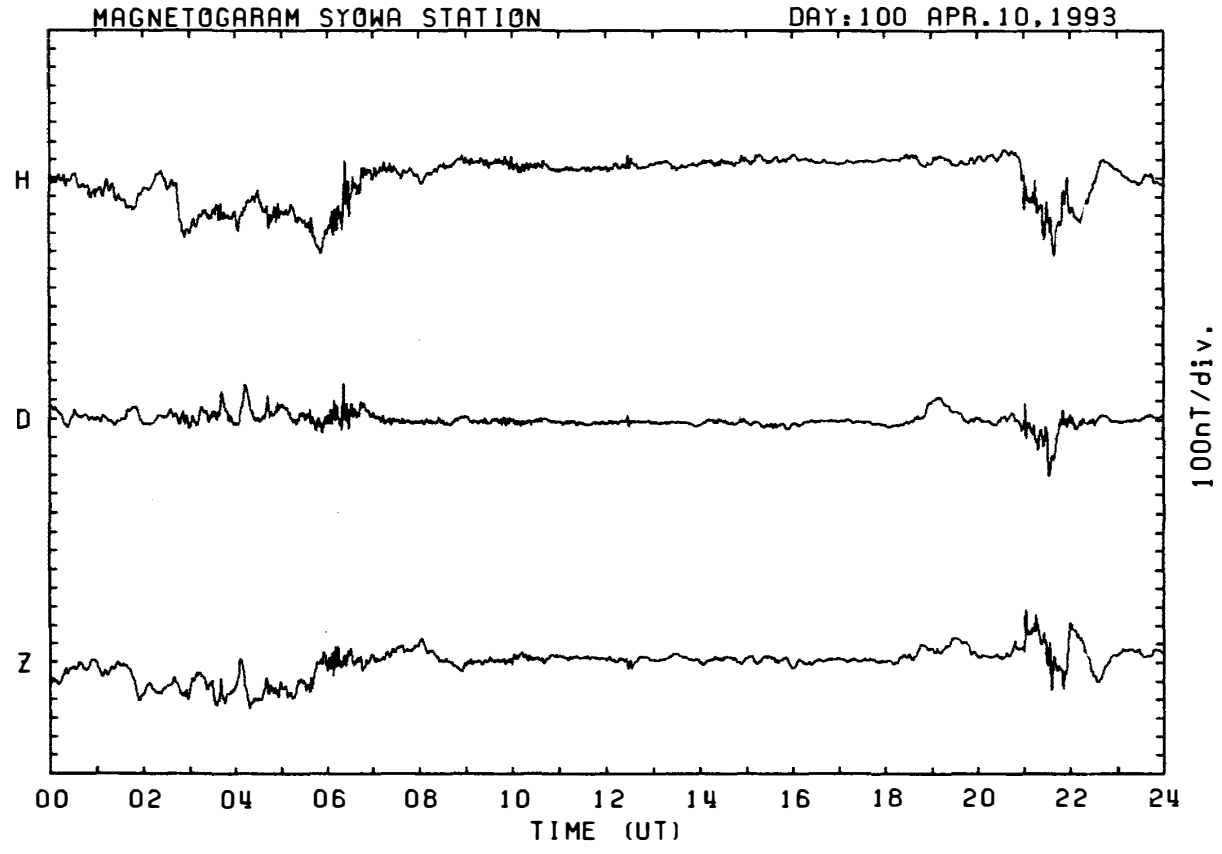
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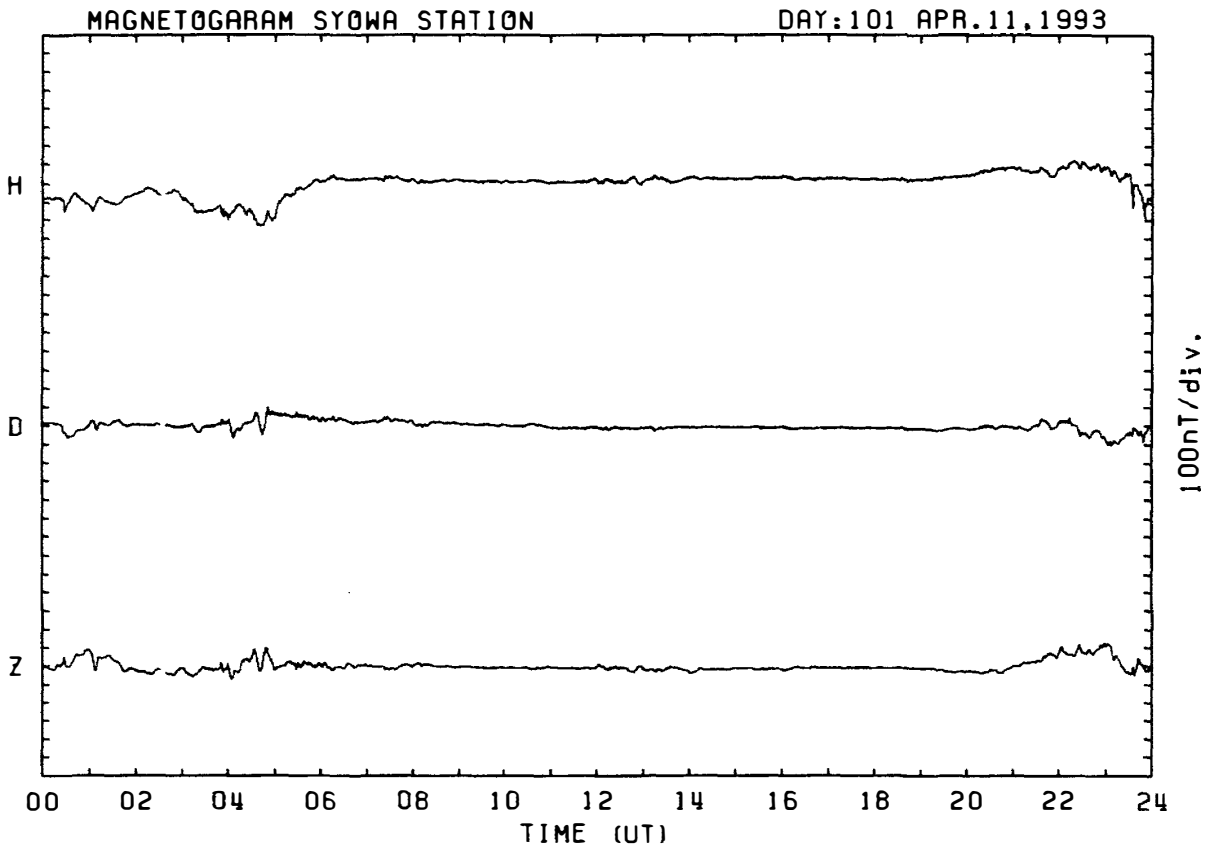
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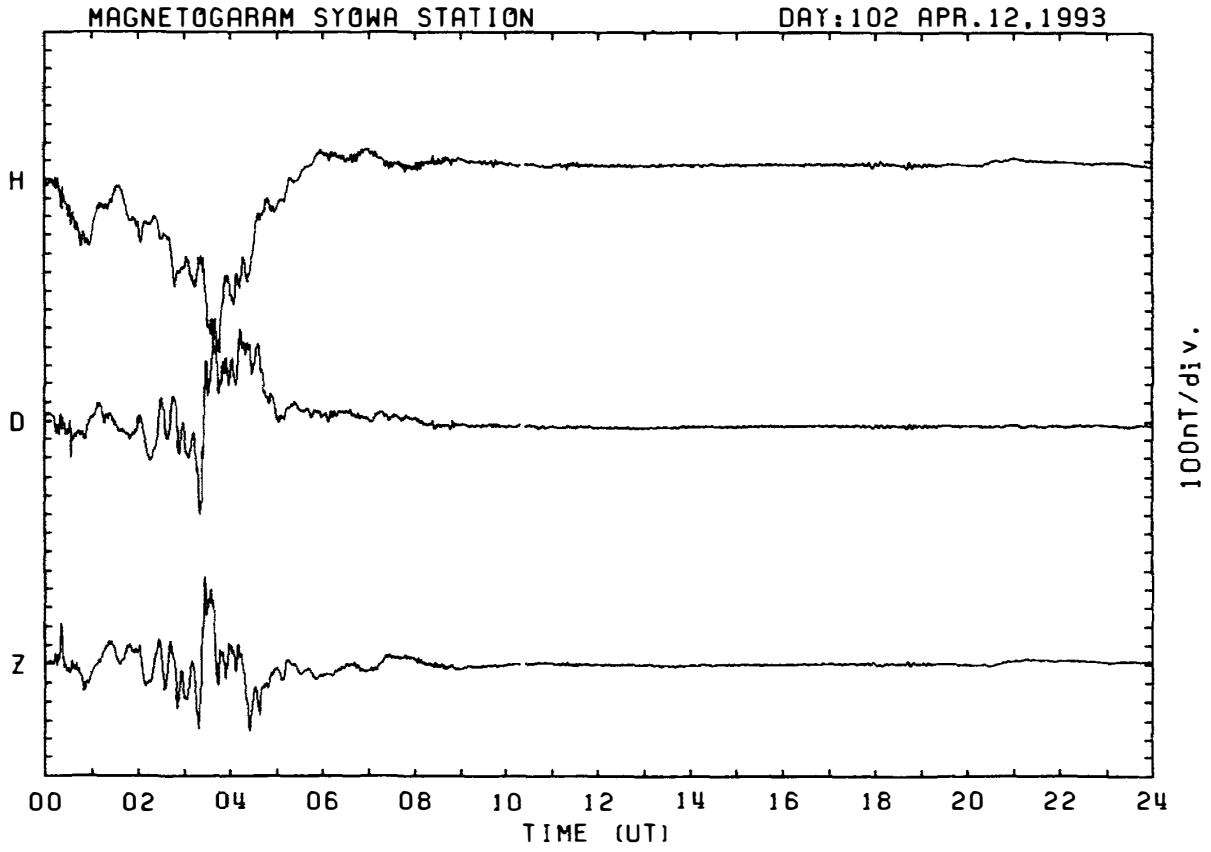
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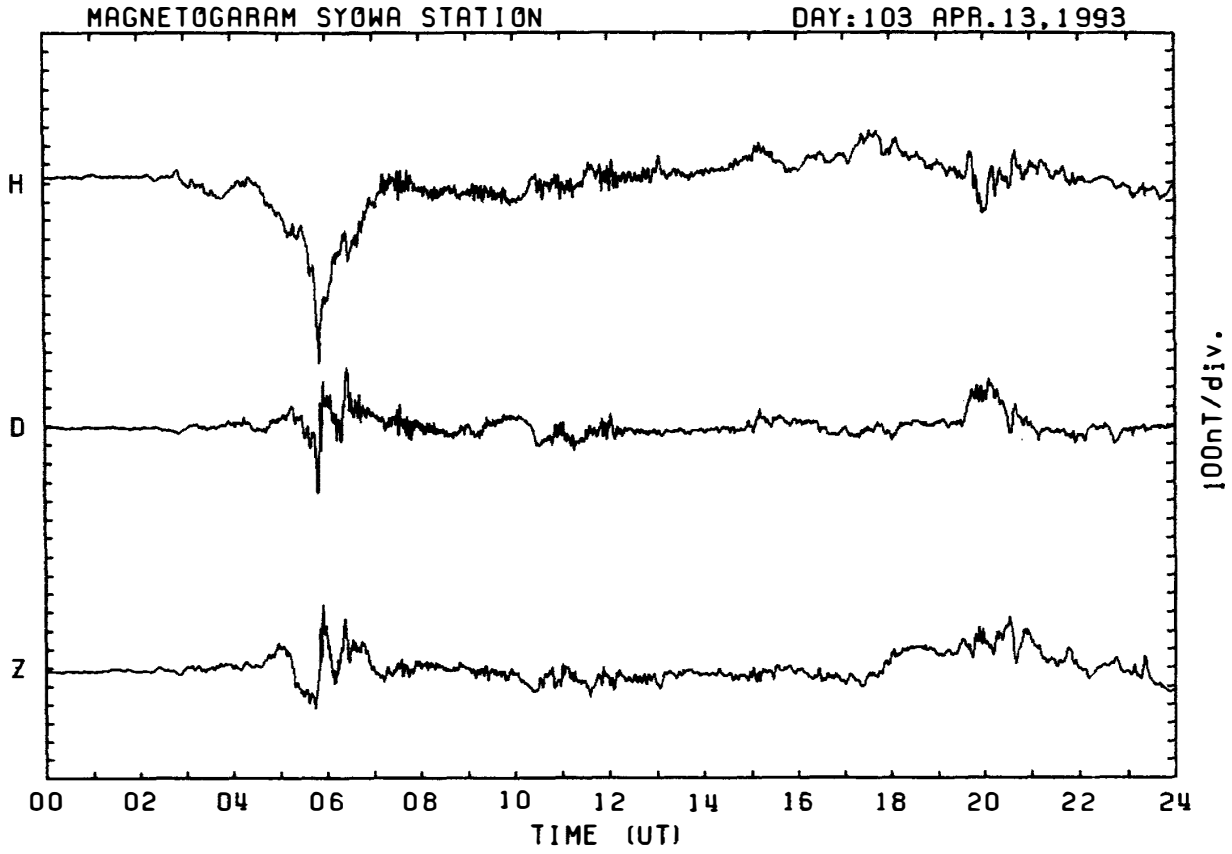
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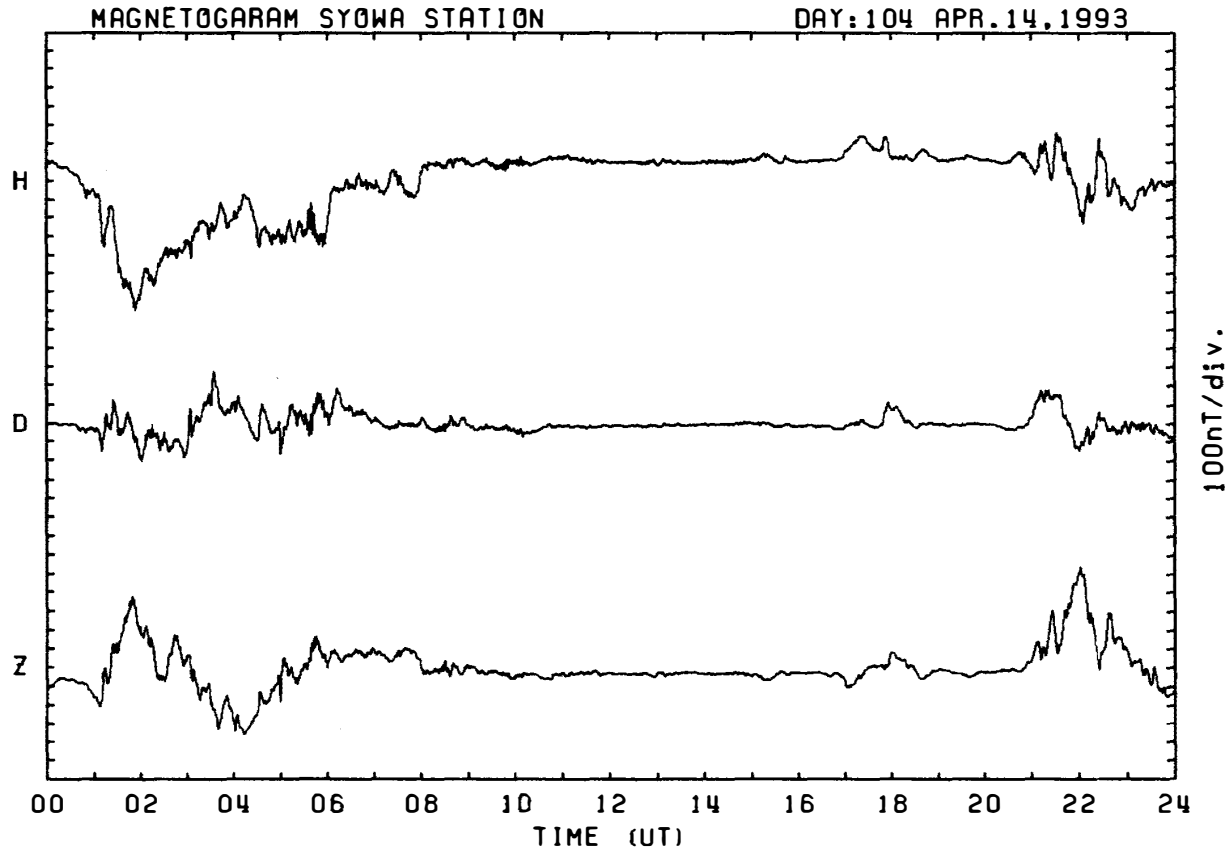
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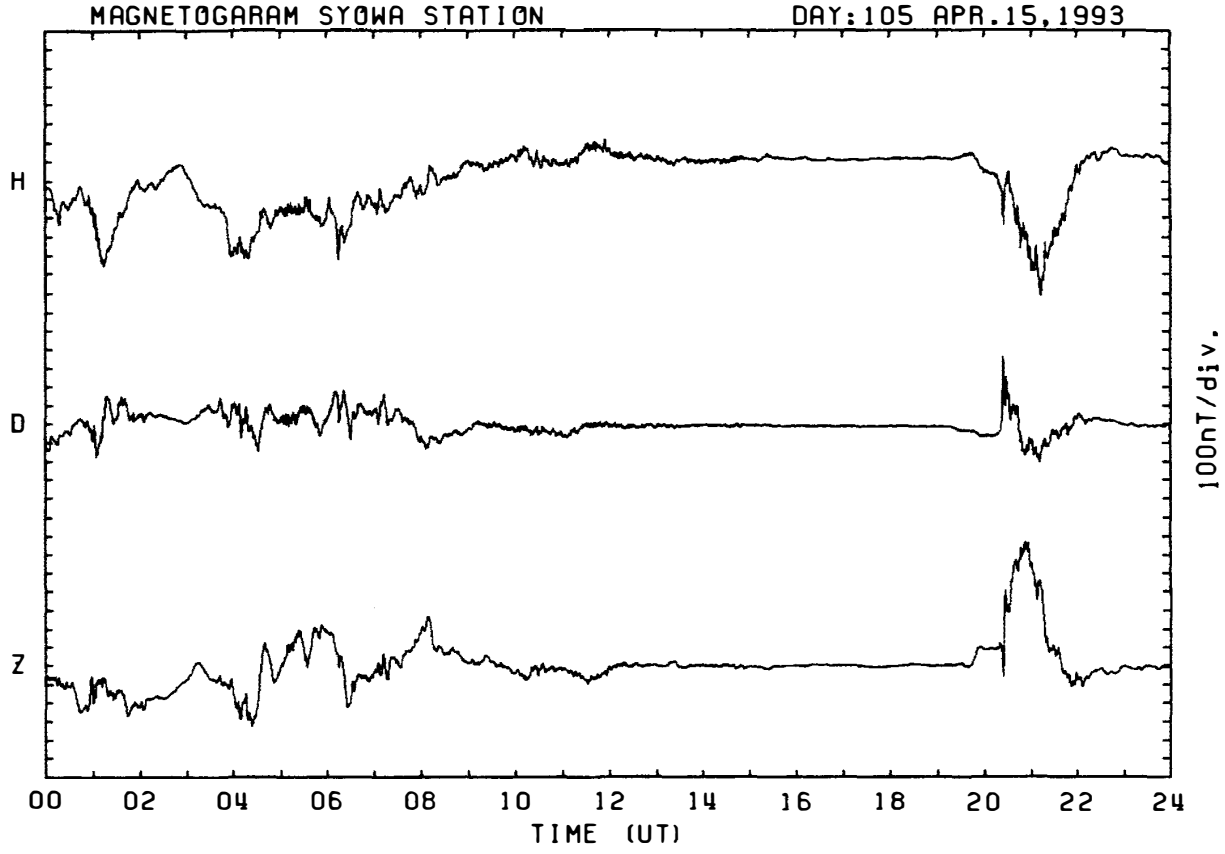
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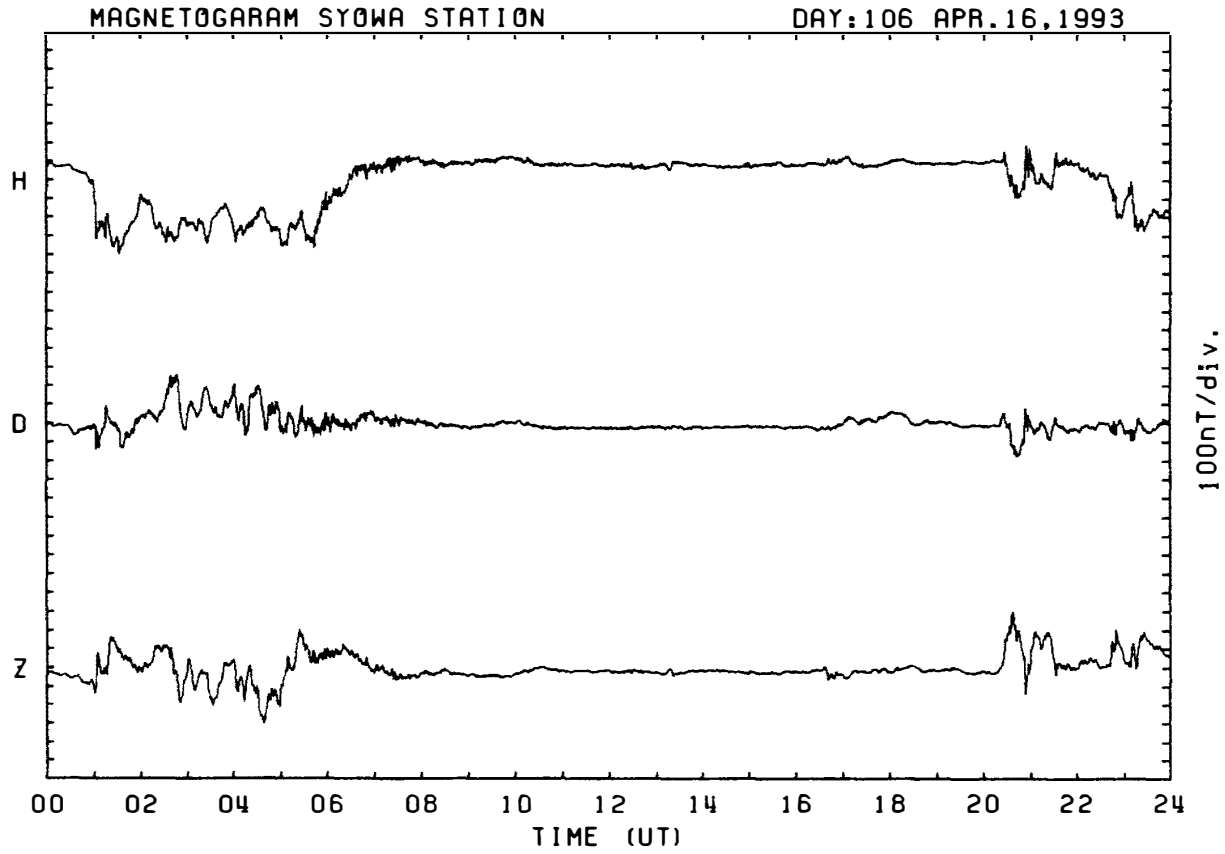
TIME (UT)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DAY:106 APR.16,1993
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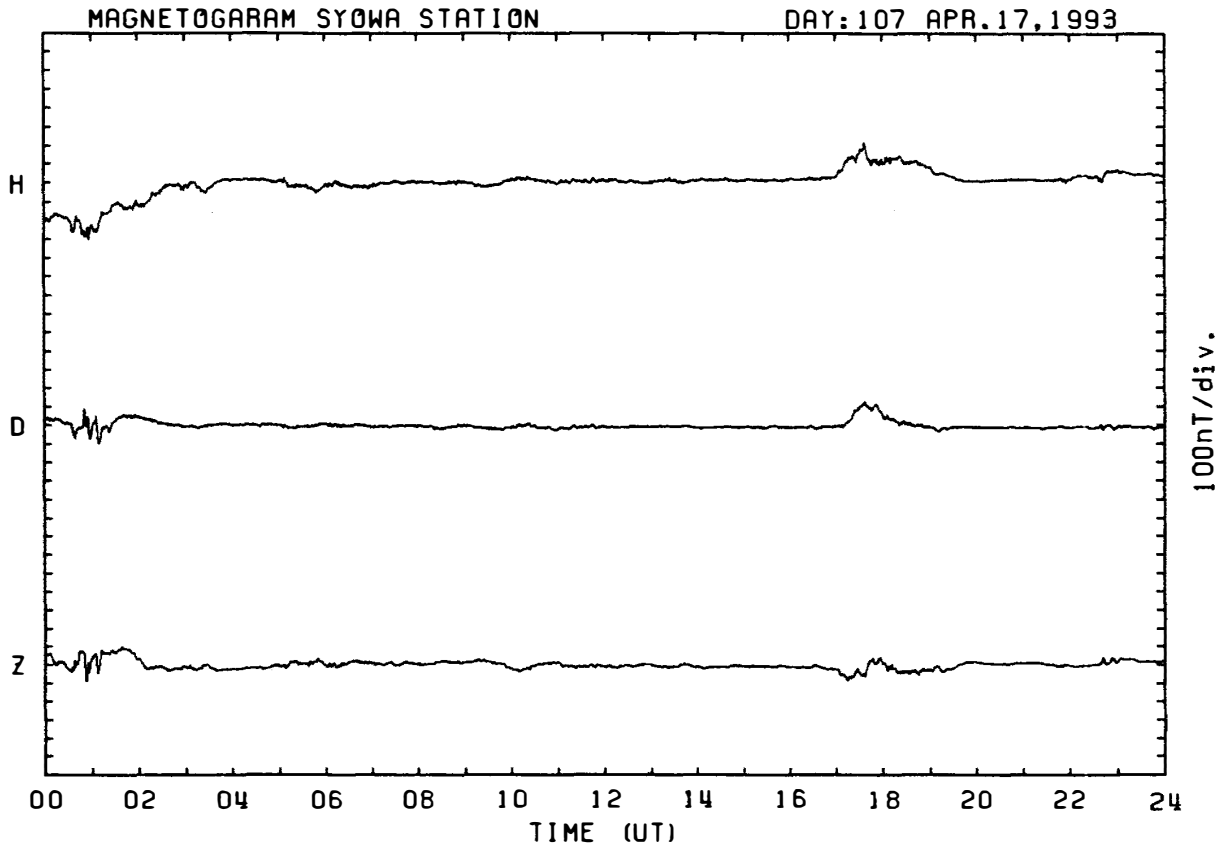
TIME (UT)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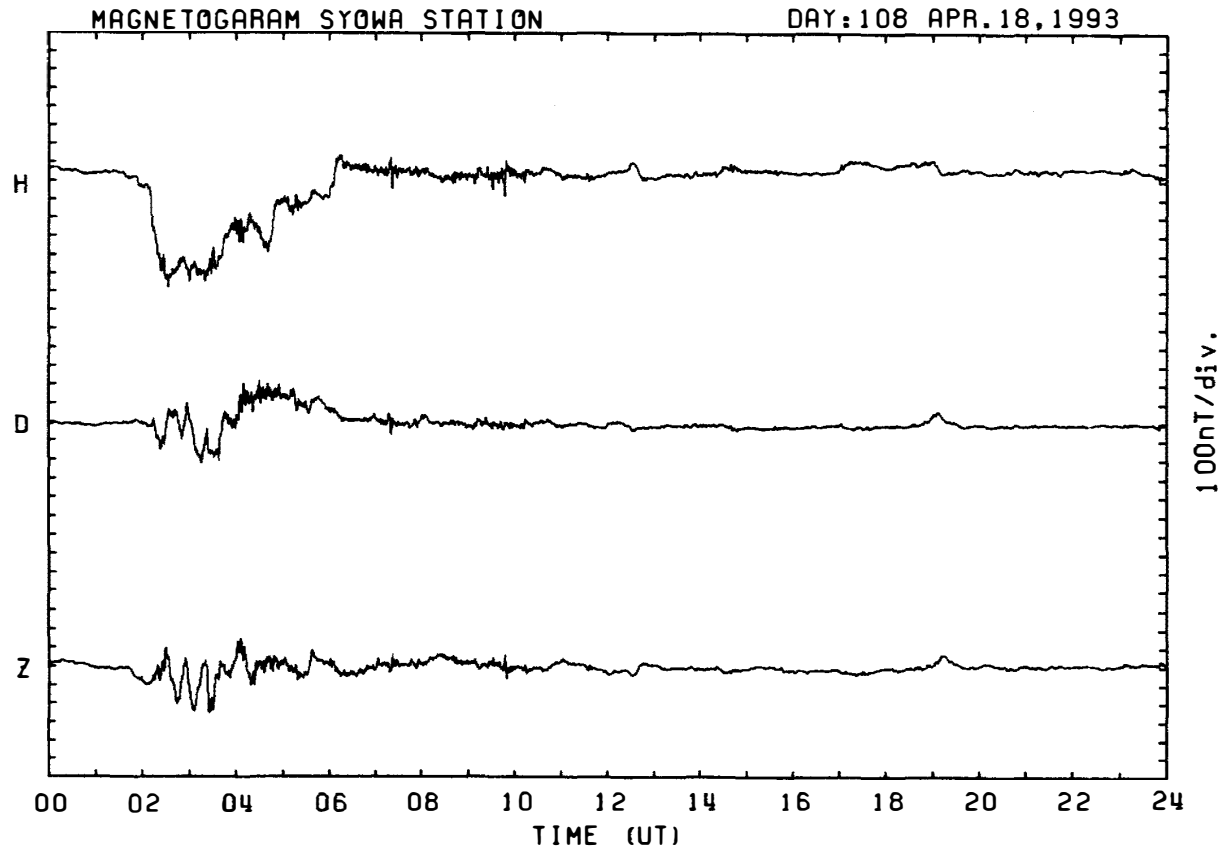
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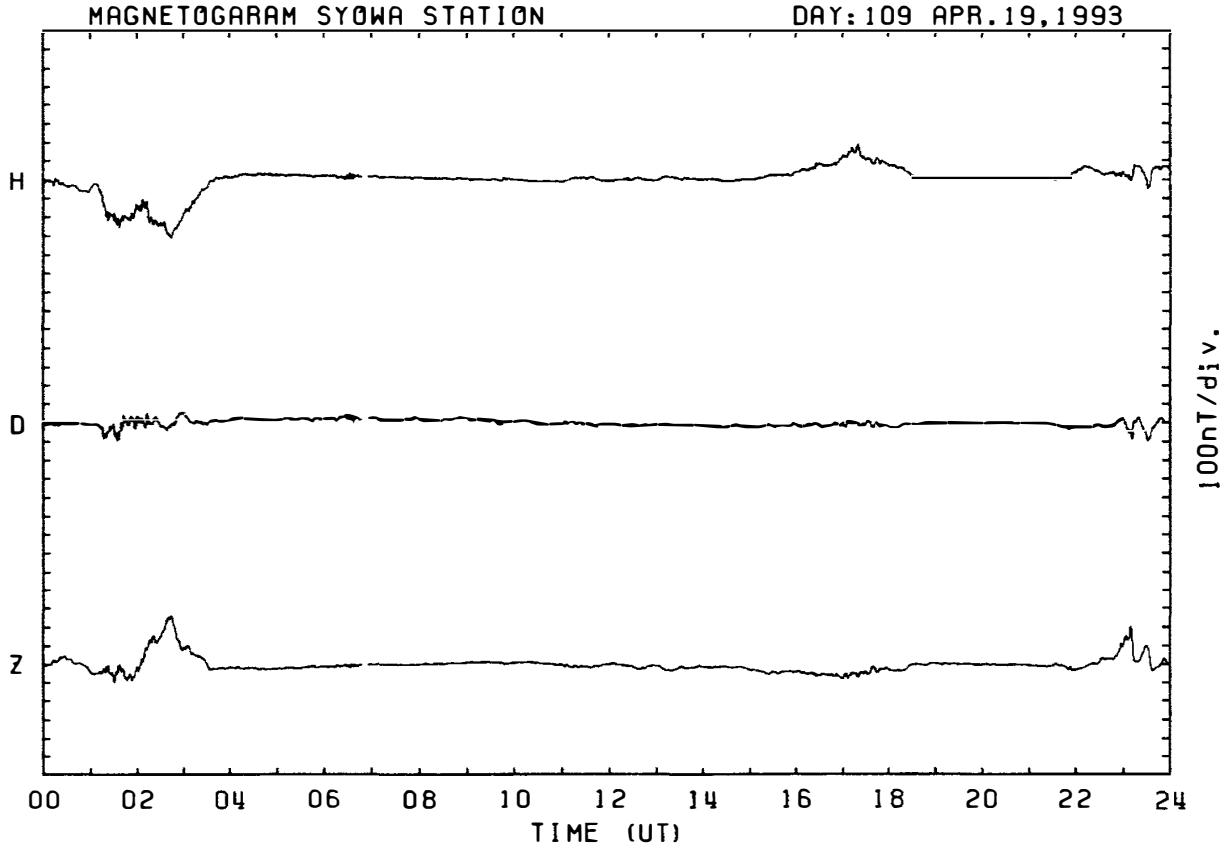
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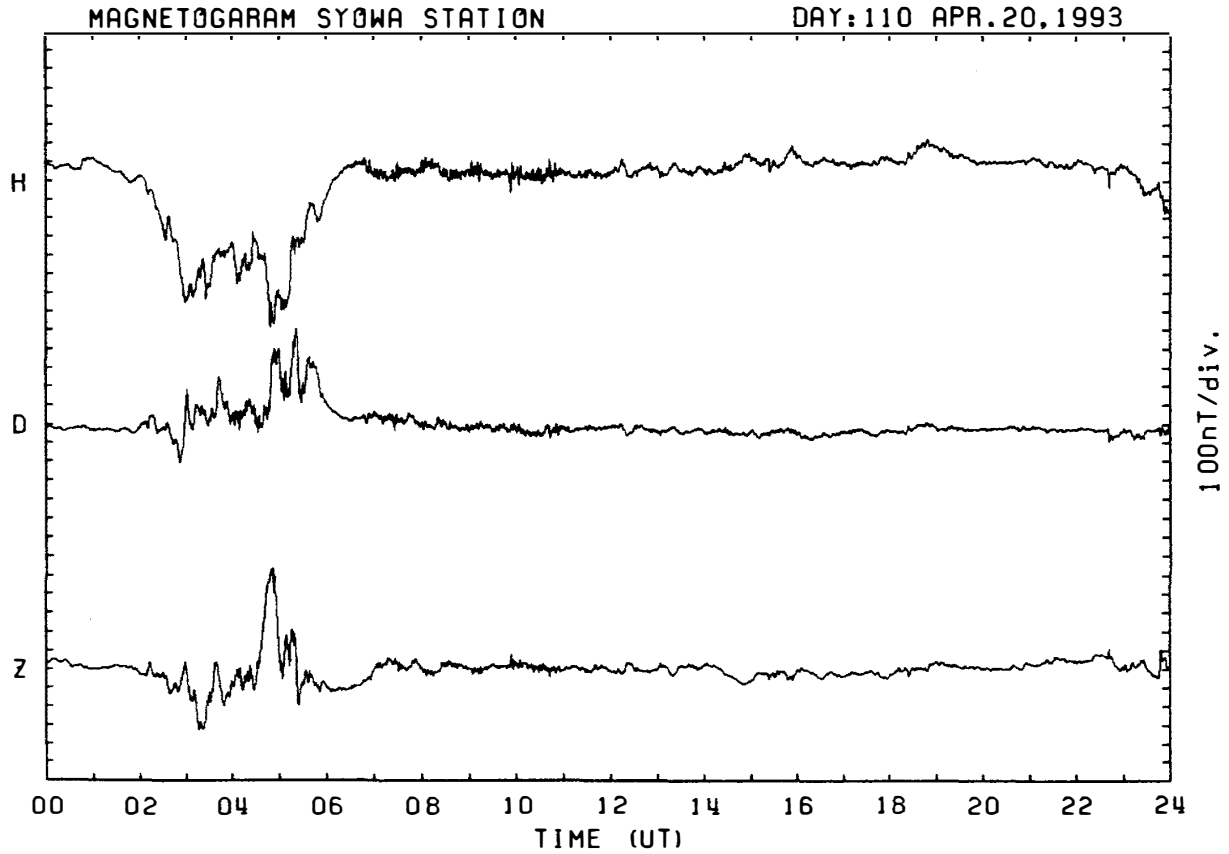
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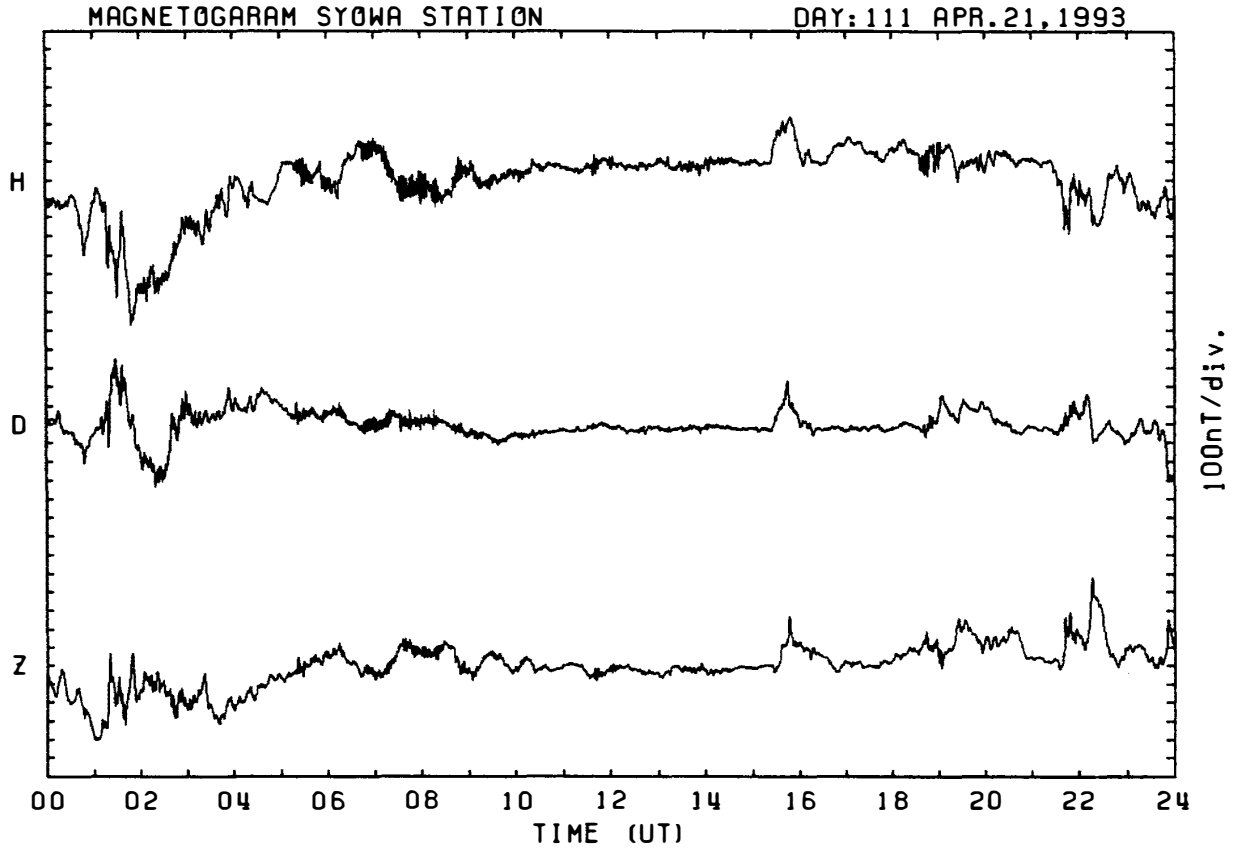
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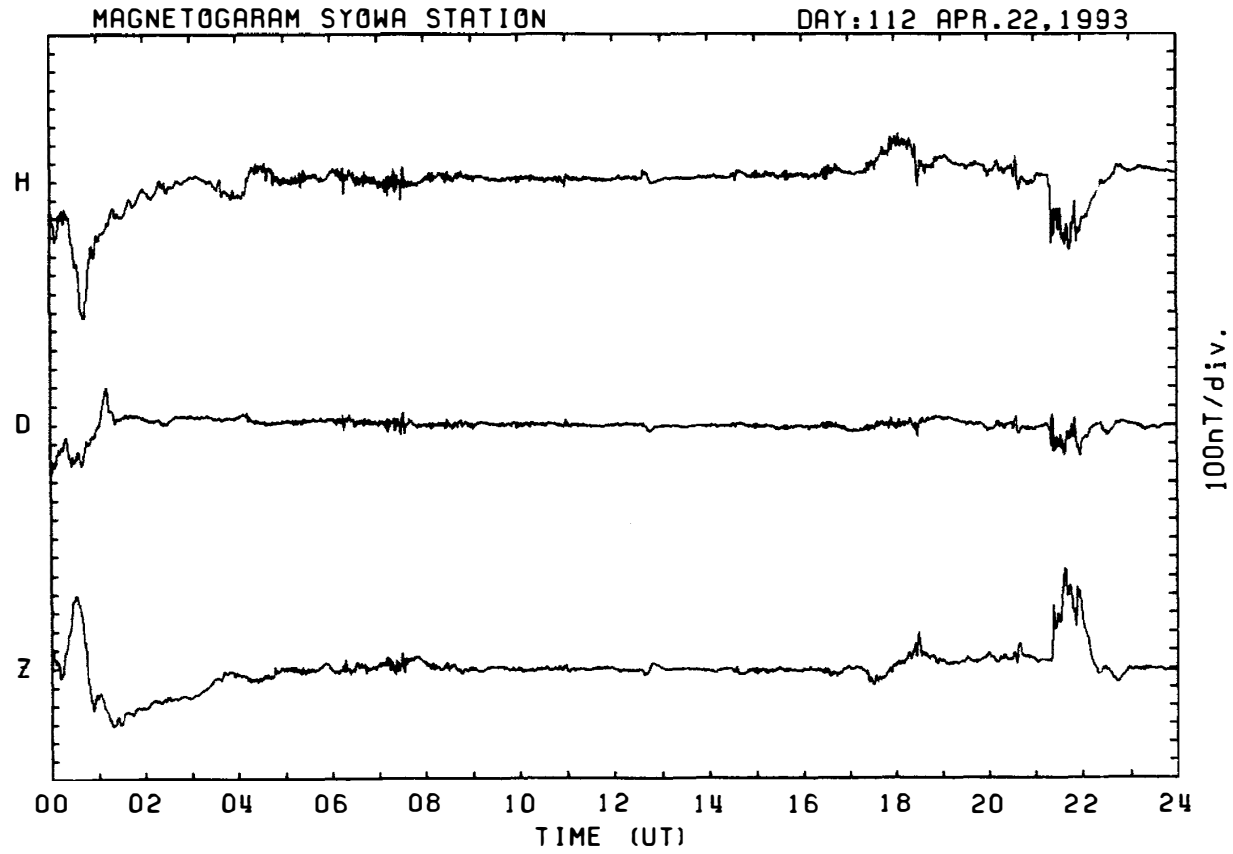
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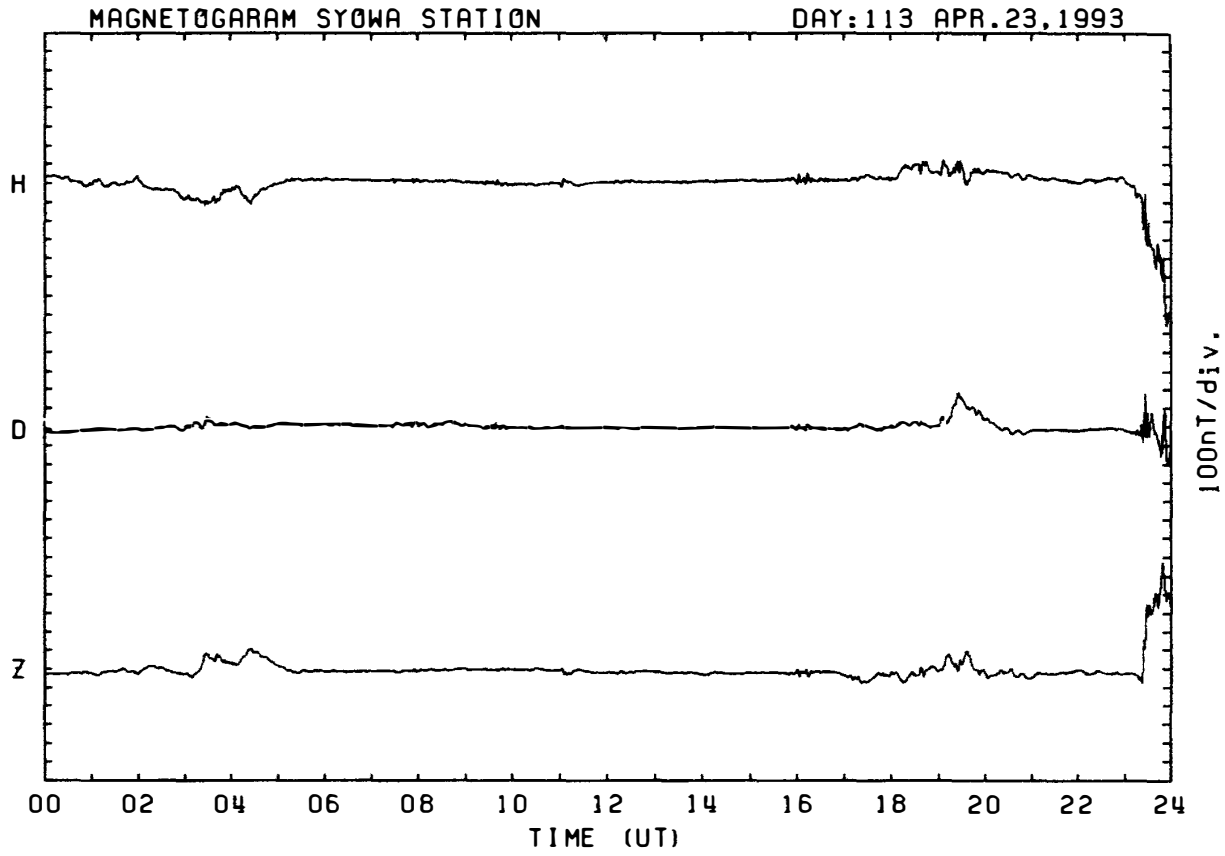
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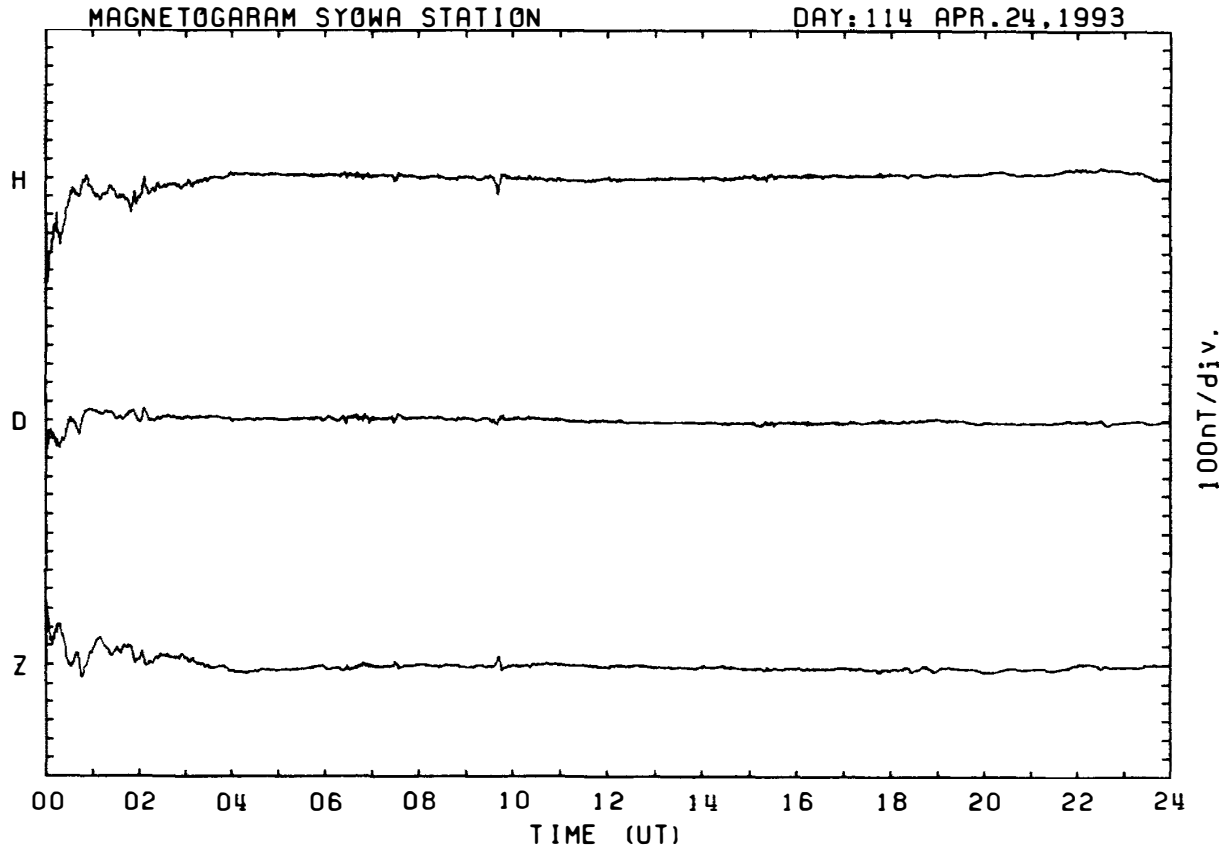
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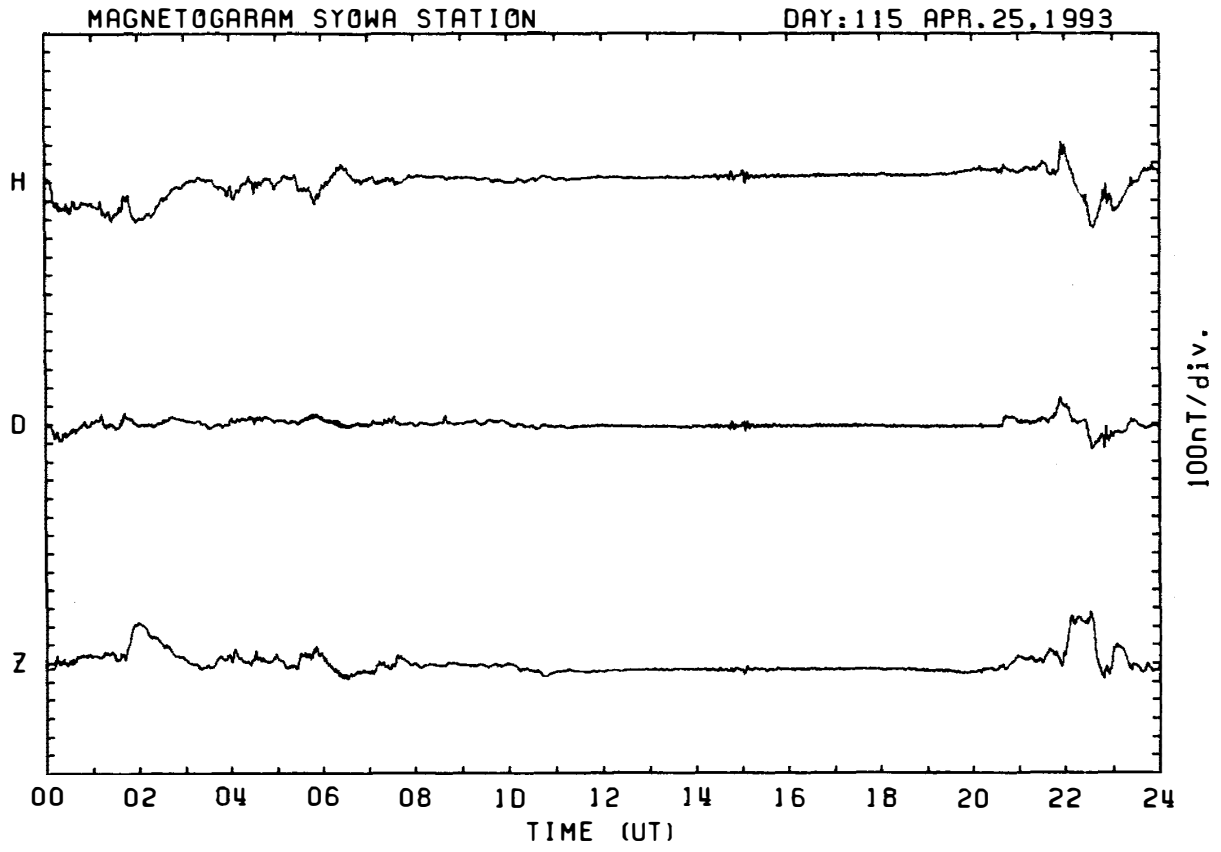
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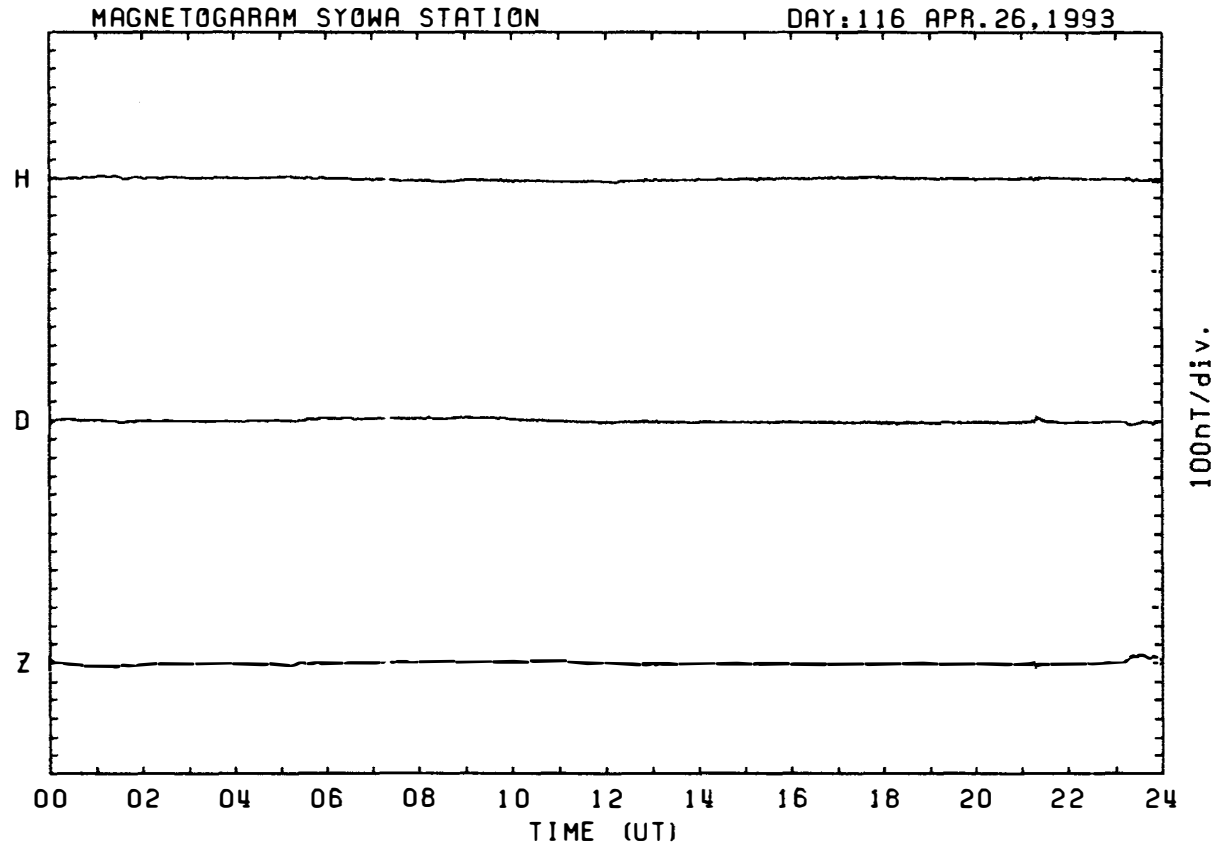
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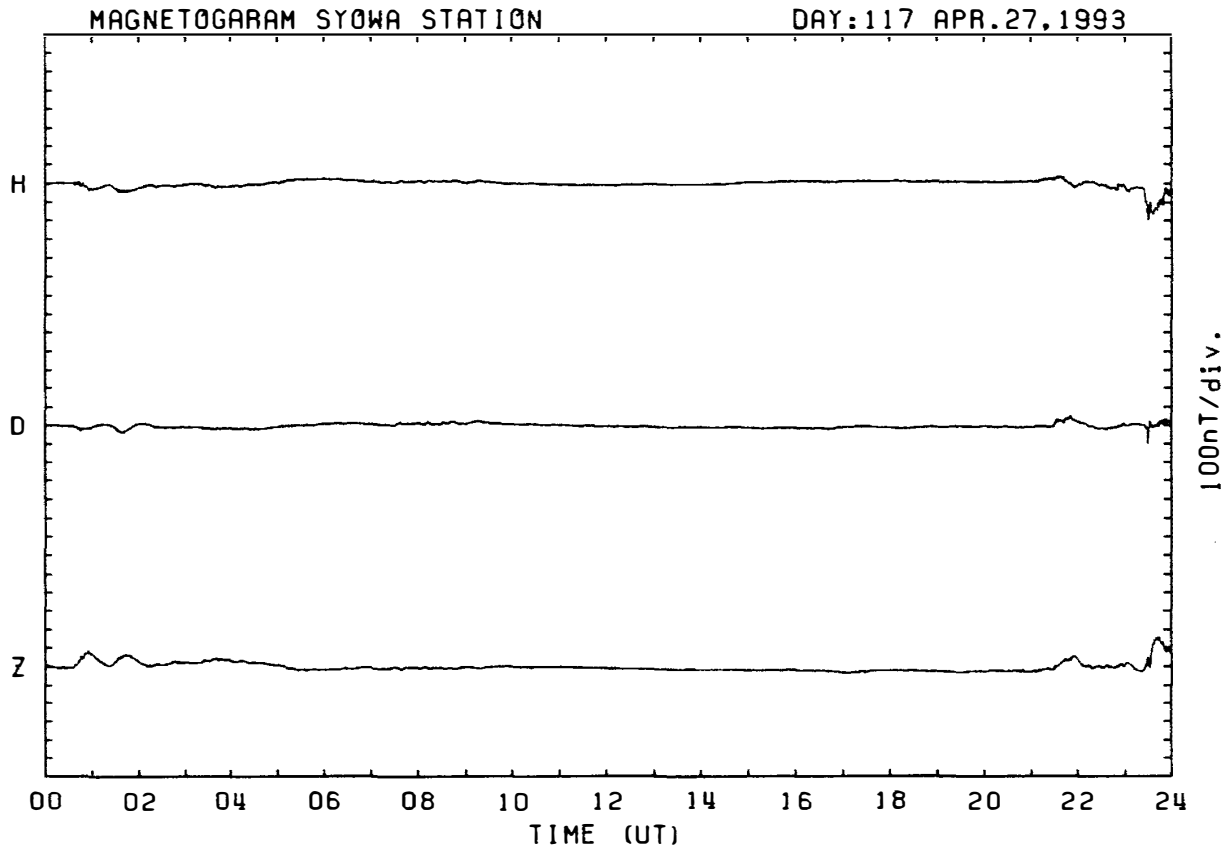
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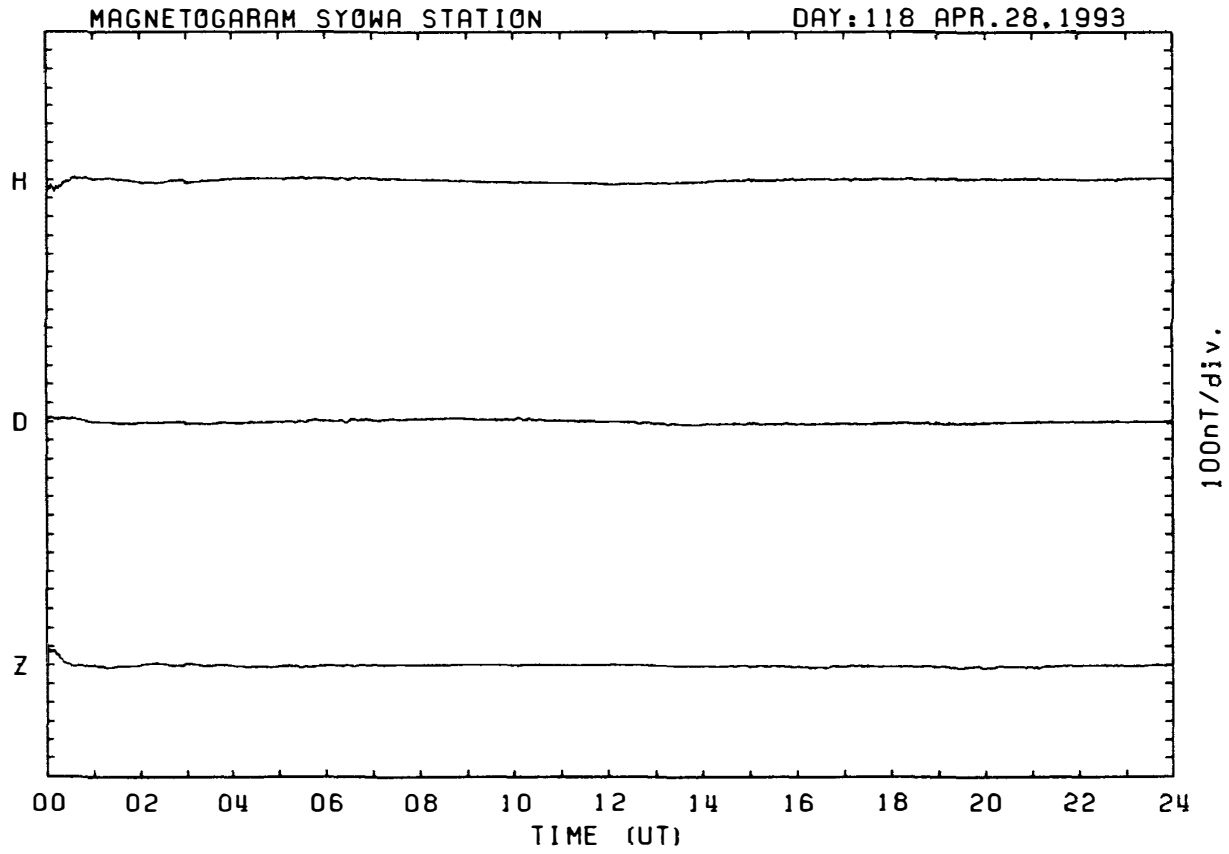
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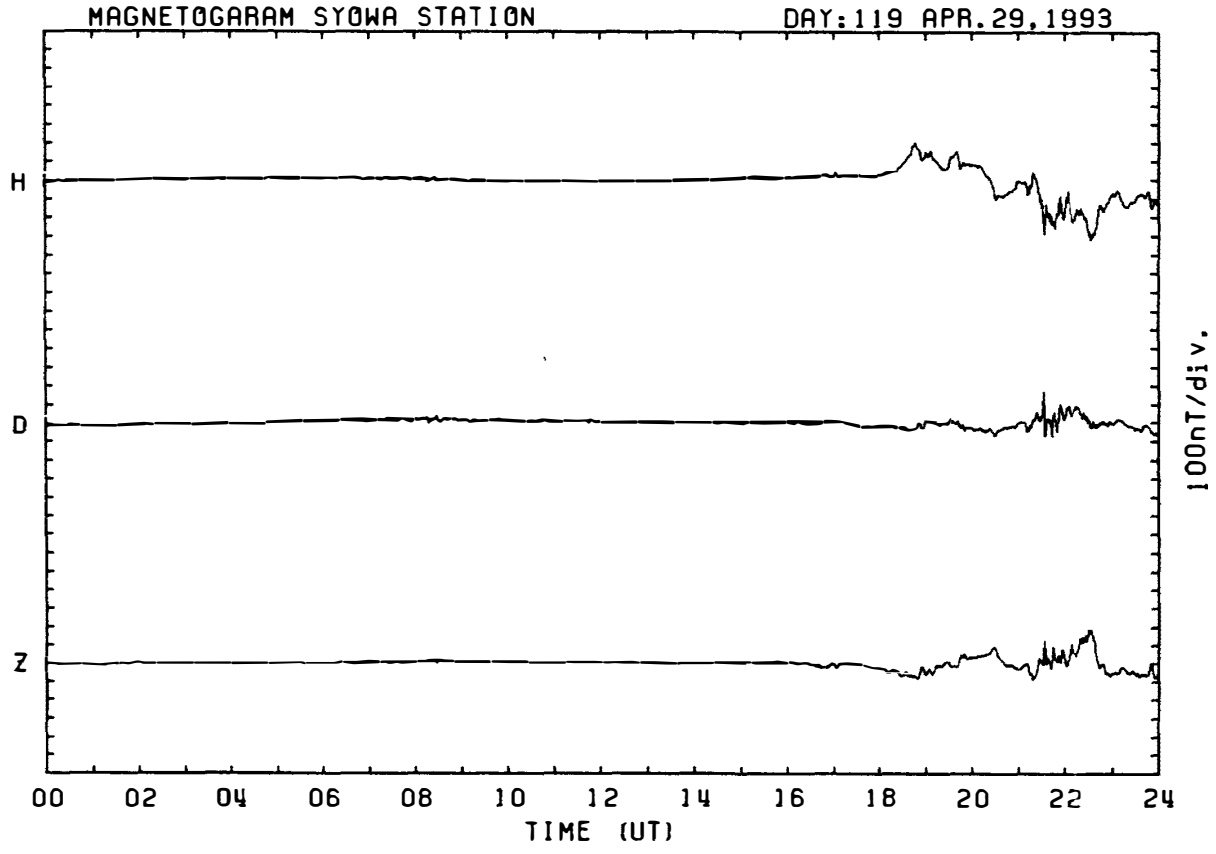
TIME (UT)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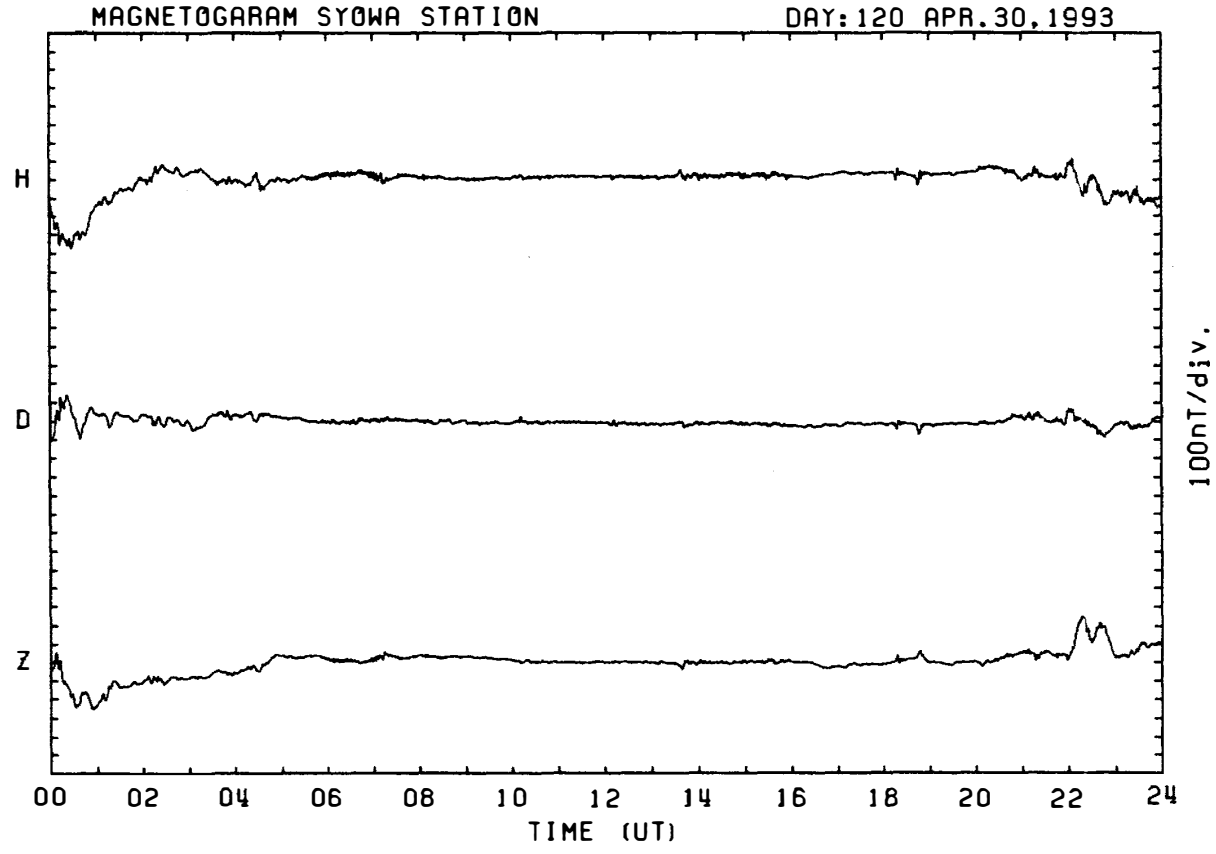
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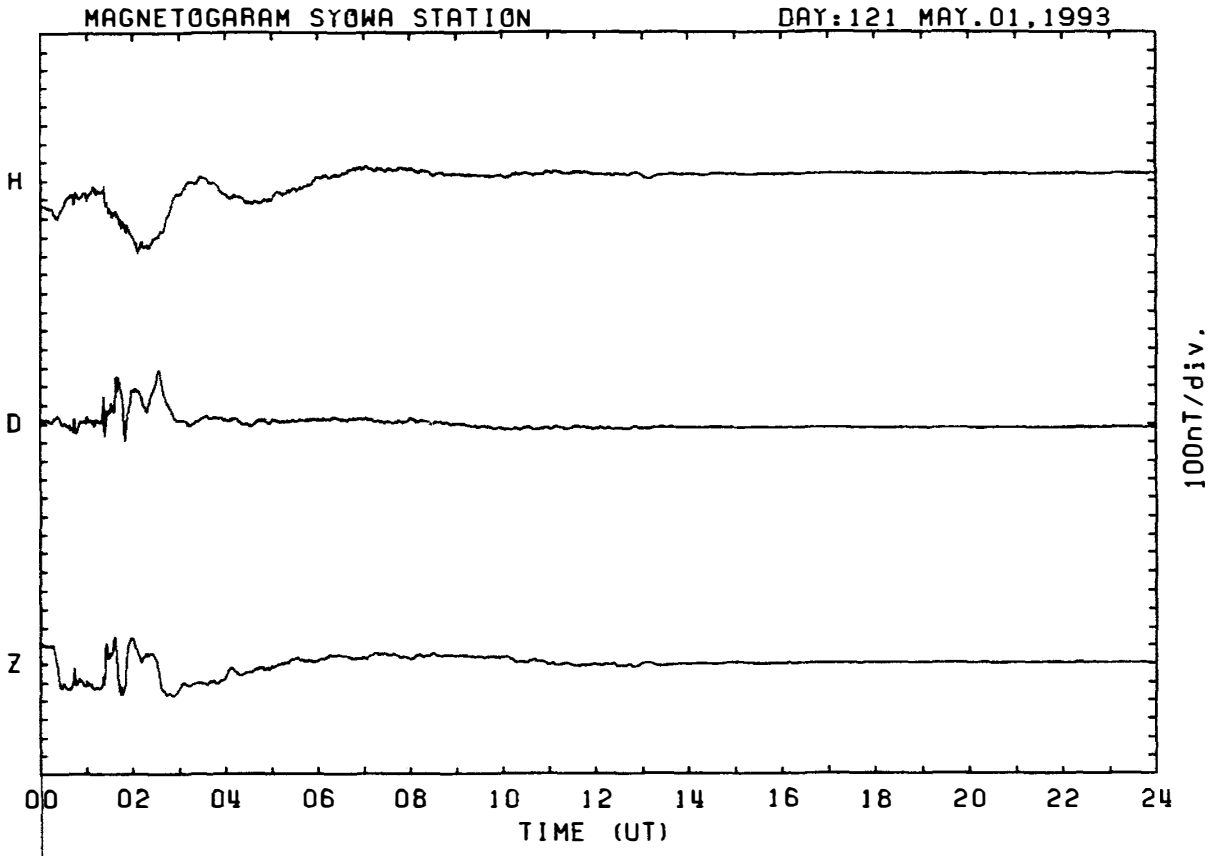
TIME (UT)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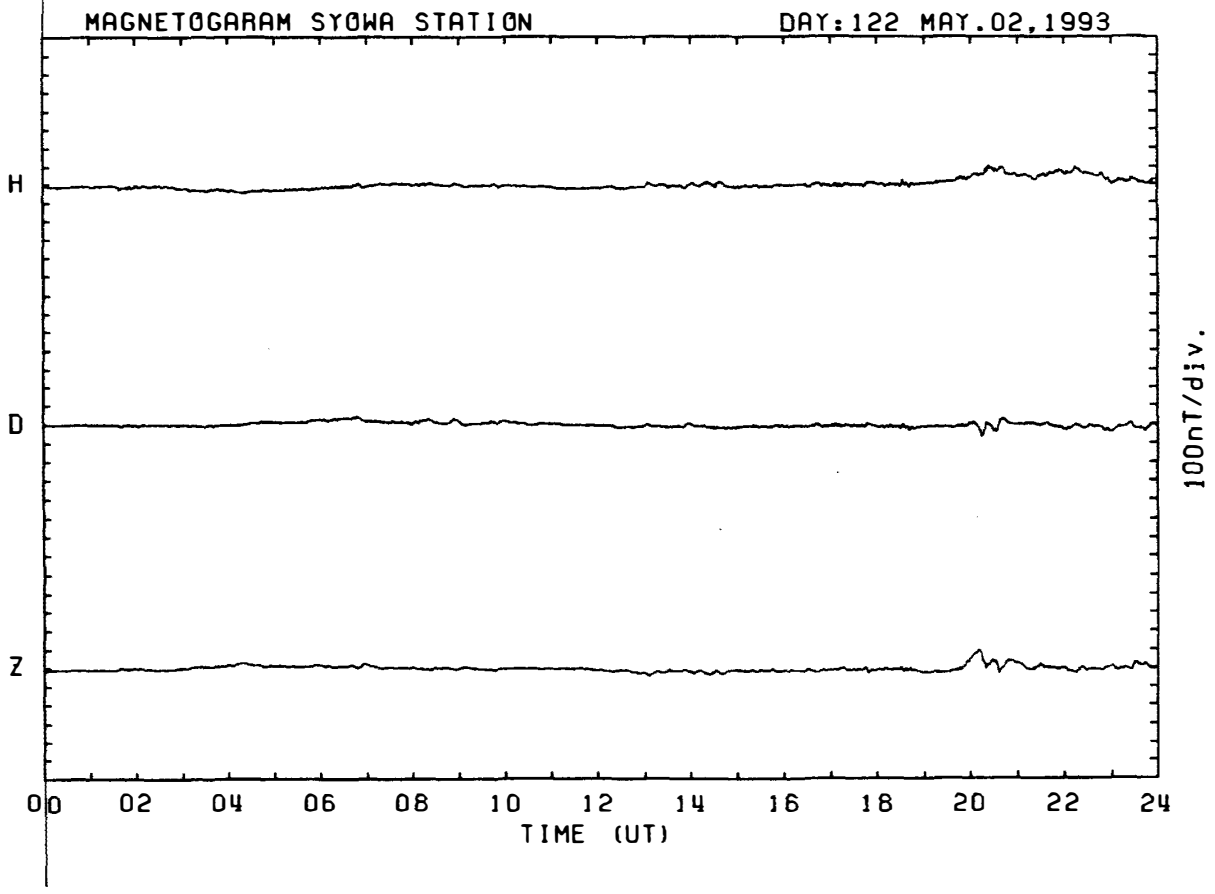
TIME (UT)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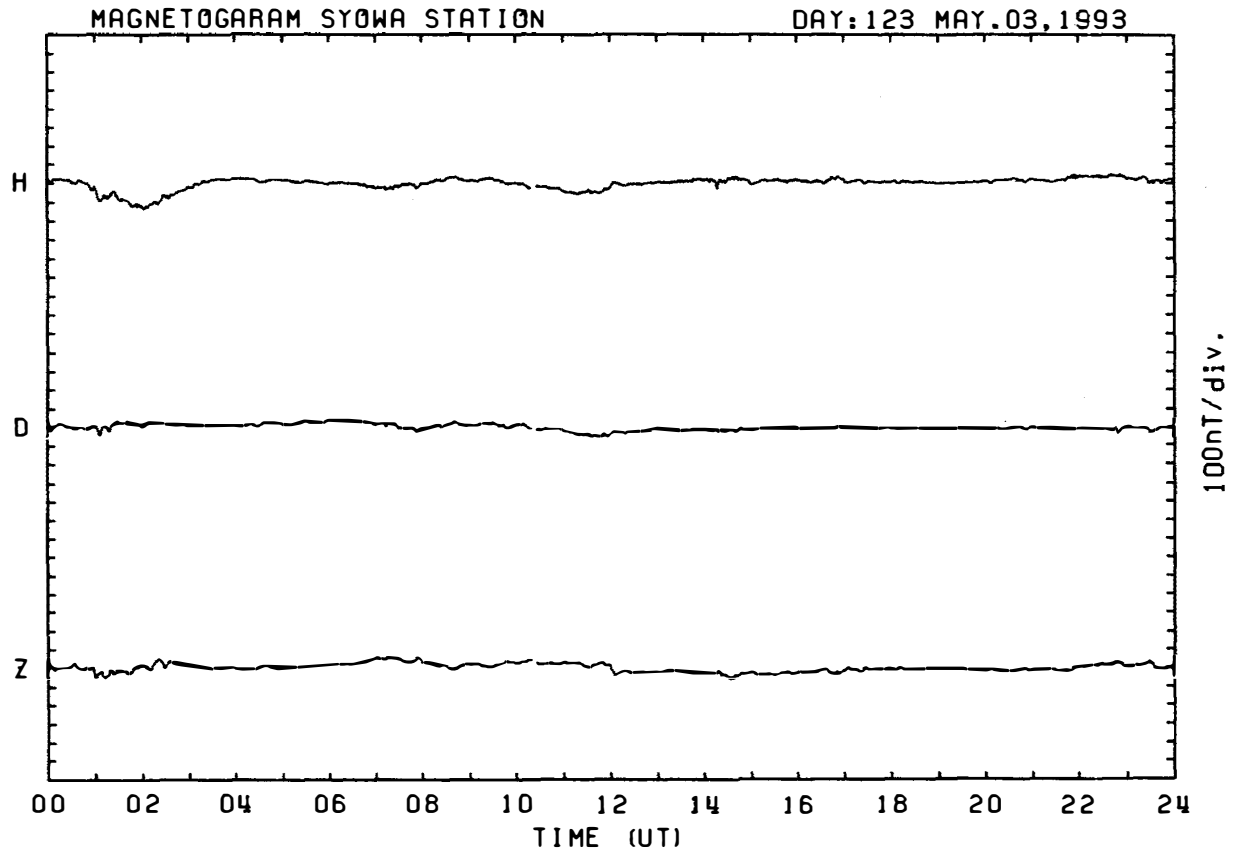
TIME (UT)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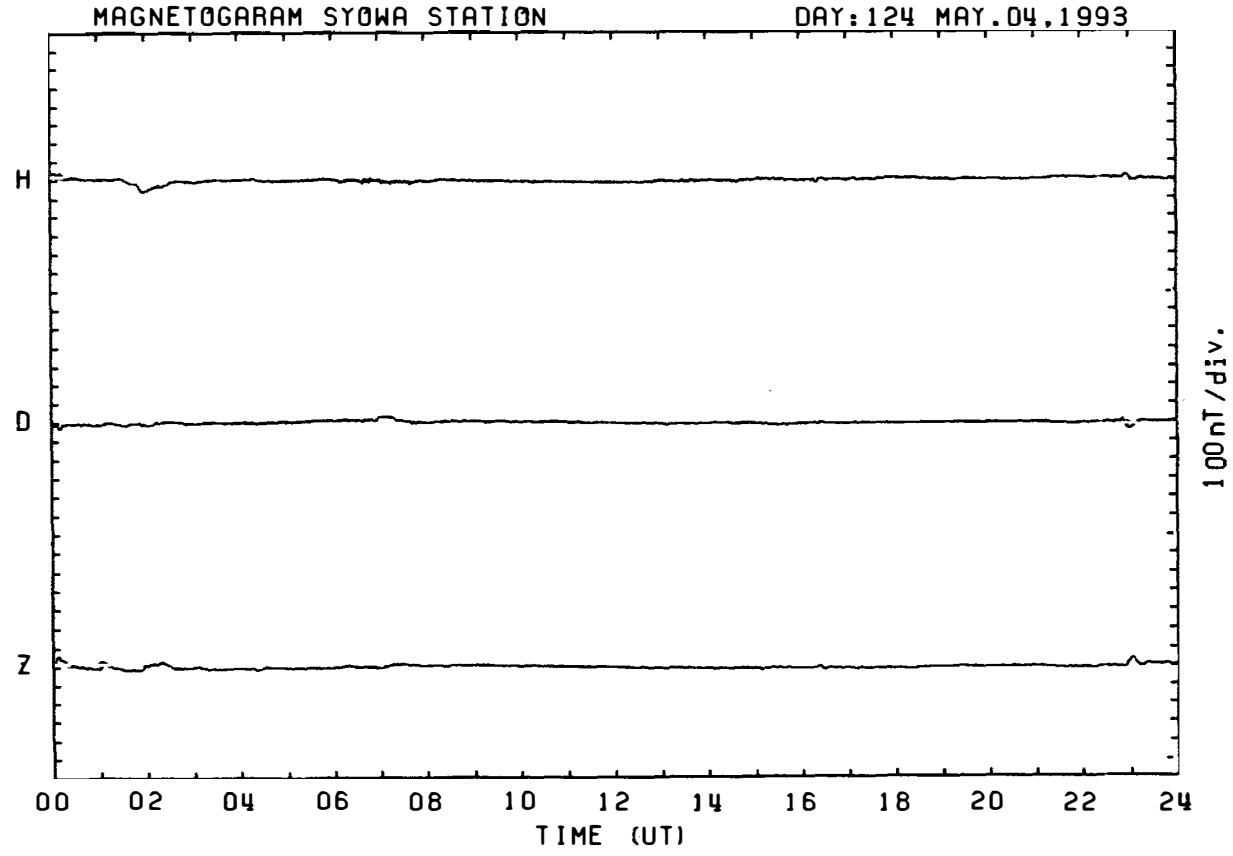
TIME (UT)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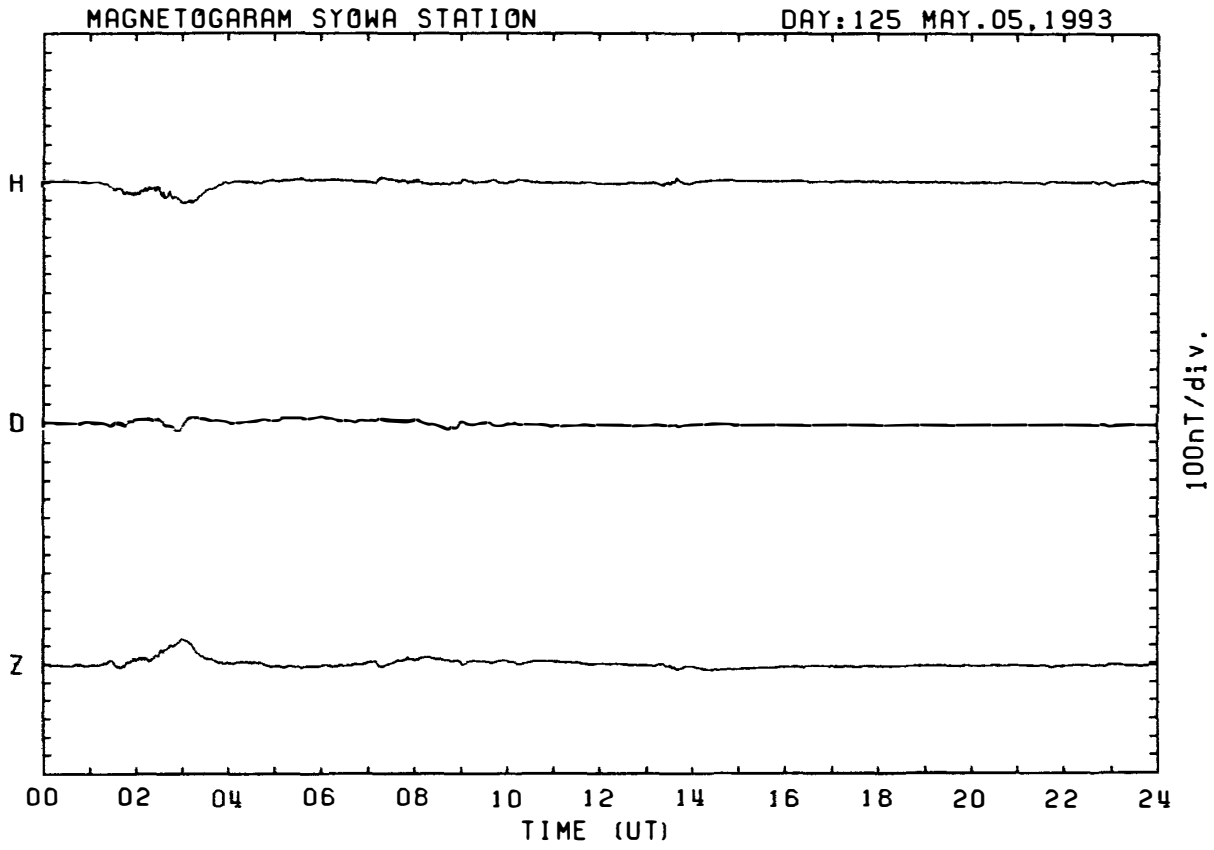
TIME (UT)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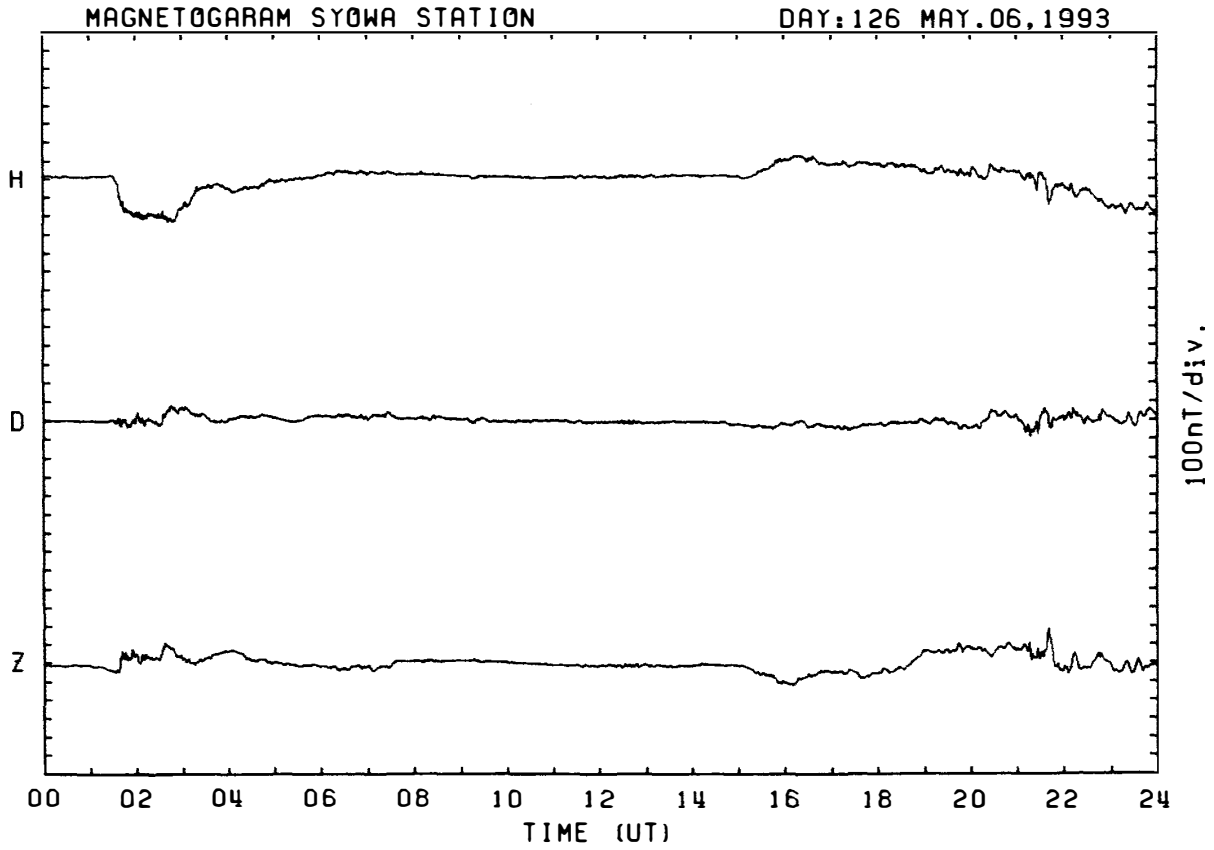
TIME (UT)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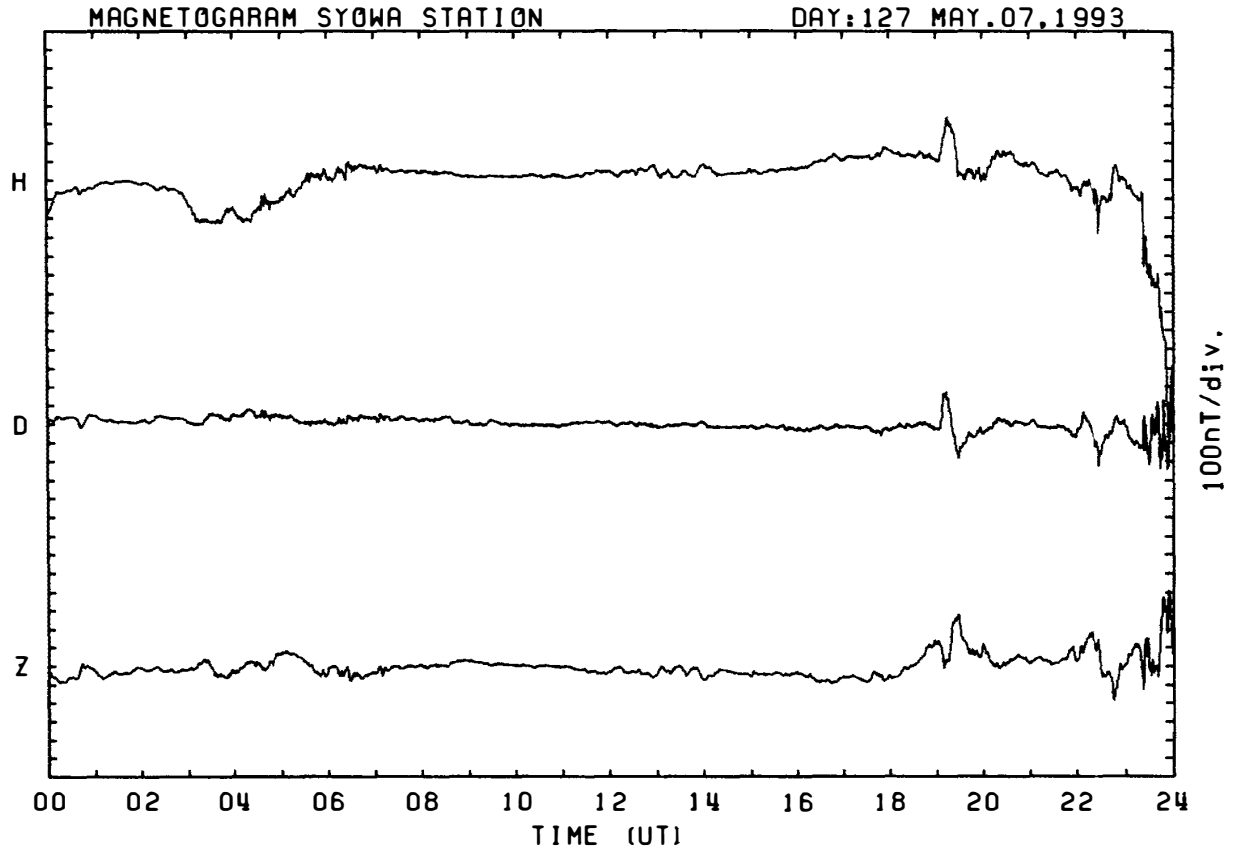
TIME (UT)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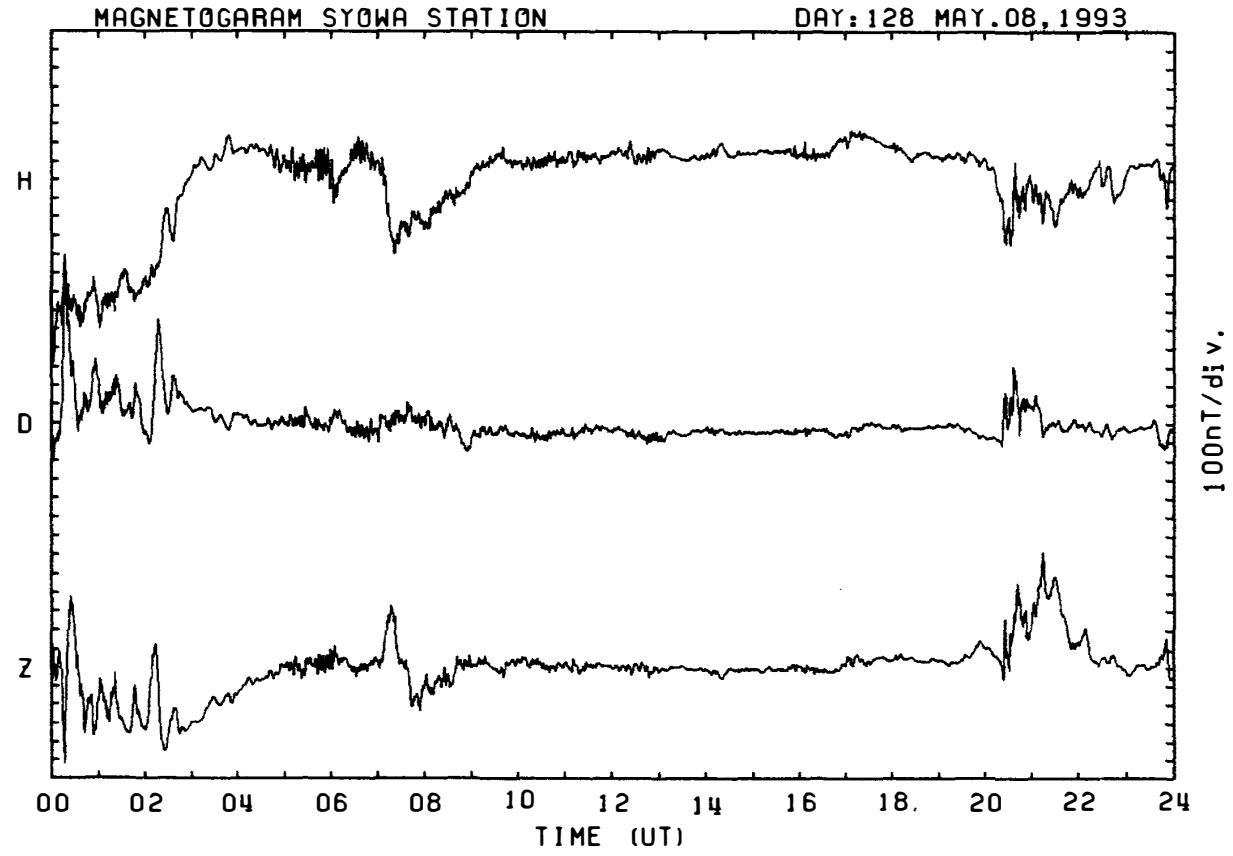
TIME (UT)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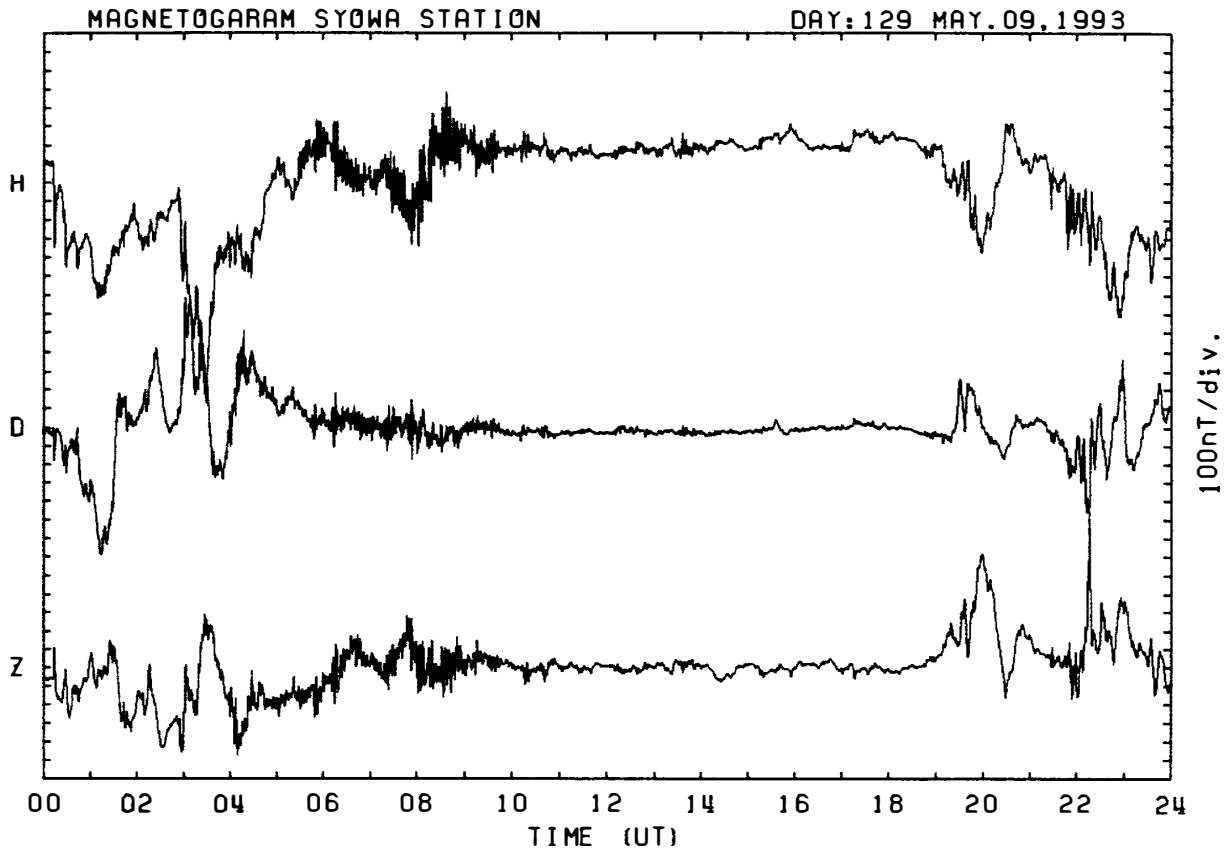
TIME (UT)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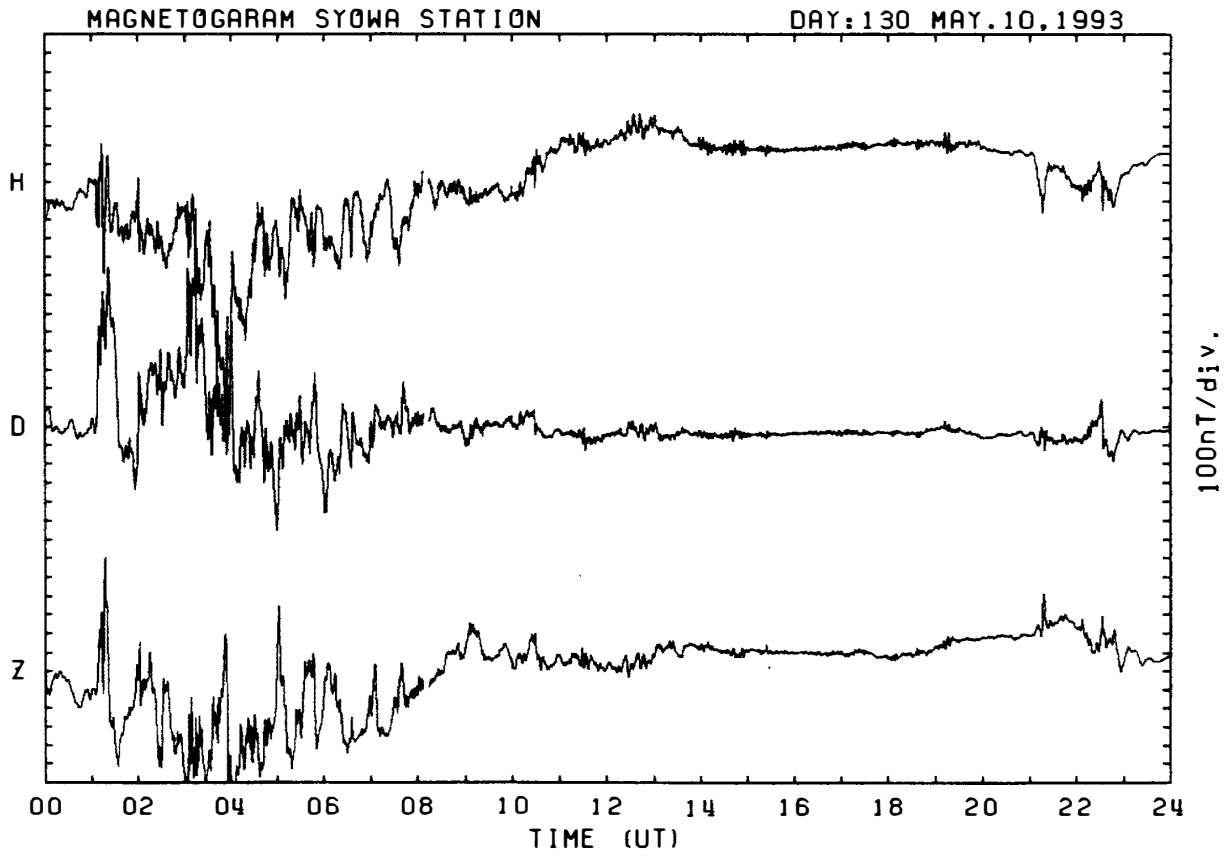
TIME (UT)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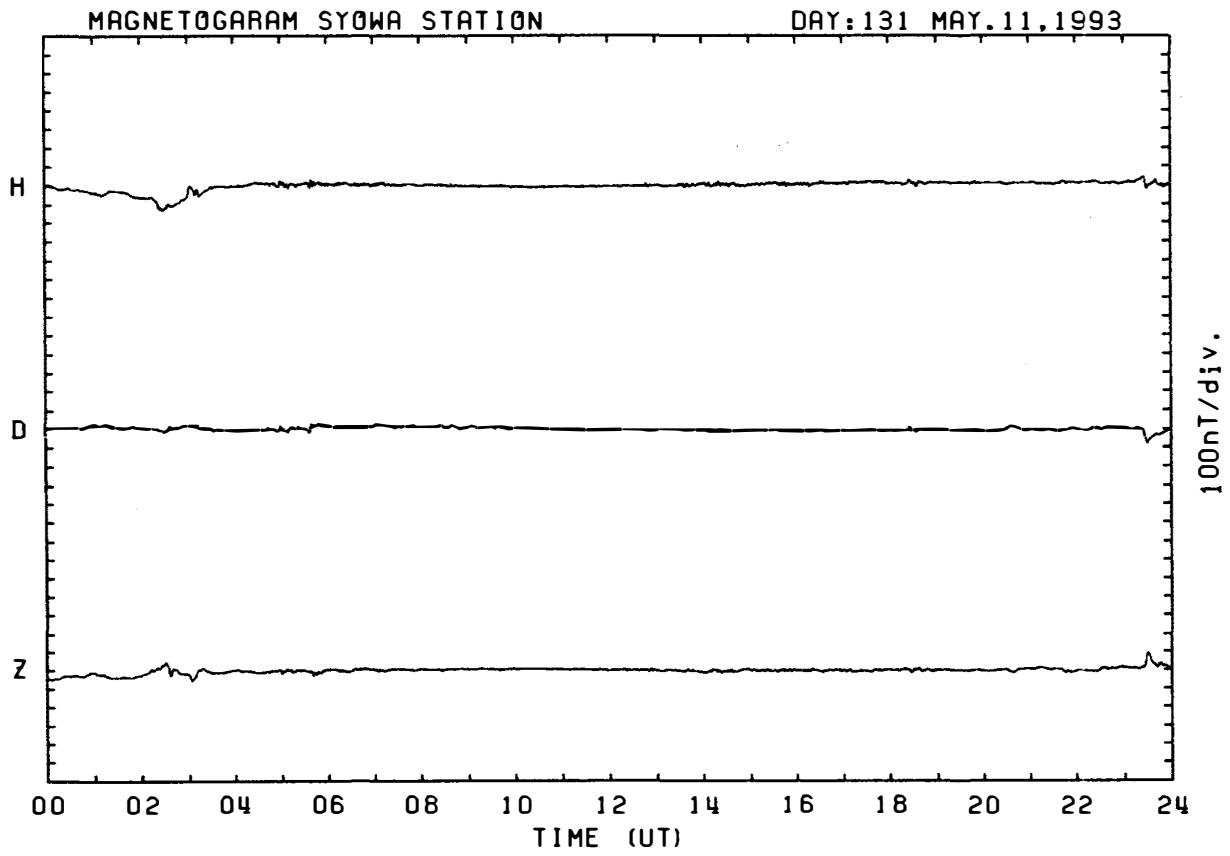
TIME (UT)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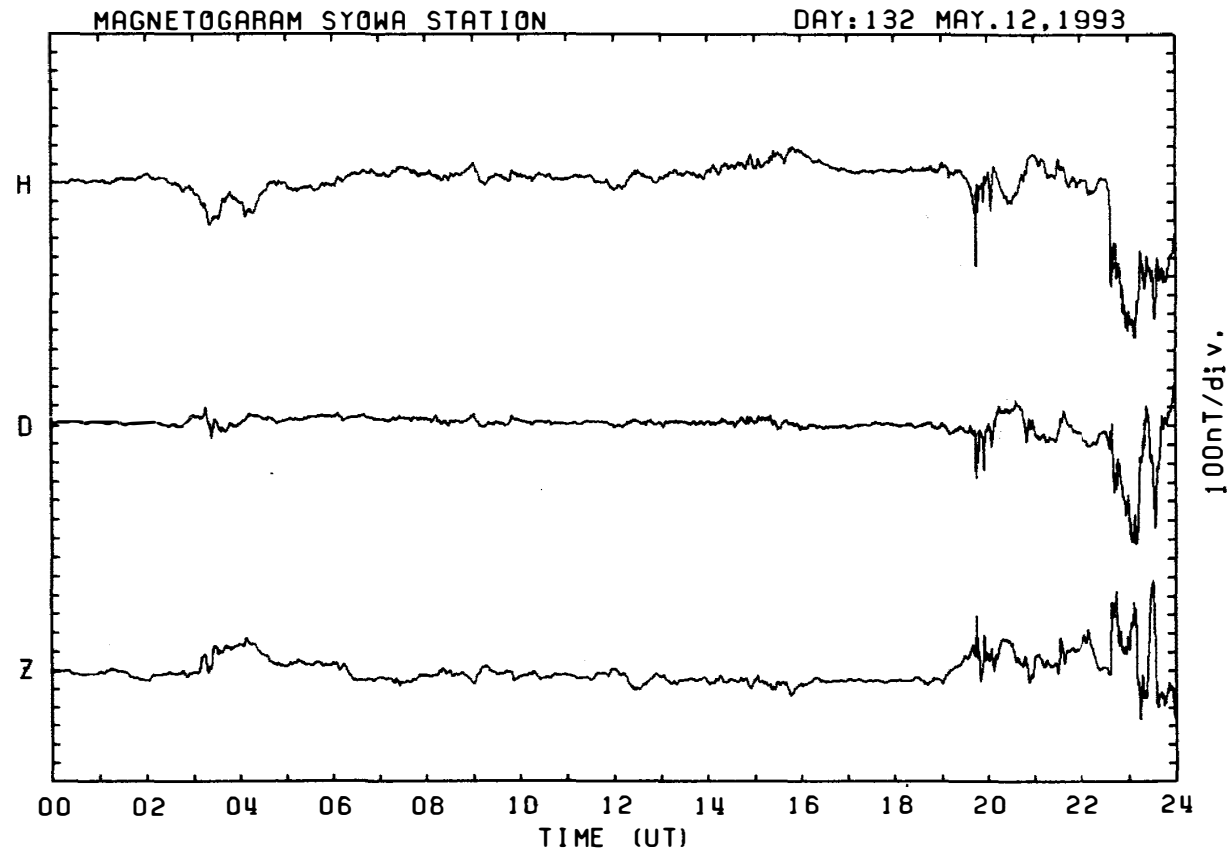
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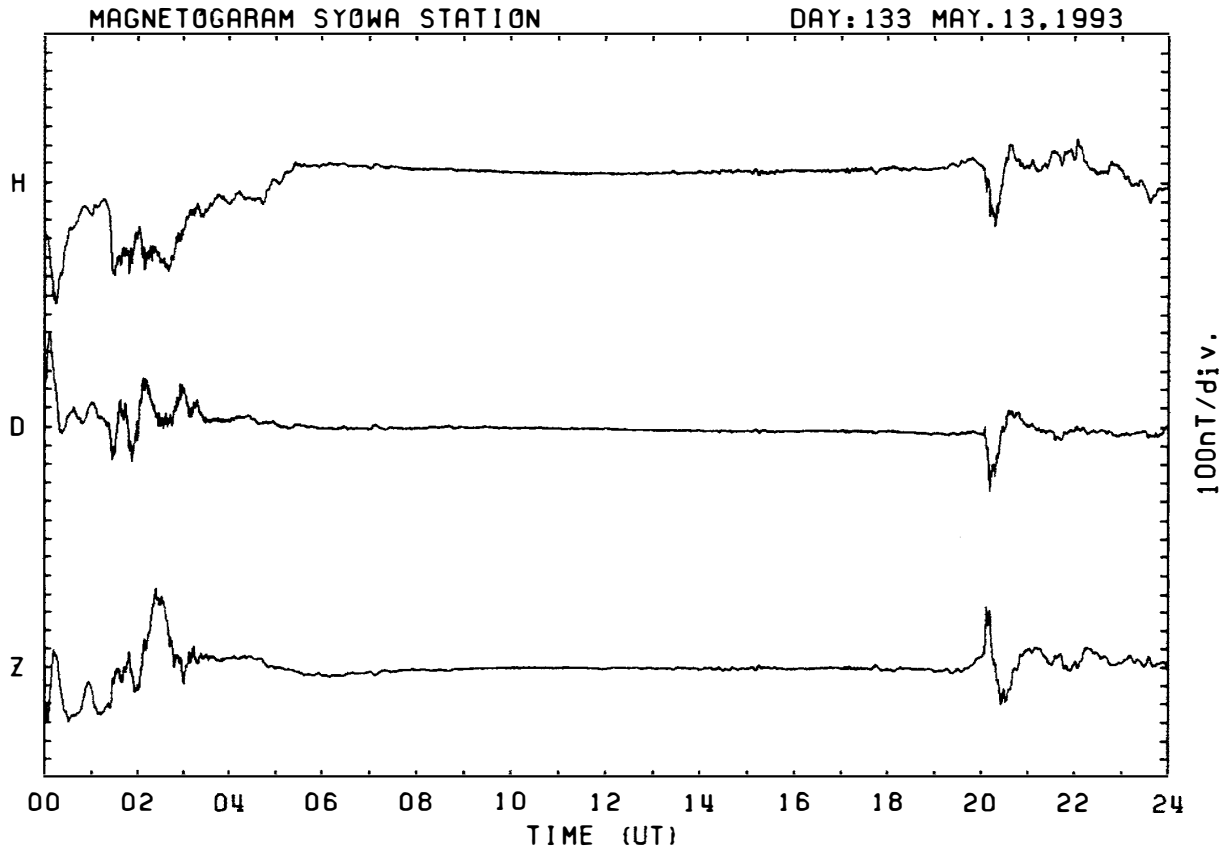
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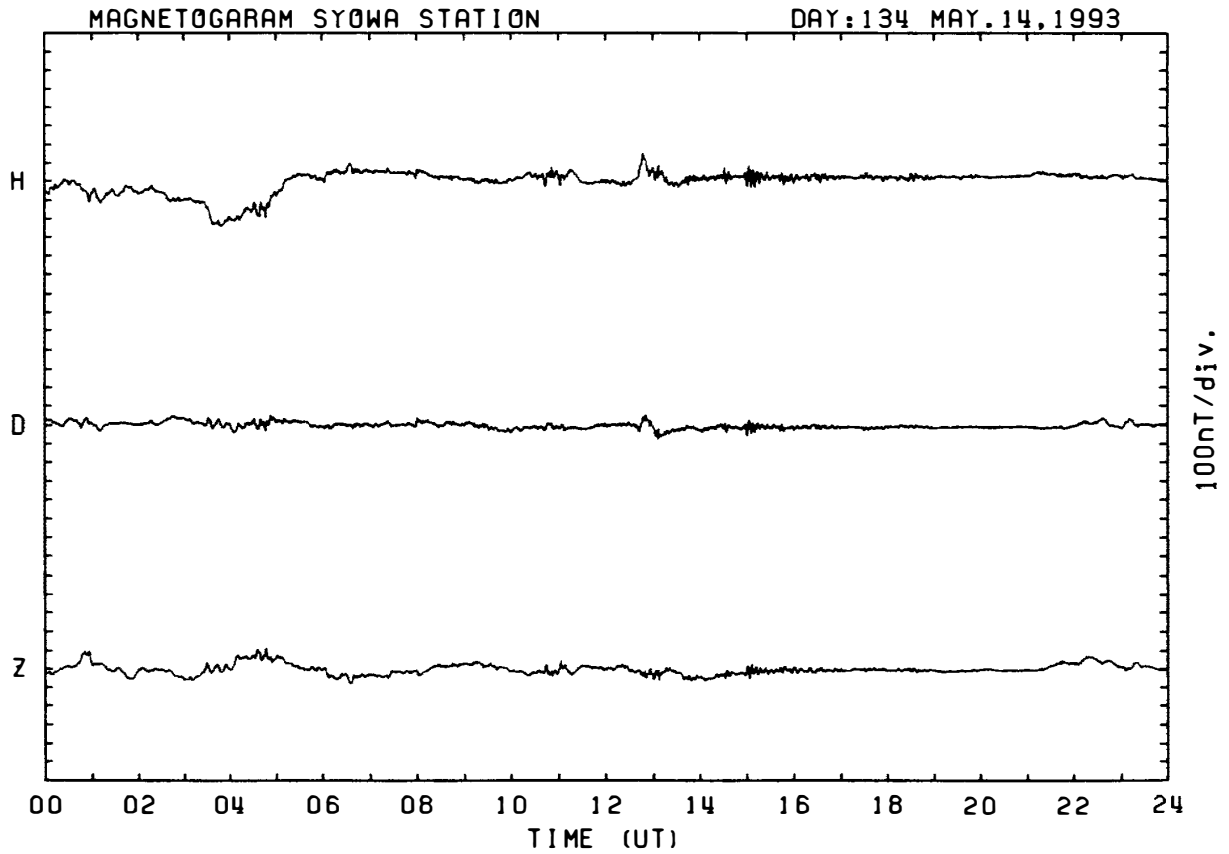
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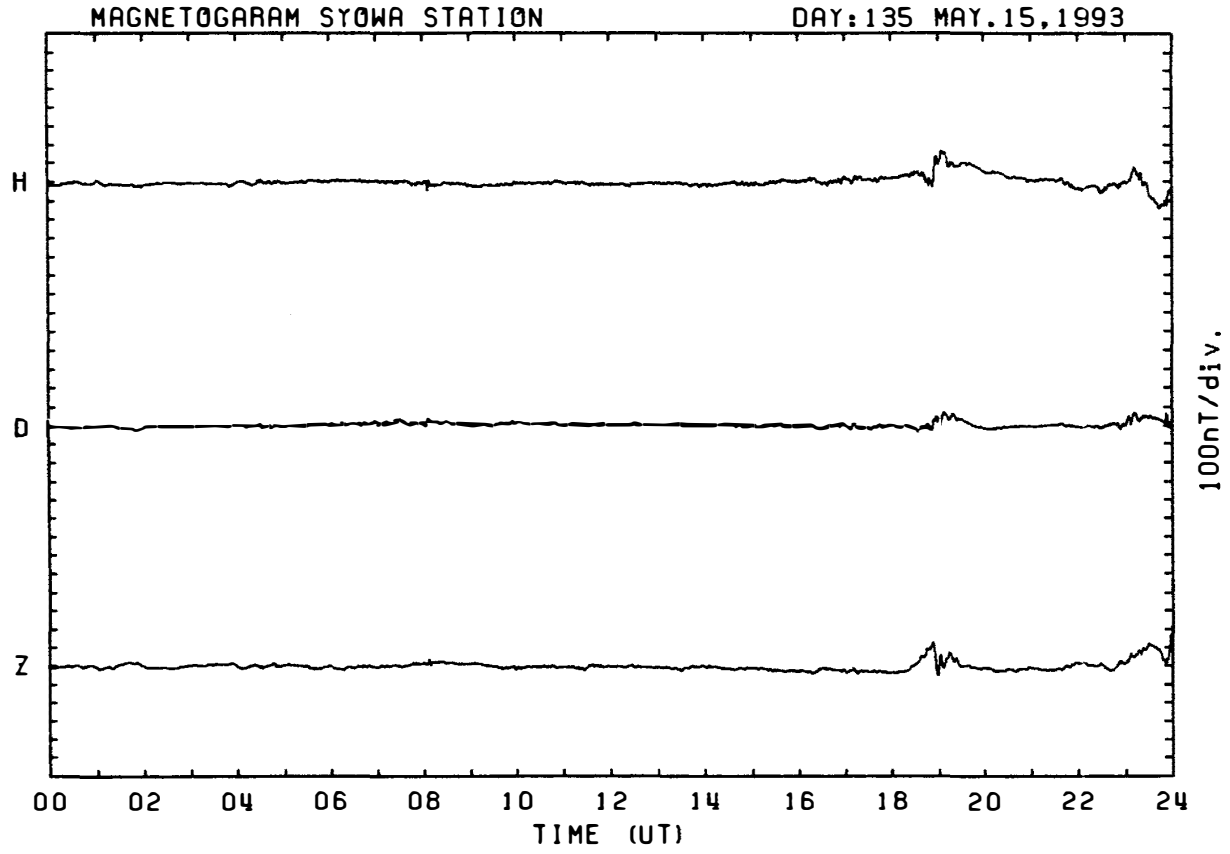
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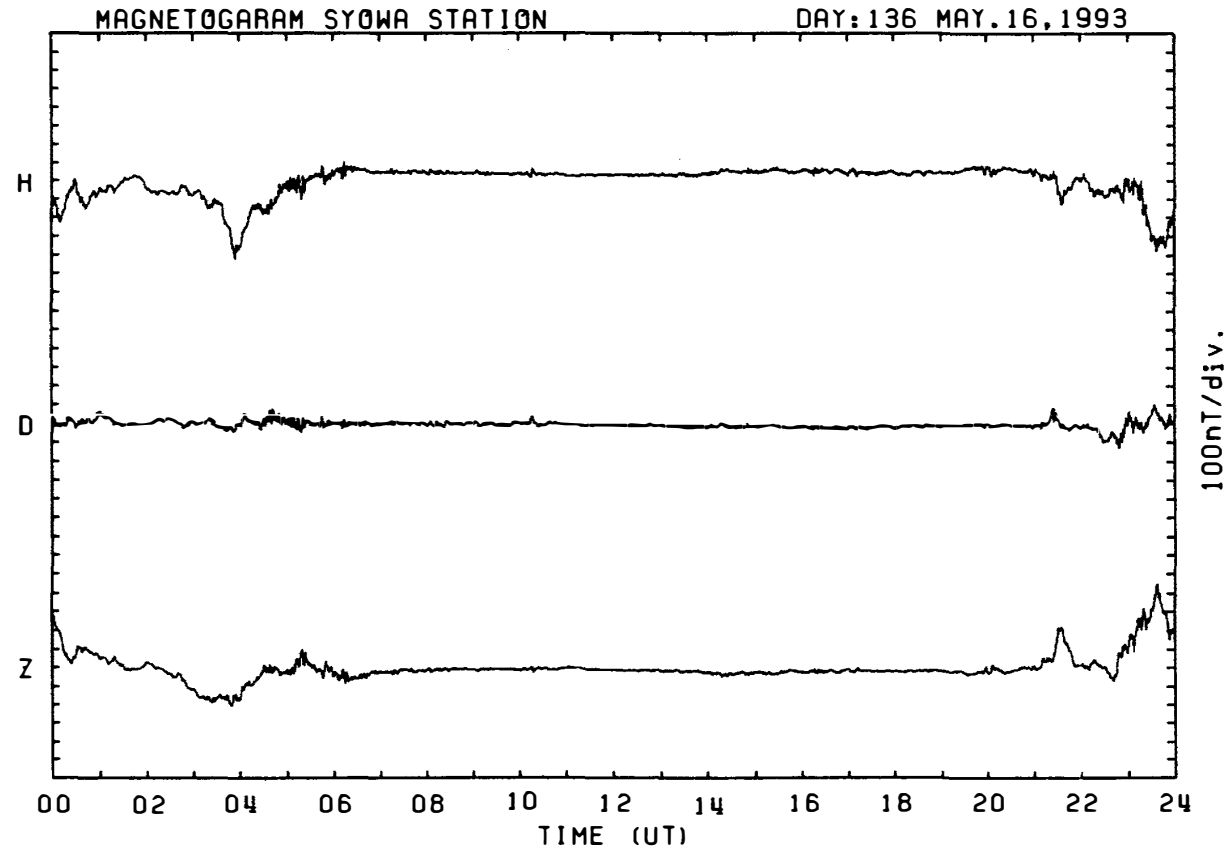
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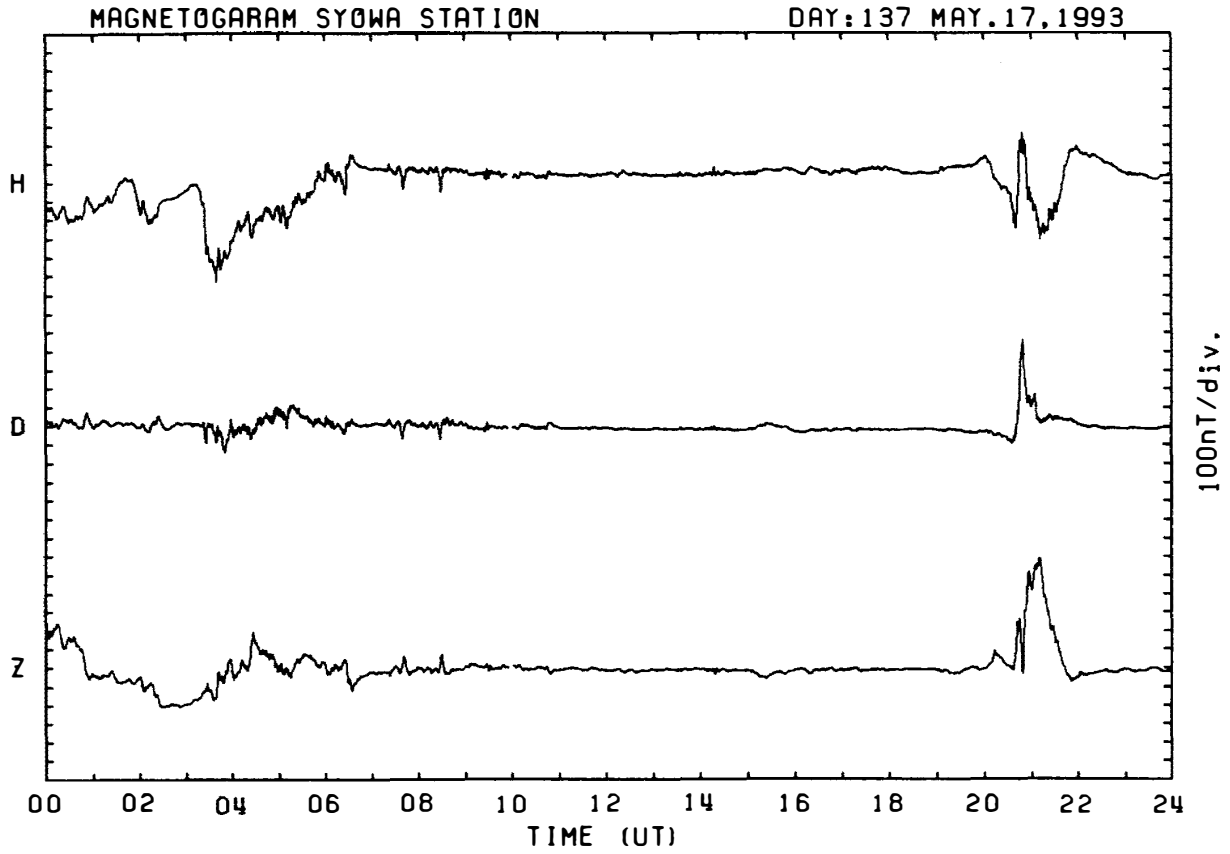
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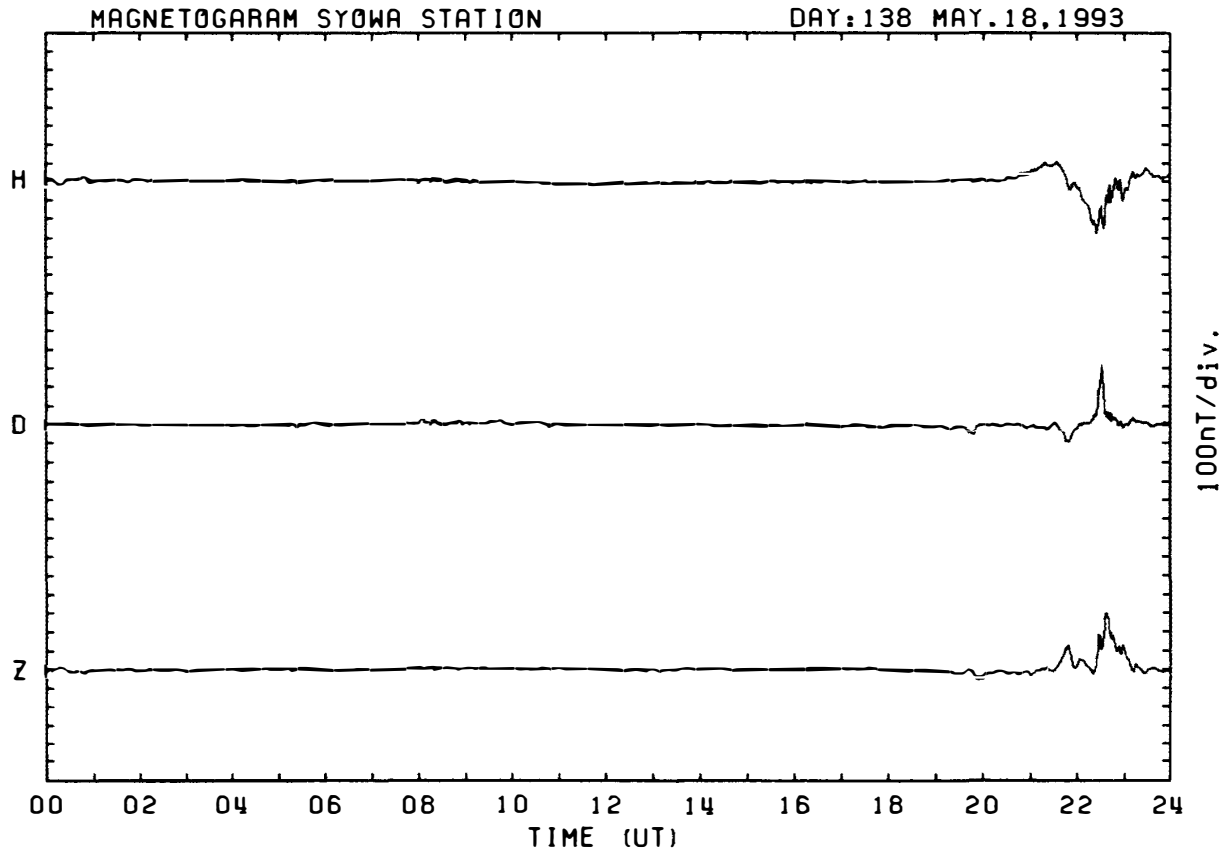
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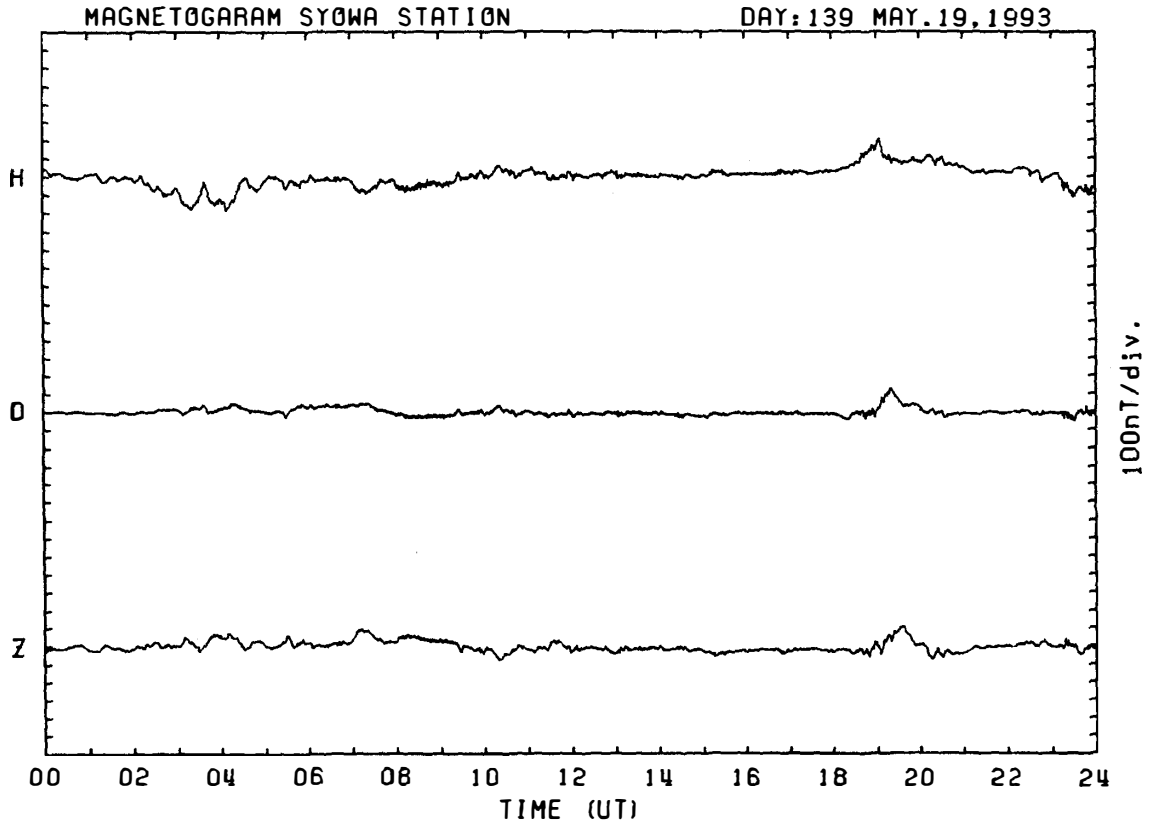
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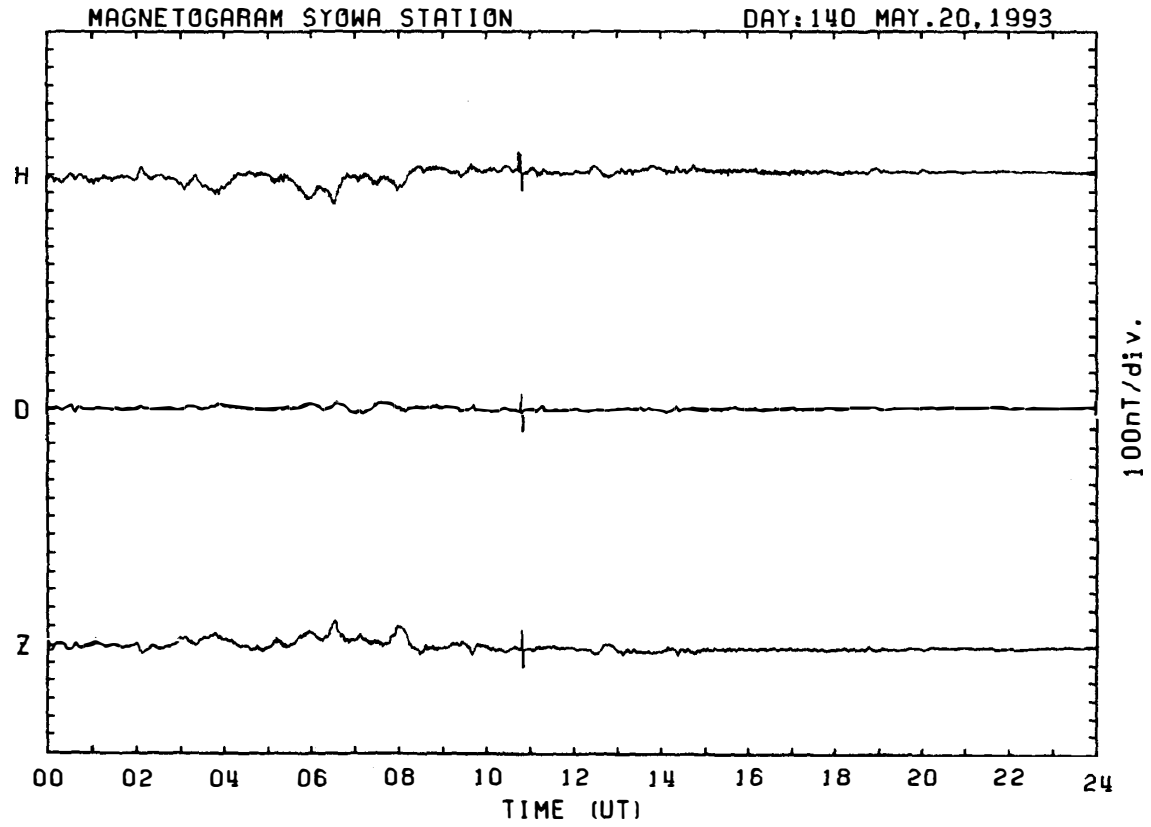
TIME (UT)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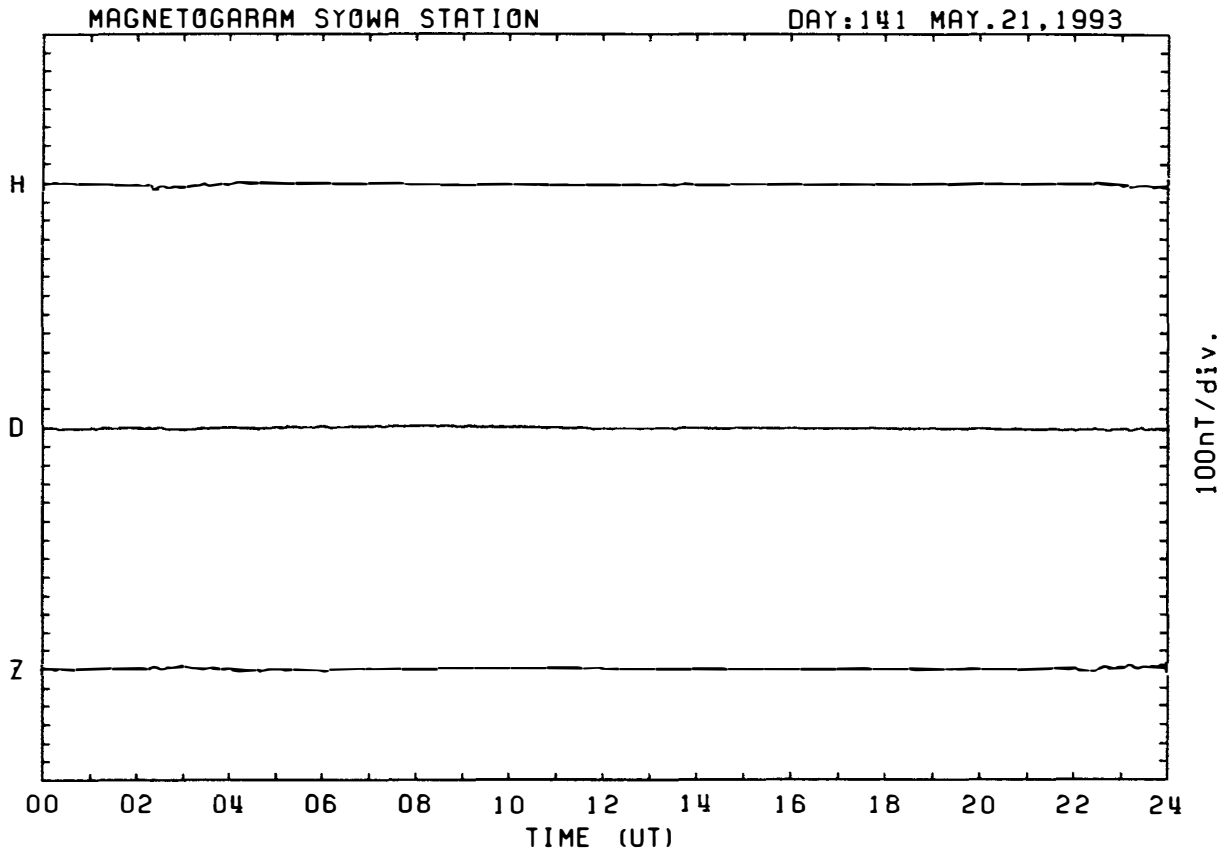
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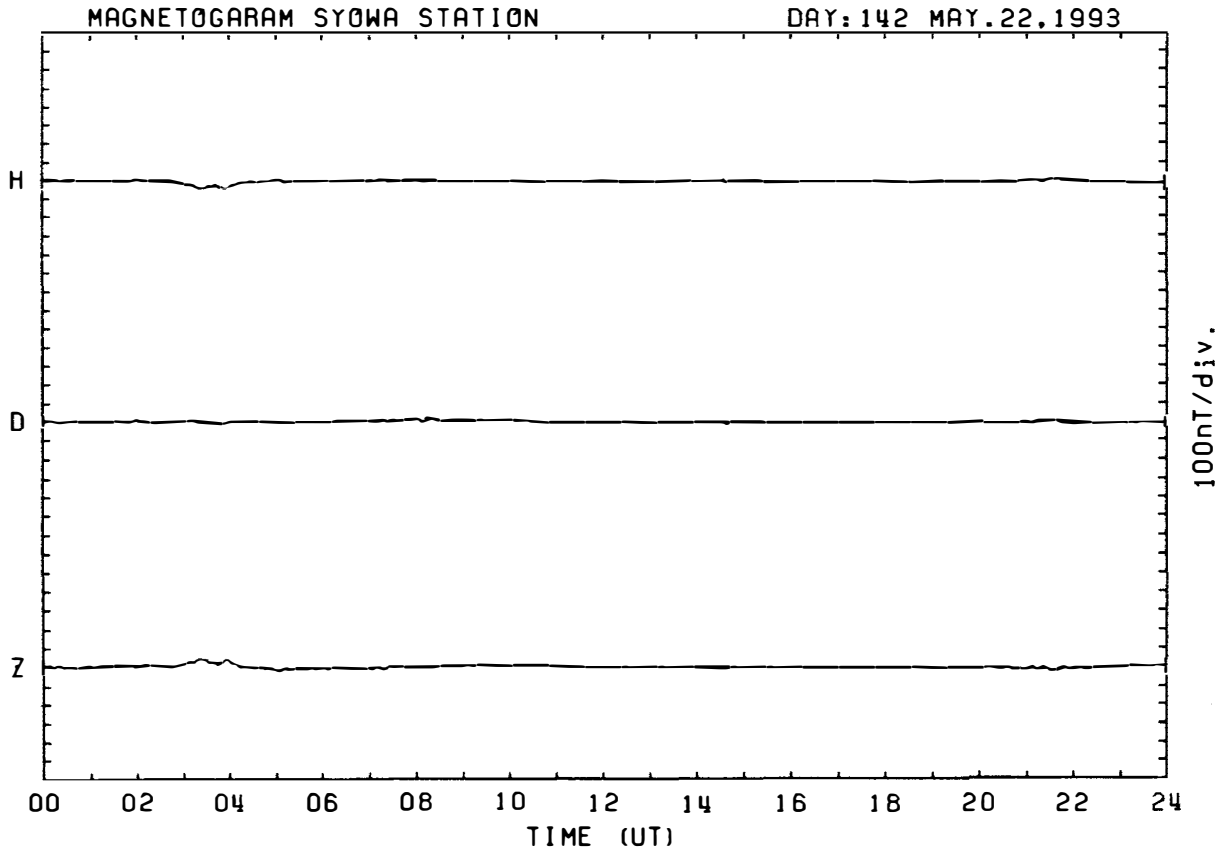
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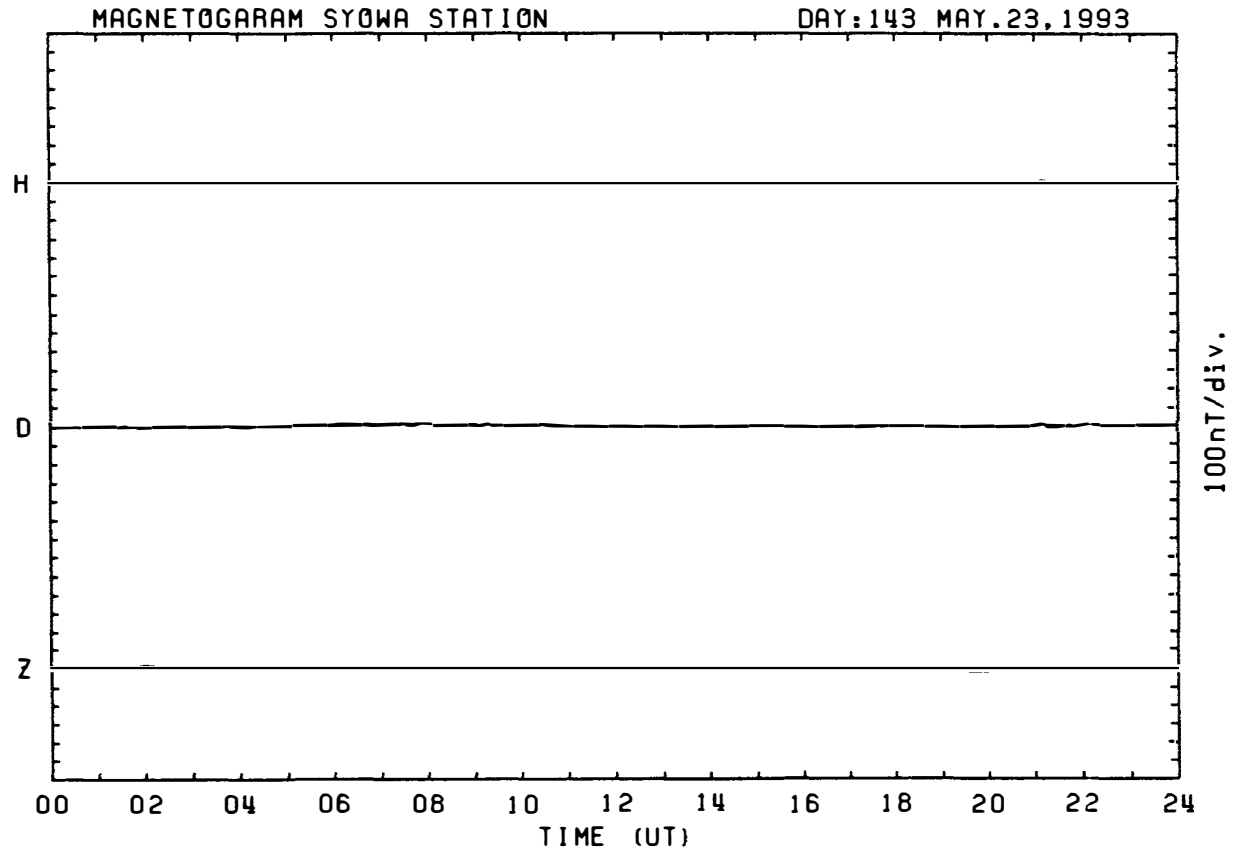
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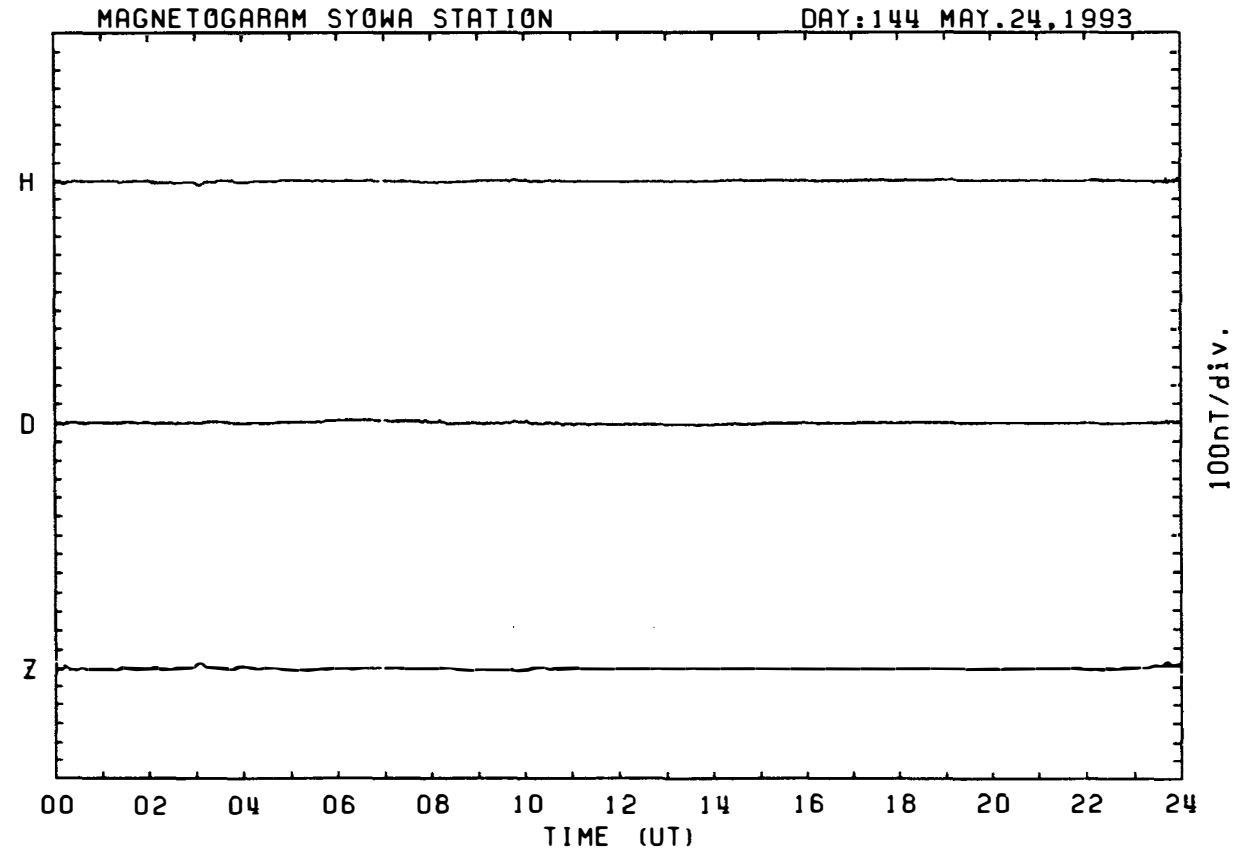
TIME (UT)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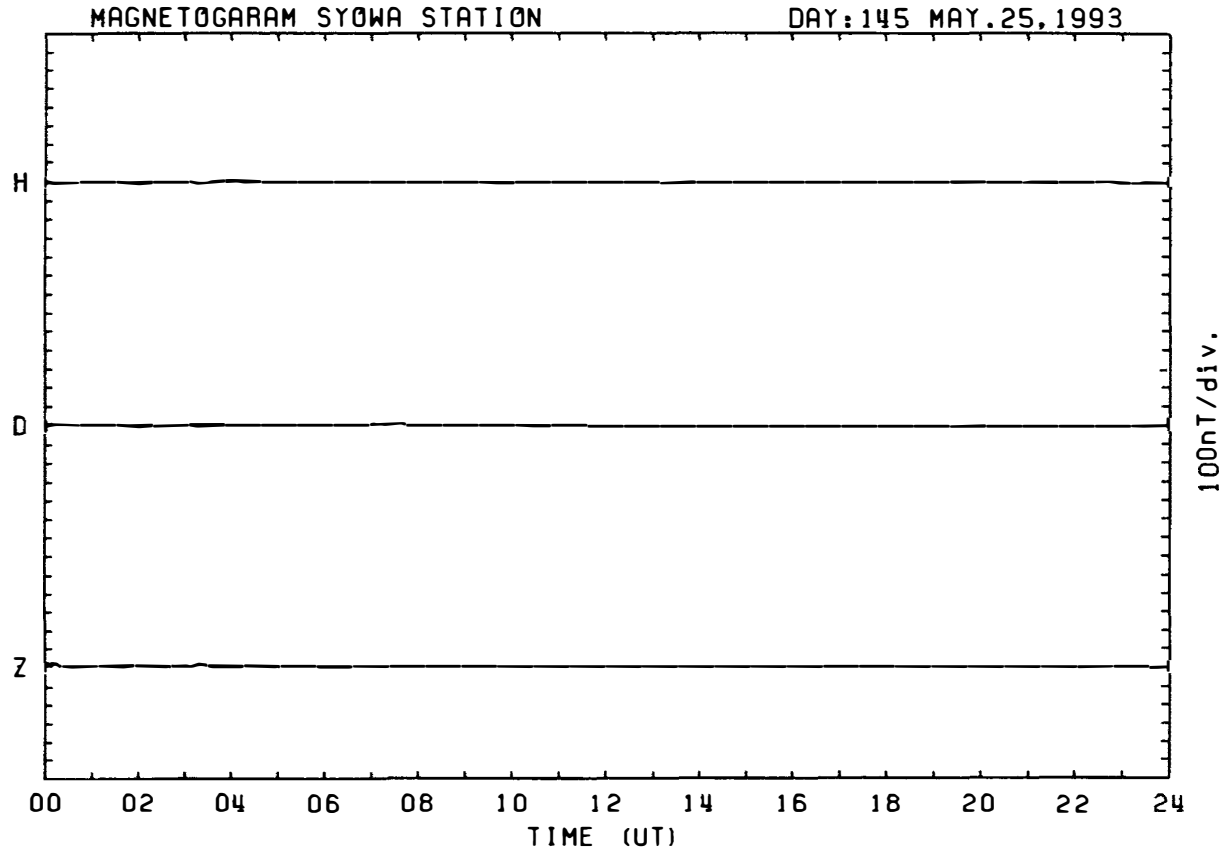
TIME (UT)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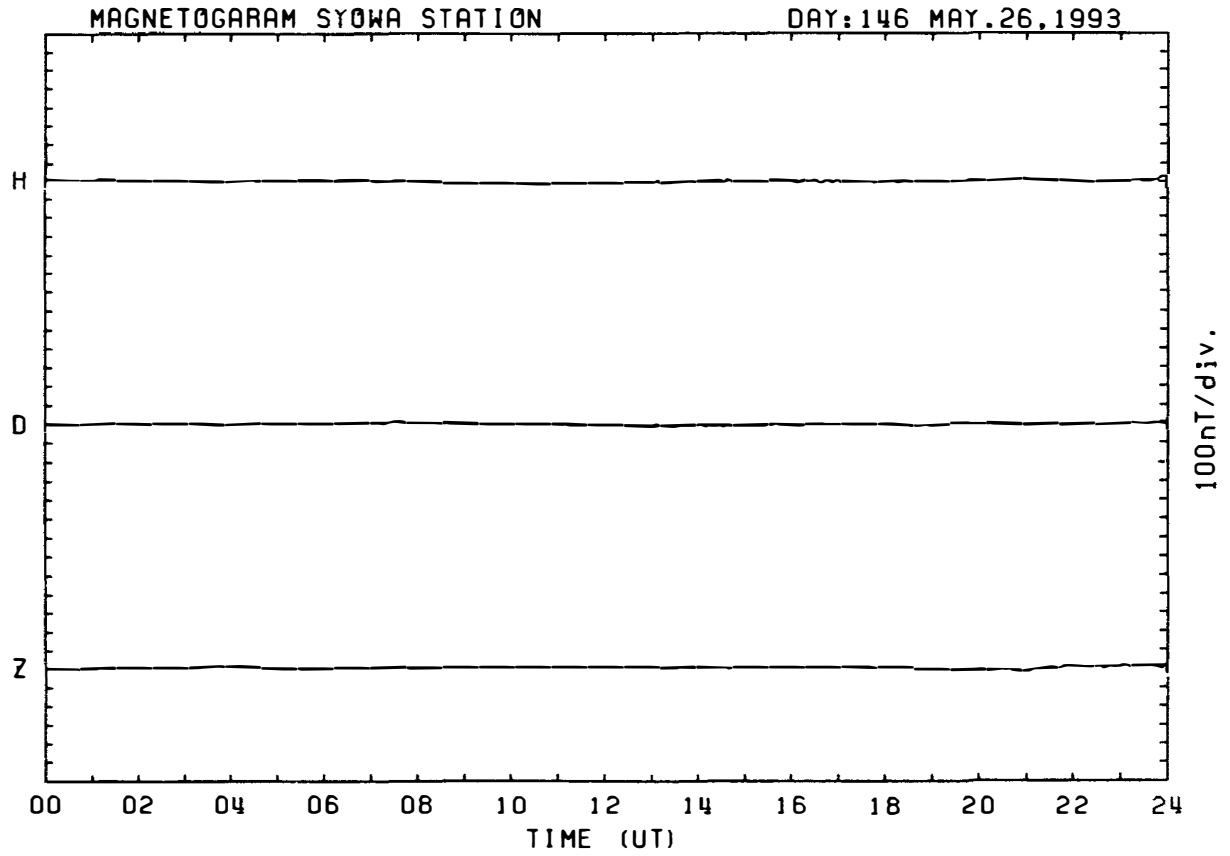
TIME (UT)


MAGNETOGARAM SYOWA STATION
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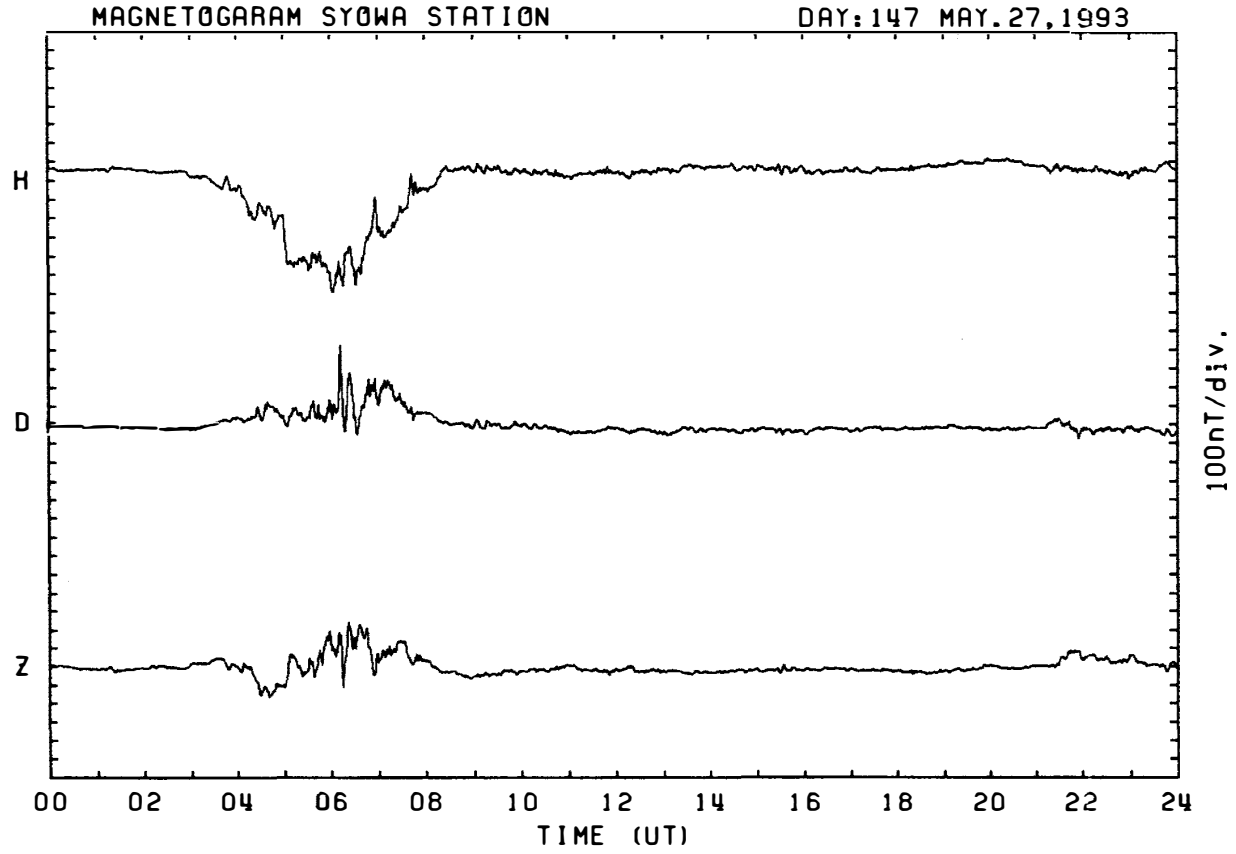
MAGNETOGARAM SYOWA STATION
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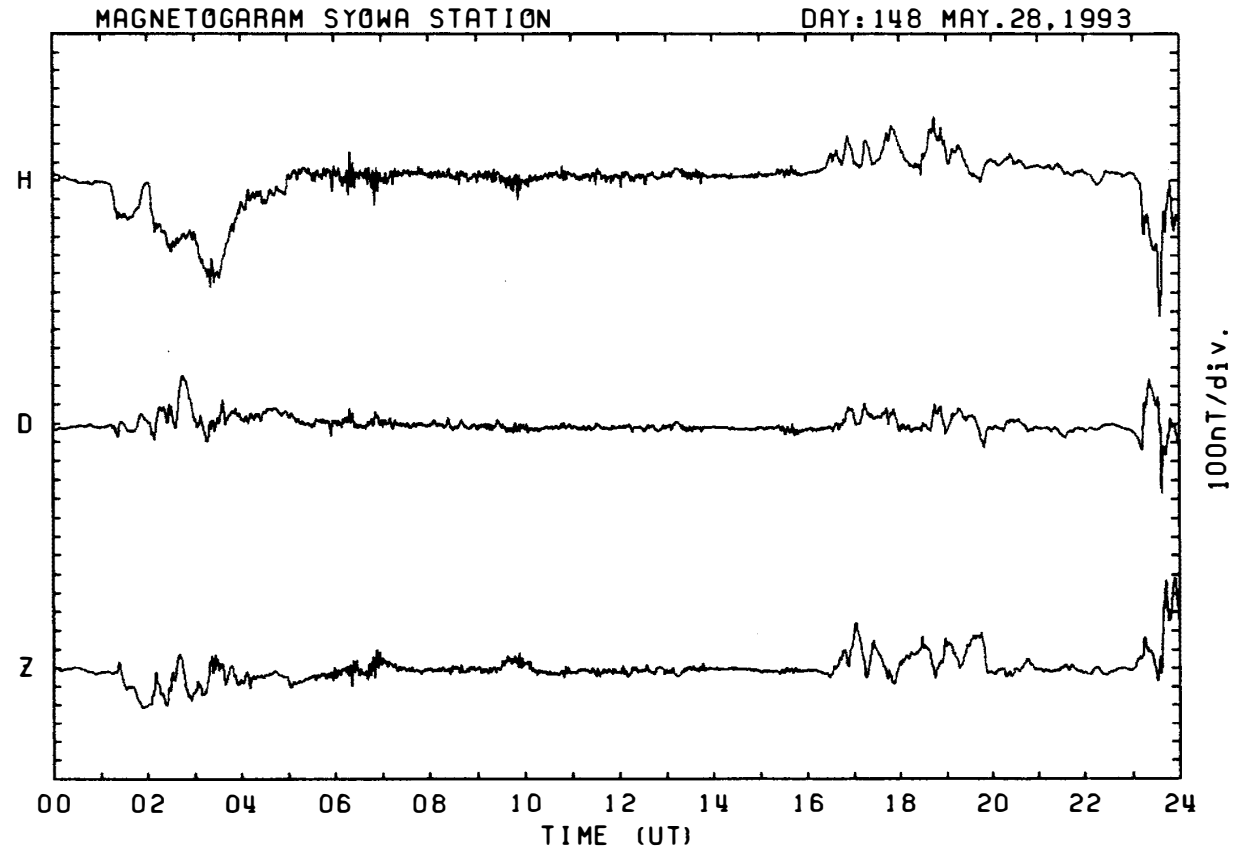
TIME (UT)


MAGNETOGARAM SYOWA STATION
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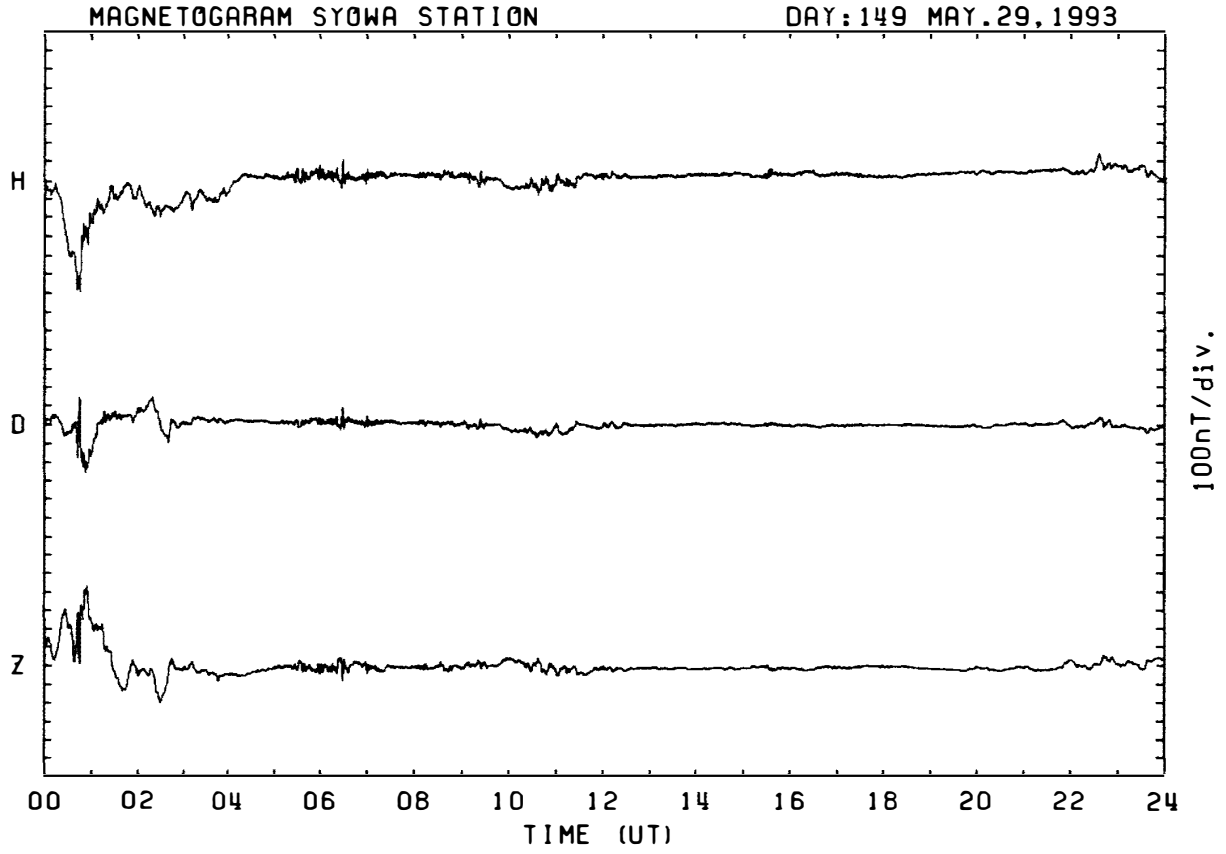
TIME (UT)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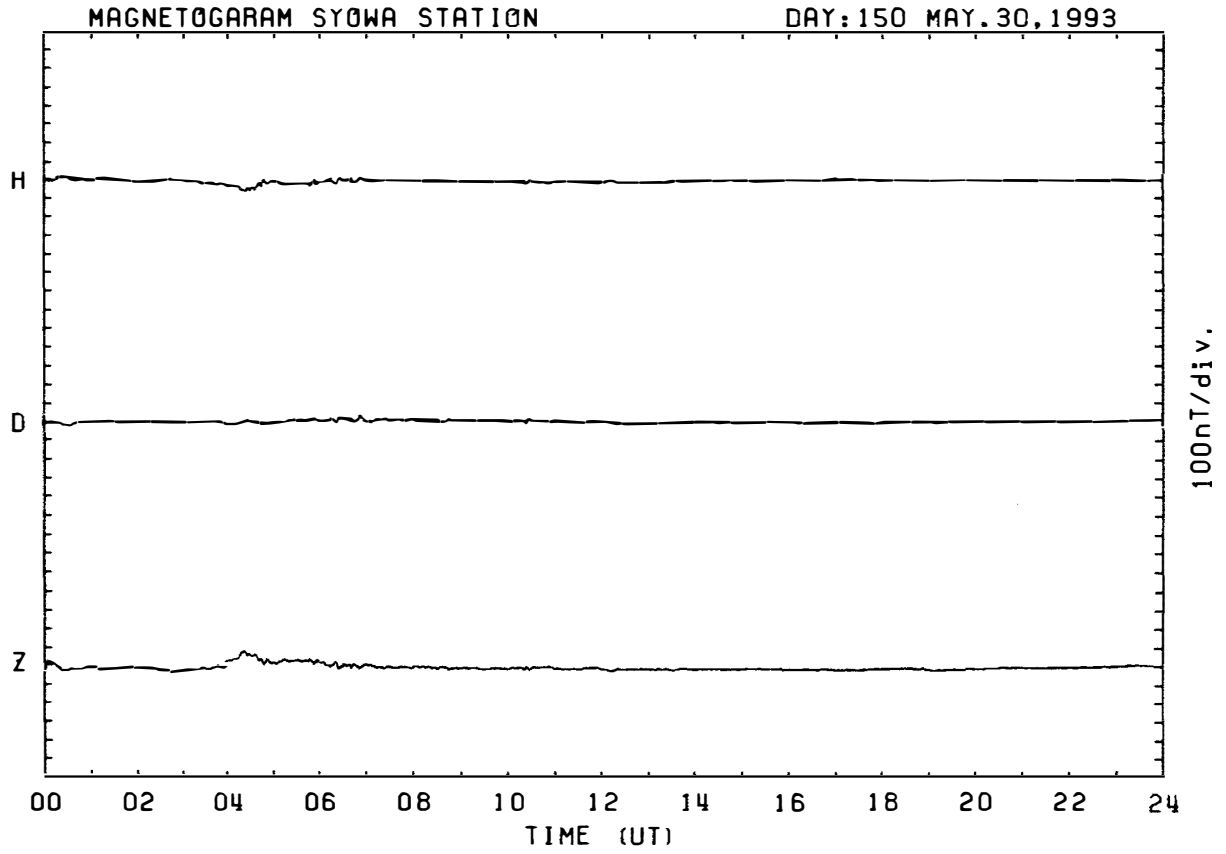
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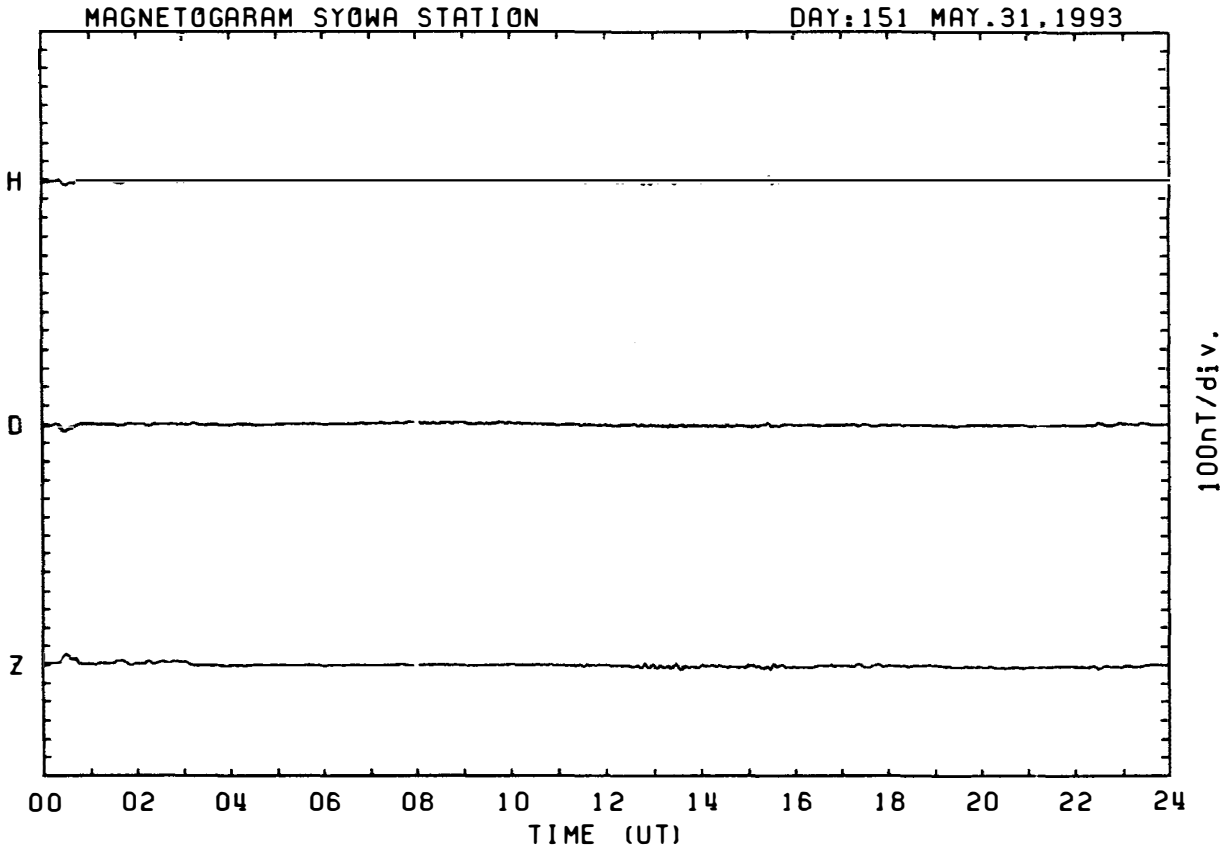
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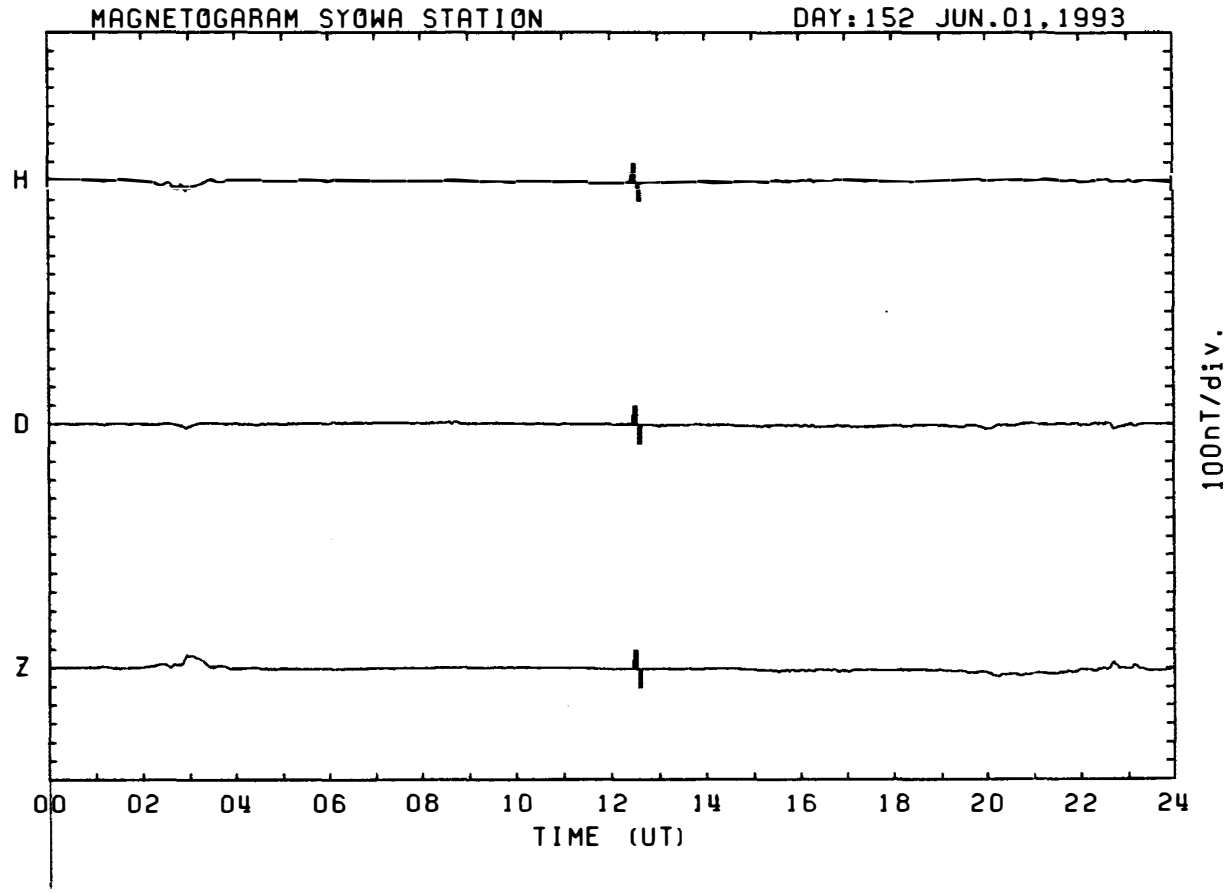
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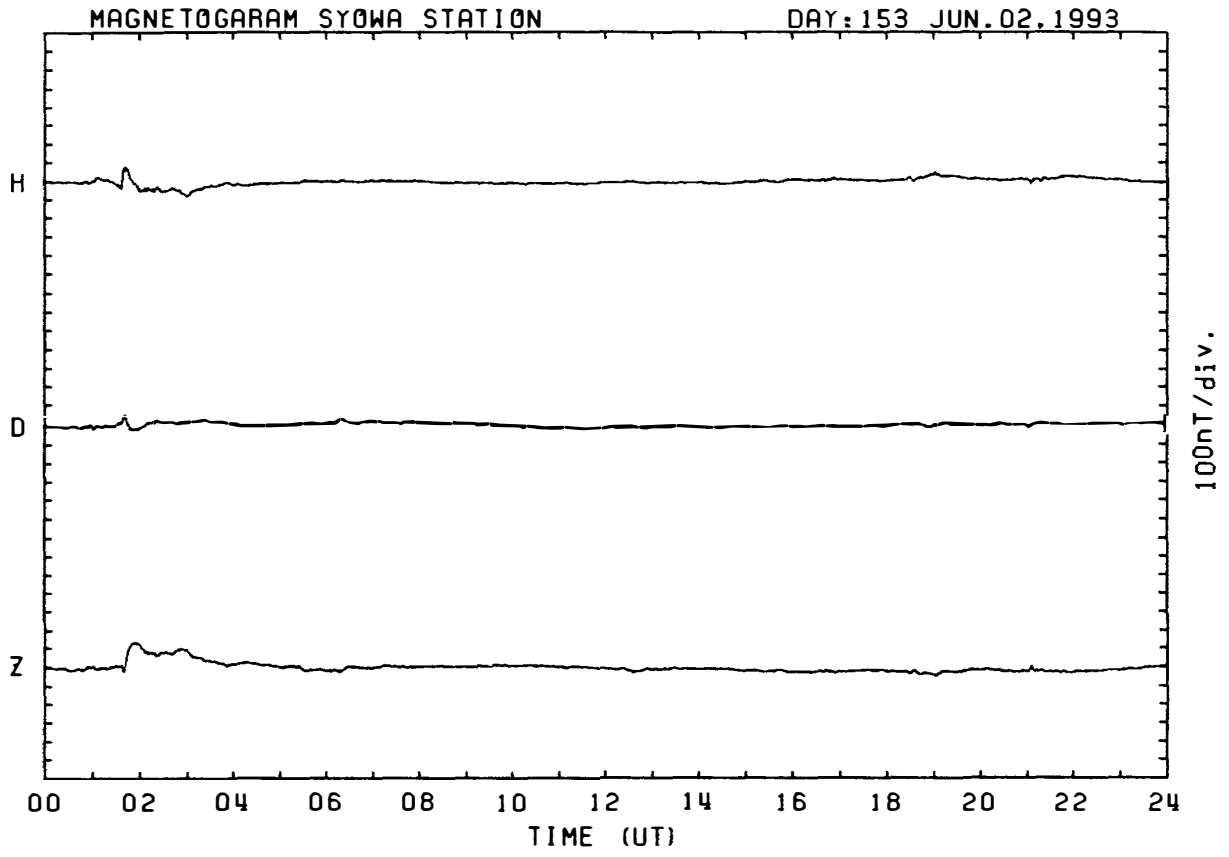
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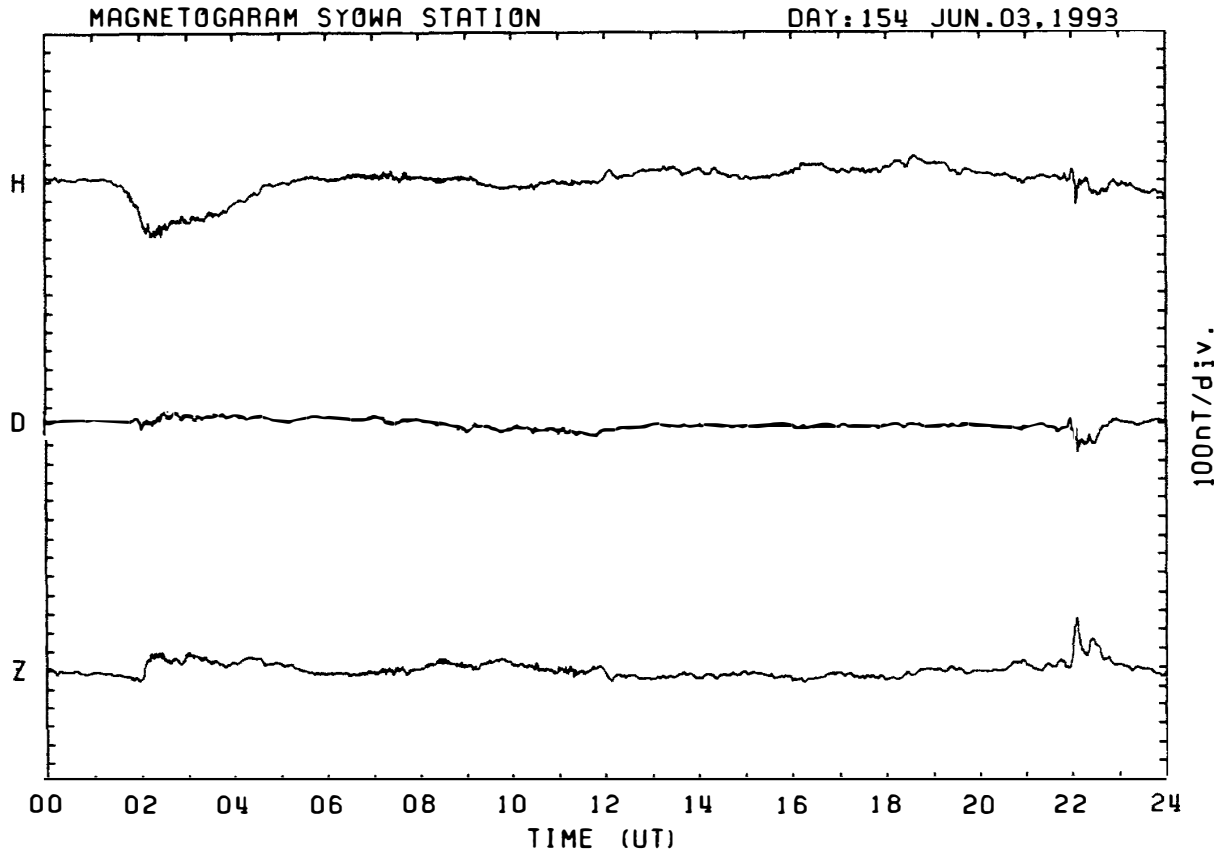
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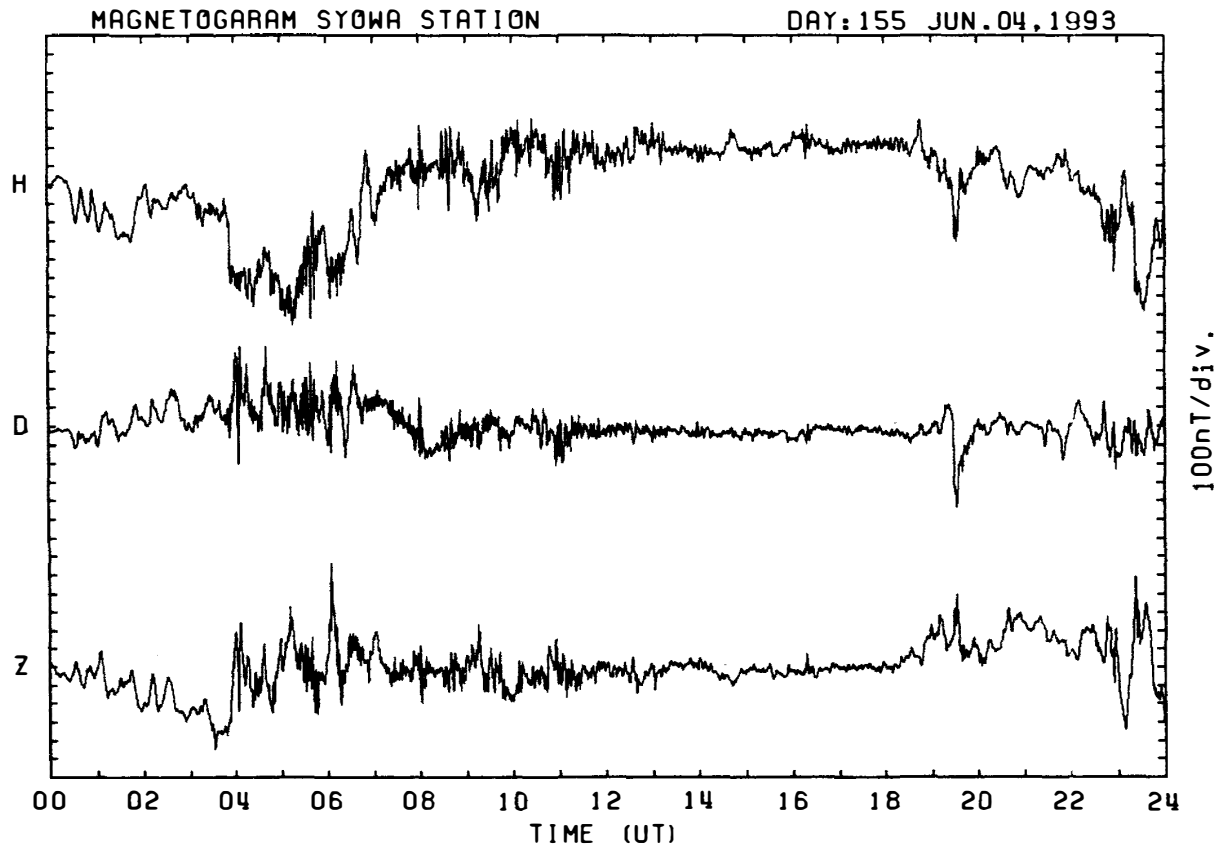
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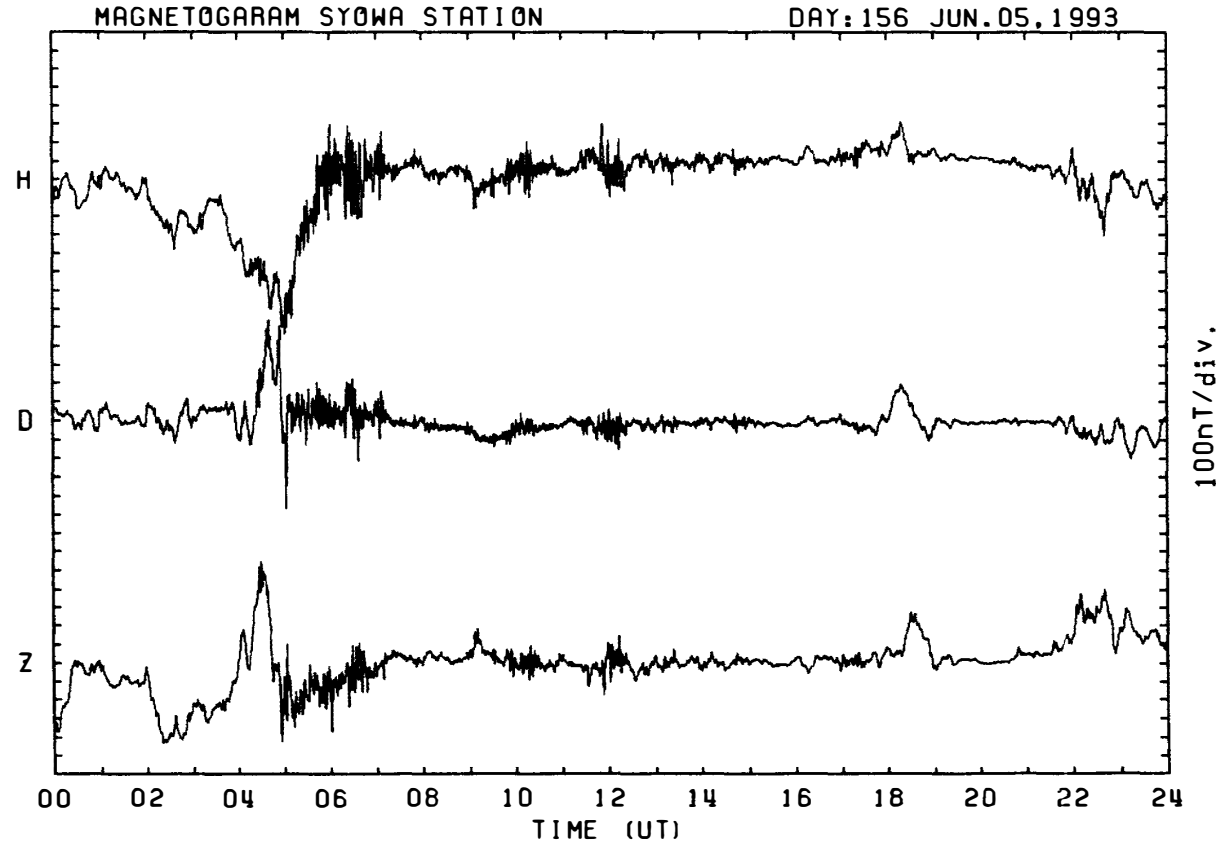
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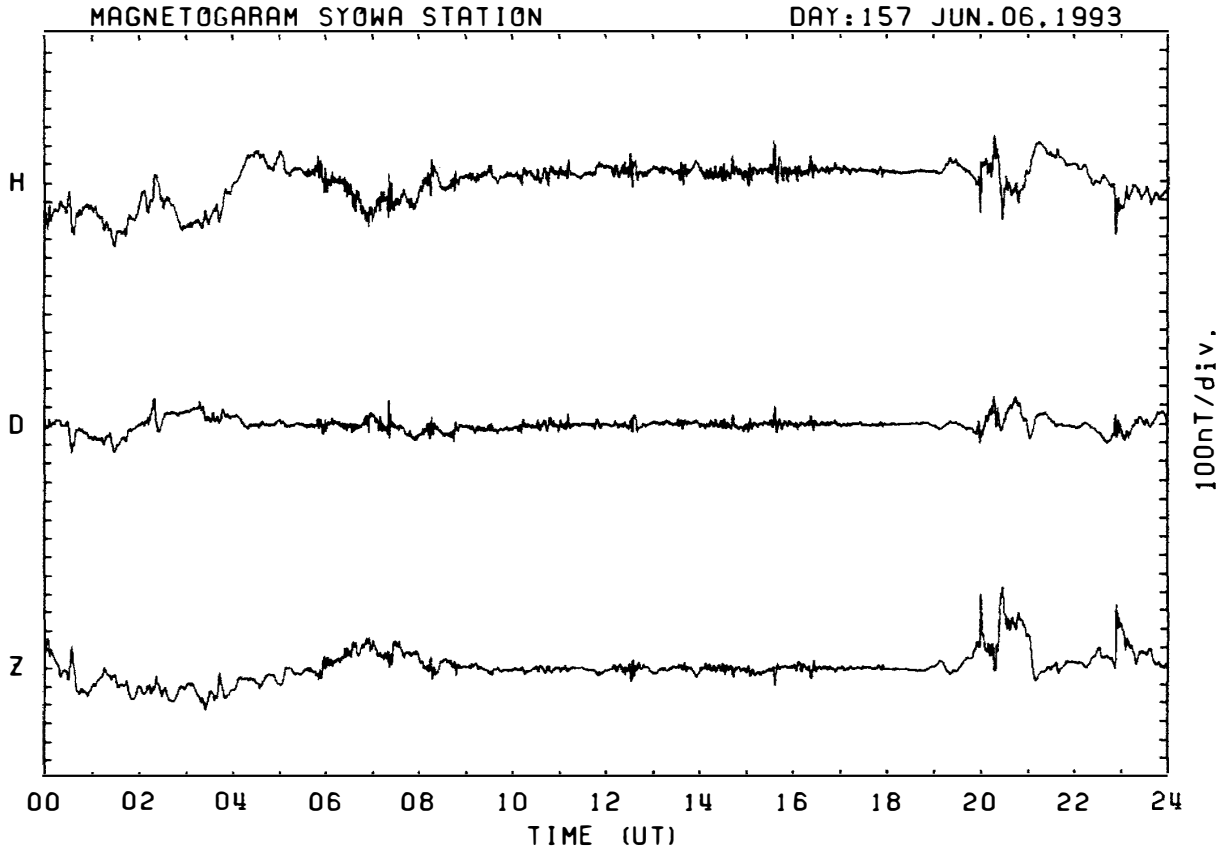
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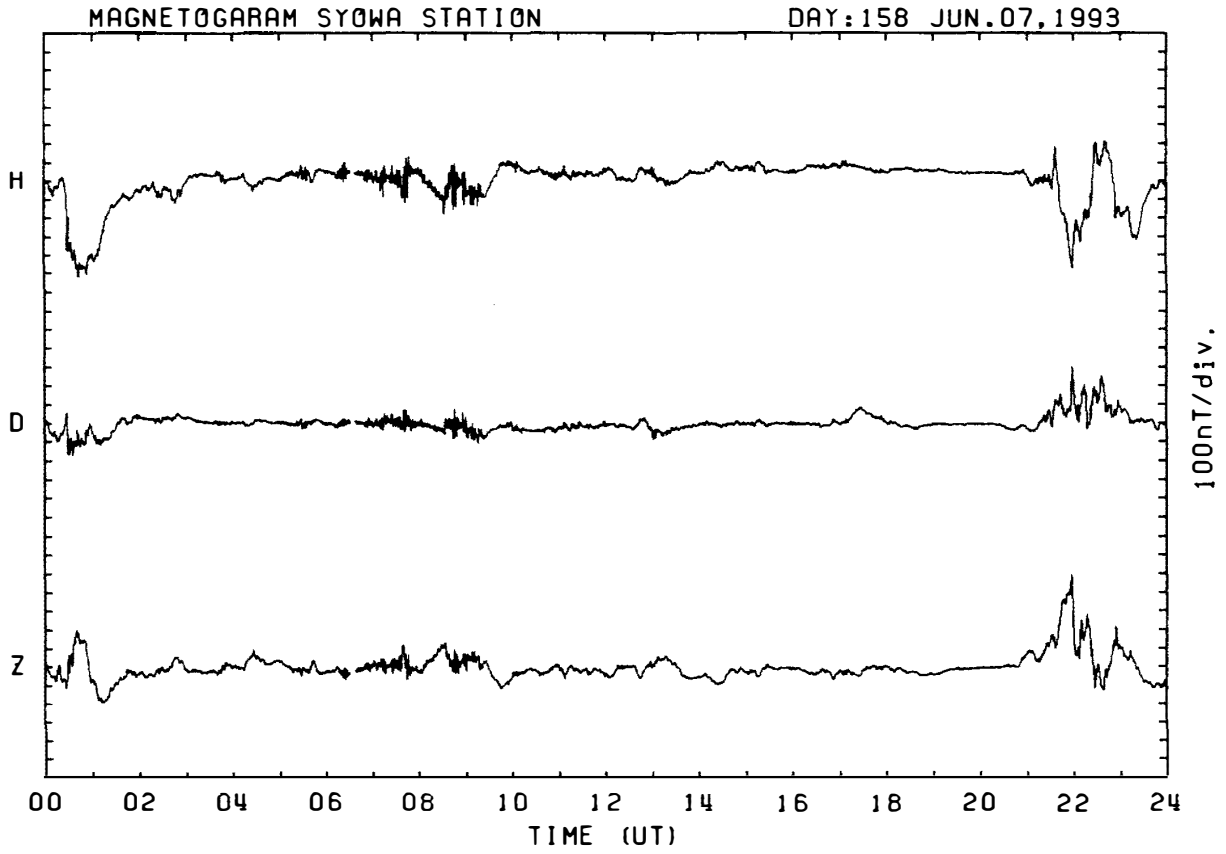
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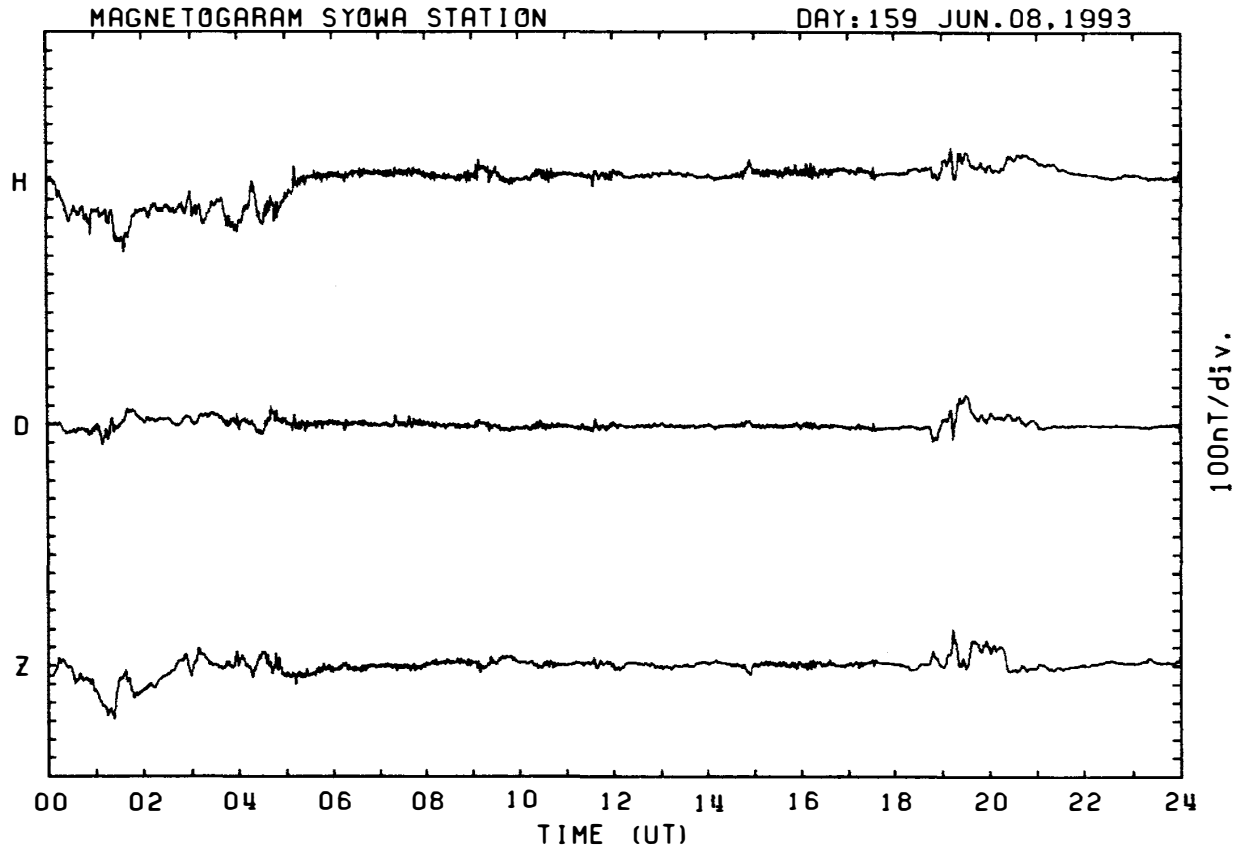
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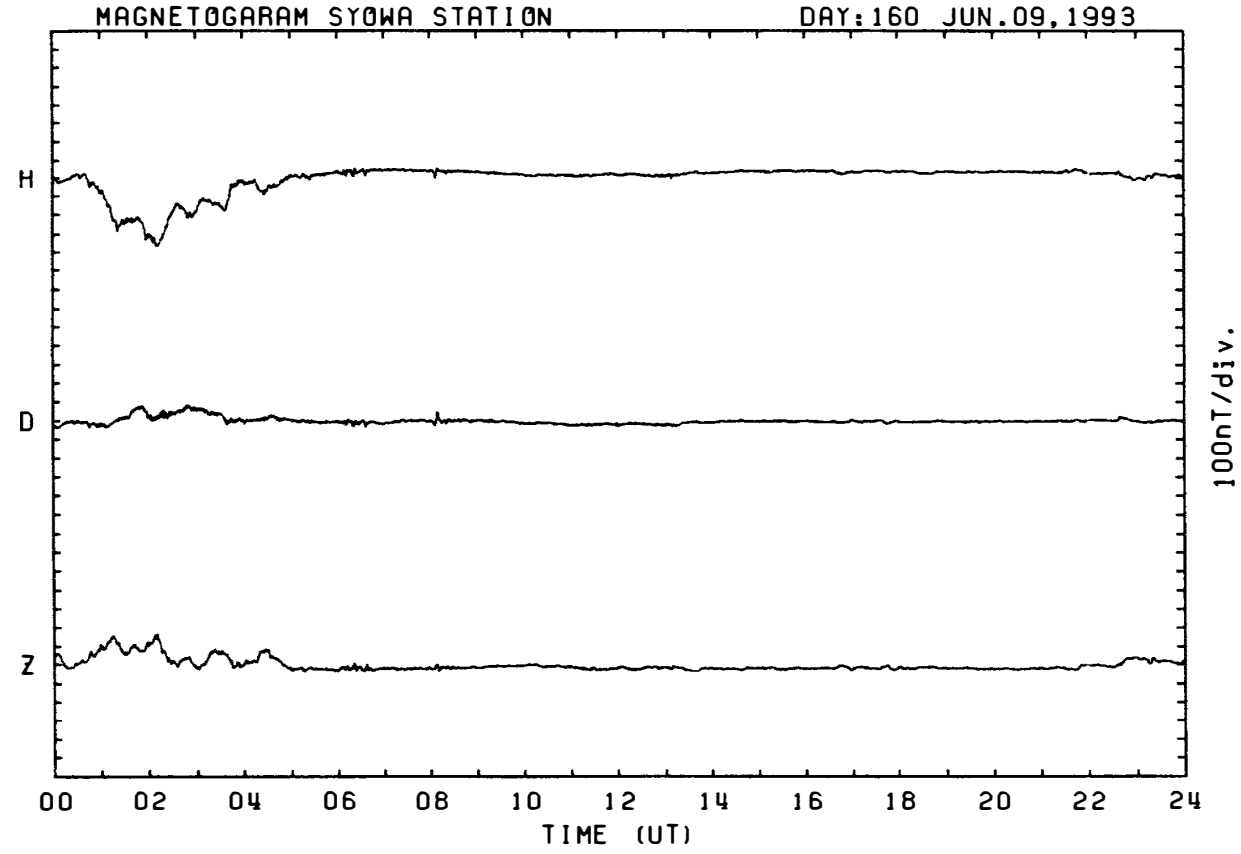
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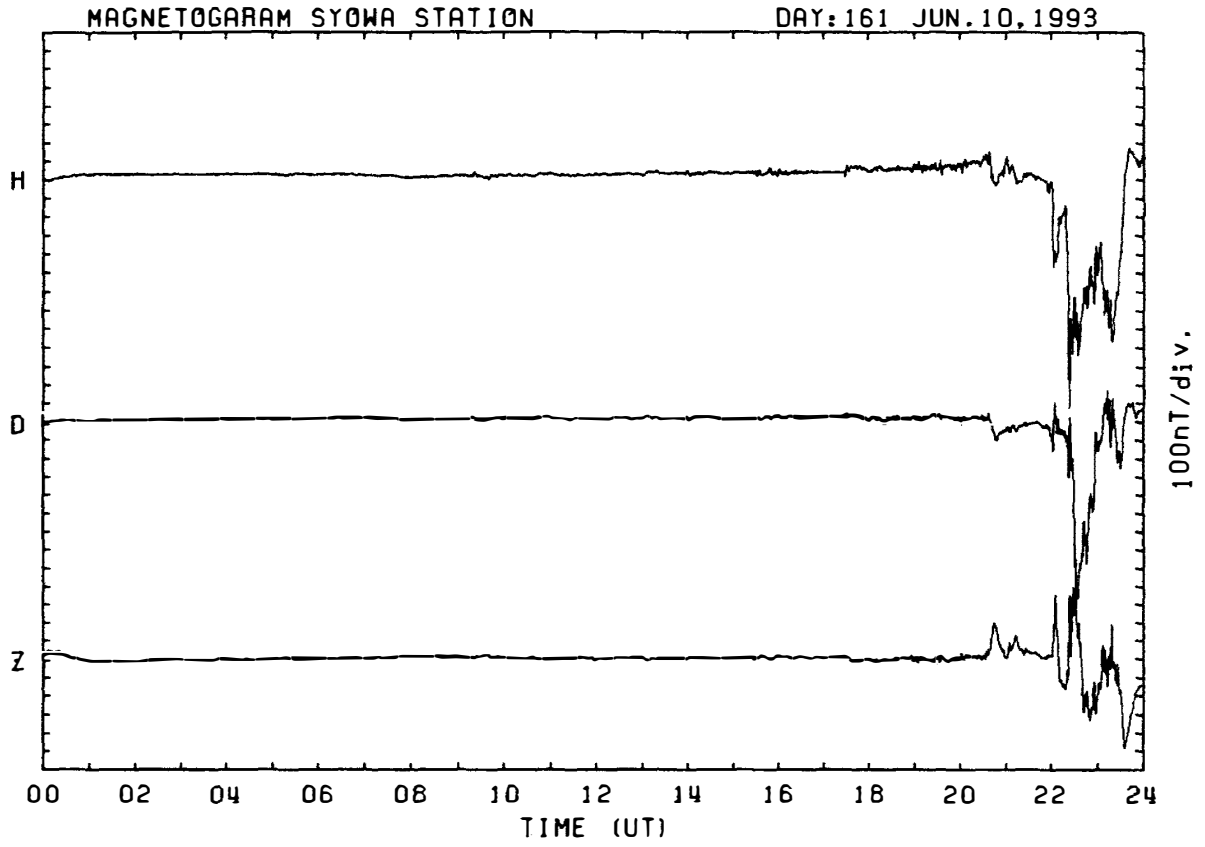
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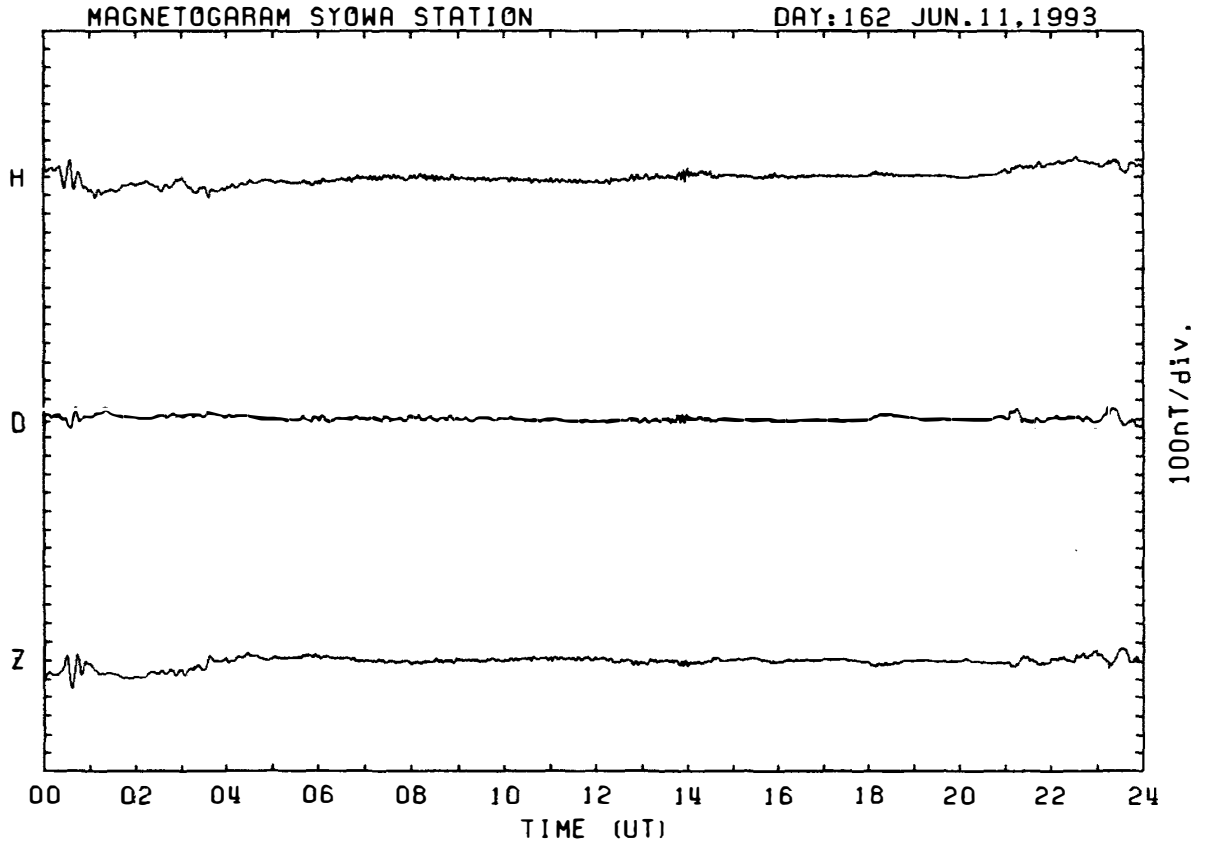
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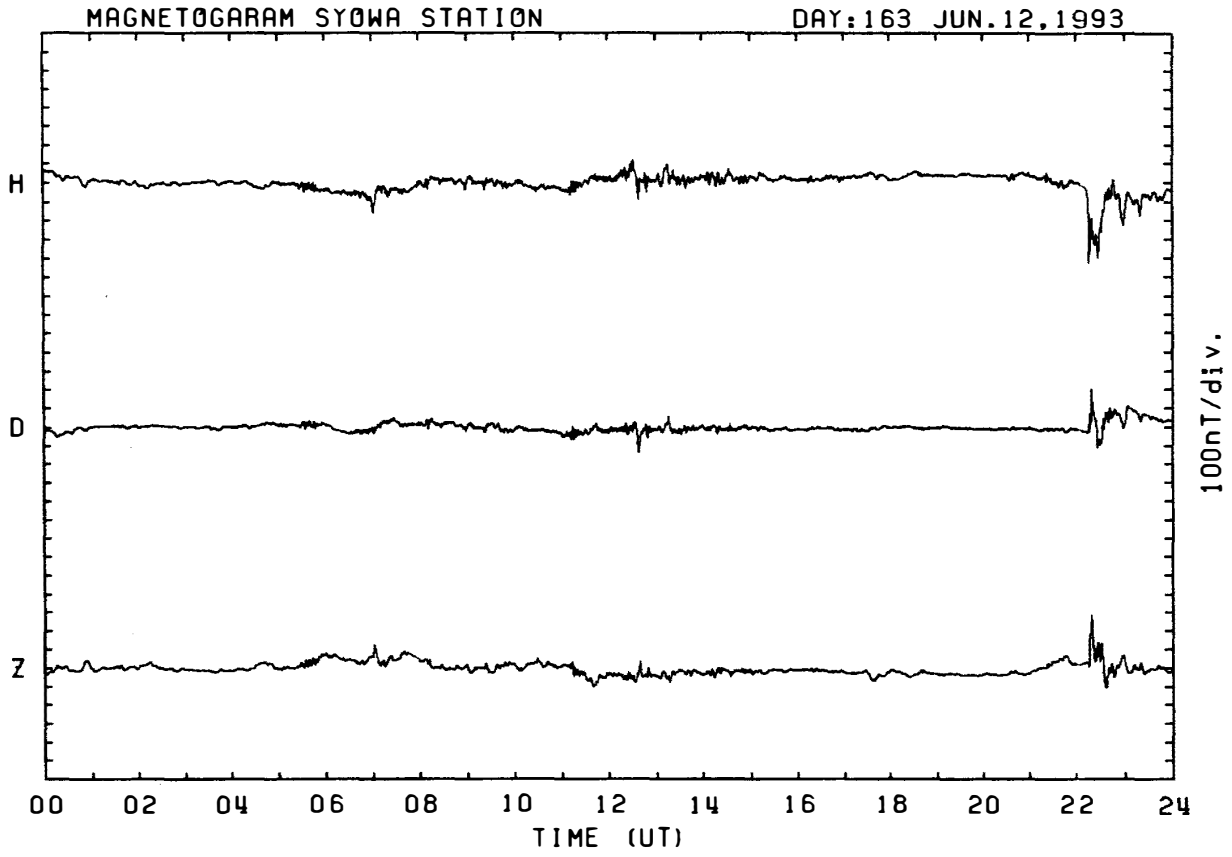
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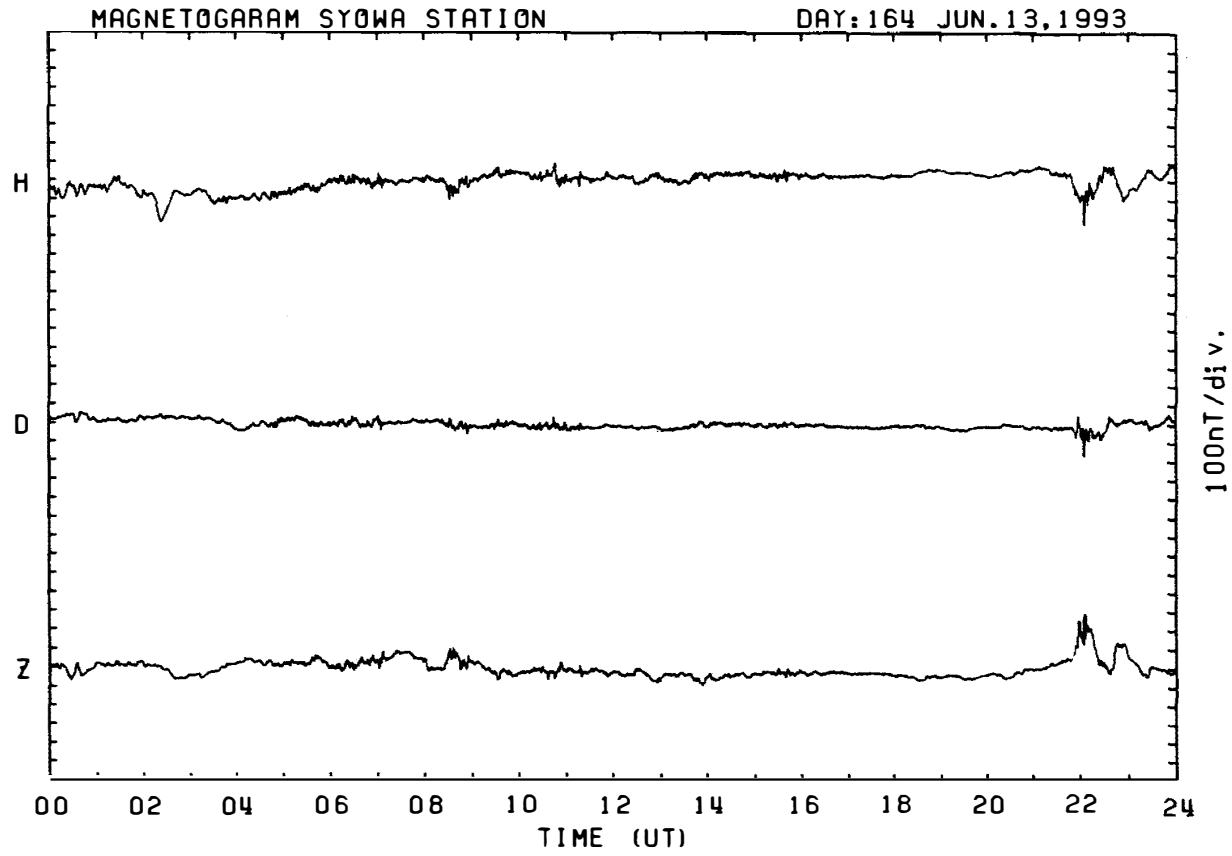
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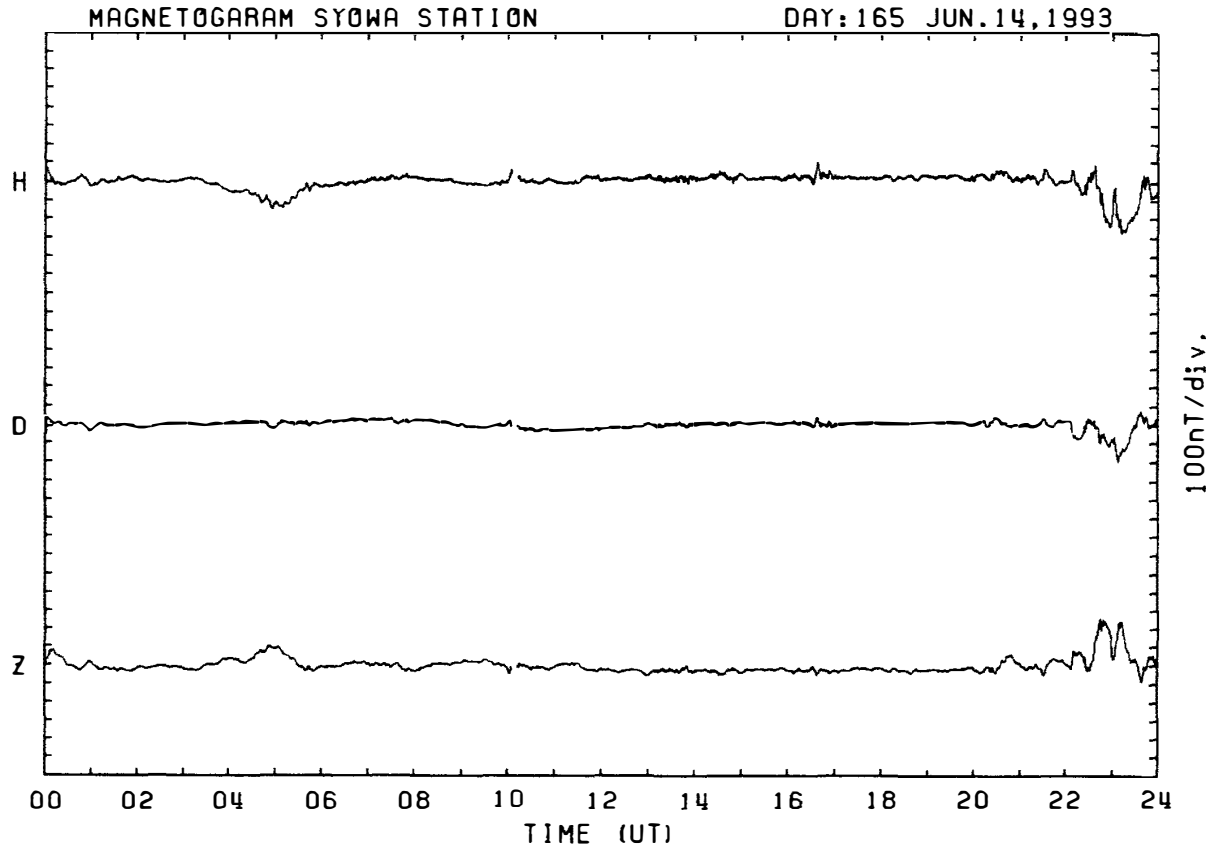
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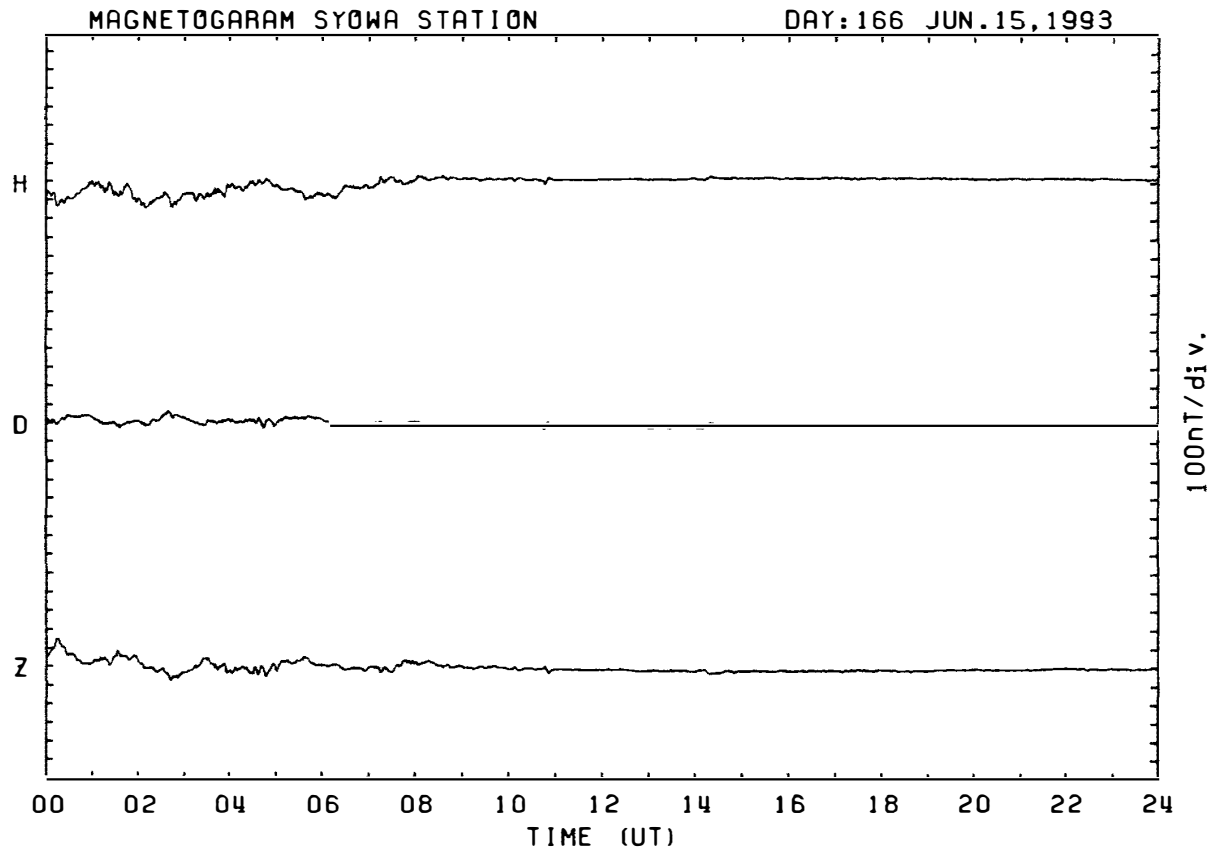
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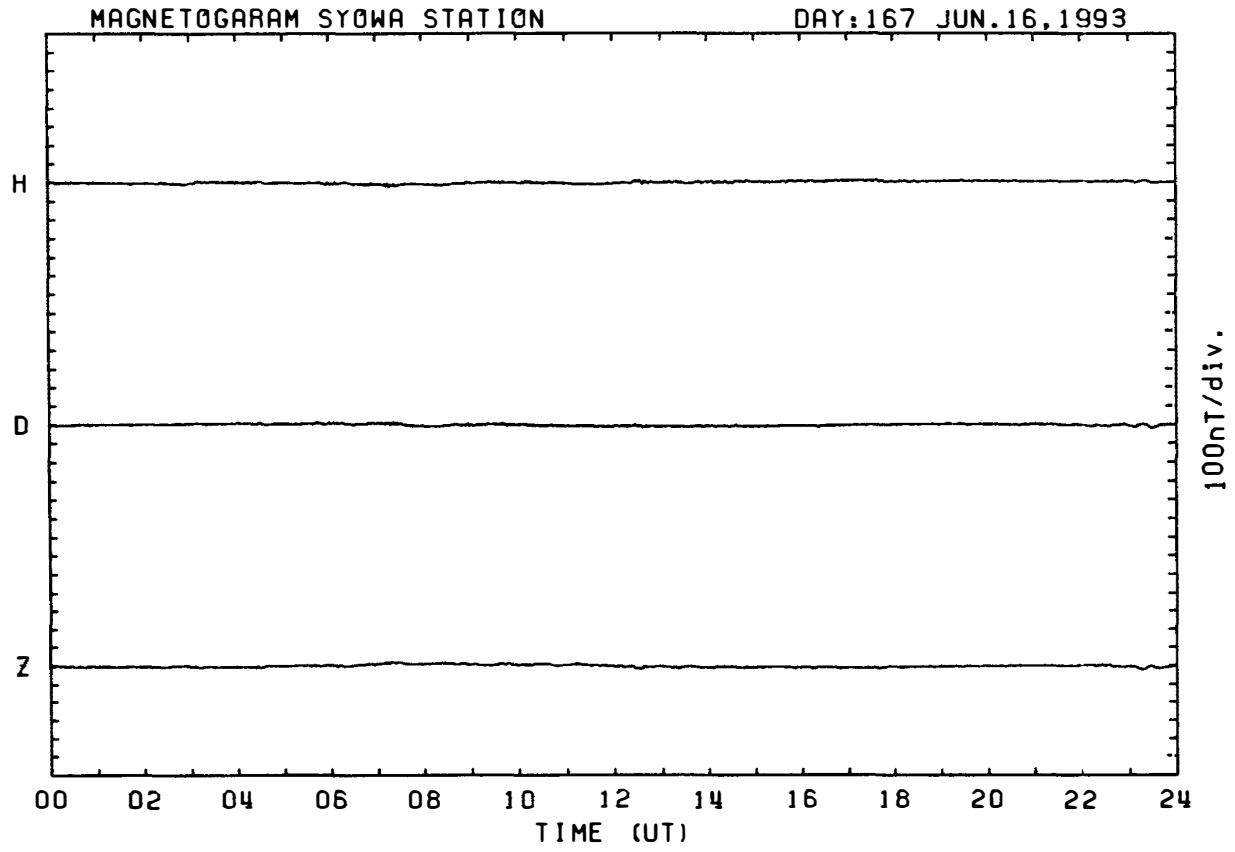
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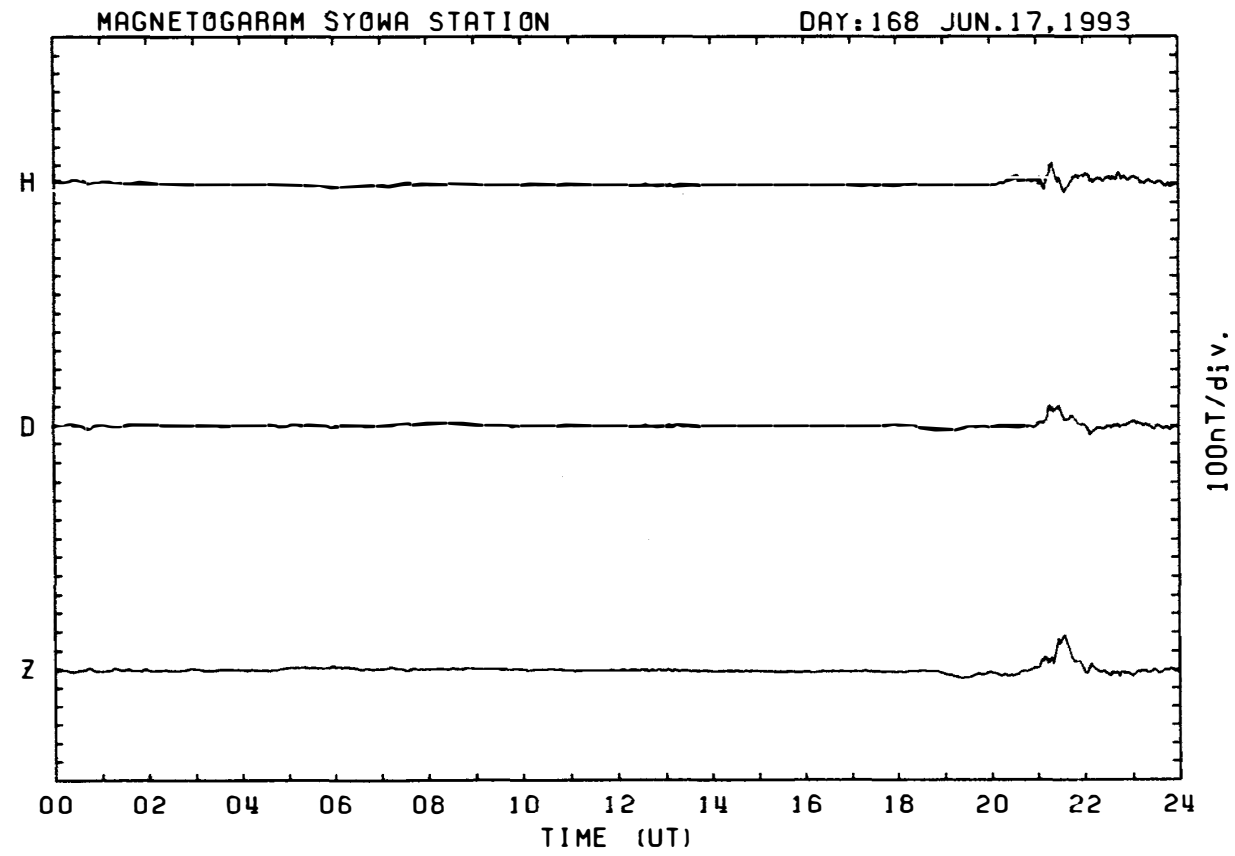
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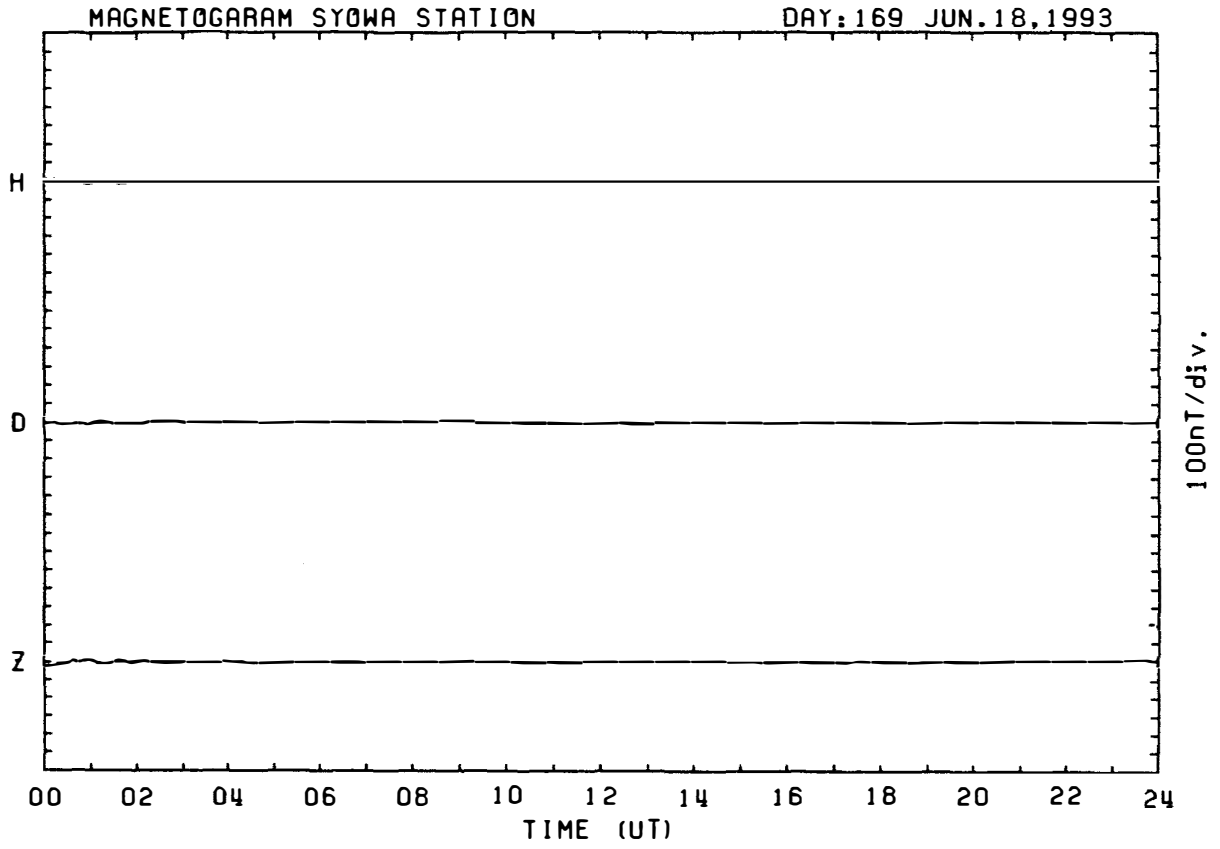
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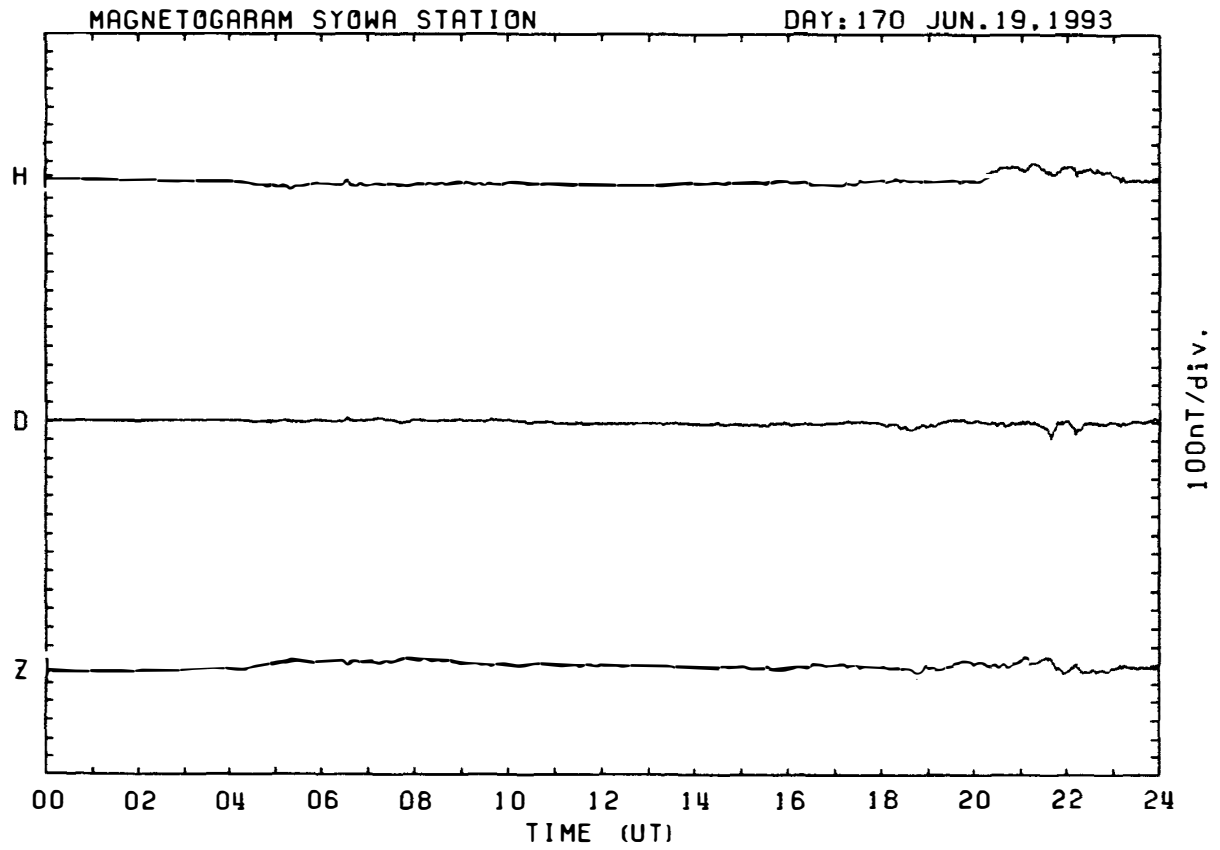
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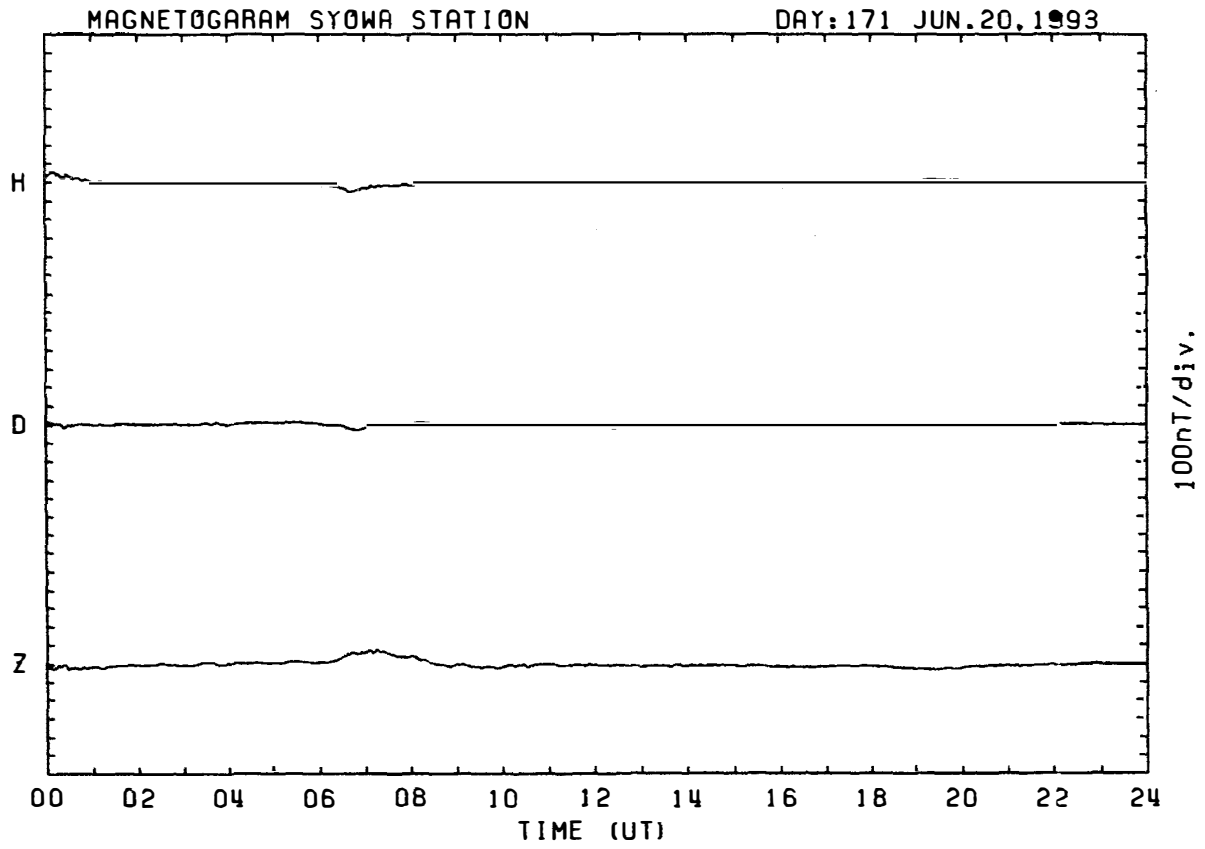
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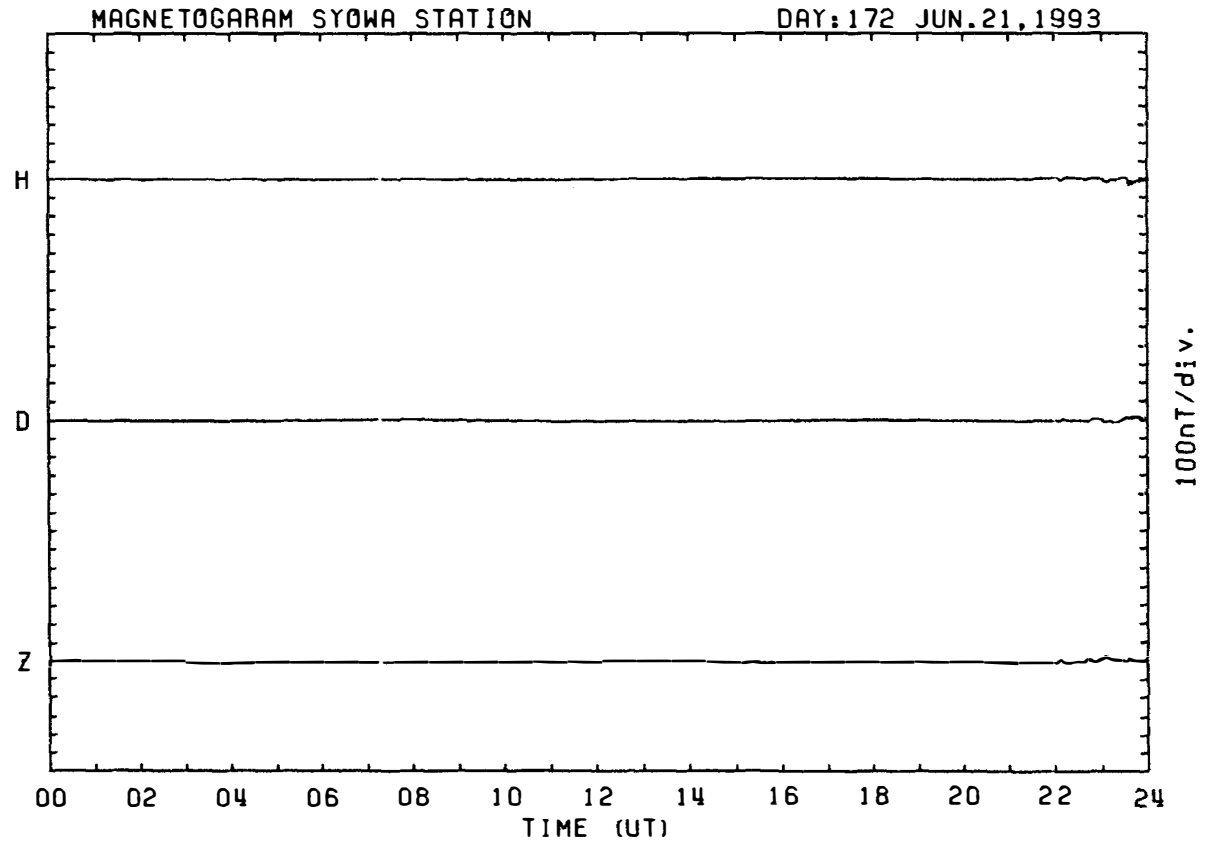
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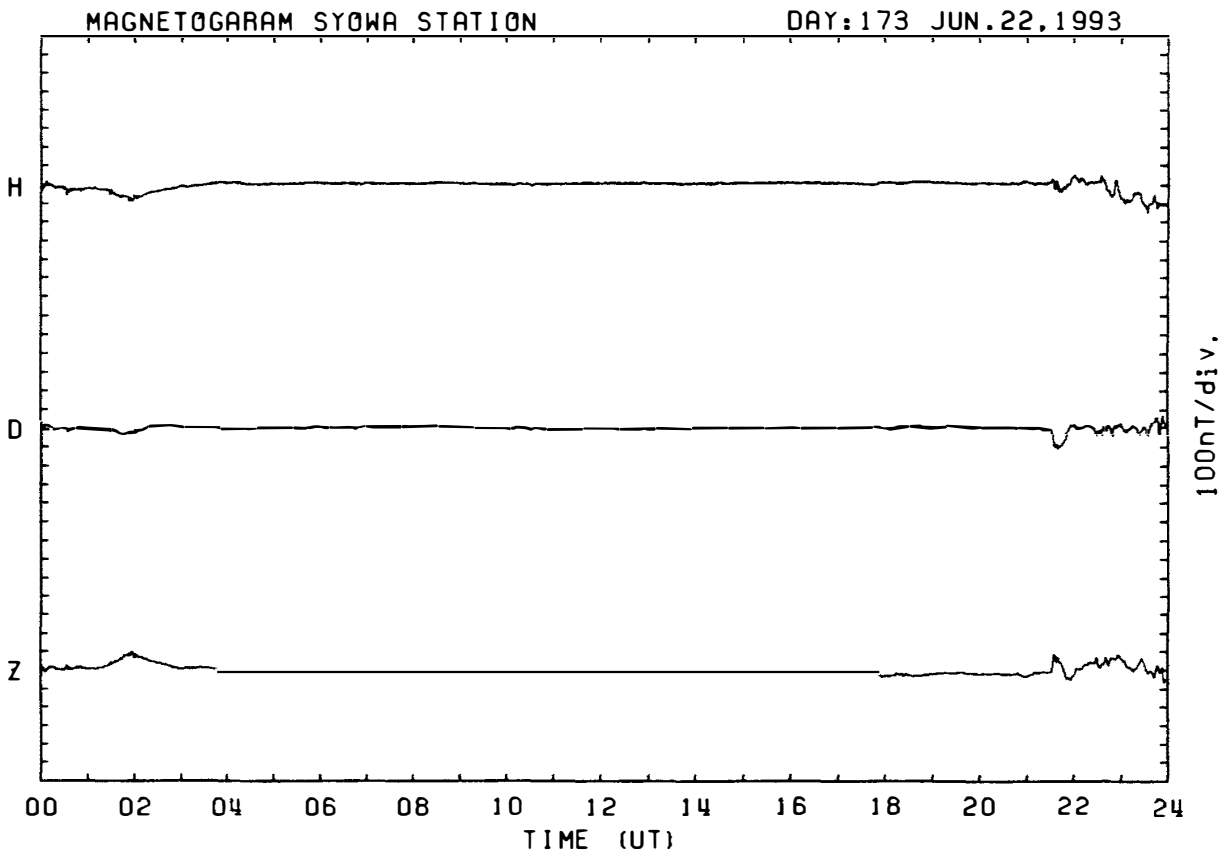
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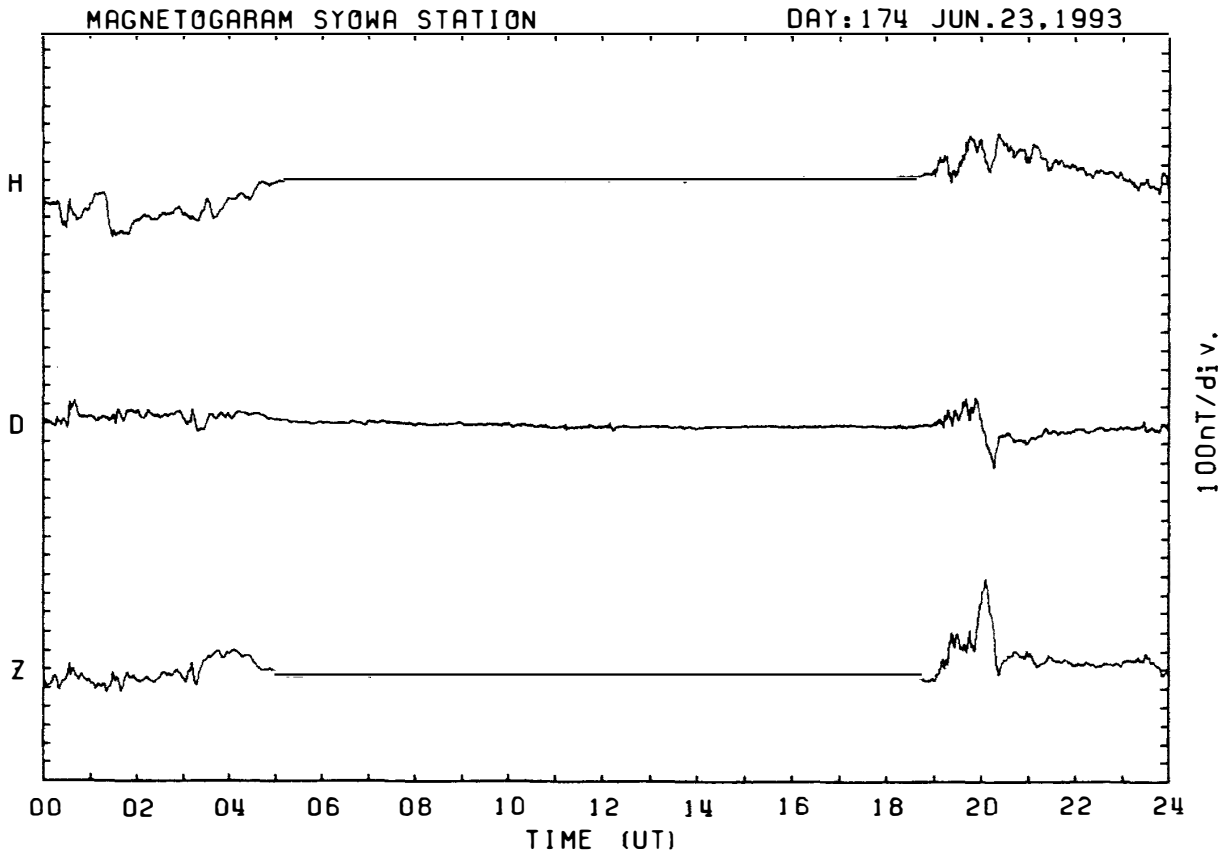
TIME (UT)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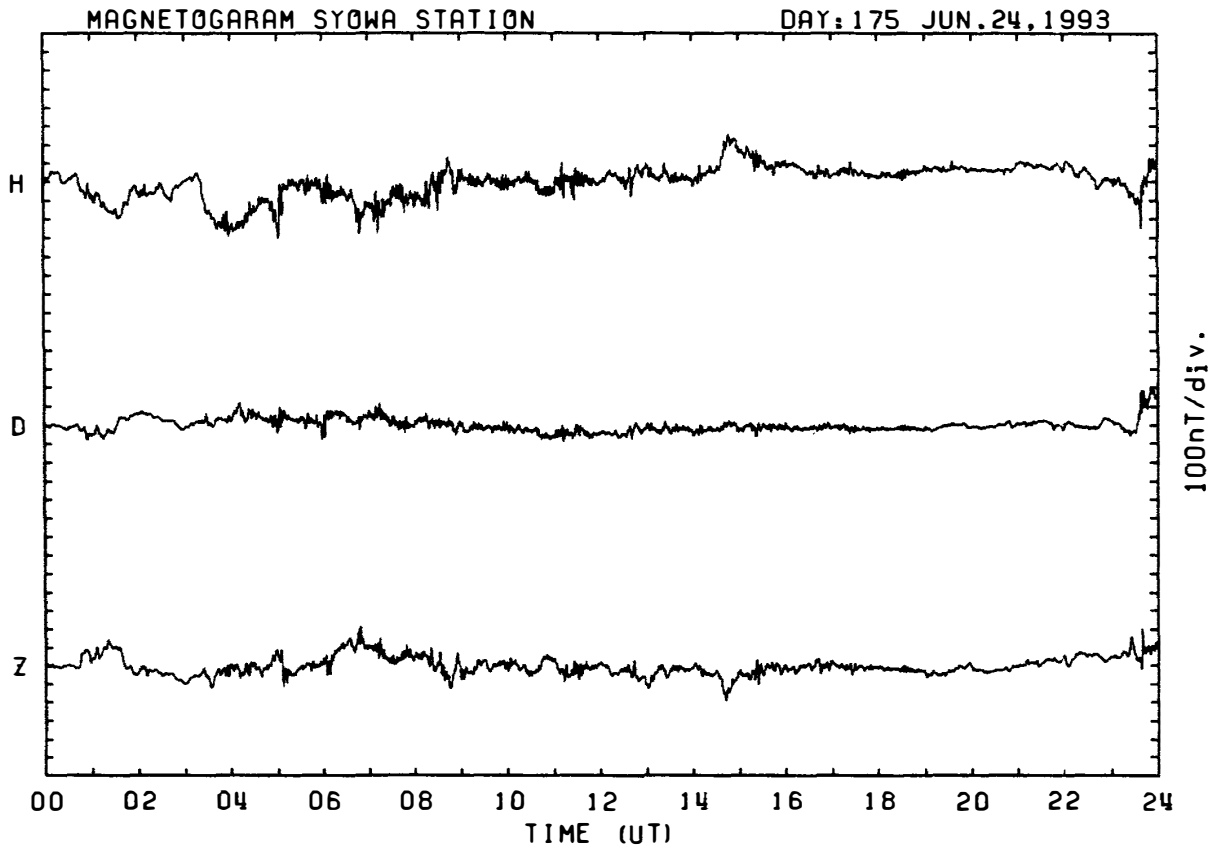
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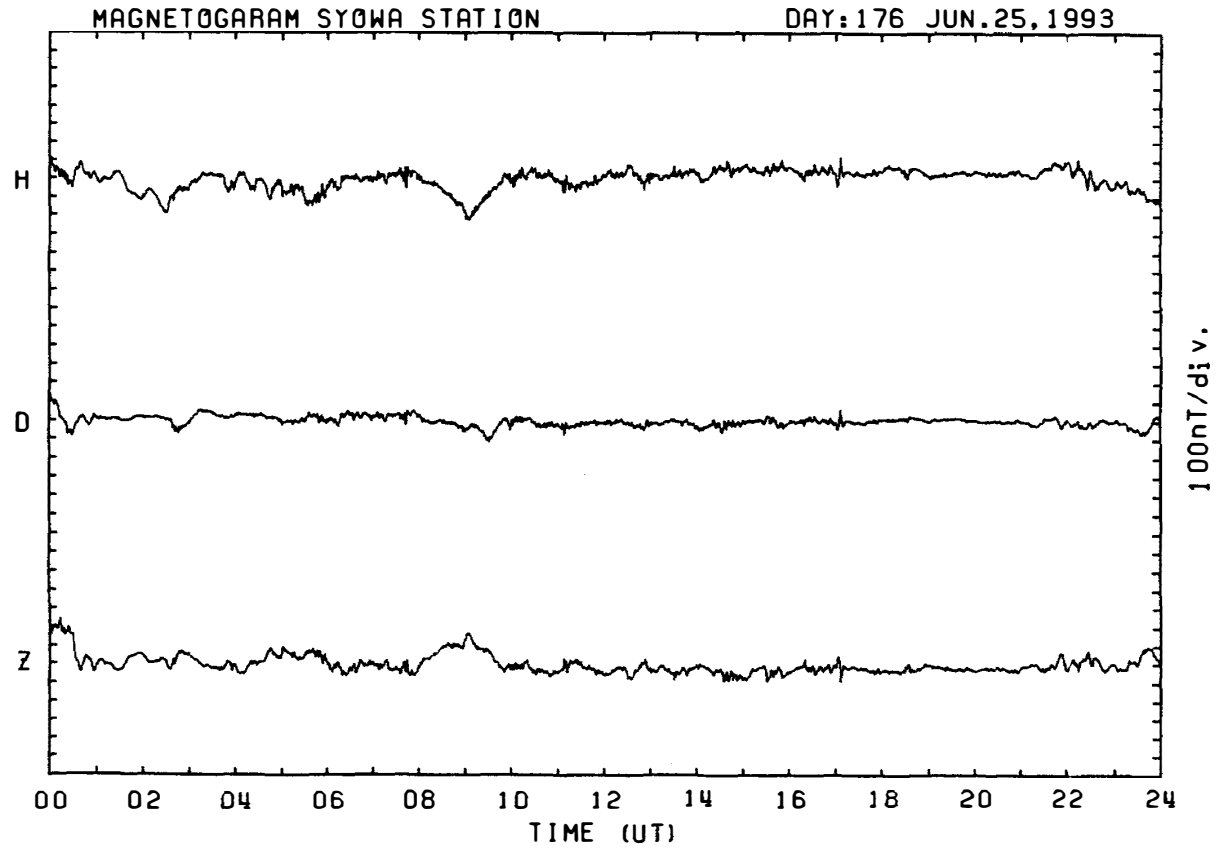
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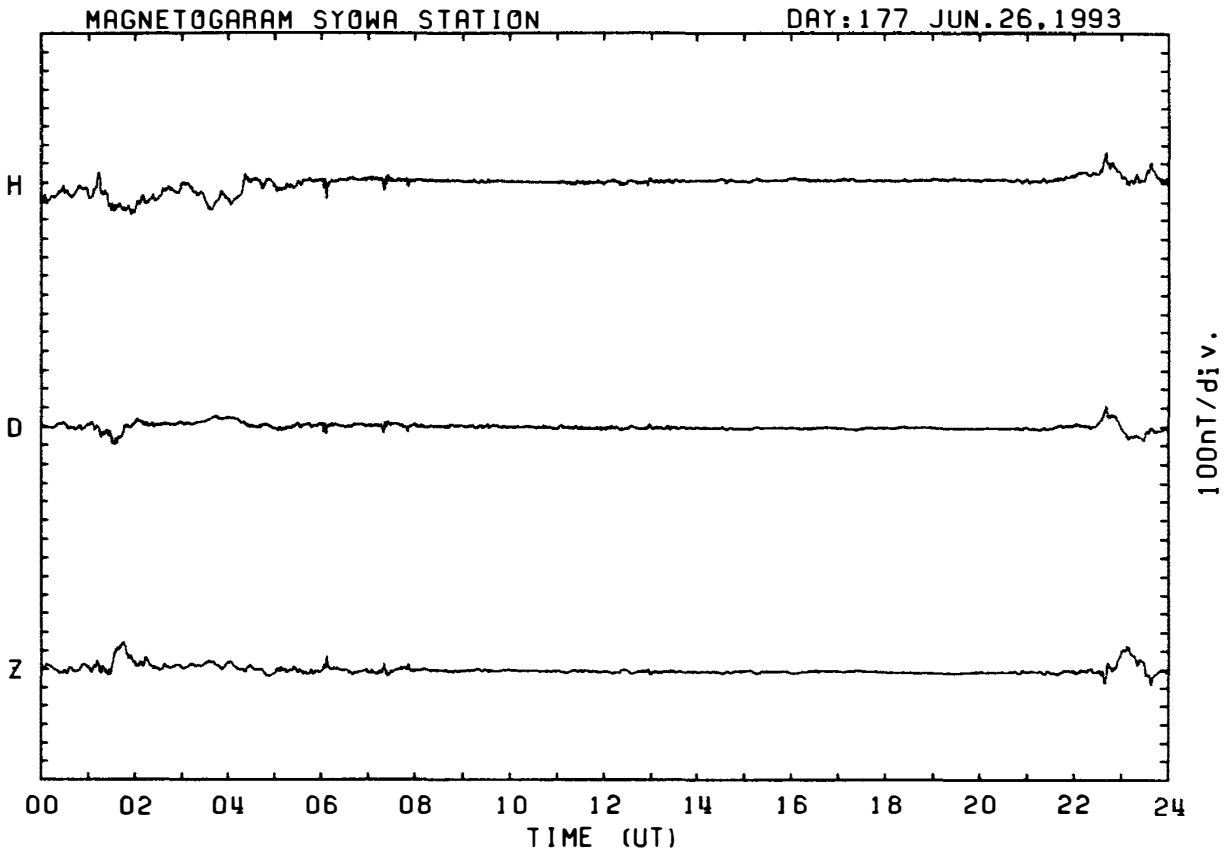
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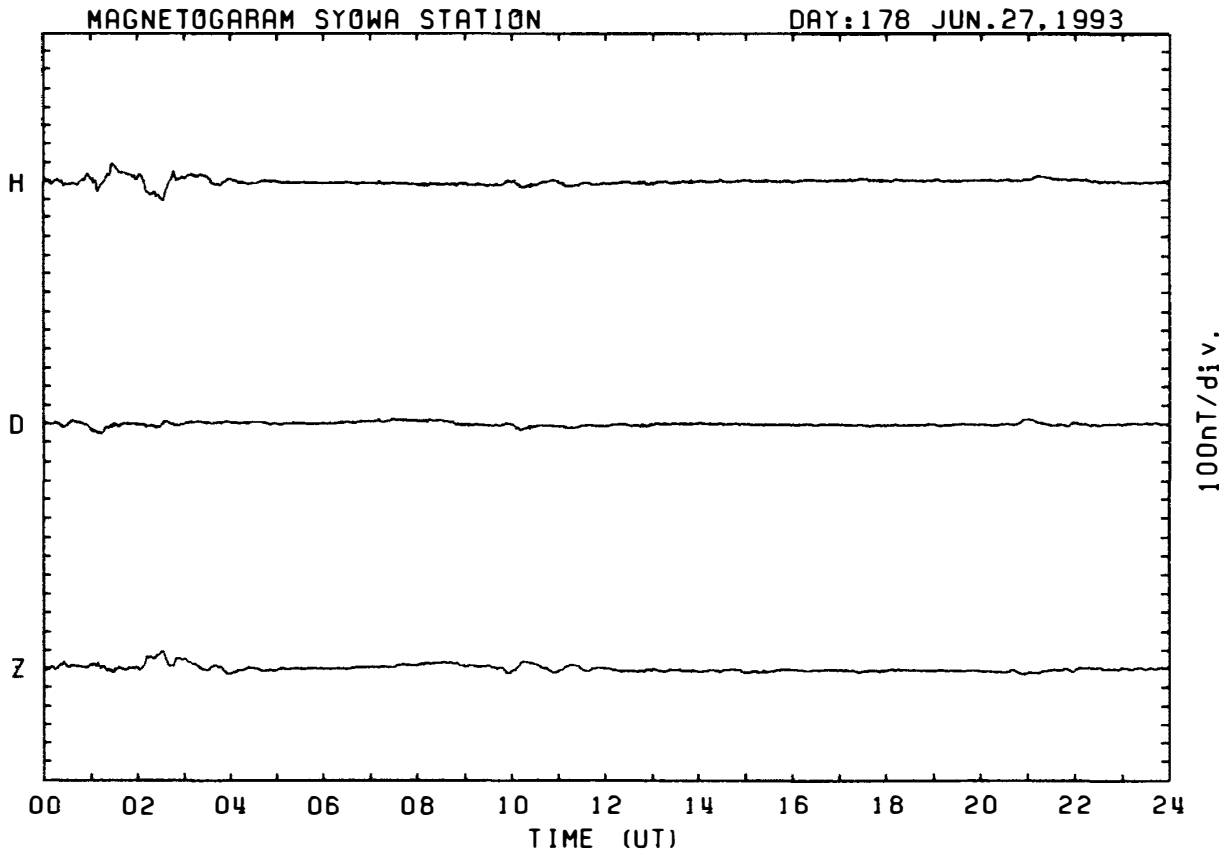
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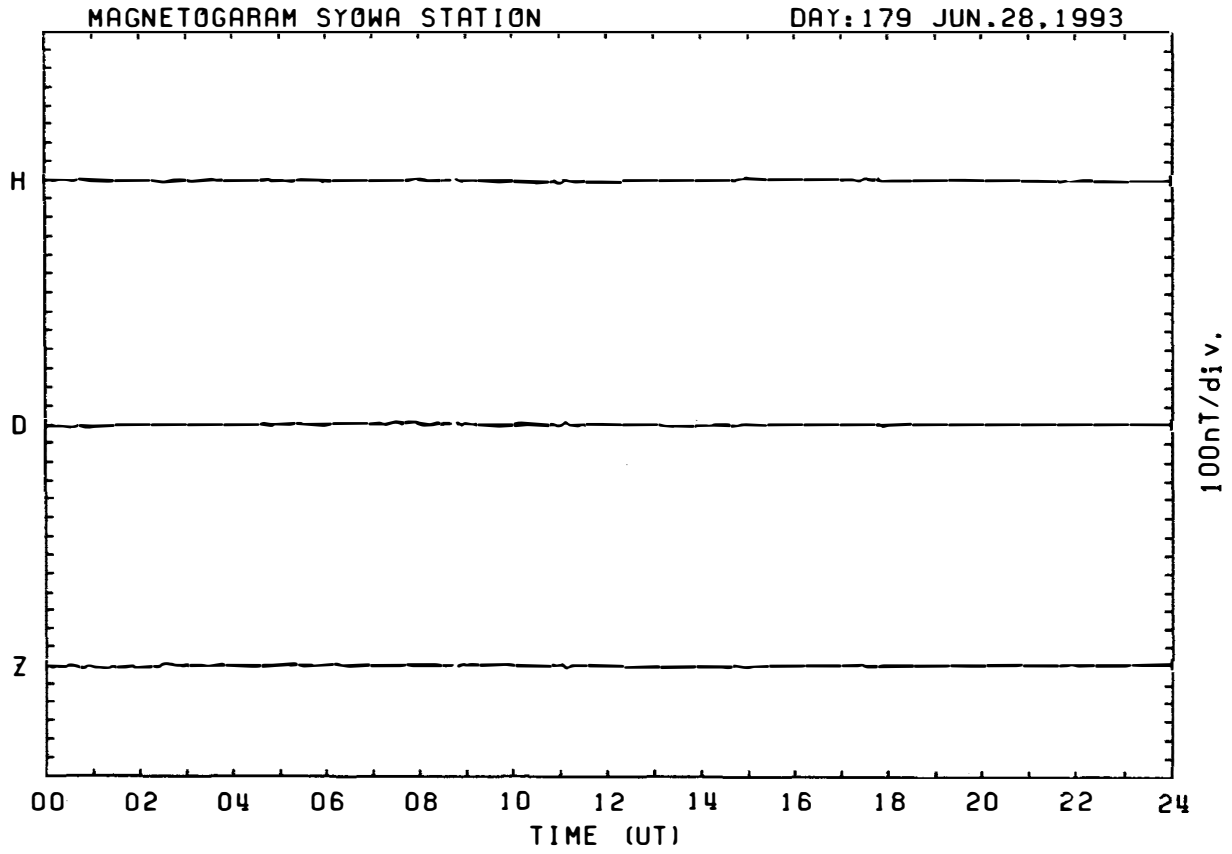
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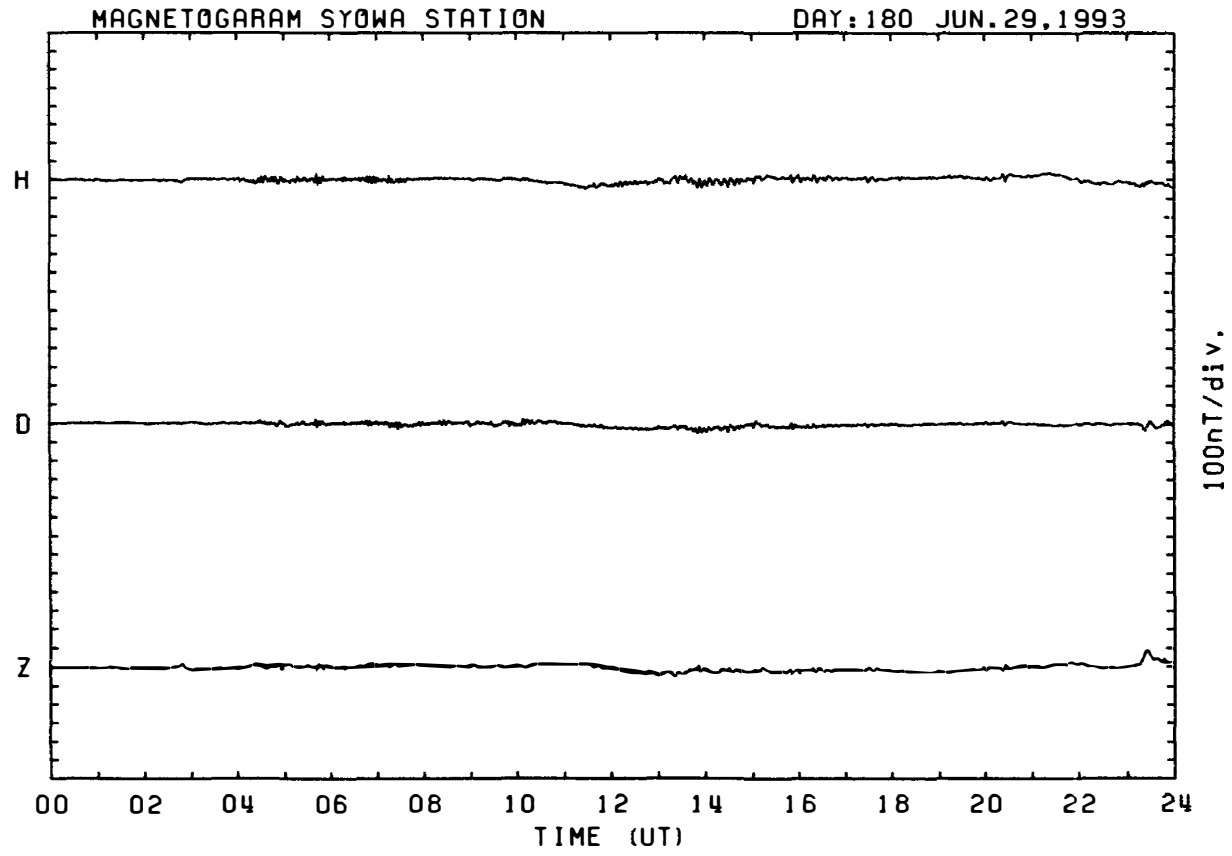
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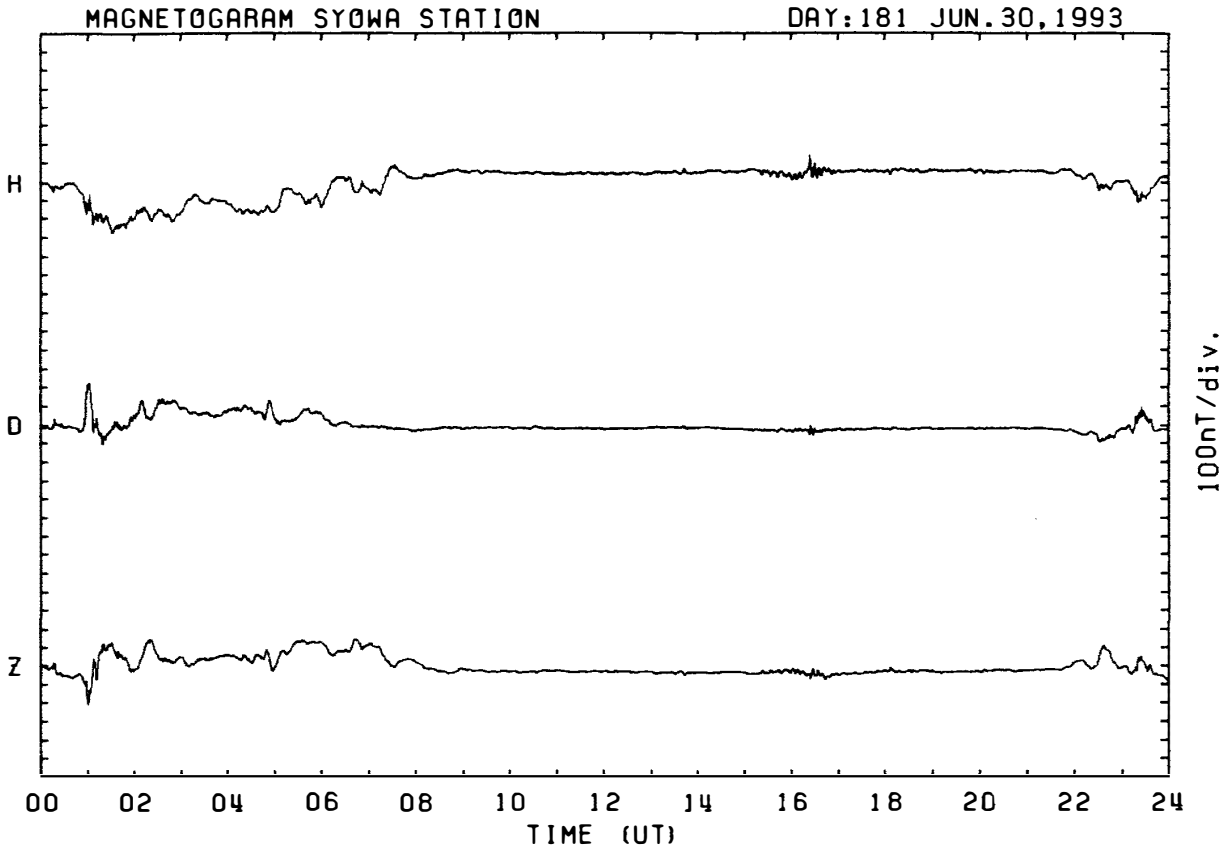
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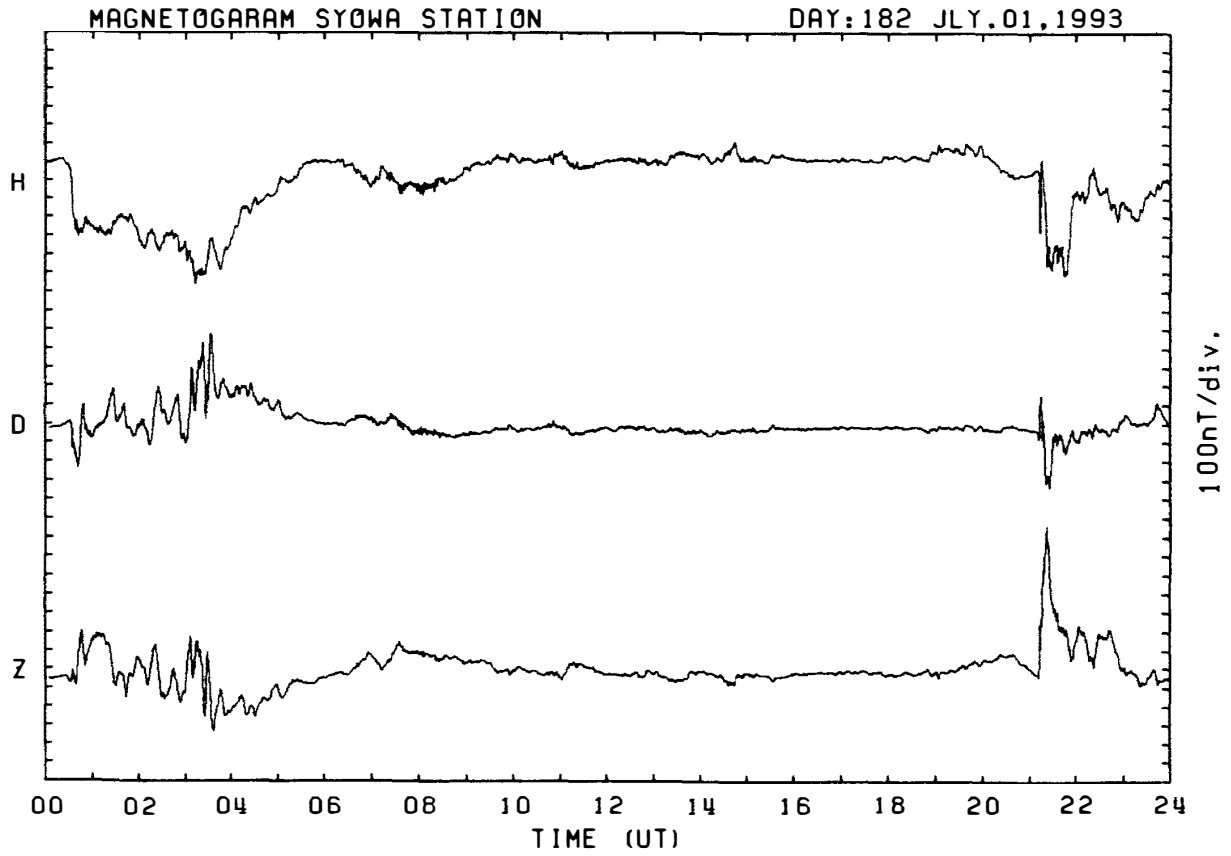
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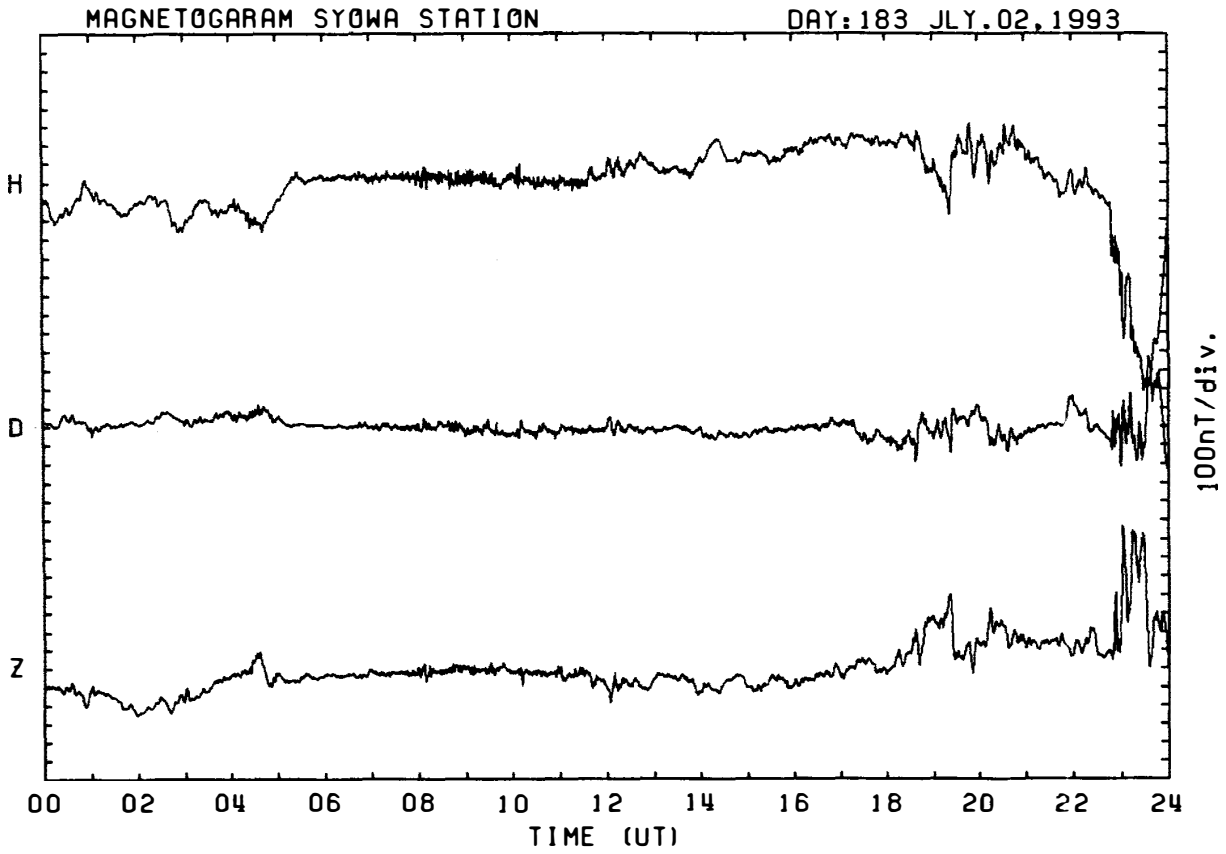
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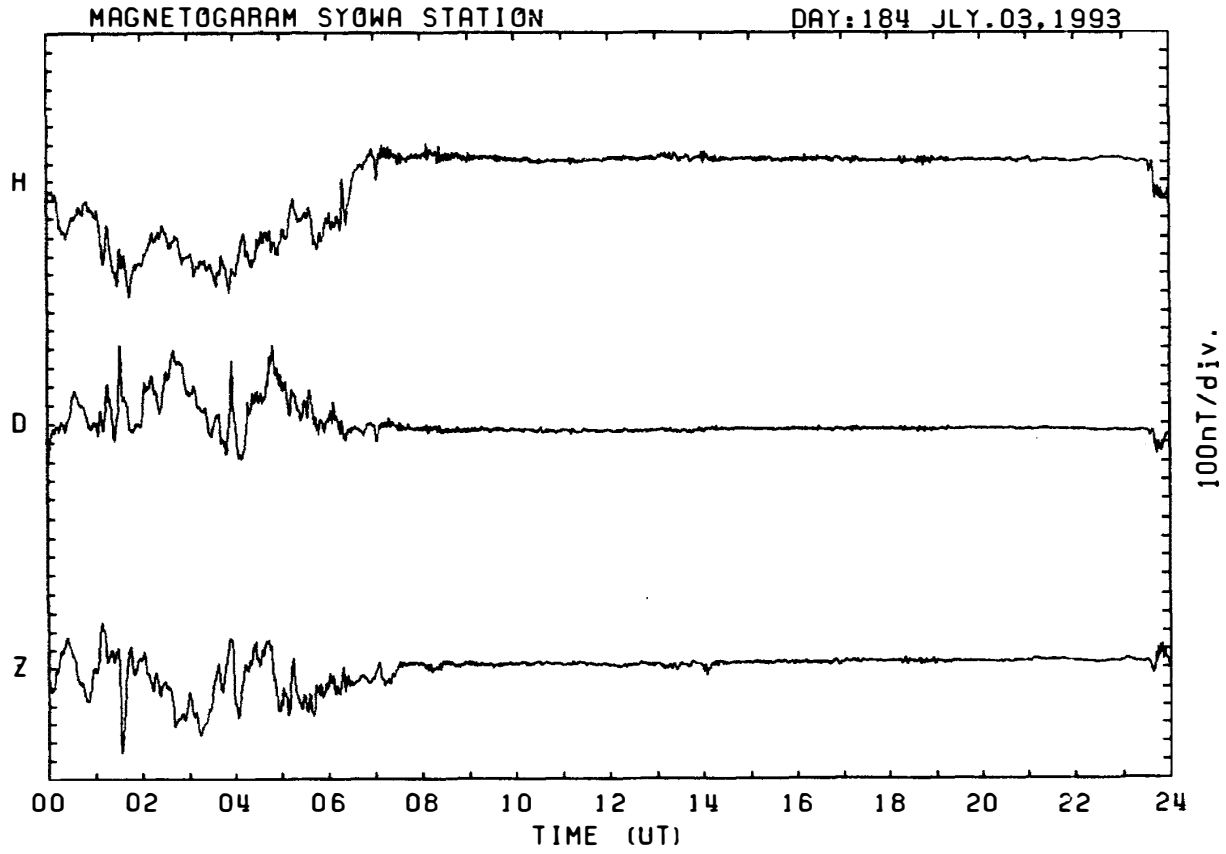
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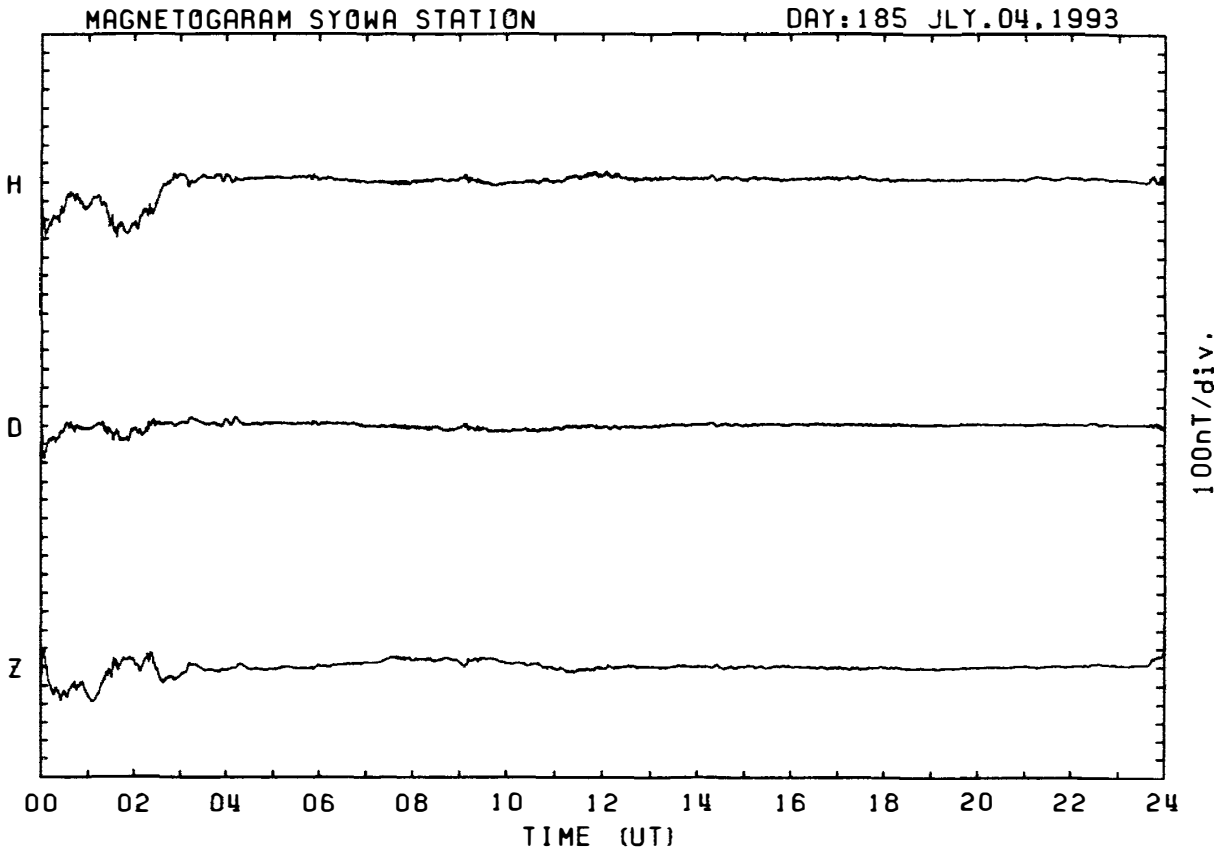
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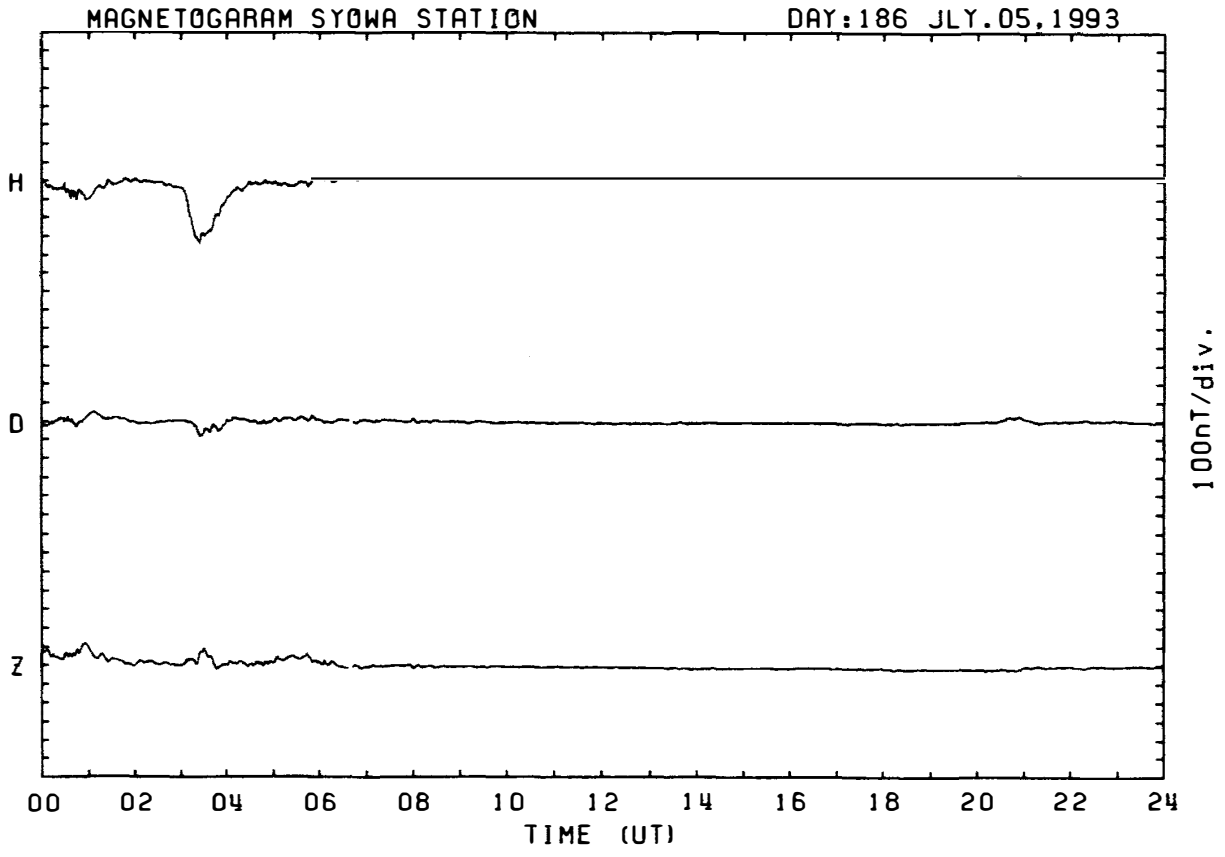
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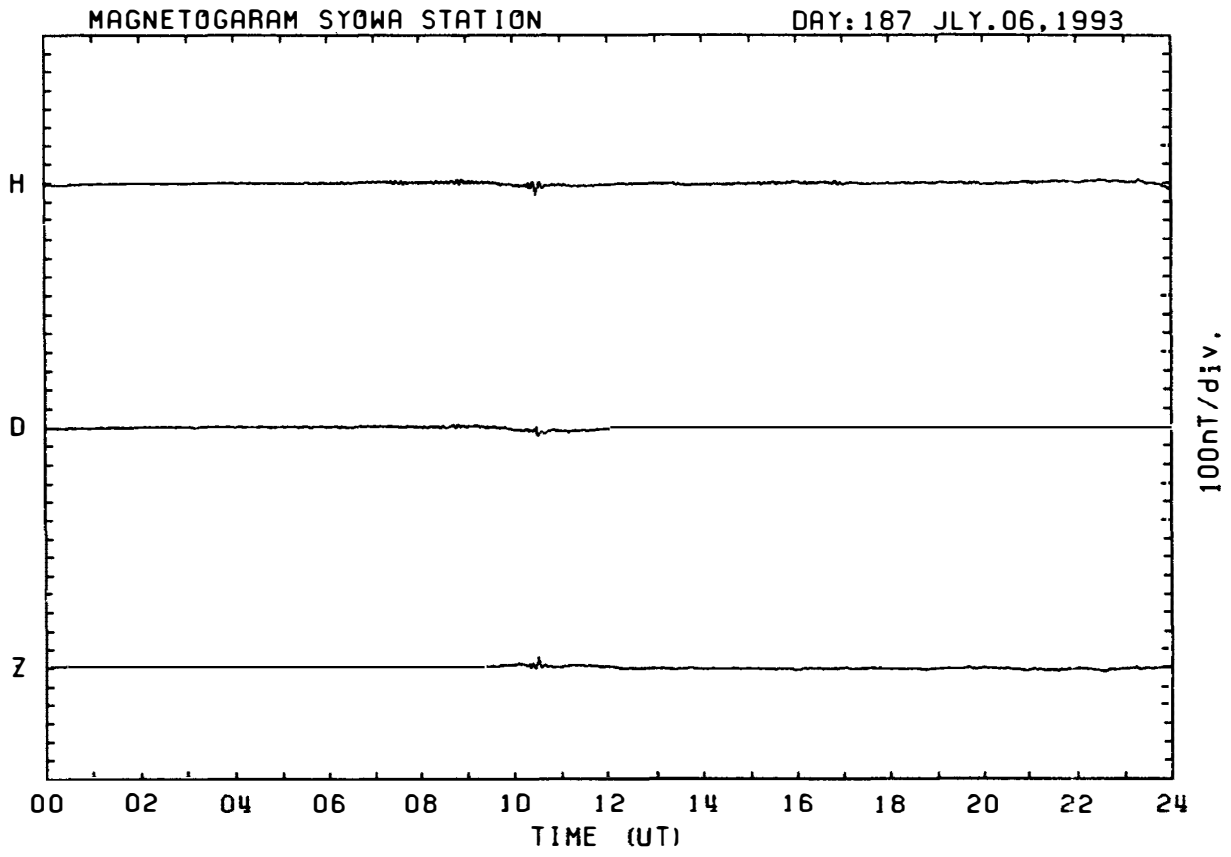
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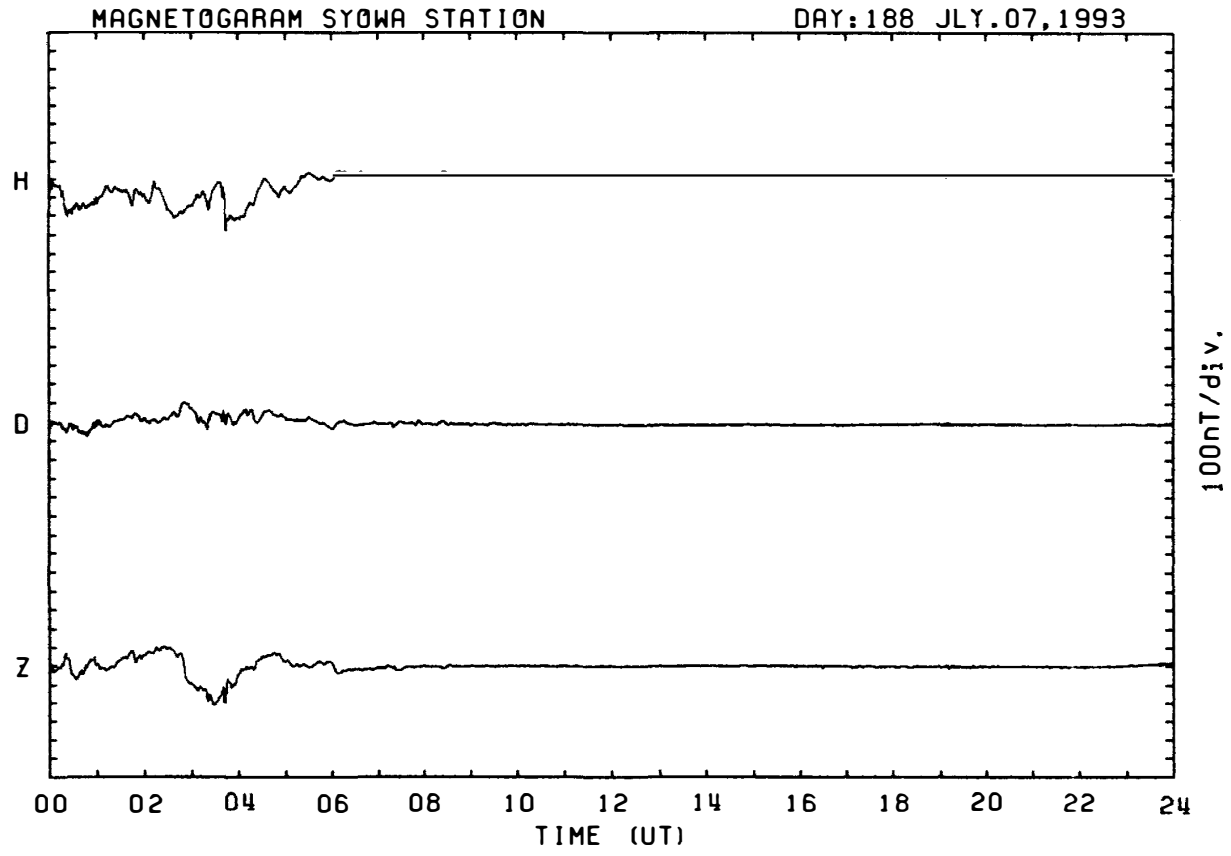
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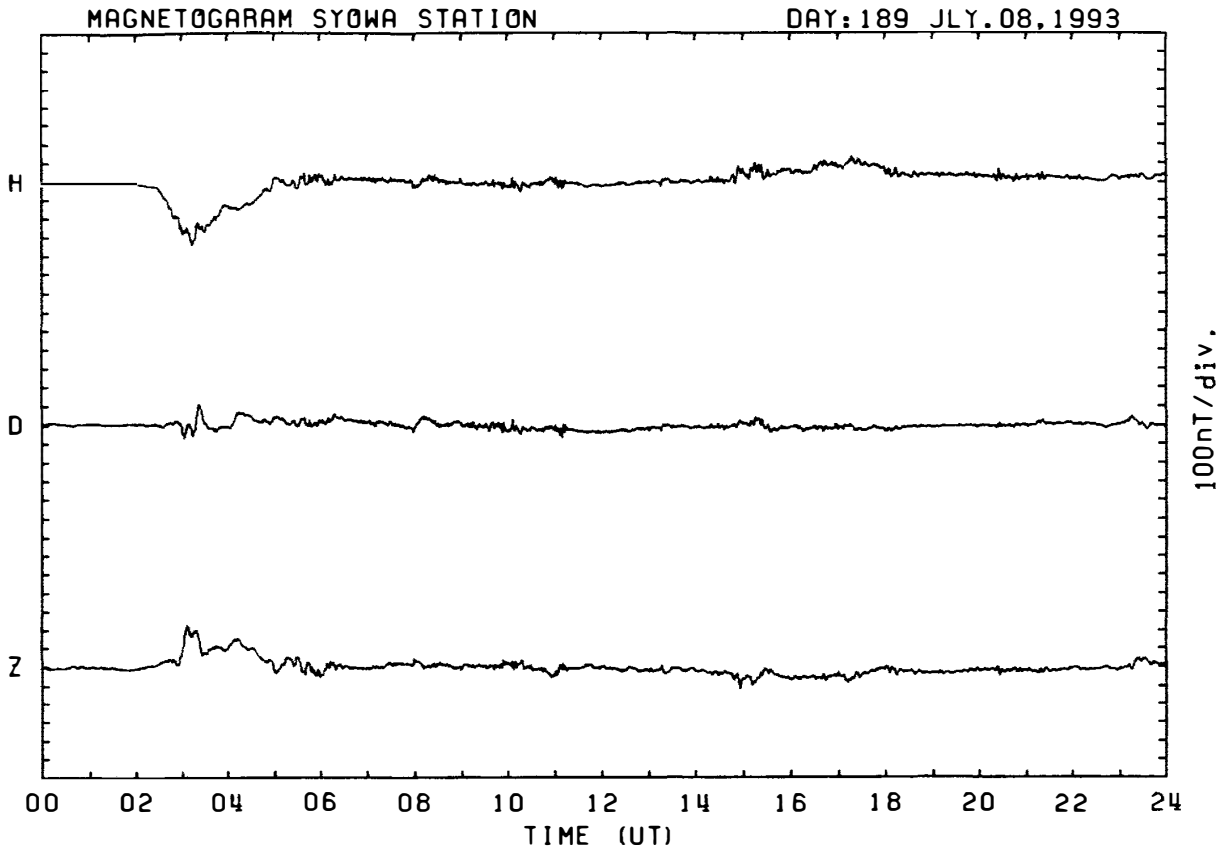
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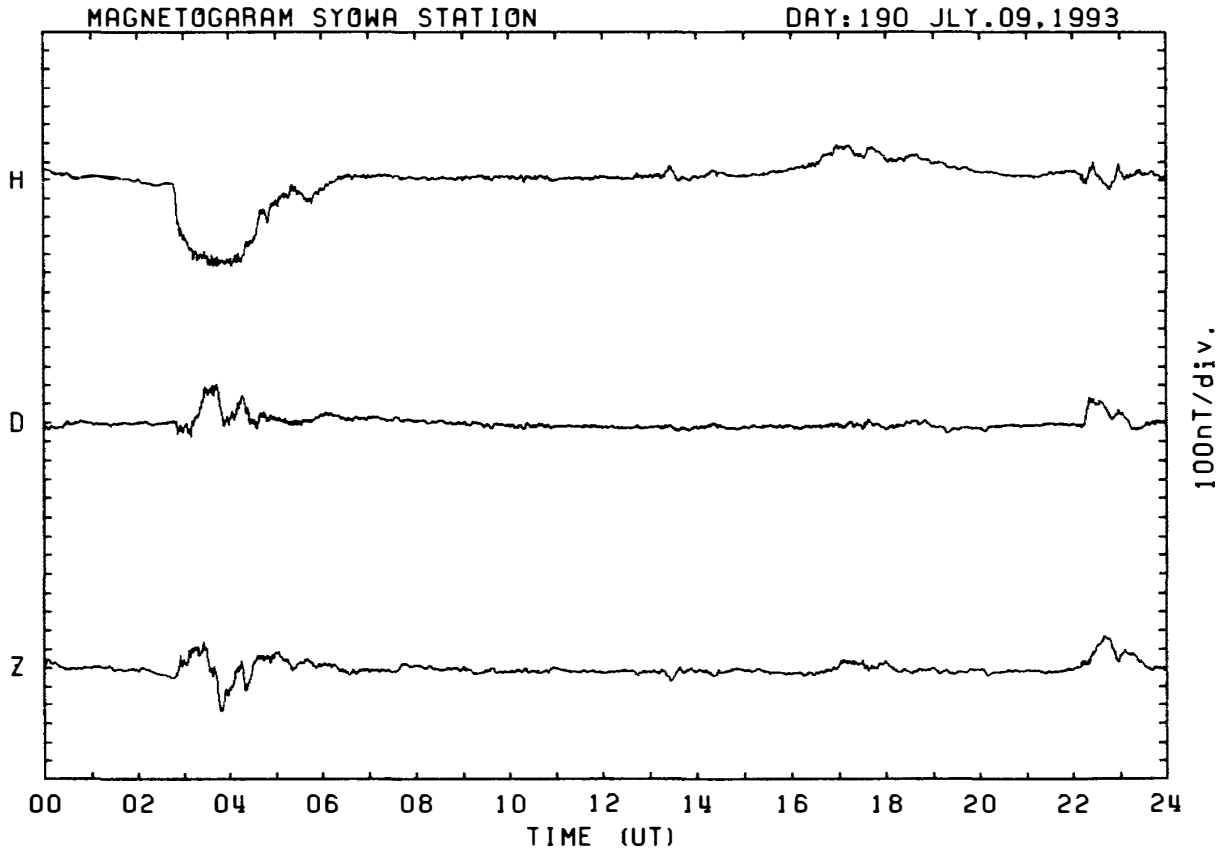
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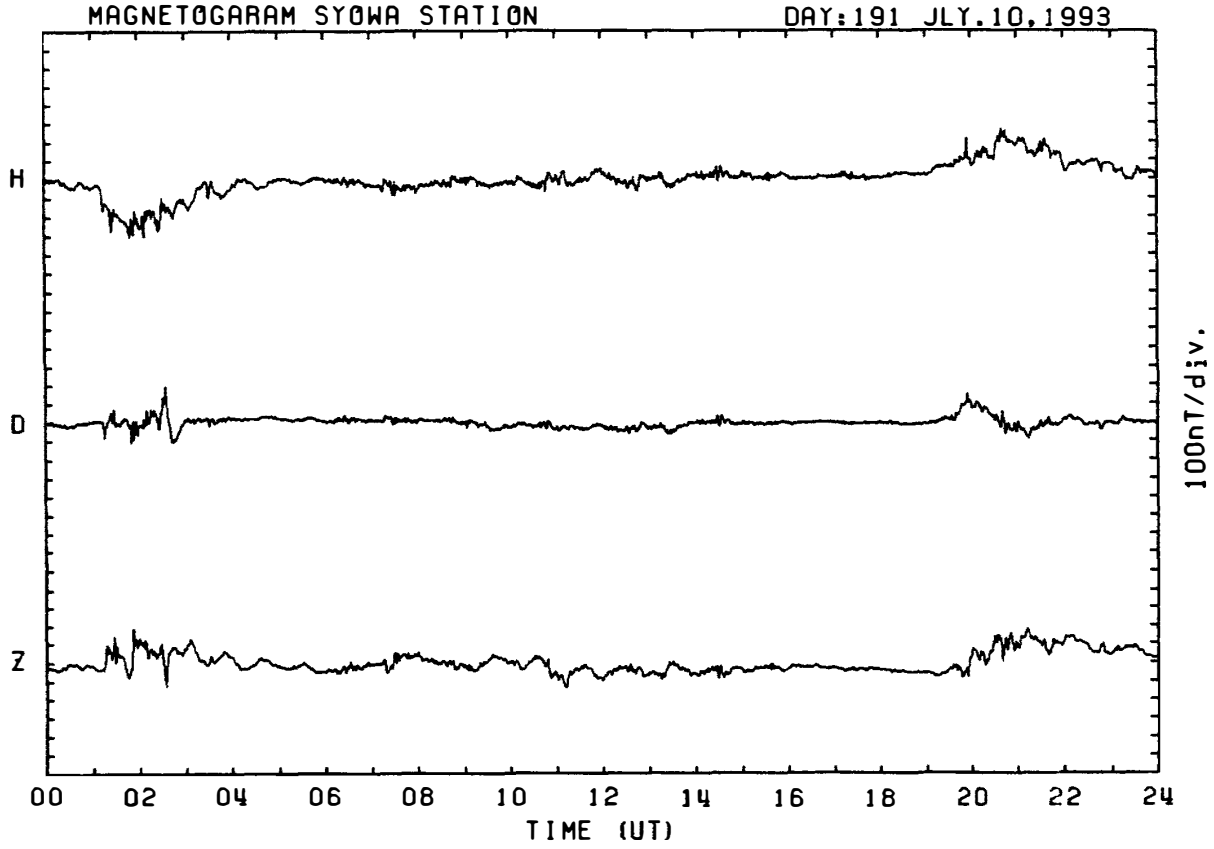
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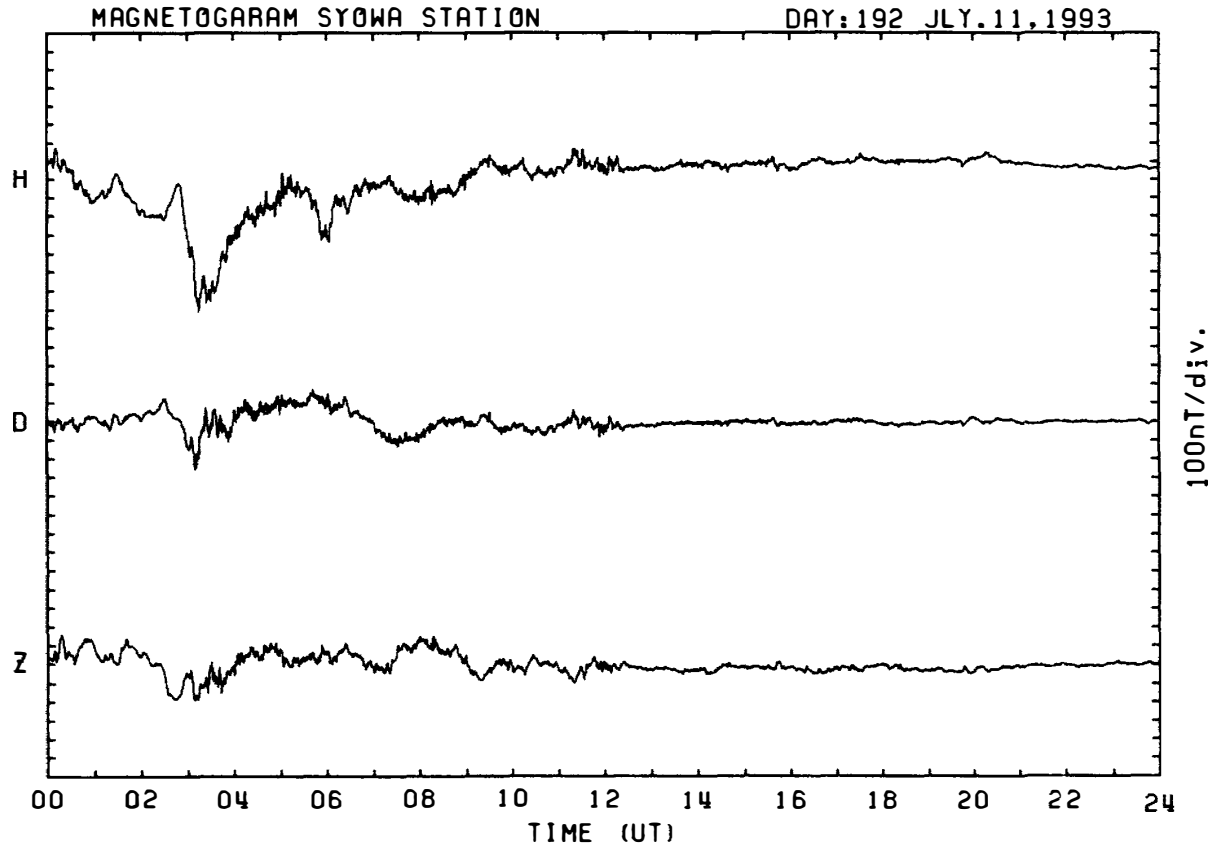
TIME (UT)


MAGNETOGARAM SYOWA STATION
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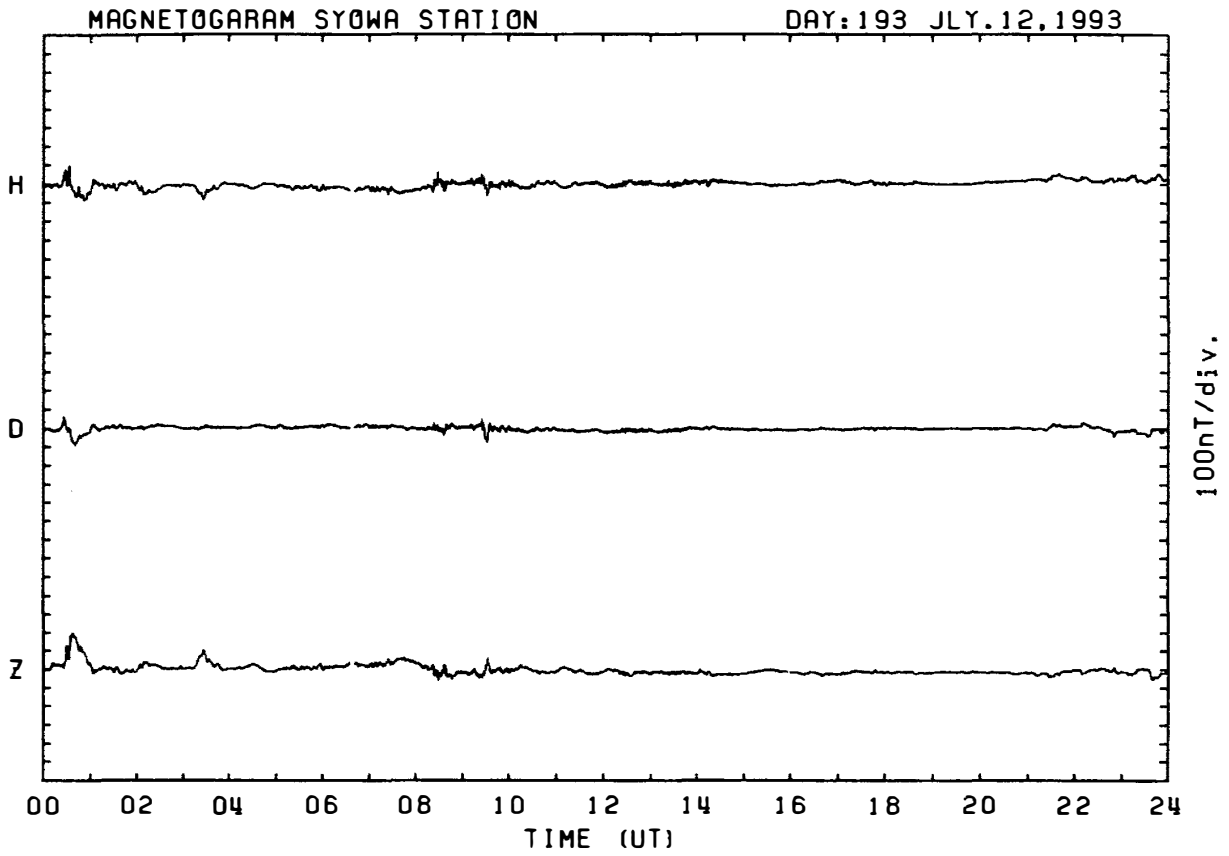
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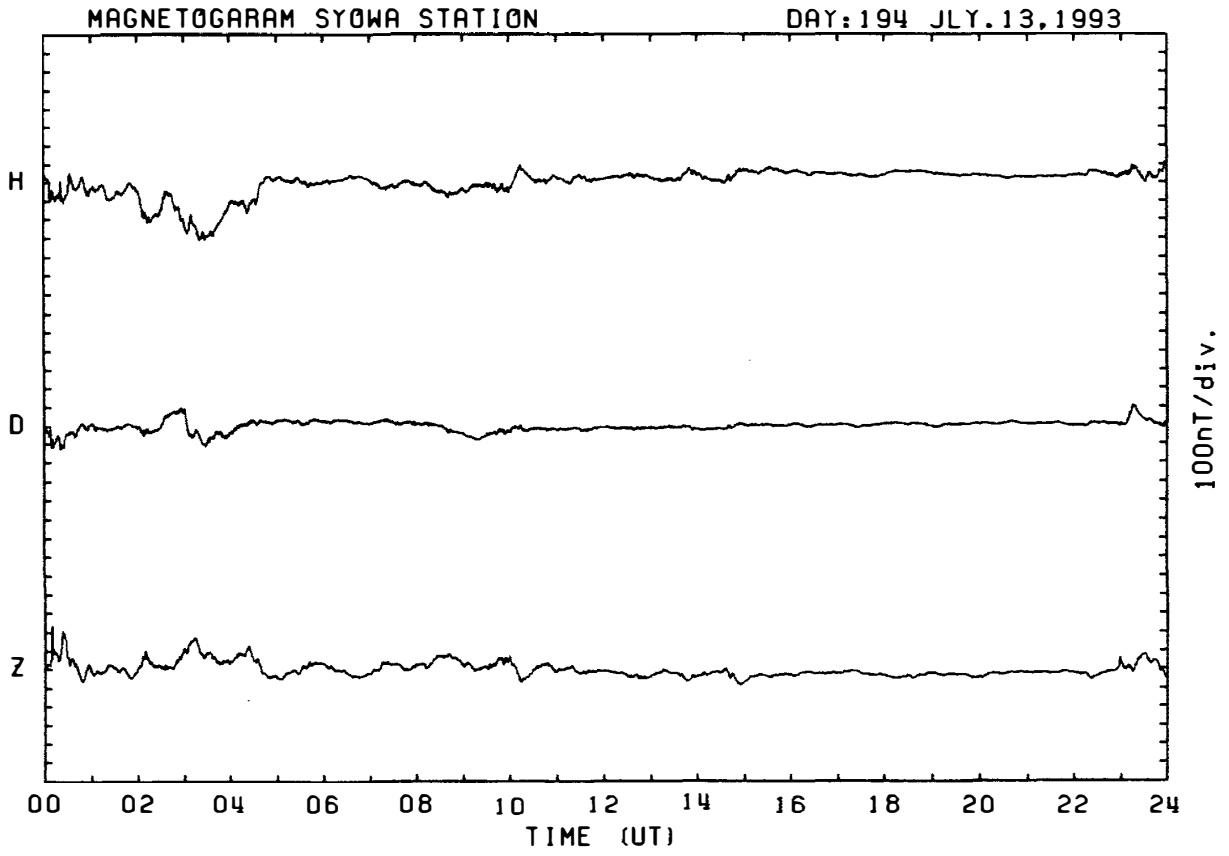
TIME (UT)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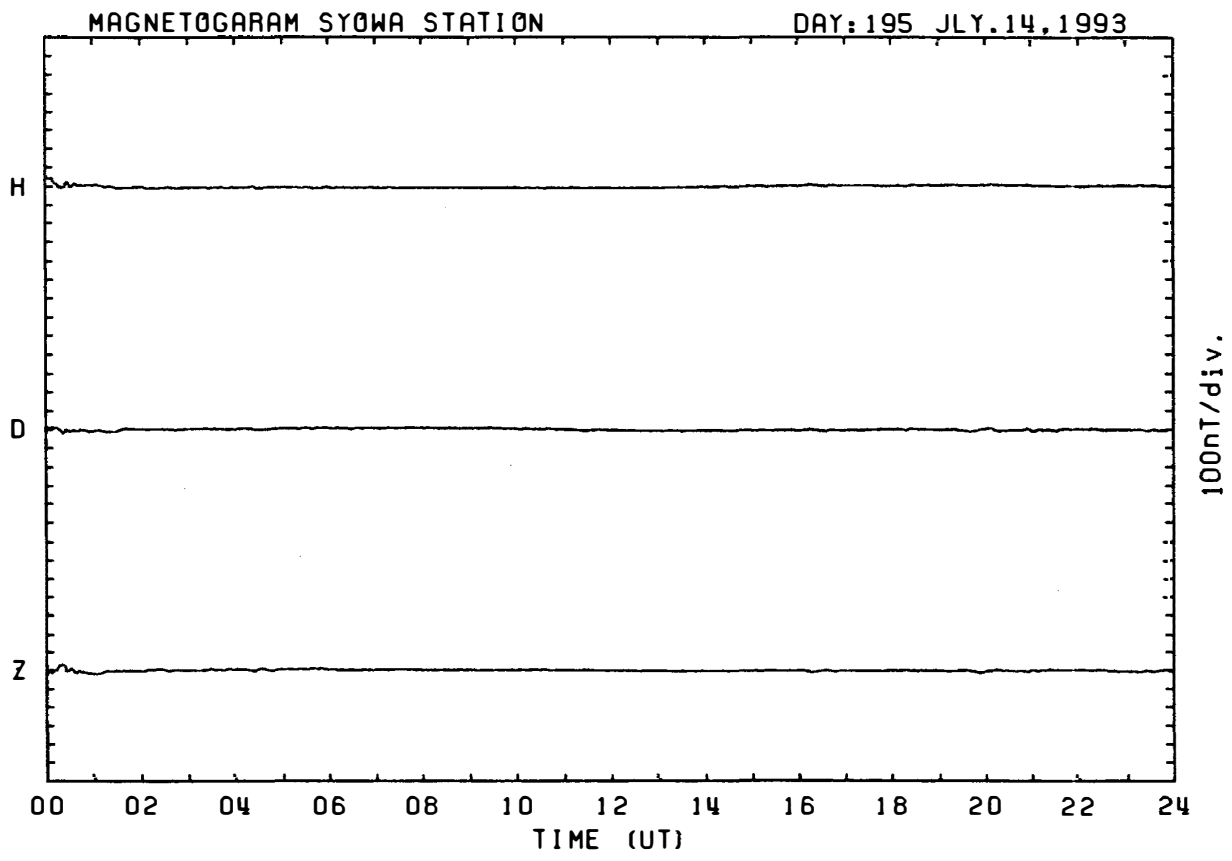
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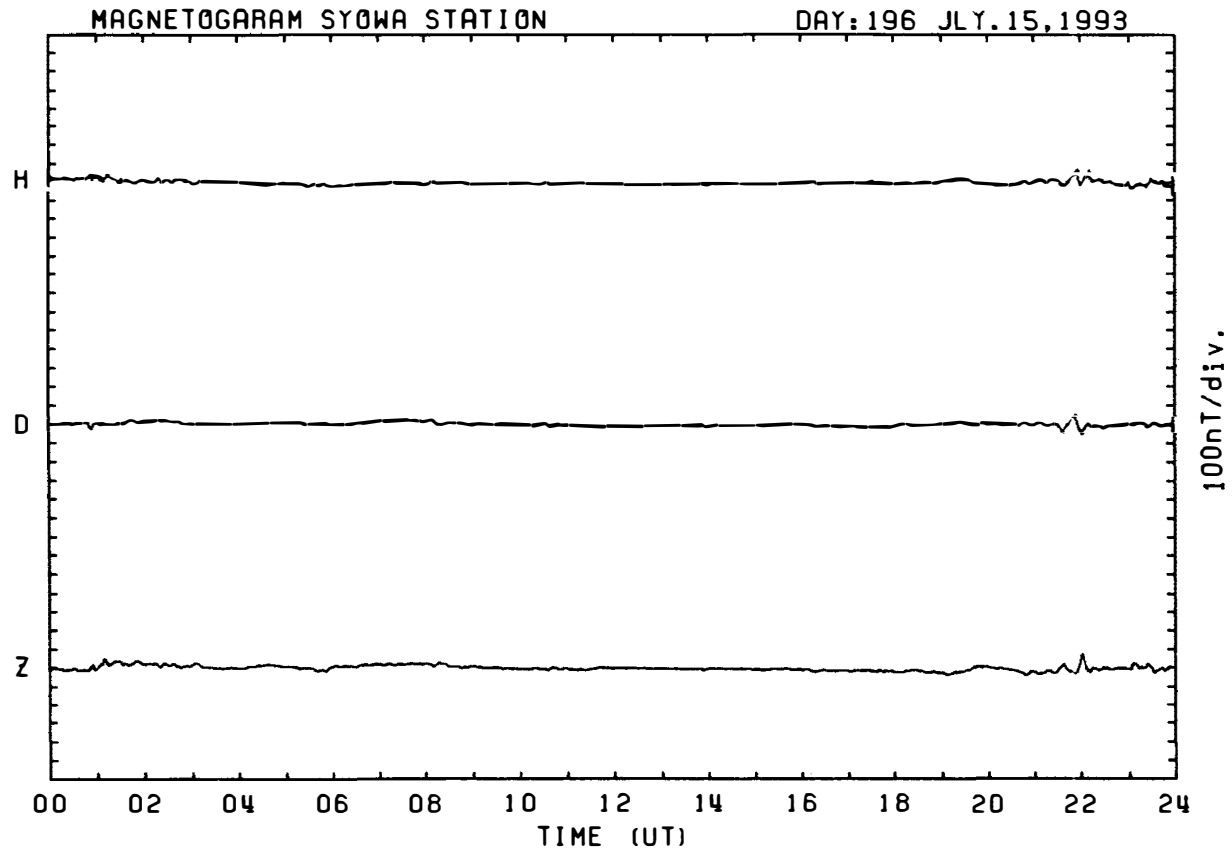
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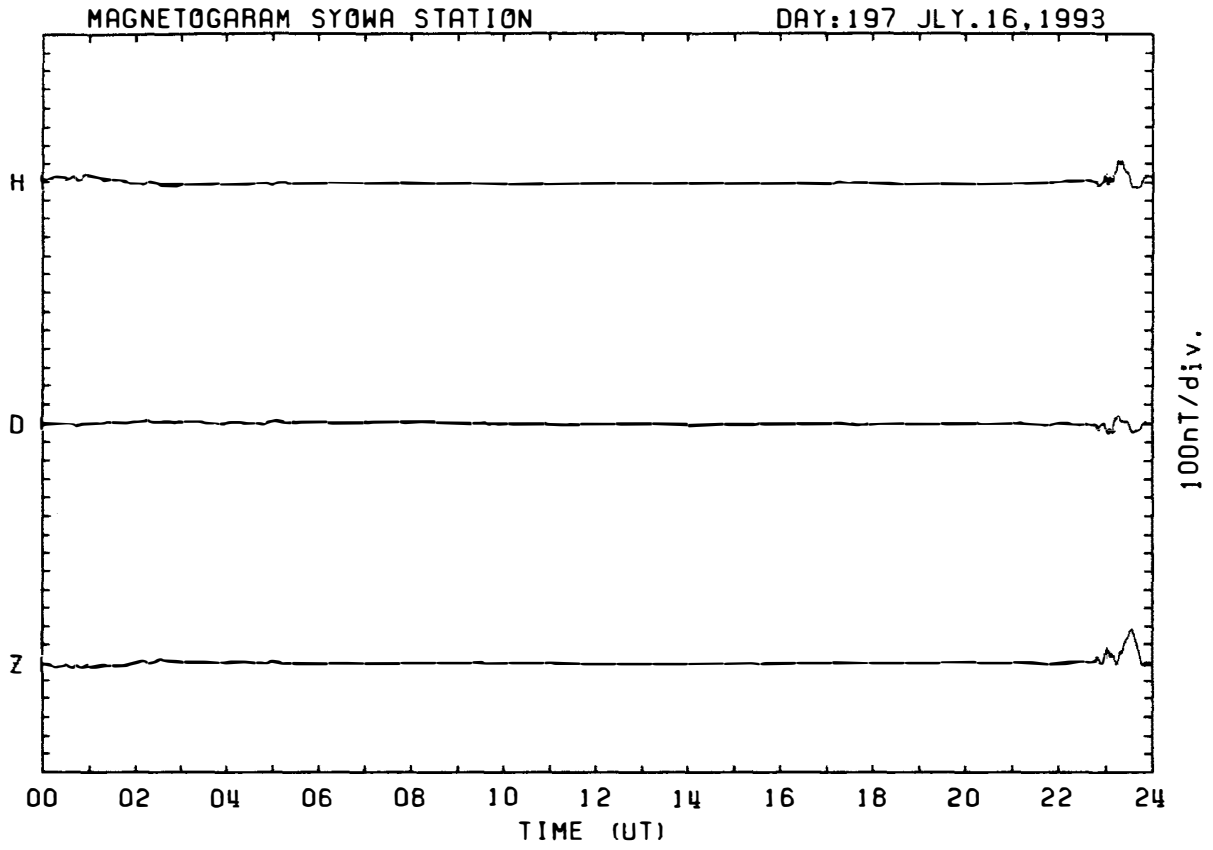
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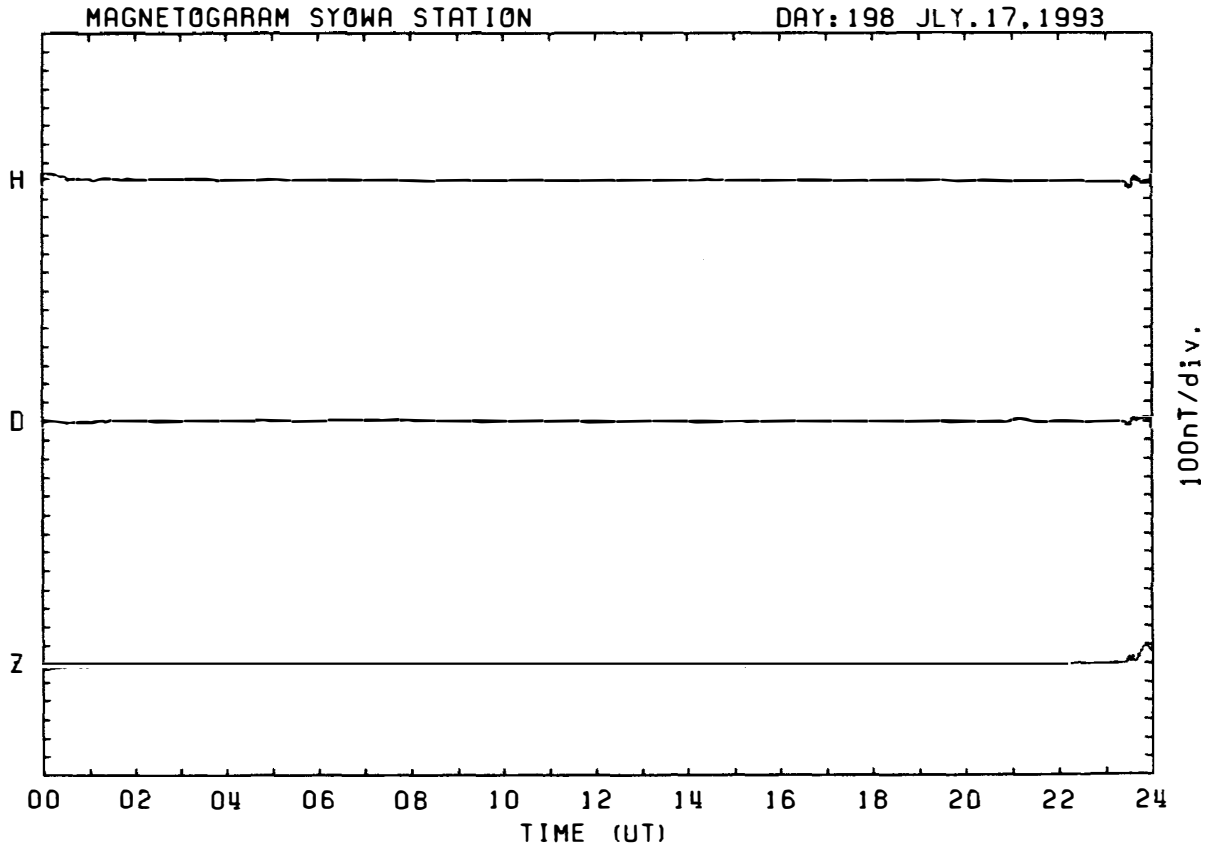
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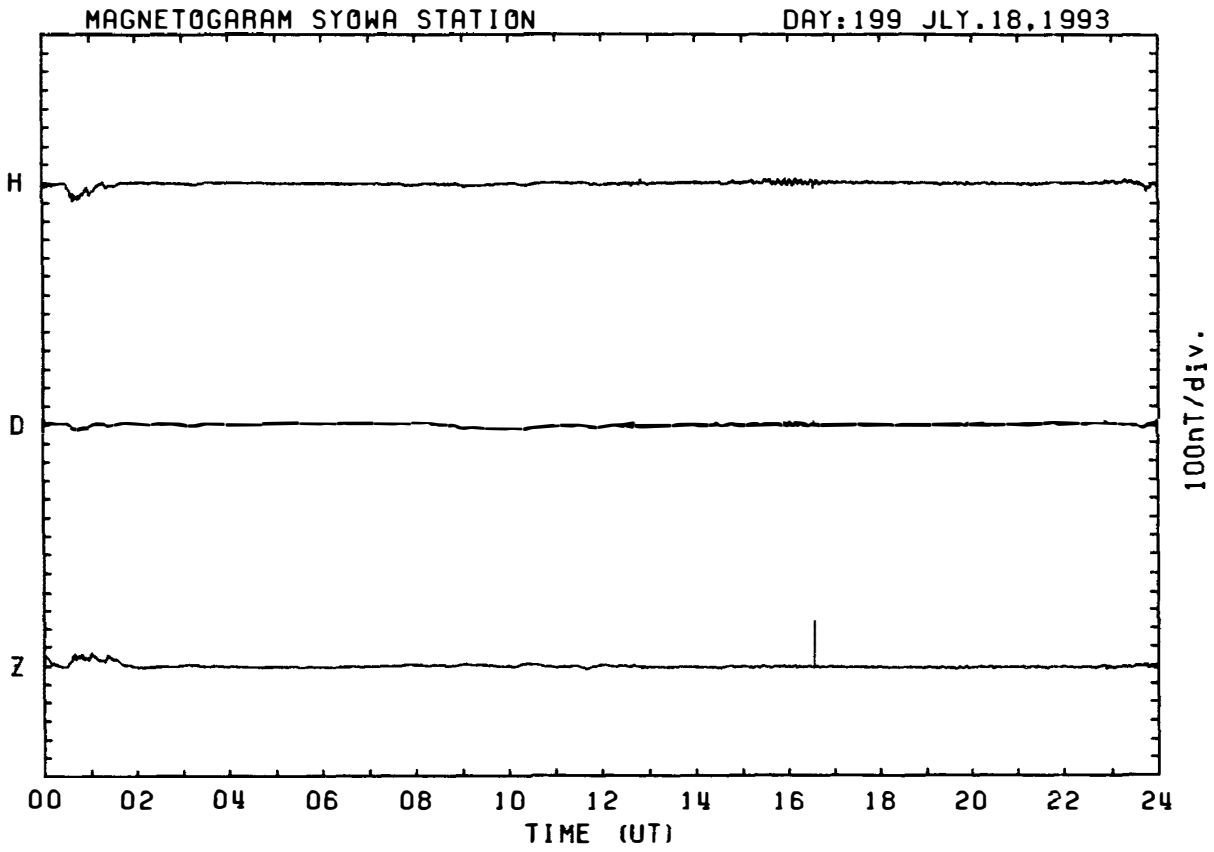
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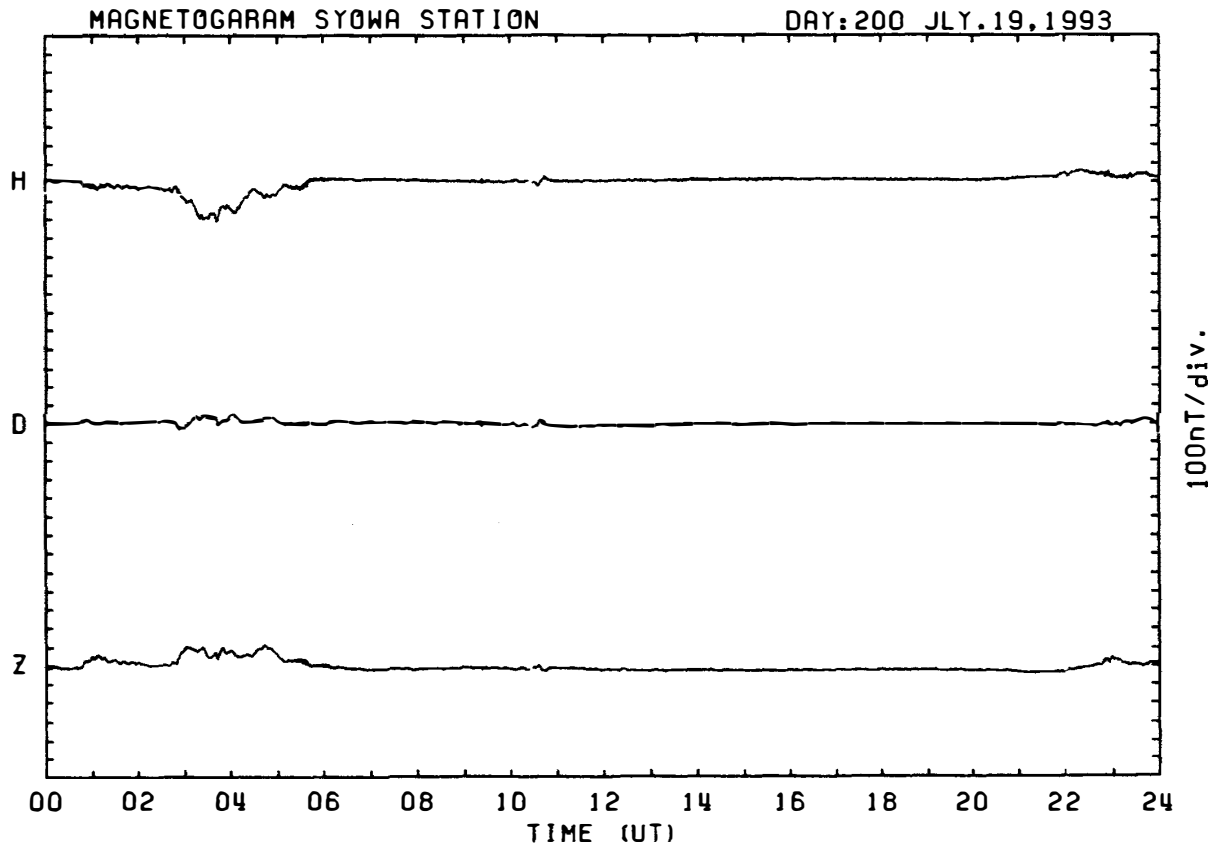
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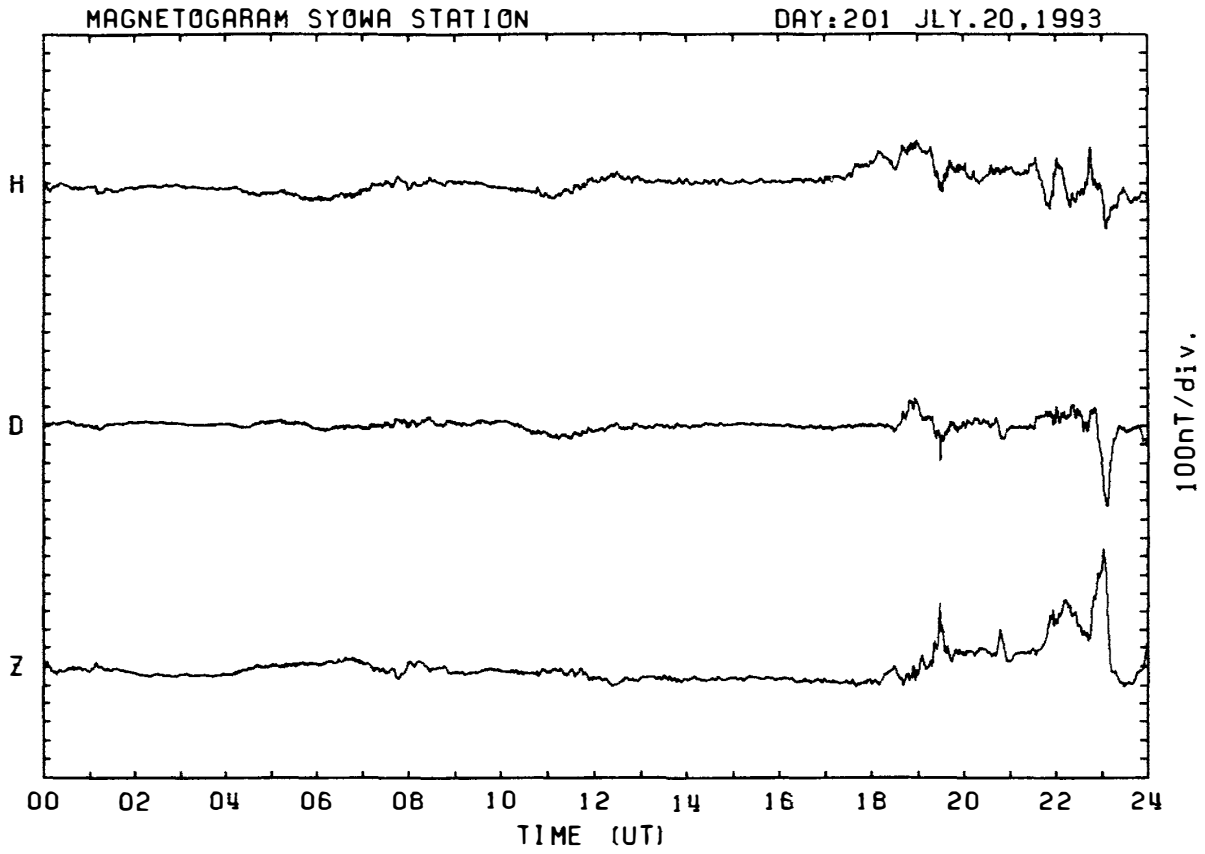
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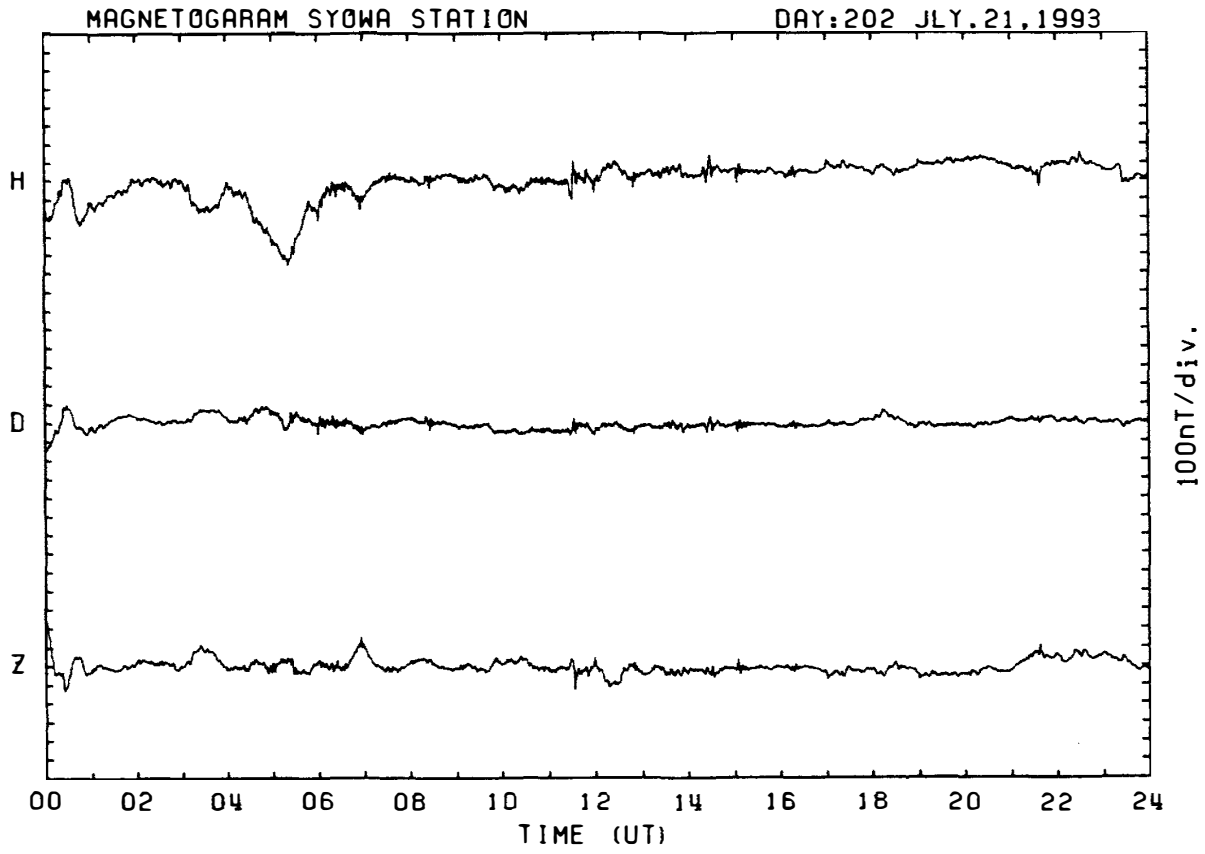
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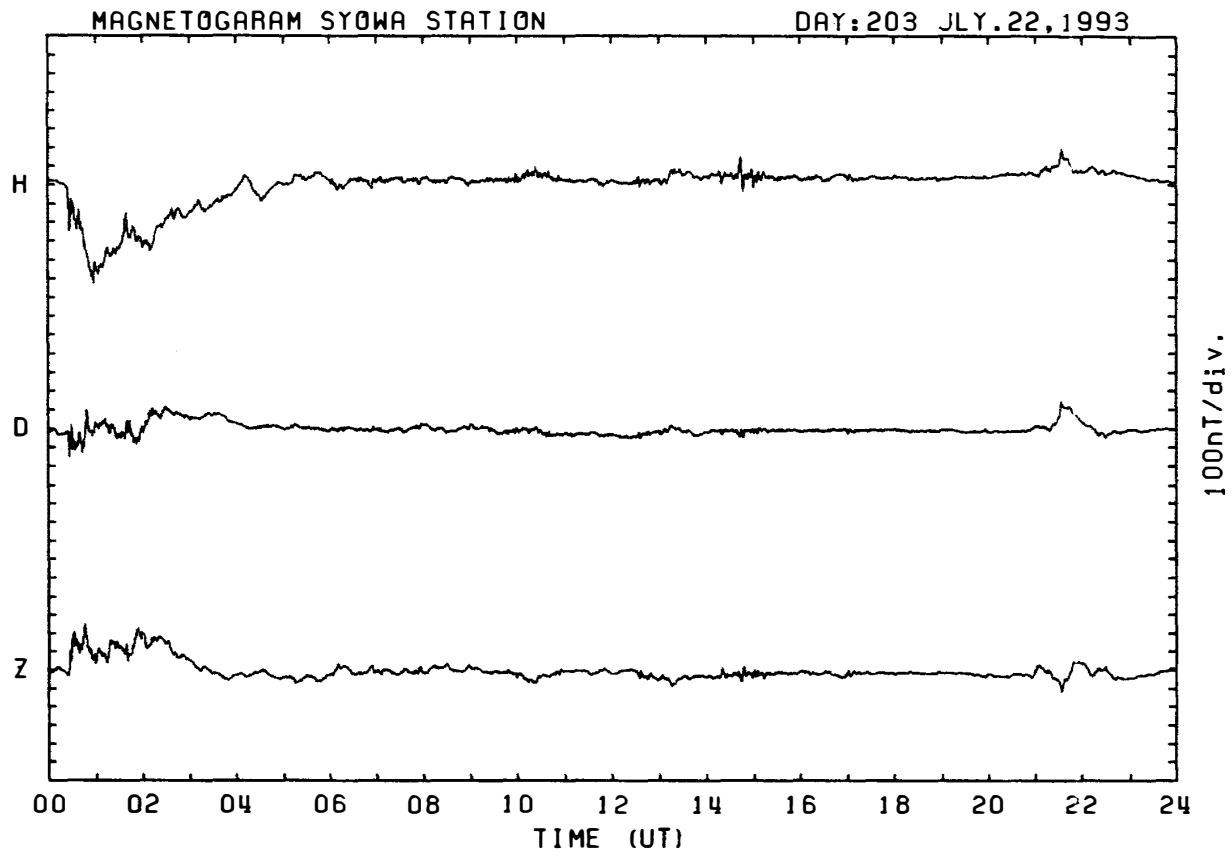
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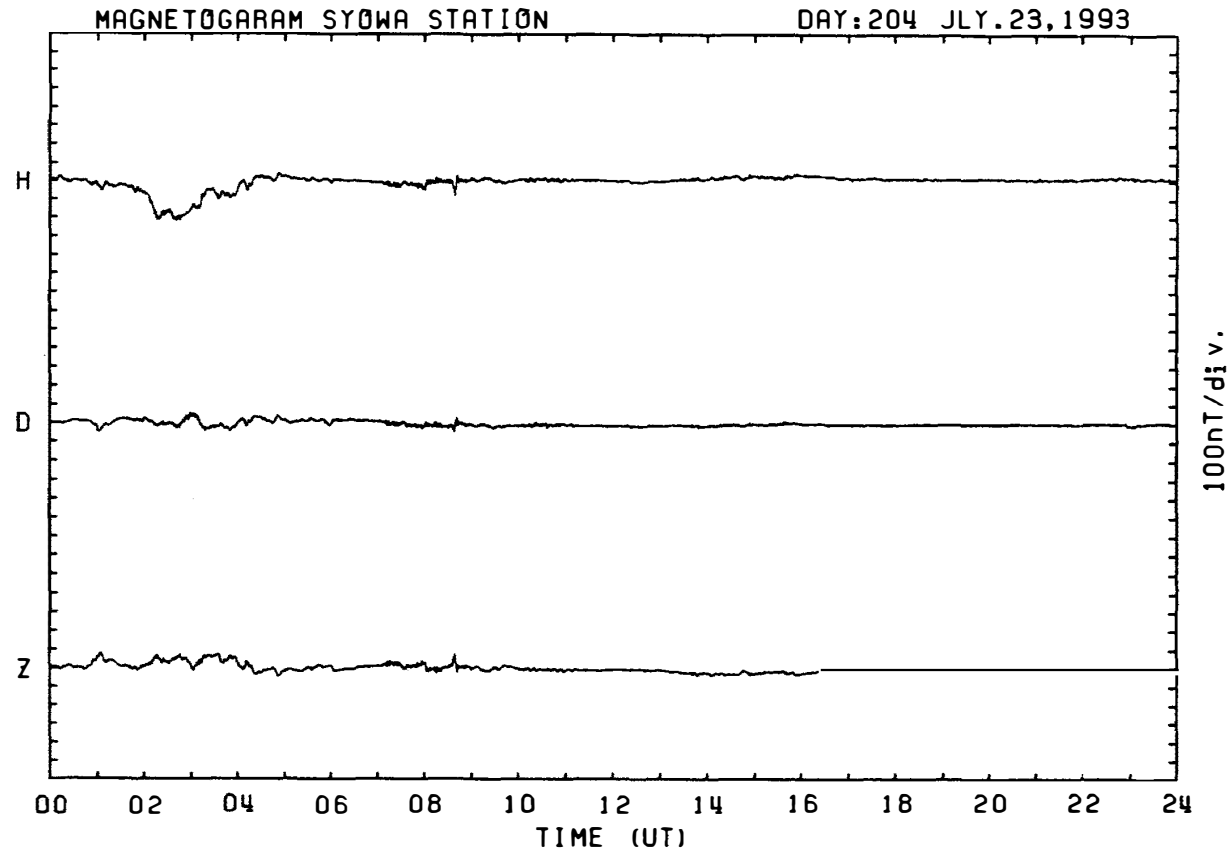
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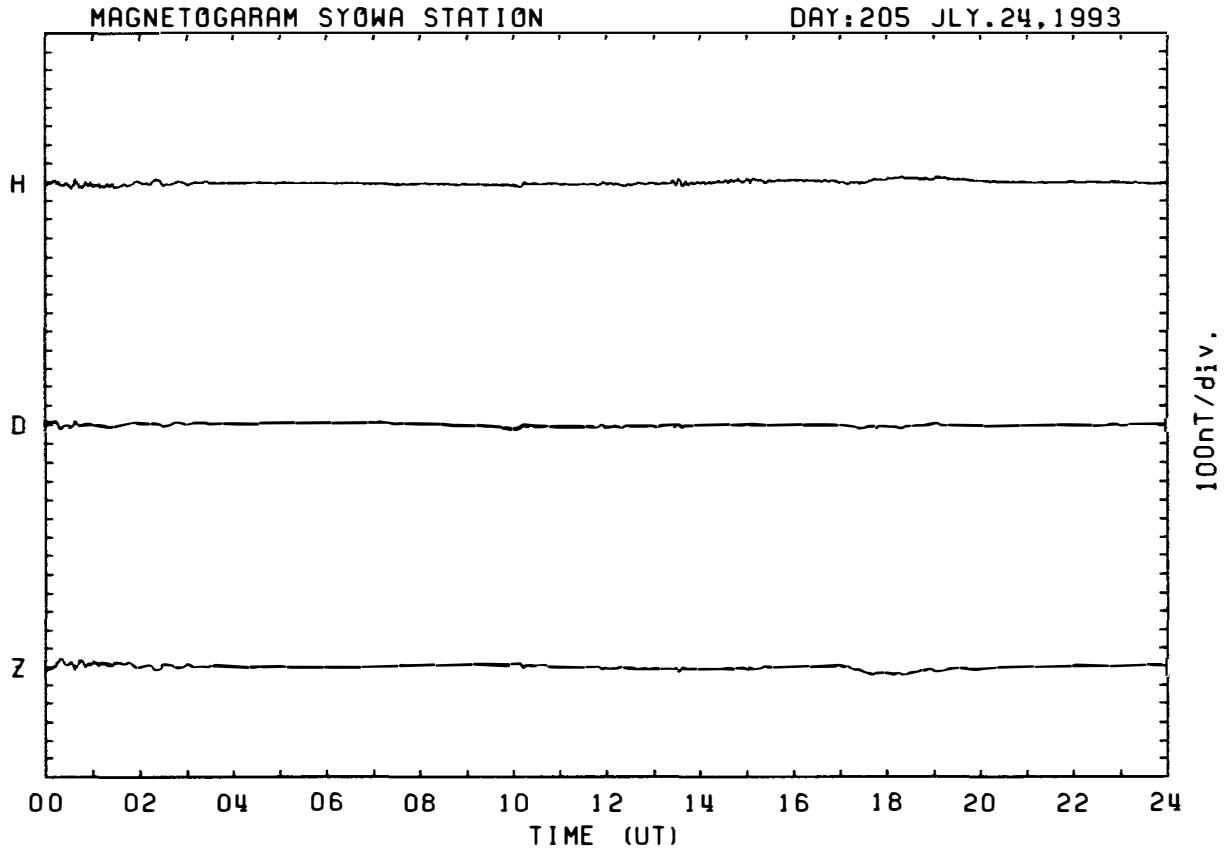
TIME (UT)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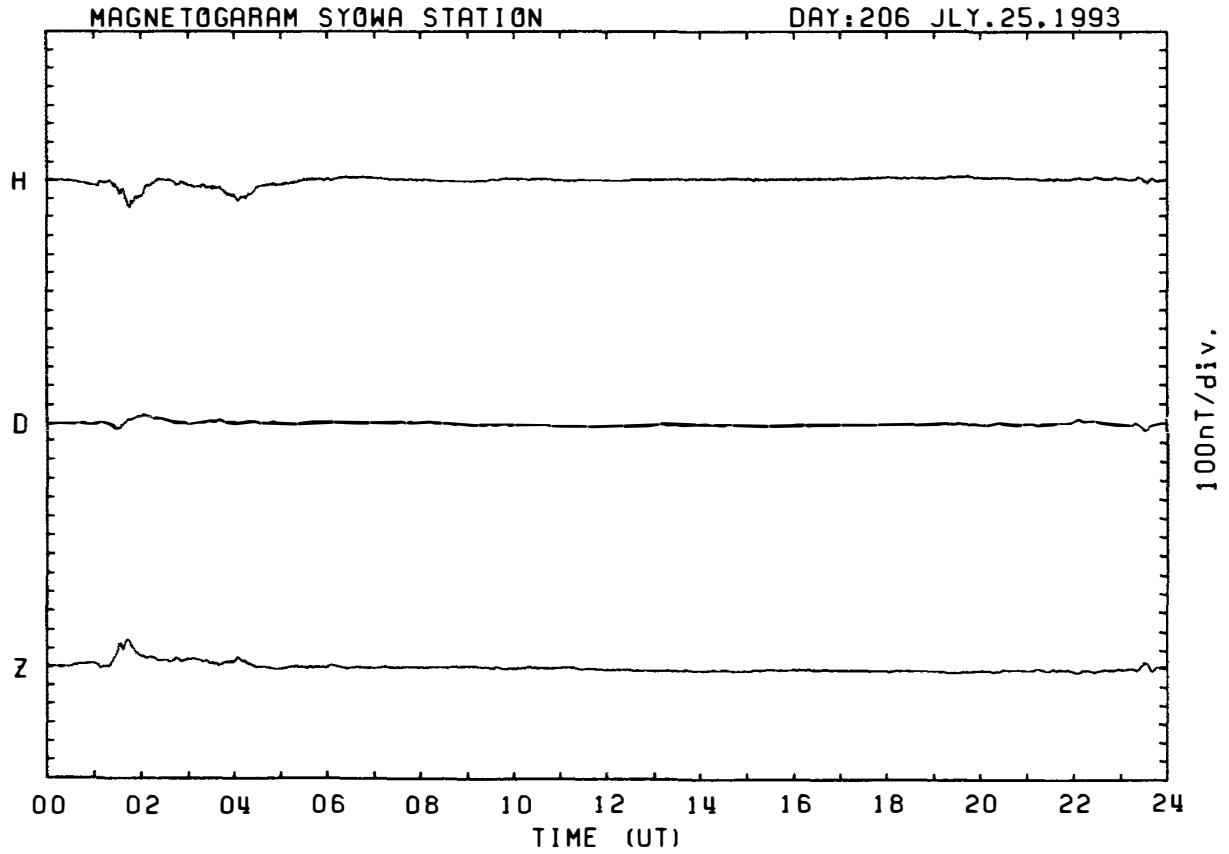
TIME (UT)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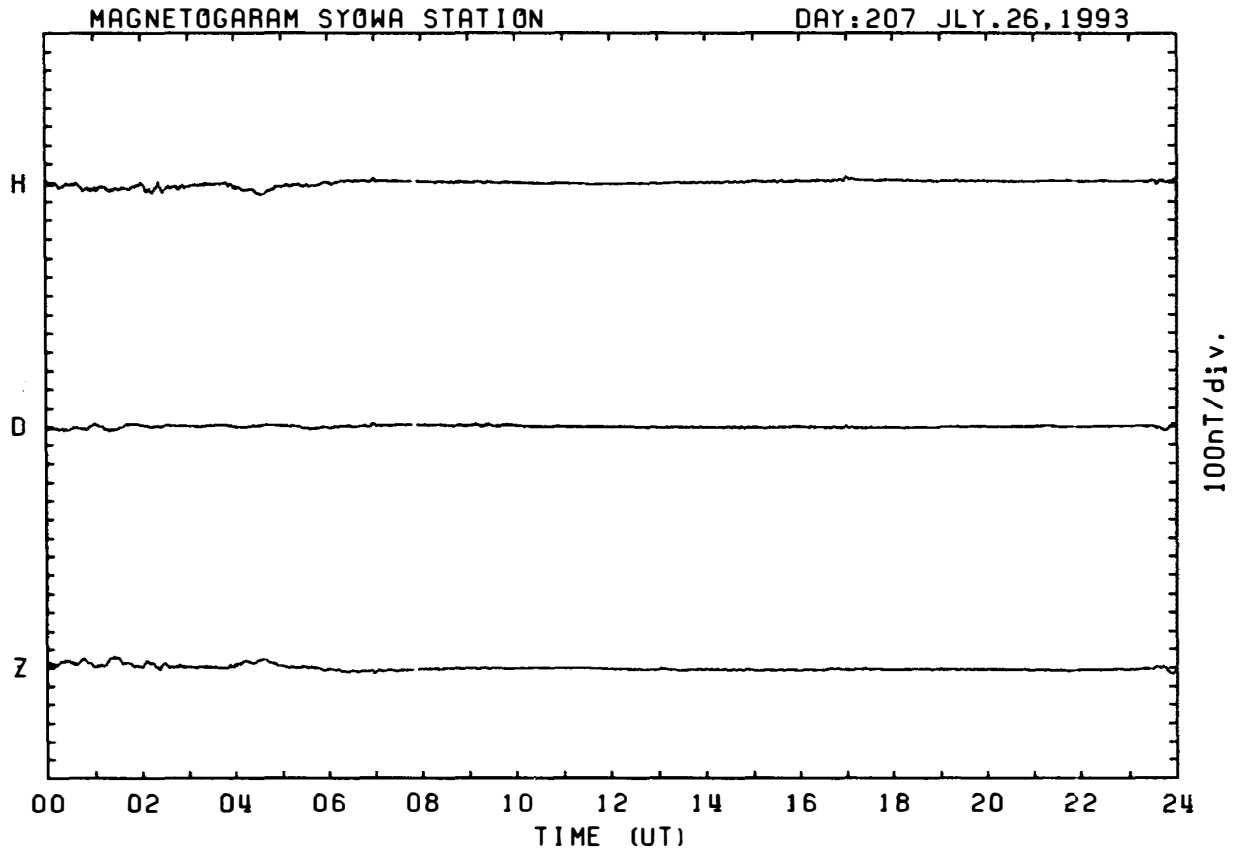
TIME (UT)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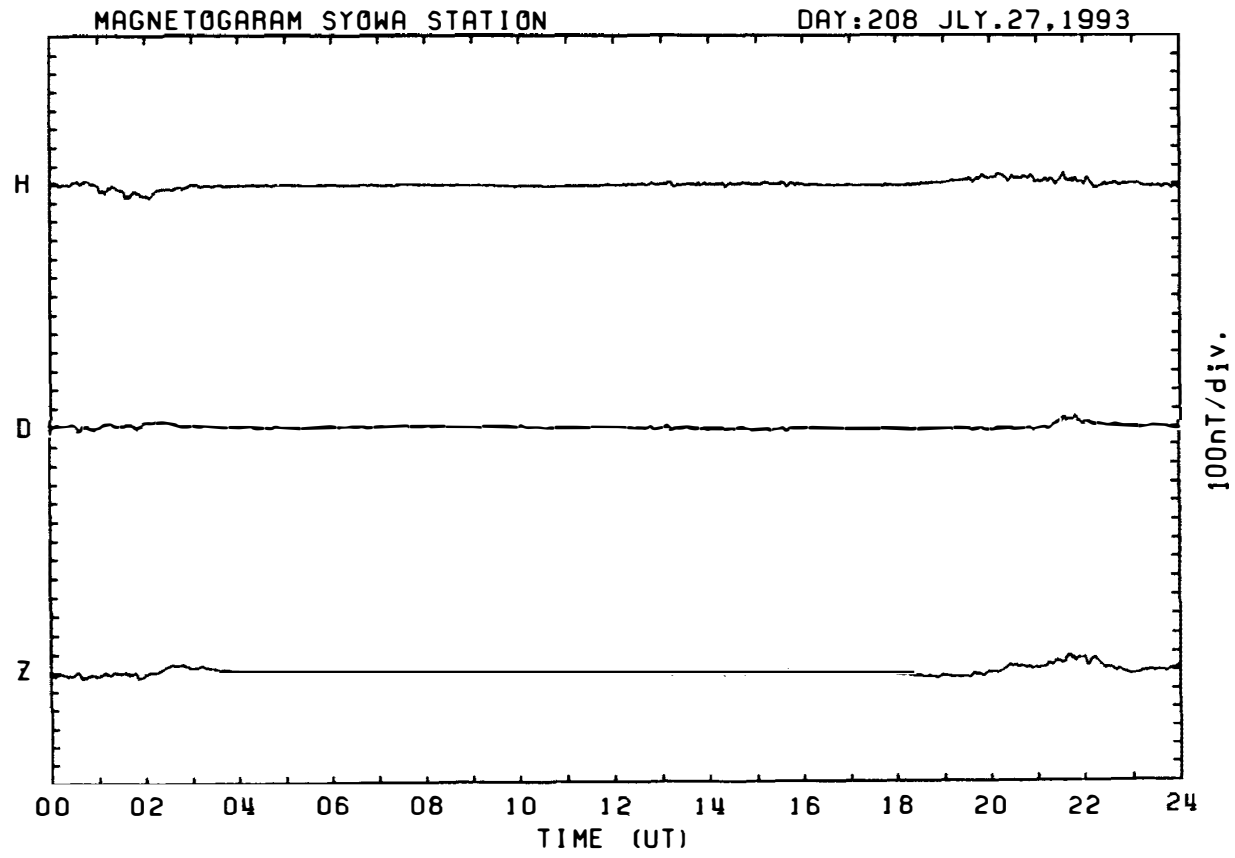
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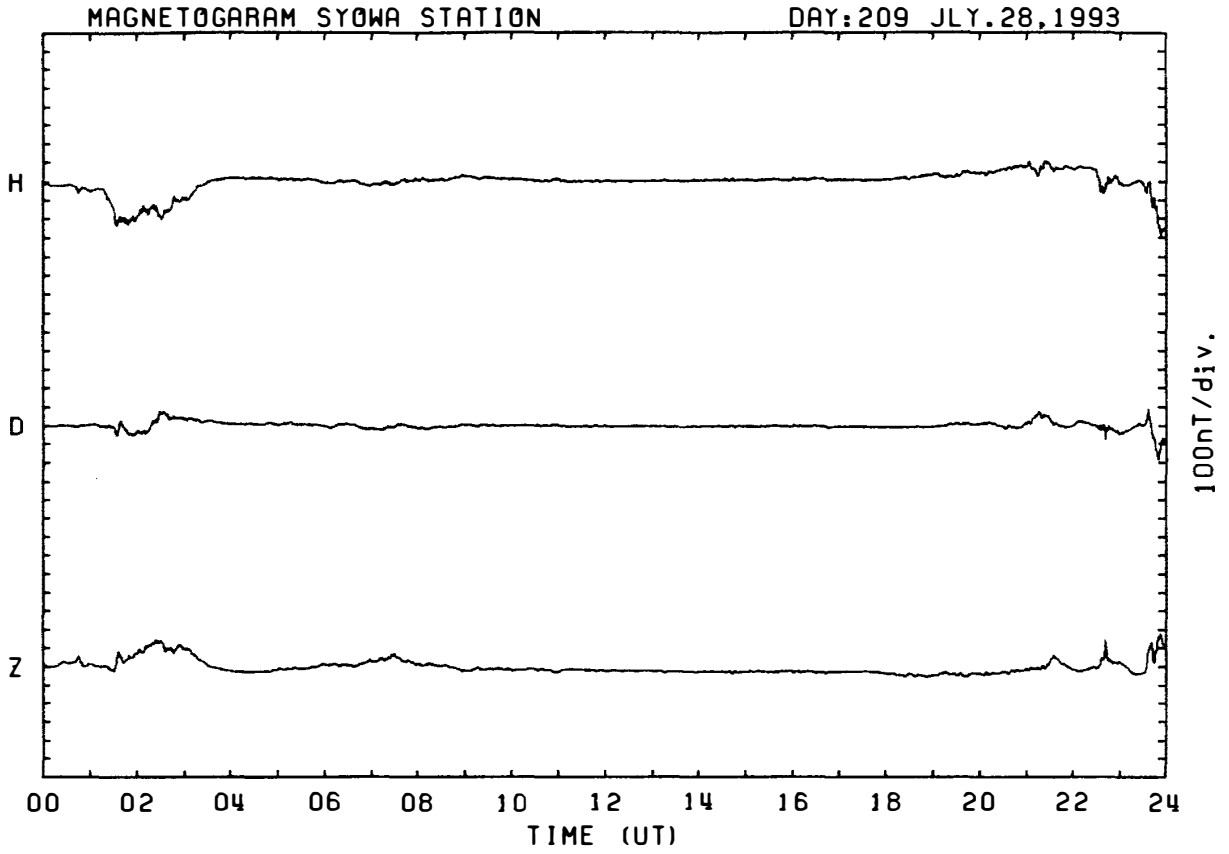
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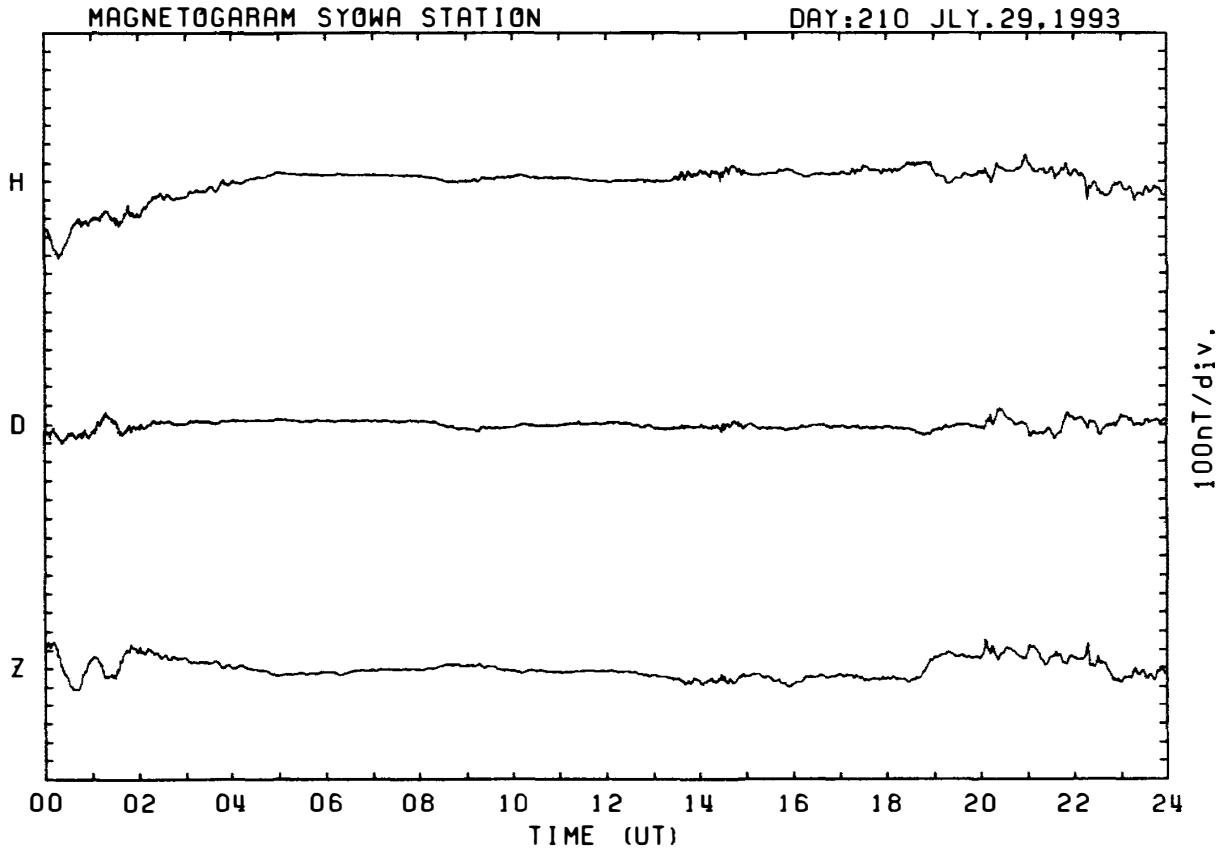
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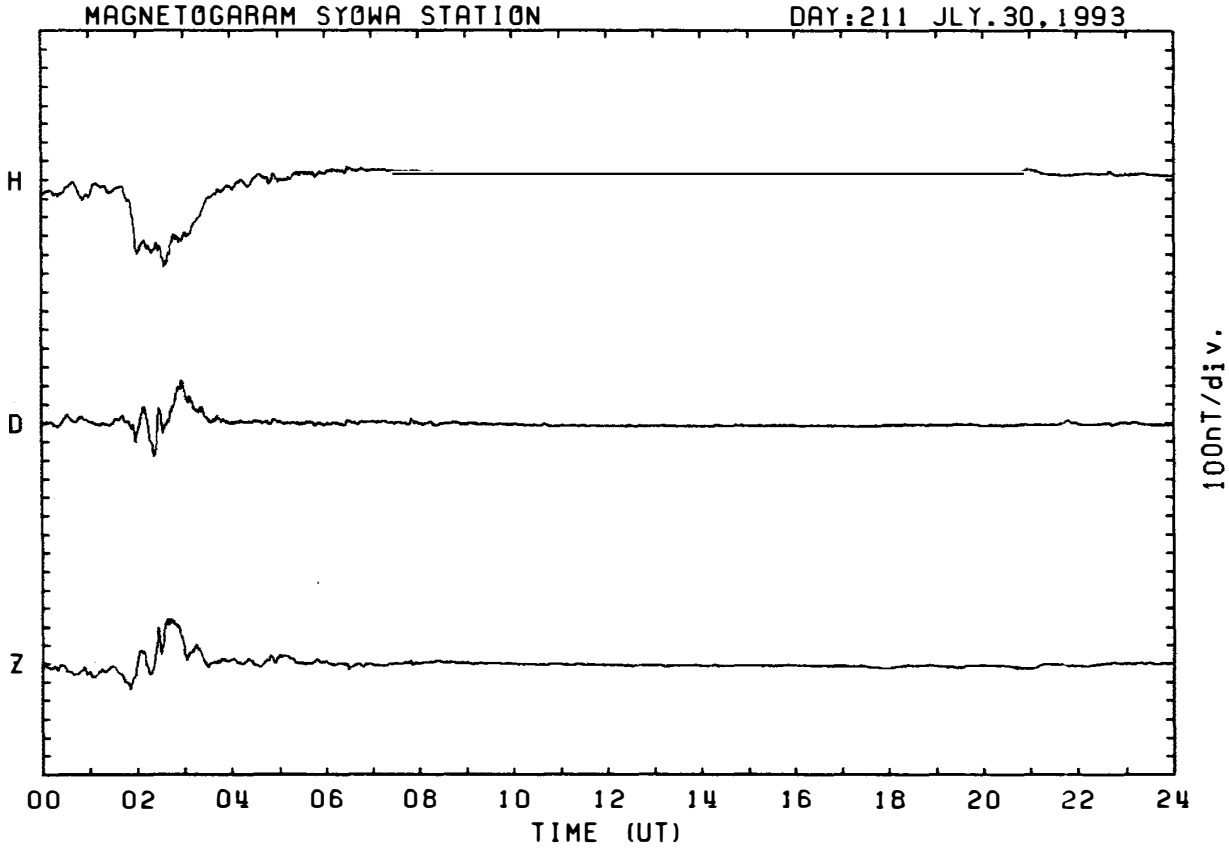
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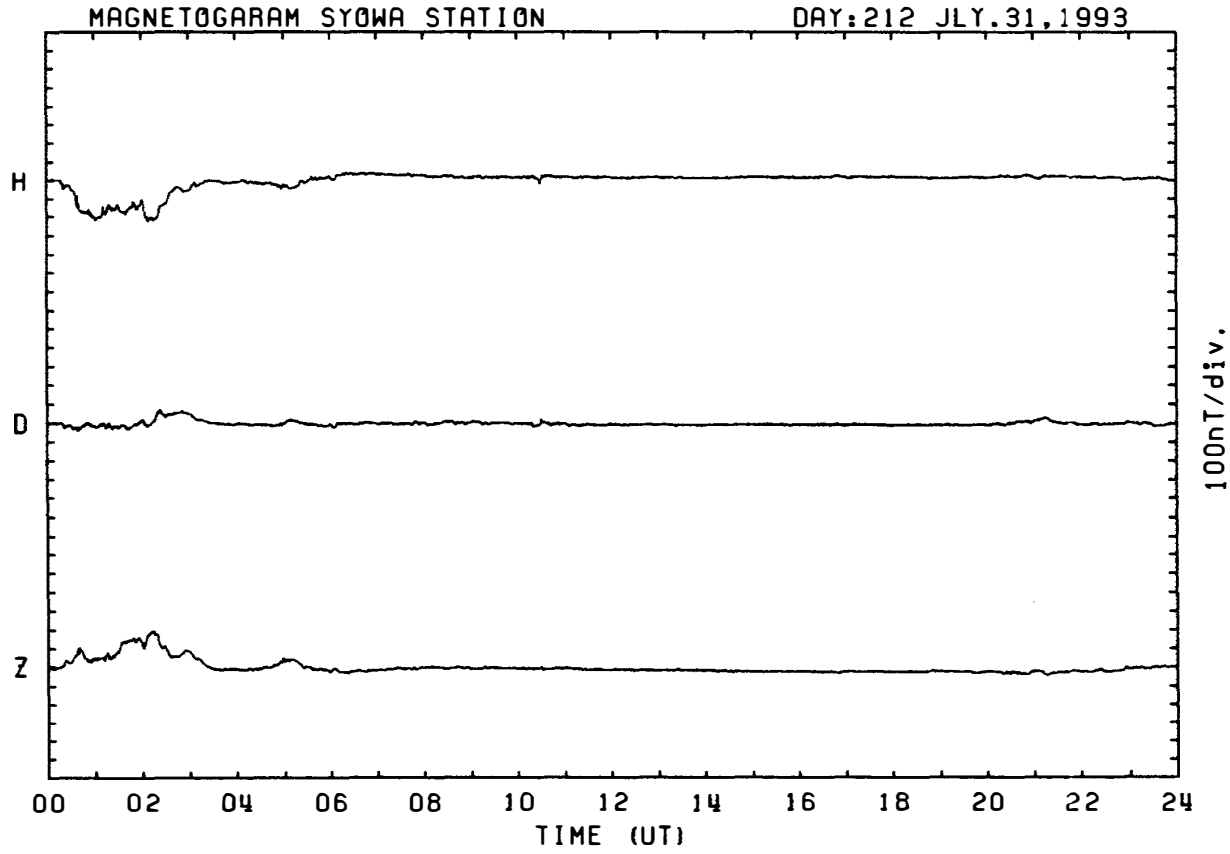
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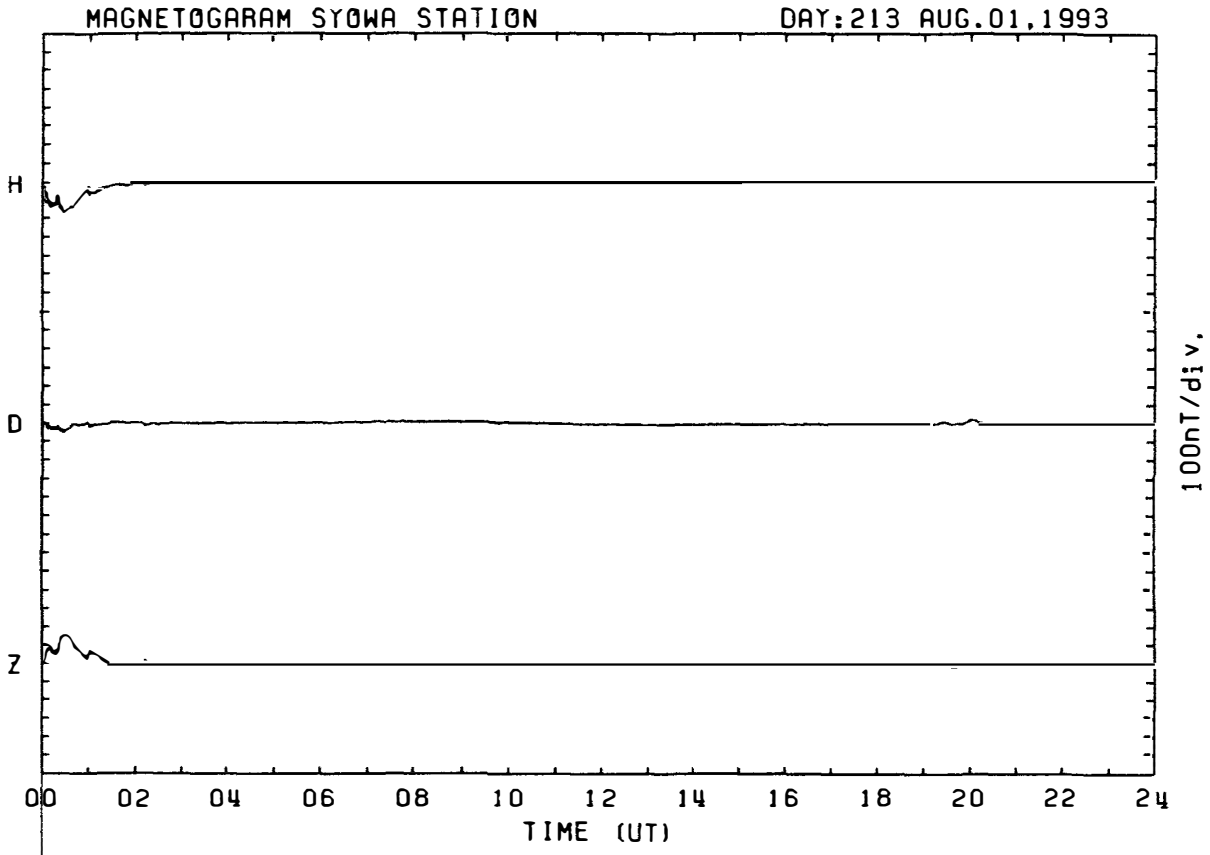
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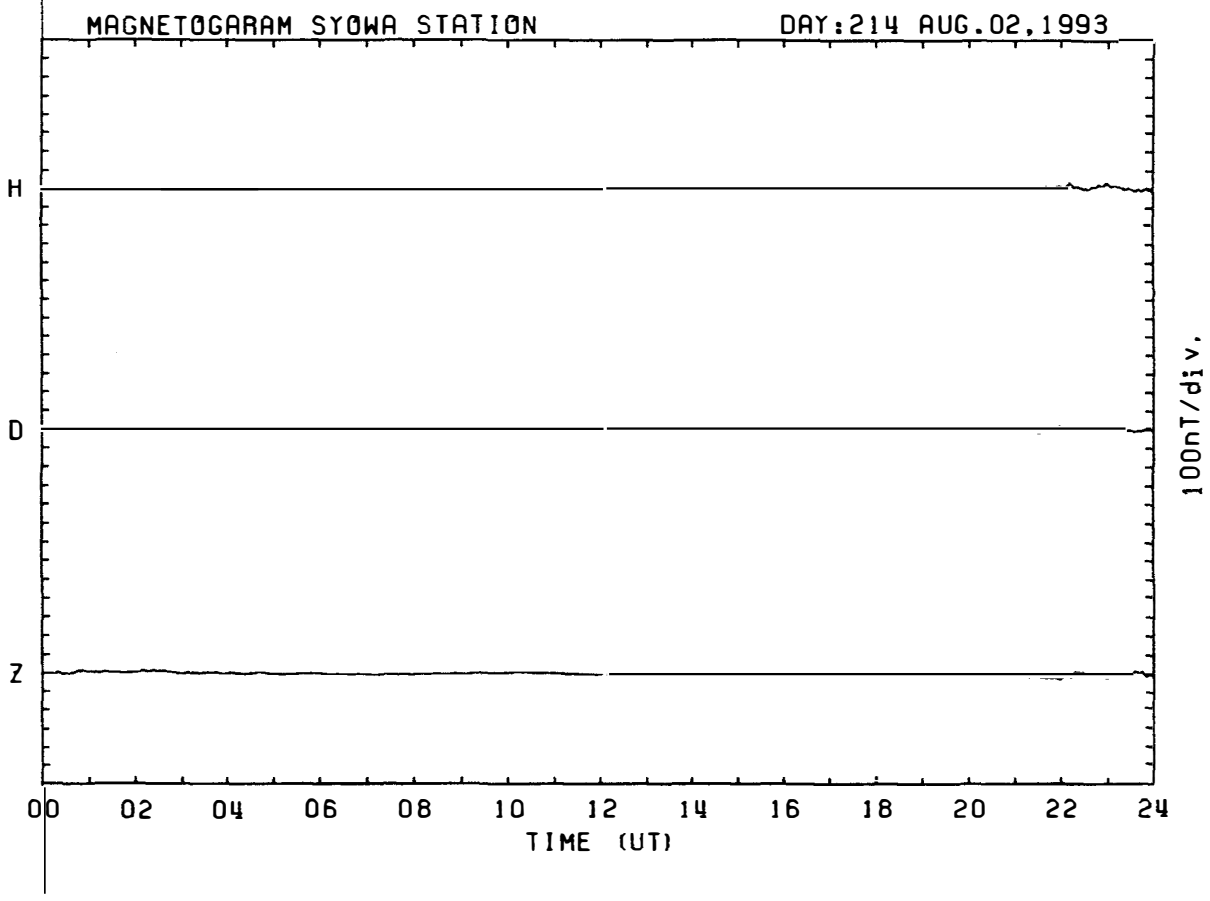
TIME (UT)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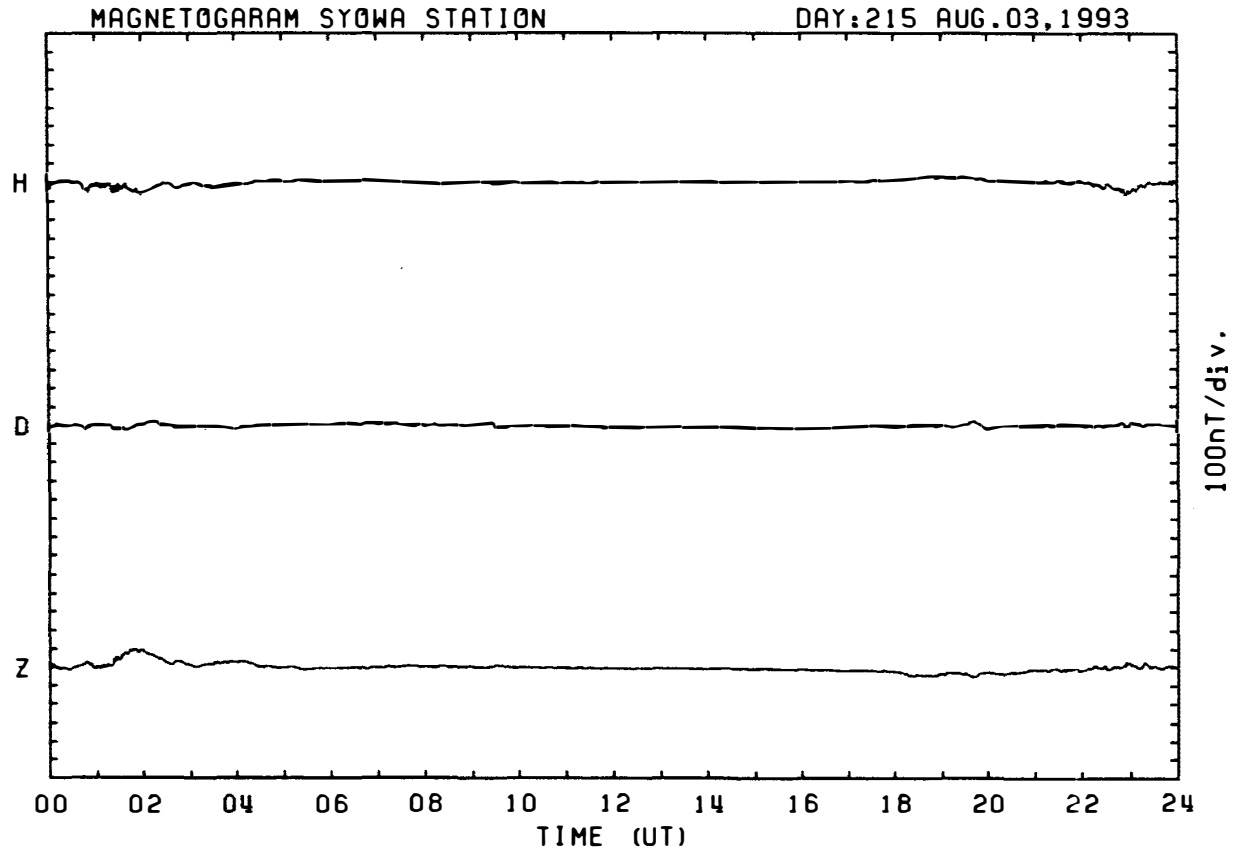
TIME (UT)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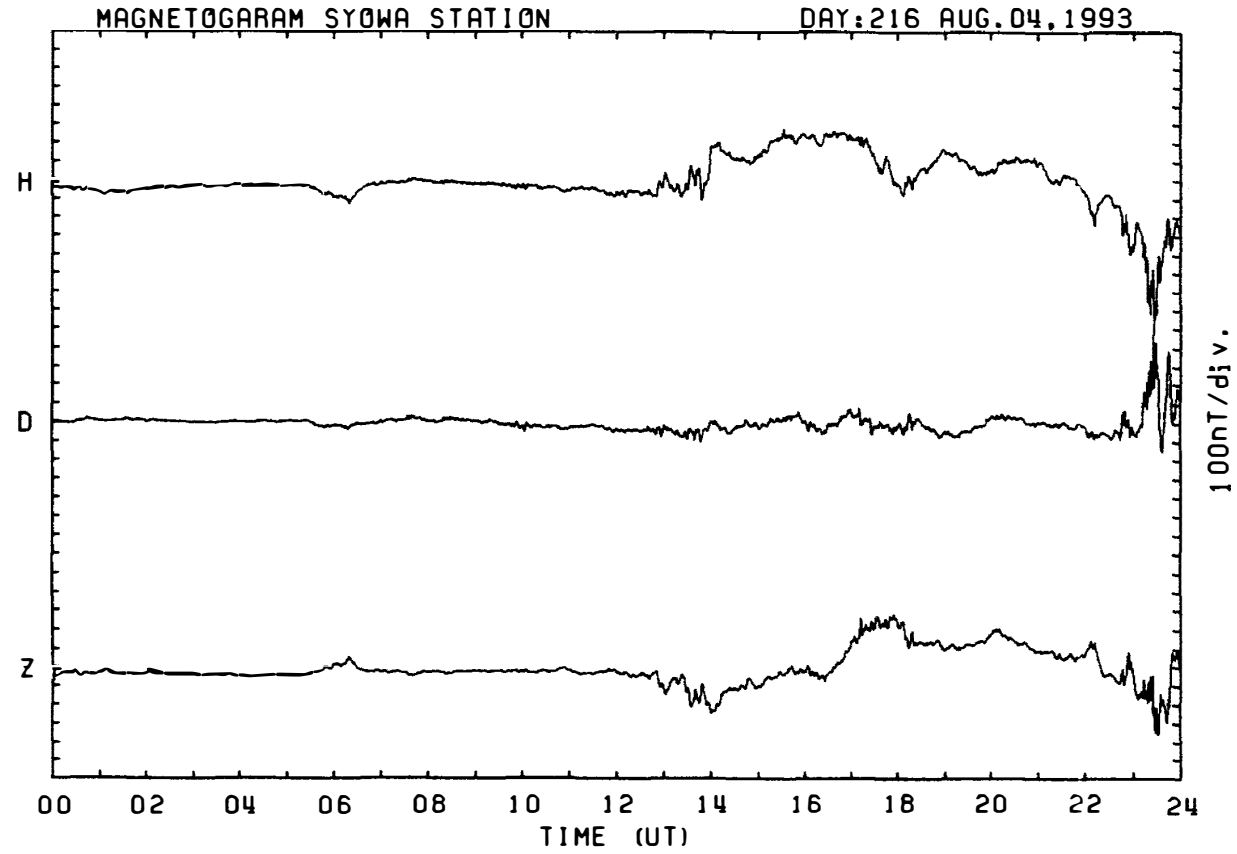
TIME (UT)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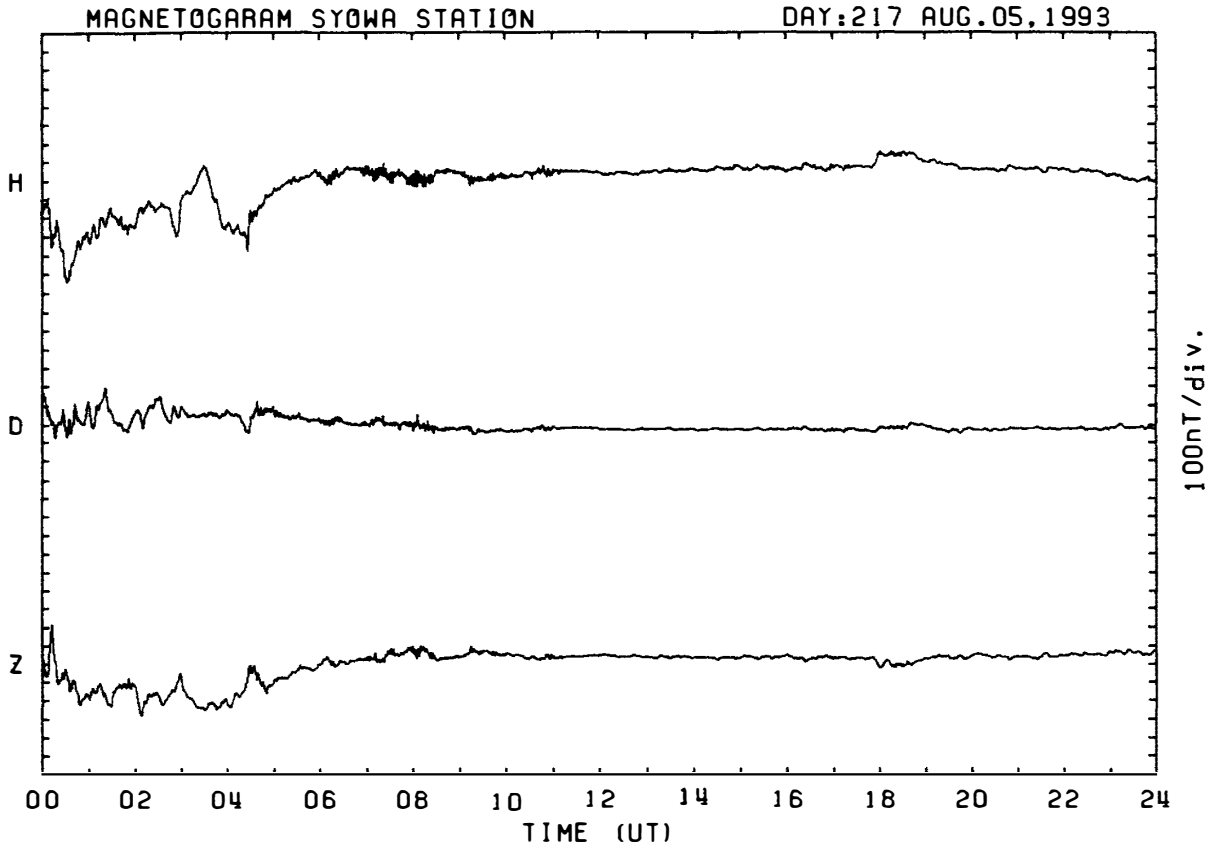
TIME (UT)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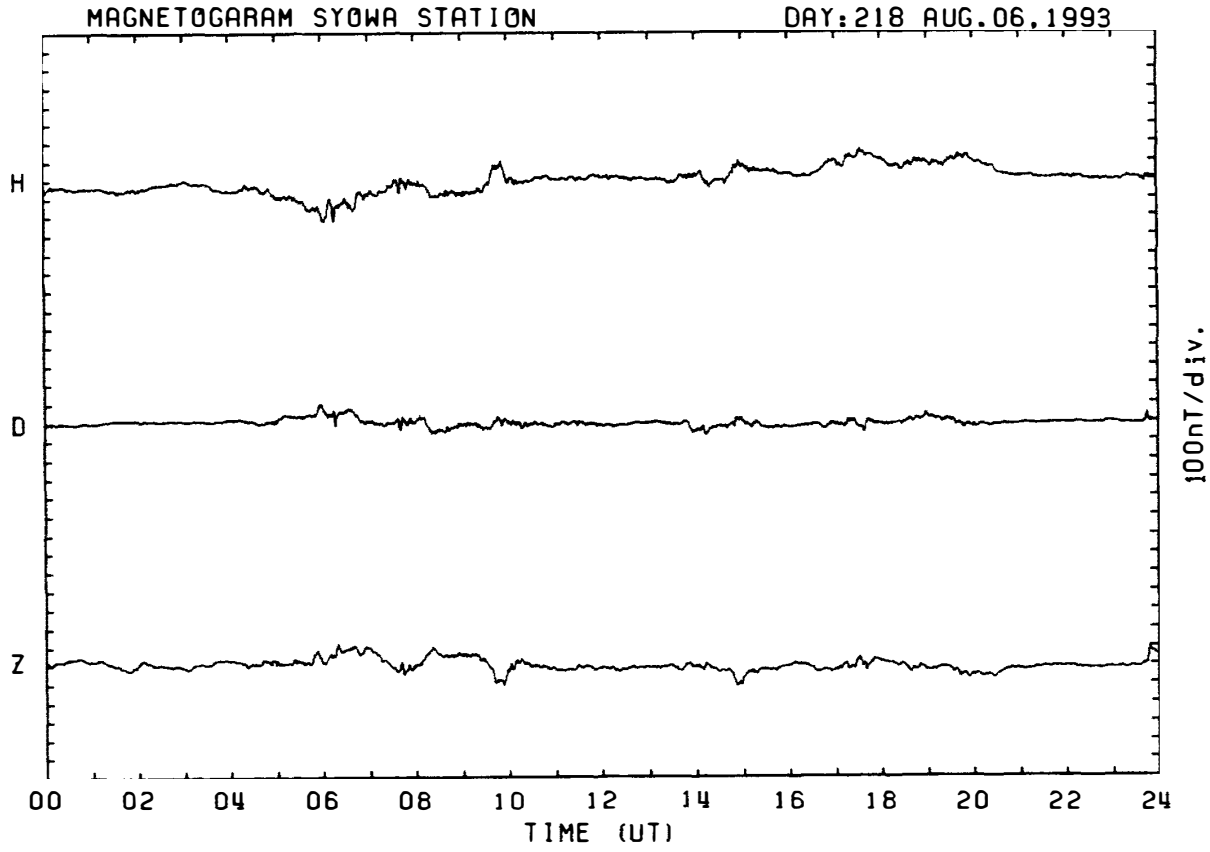
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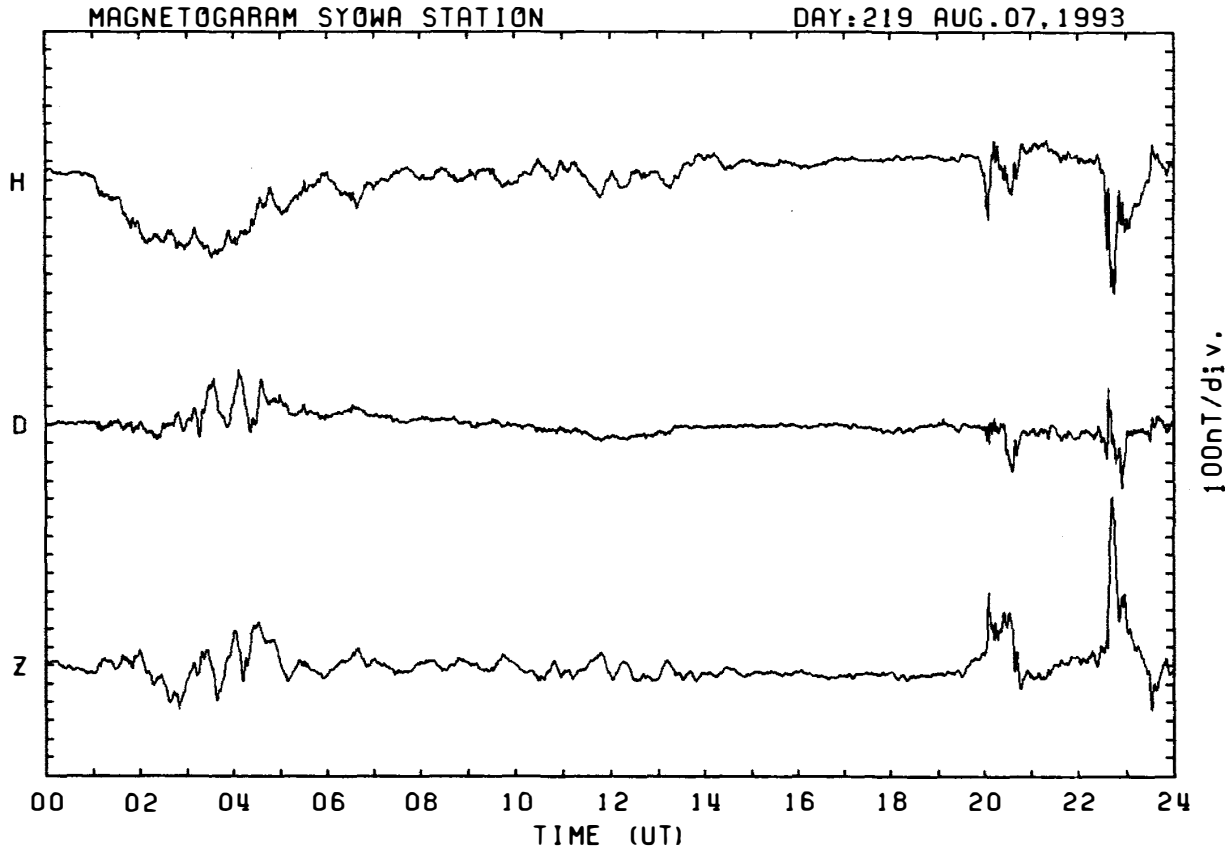
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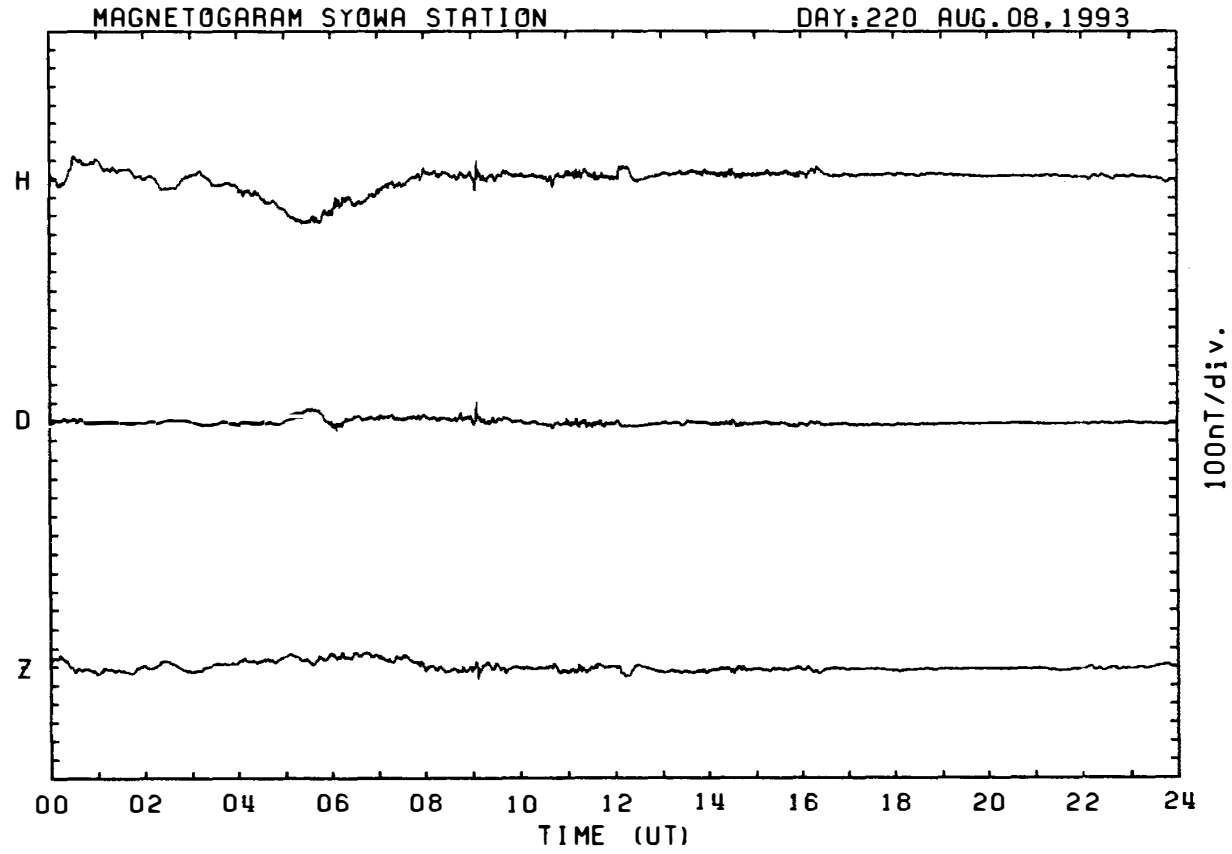
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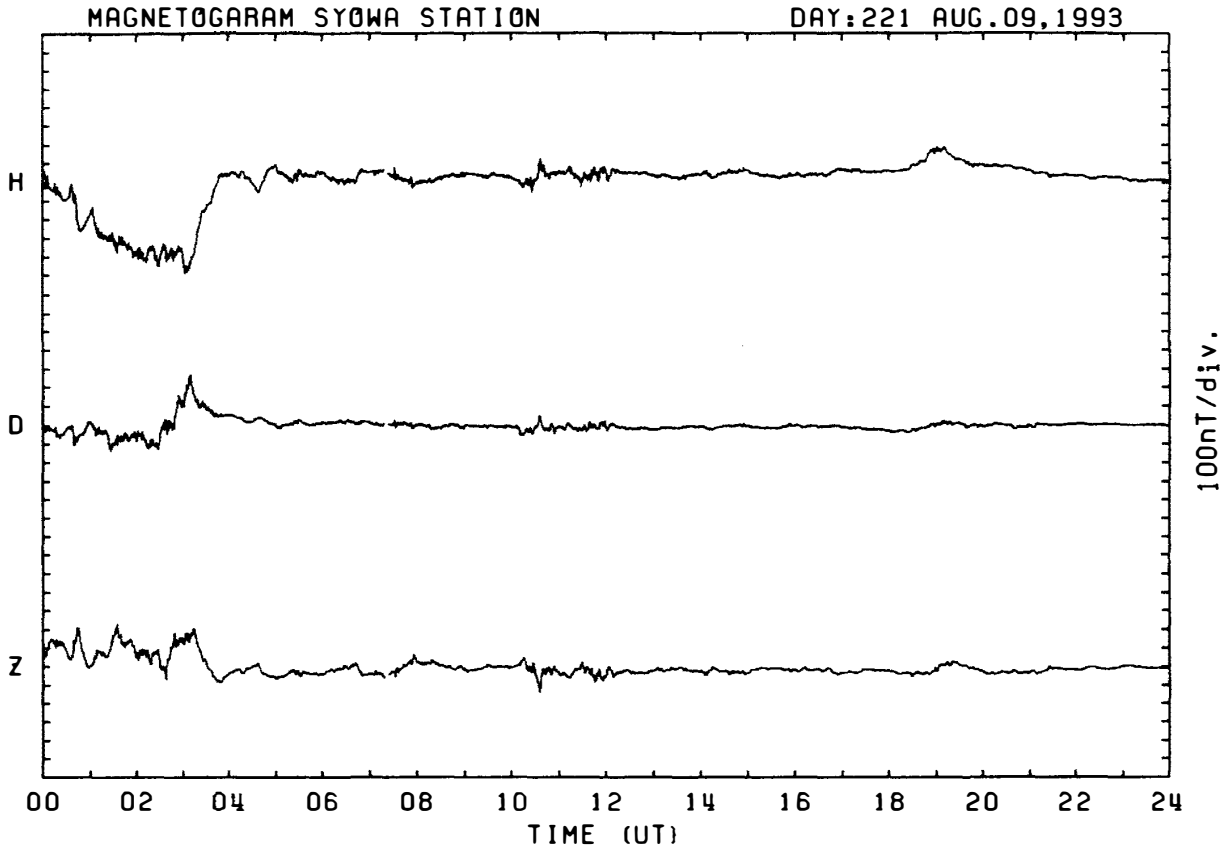
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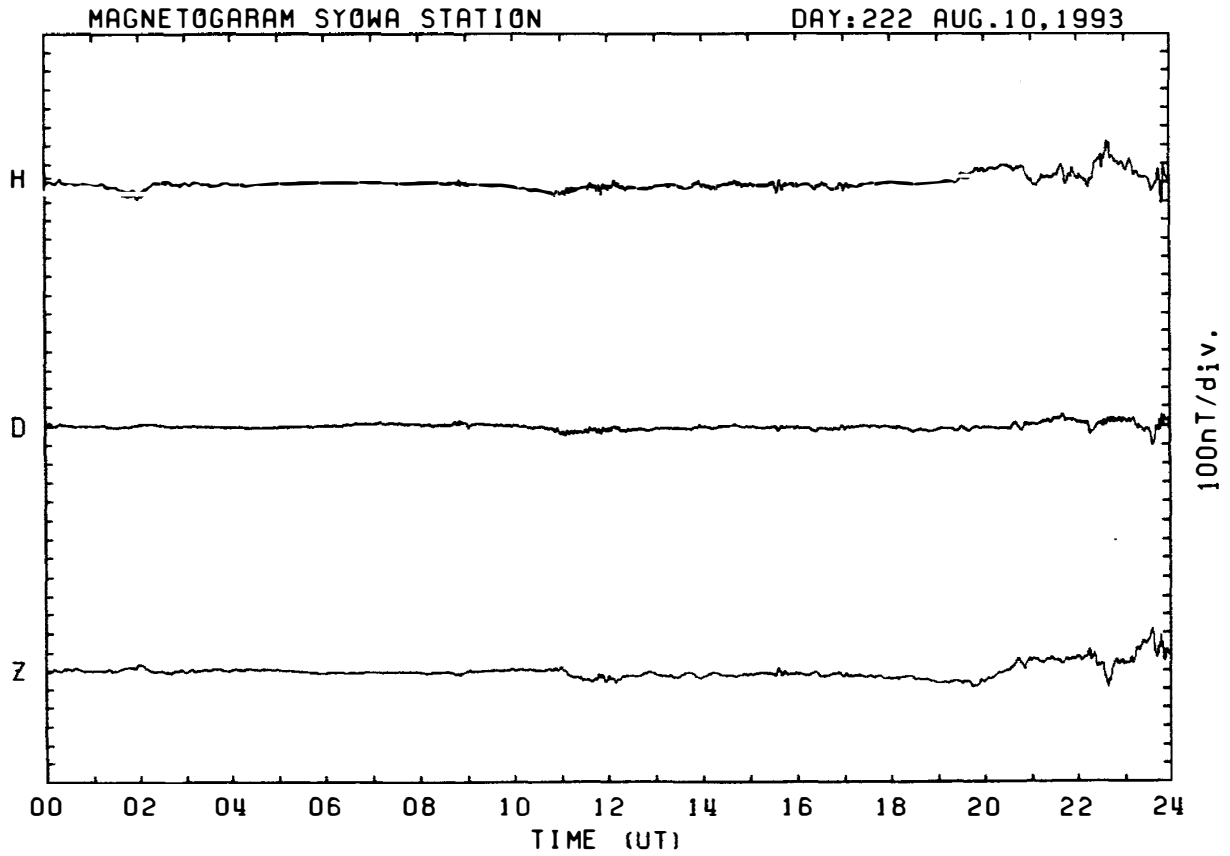
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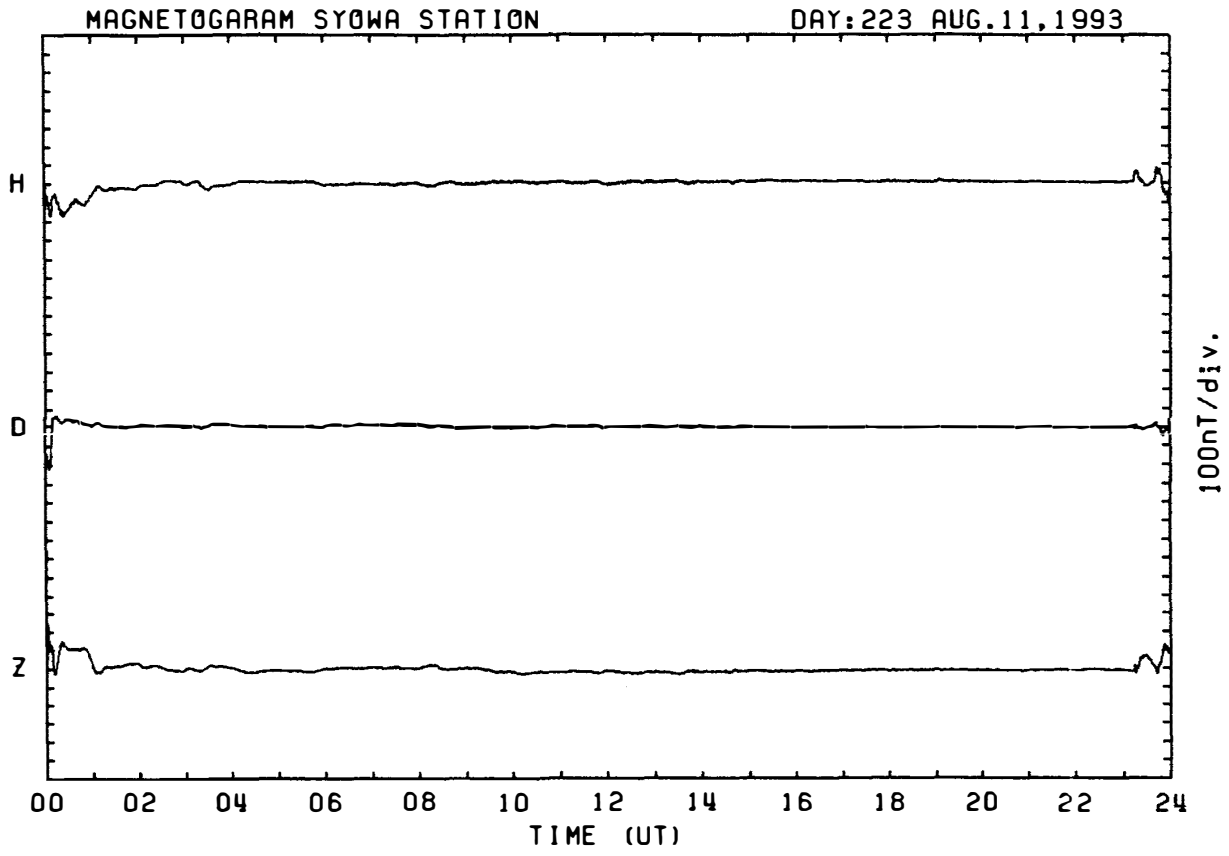
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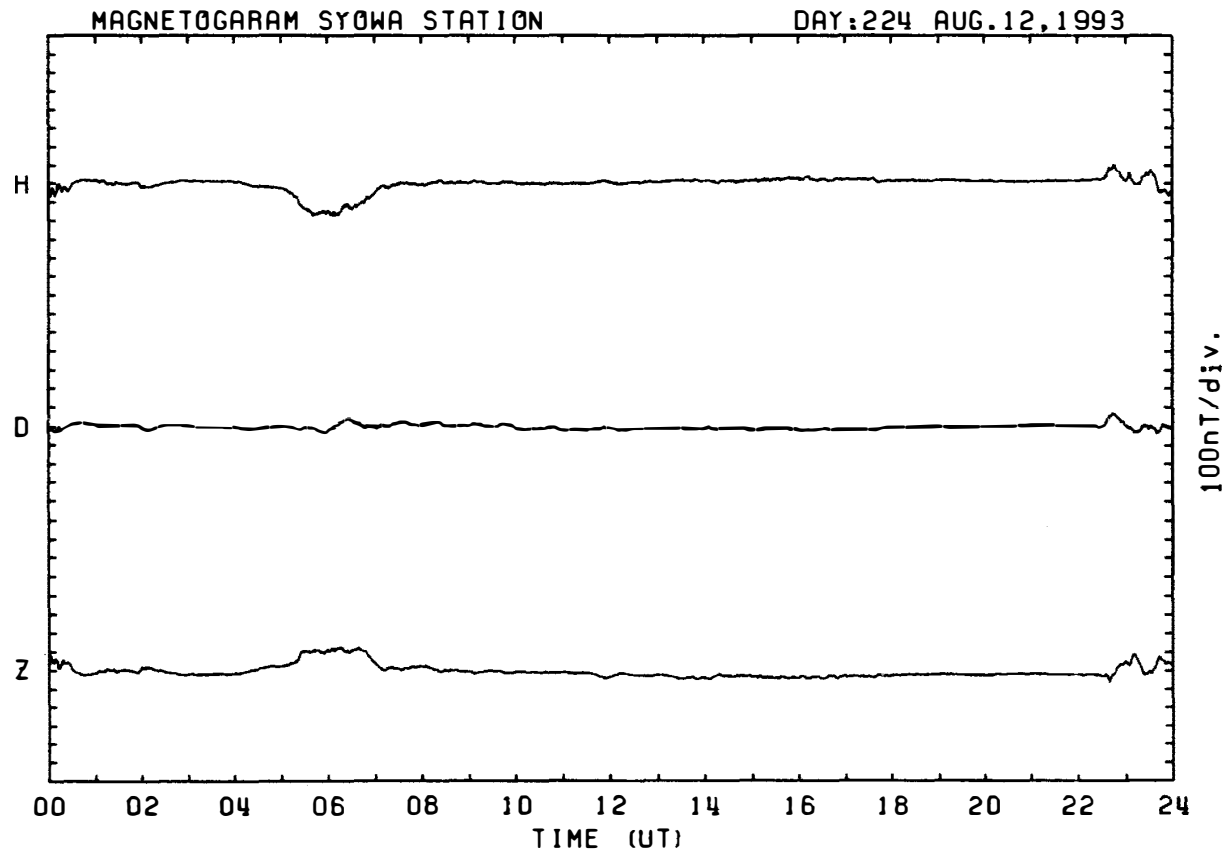
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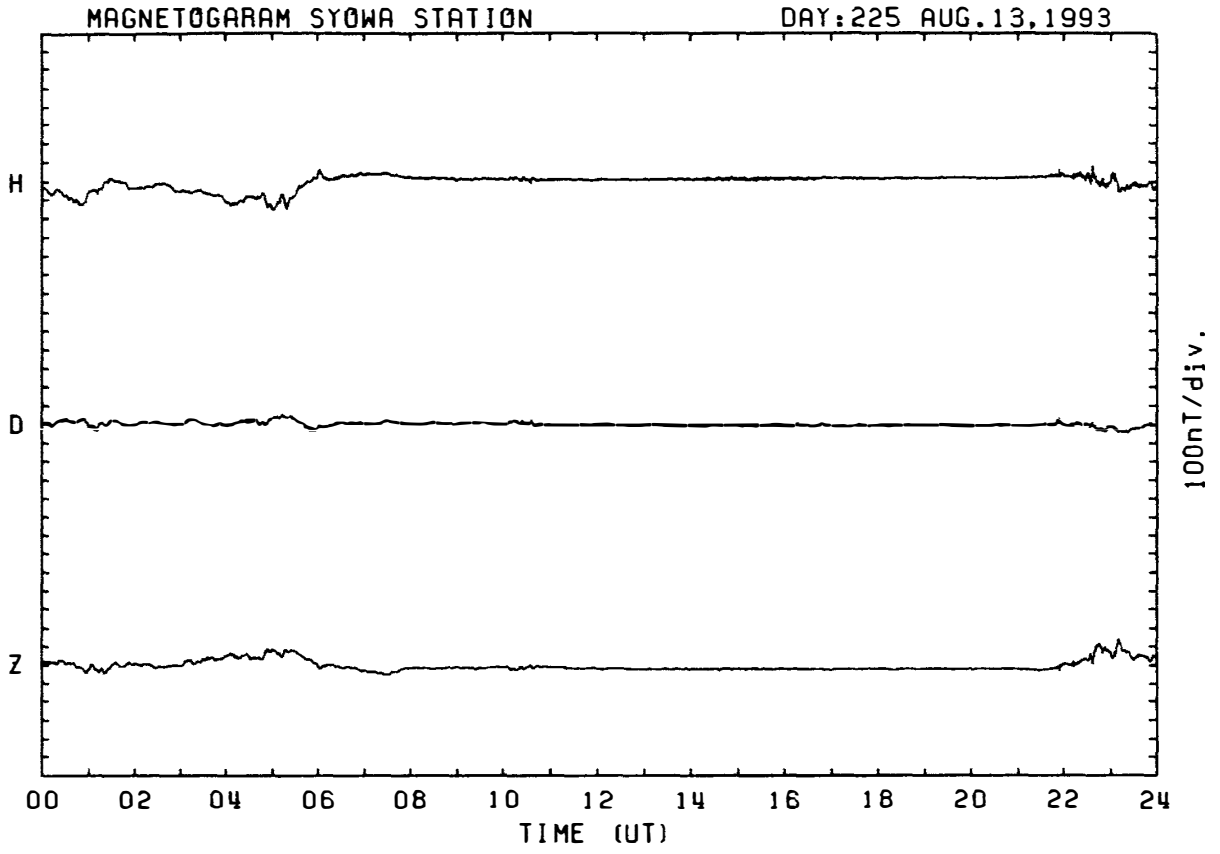
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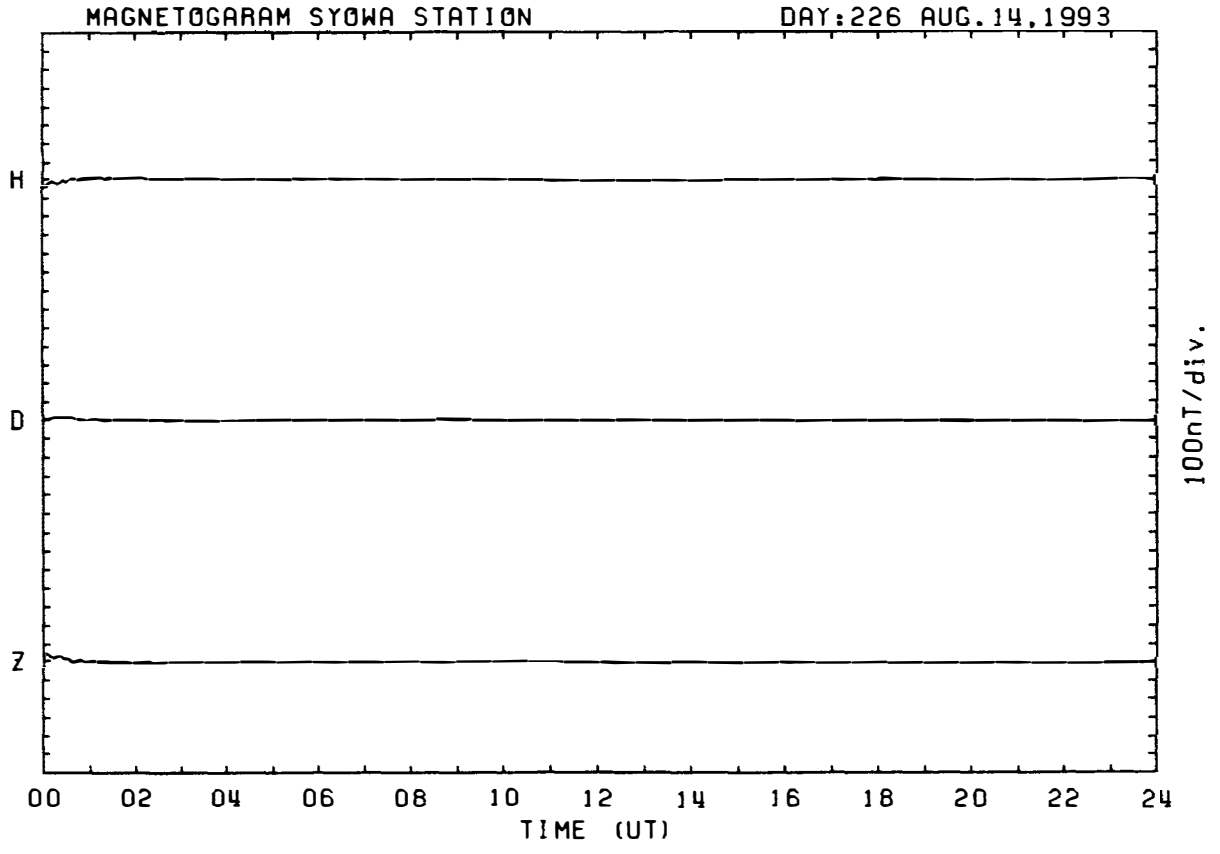
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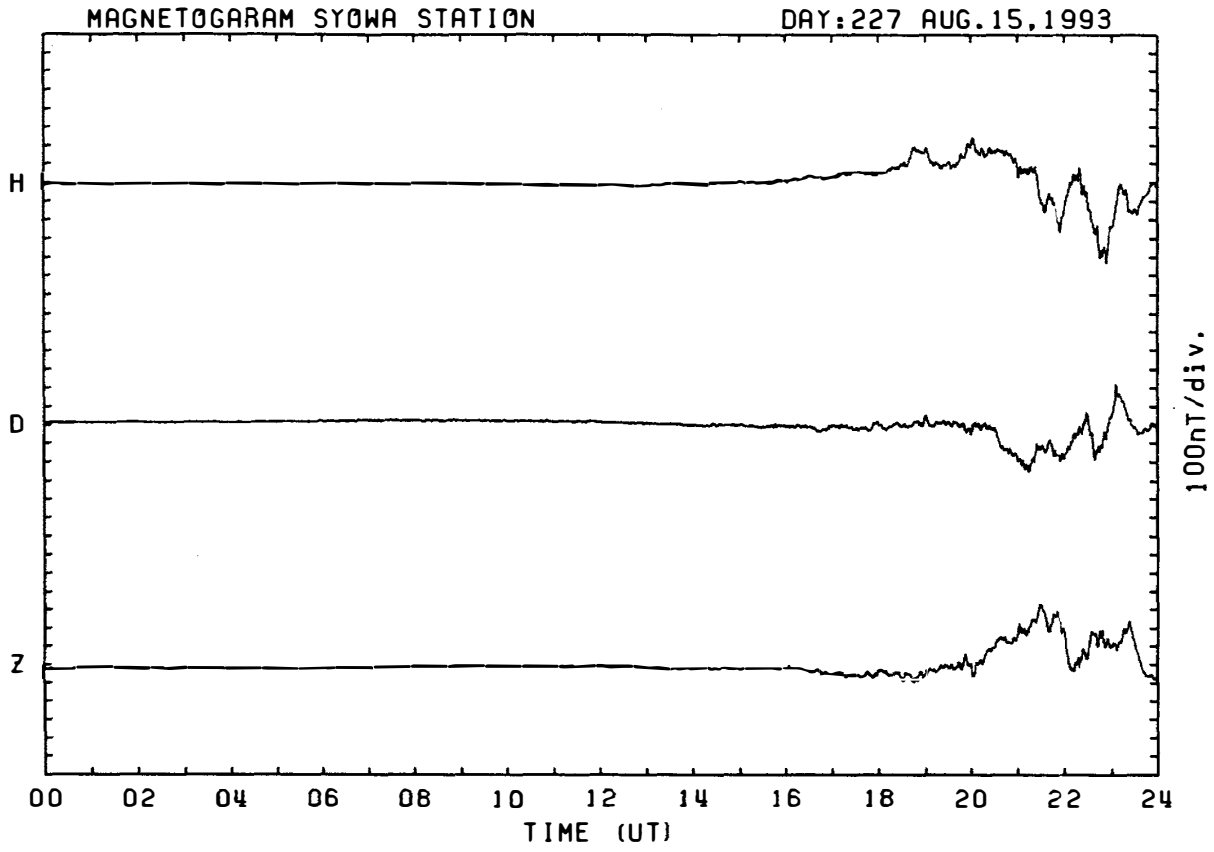
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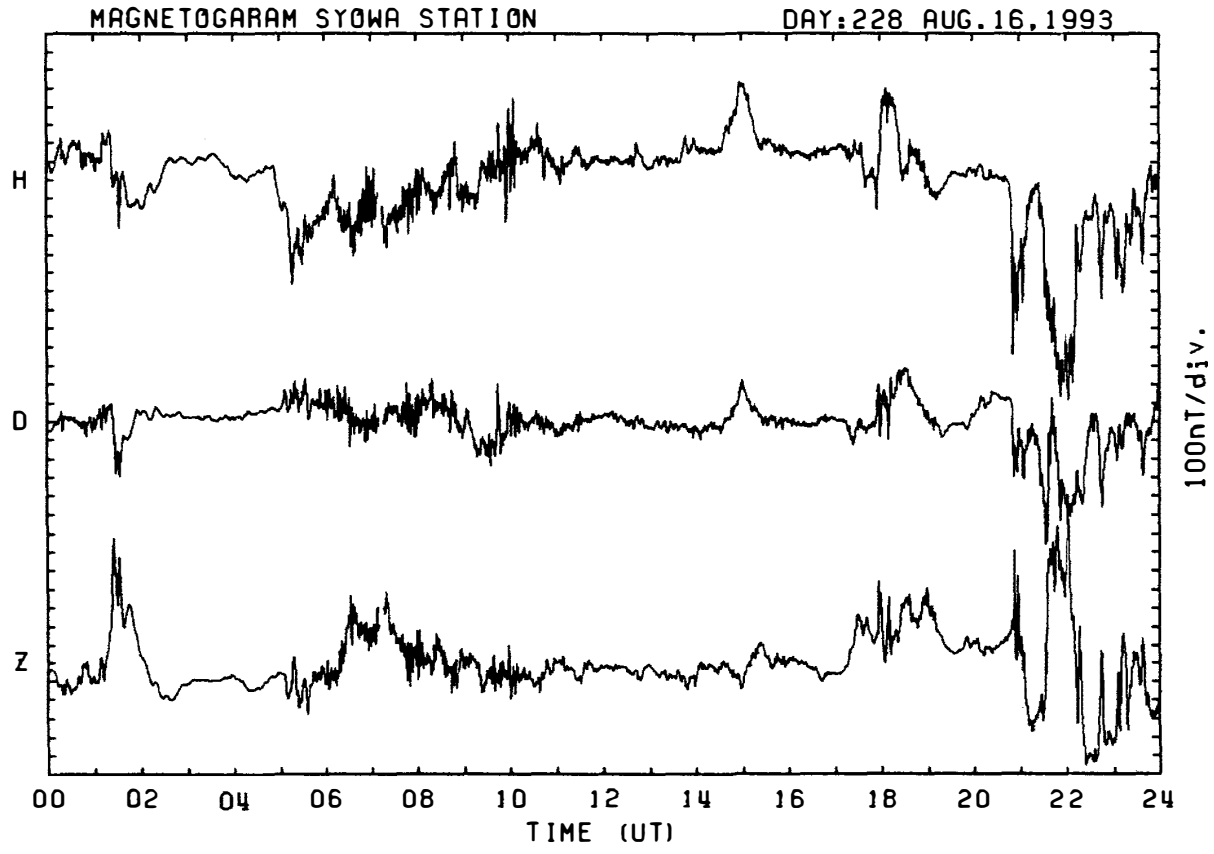
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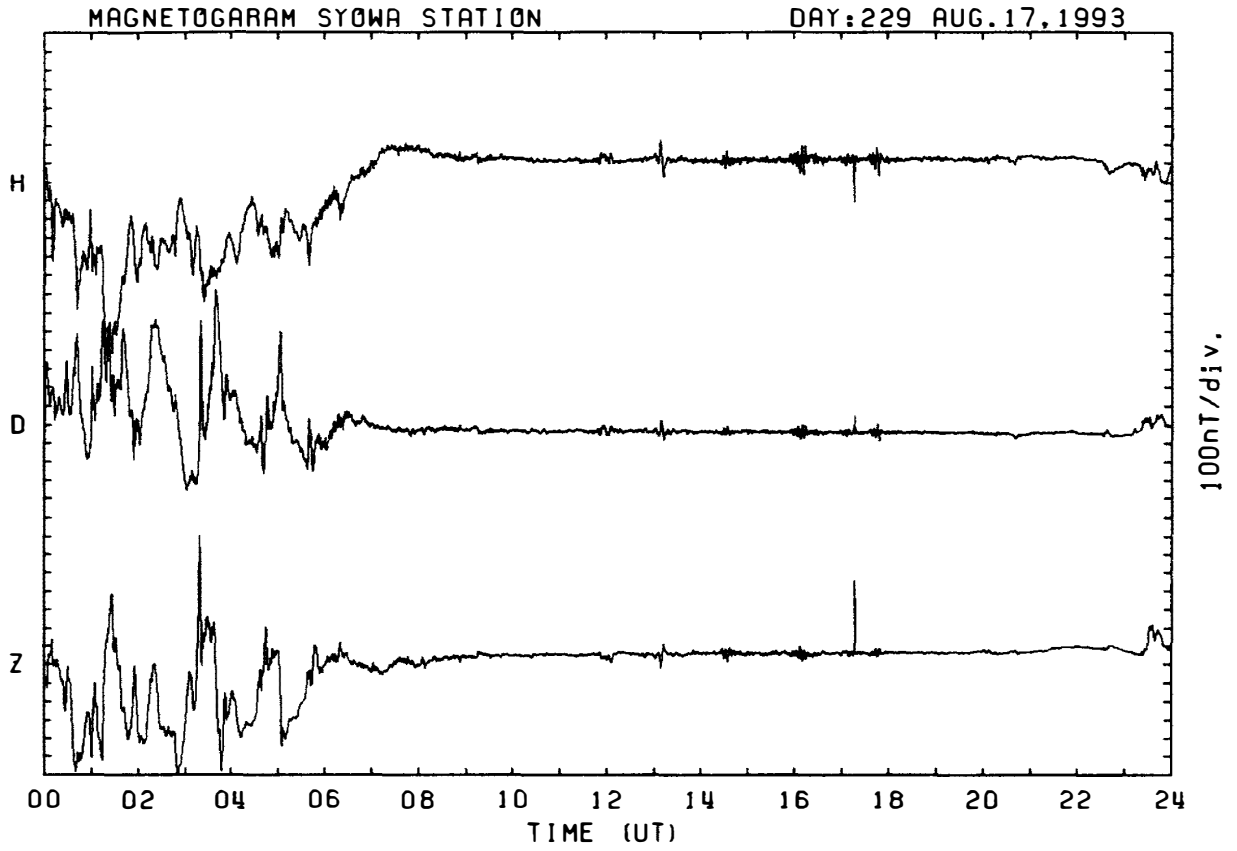
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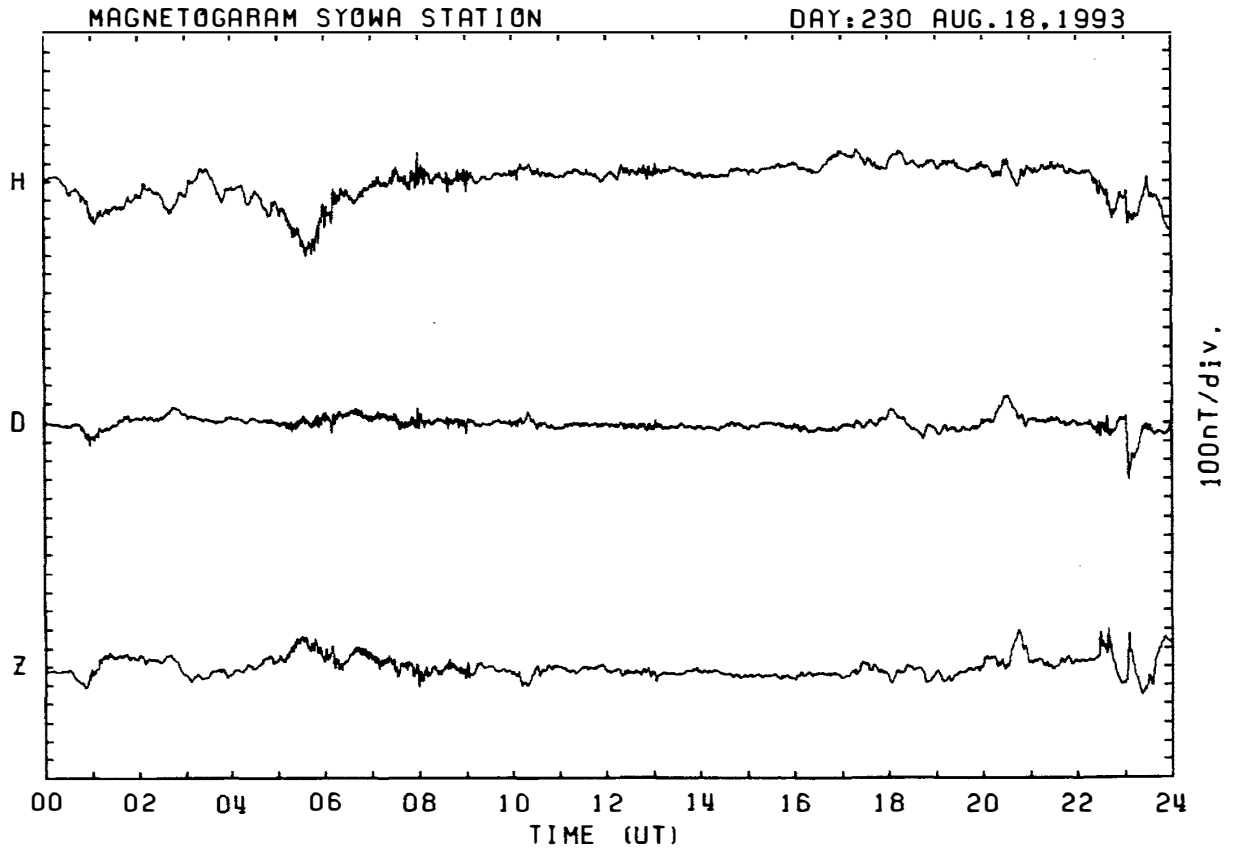
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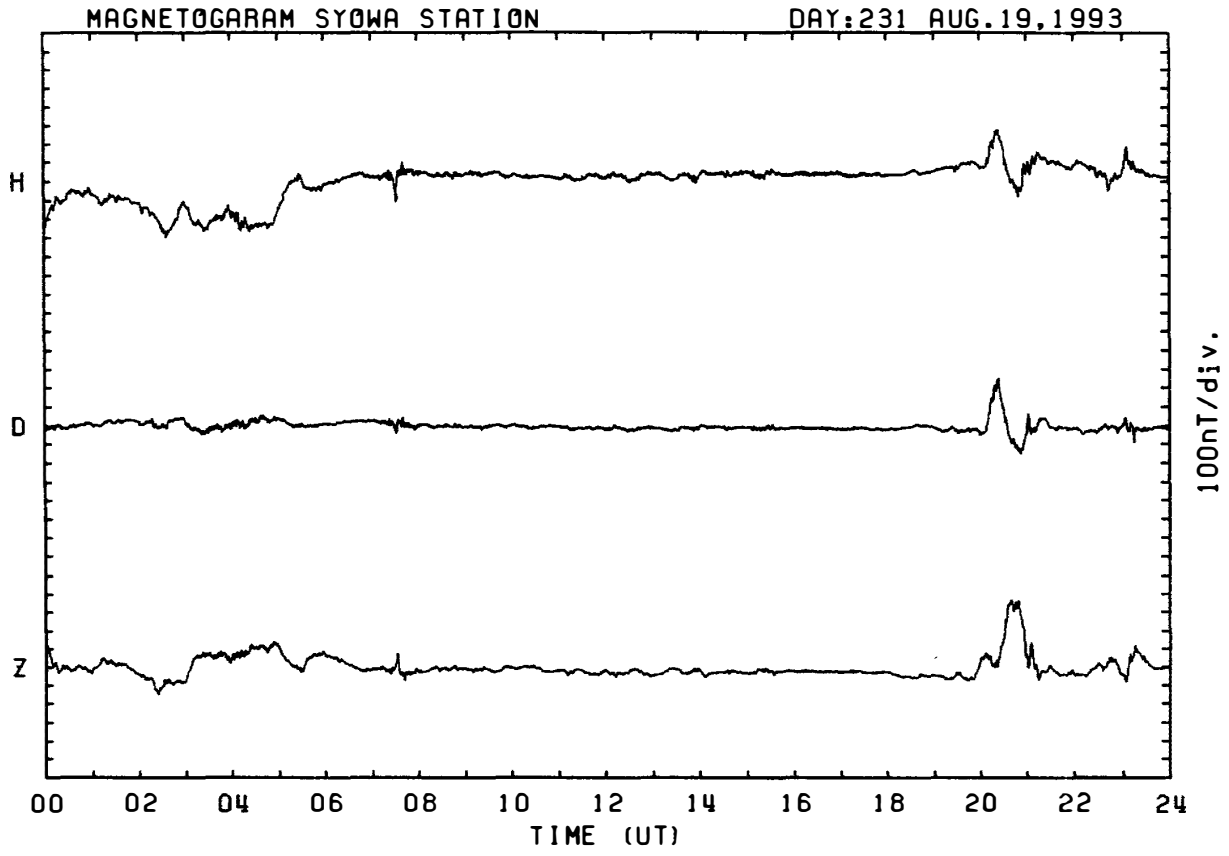
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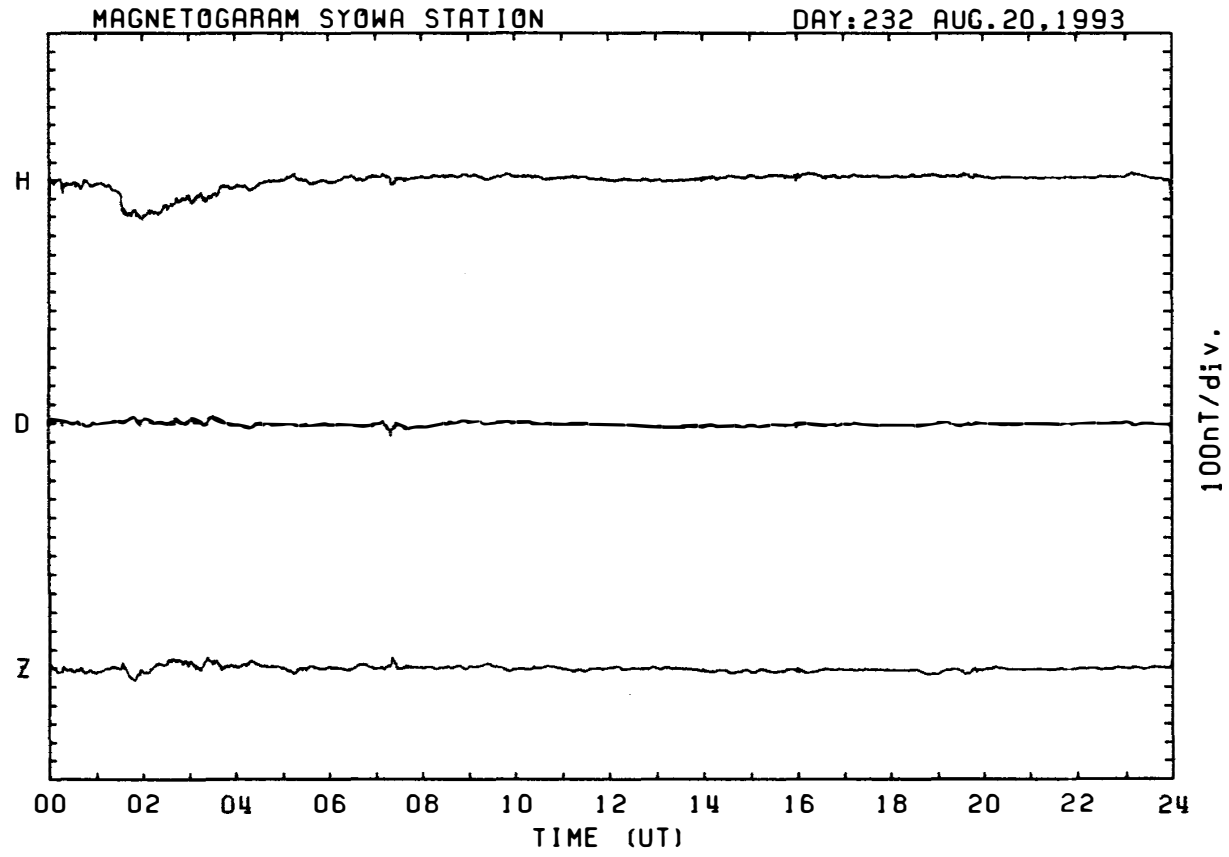
TIME (UT)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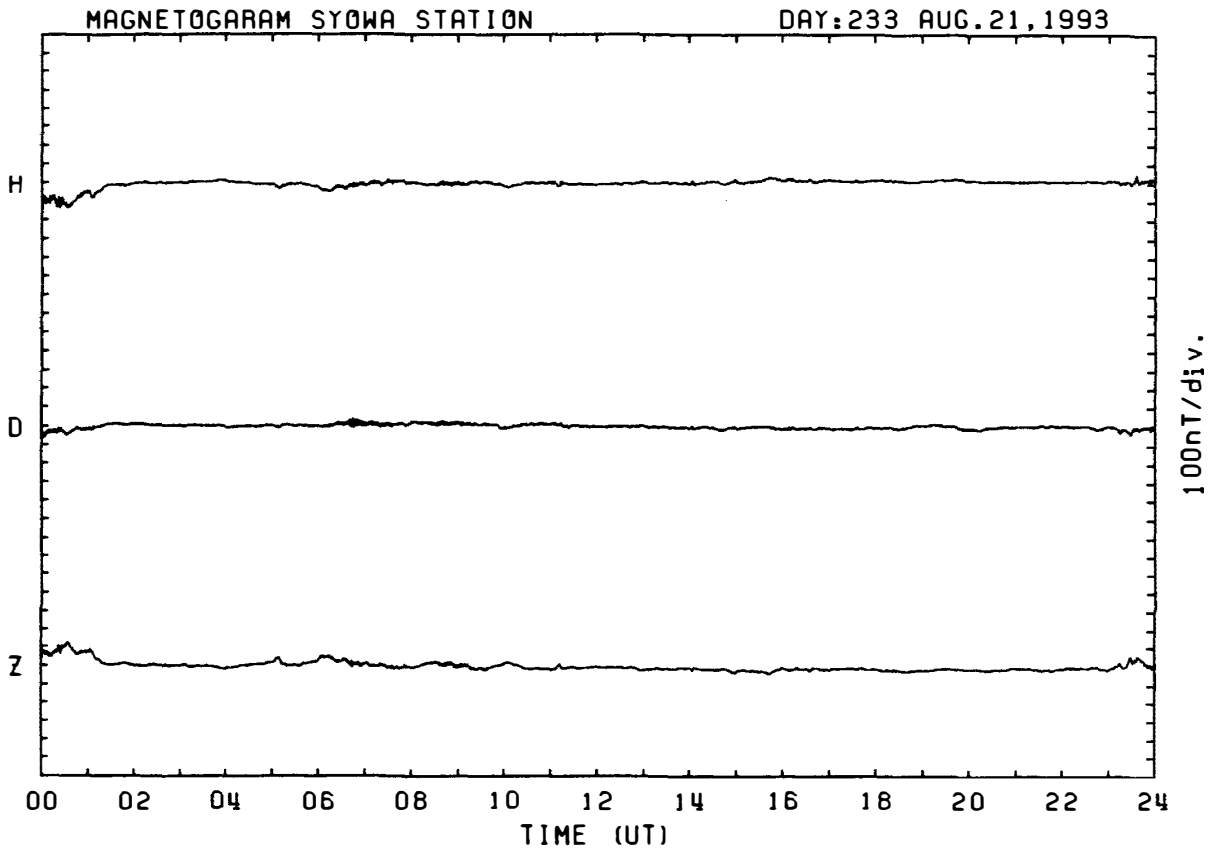
TIME (UT)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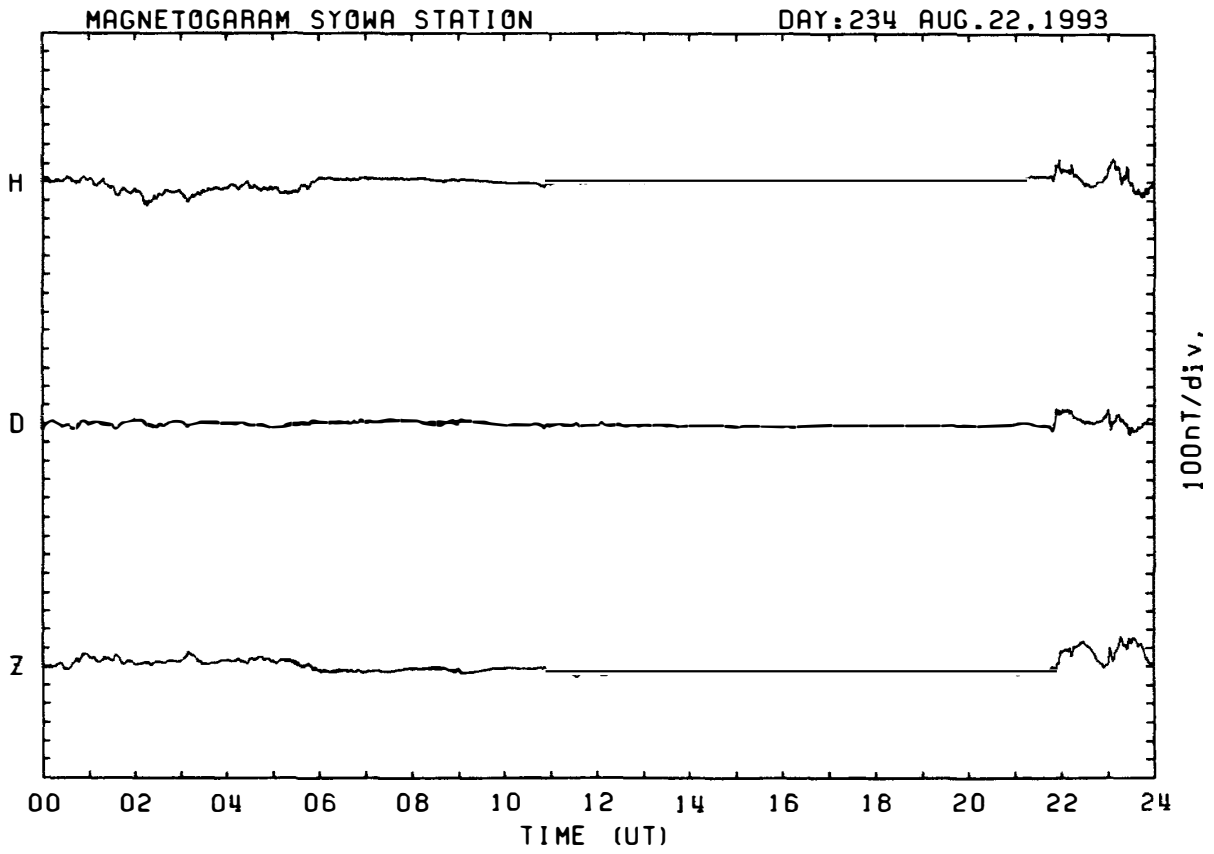
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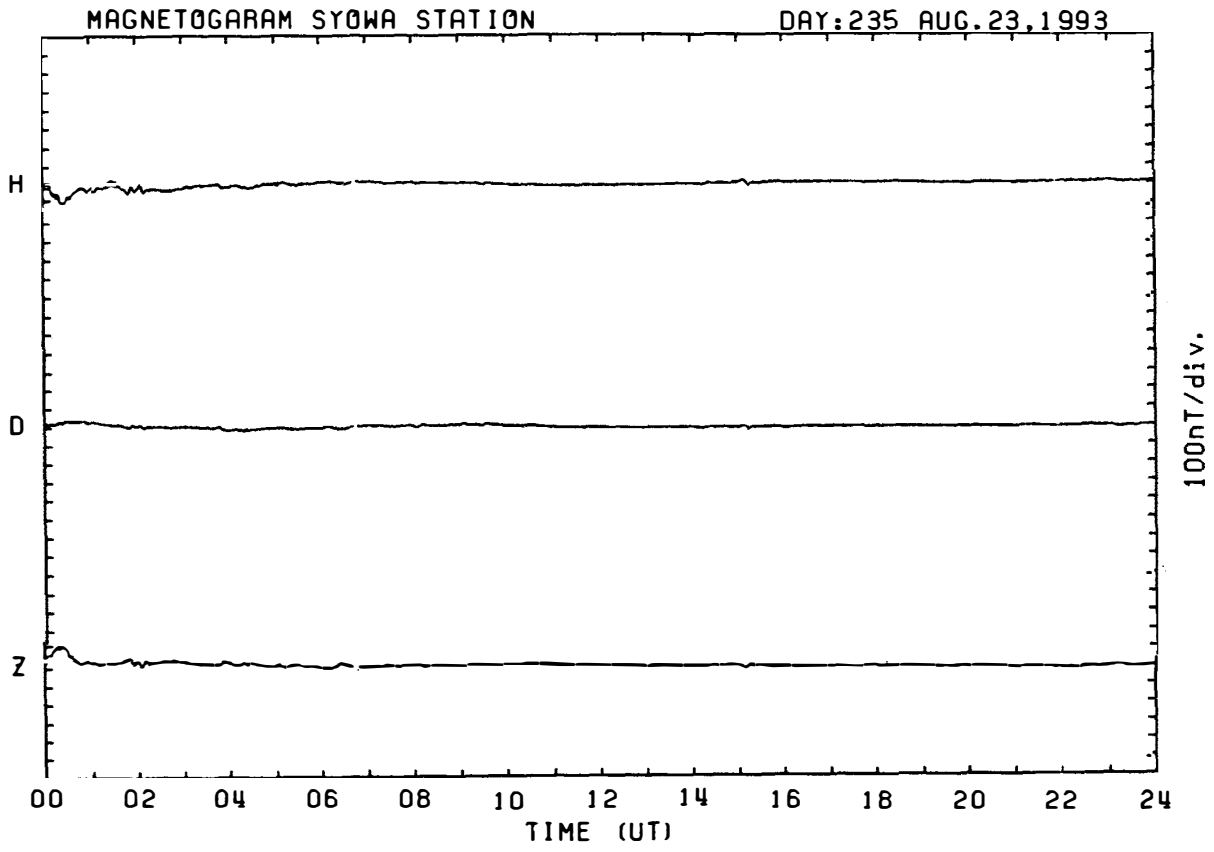
TIME (UT)


MAGNETOGARAM SYOWA STATION
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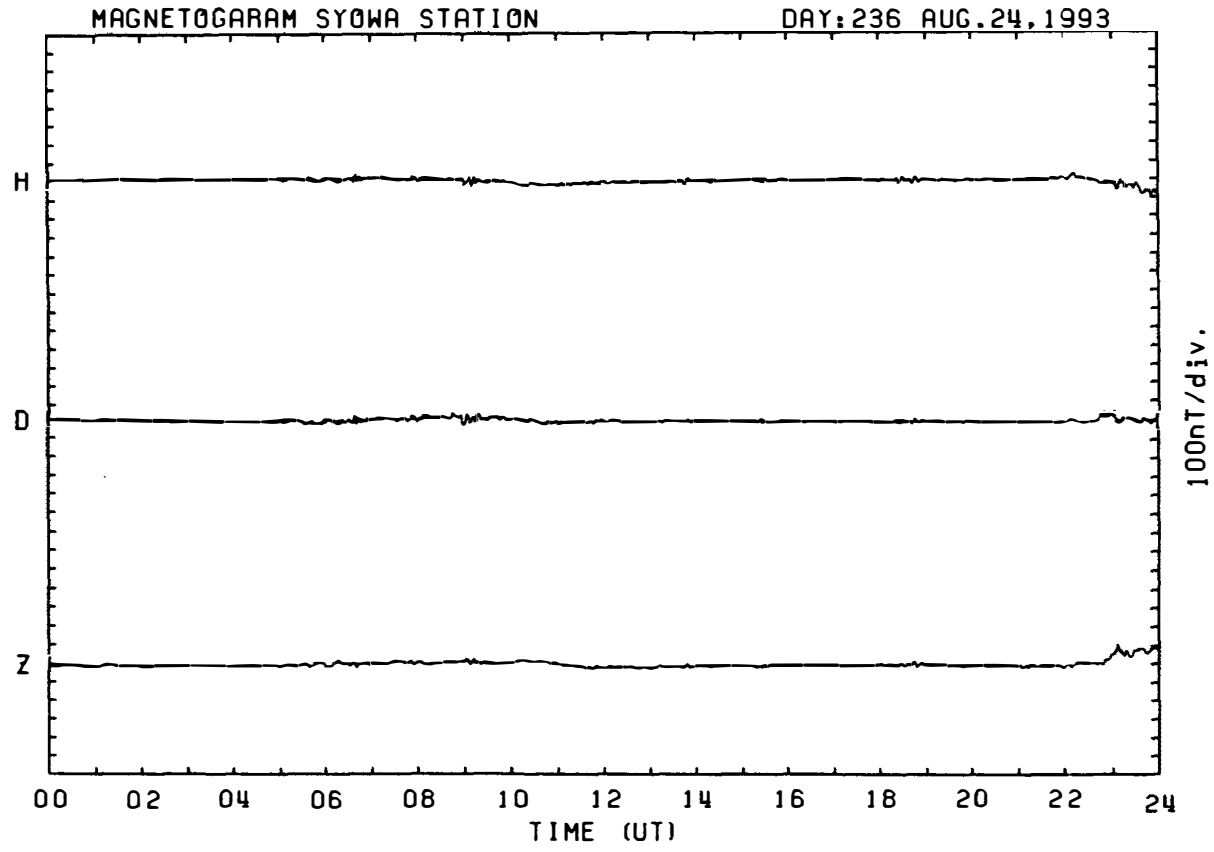
TIME (UT)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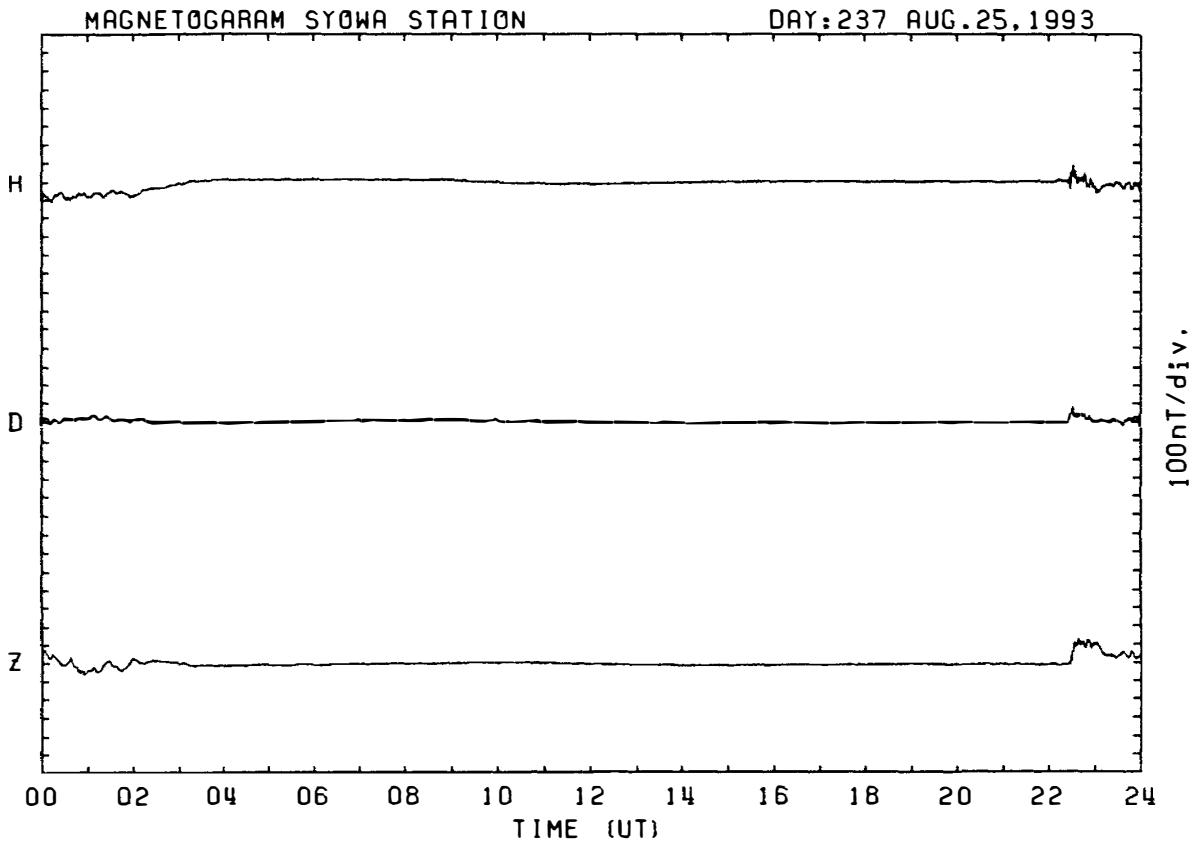
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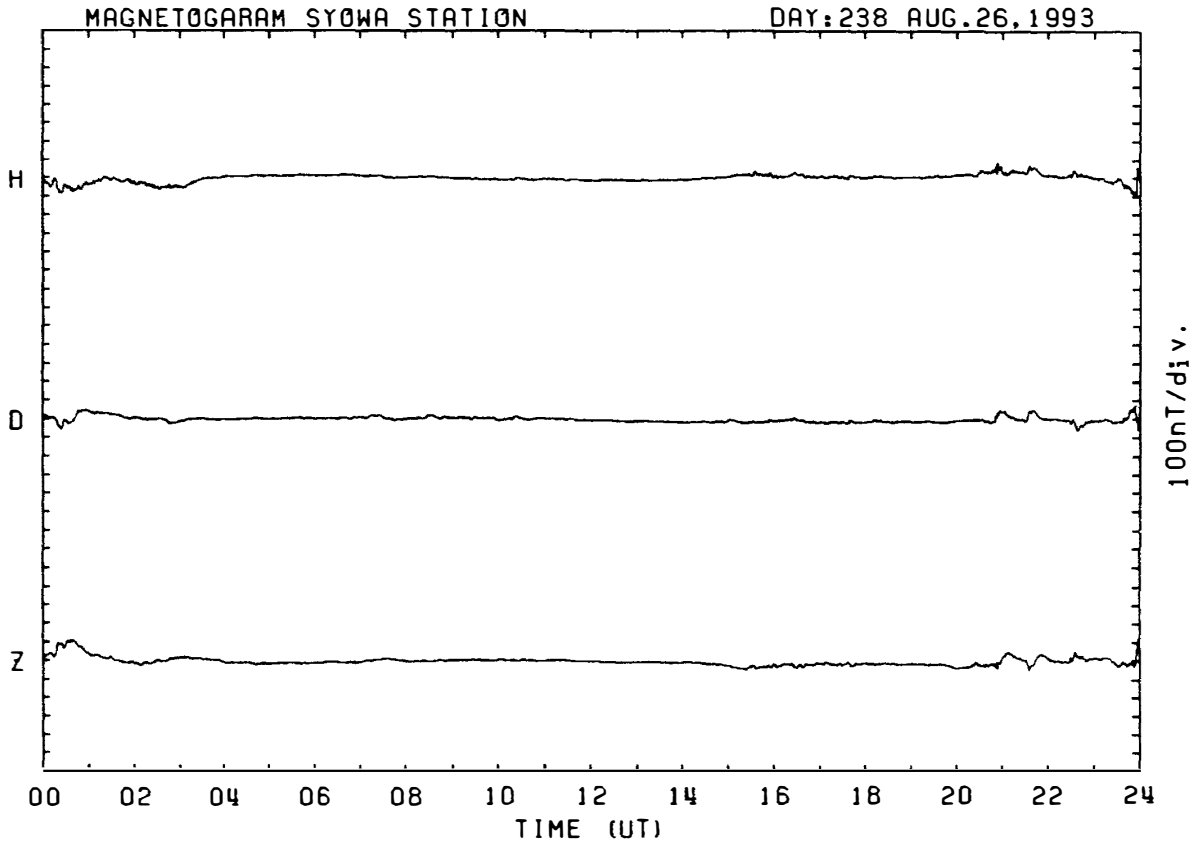
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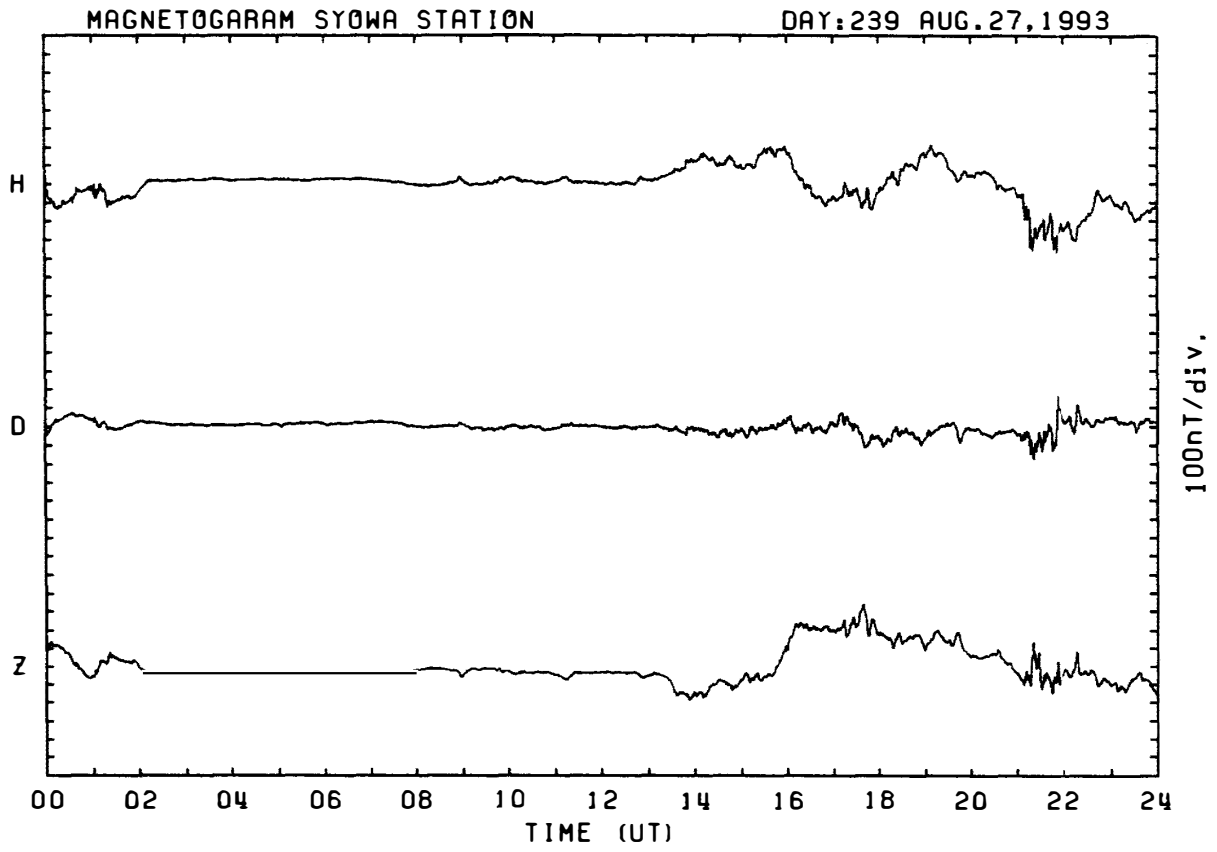
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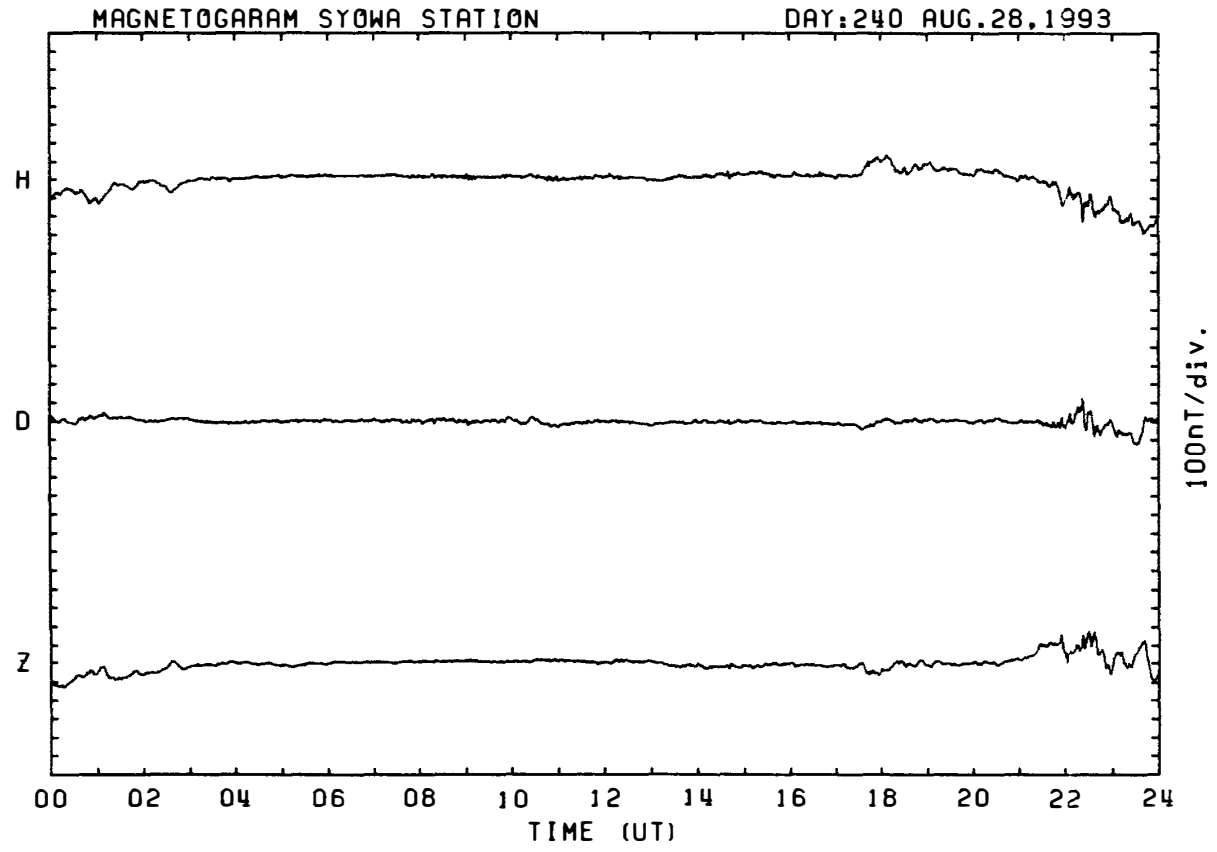
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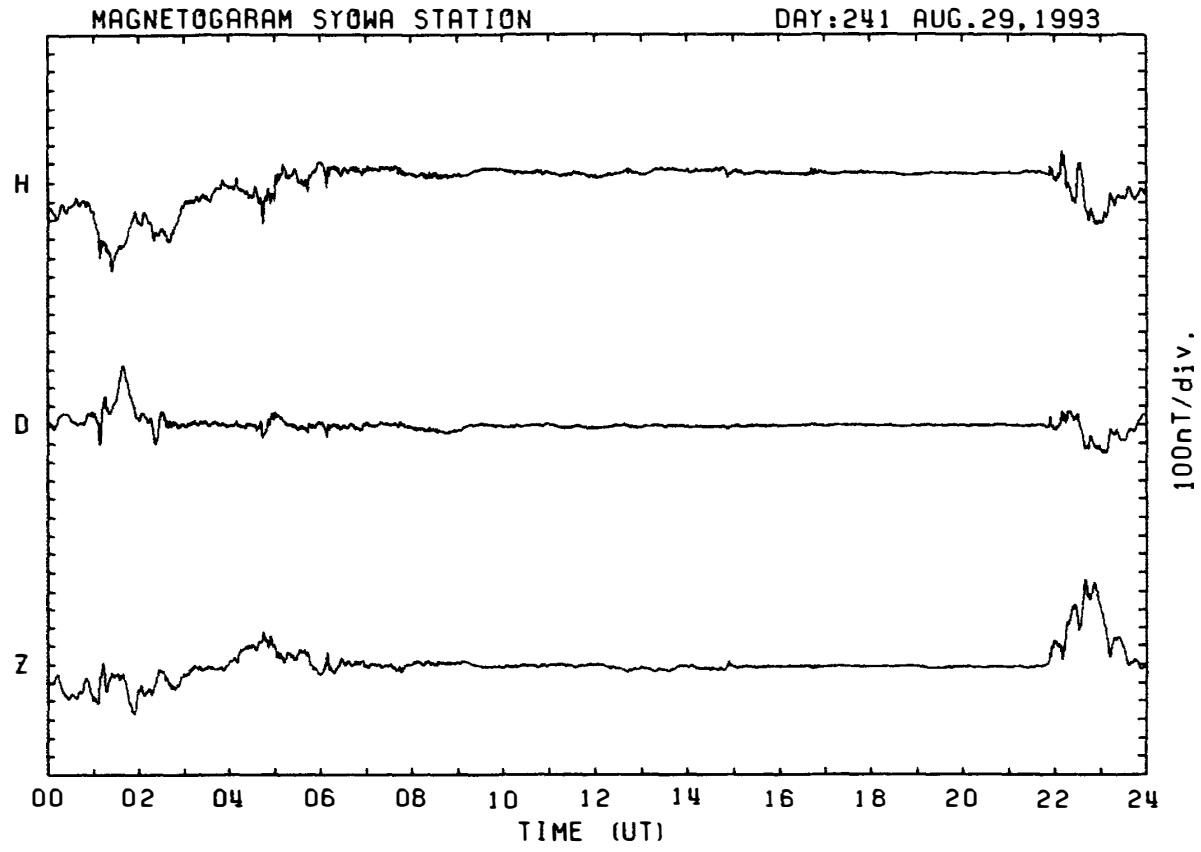
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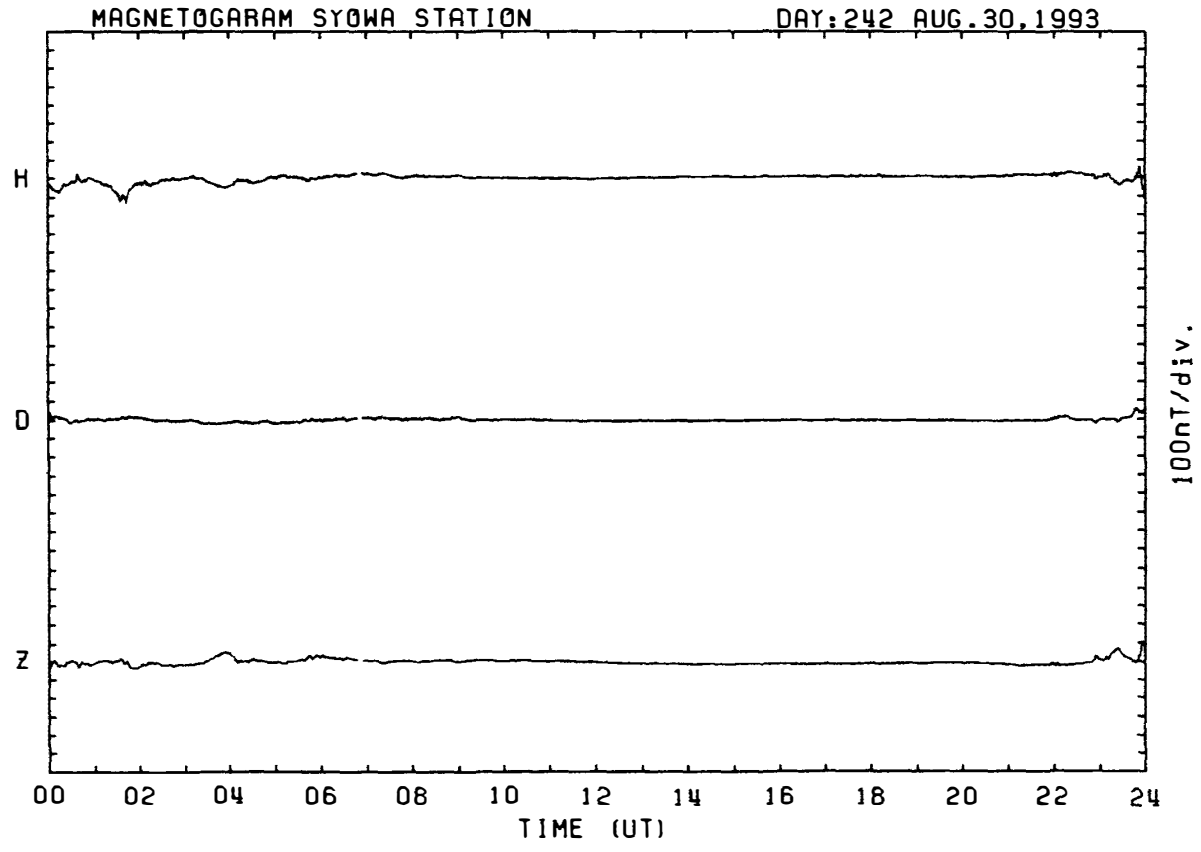
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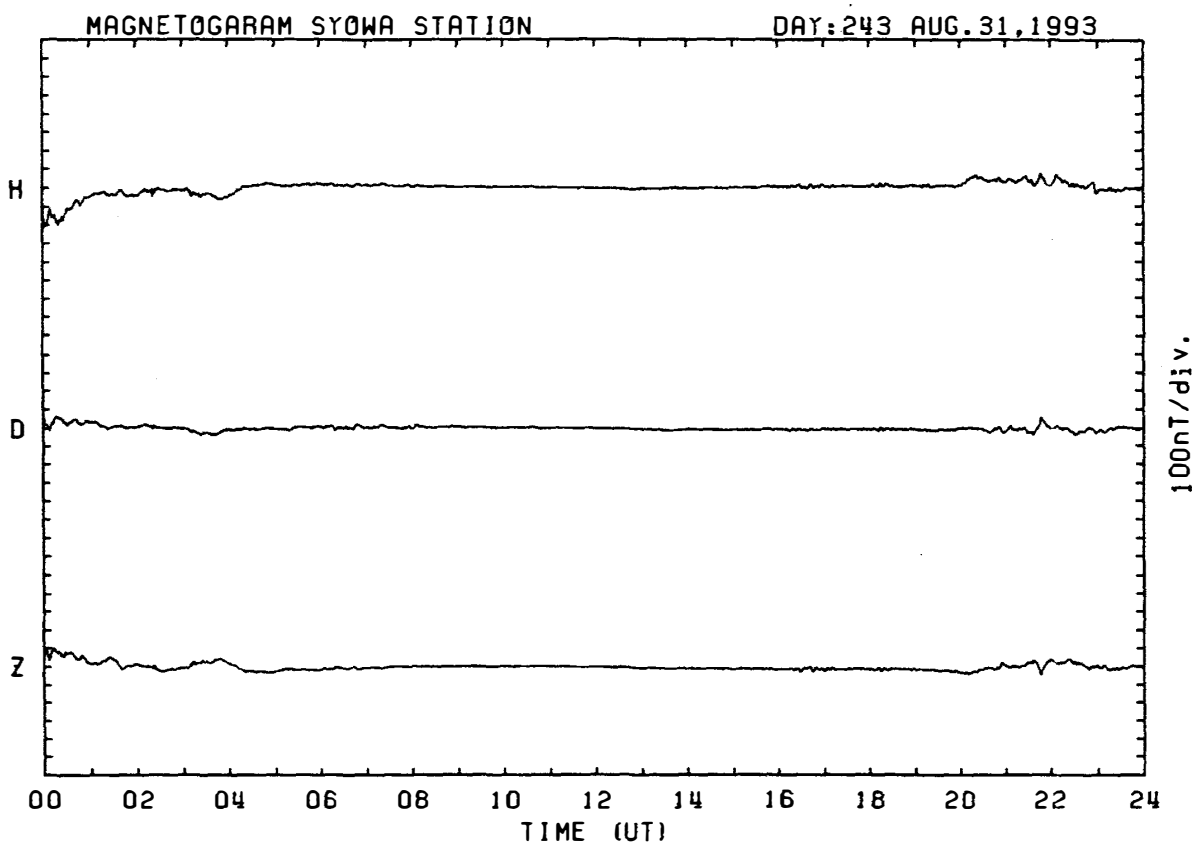
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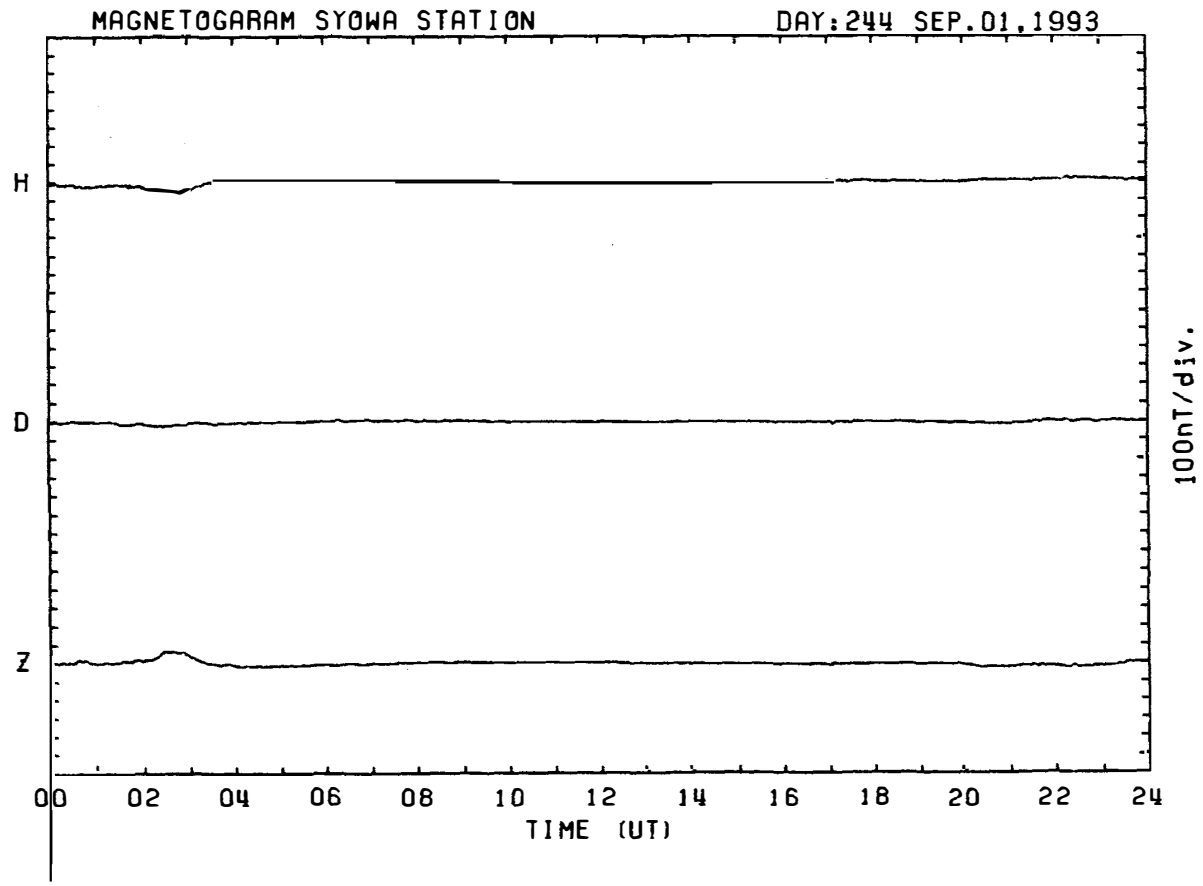
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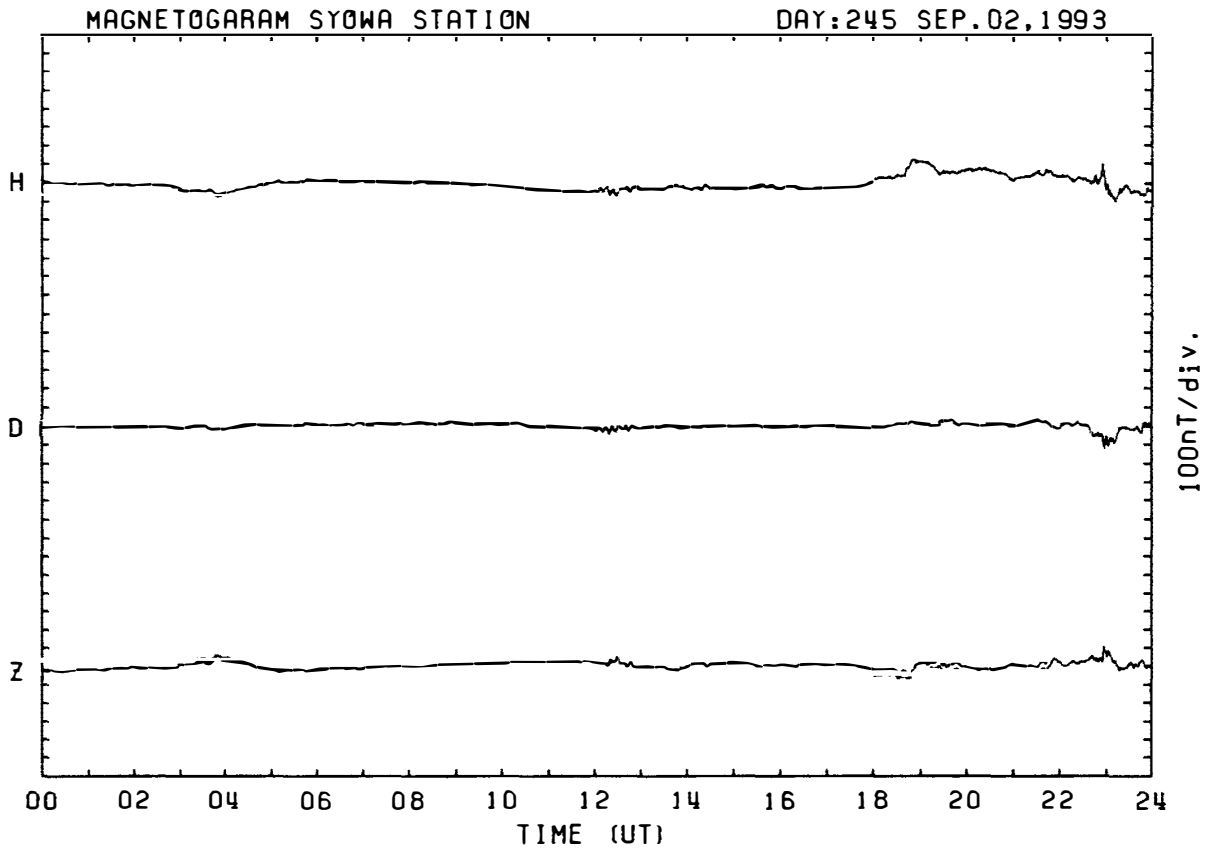
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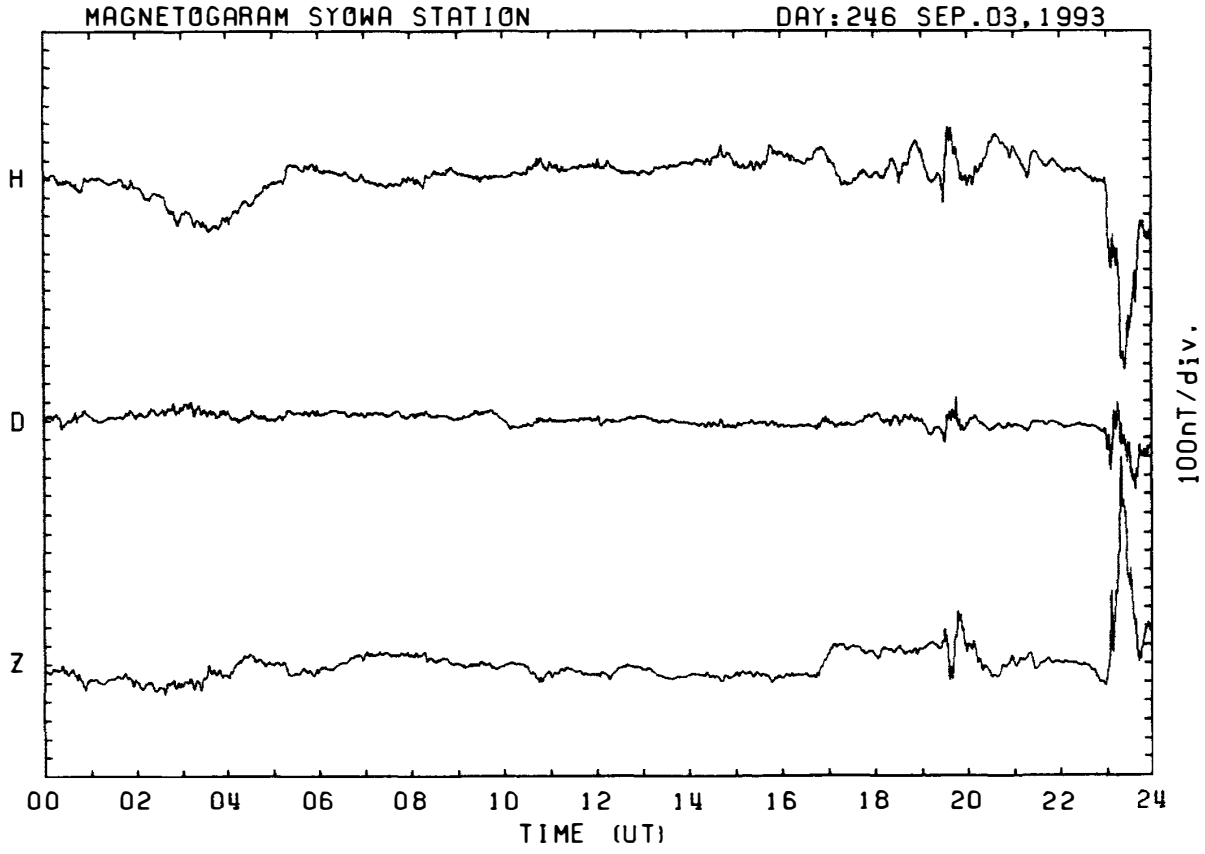
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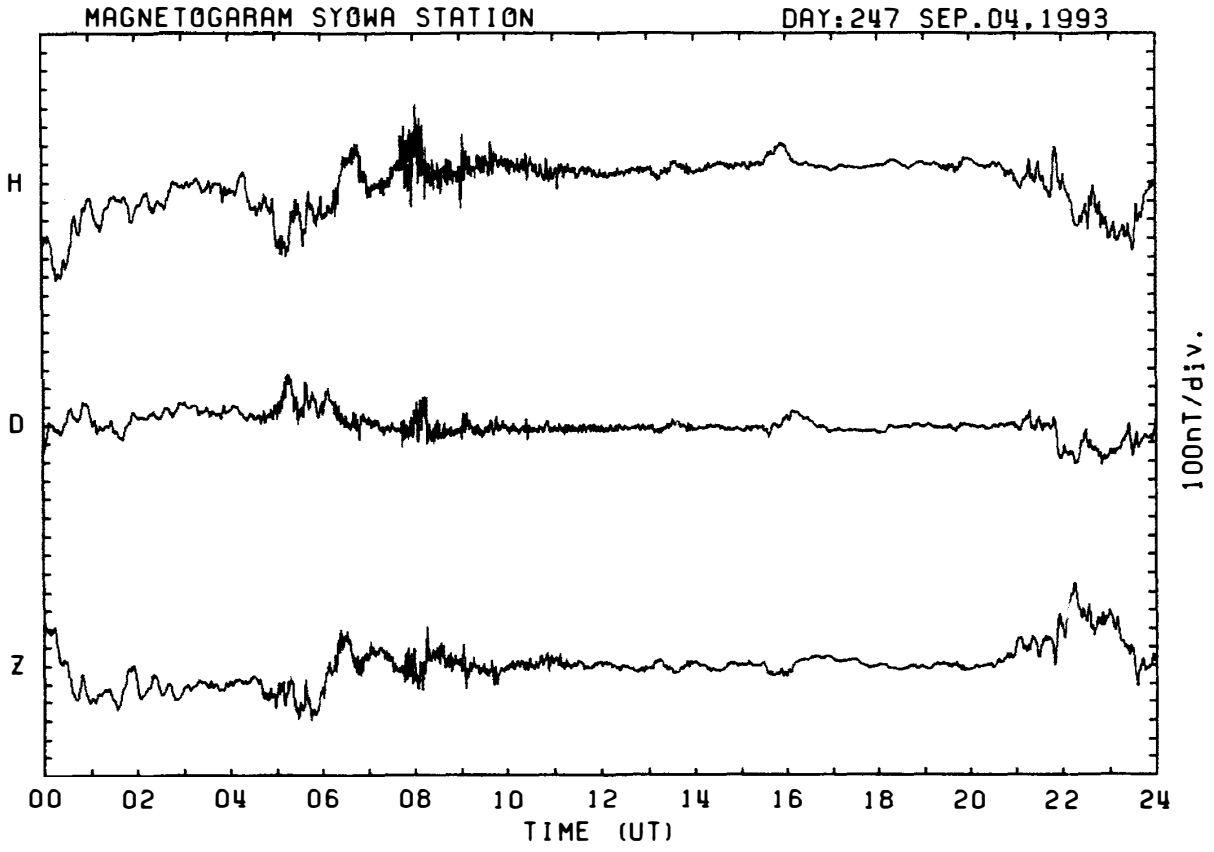
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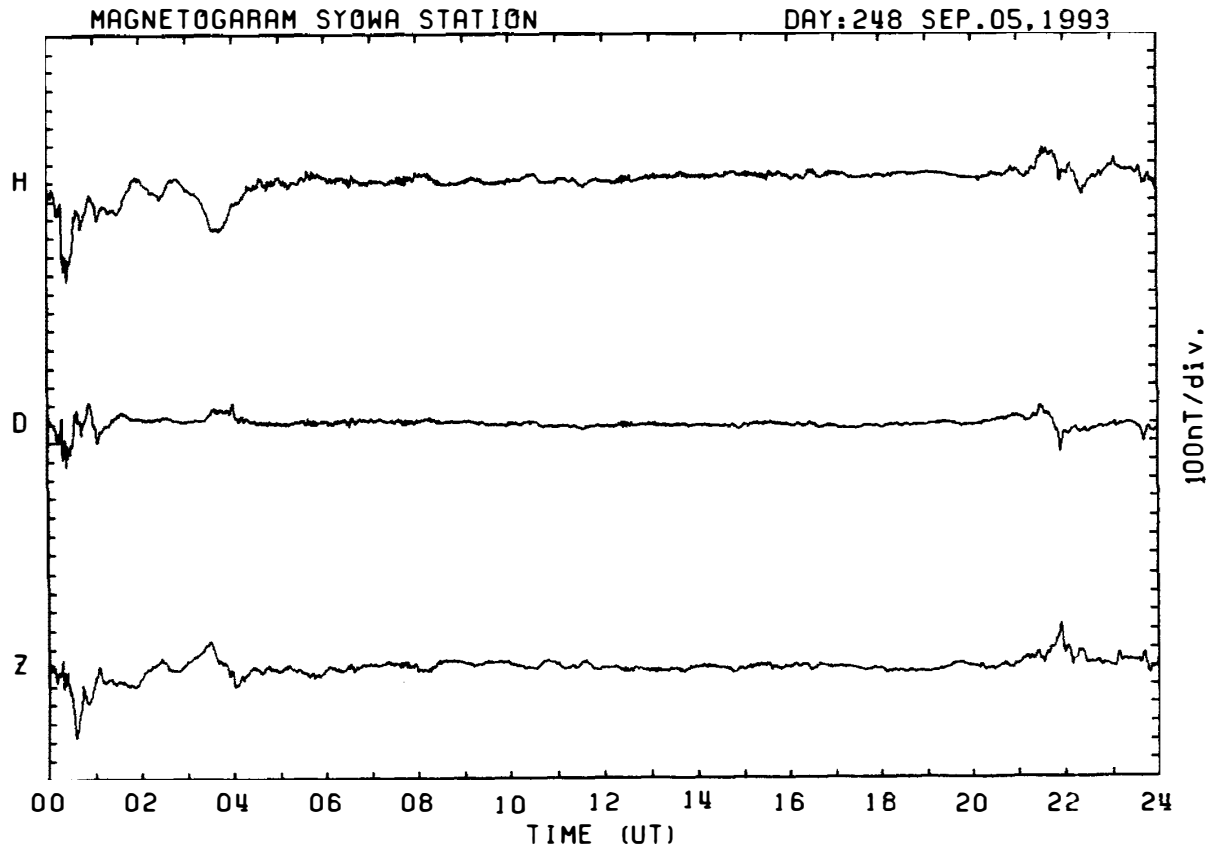
TIME (UT)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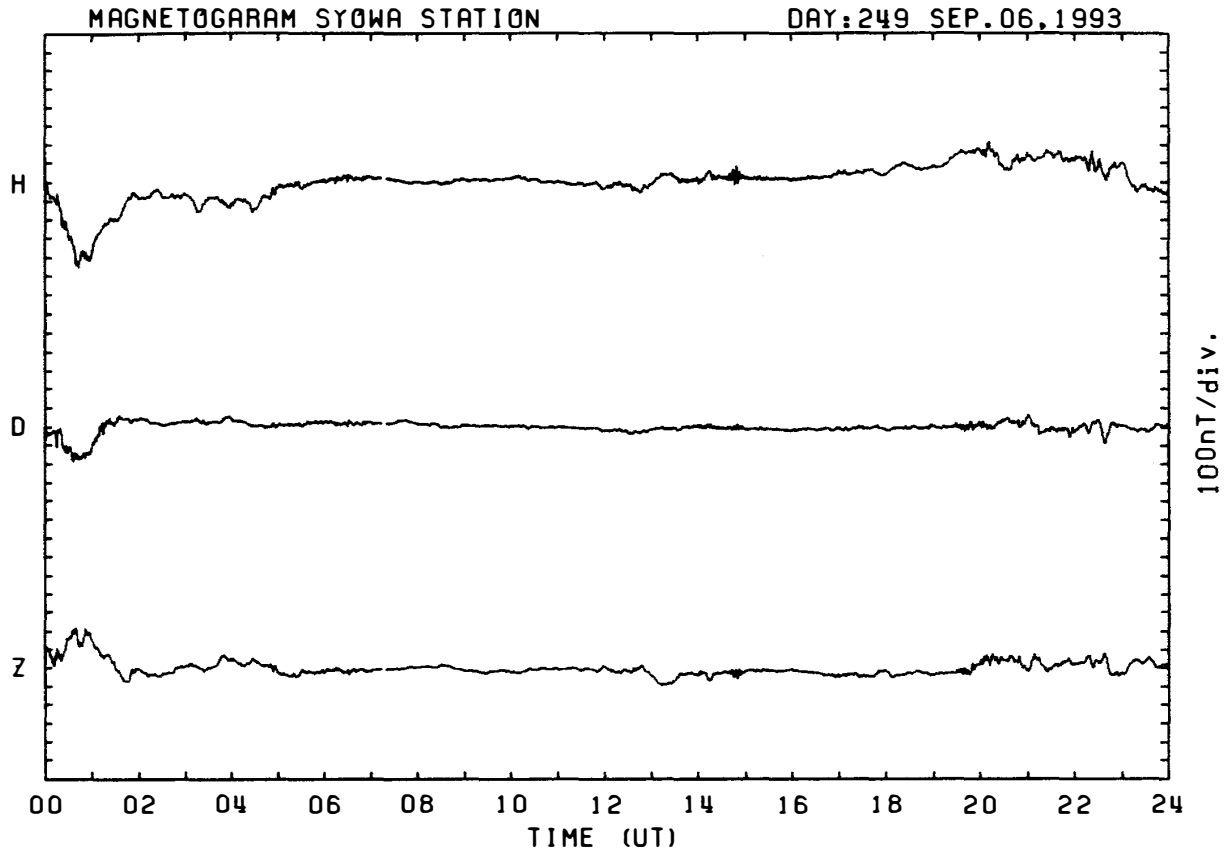
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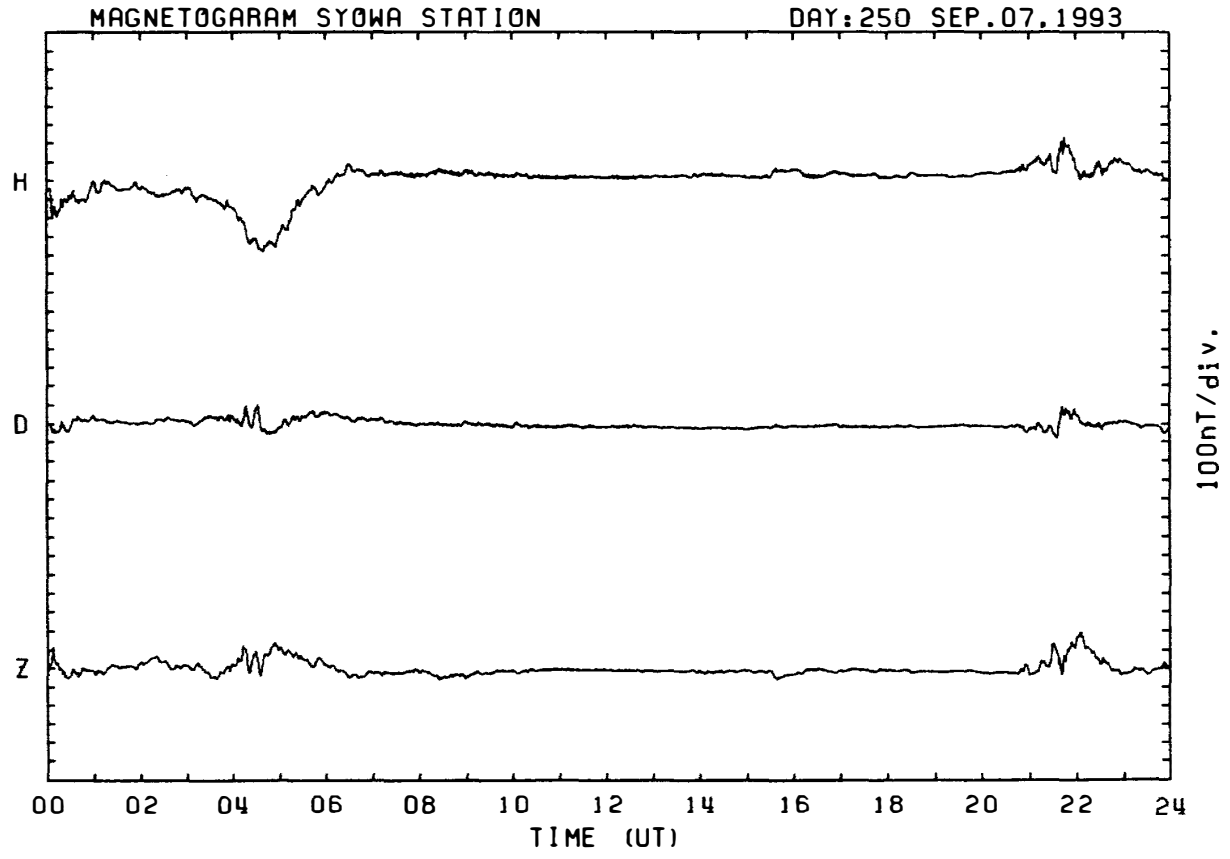
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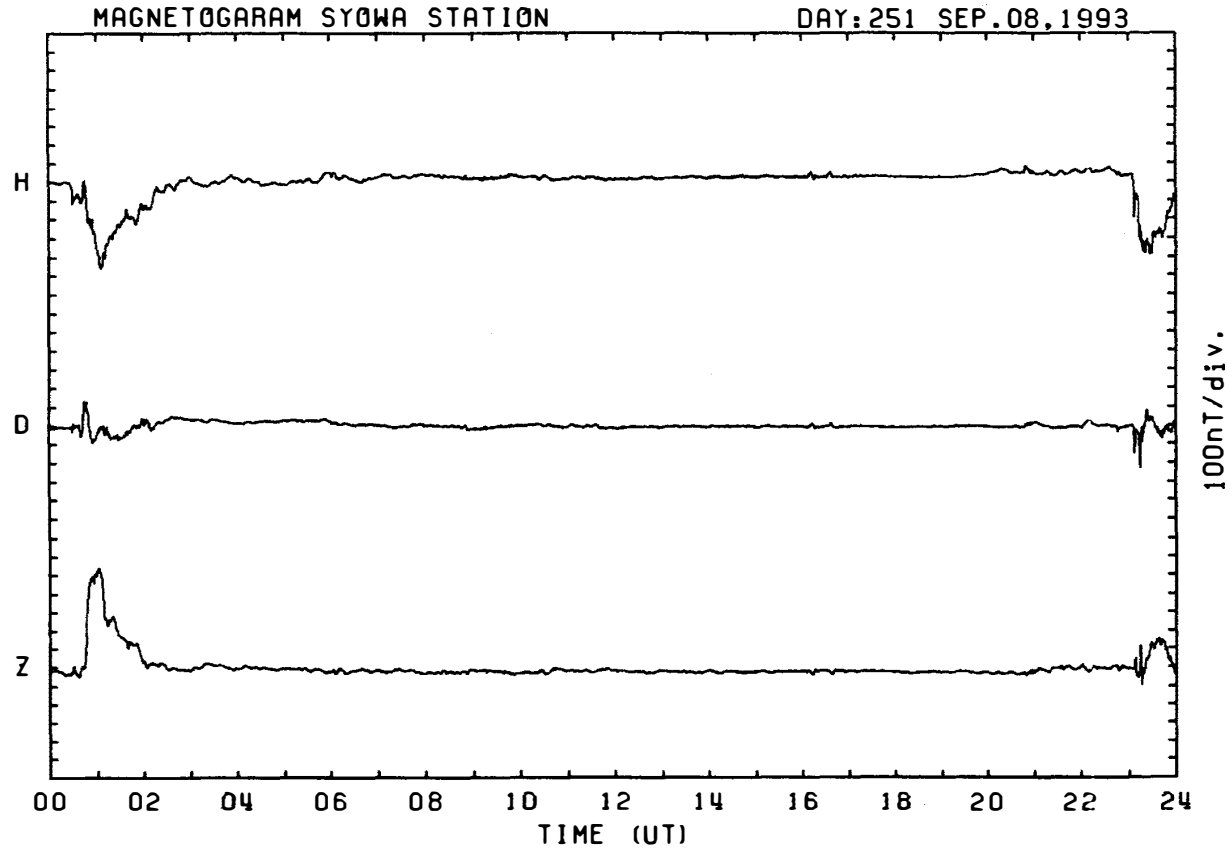
TIME (UT)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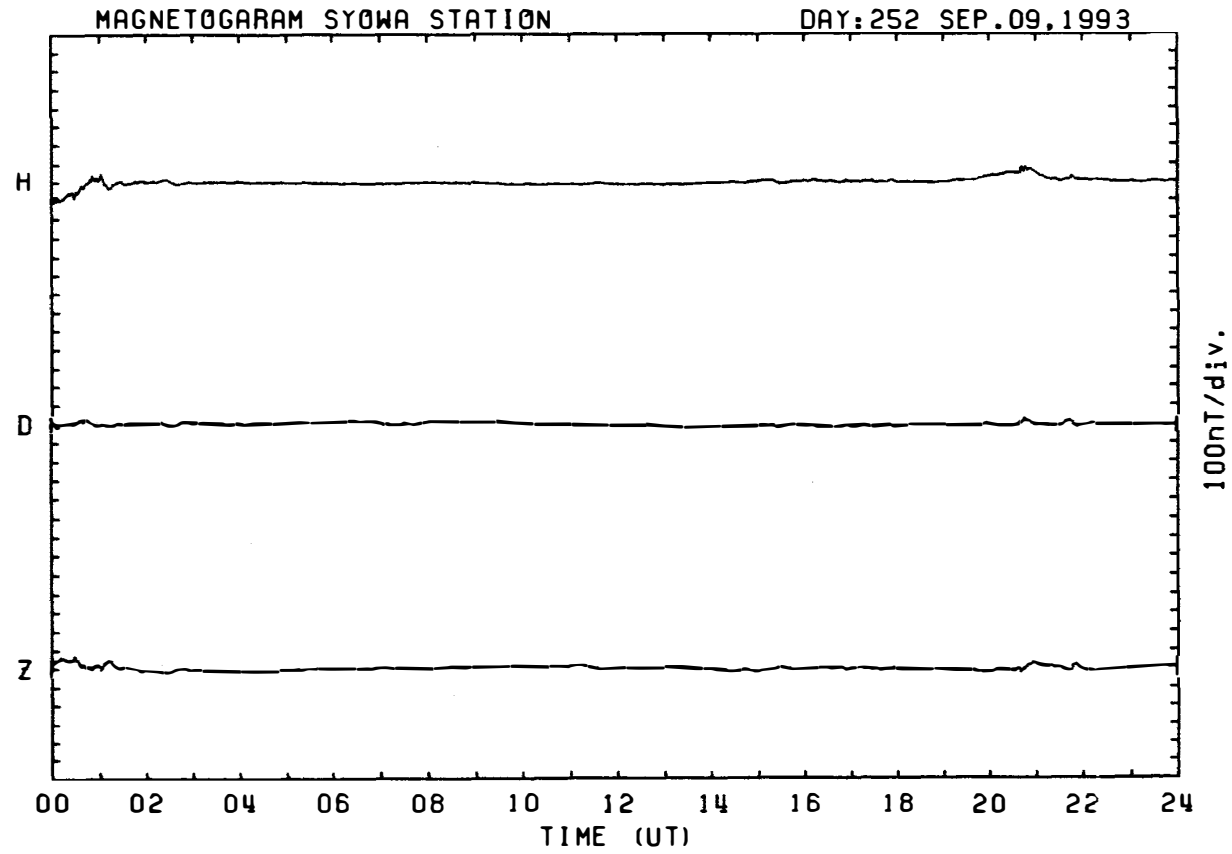
TIME (UT)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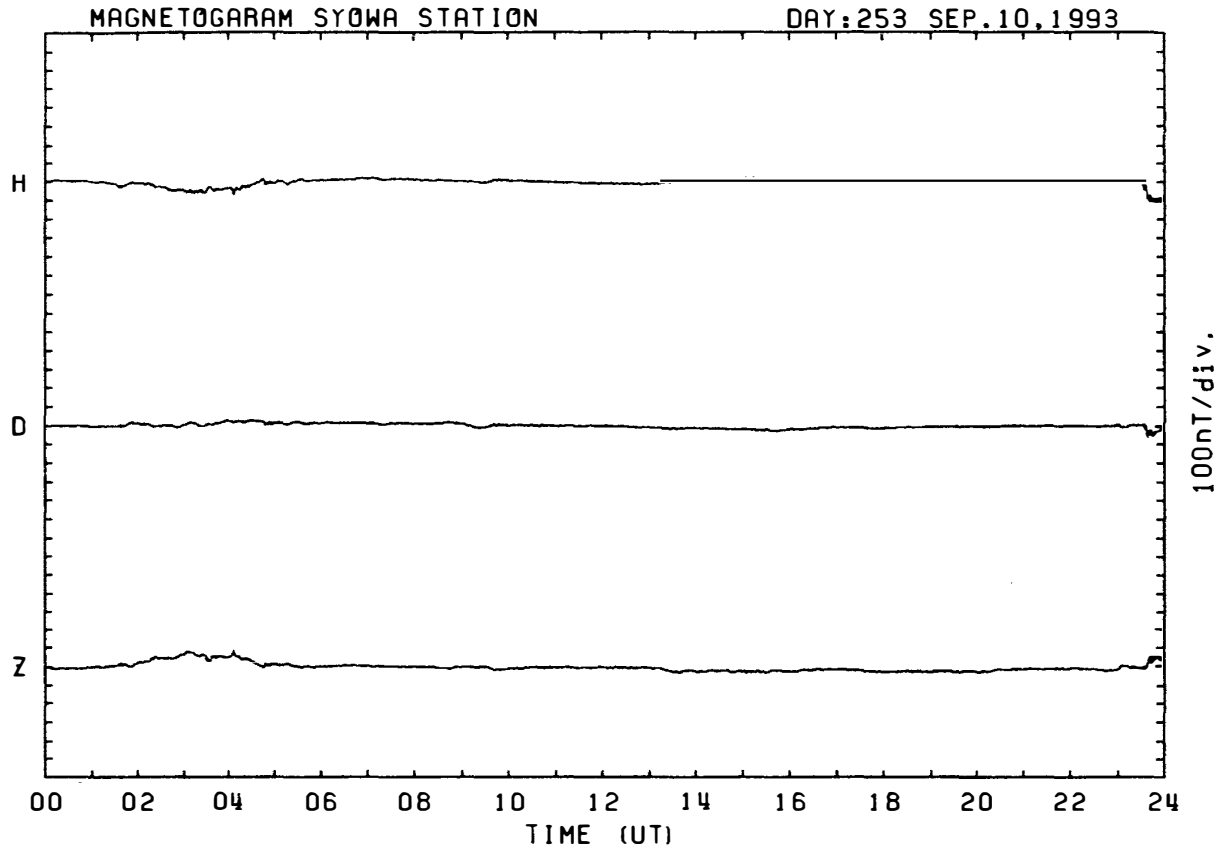
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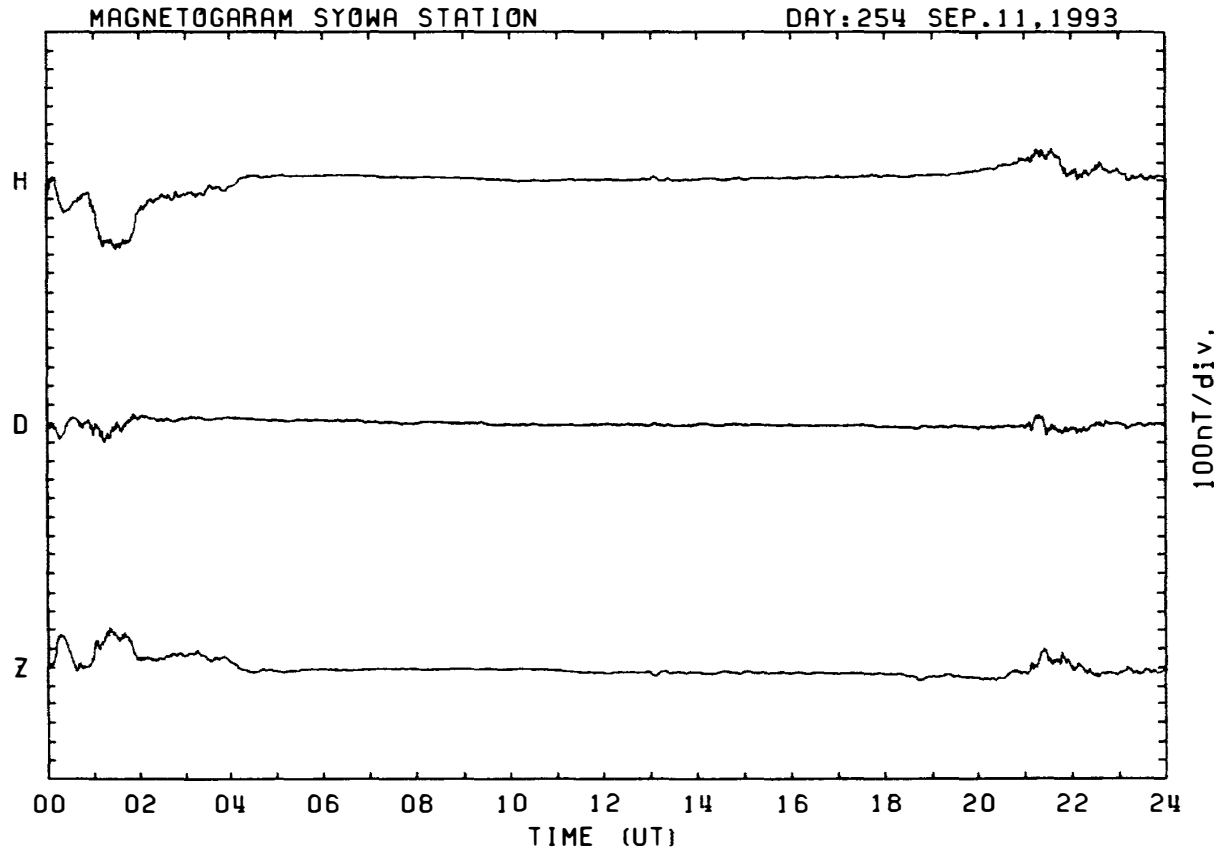
TIME (UT)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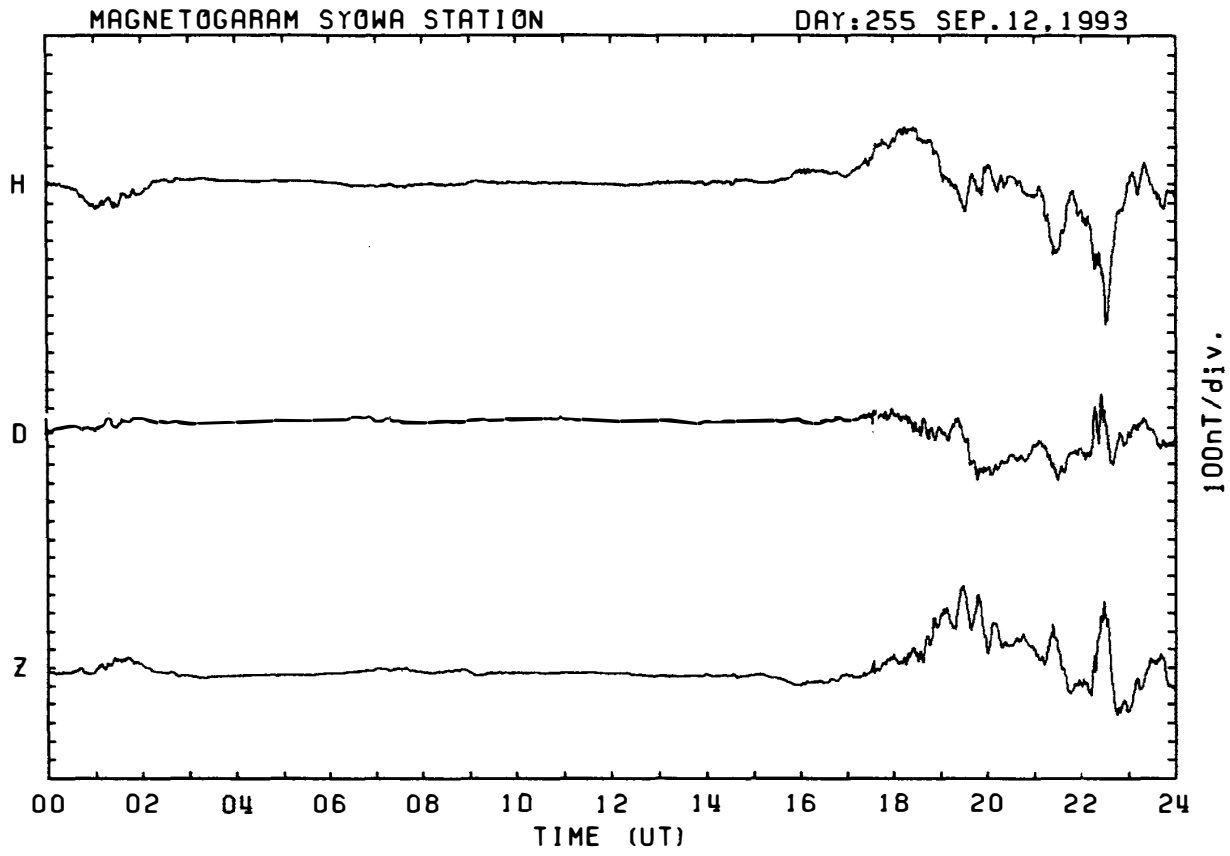
TIME (UT)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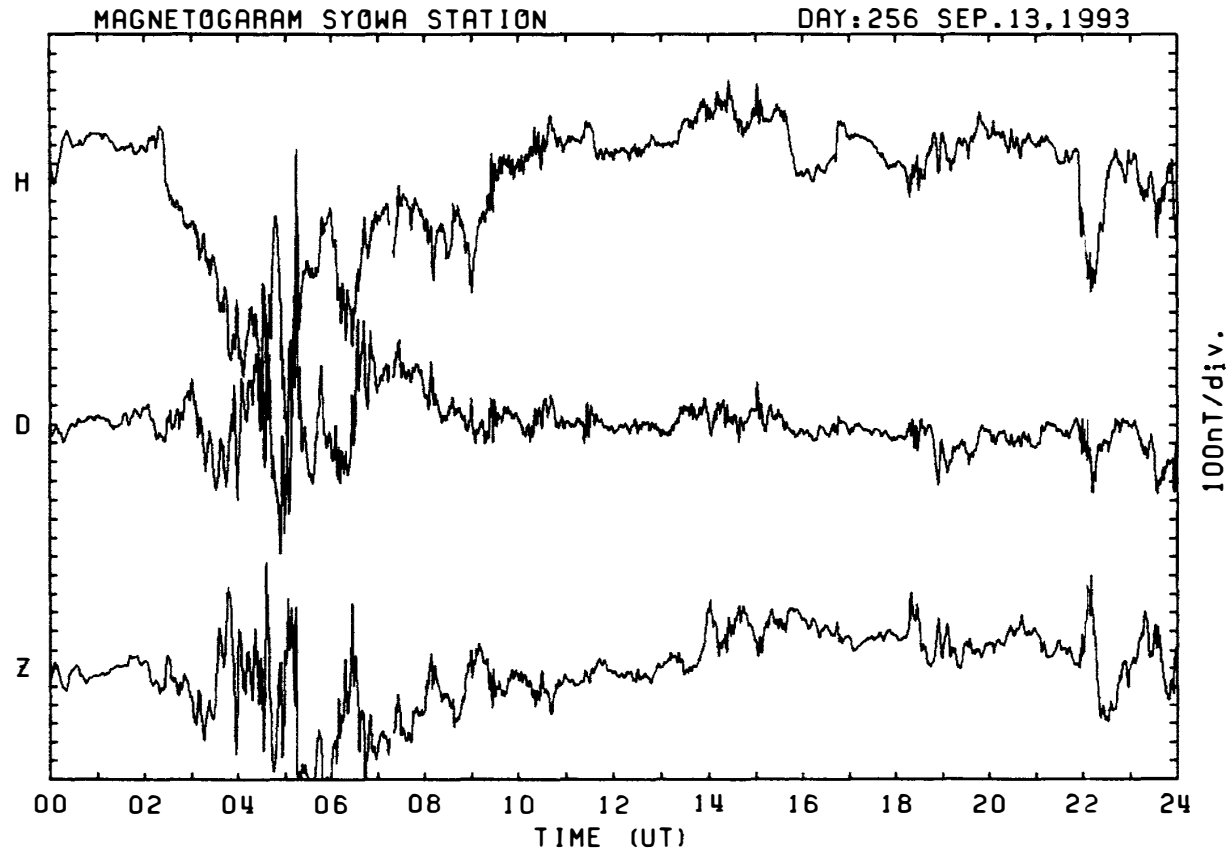
TIME (UT)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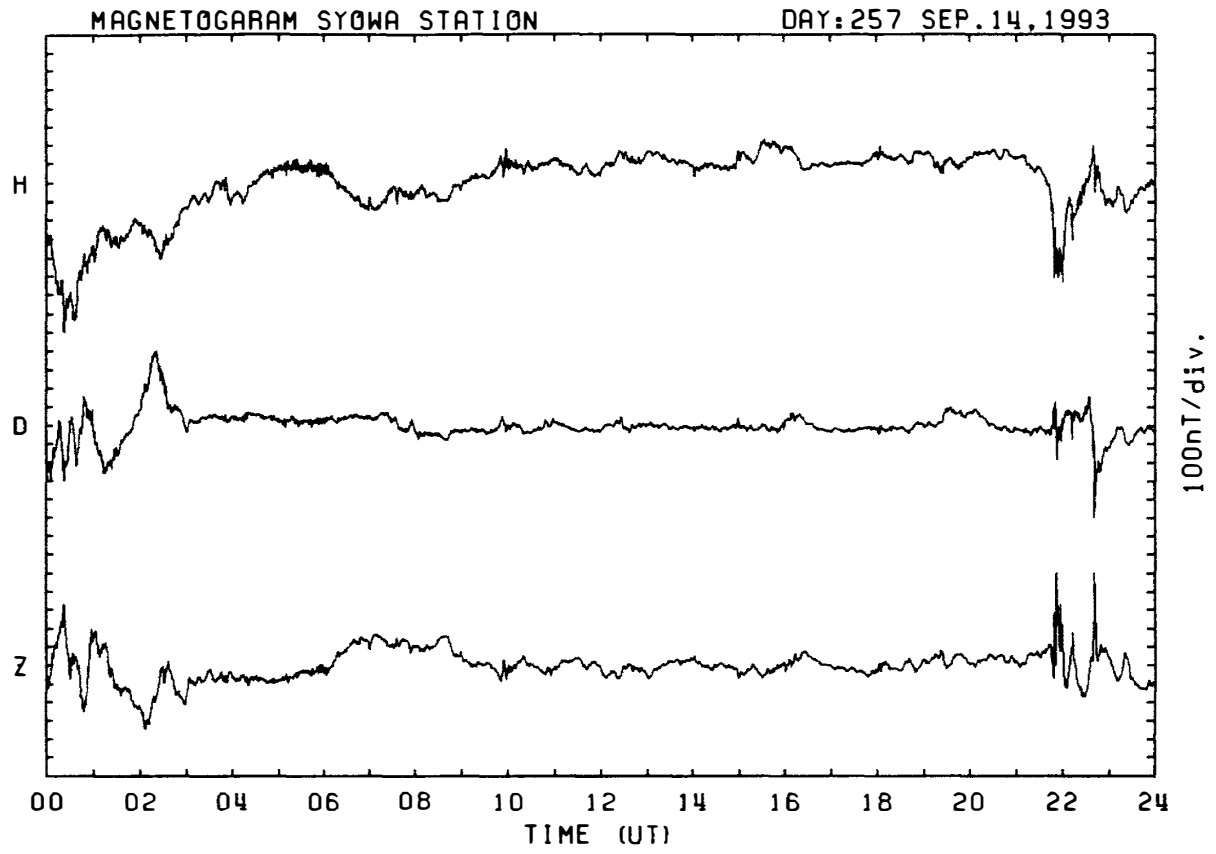
TIME (UT)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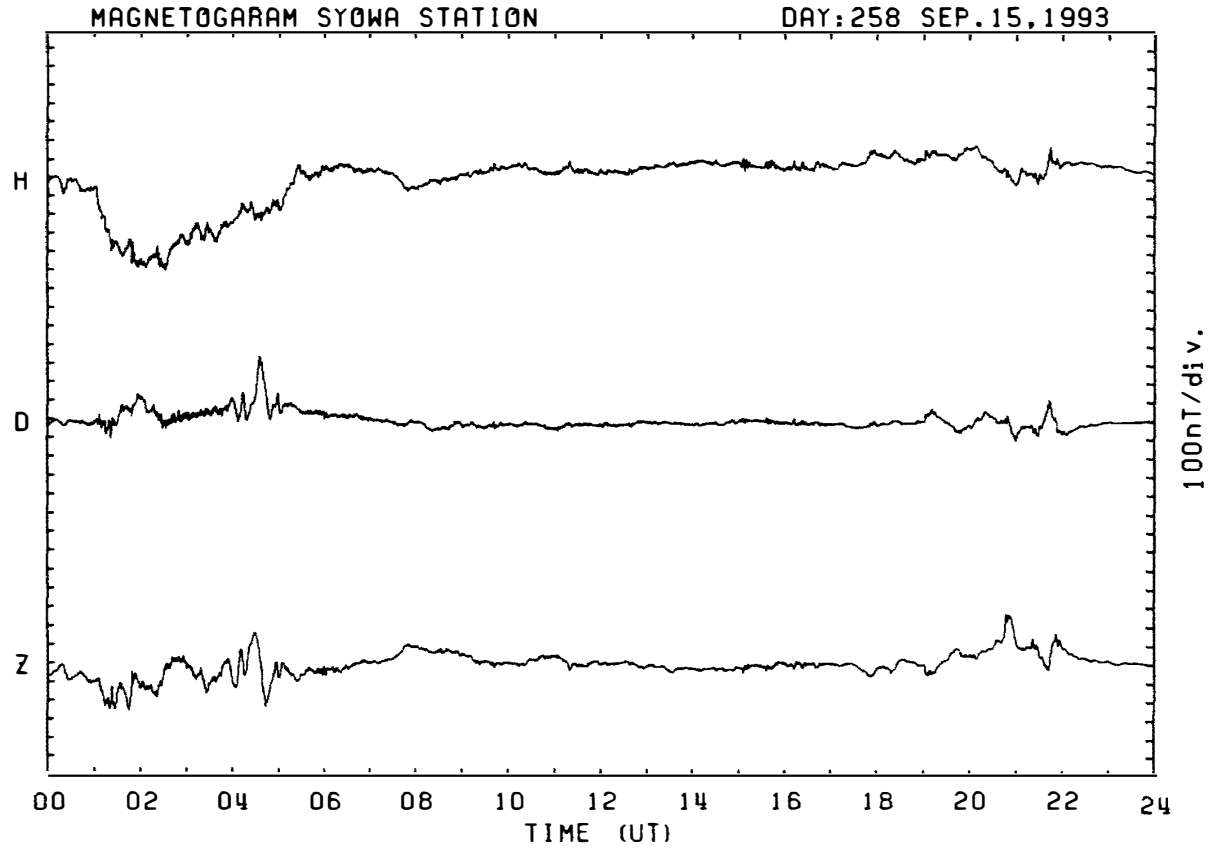
TIME (UT)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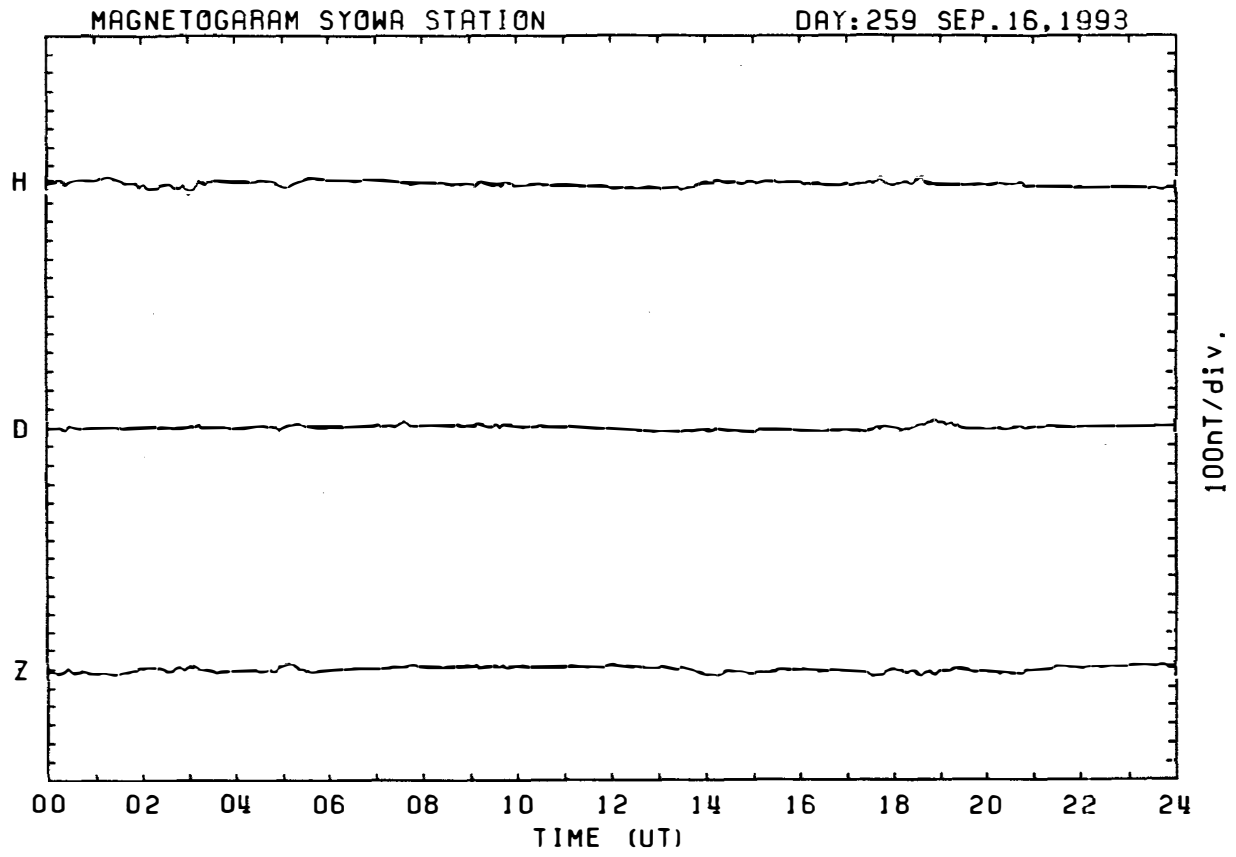
TIME (UT)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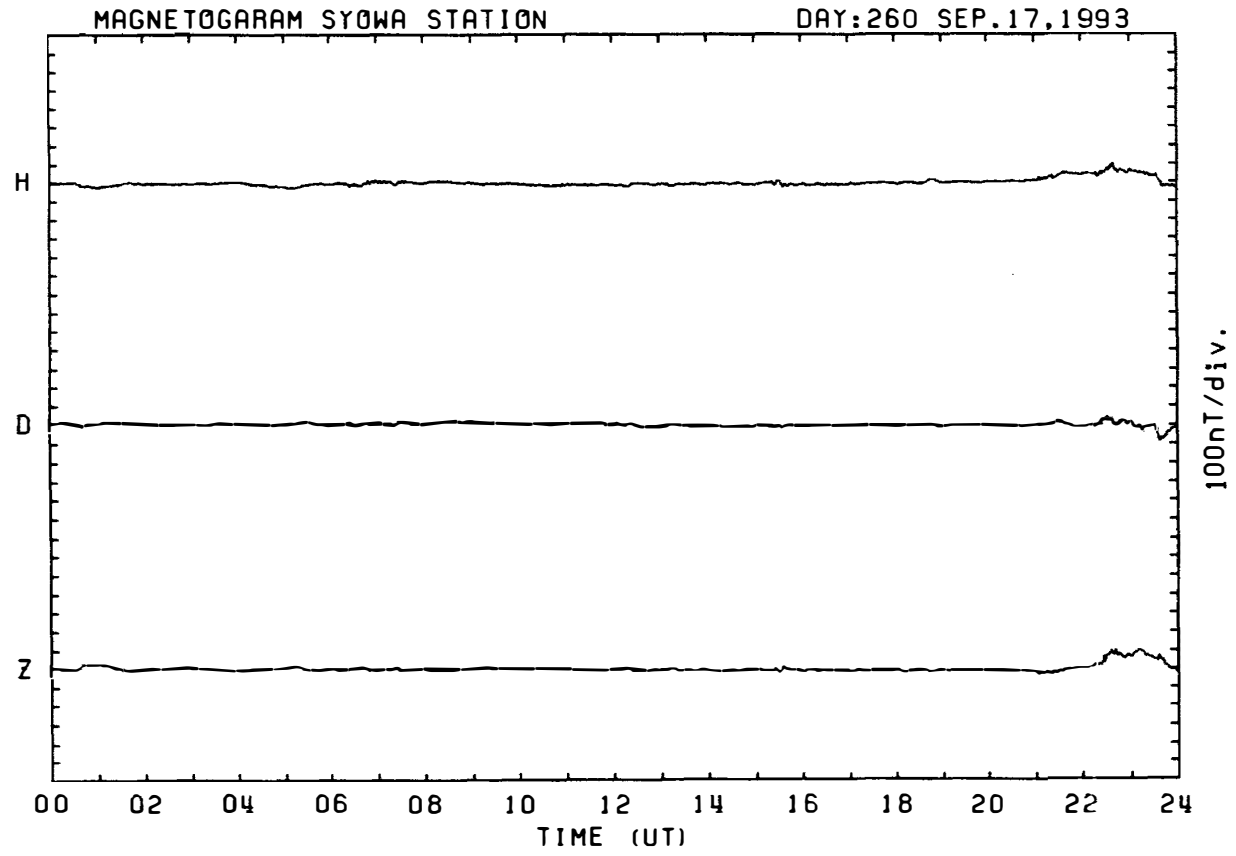
TIME (UT)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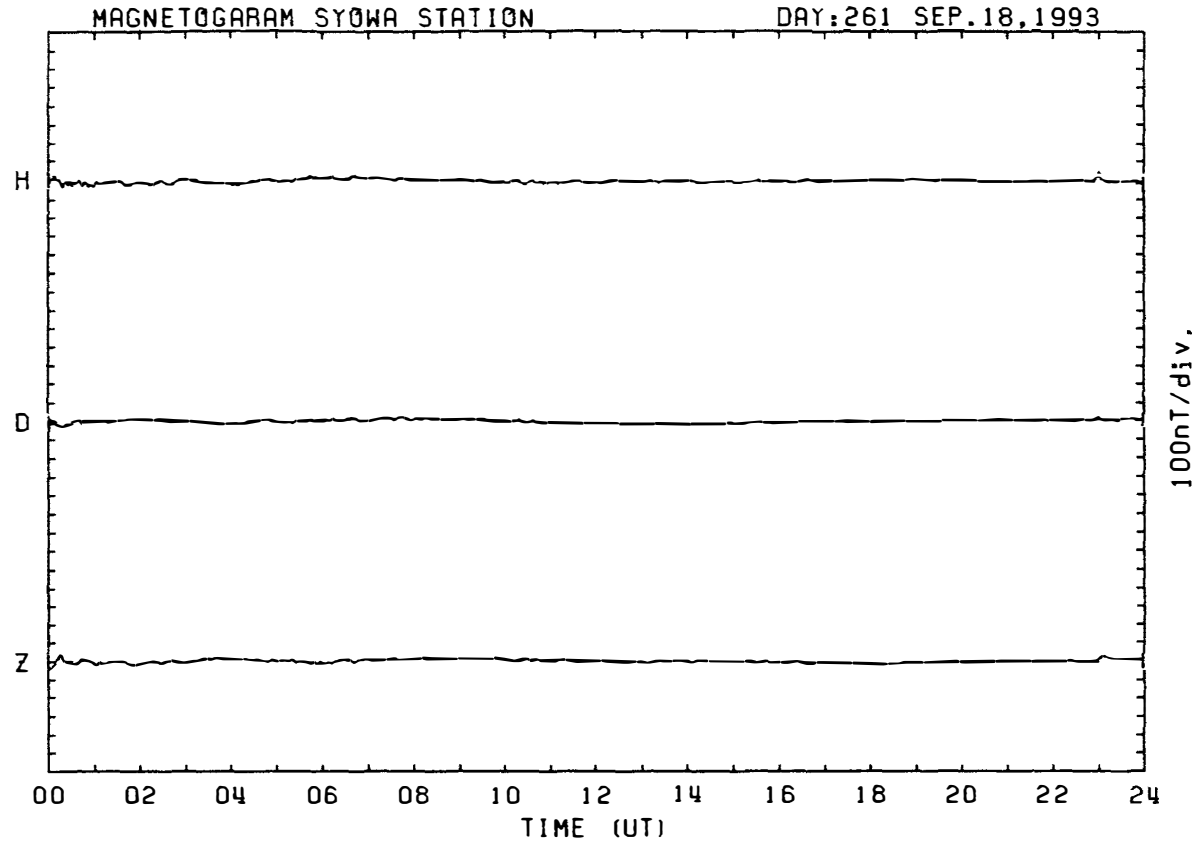
TIME (UT)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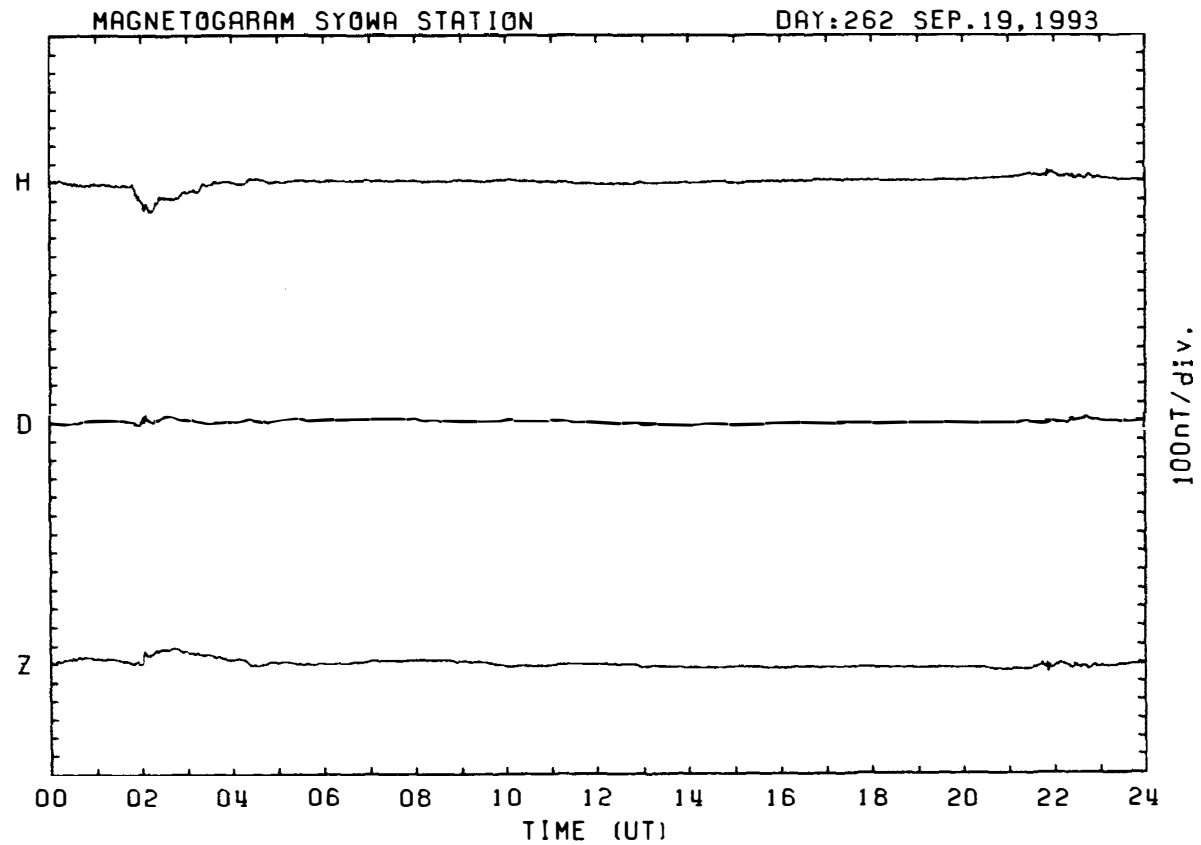
TIME (UT)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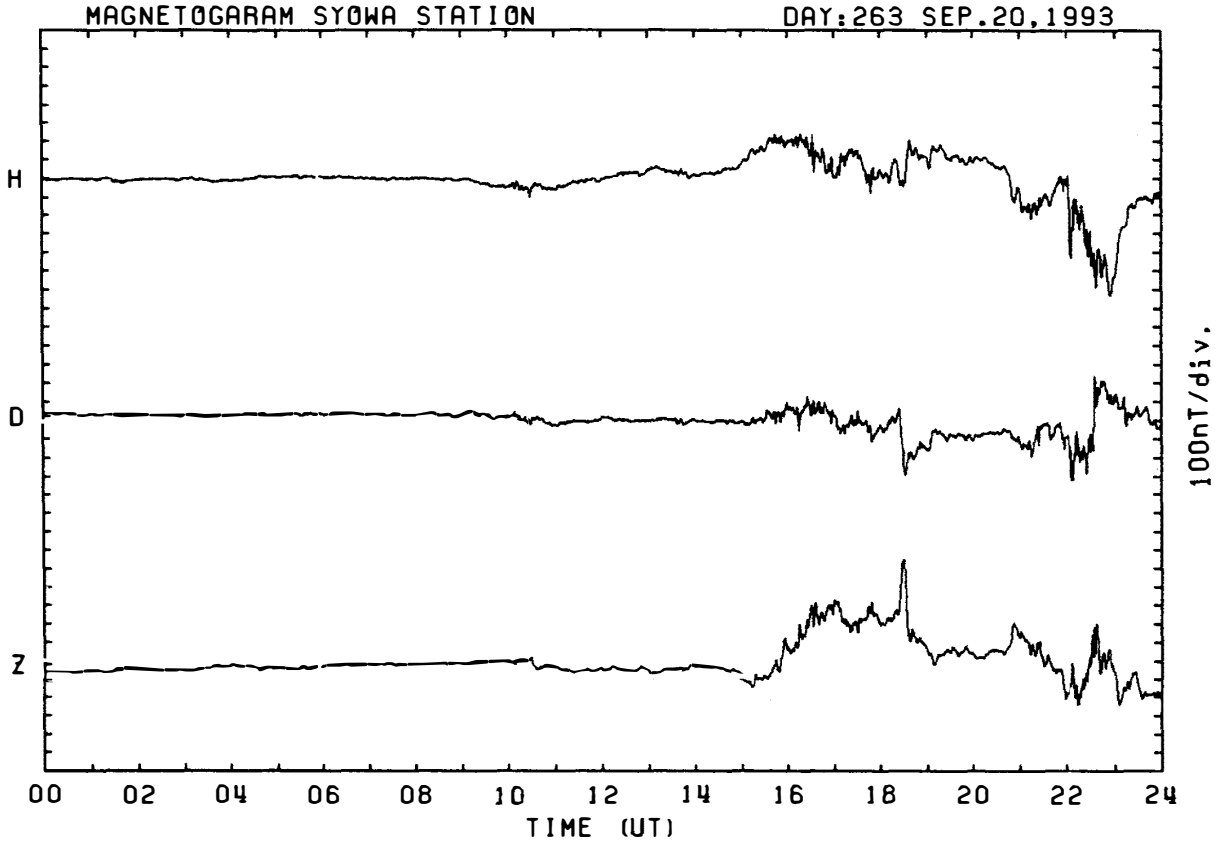
TIME (UT)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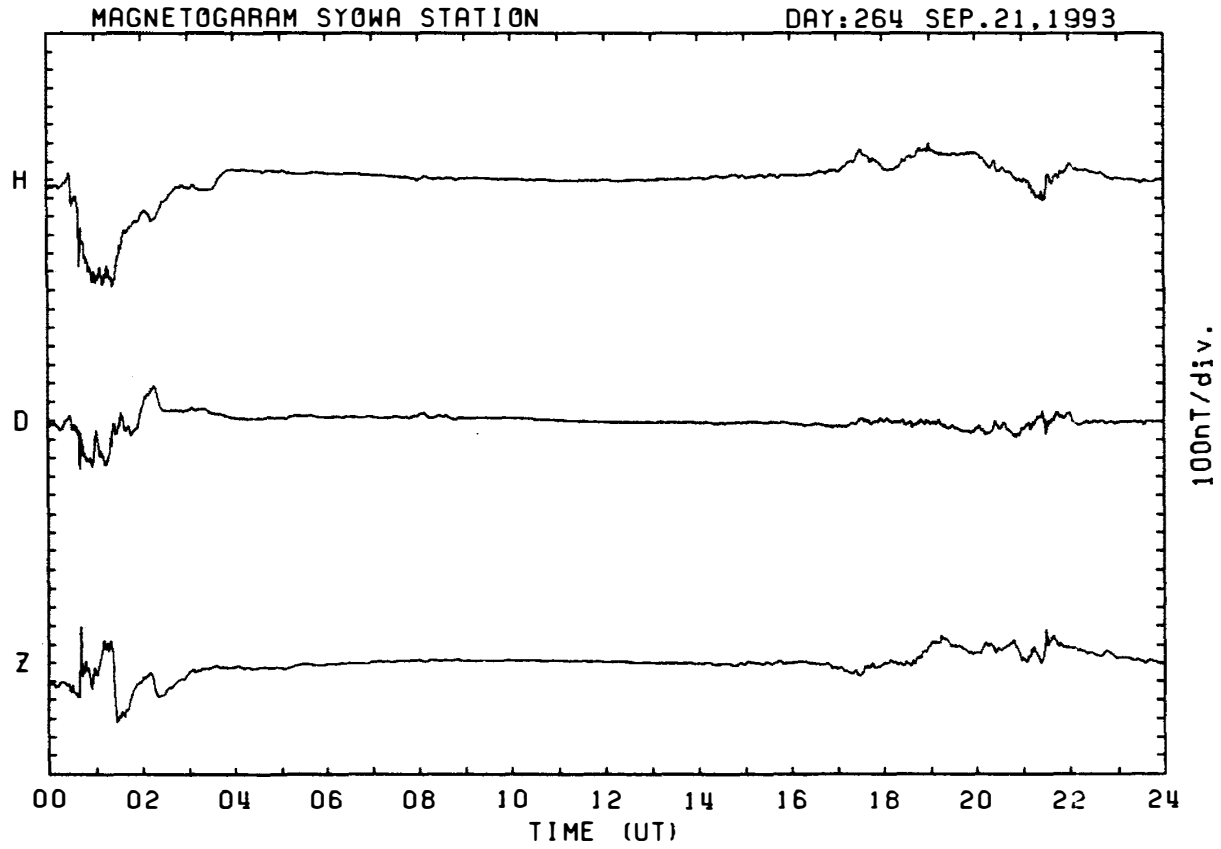
TIME (UT)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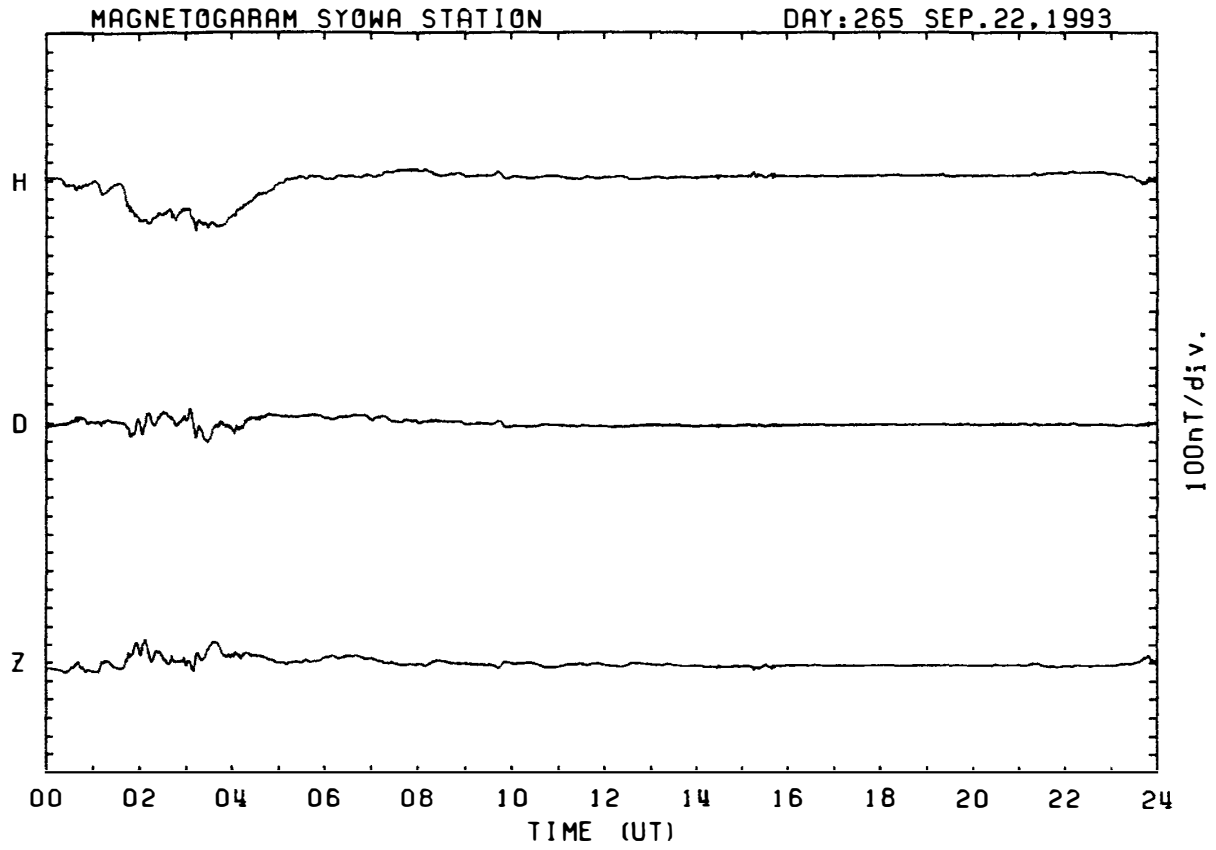
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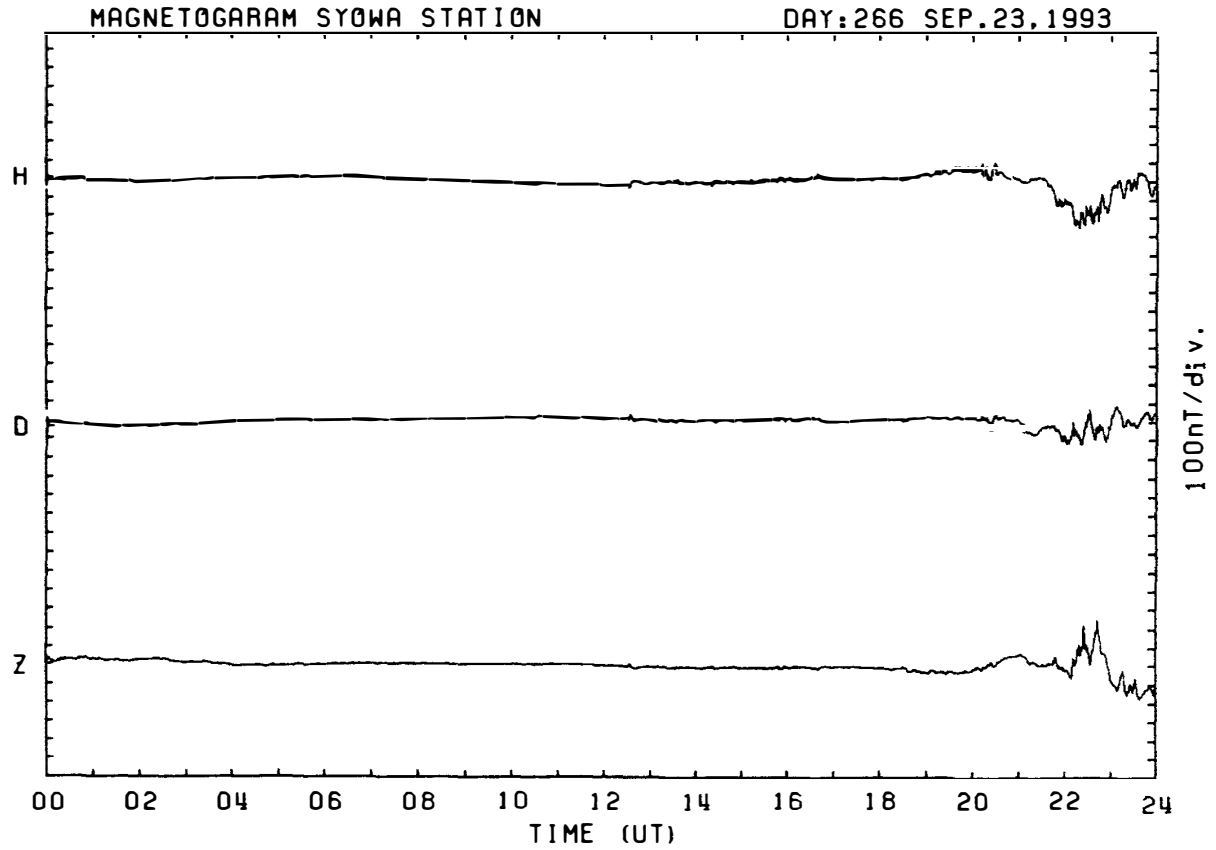
TIME (UT)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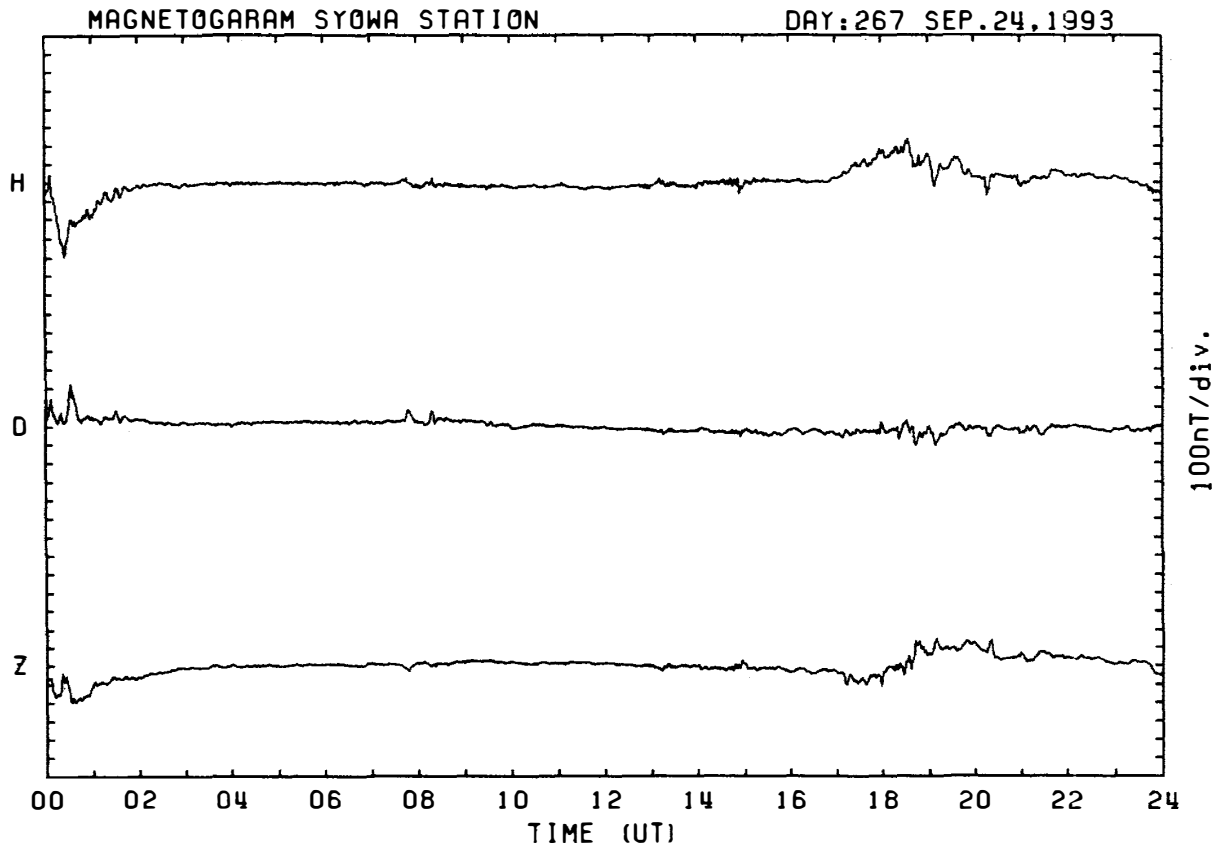
TIME (UT)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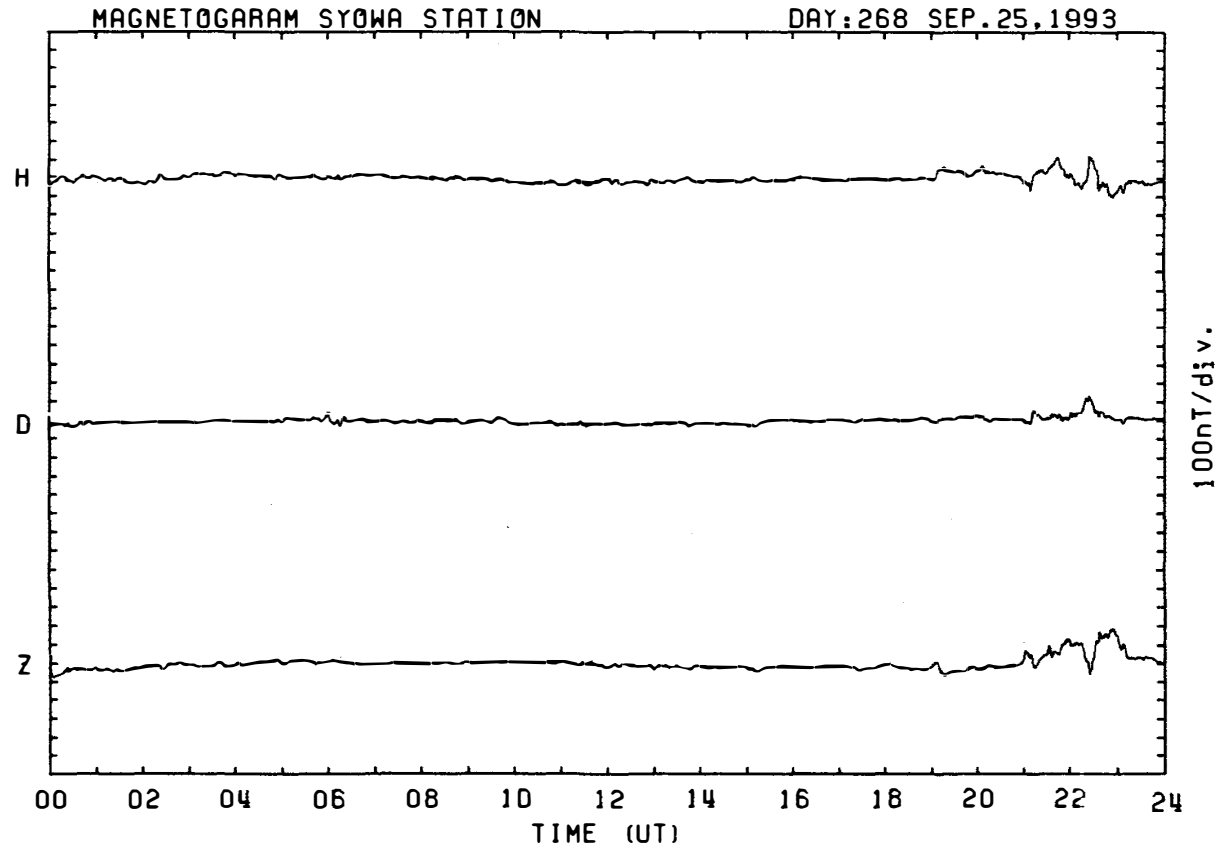
TIME (UT)


MAGNETOGARAM SYOWA STATION
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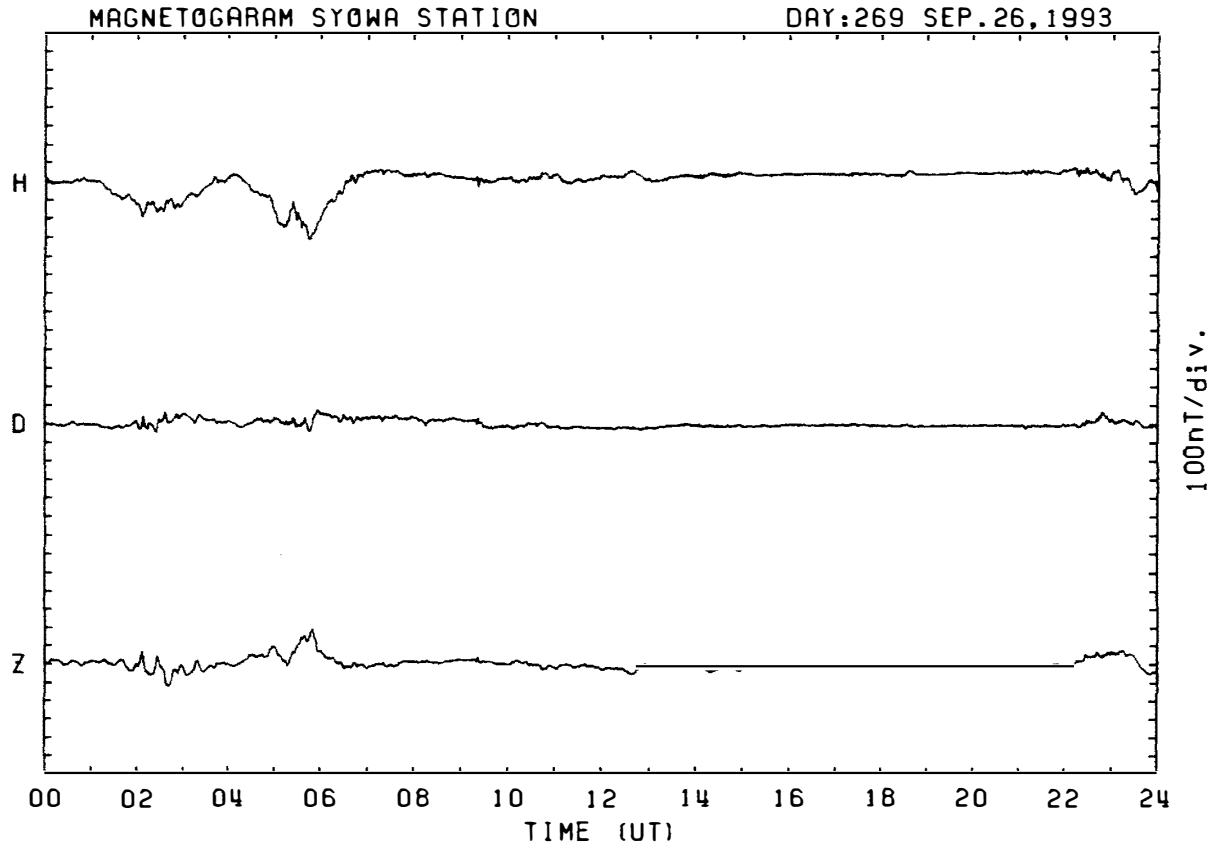
TIME (UT)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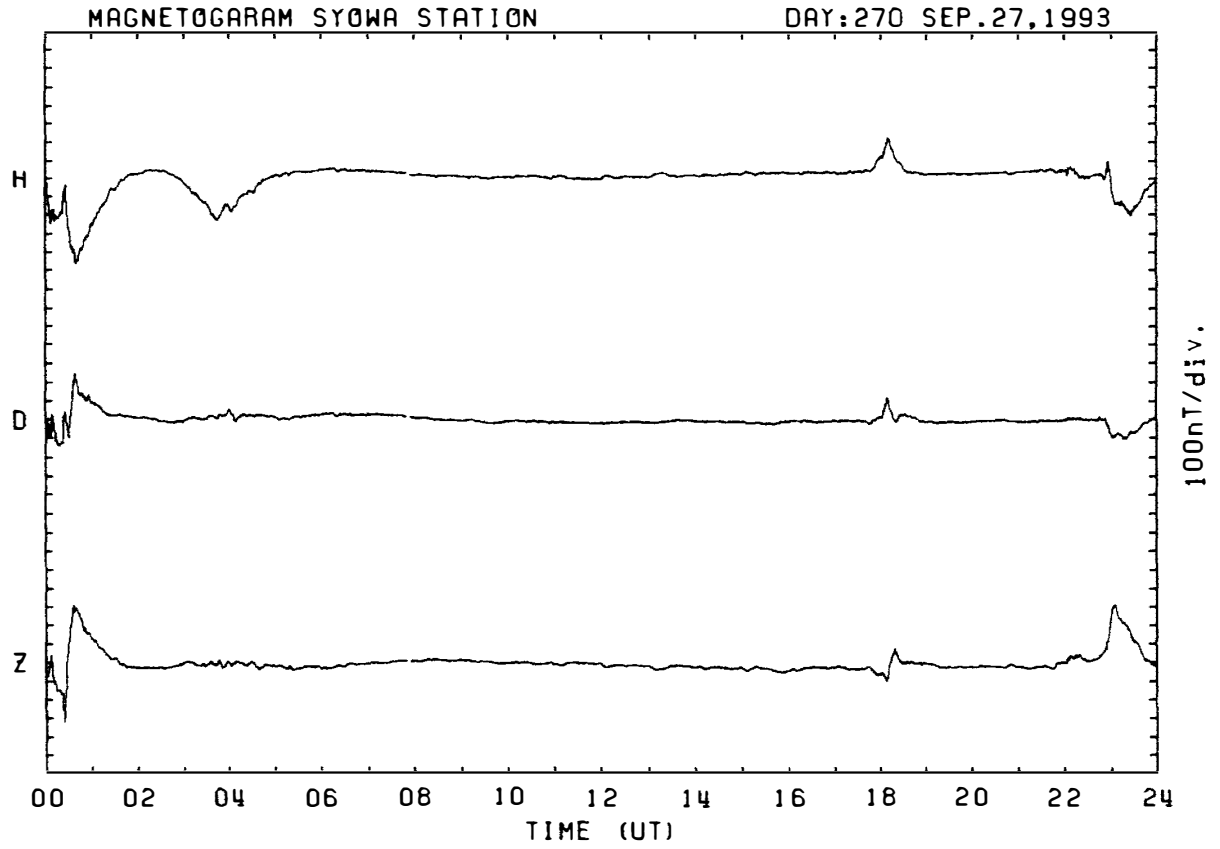
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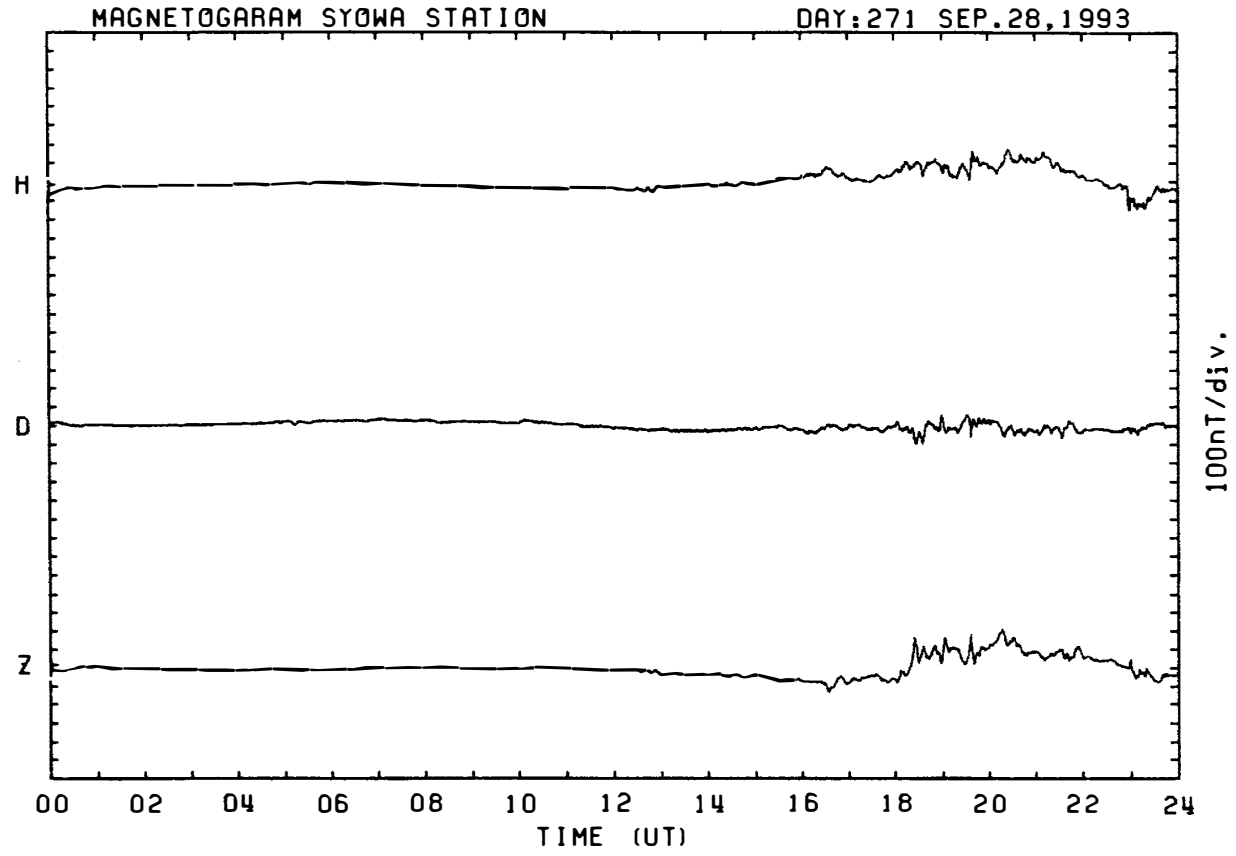
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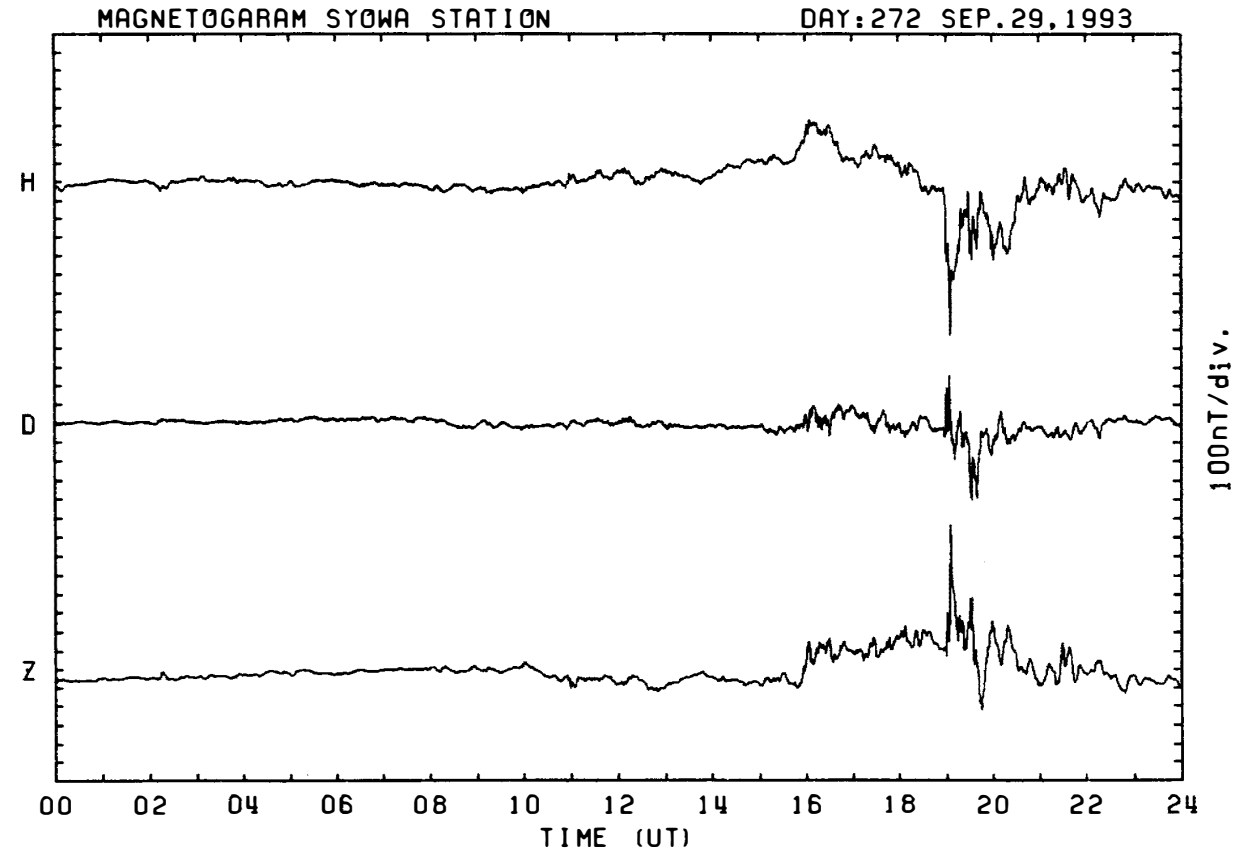
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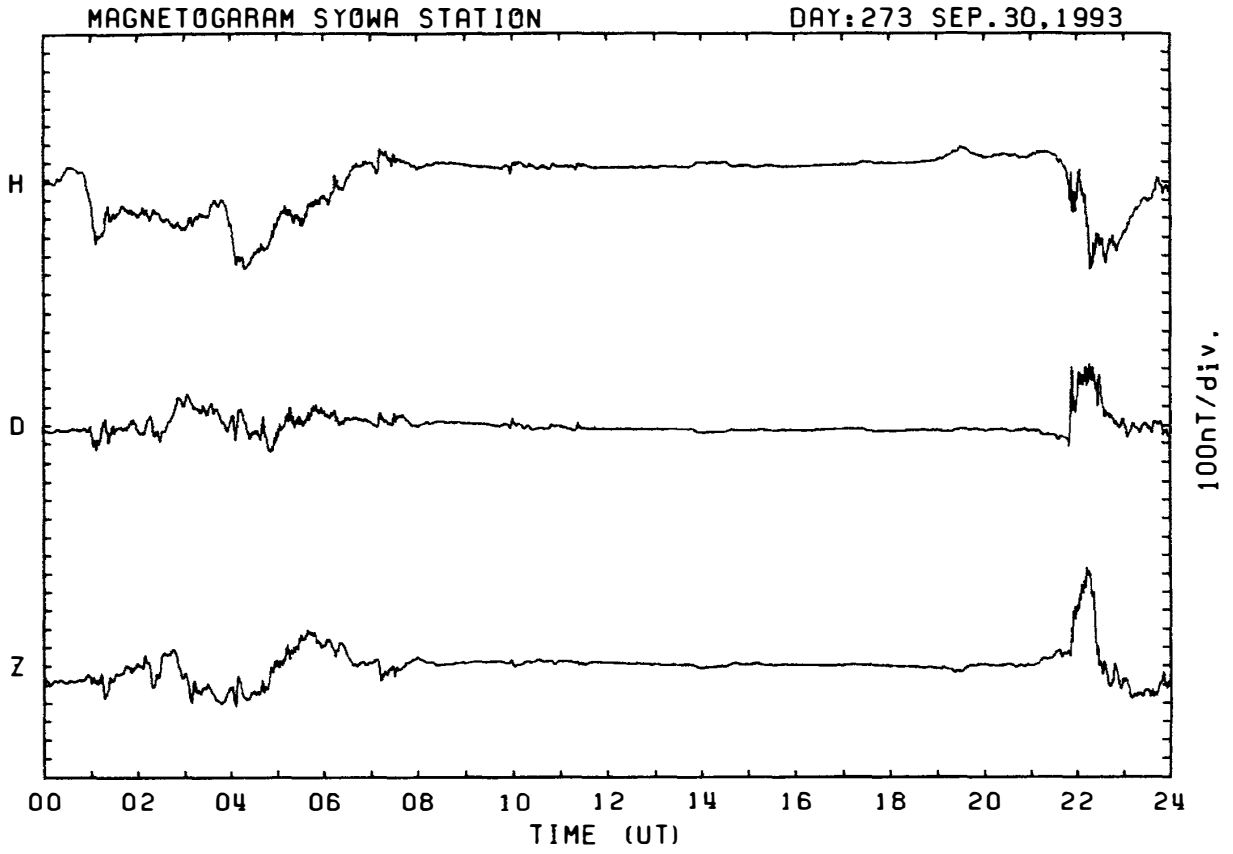
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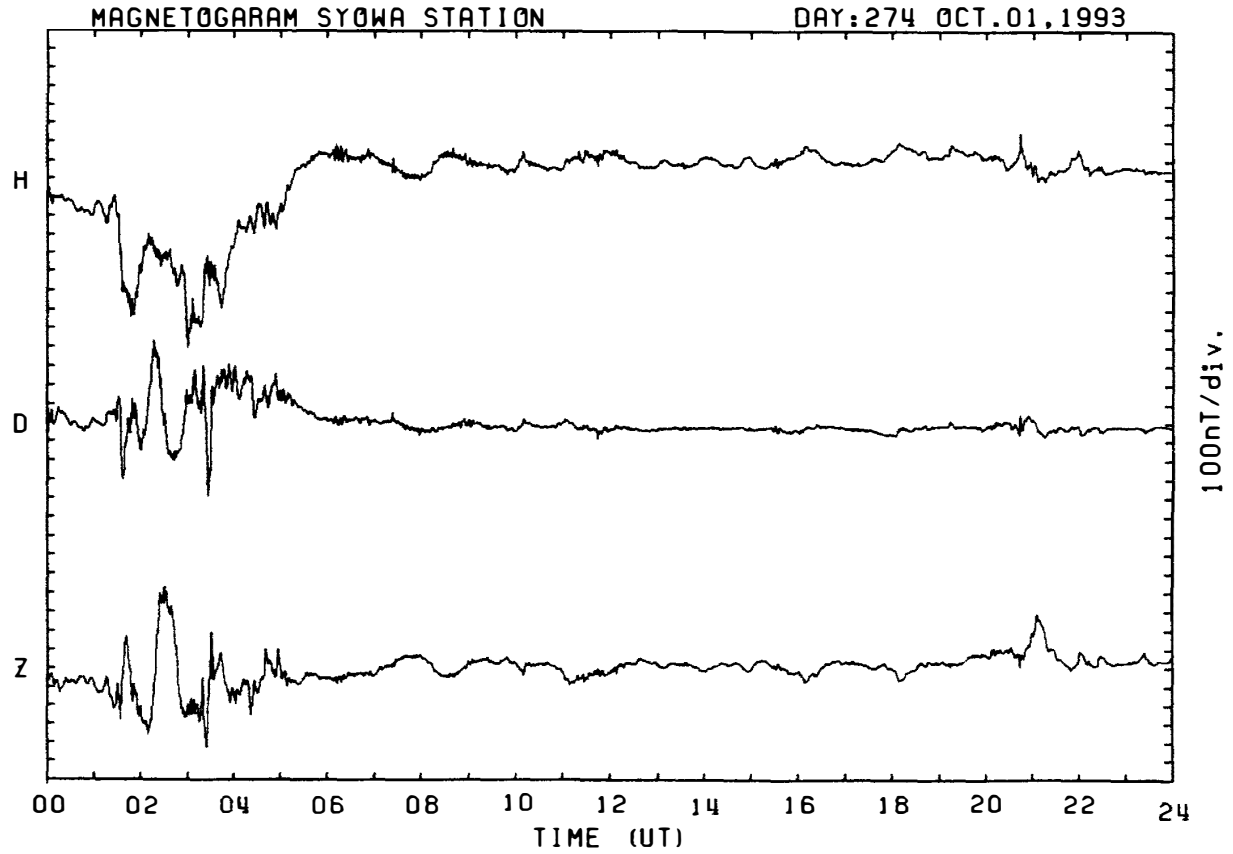
TIME (UT)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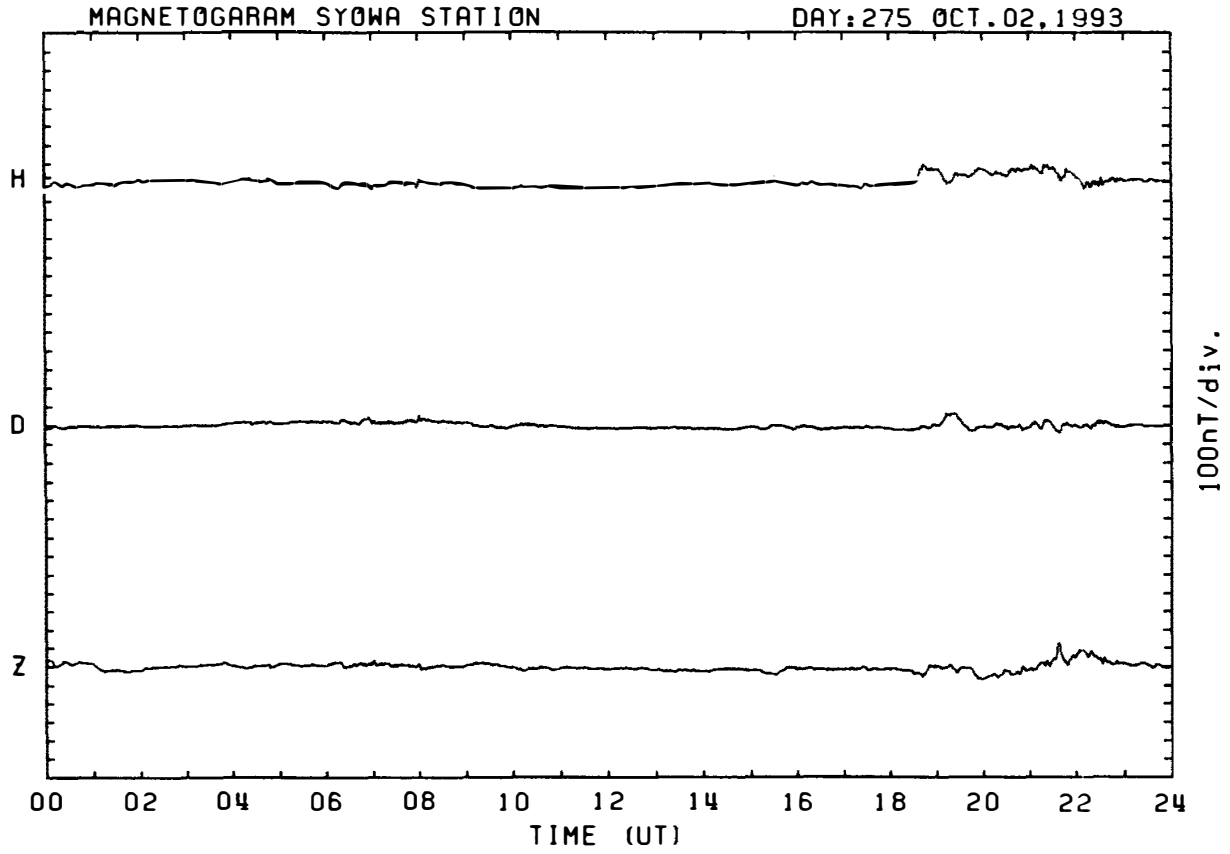
TIME (UT)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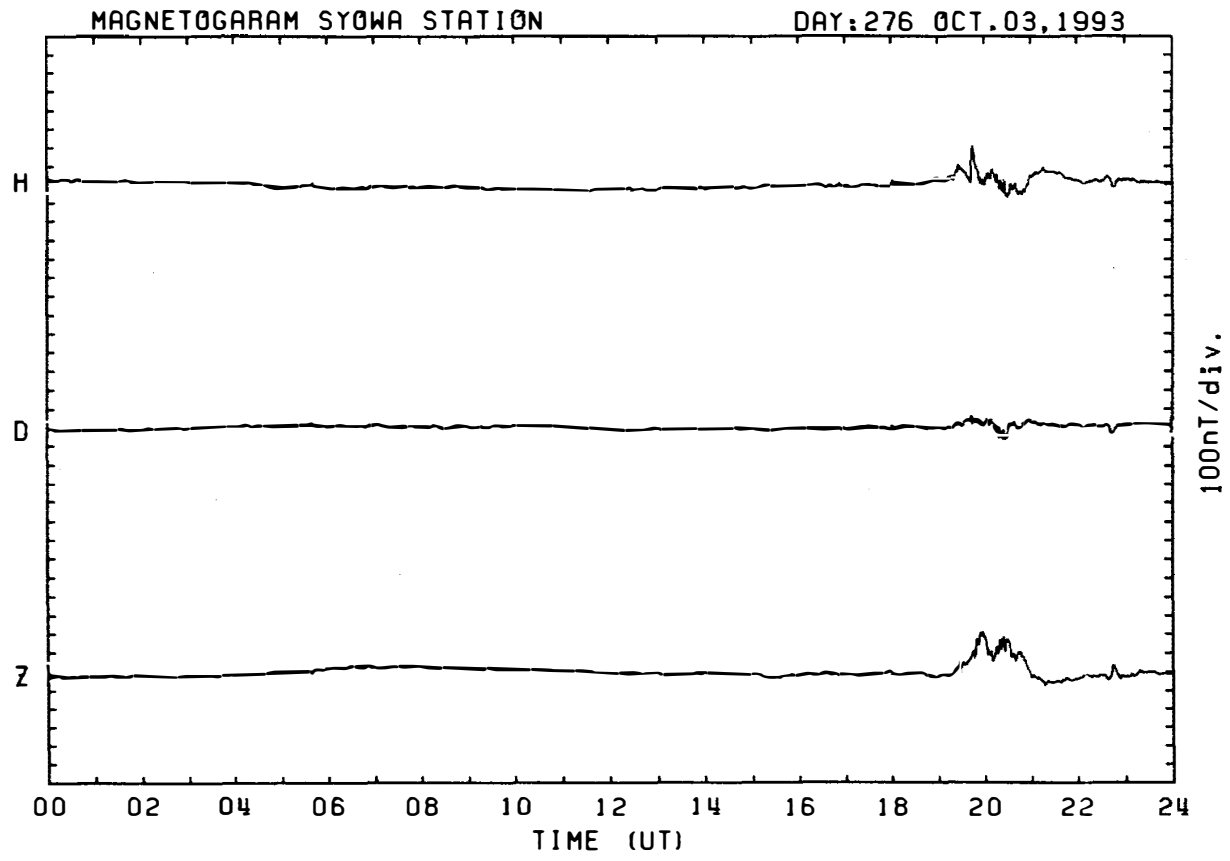
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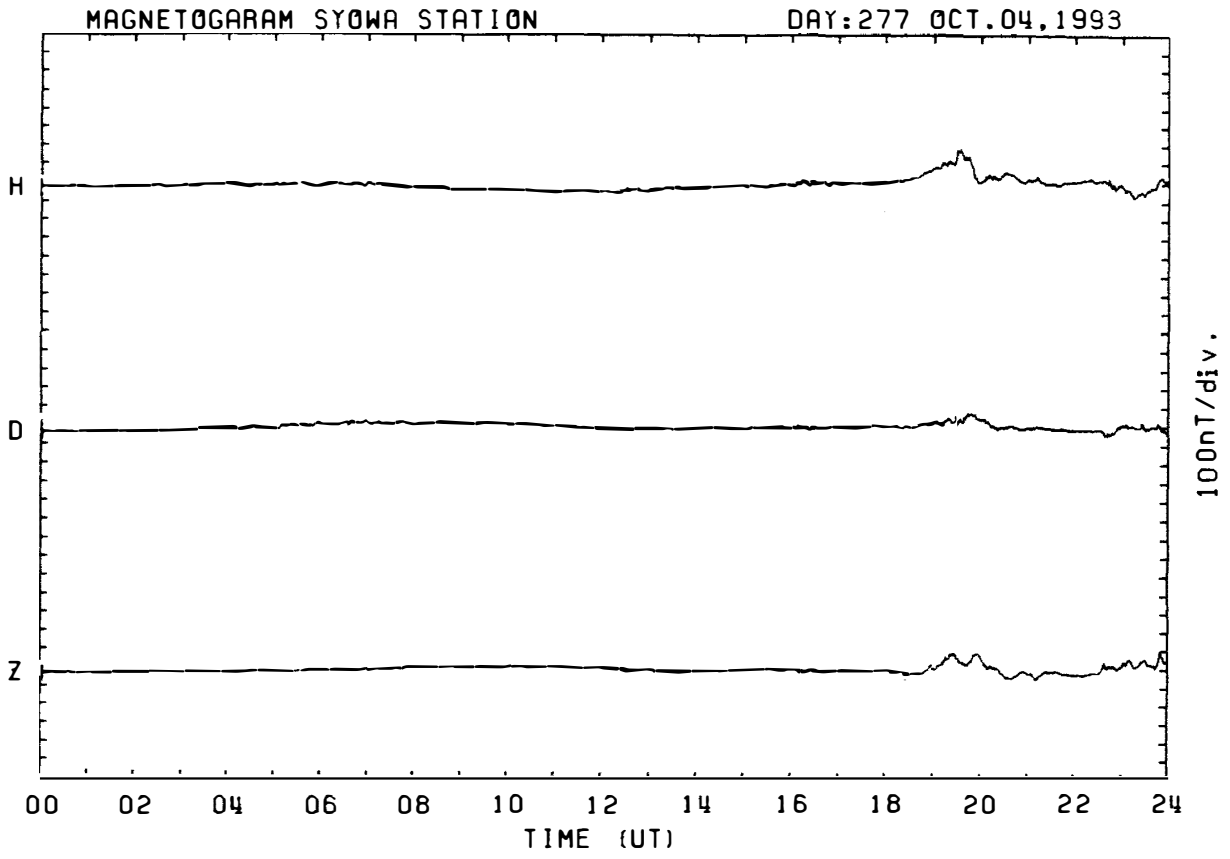
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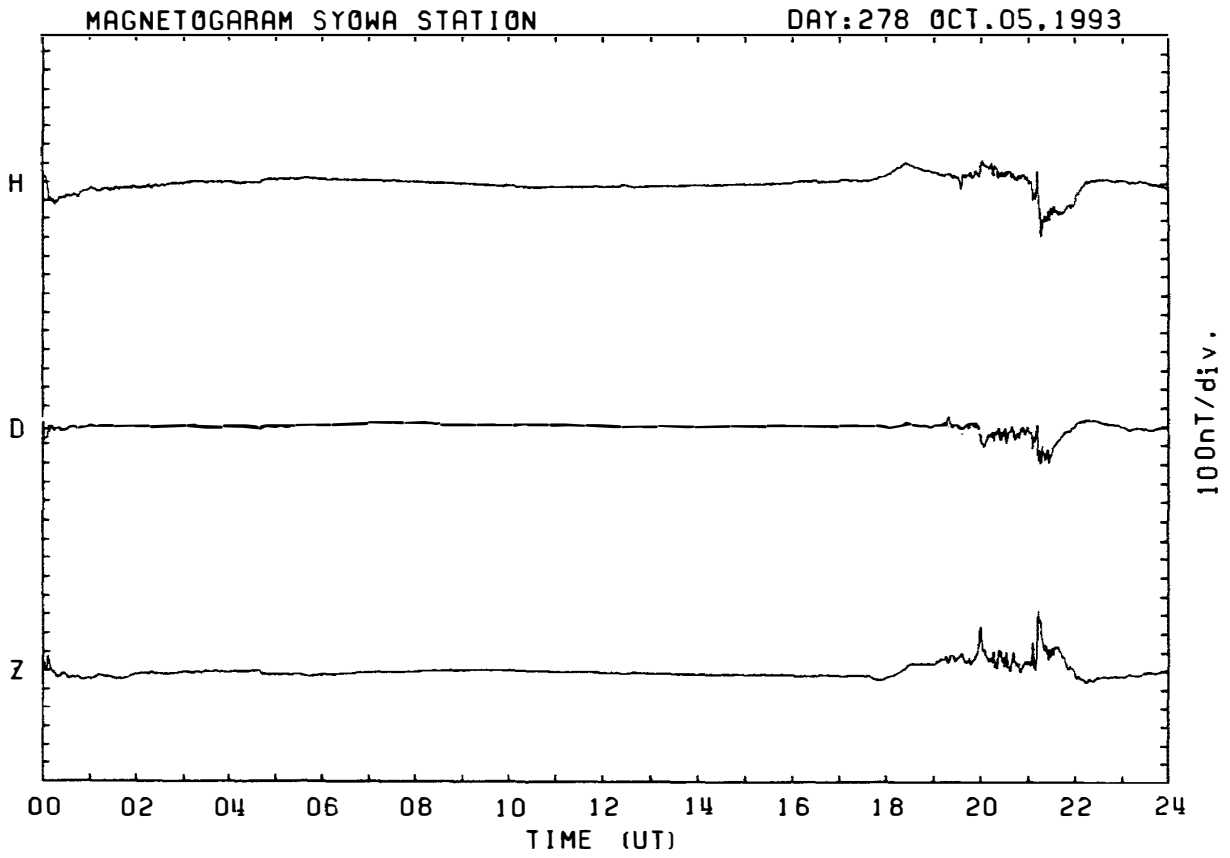
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:278 OCT.05,1993
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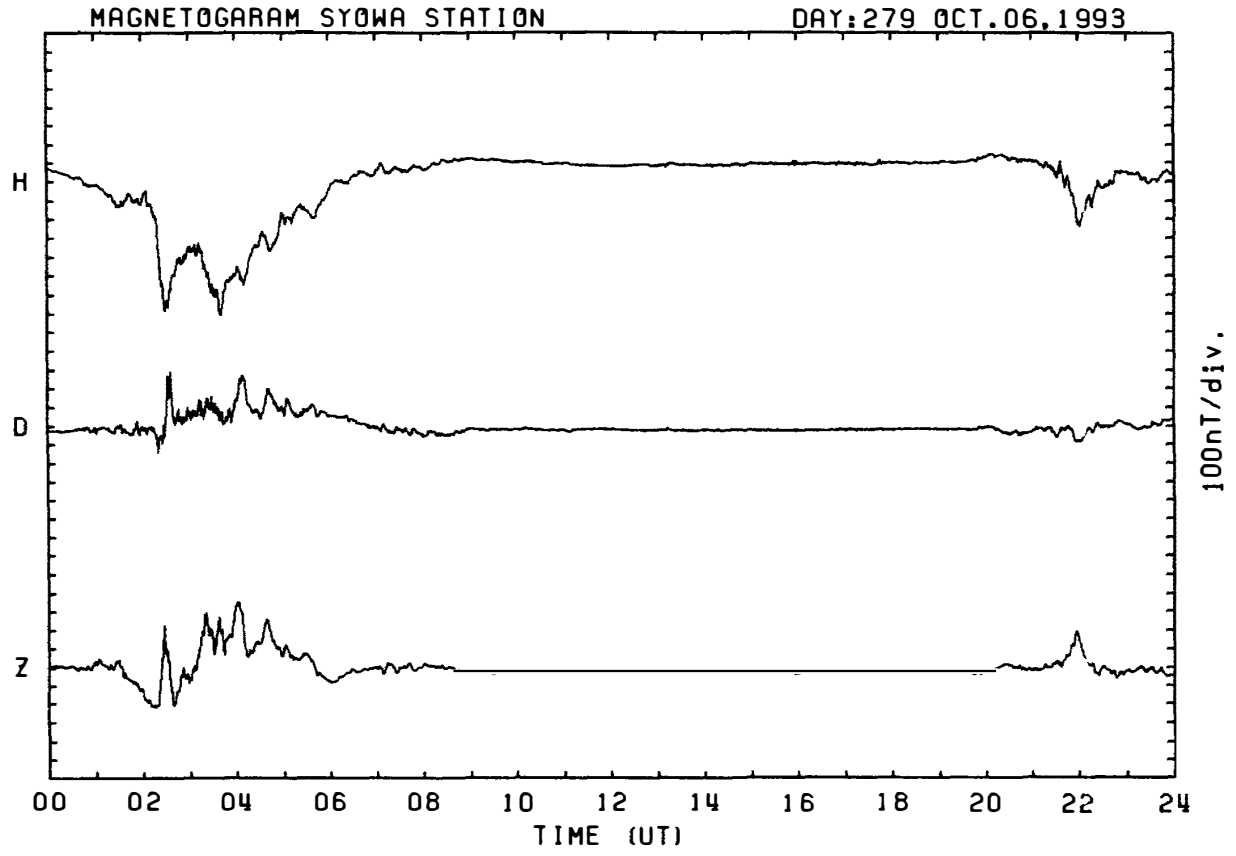
TIME (UT)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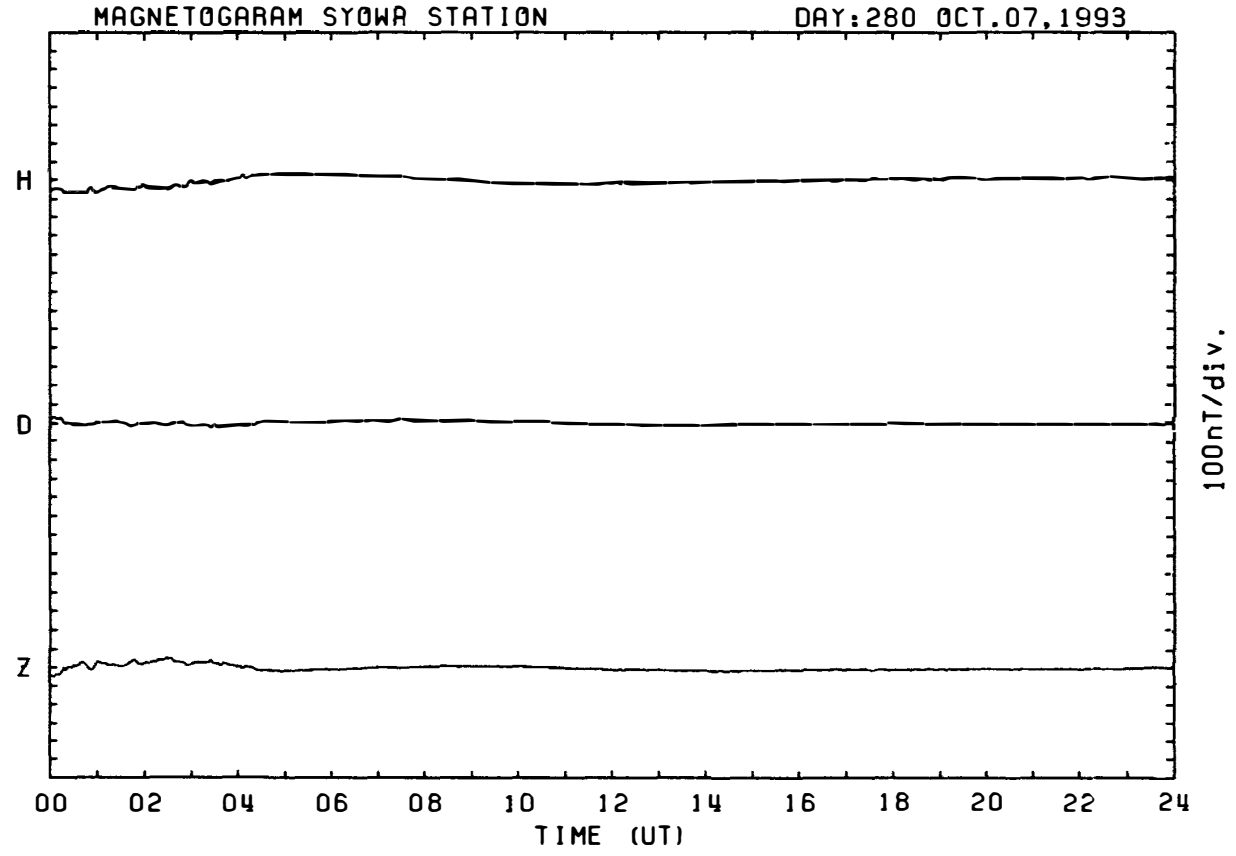
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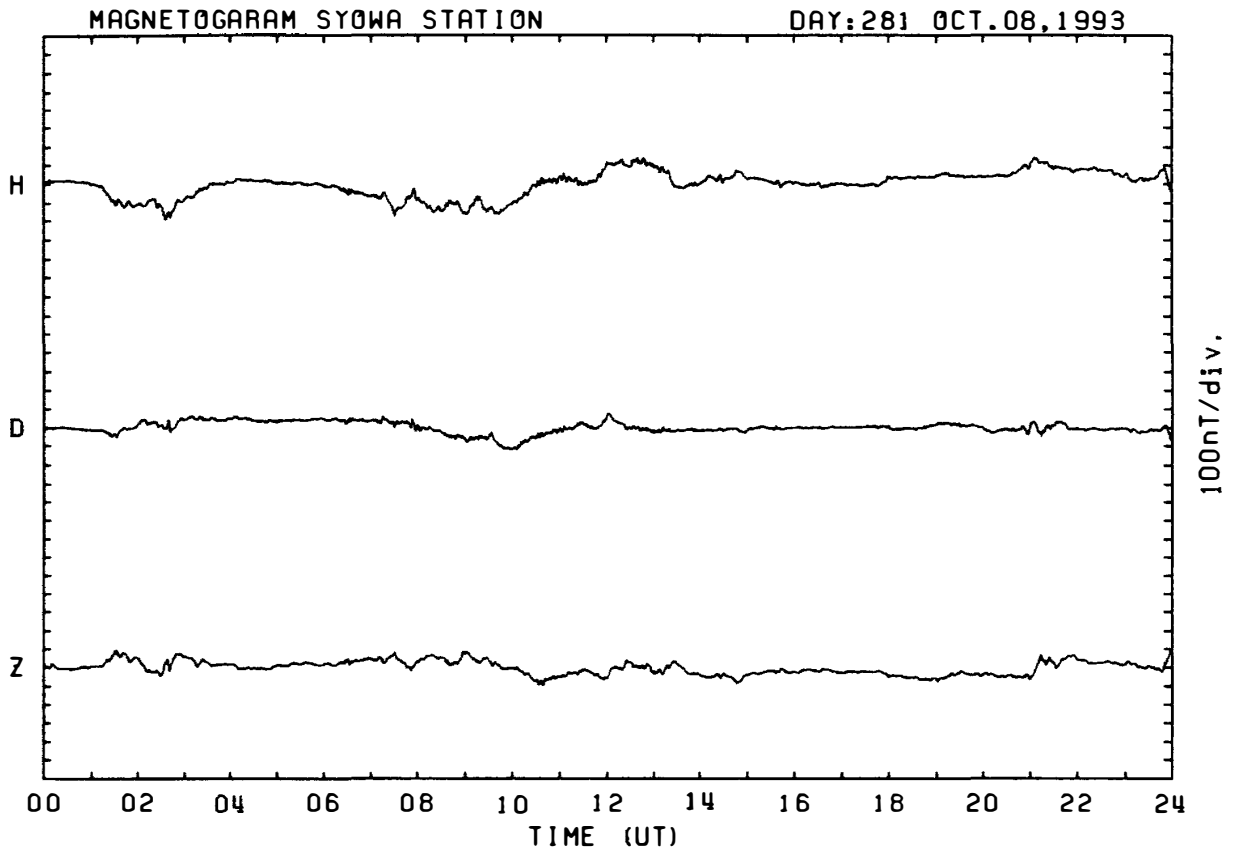
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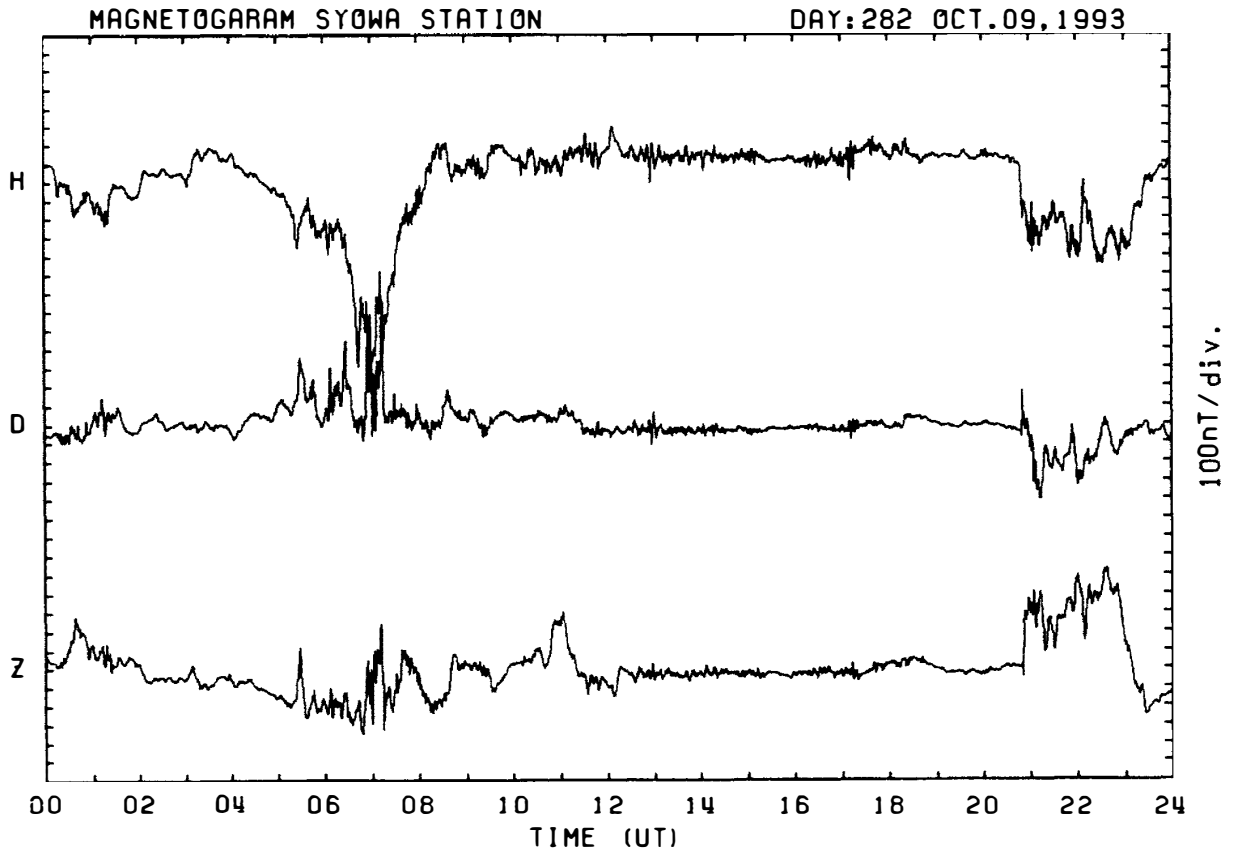
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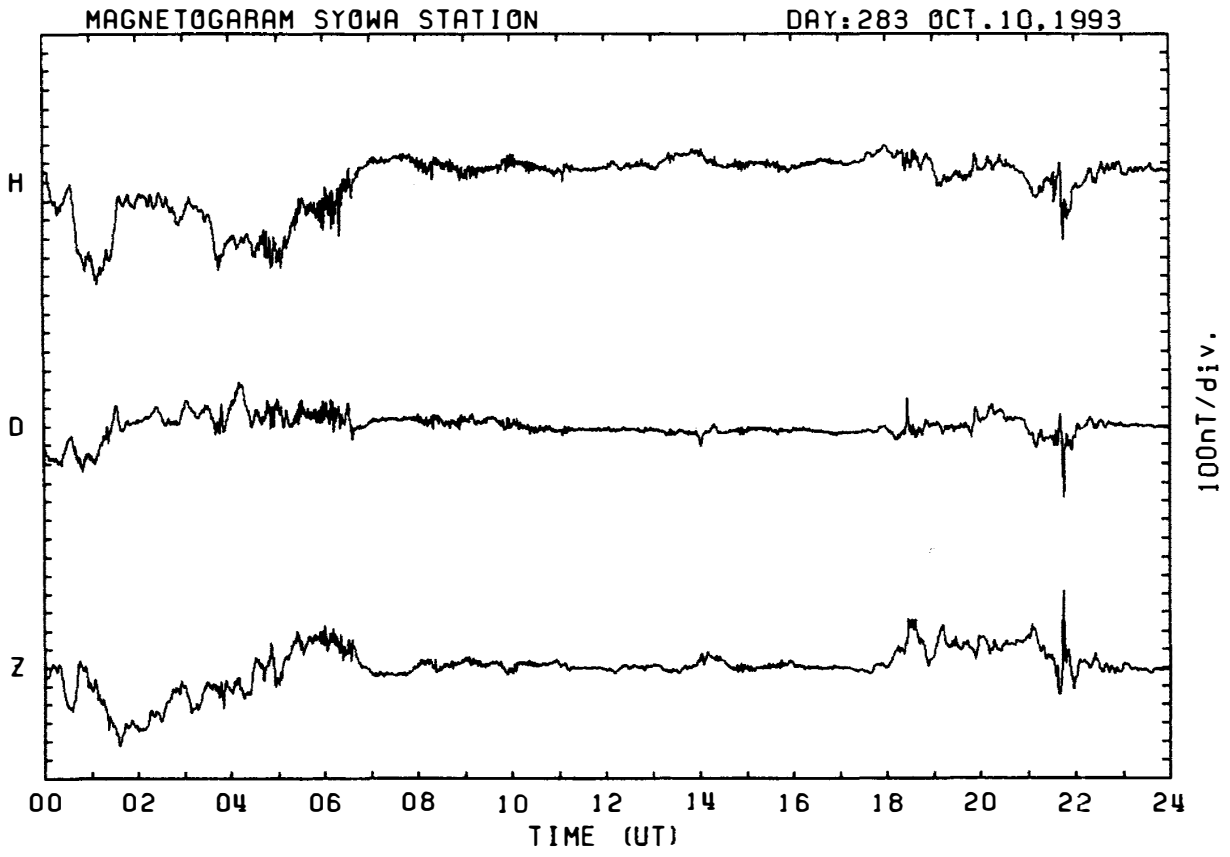
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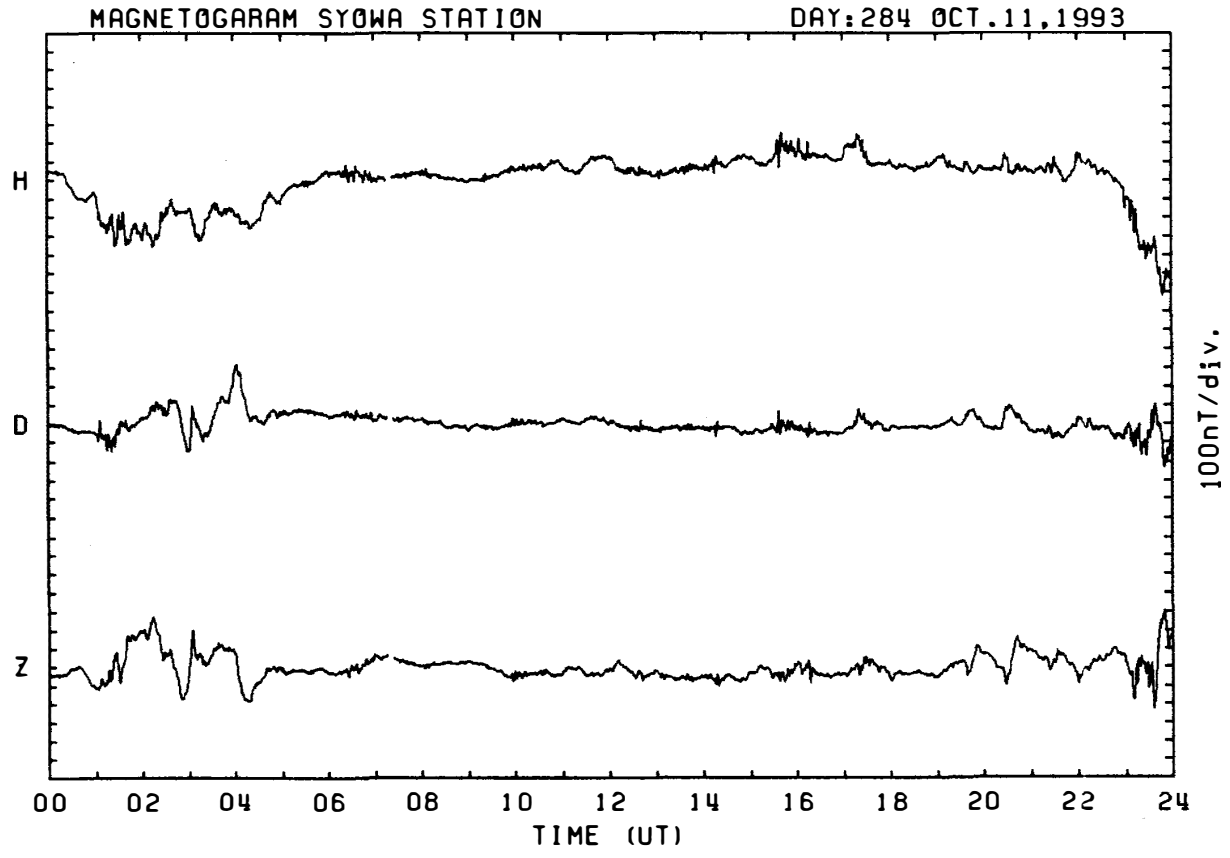
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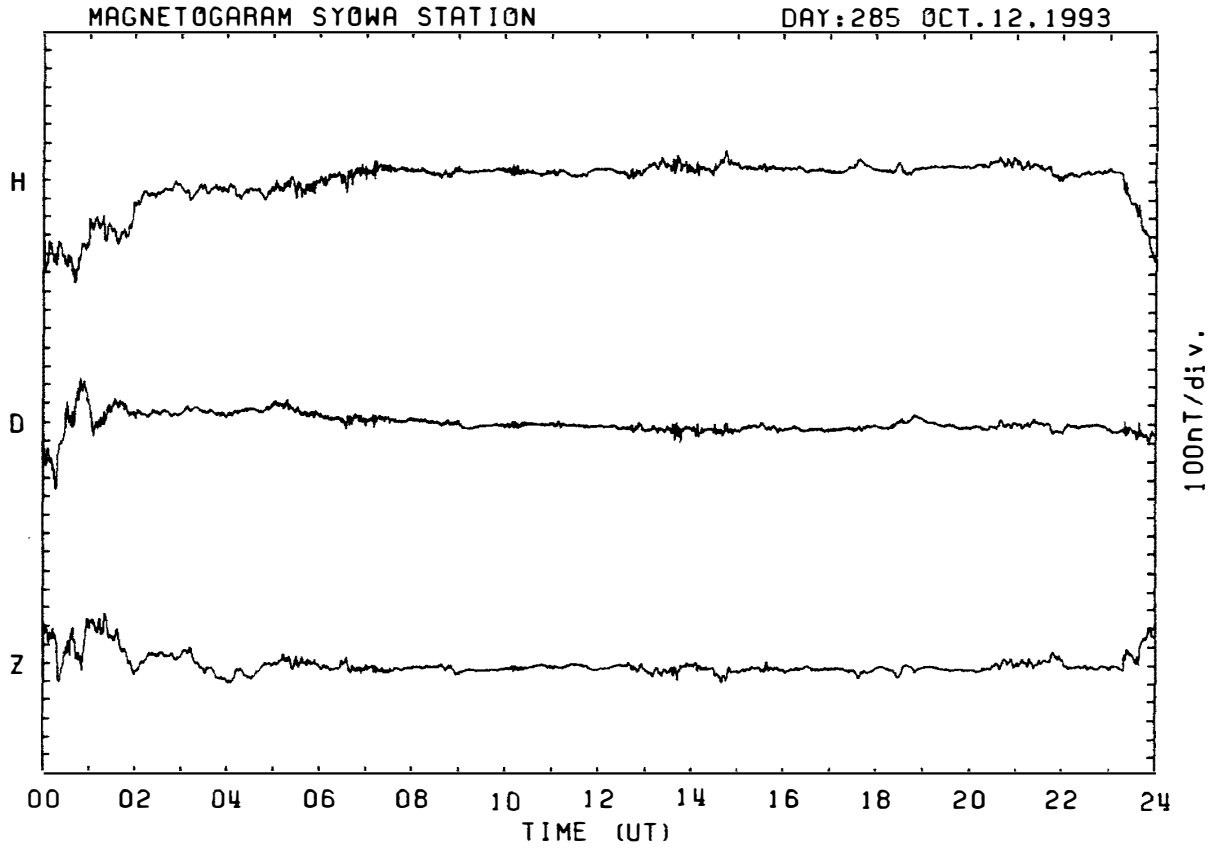
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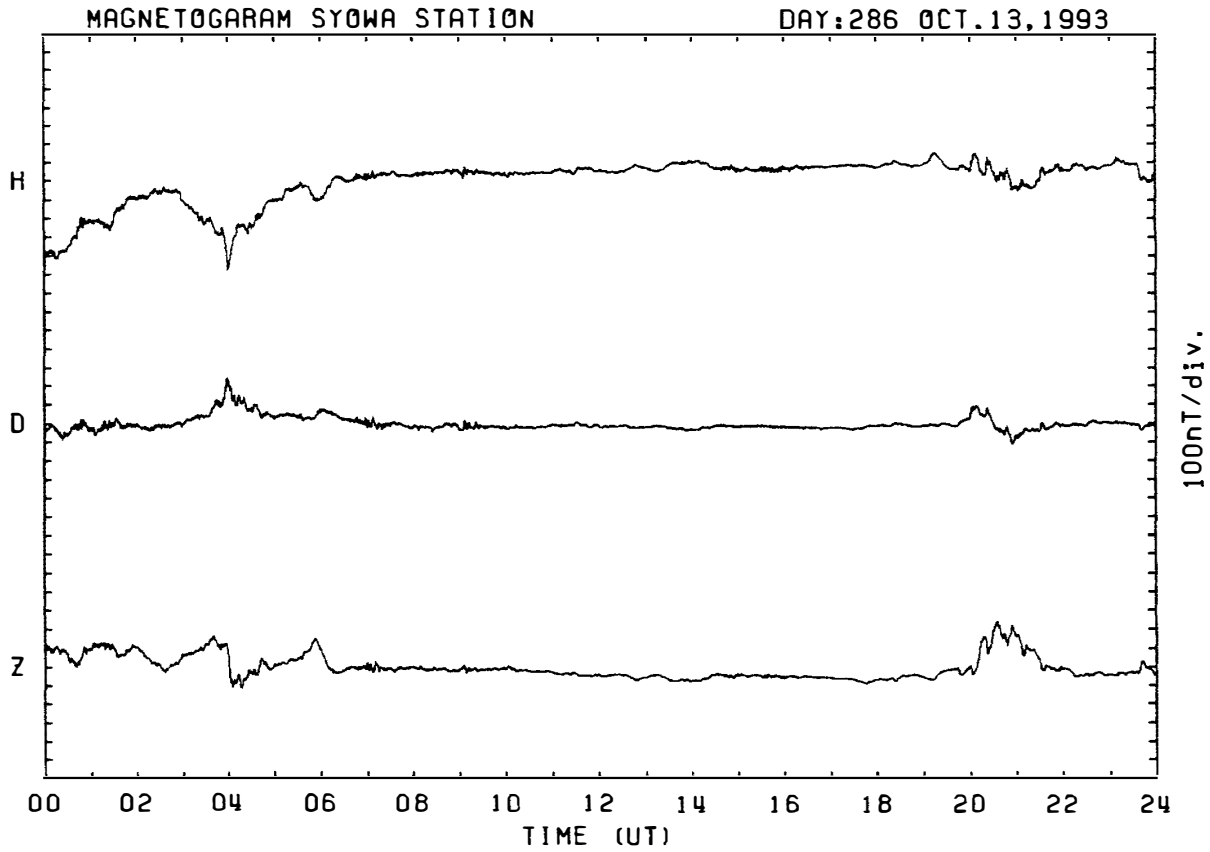
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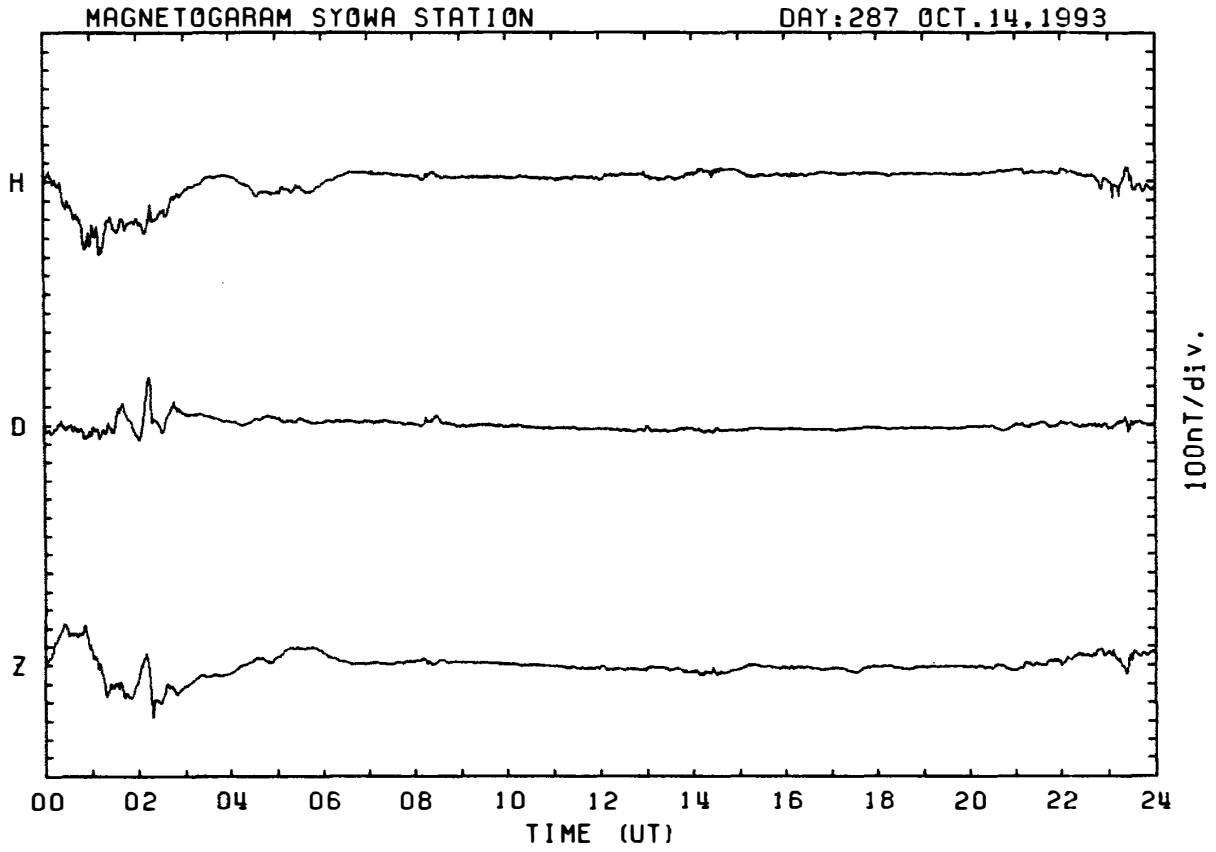
TIME (UT)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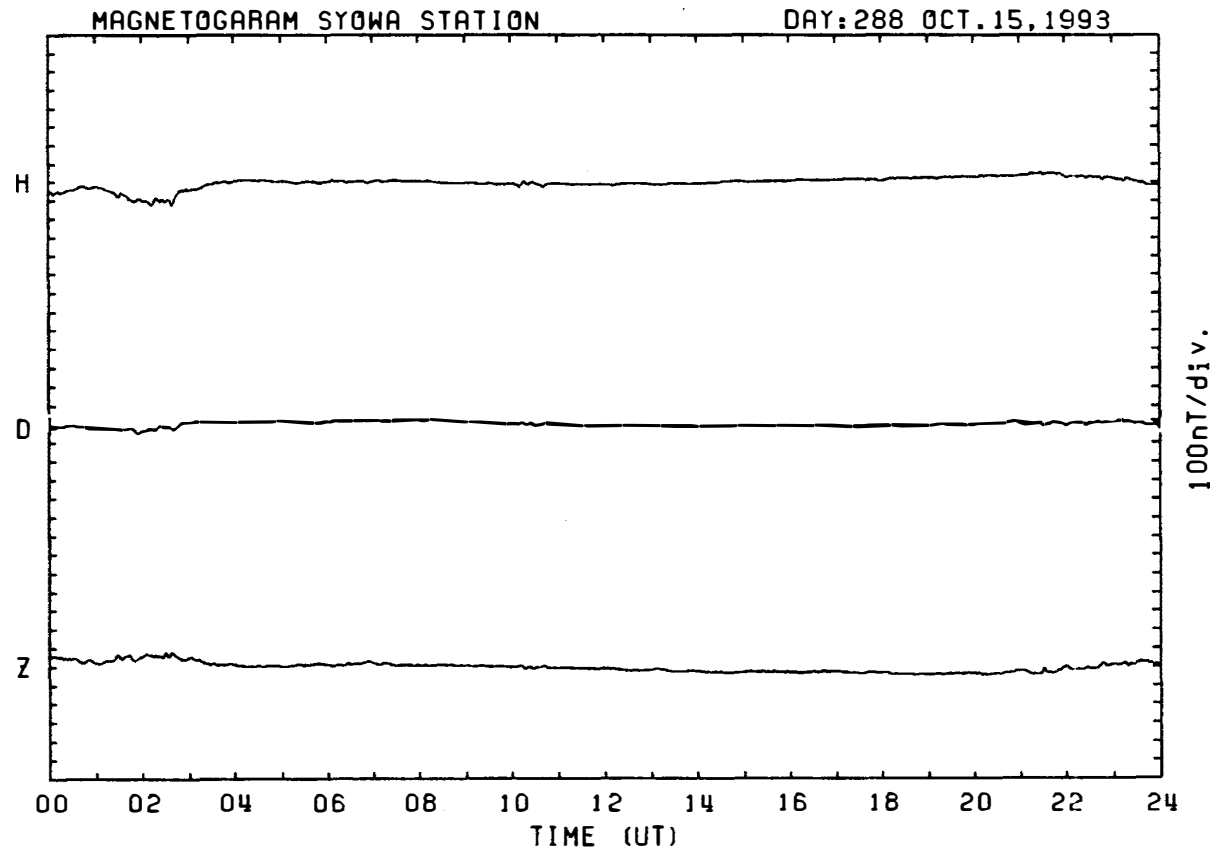
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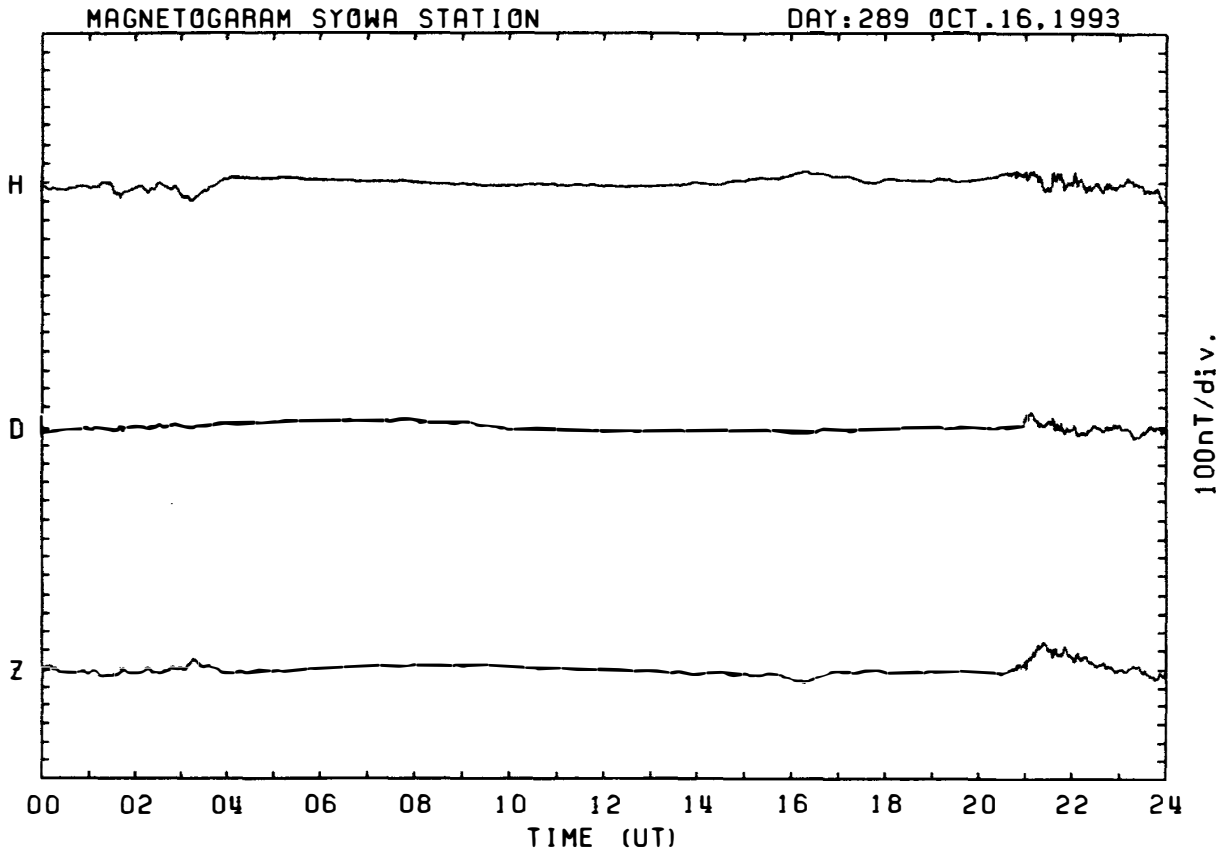
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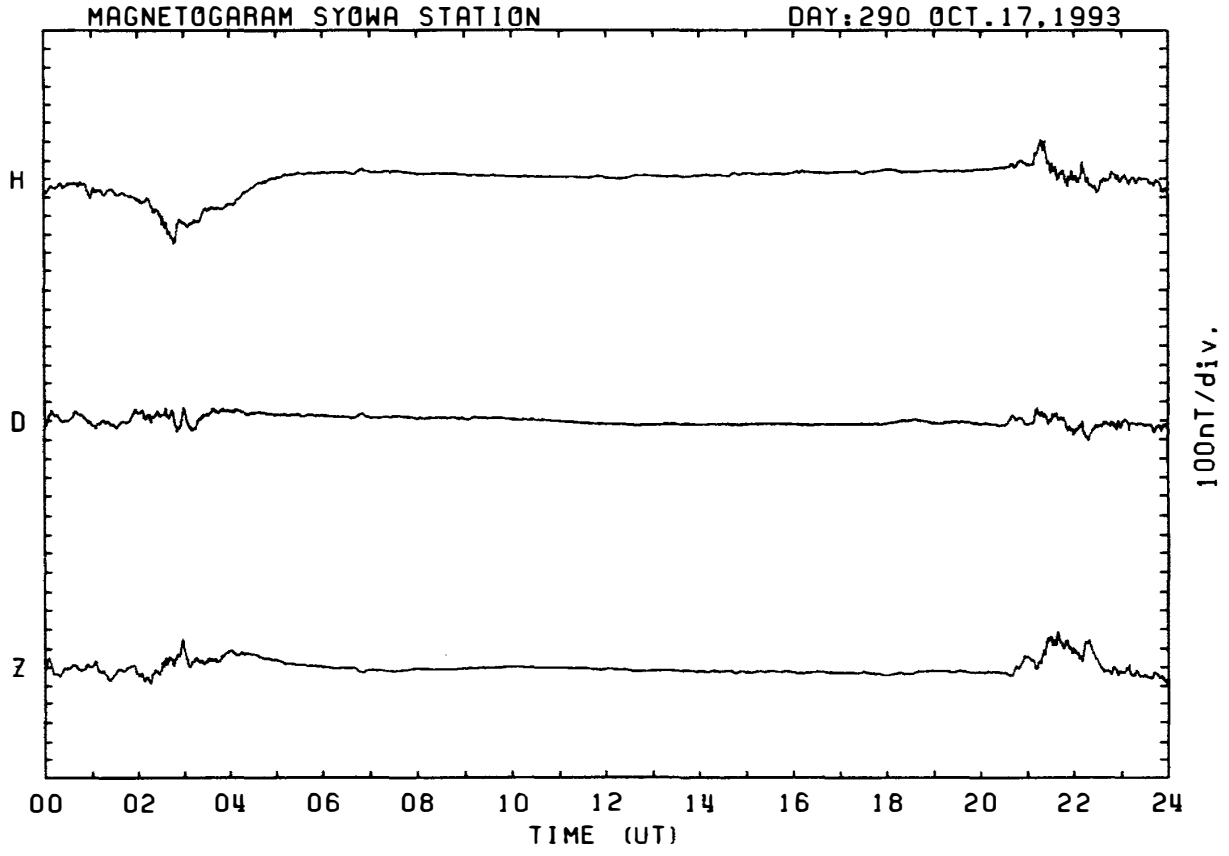
TIME (UT)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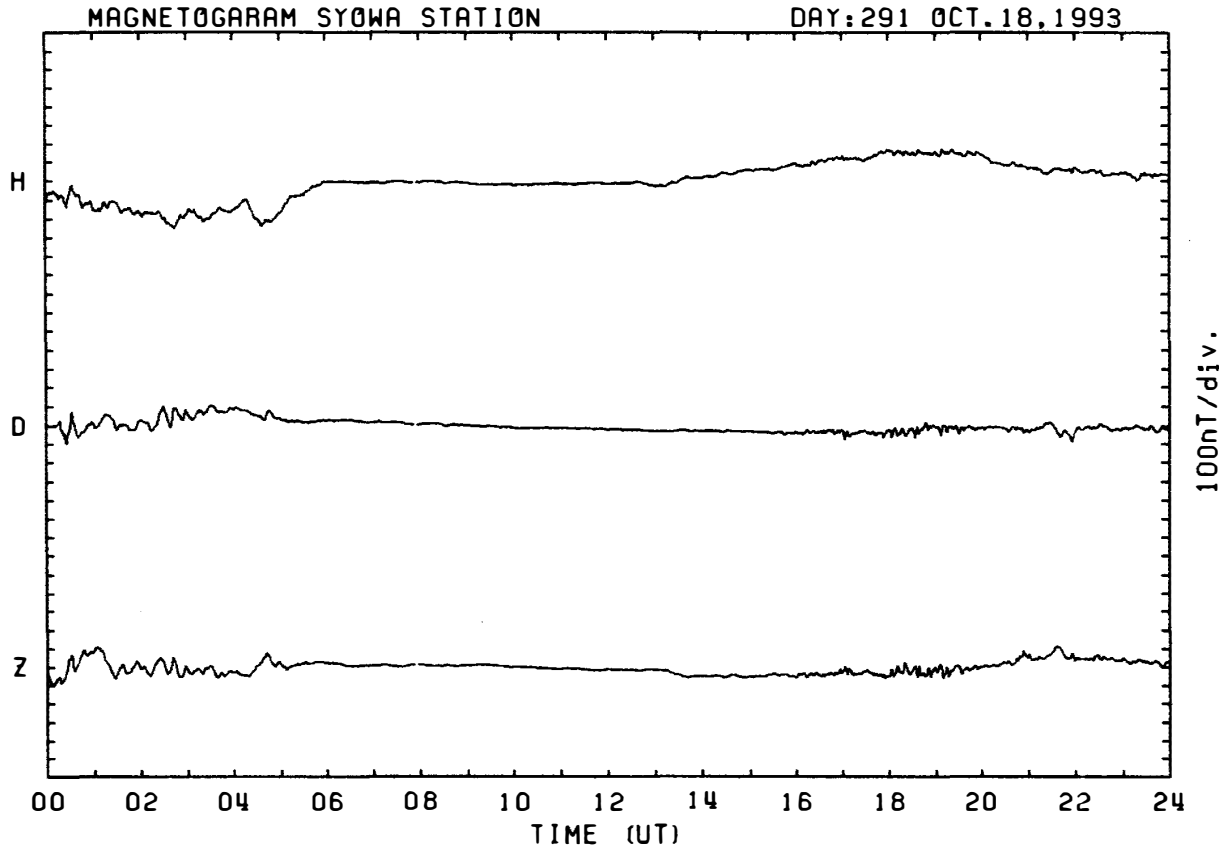
TIME (UT)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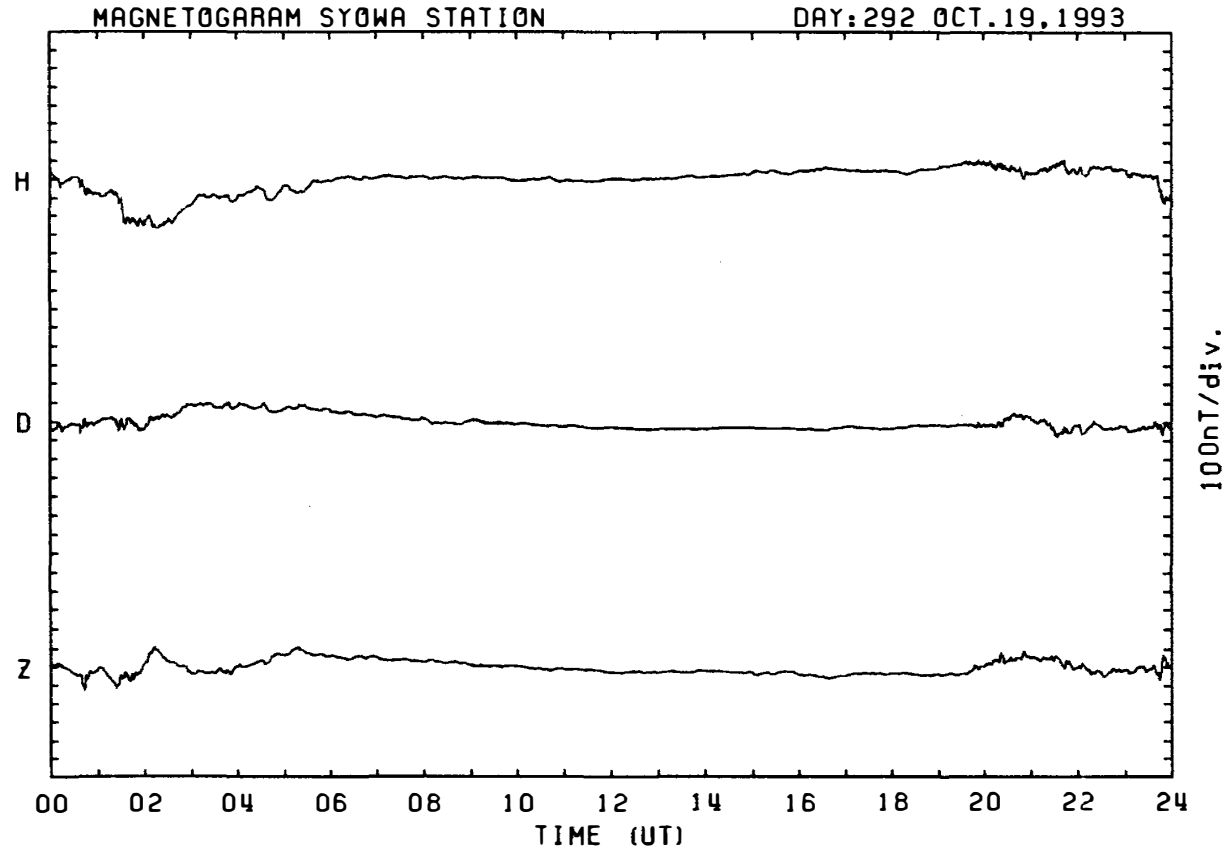
TIME (UT)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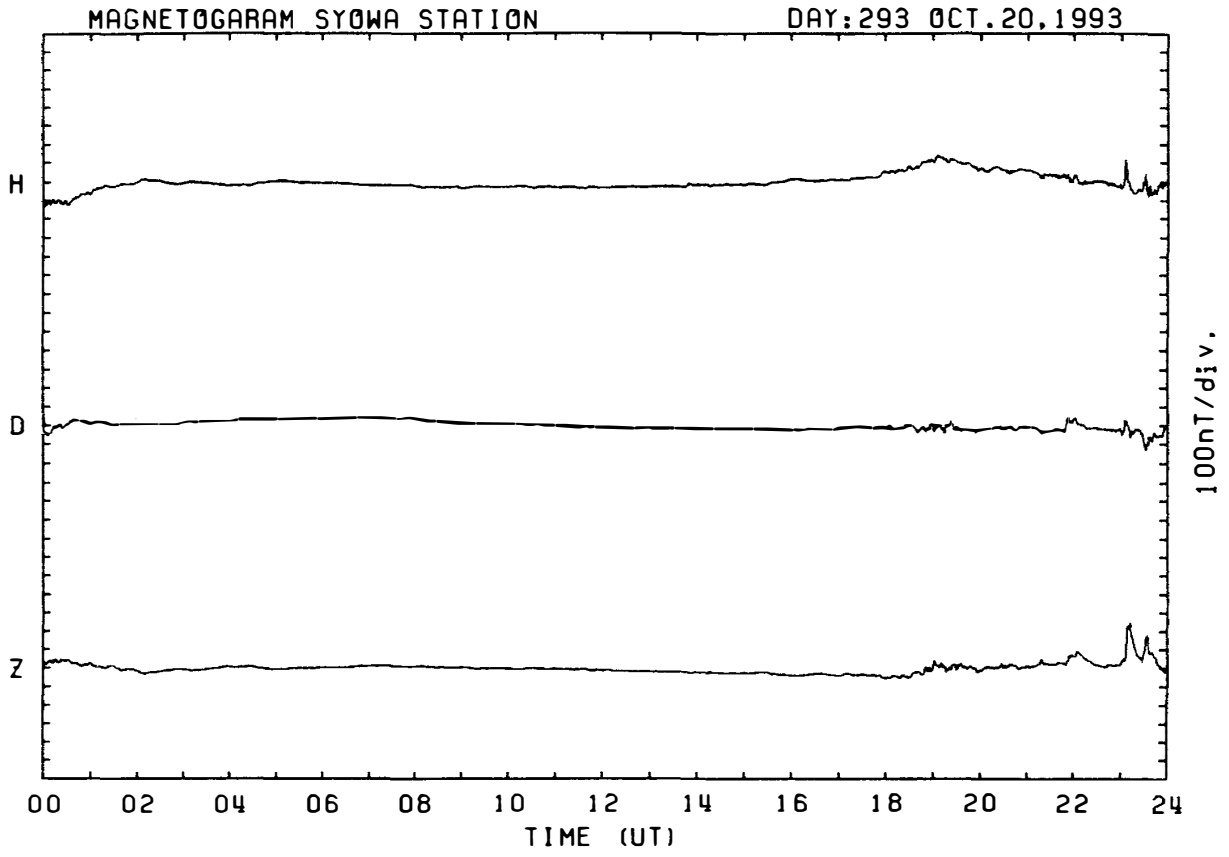
TIME (UT)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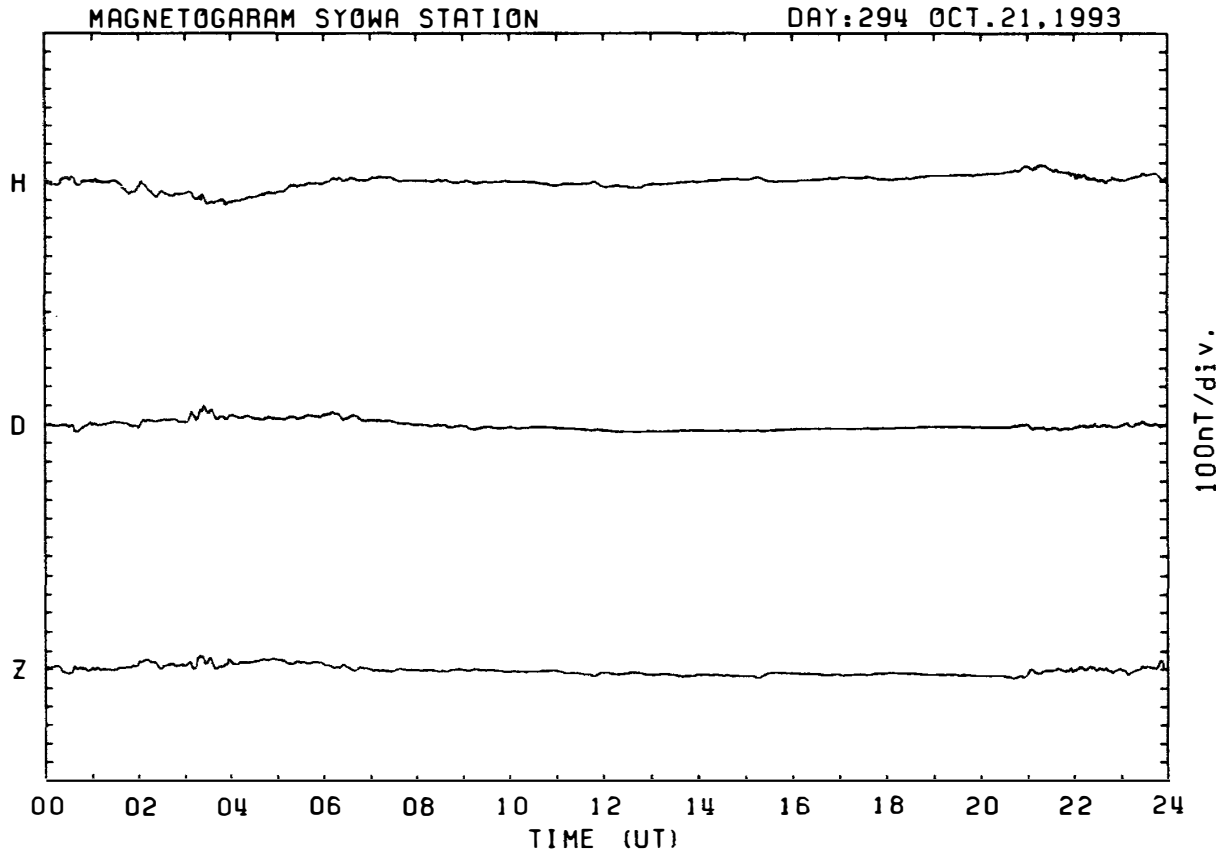
TIME (UT)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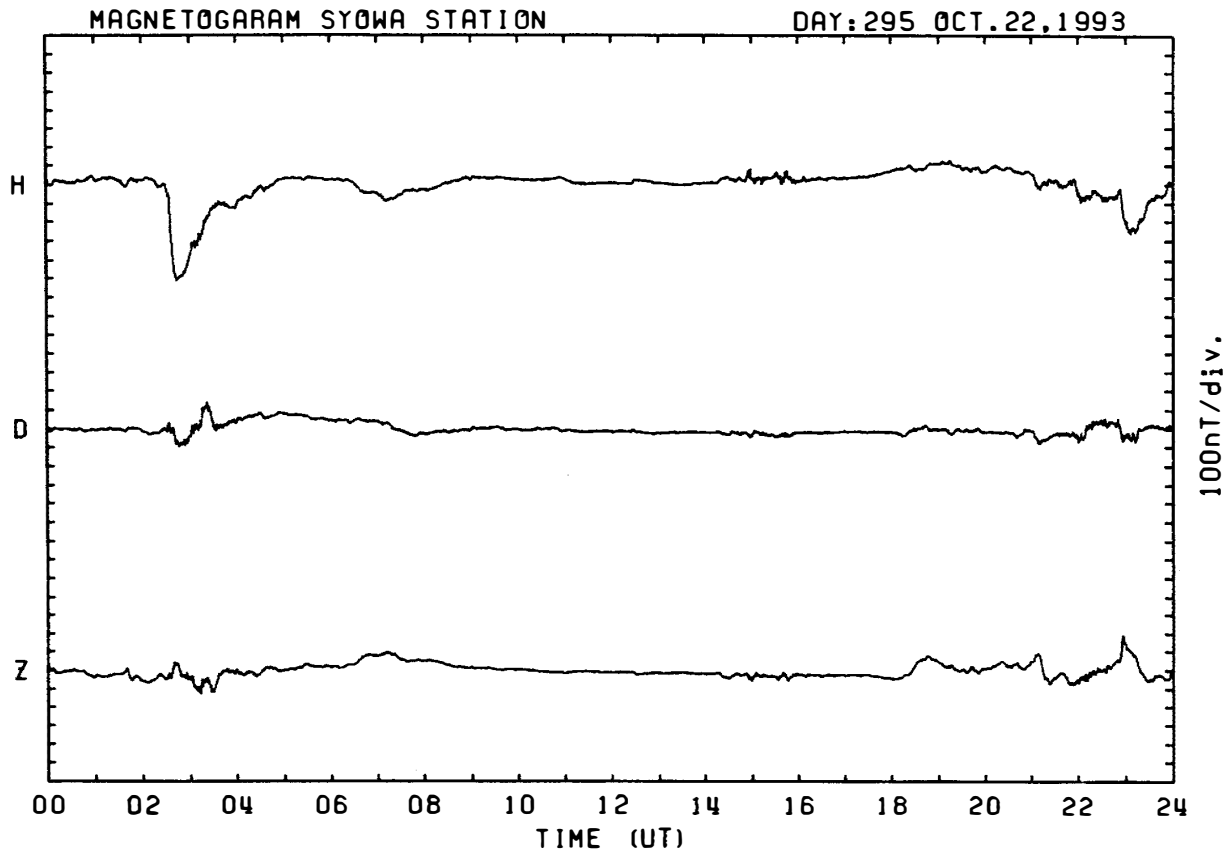
TIME (UT)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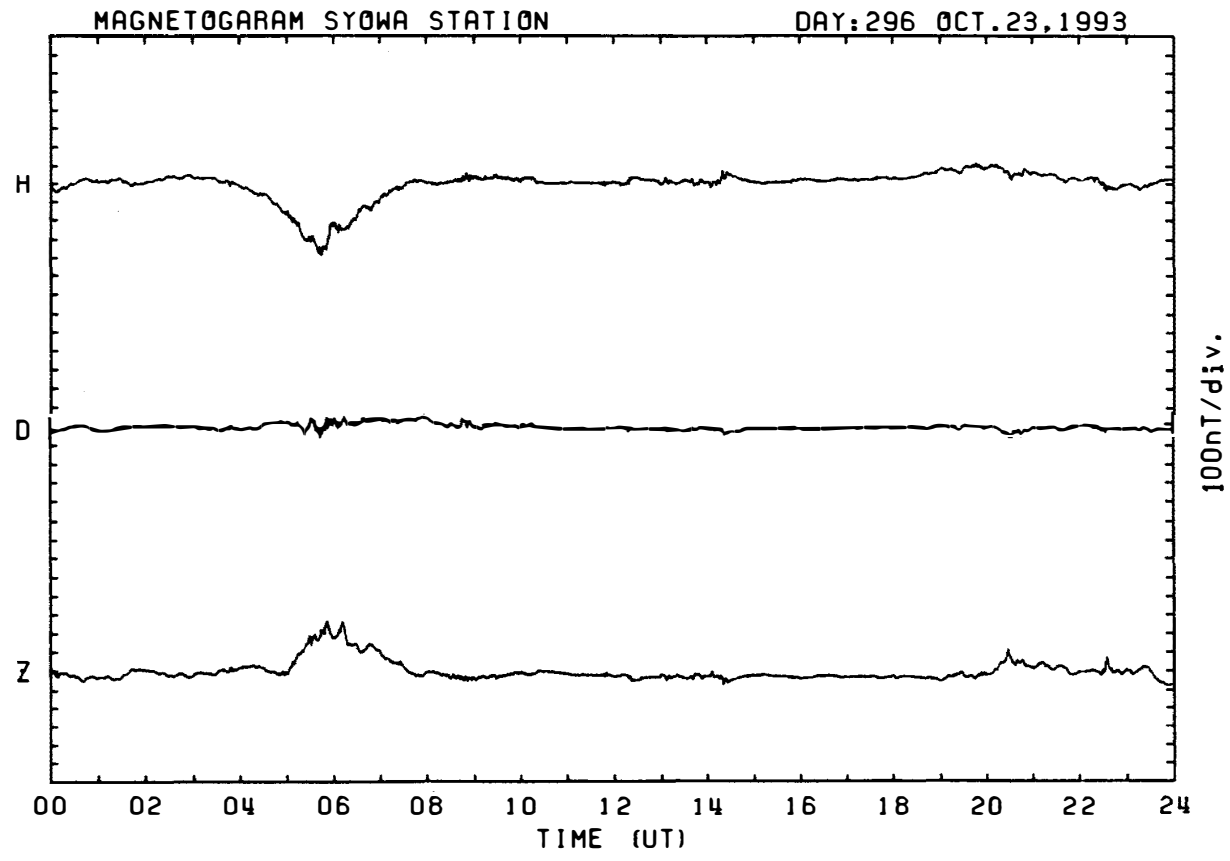
TIME (UT)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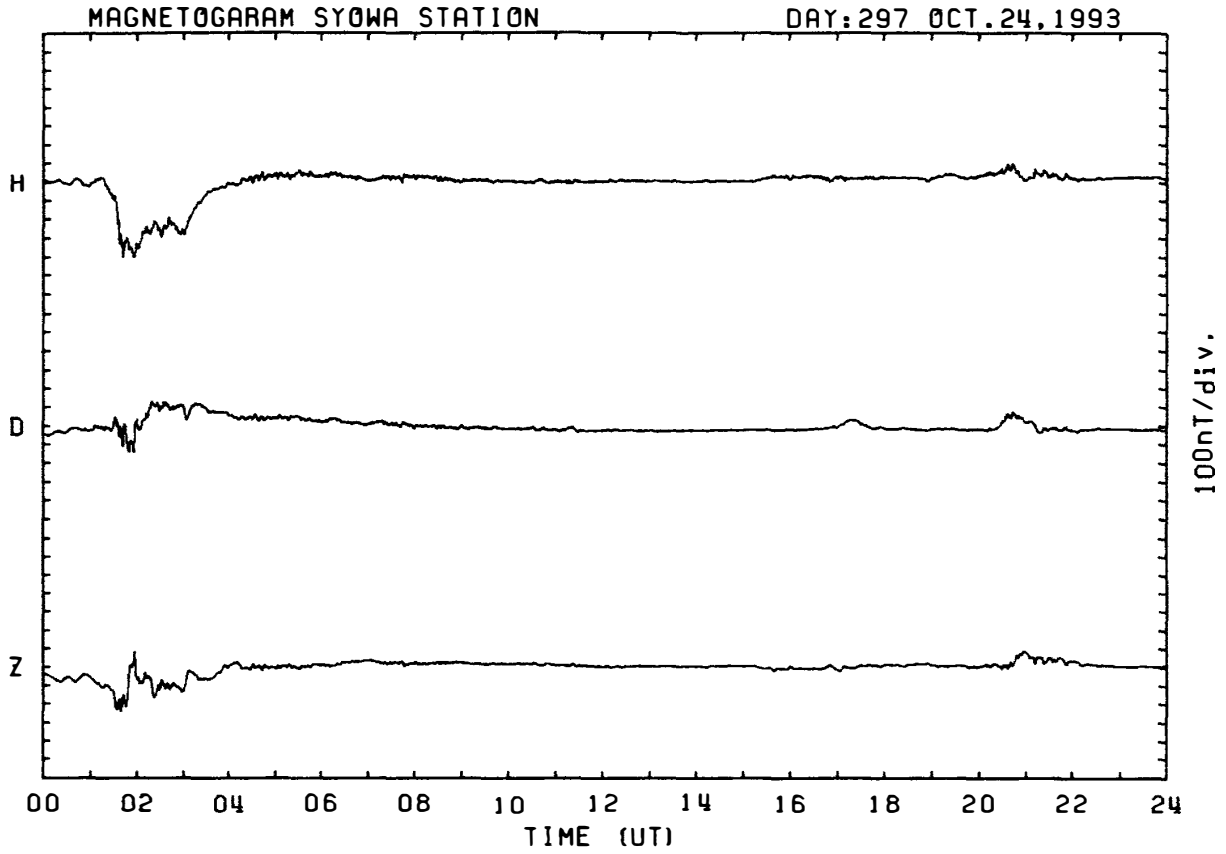
TIME (UT)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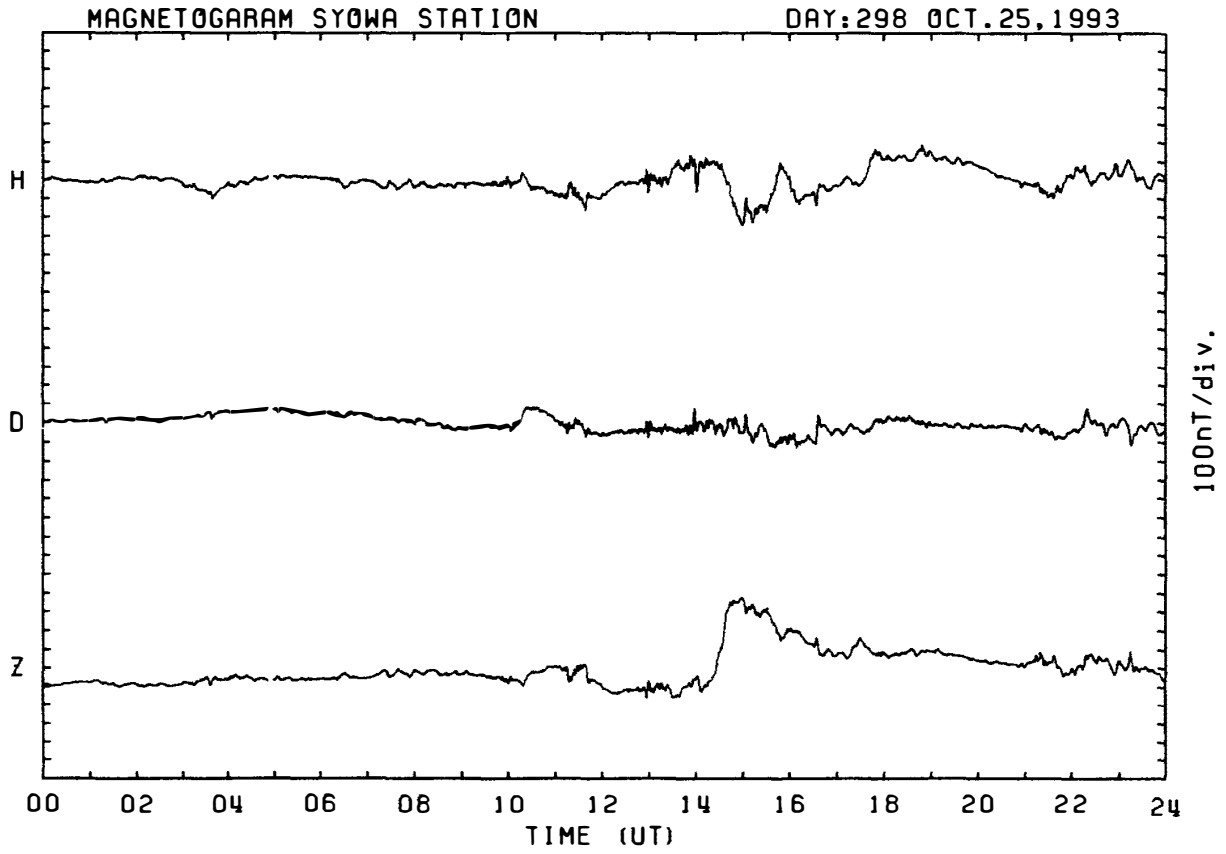
TIME (UT)


MAGNETOGARAM SYOWA STATION
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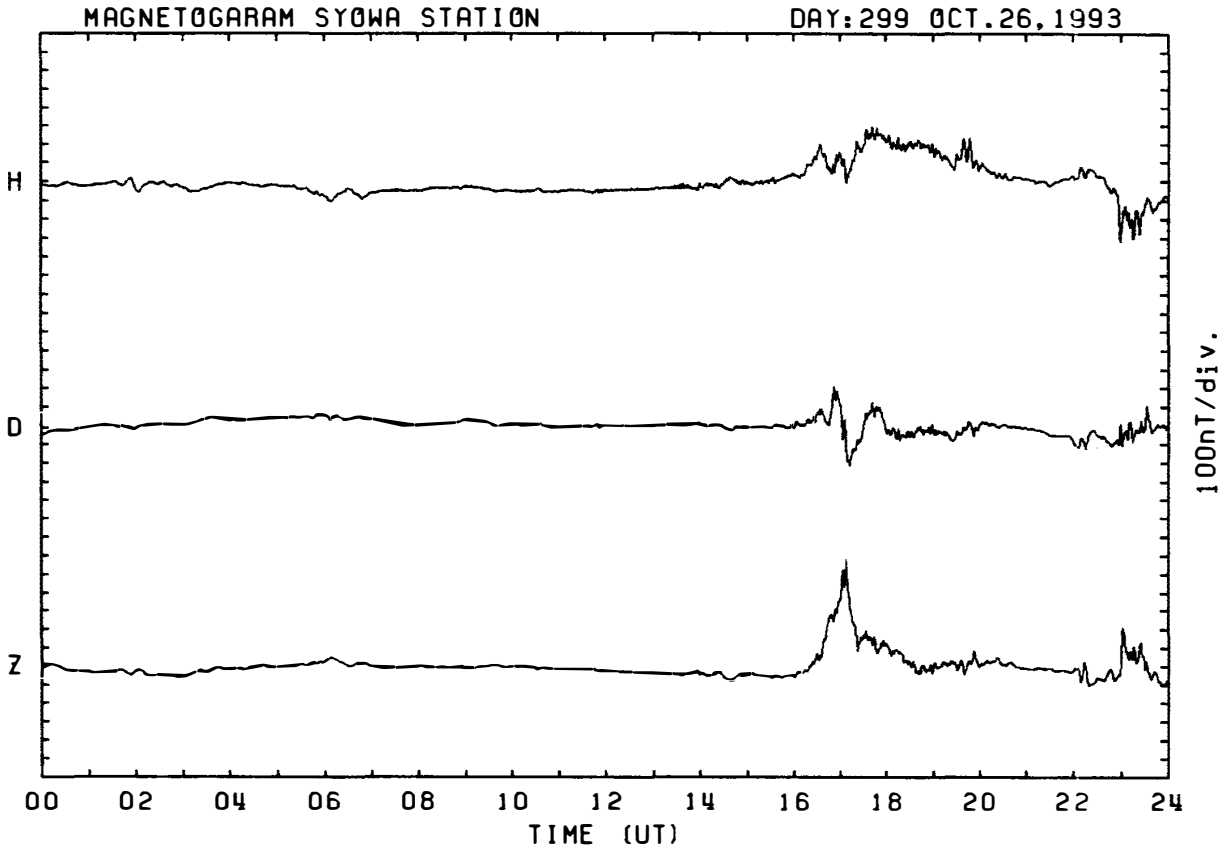
TIME (UT)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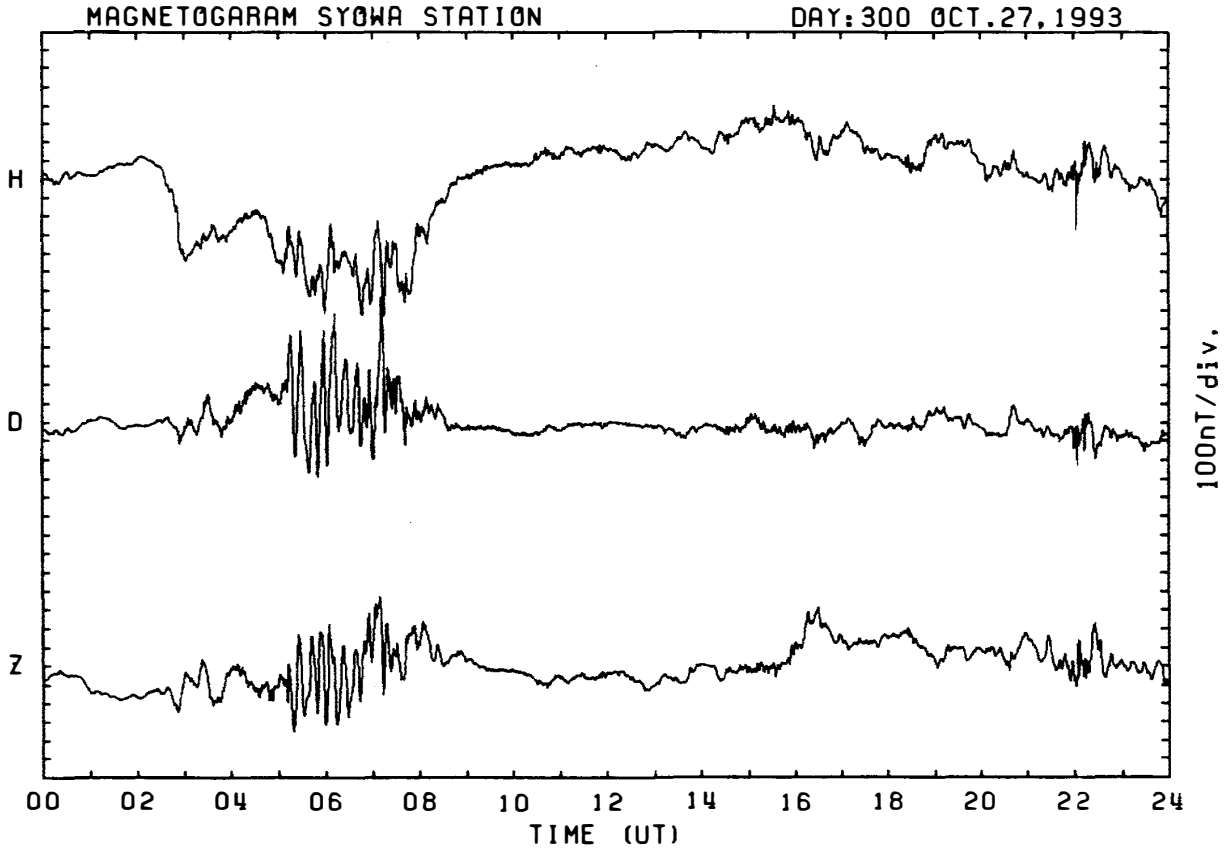
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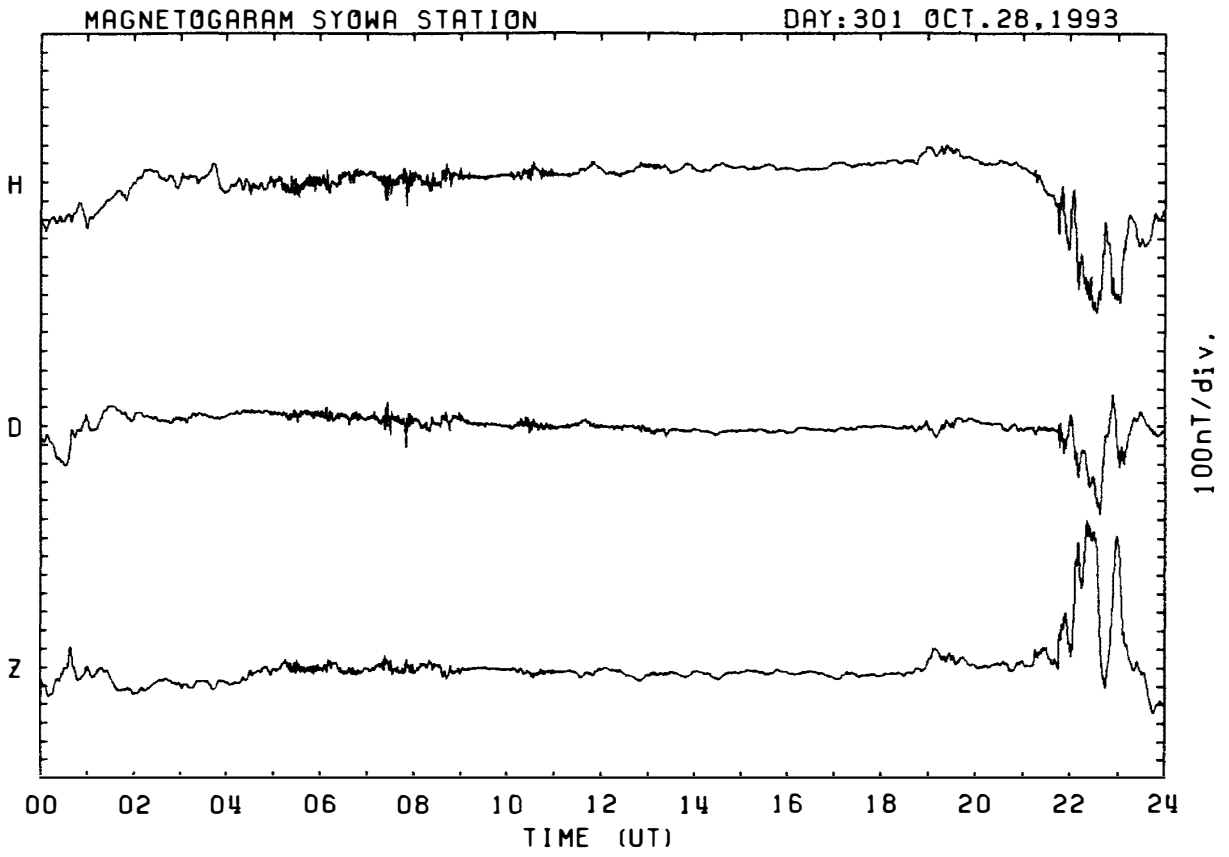
TIME (UT)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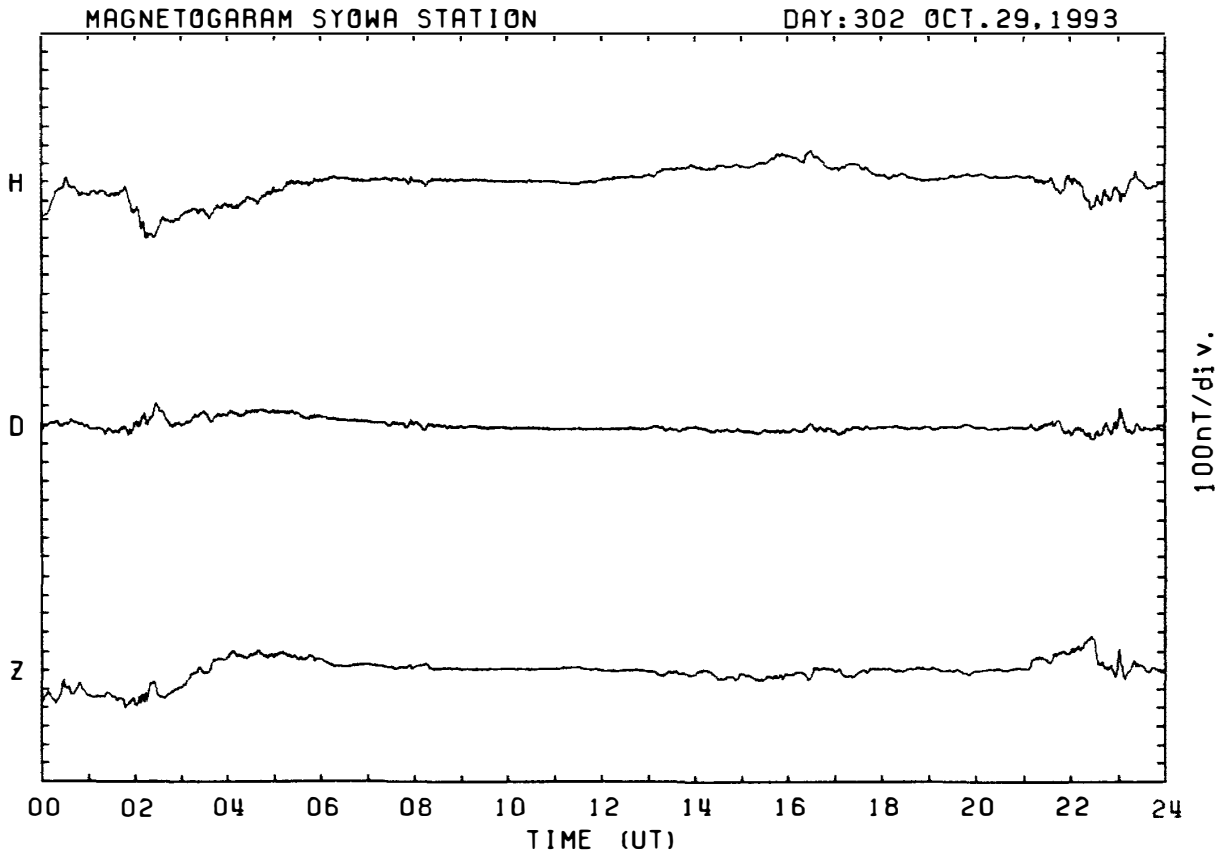
TIME (UT)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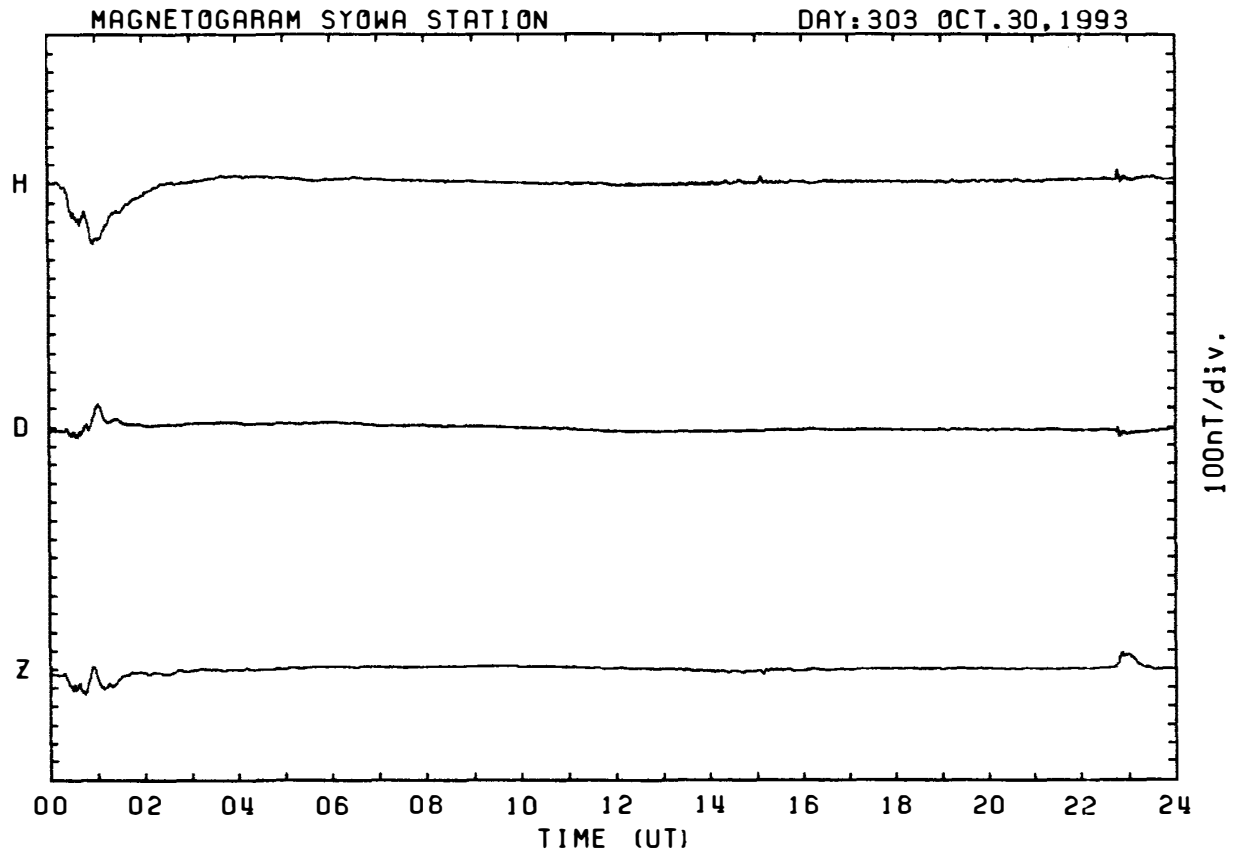
TIME (UT)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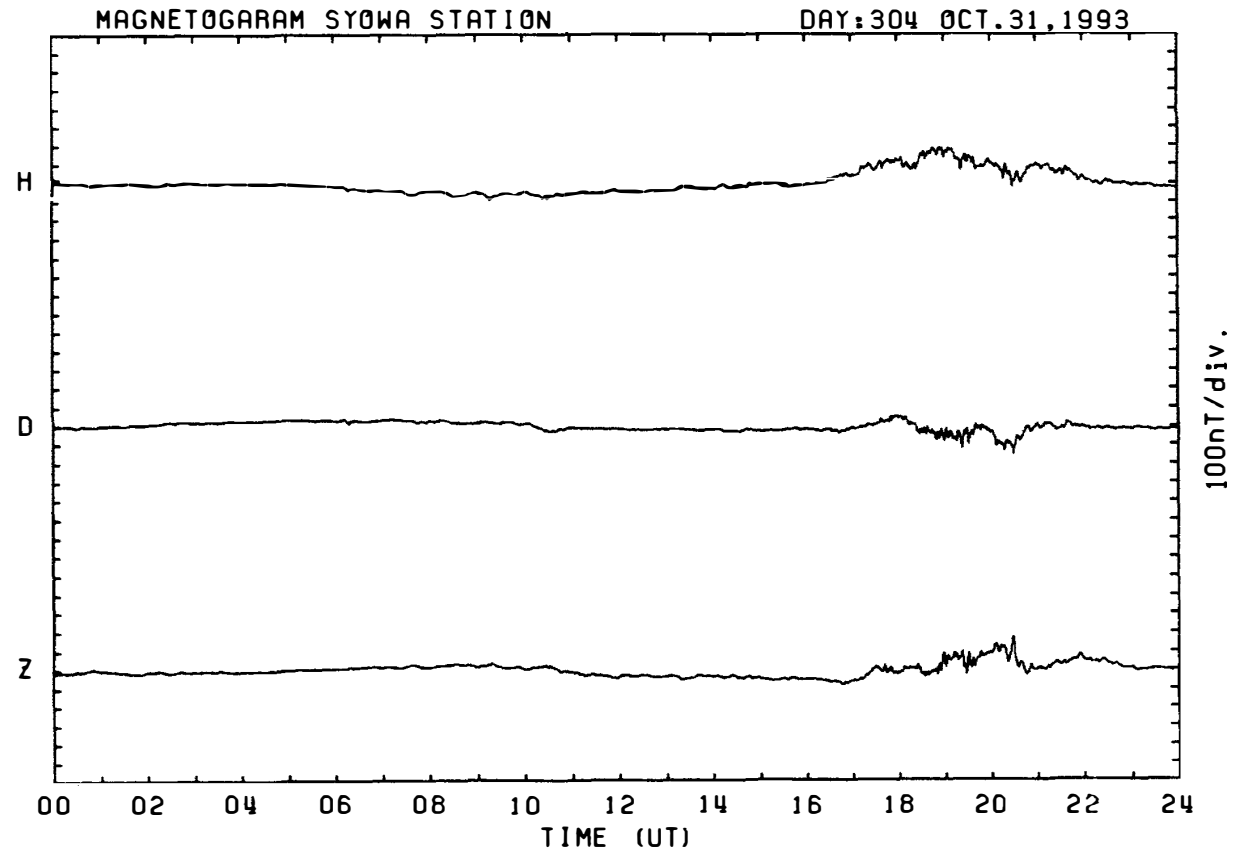
TIME (UT)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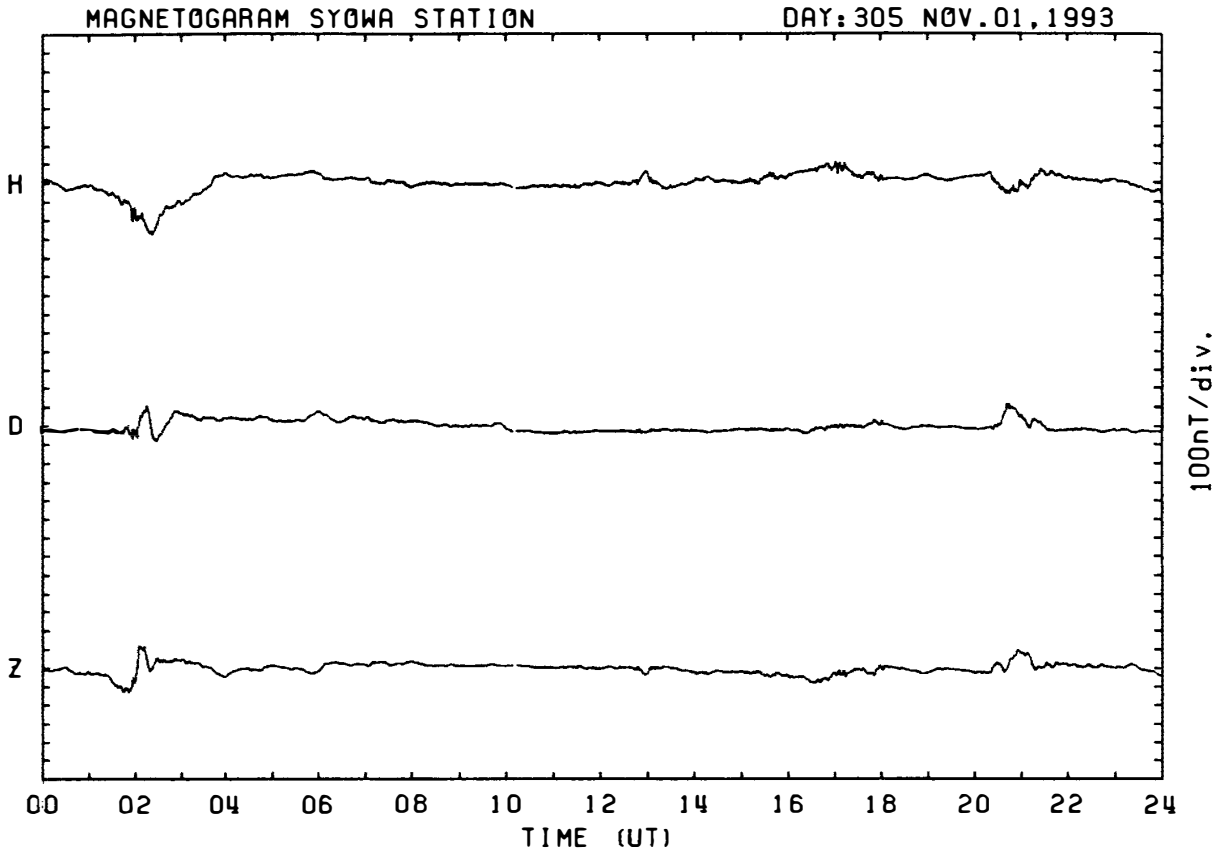
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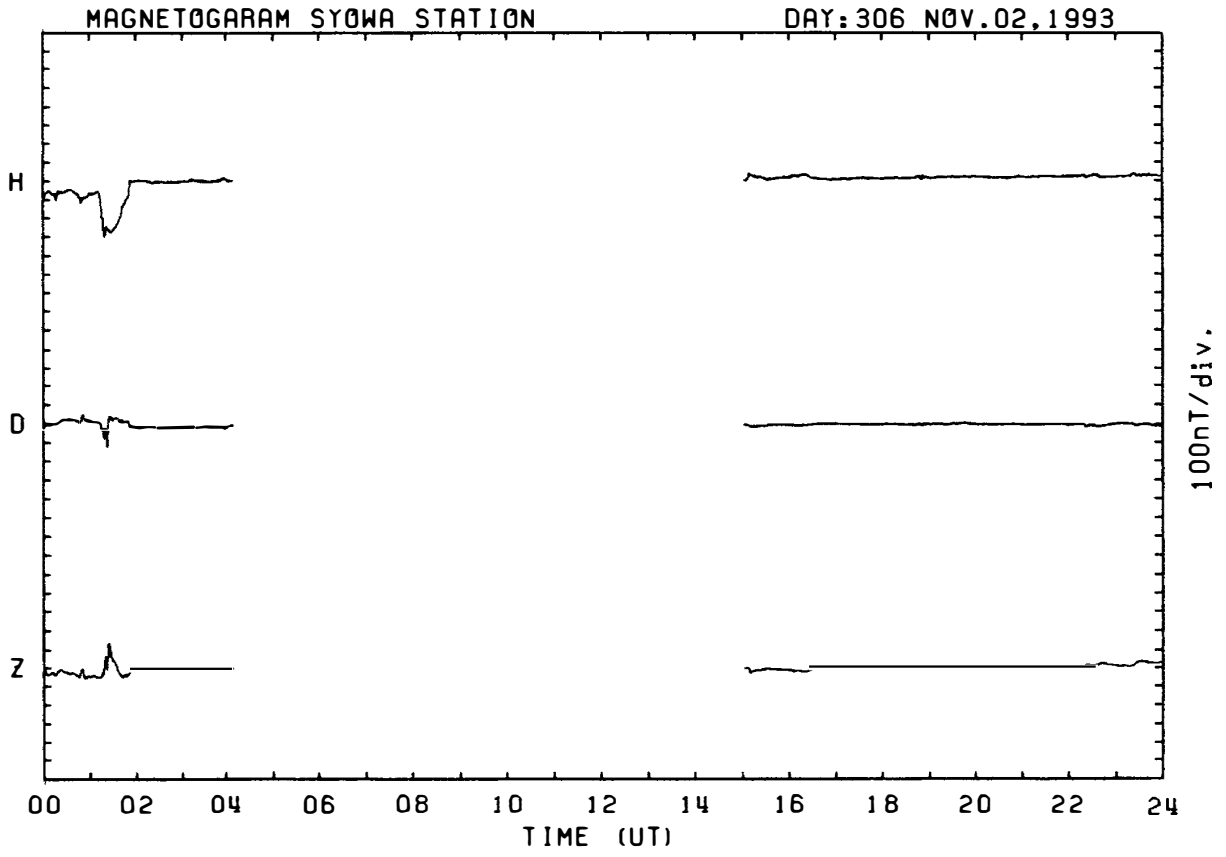
TIME (UT)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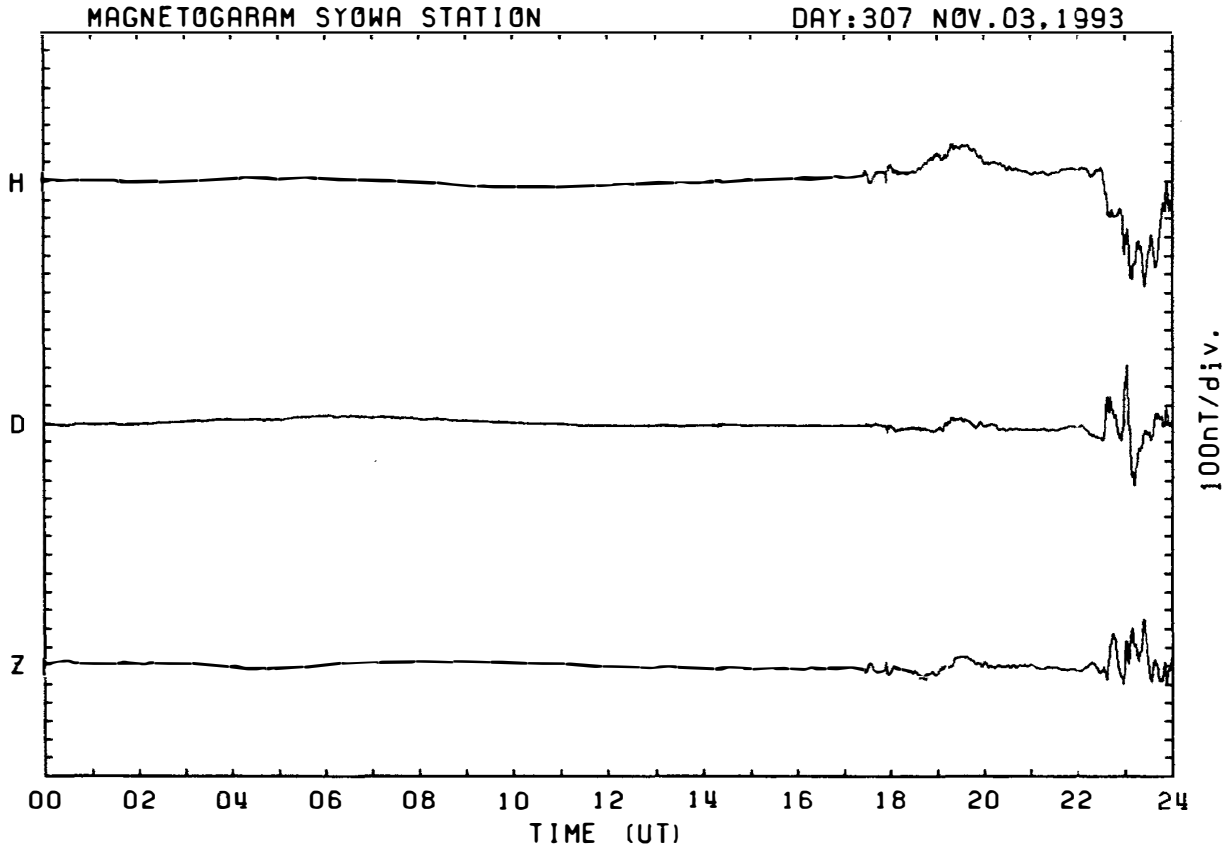
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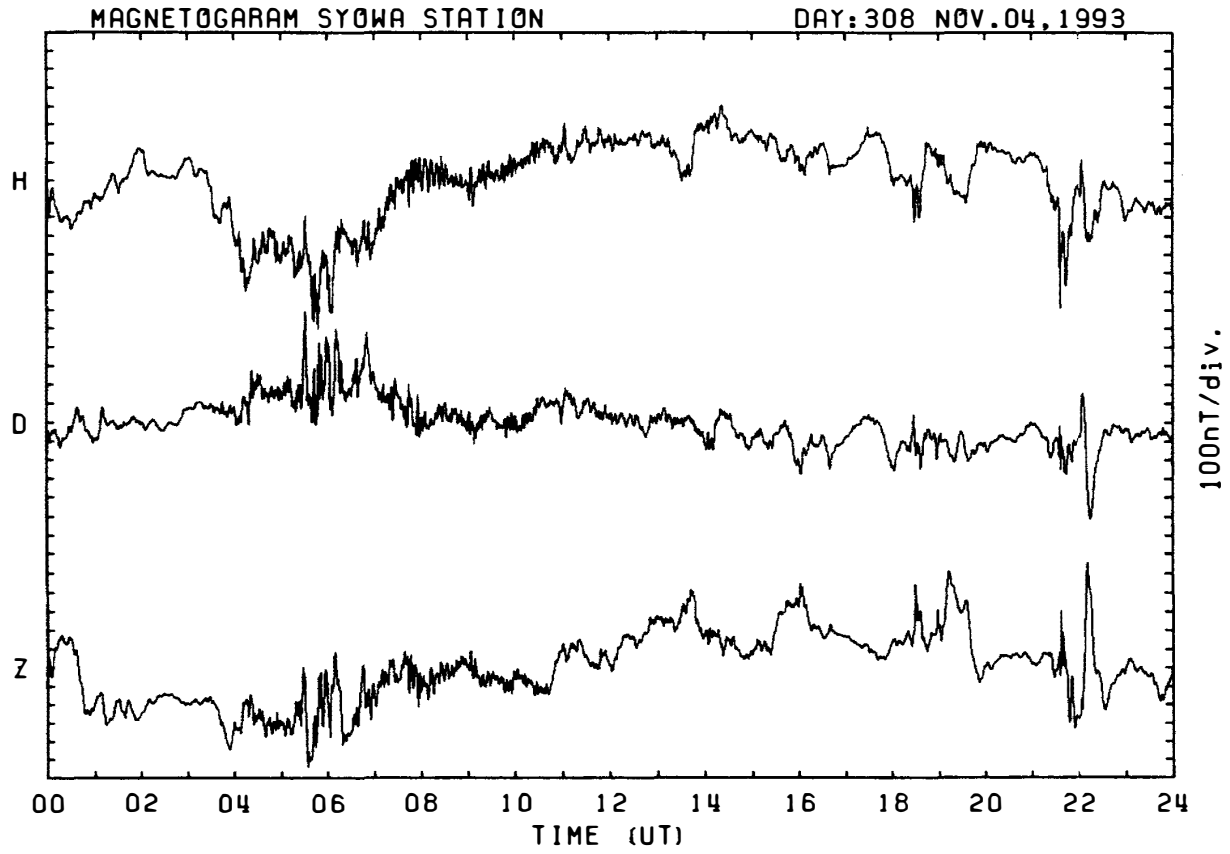
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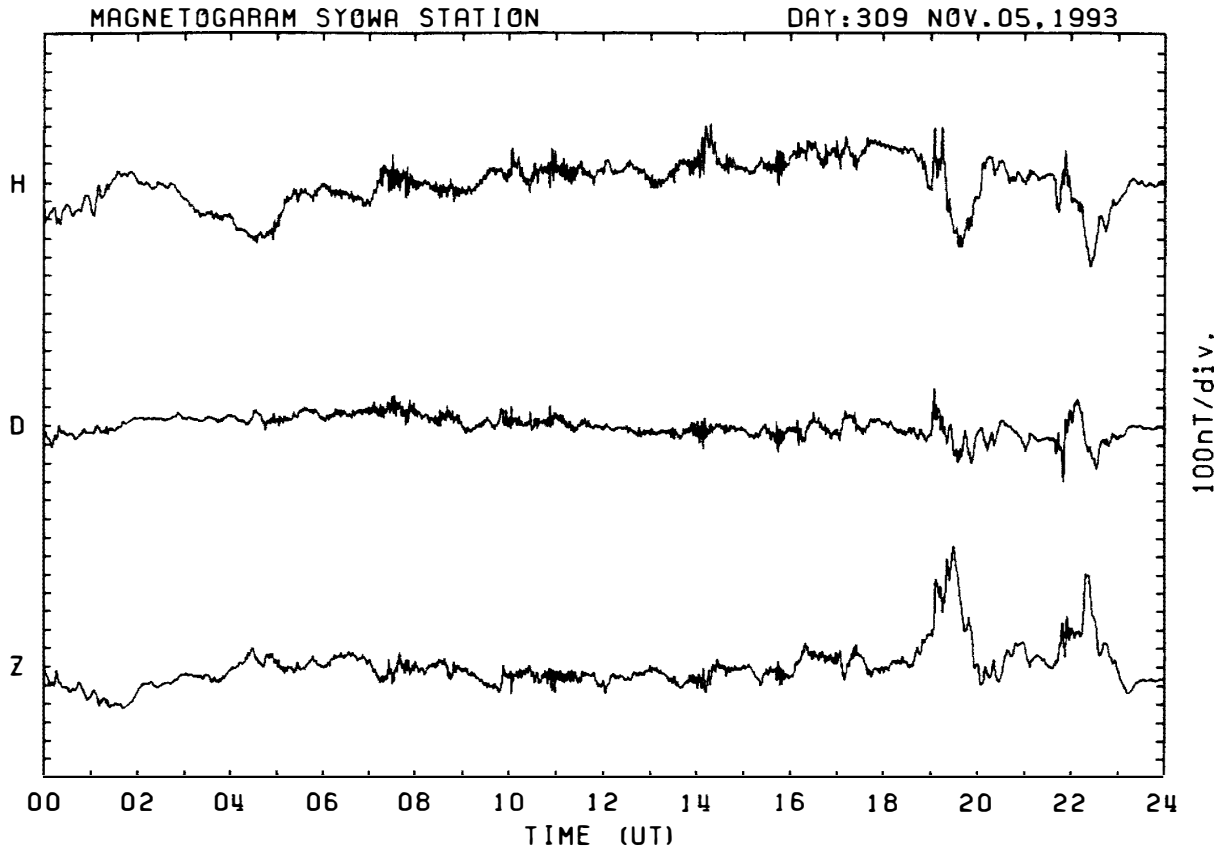
TIME (UT)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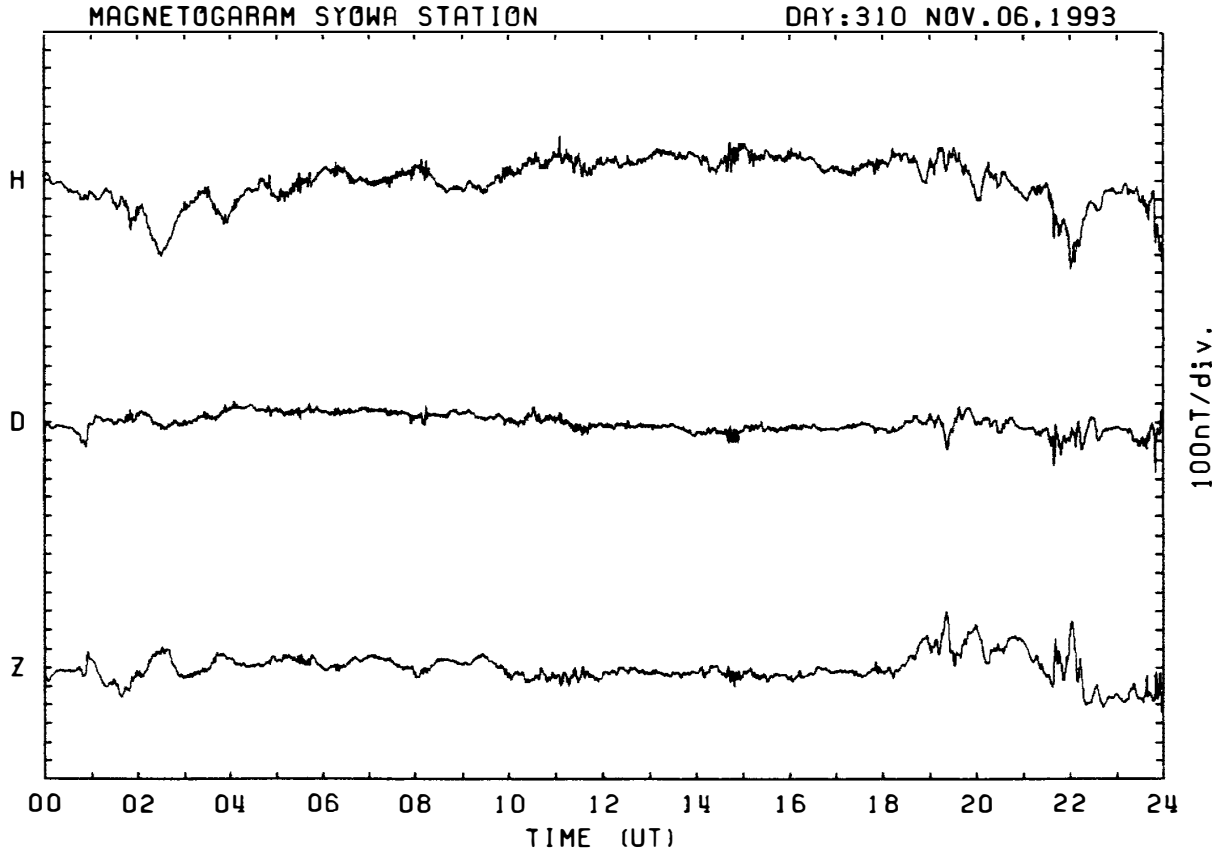
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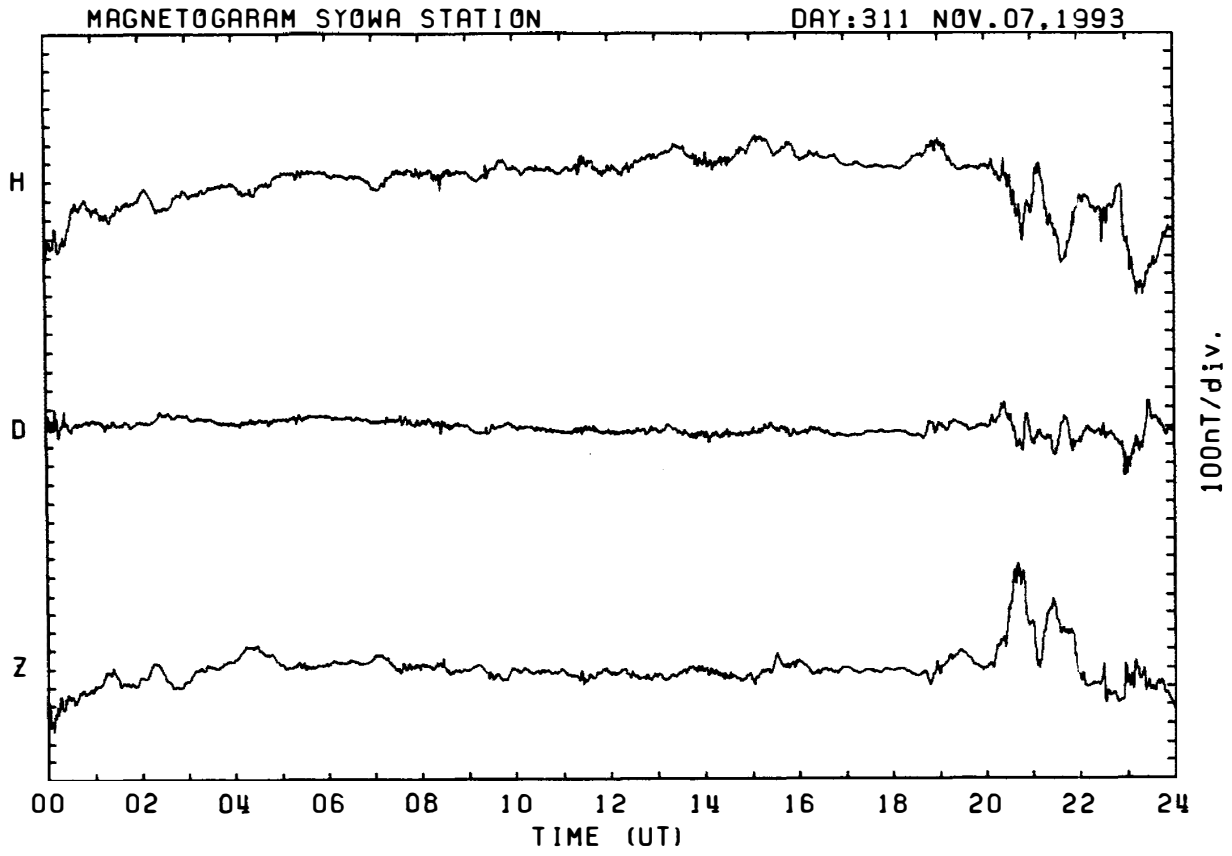
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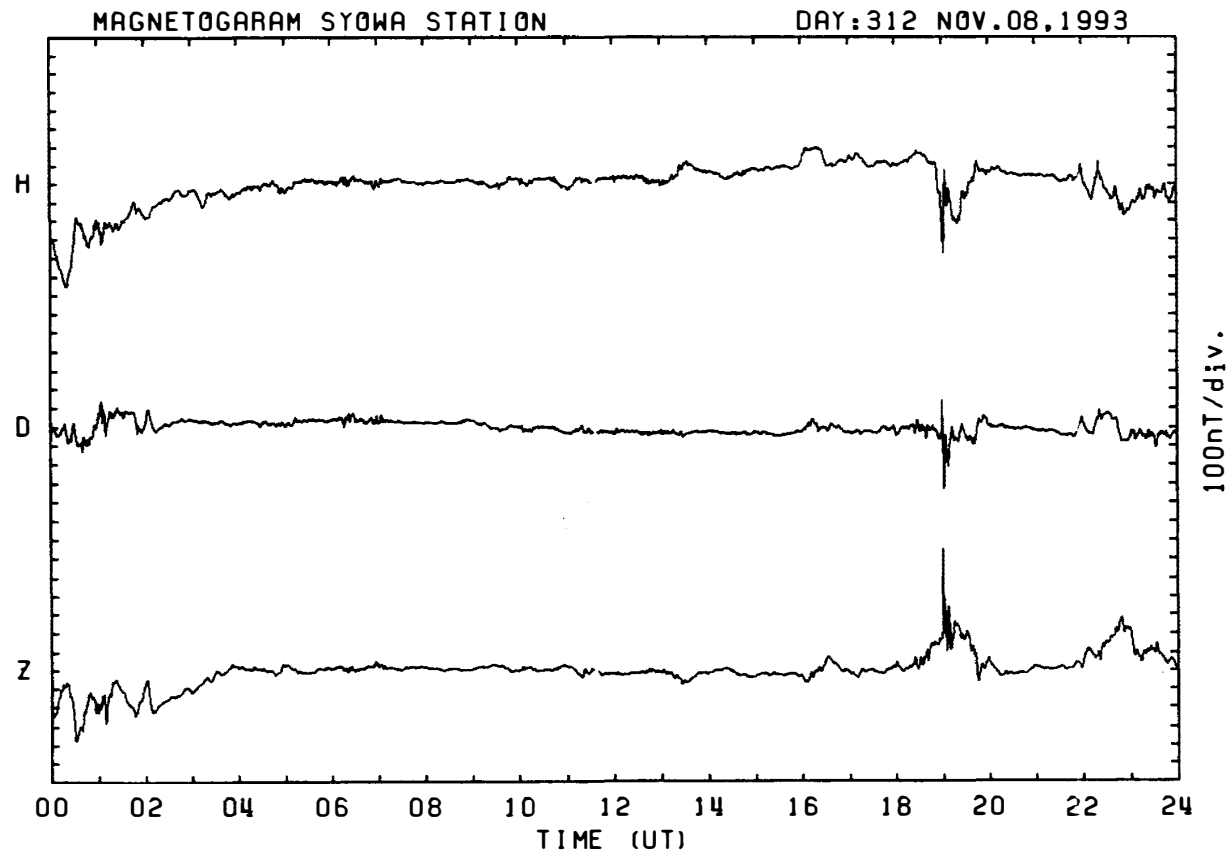
TIME (UT)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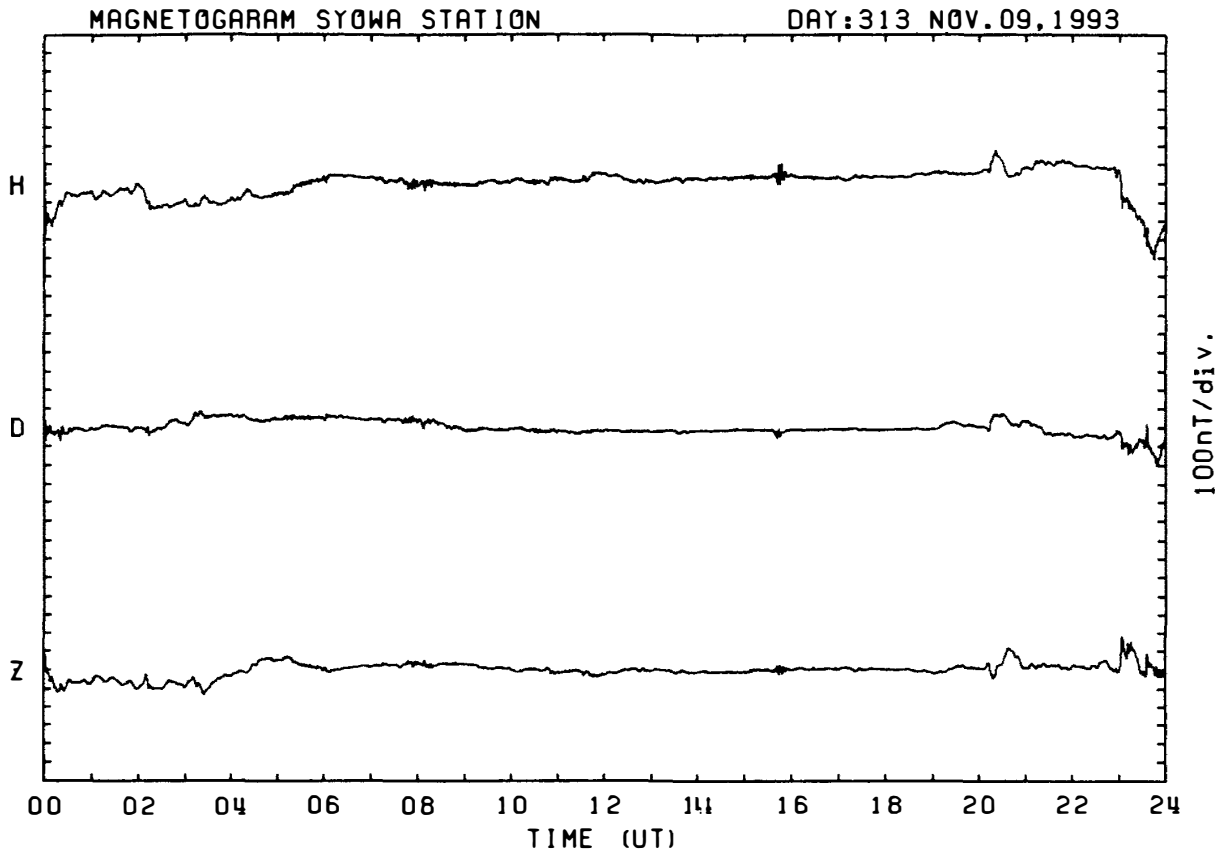
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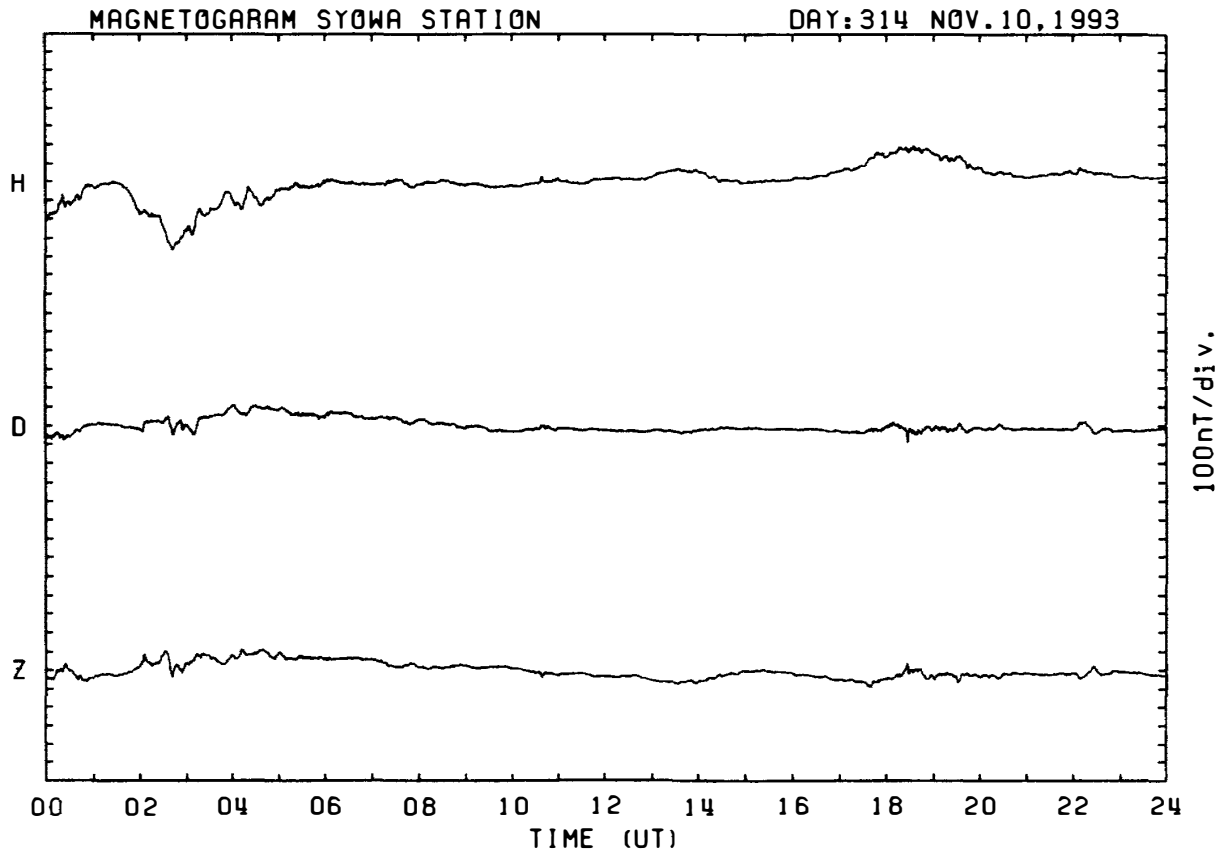
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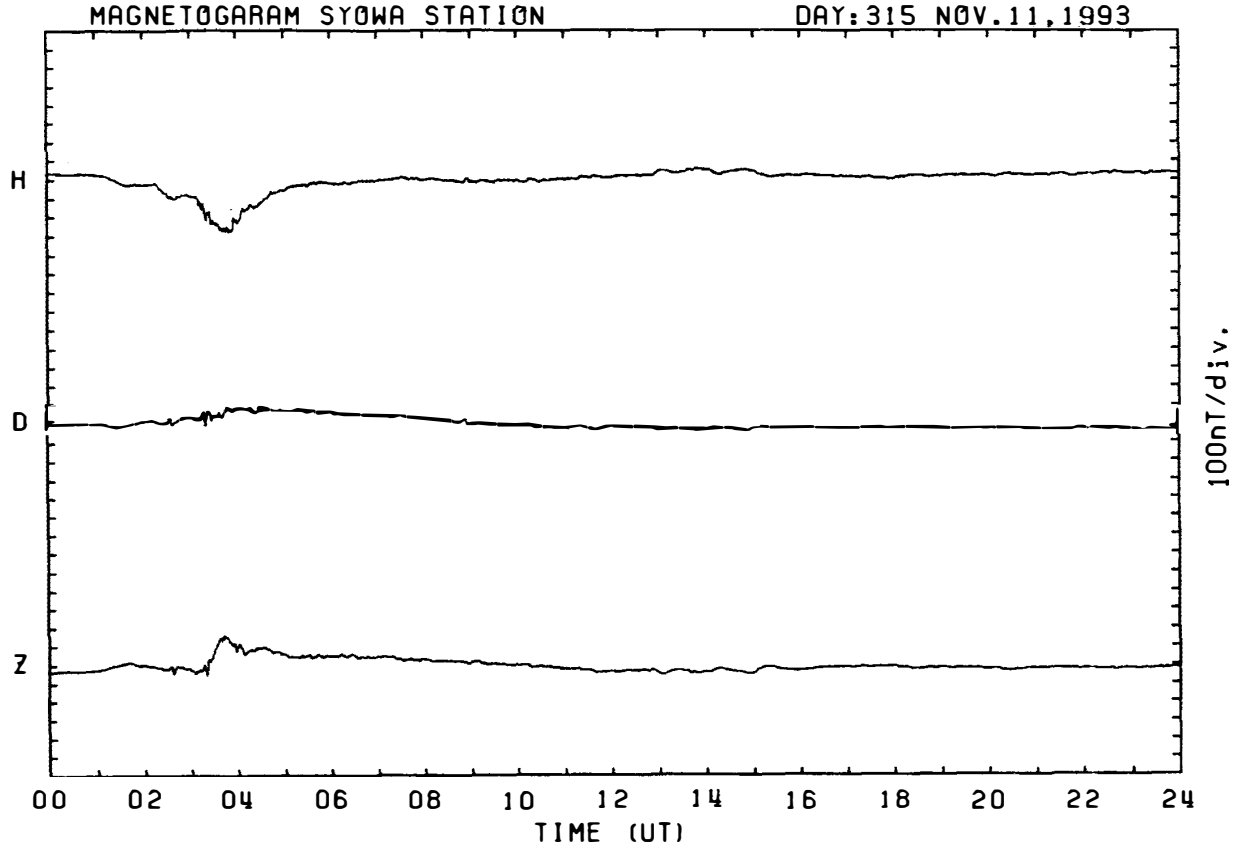
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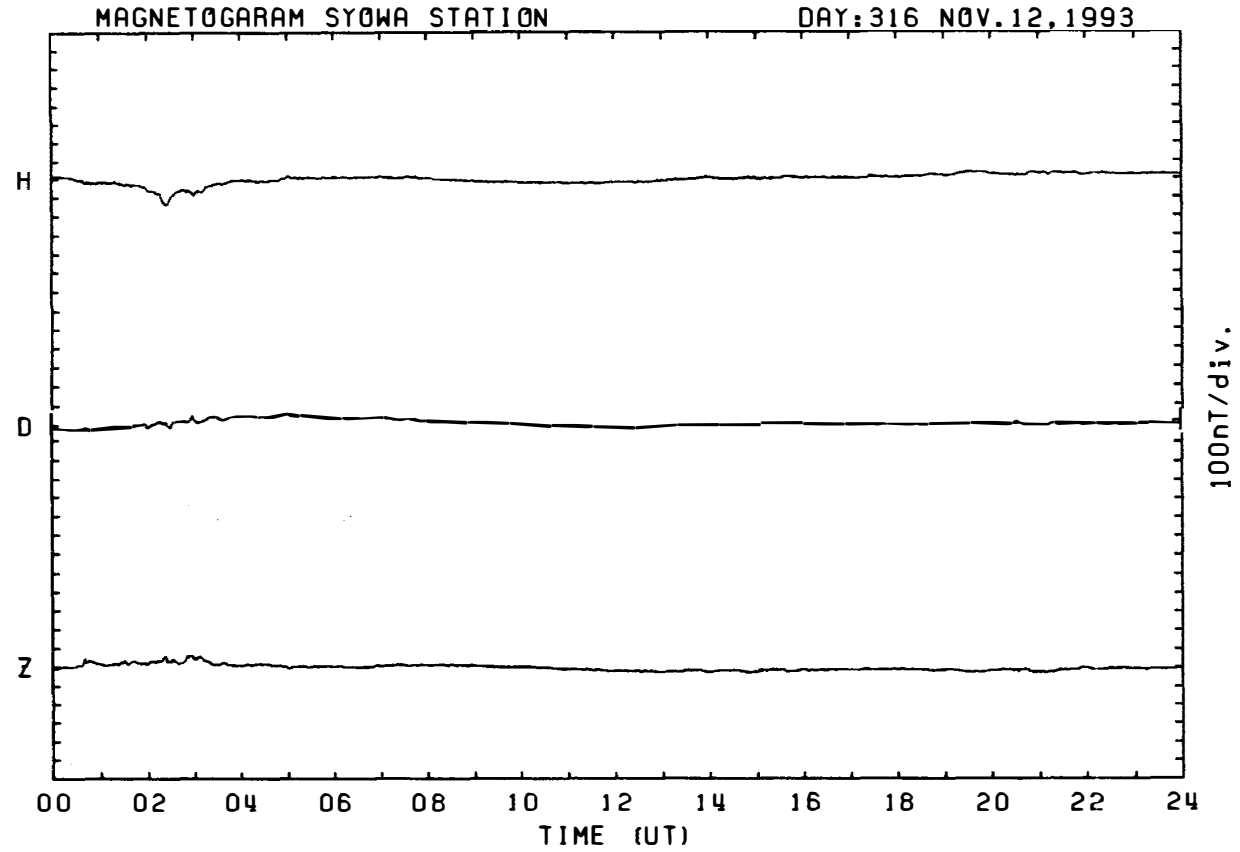
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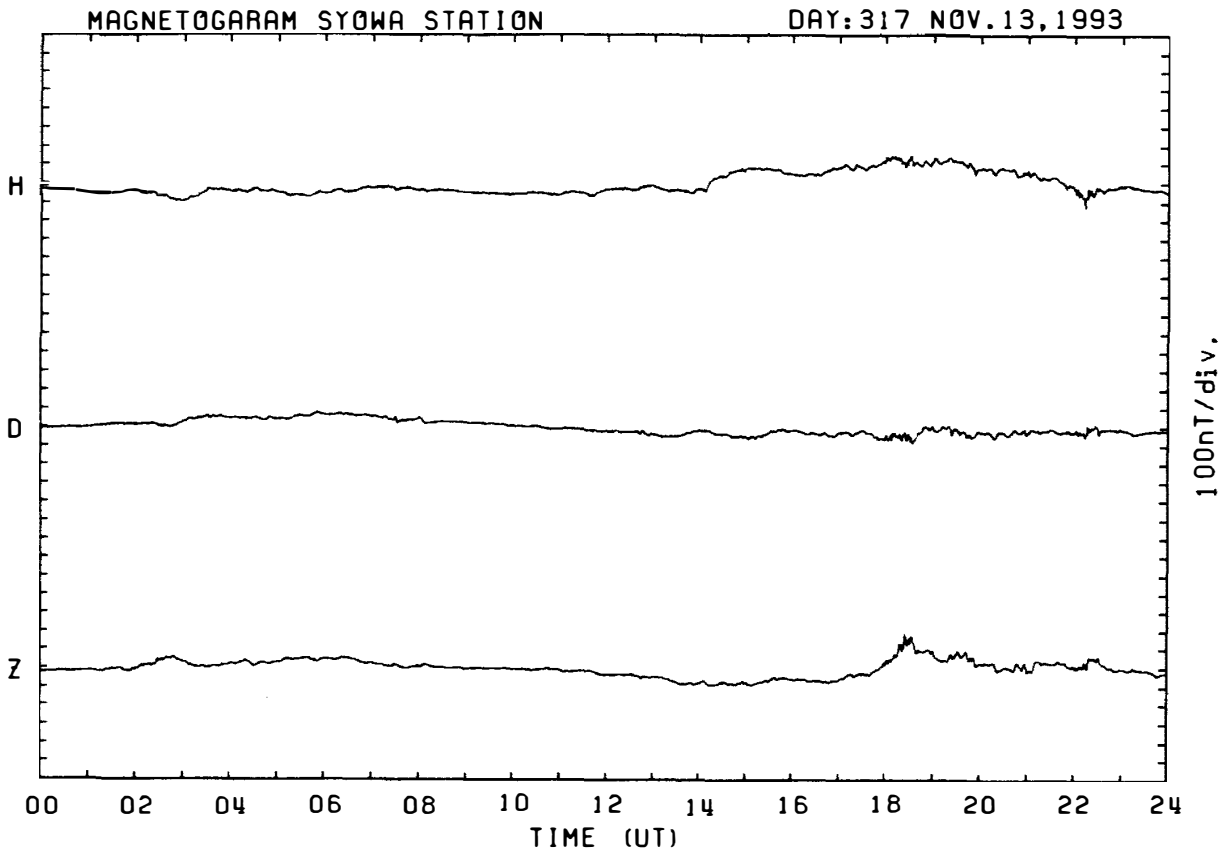
TIME (UT)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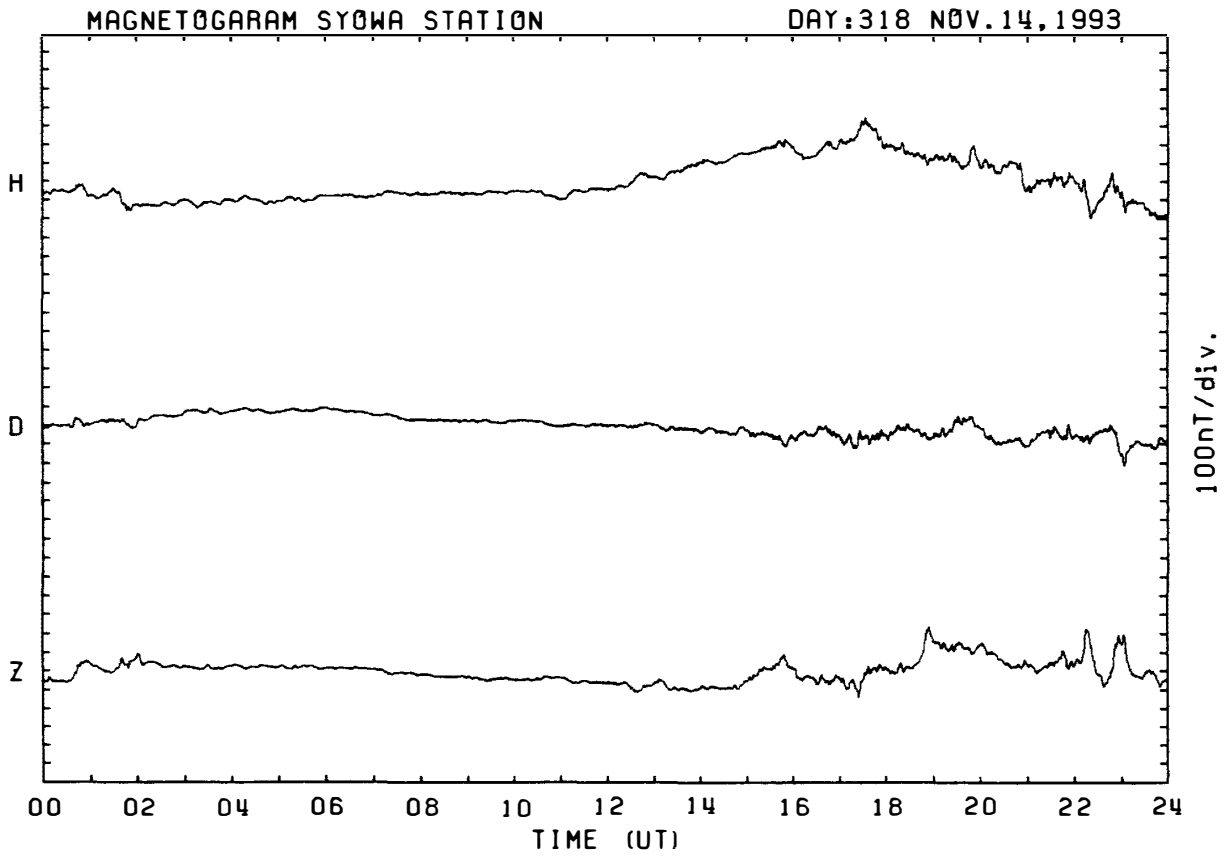
TIME (UT)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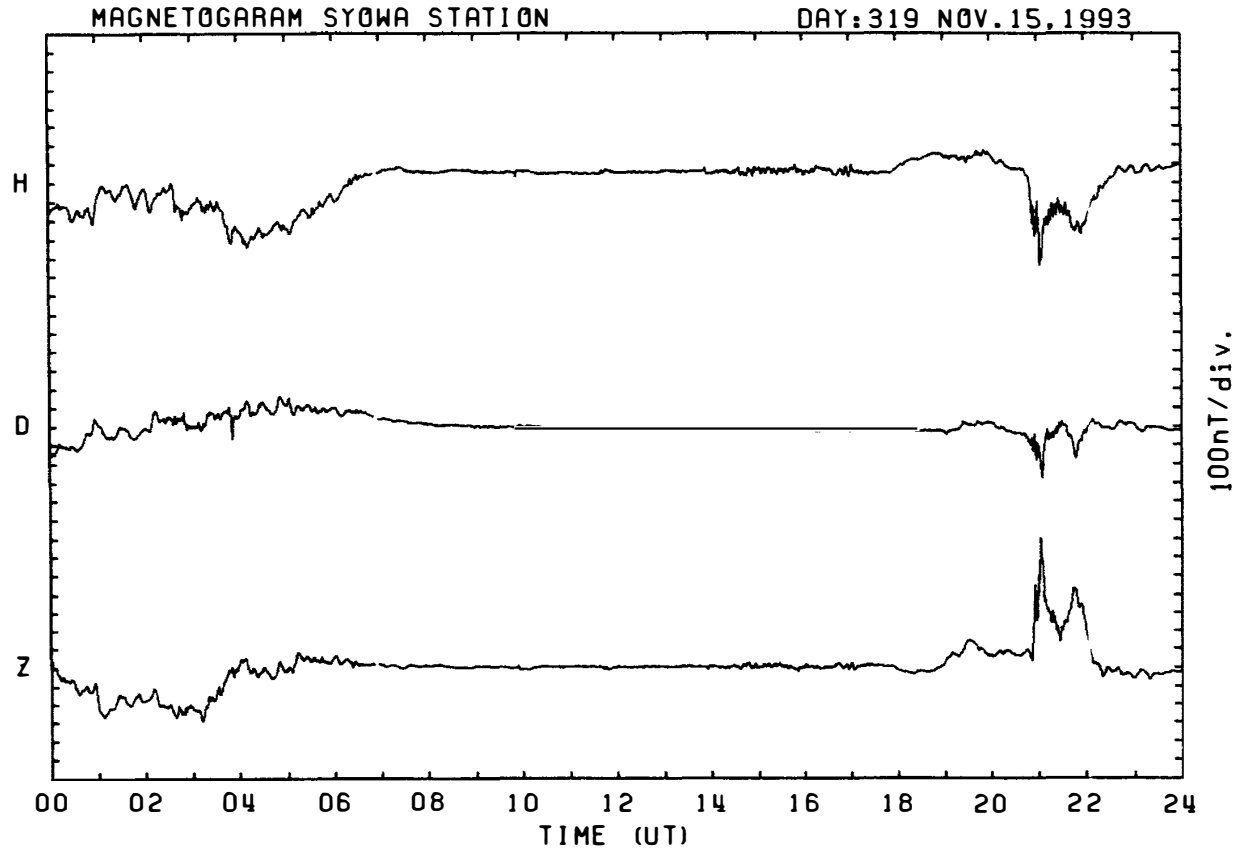
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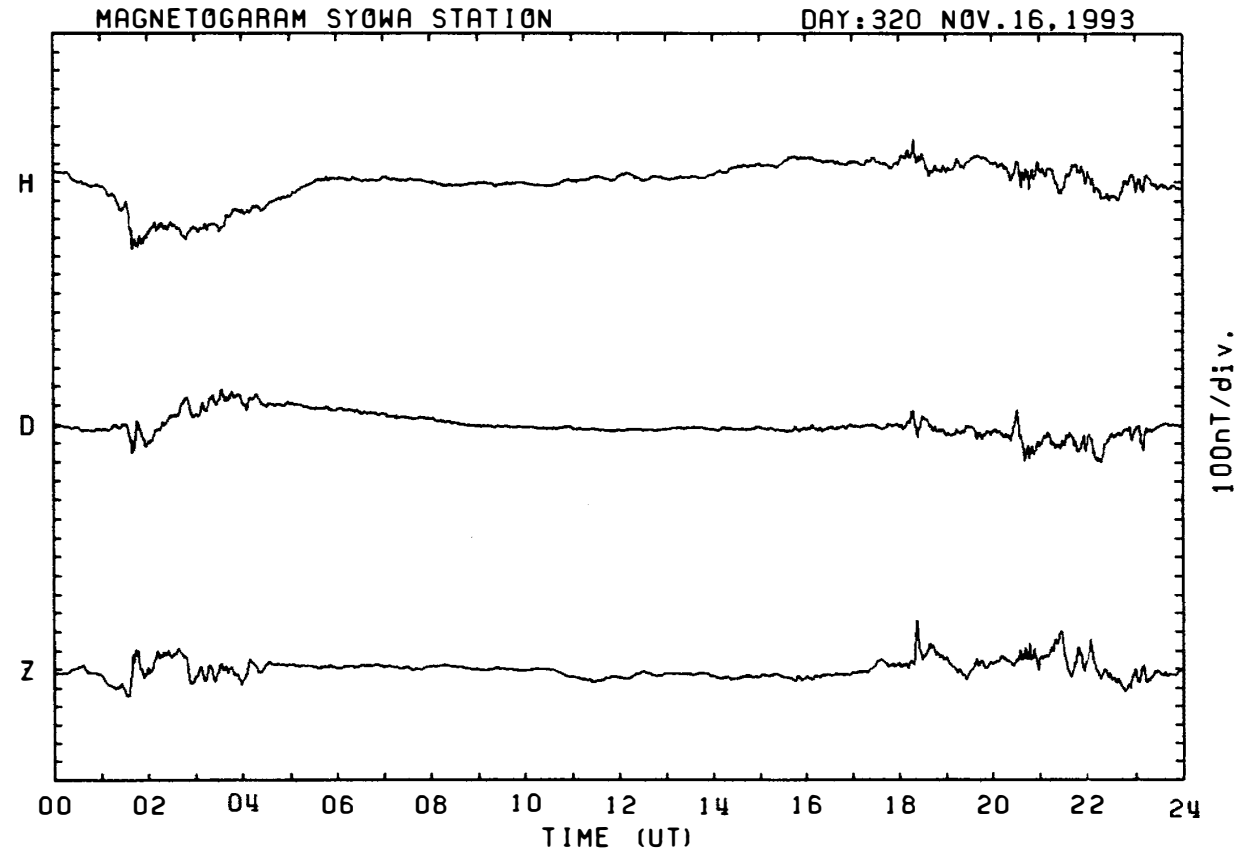
MAGNETOGARAM SYOWA STATION
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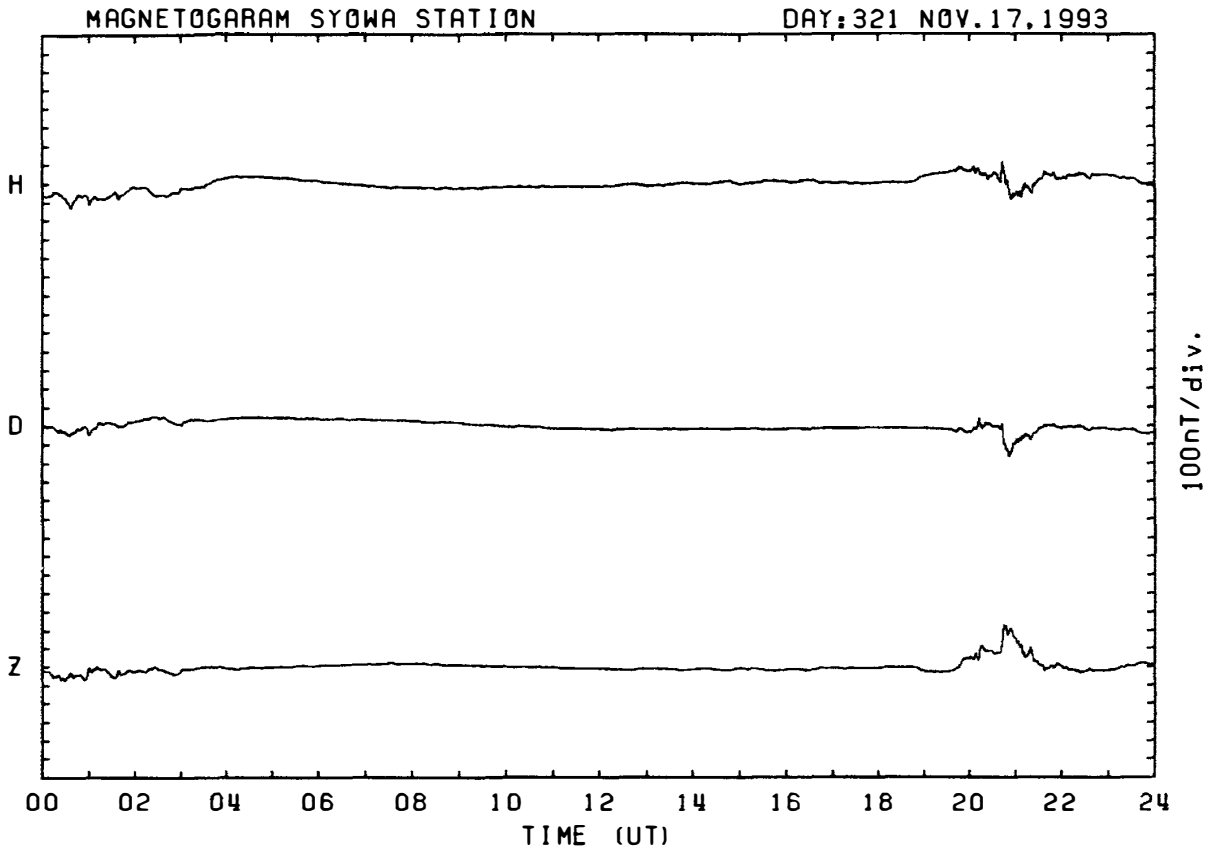
TIME (UT)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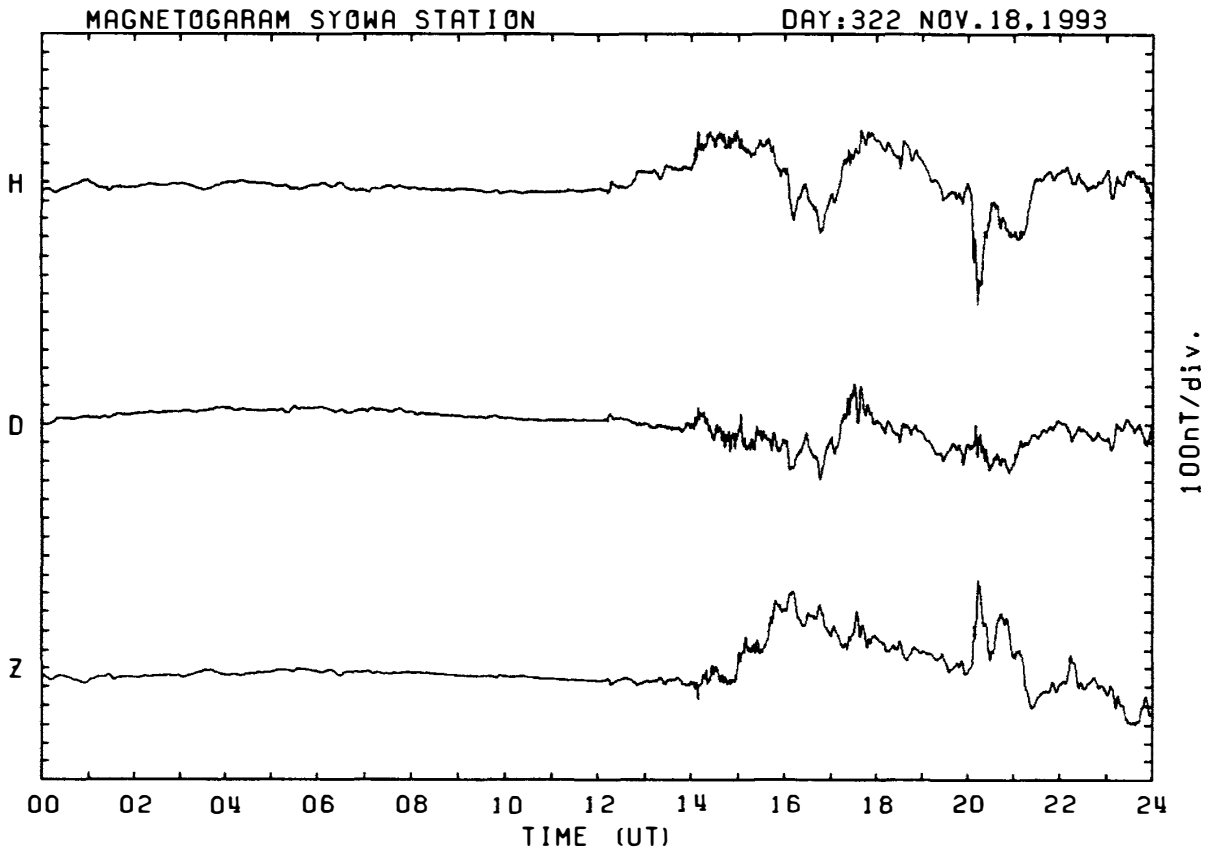
TIME (UT)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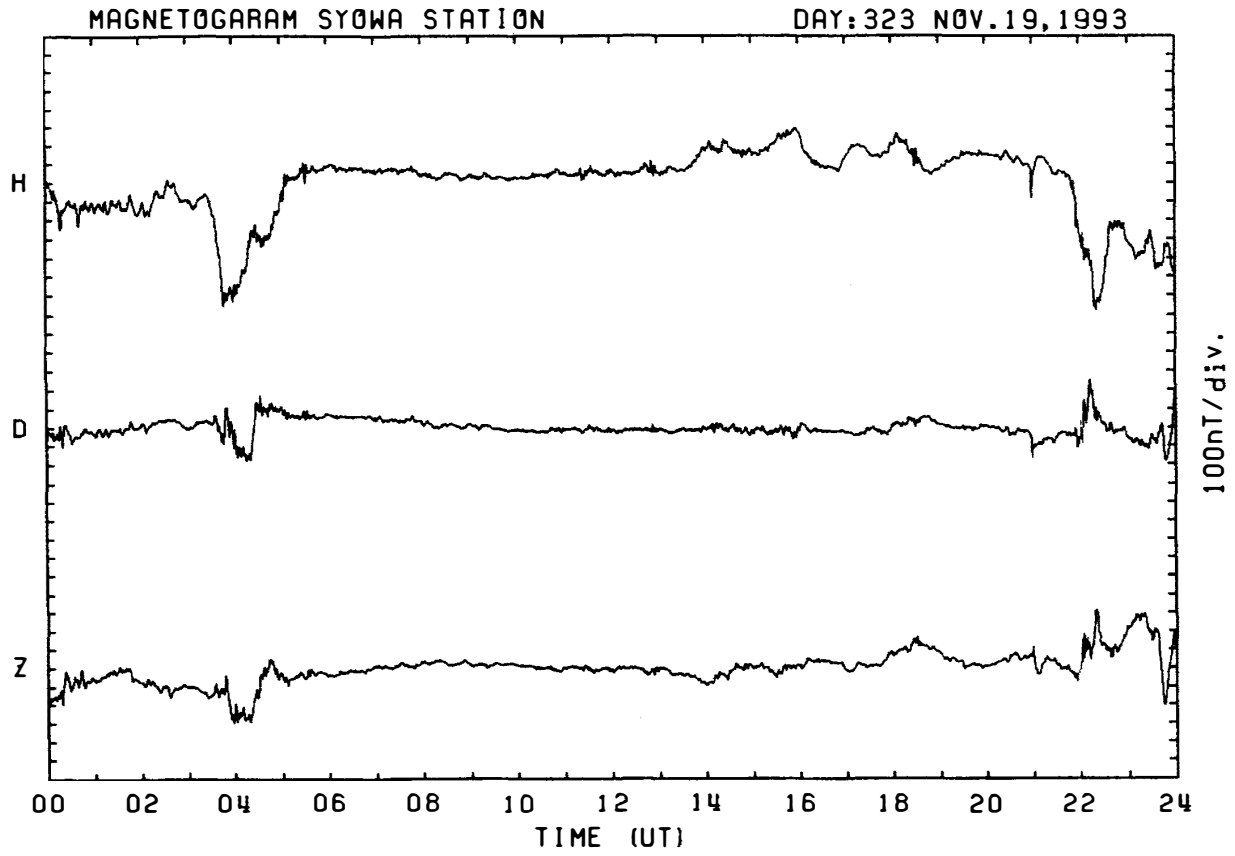
TIME (UT)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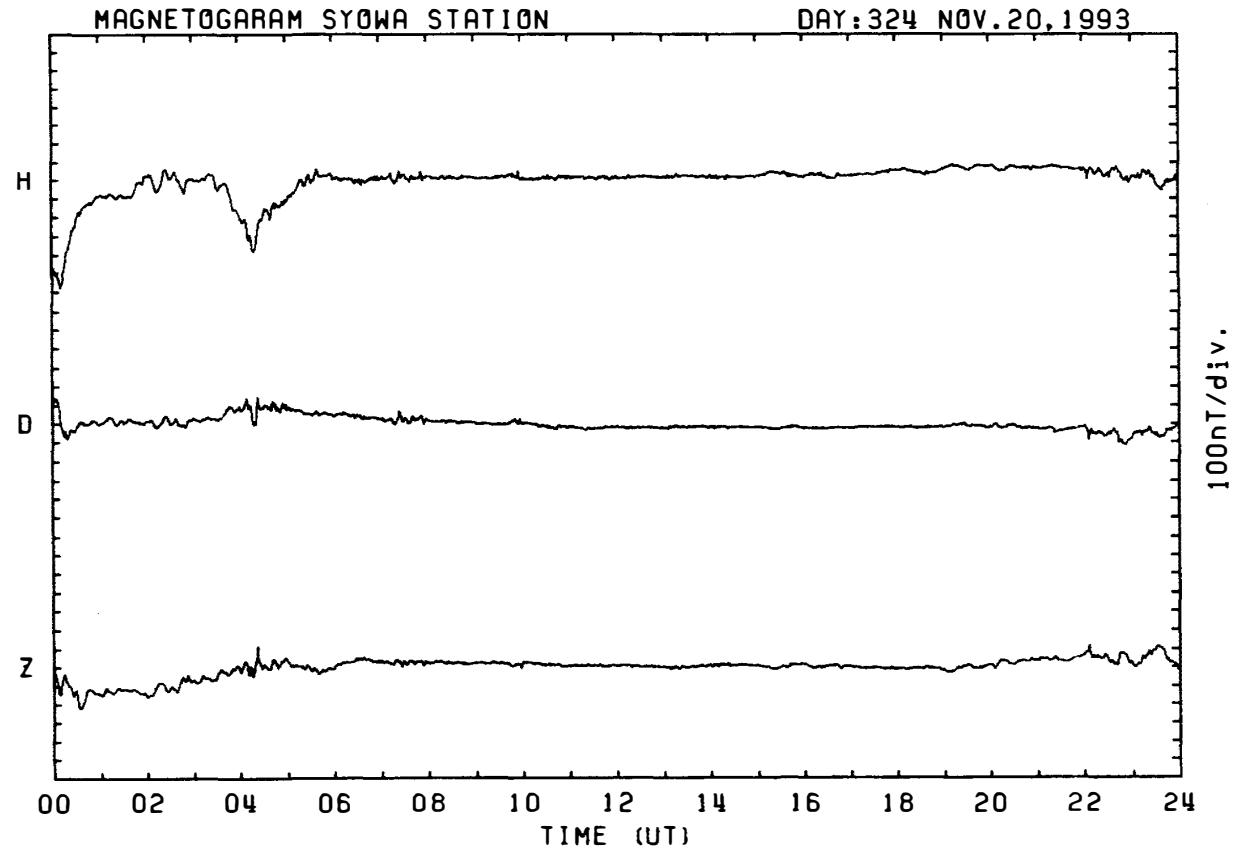
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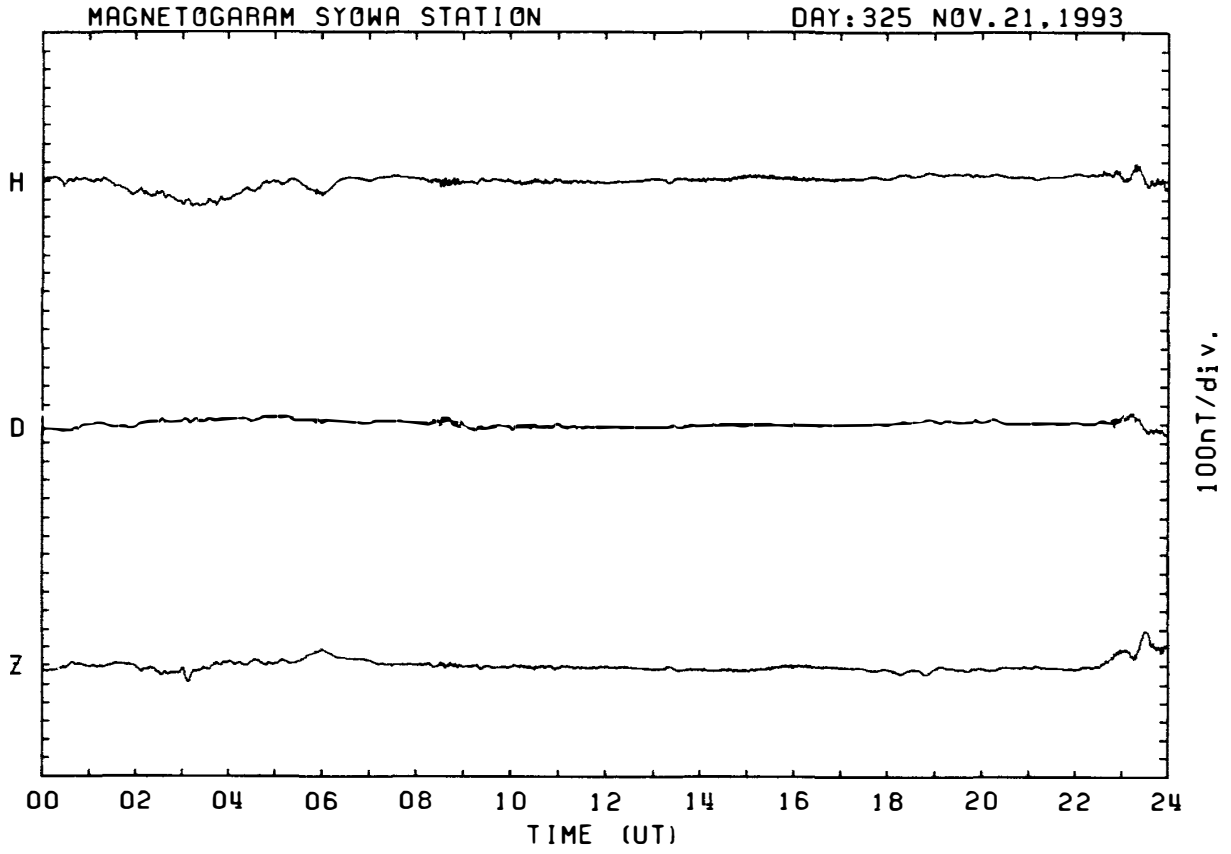
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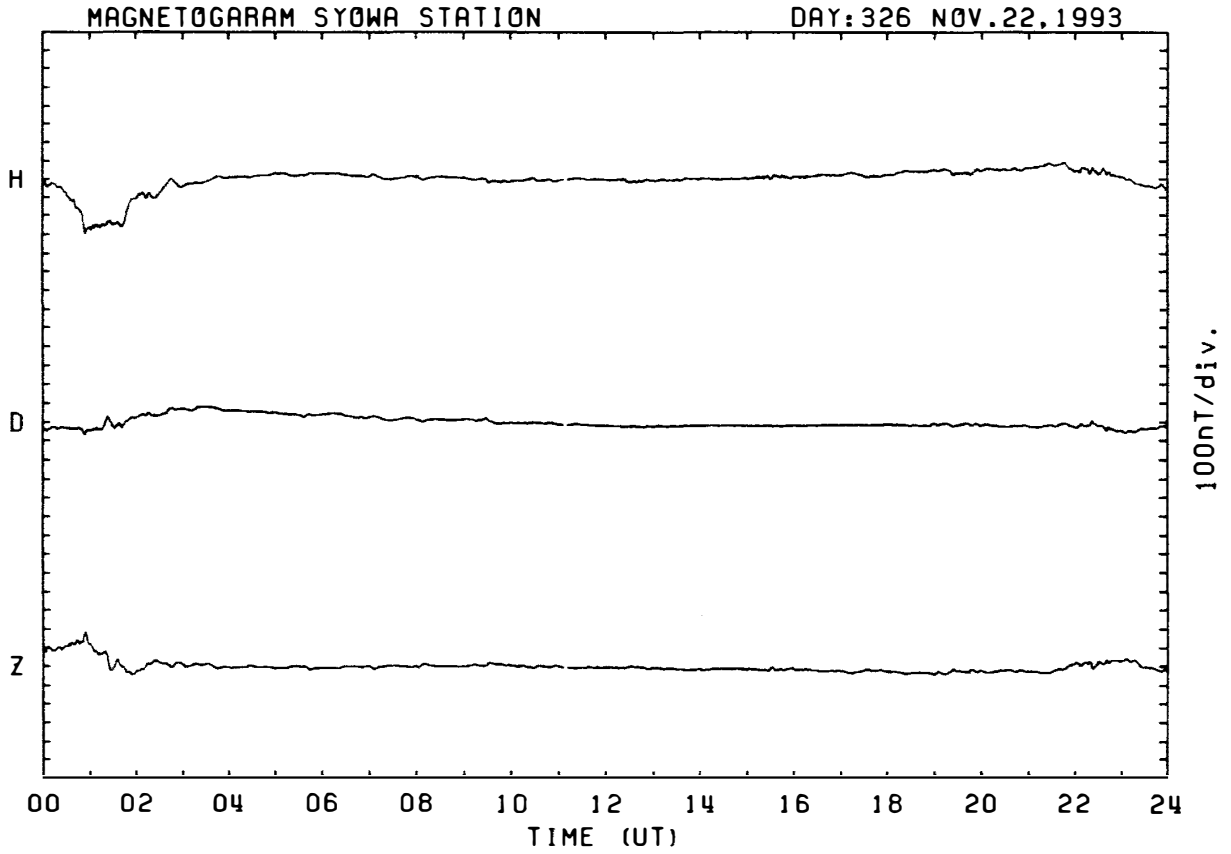
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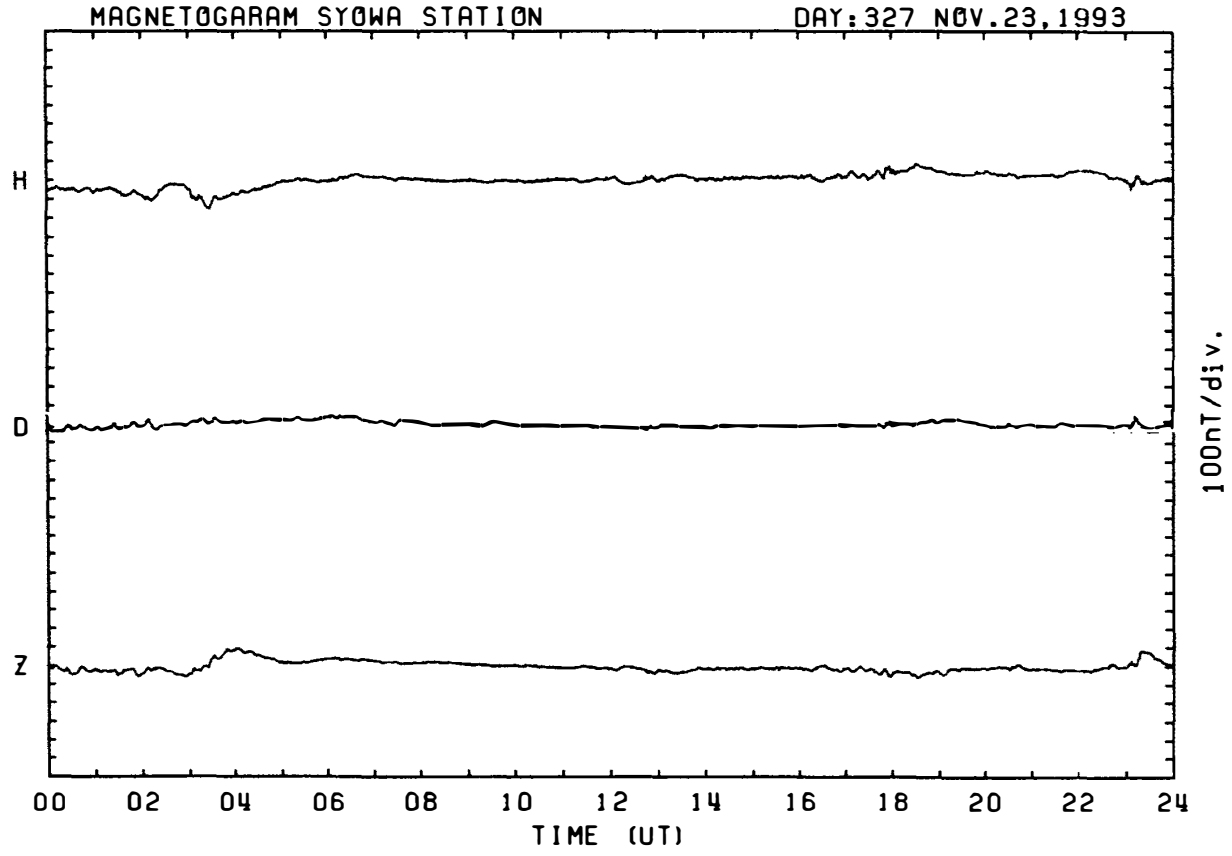
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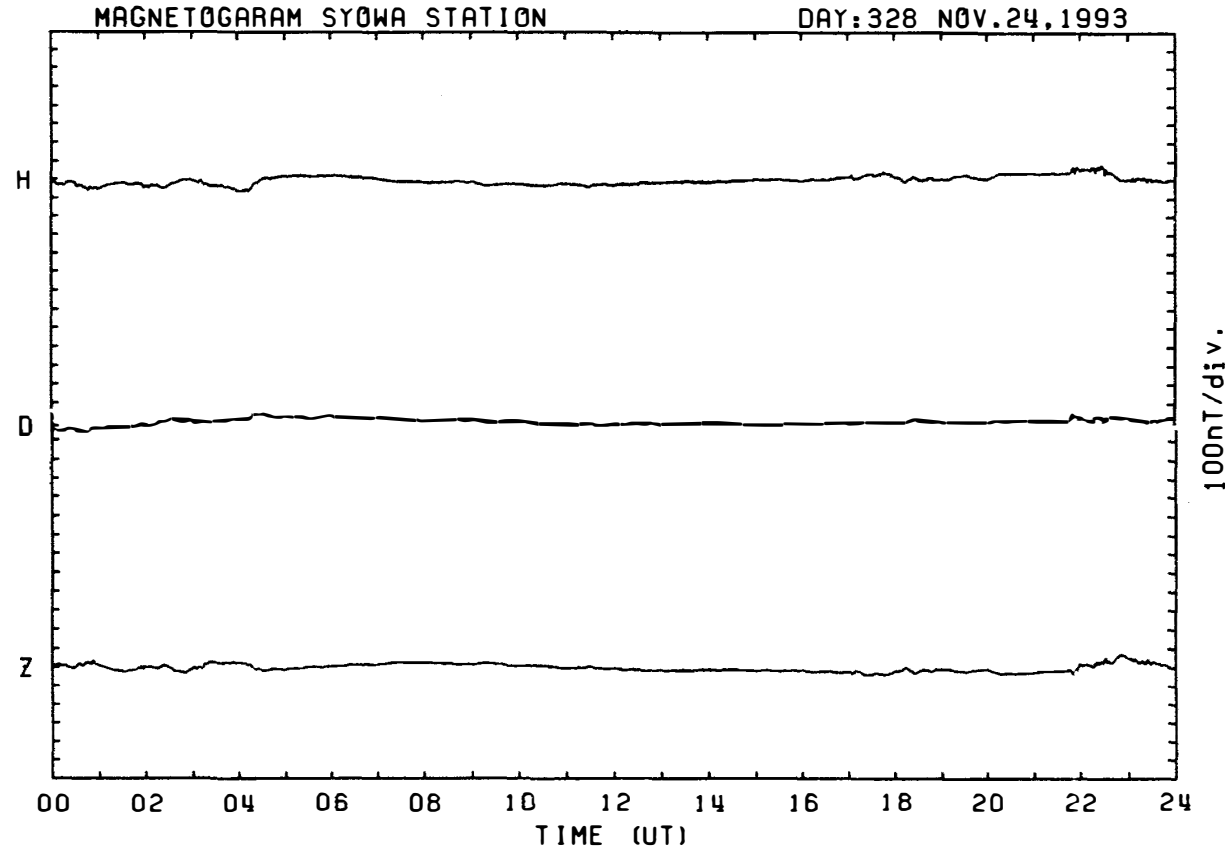
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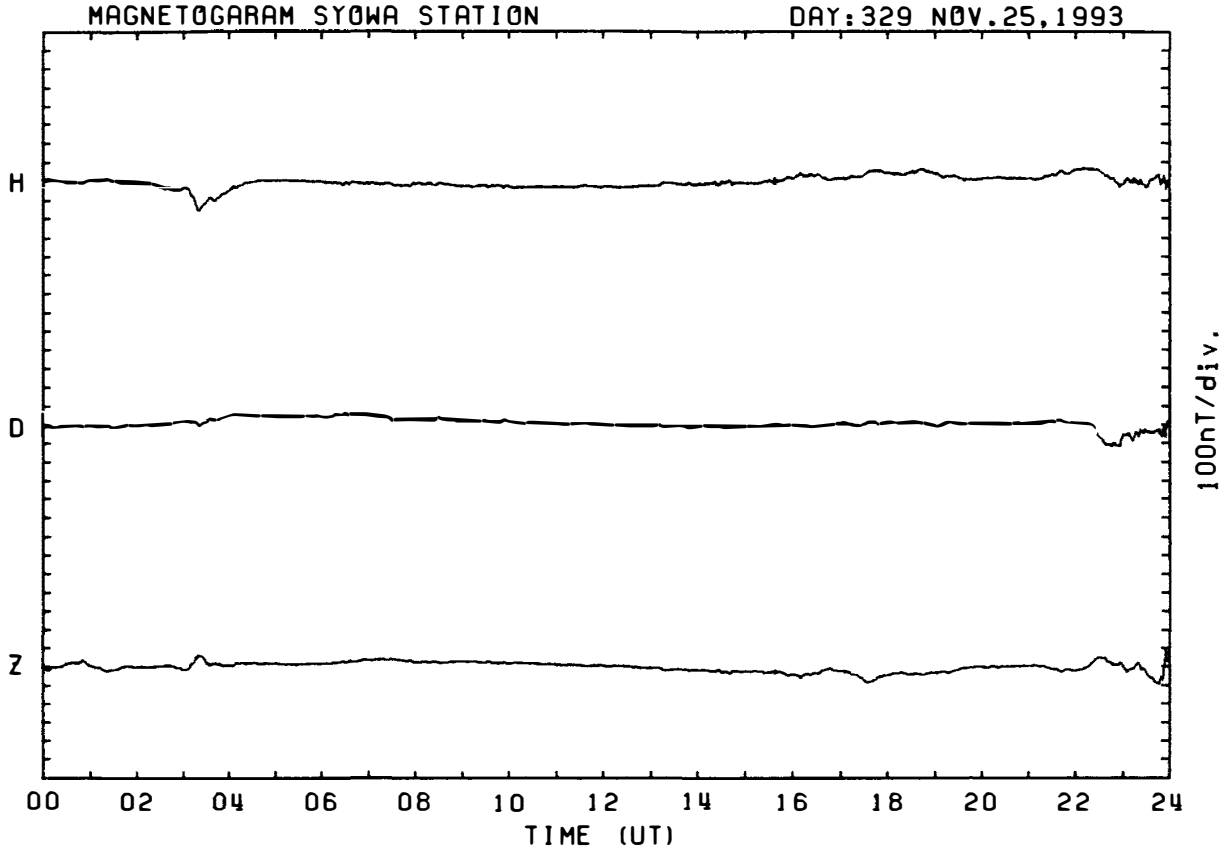
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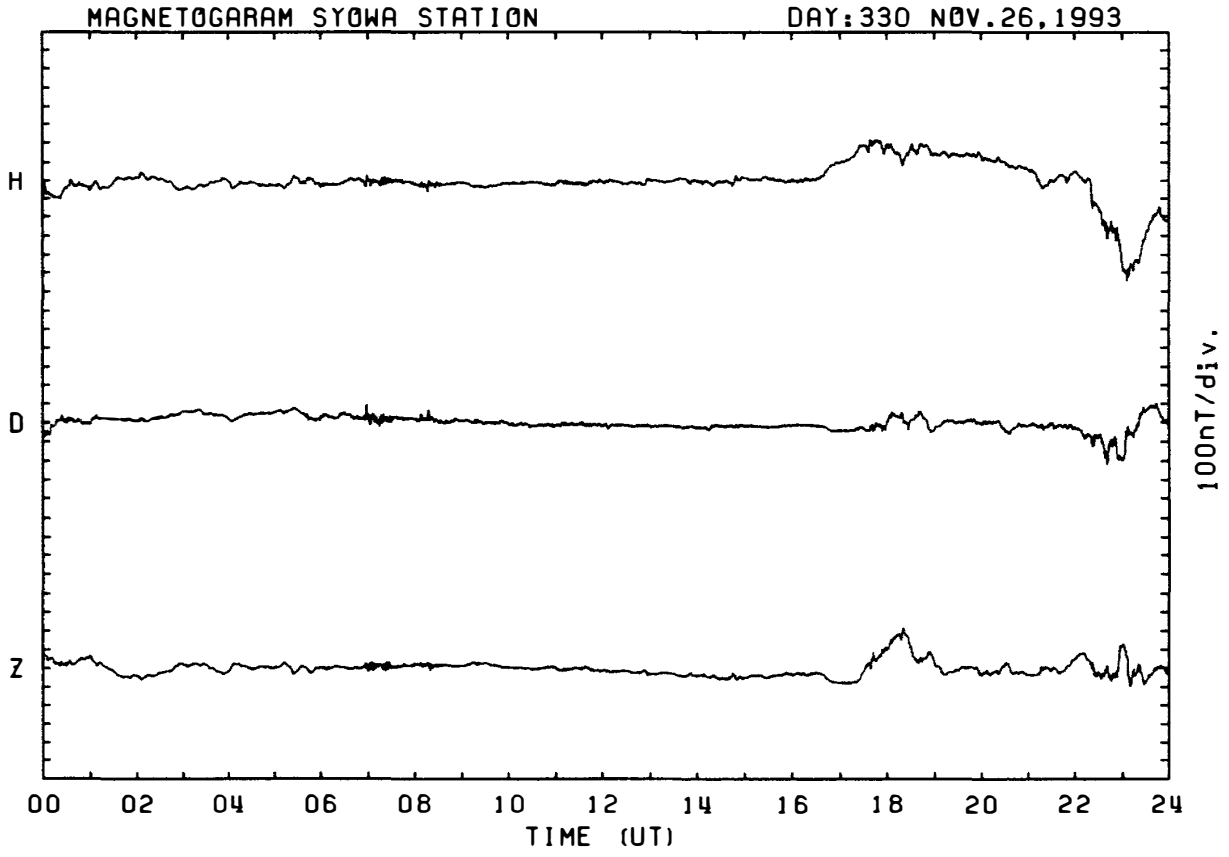
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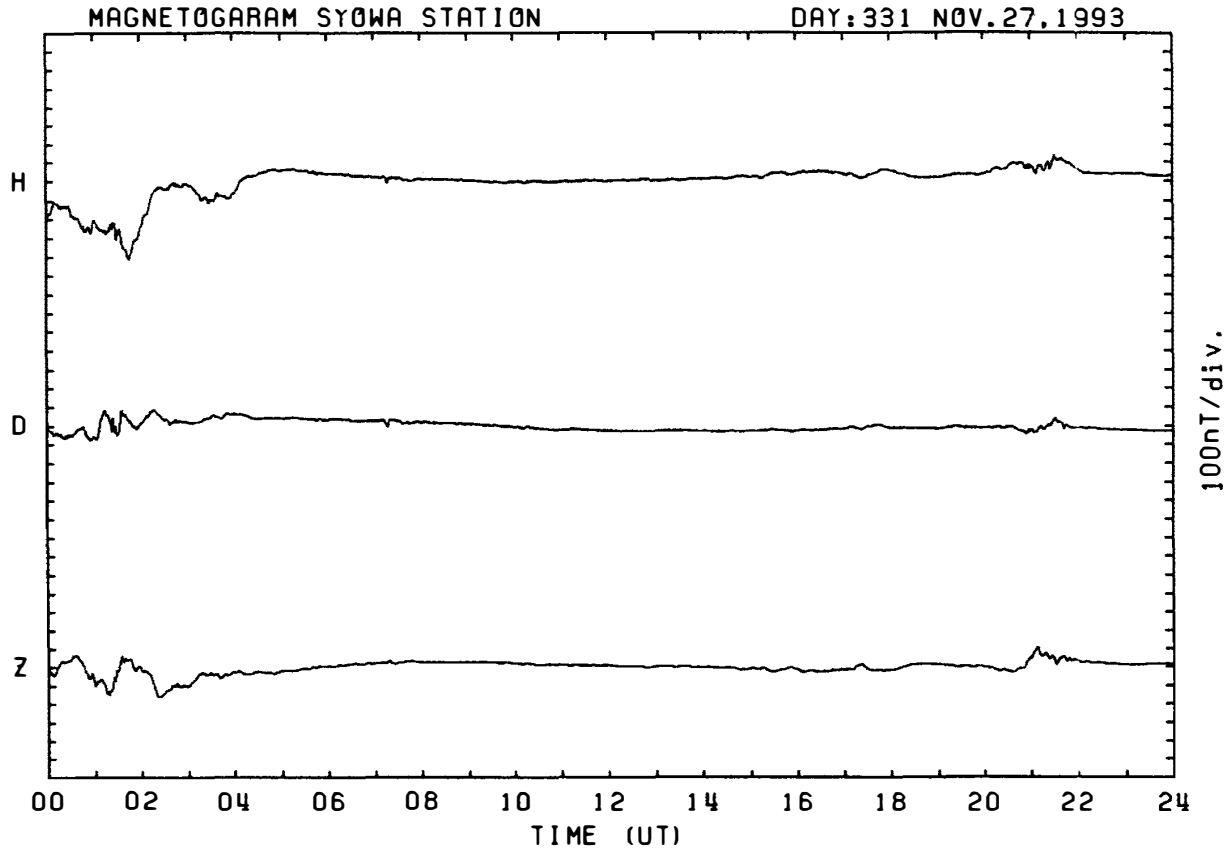
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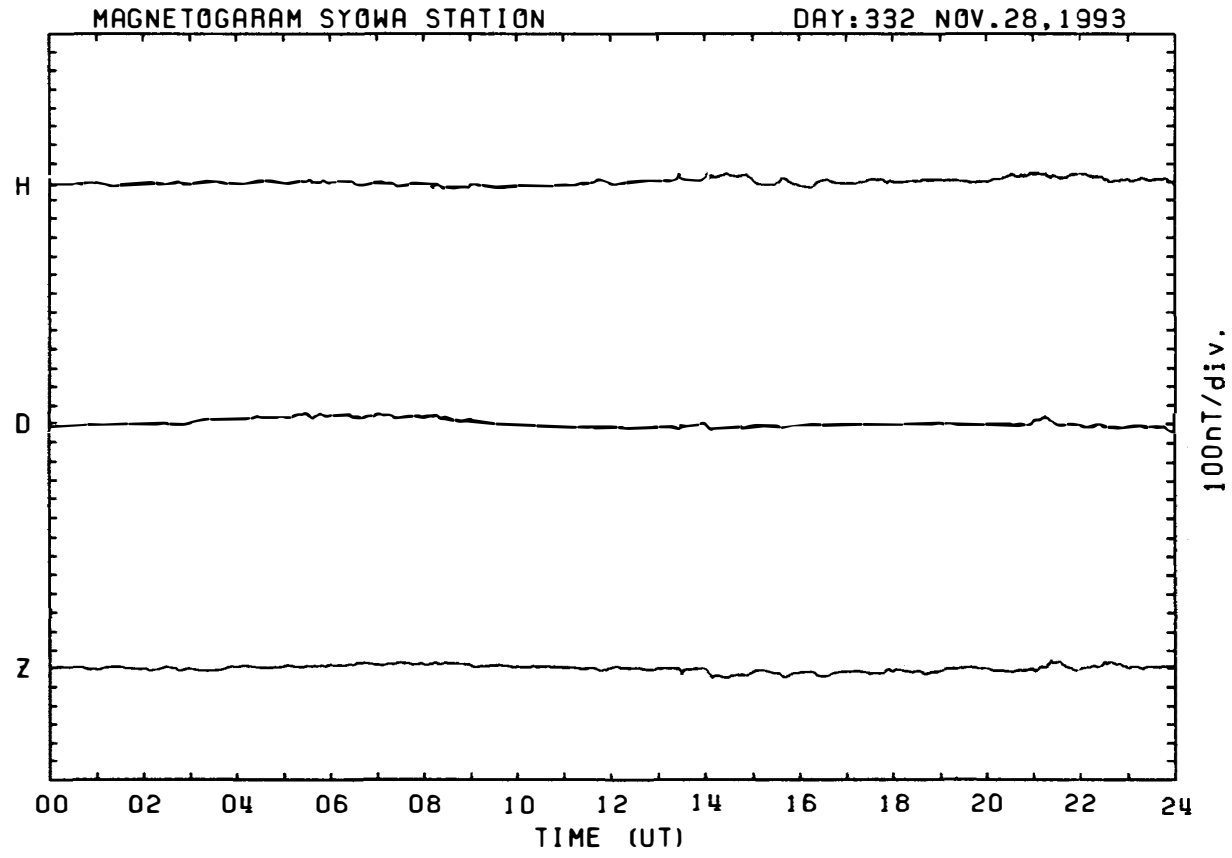
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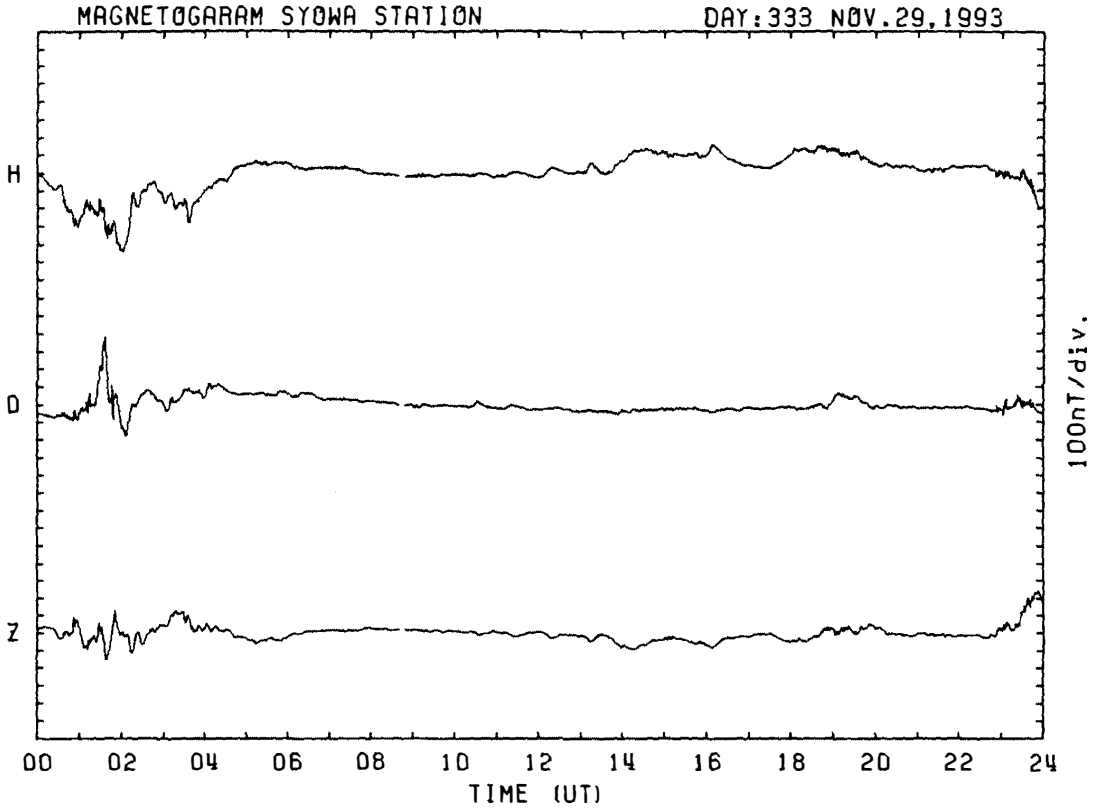
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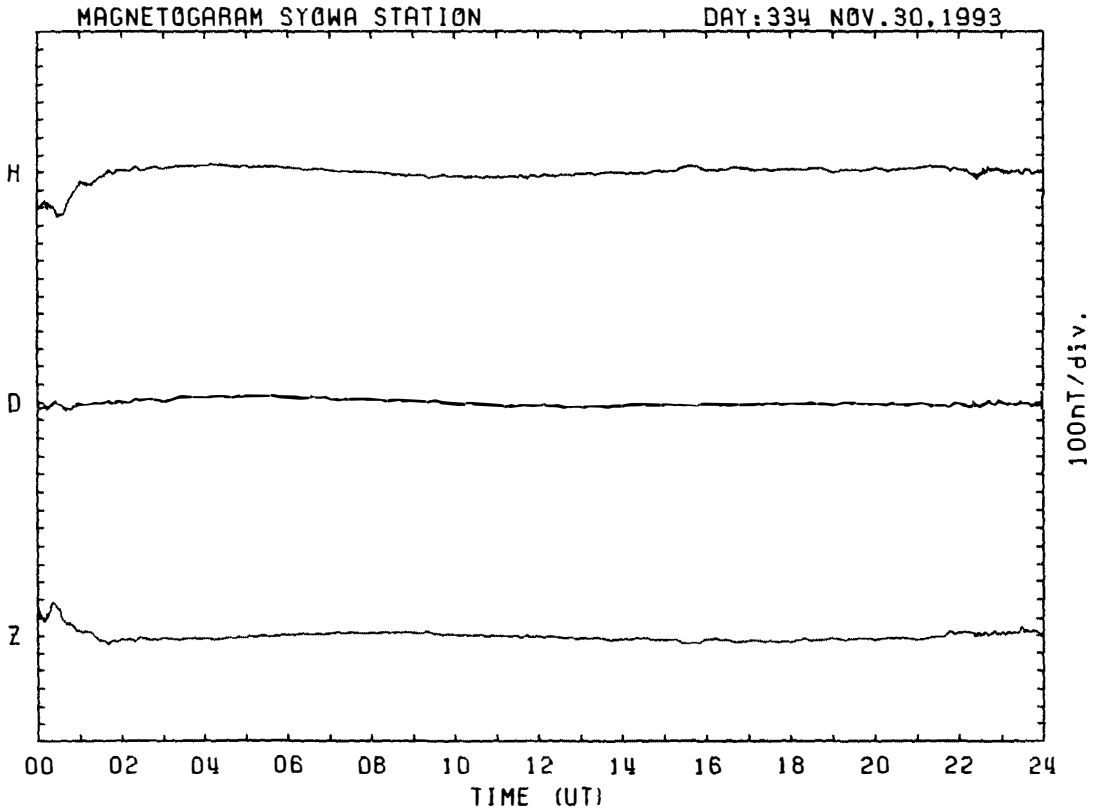
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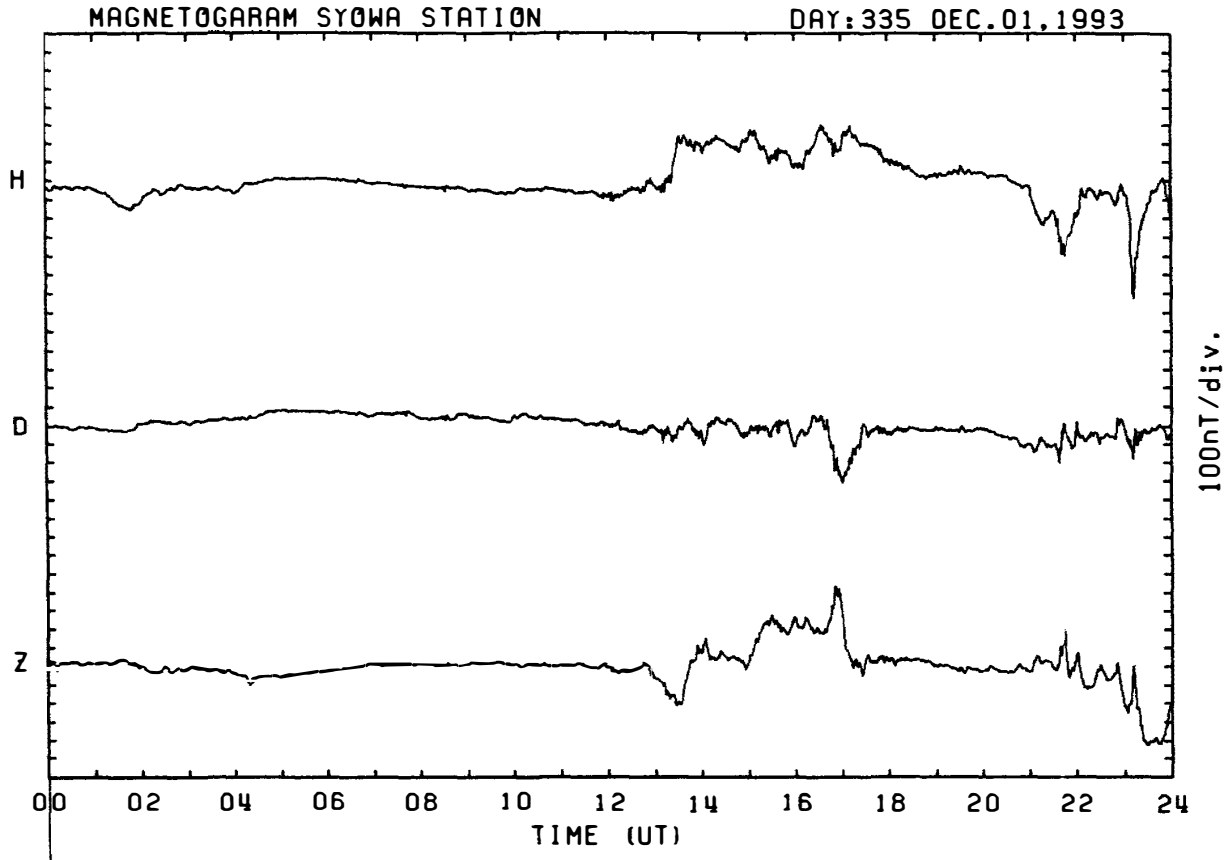
TIME (UT)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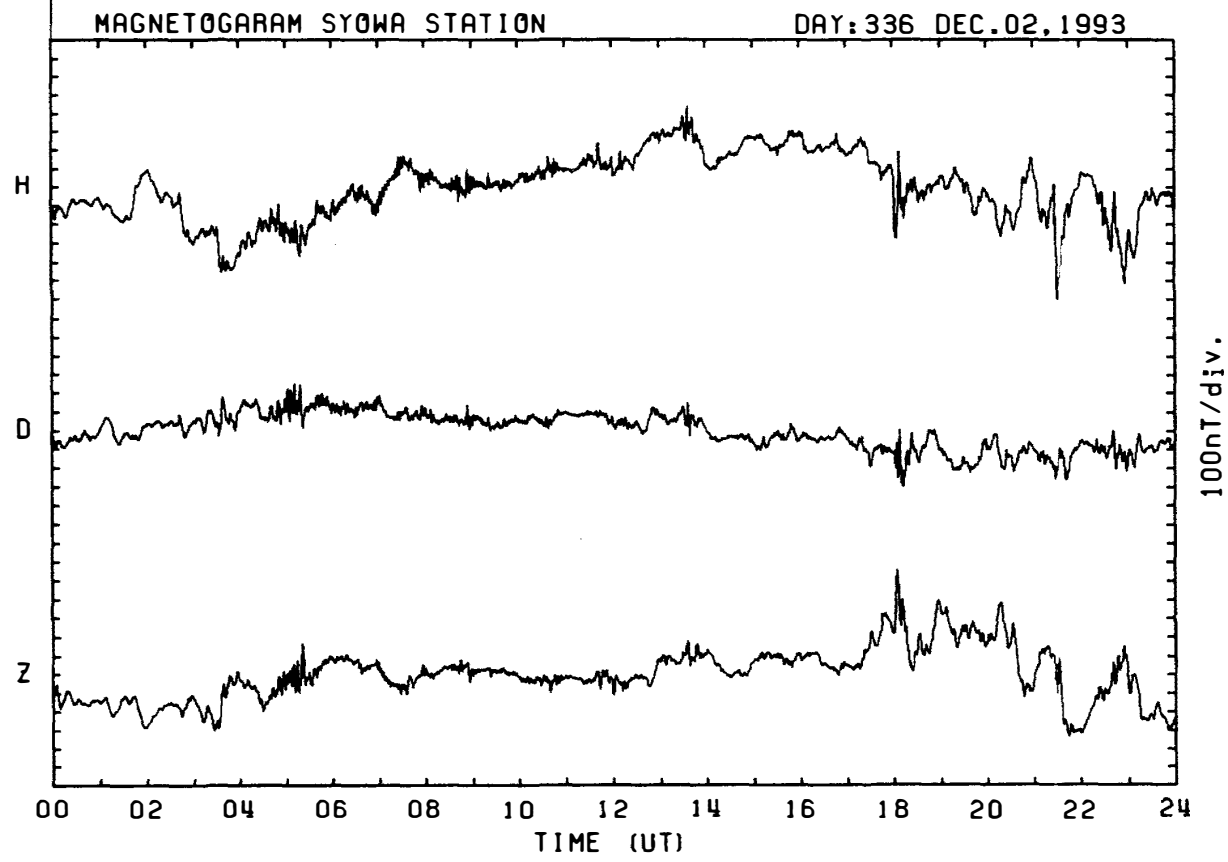
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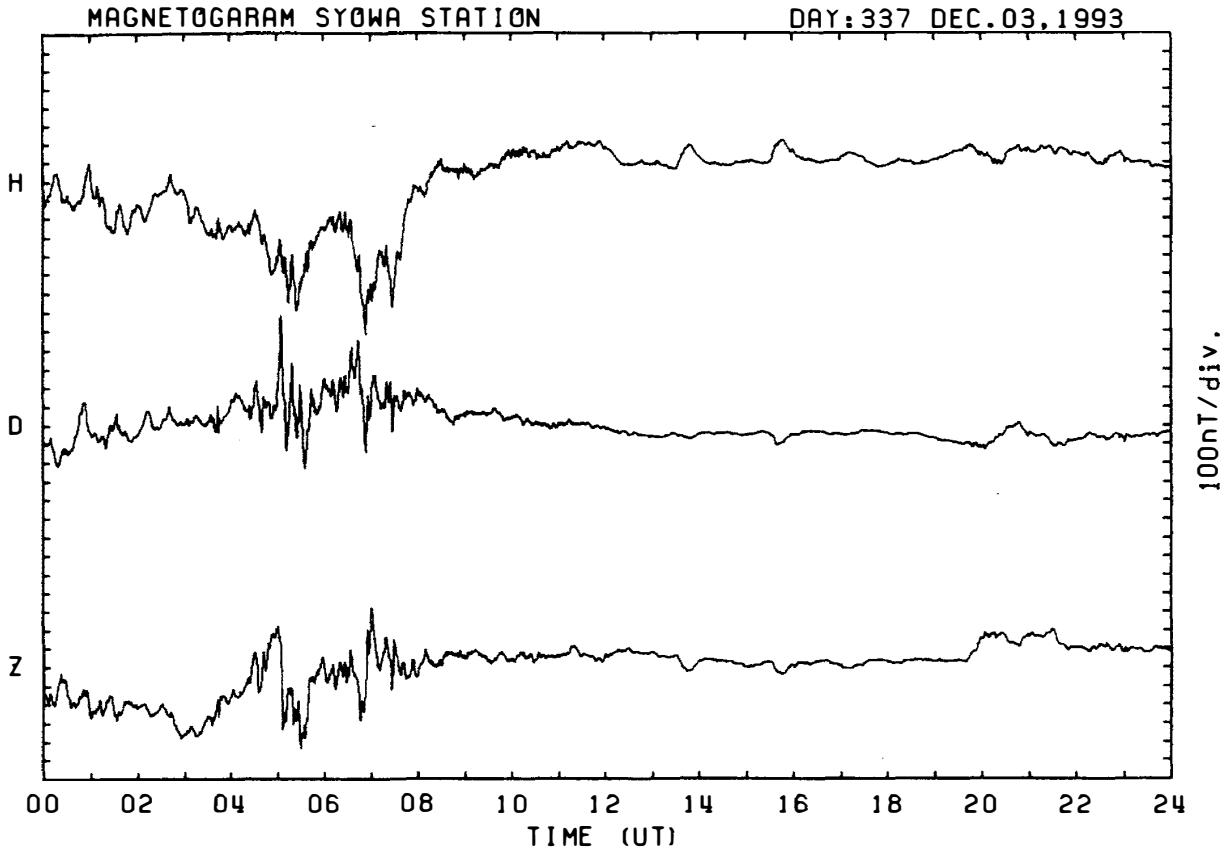
TIME (UT)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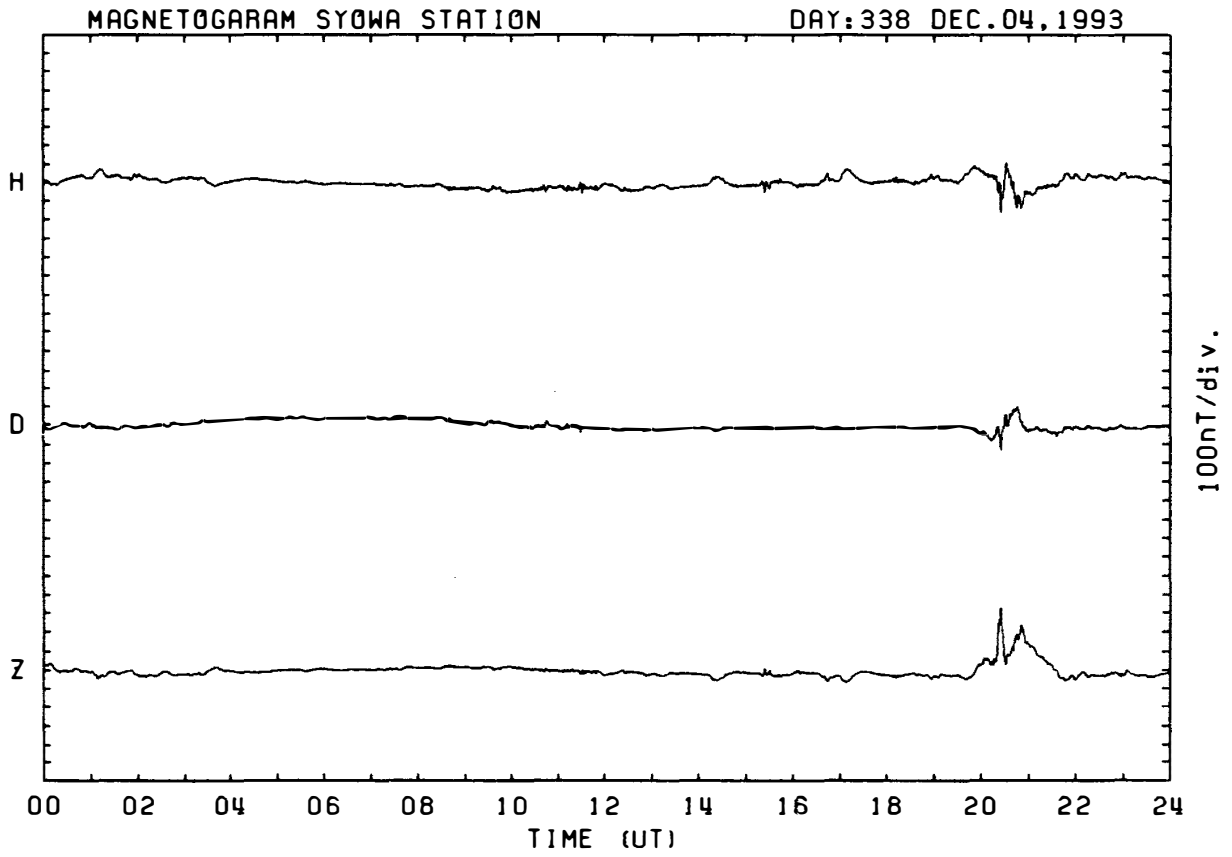
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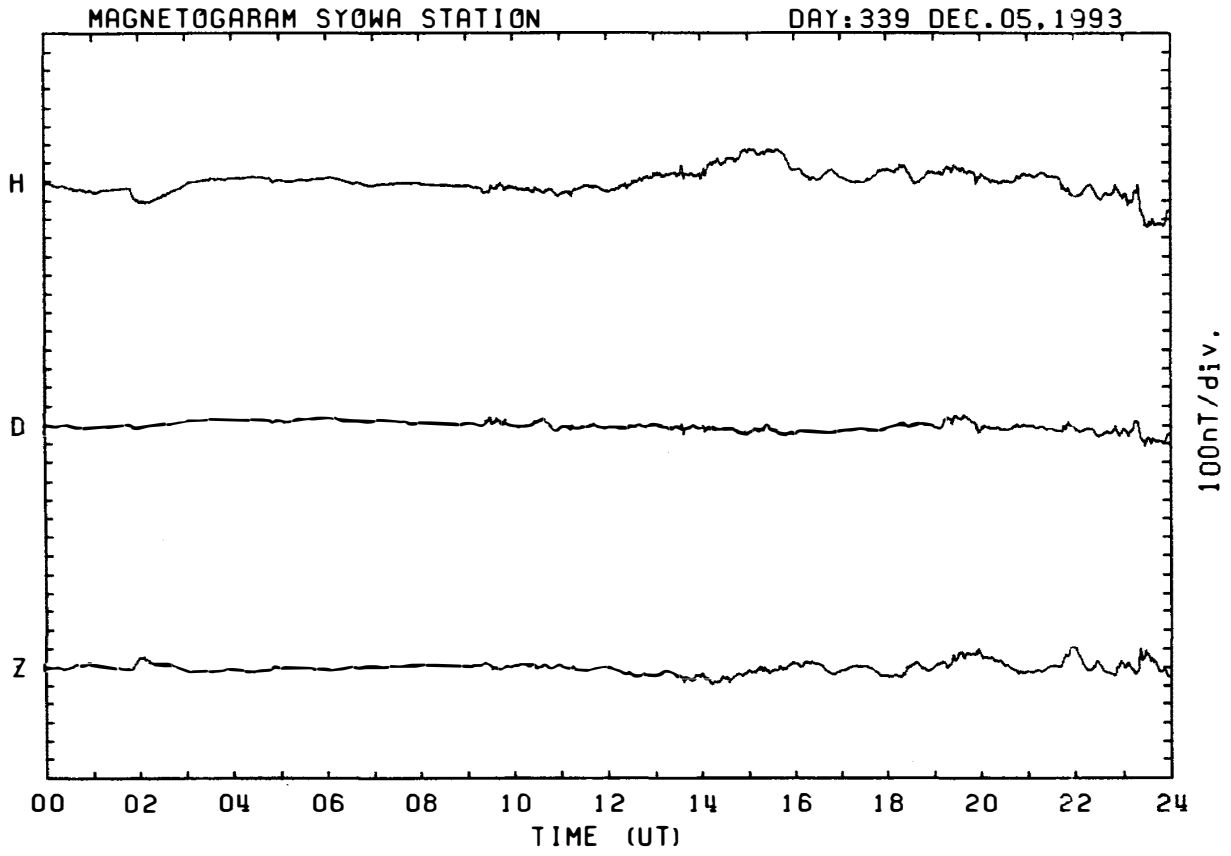
TIME (UT)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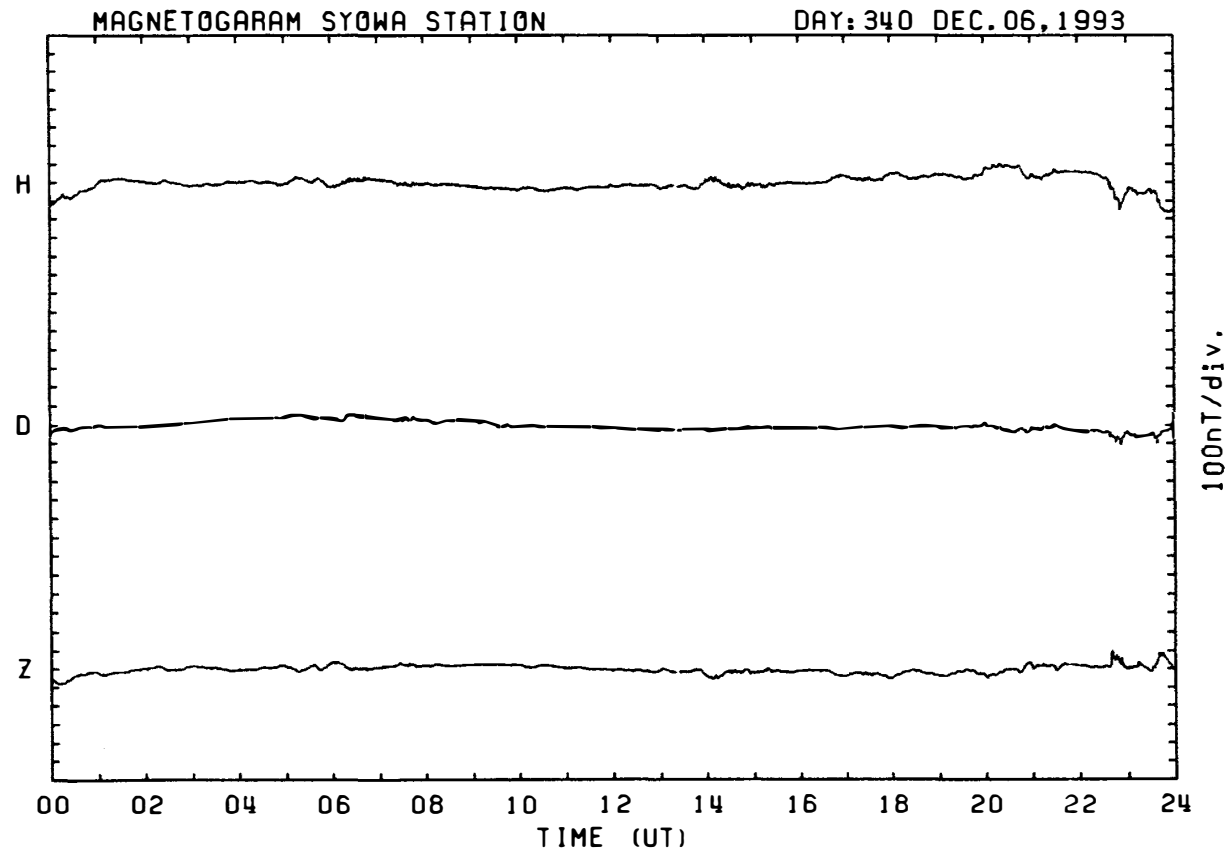
TIME (UT)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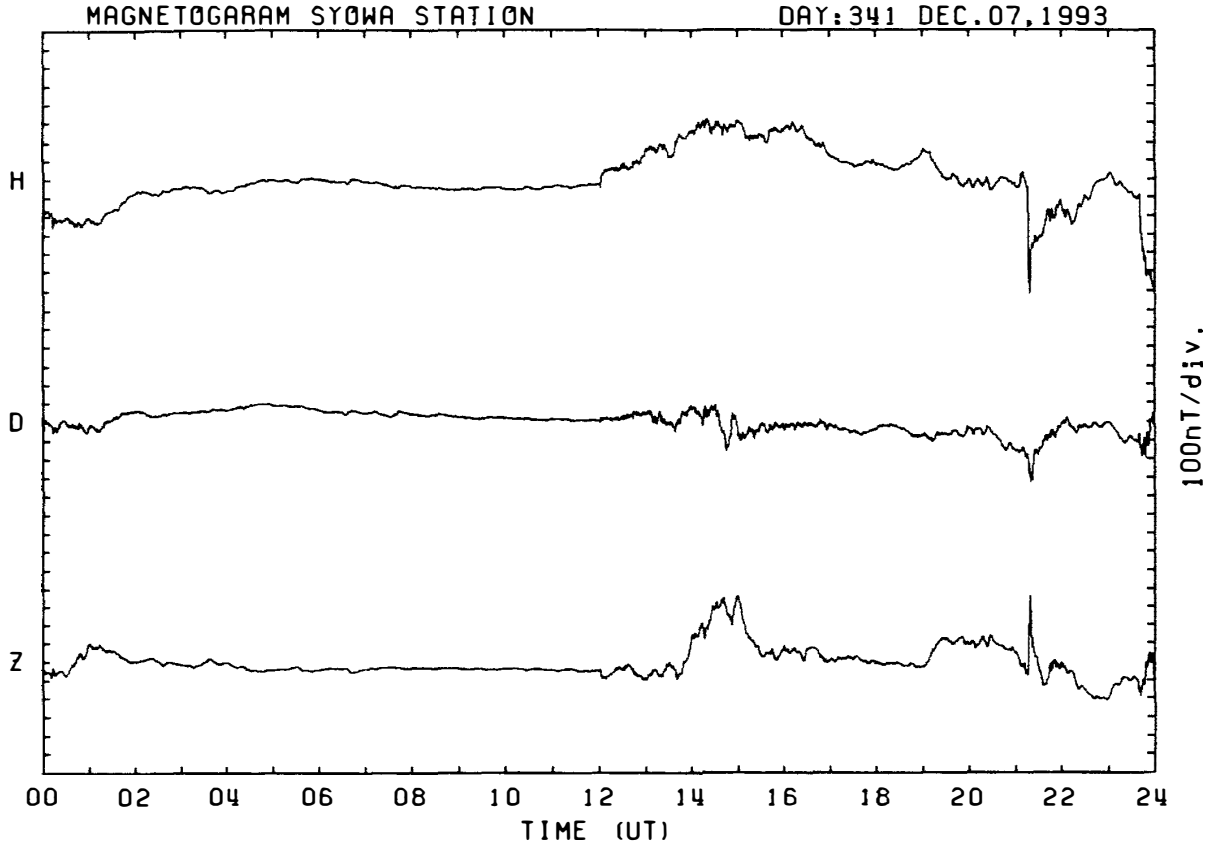
TIME (UT)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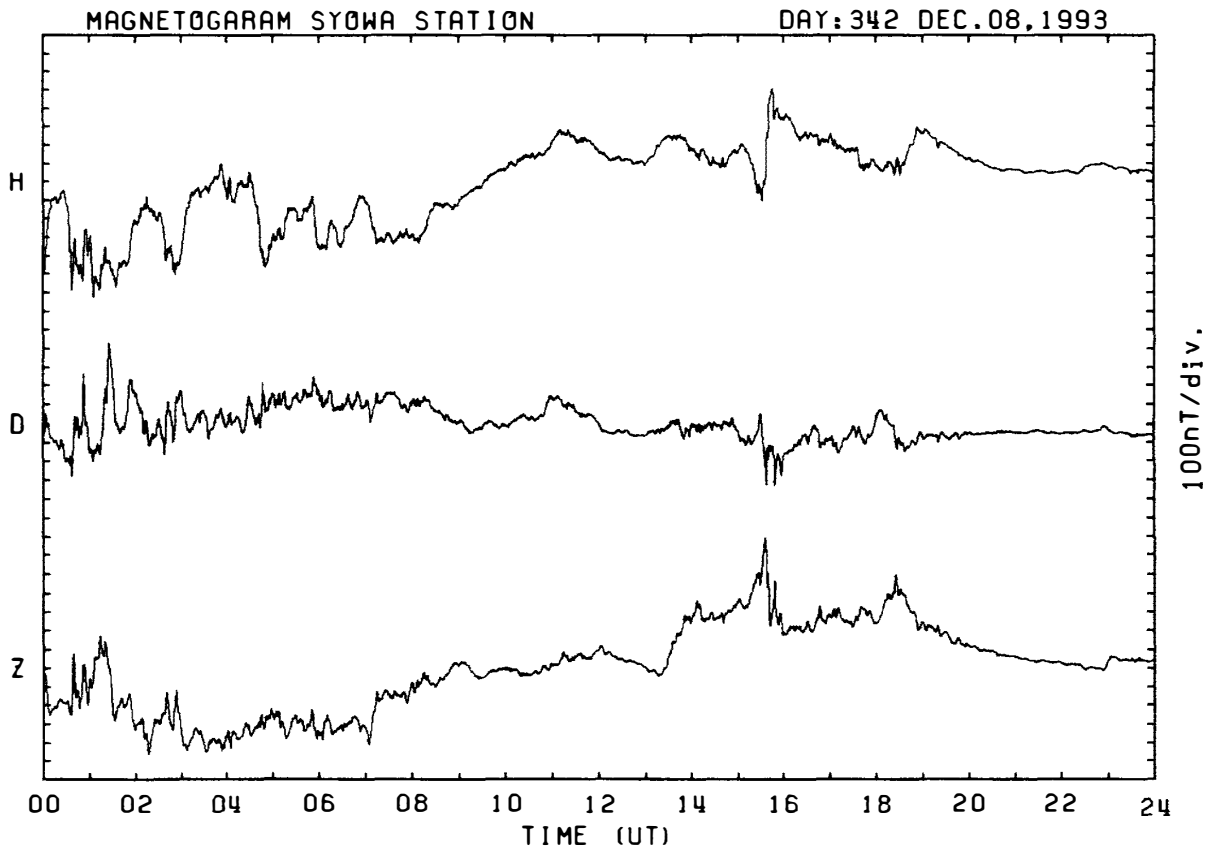
TIME (UT)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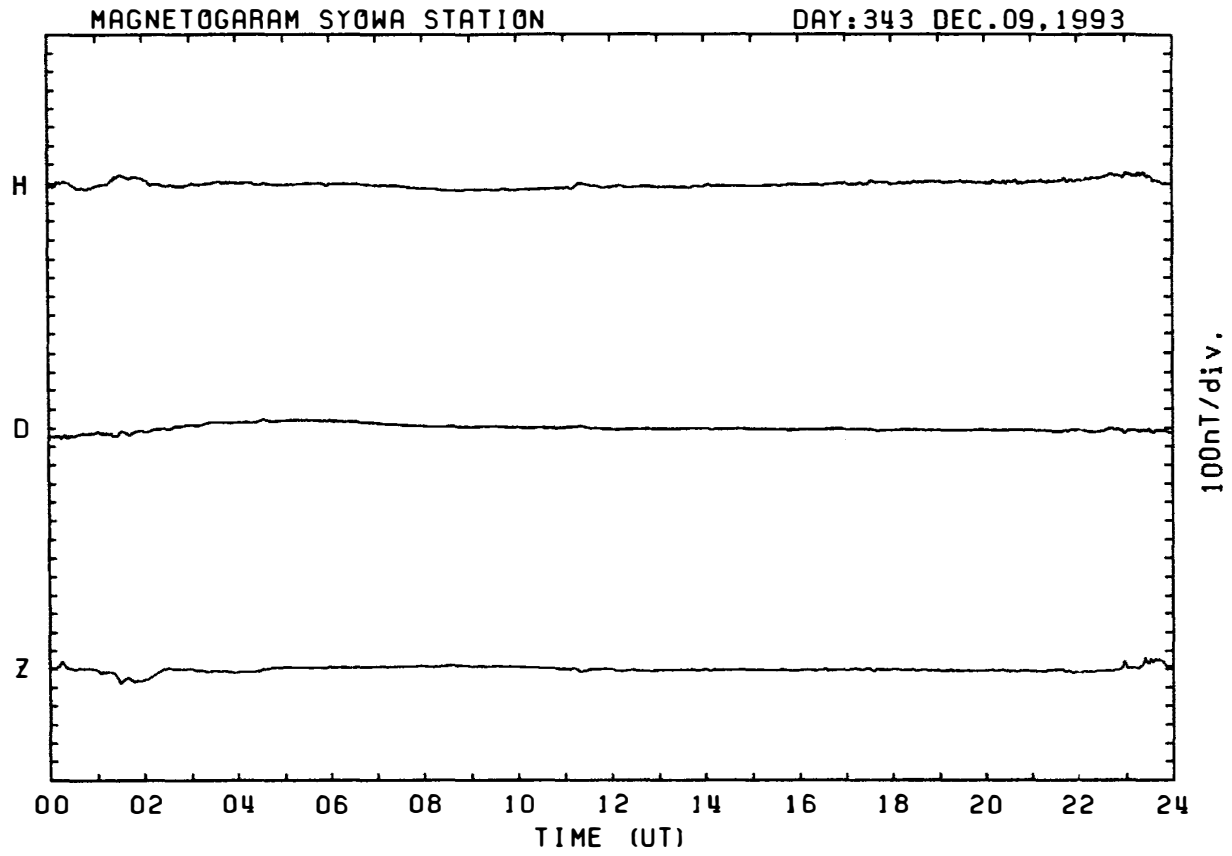
TIME (UT)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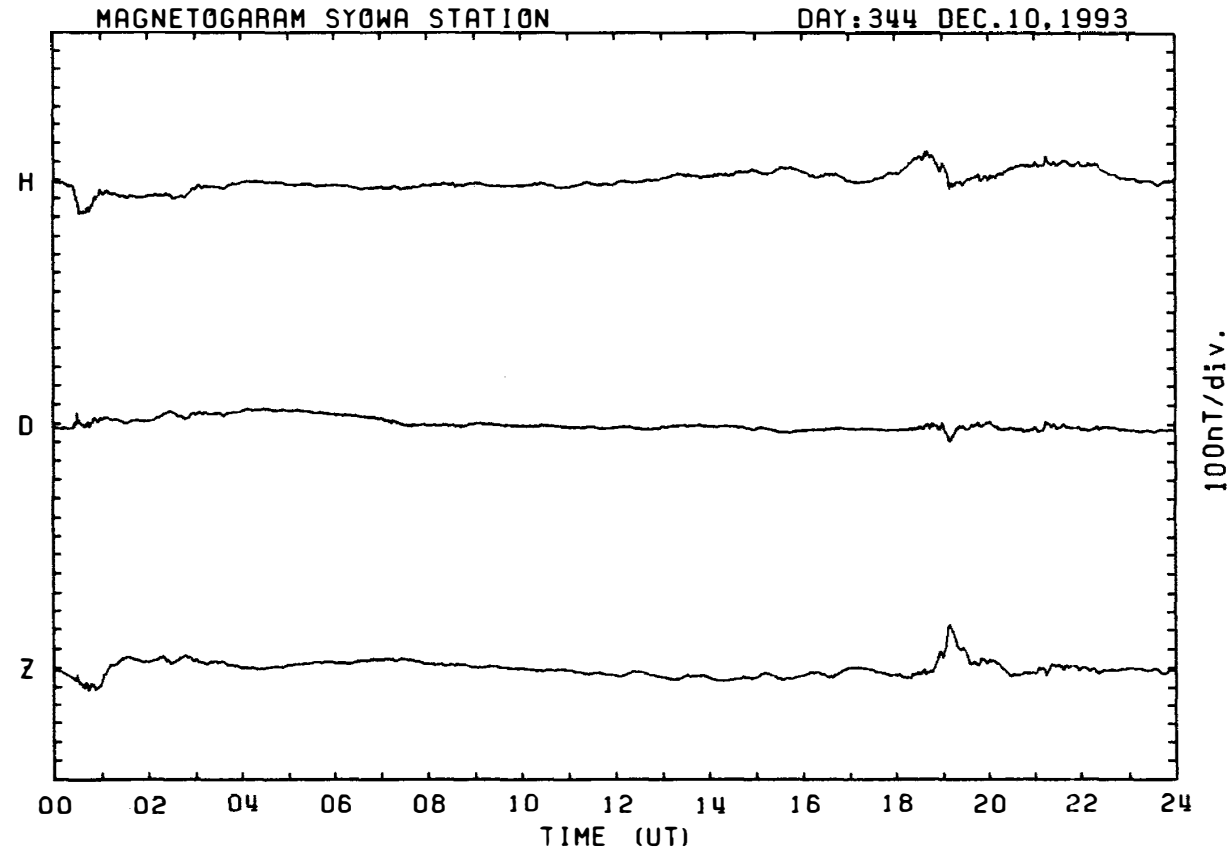
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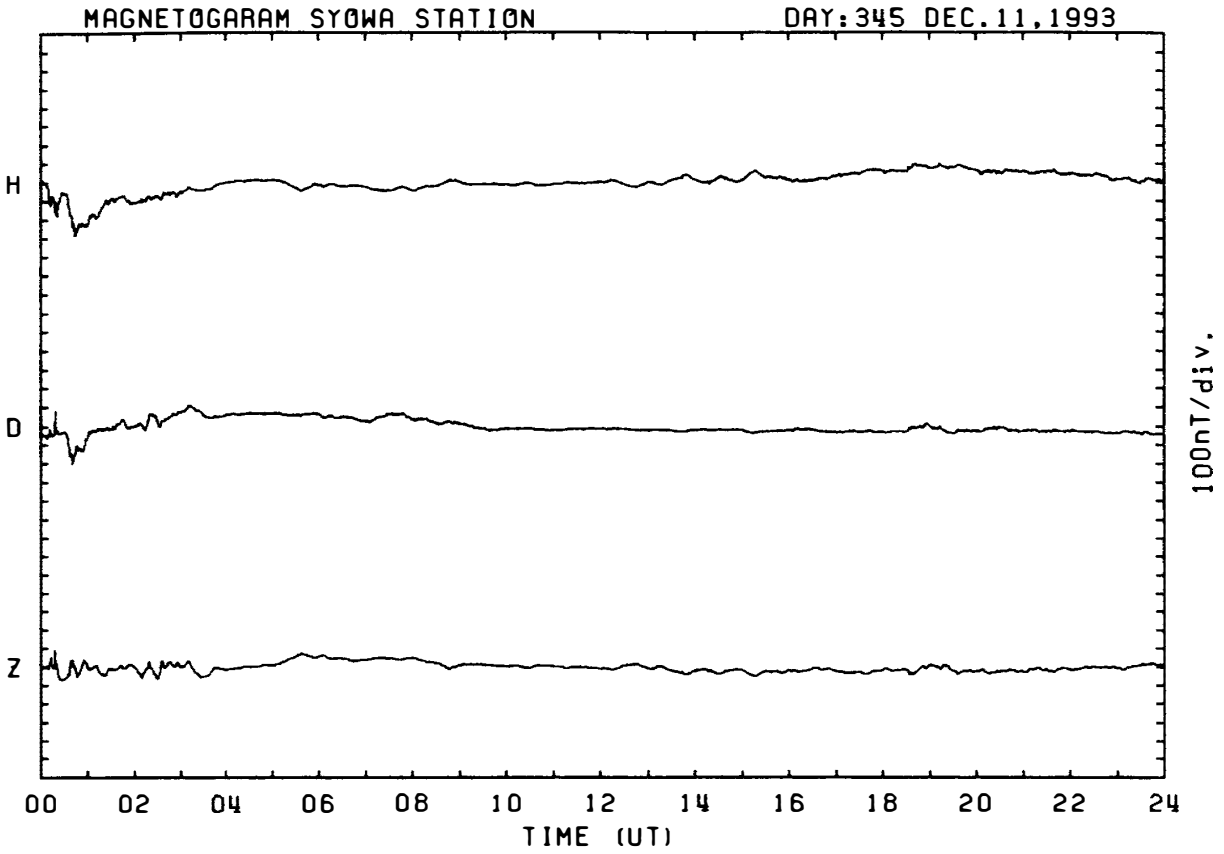
TIME (UT)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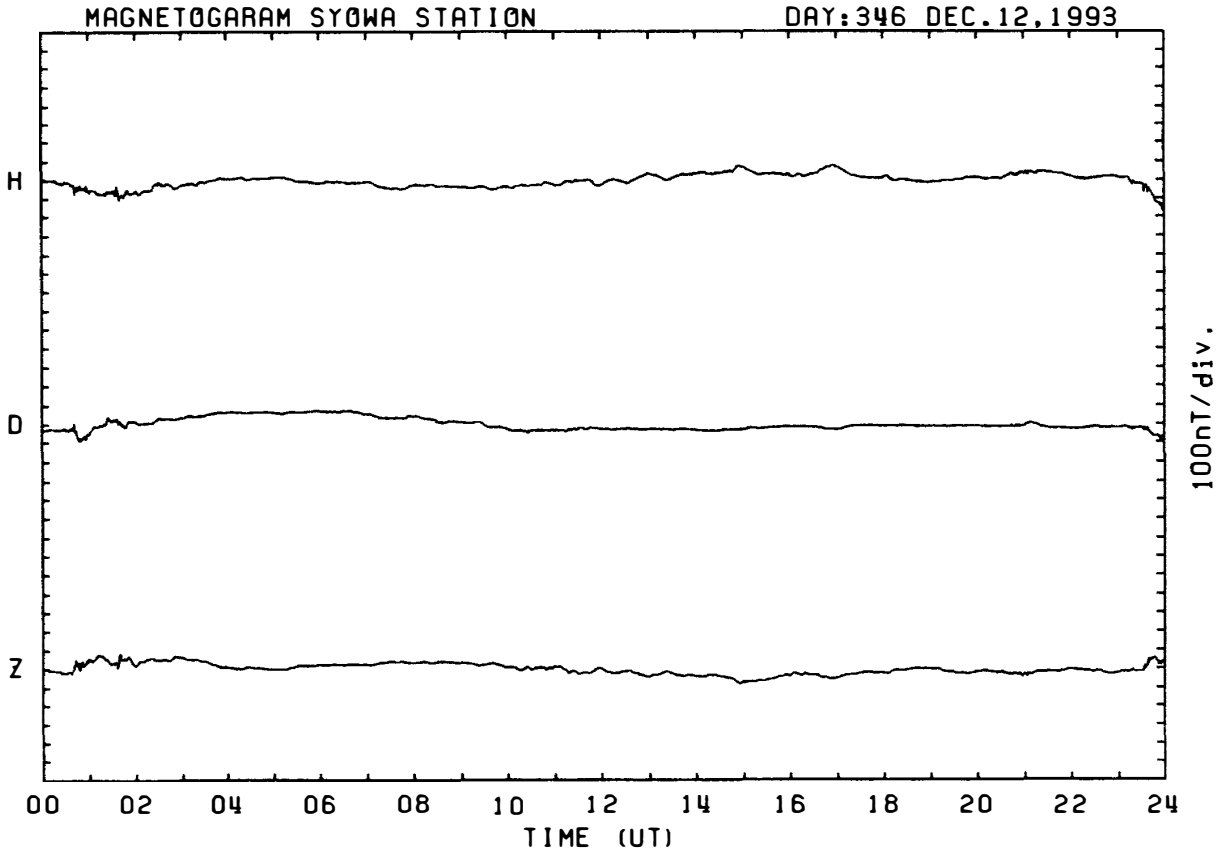
TIME (UT)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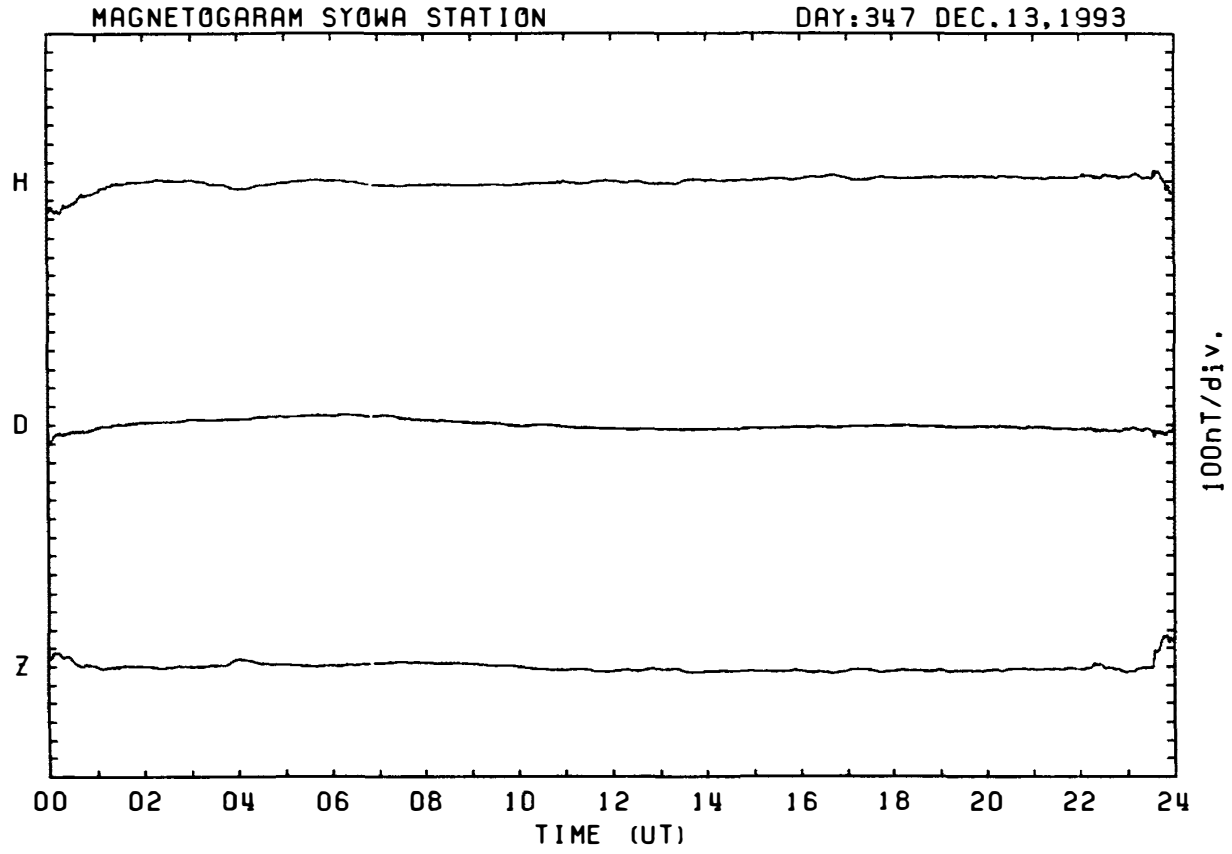
TIME (UT)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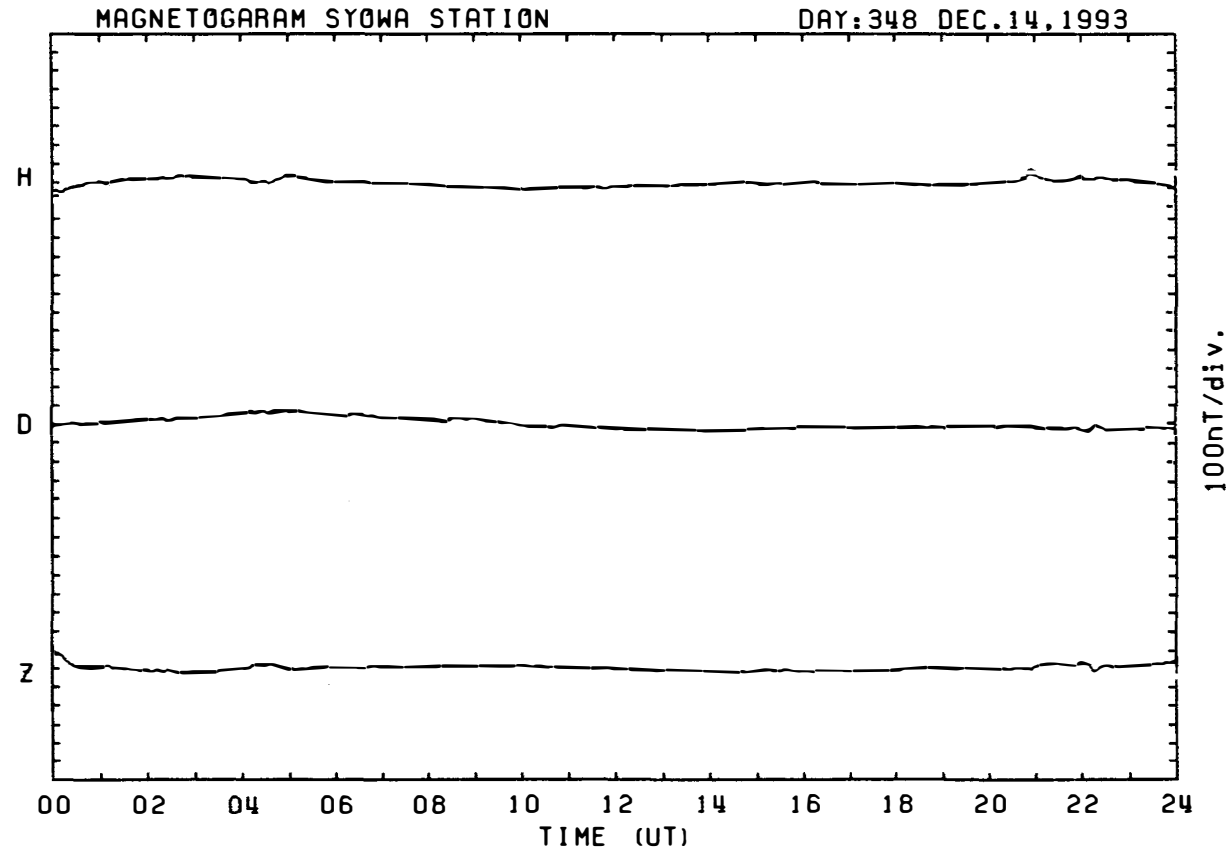
TIME (UT)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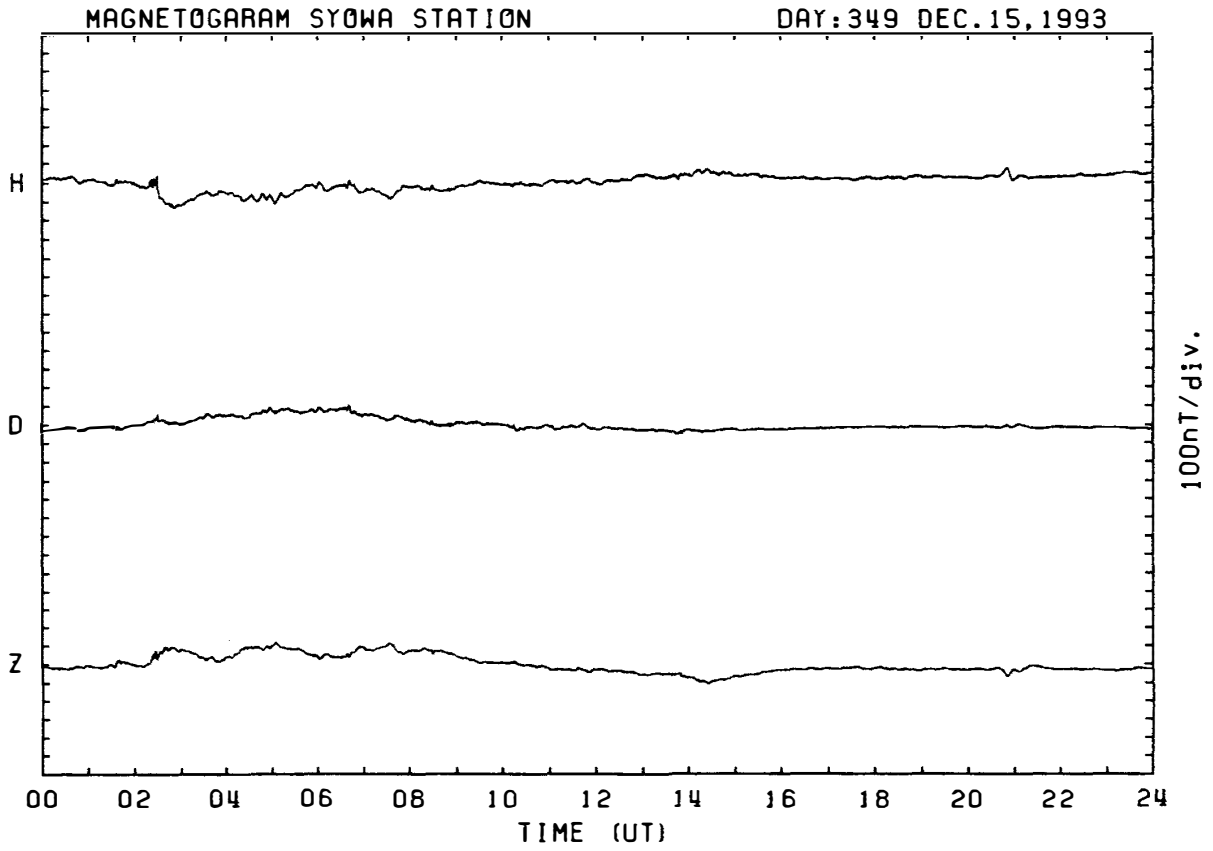
TIME (UT)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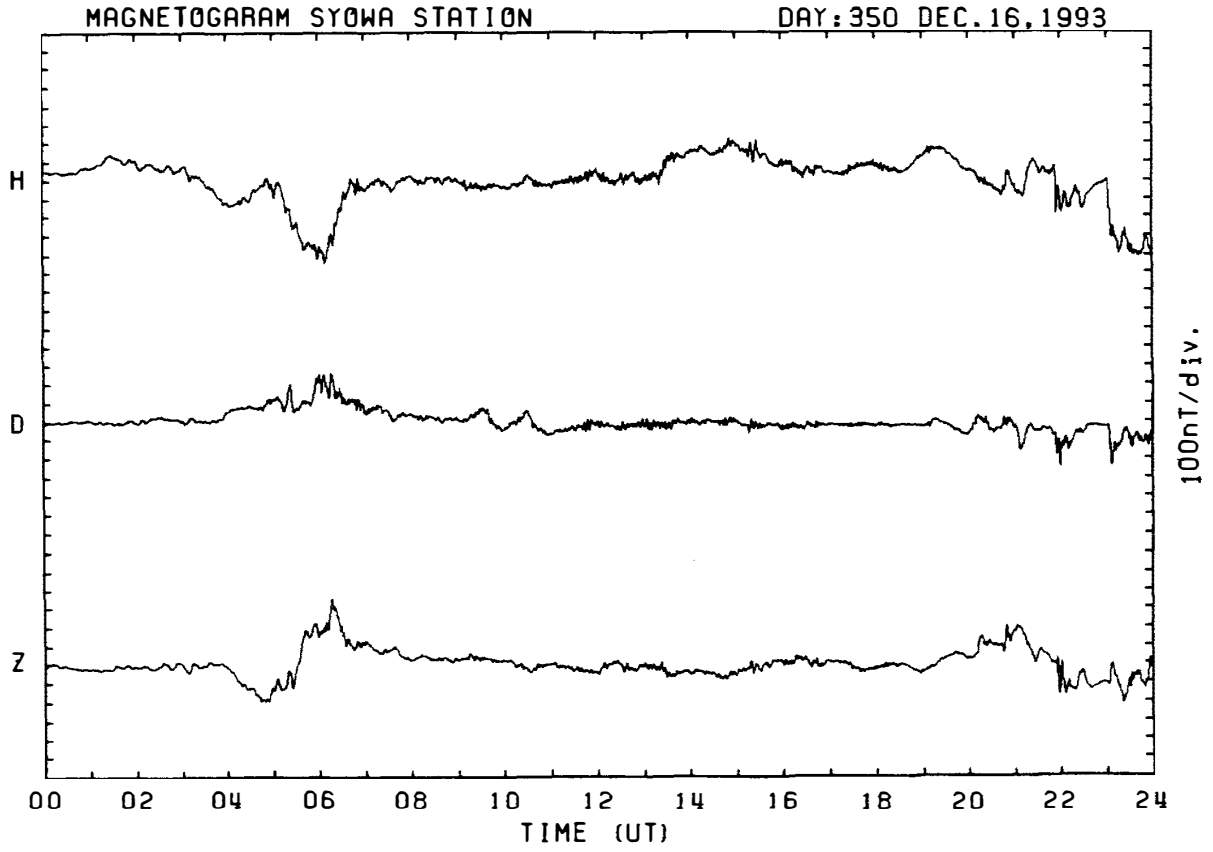
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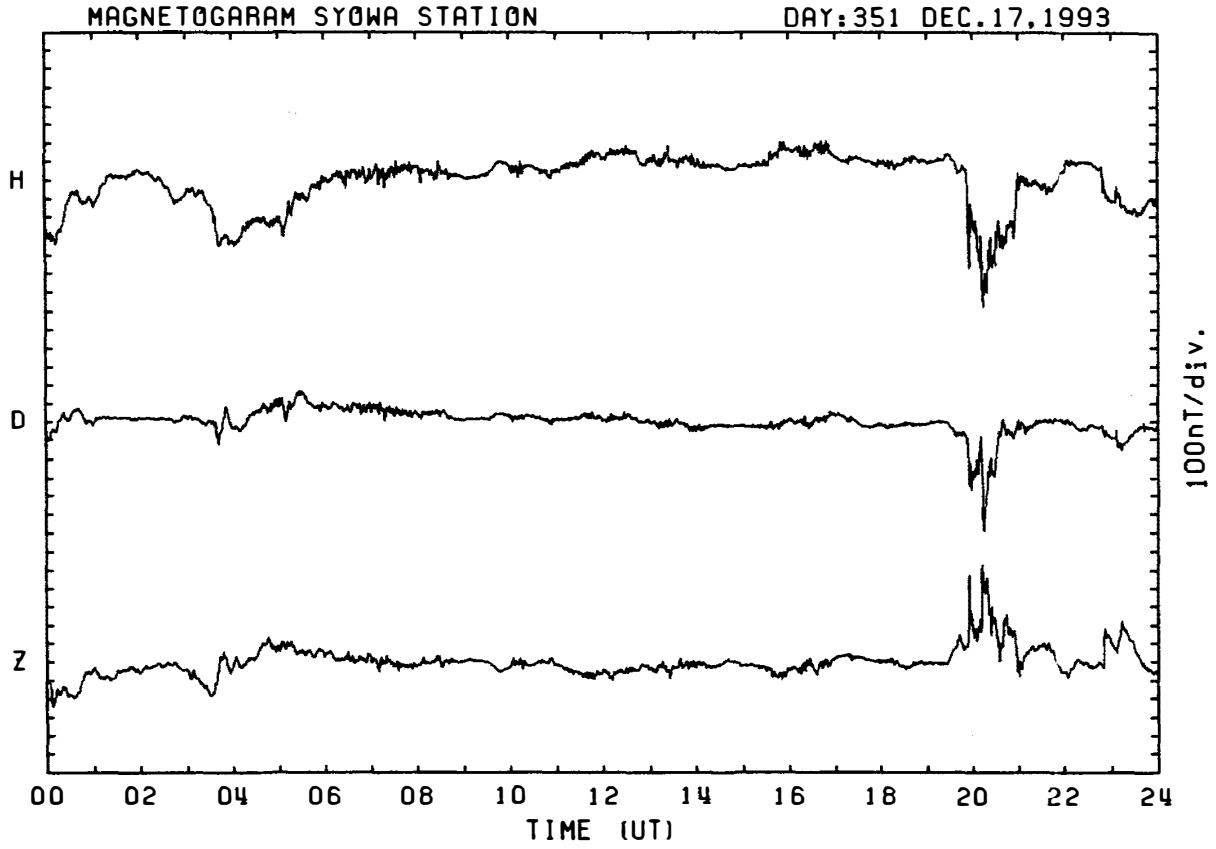
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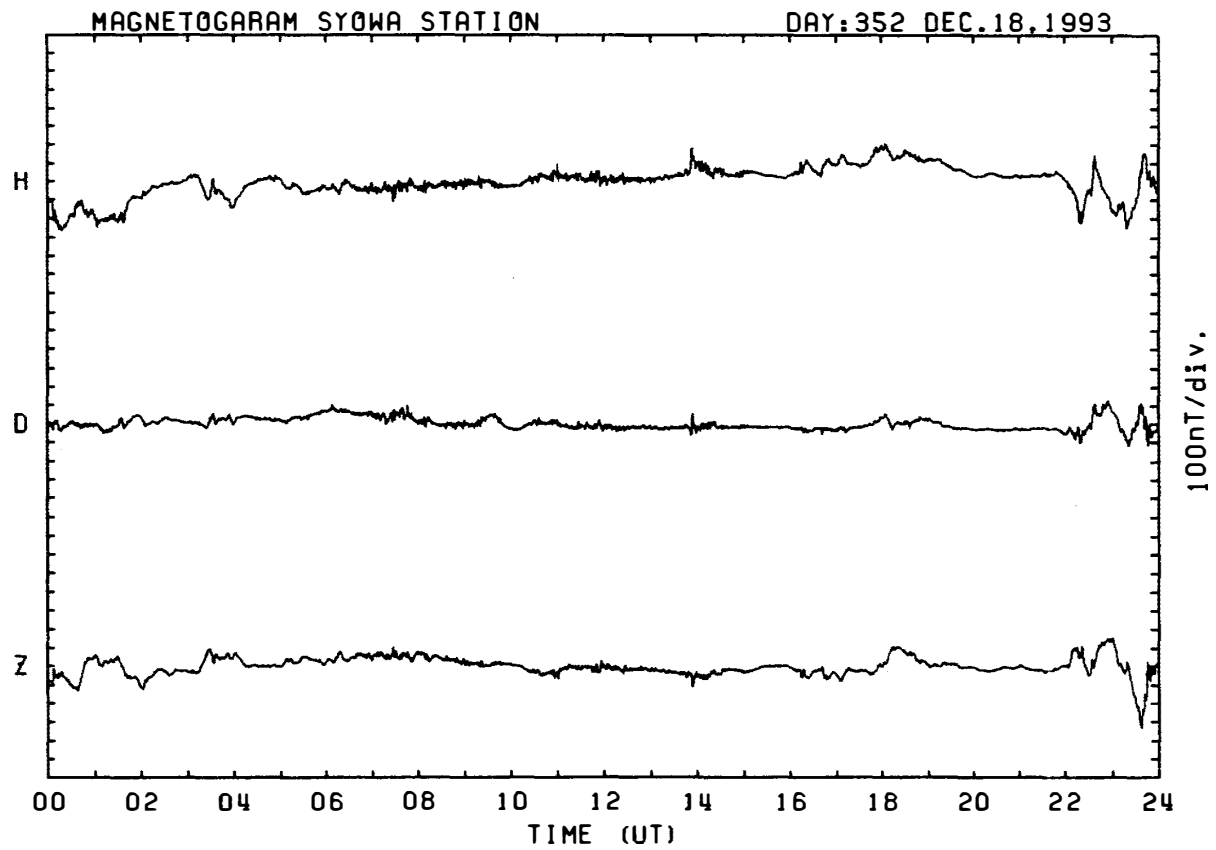
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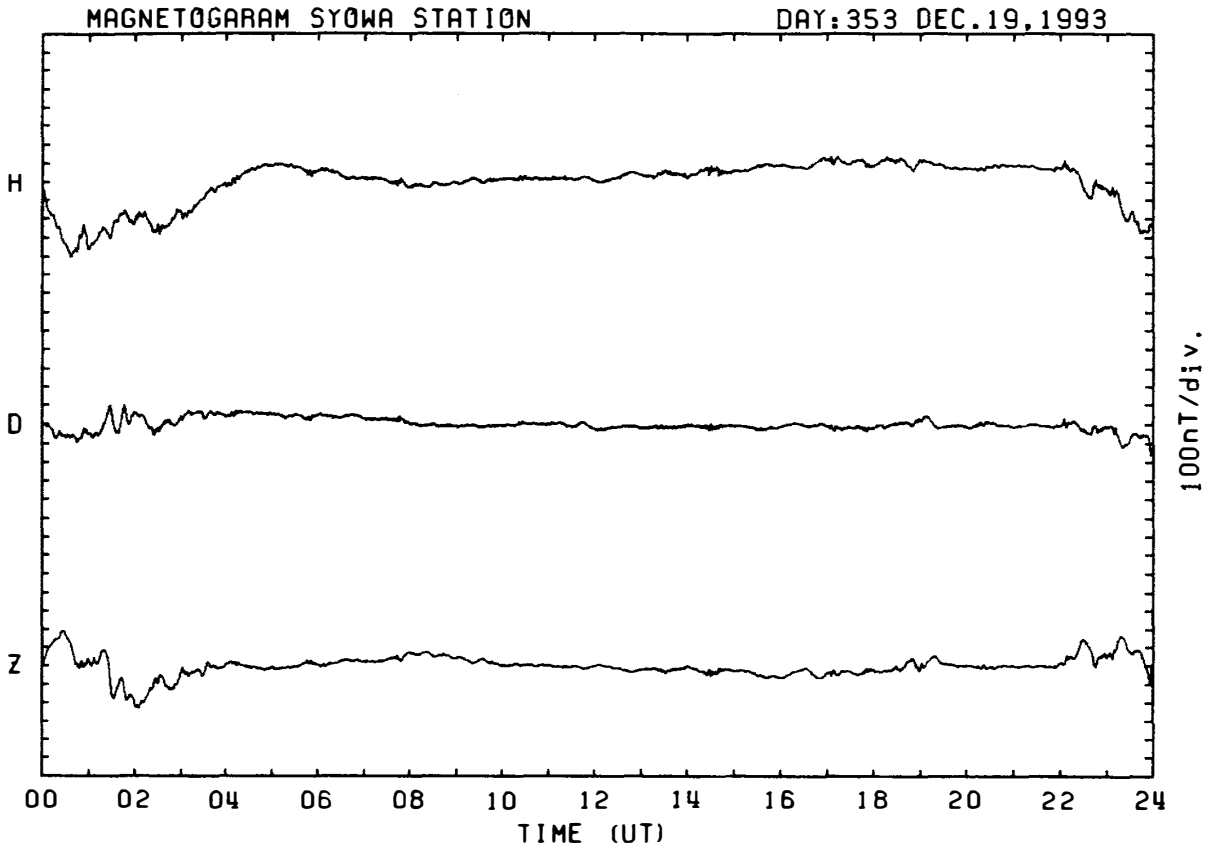
TIME (UT)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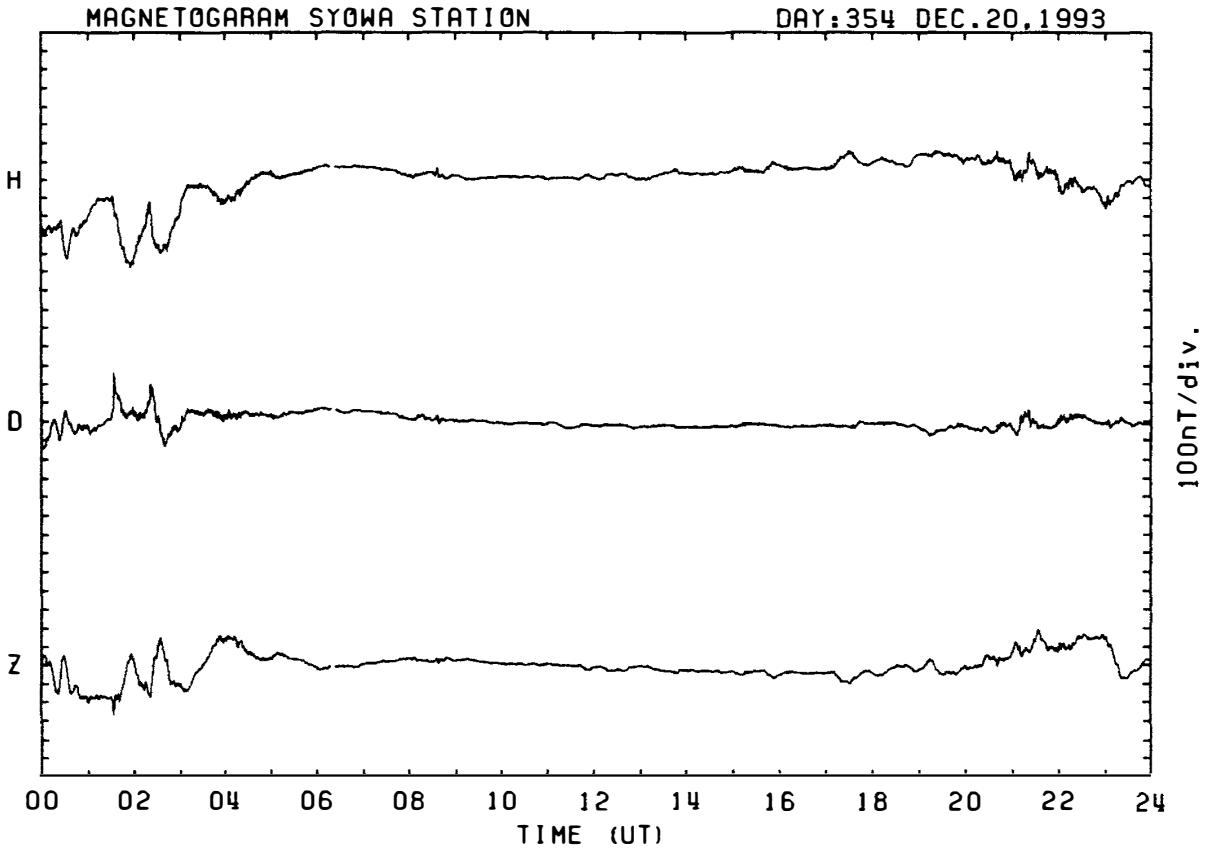
TIME (UT)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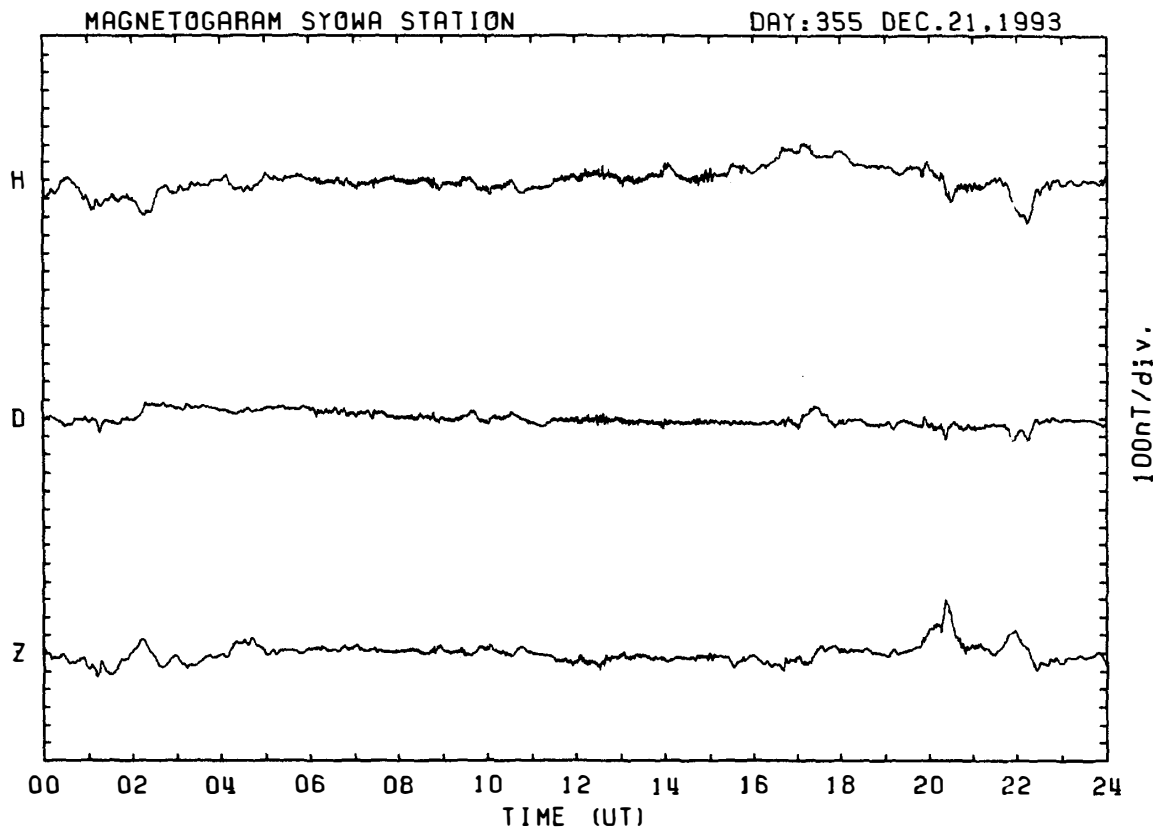
TIME (UT)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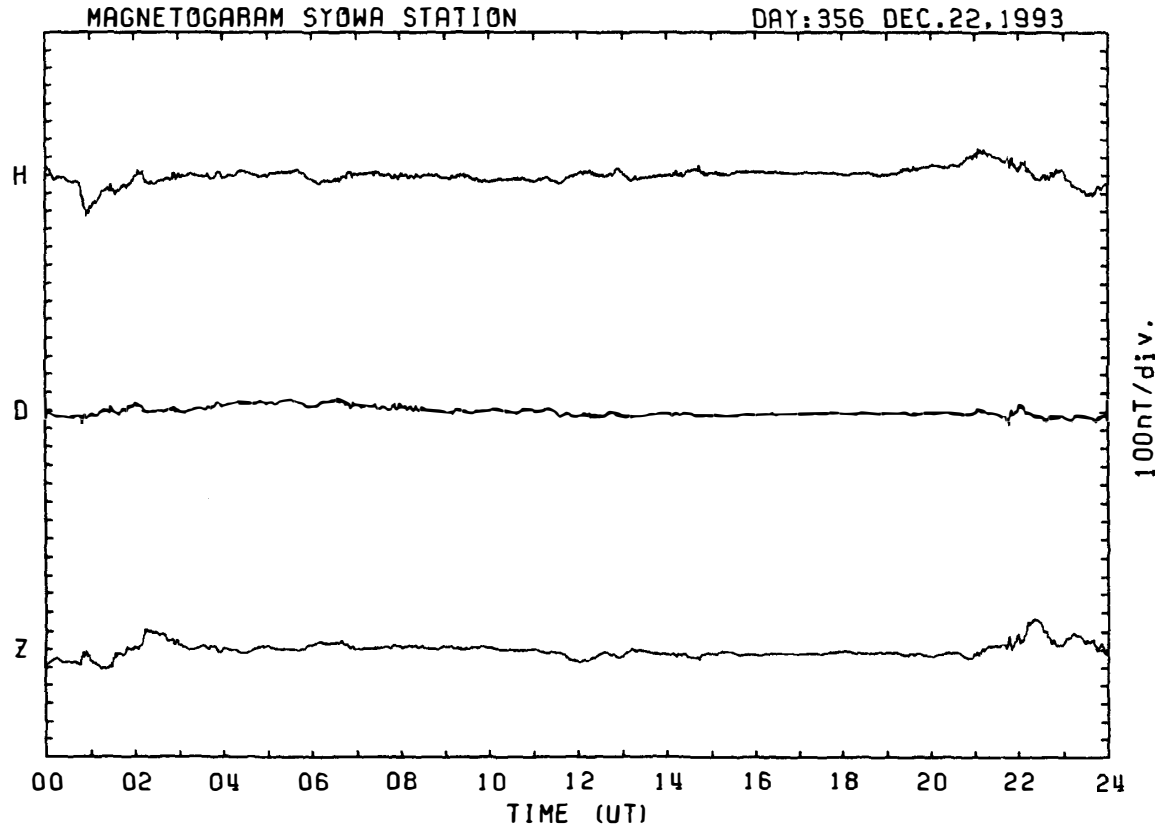
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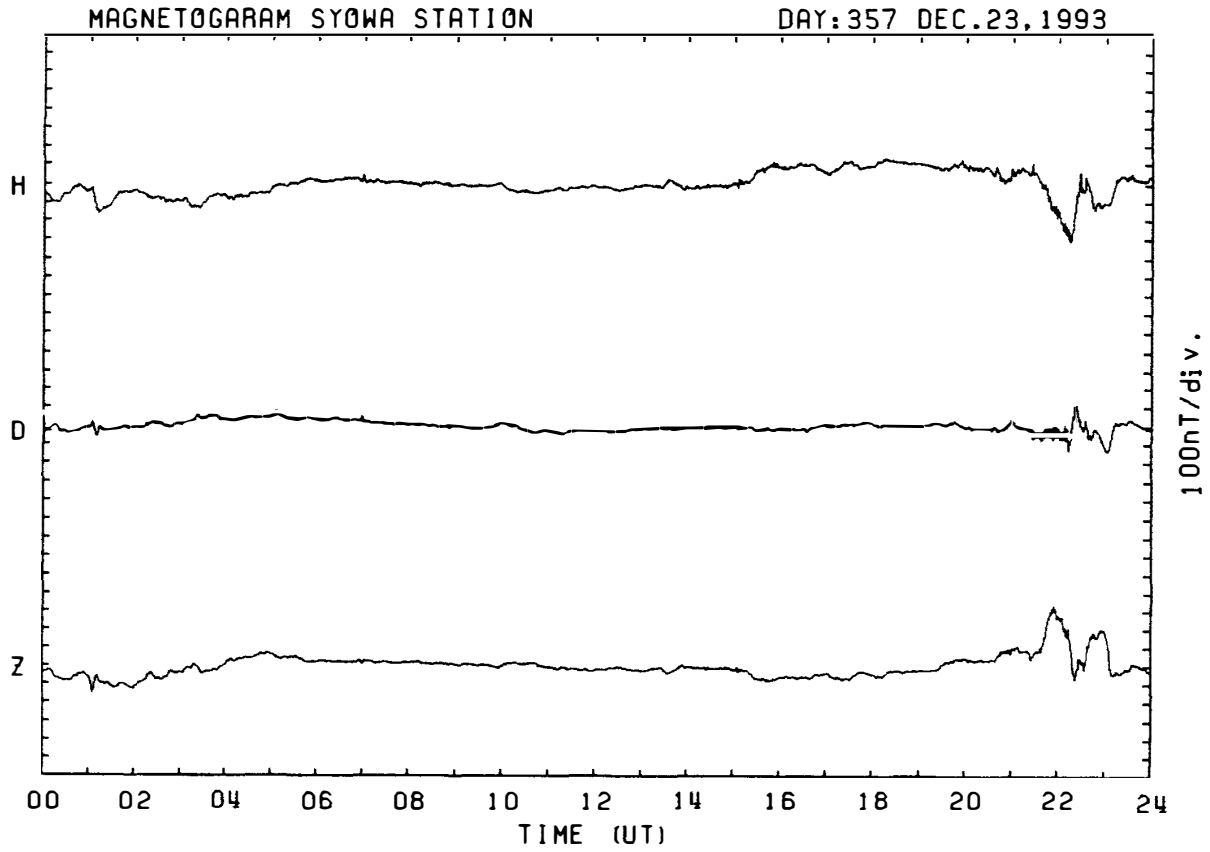
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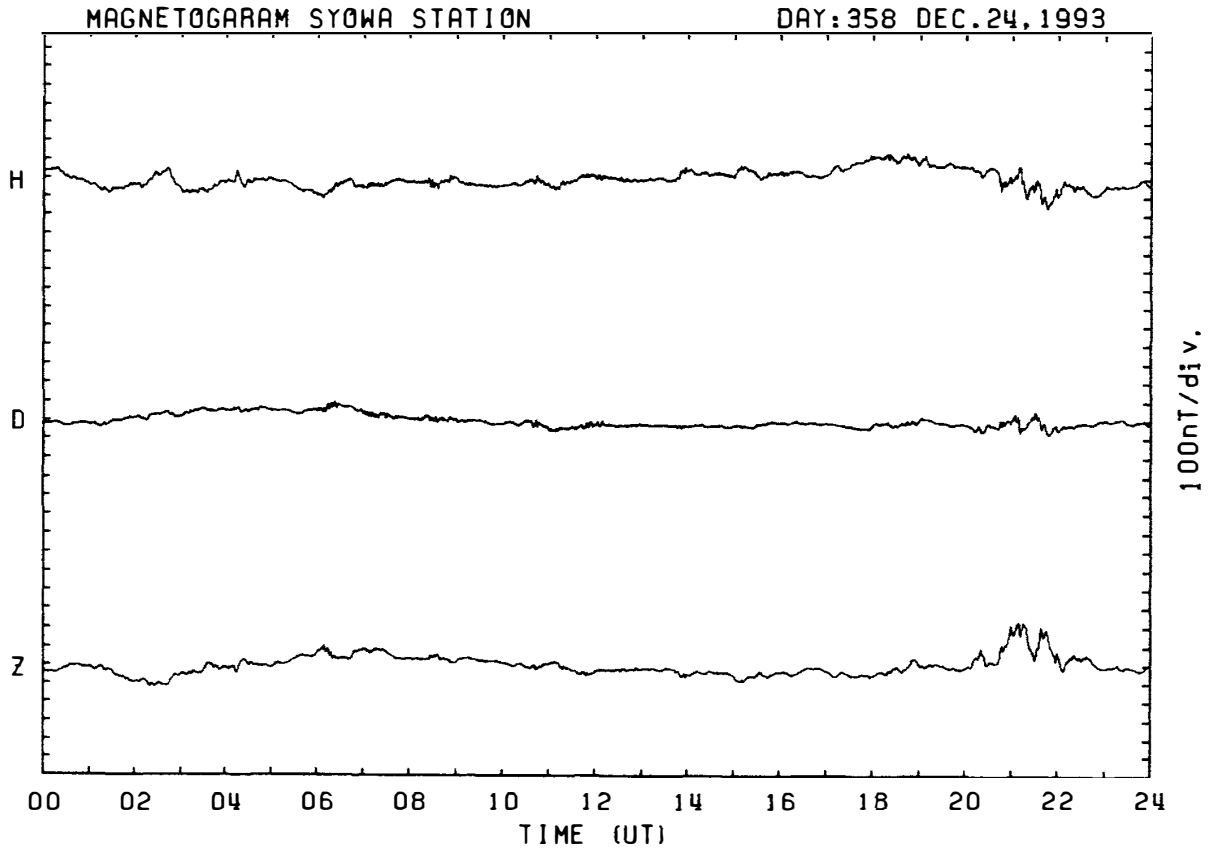
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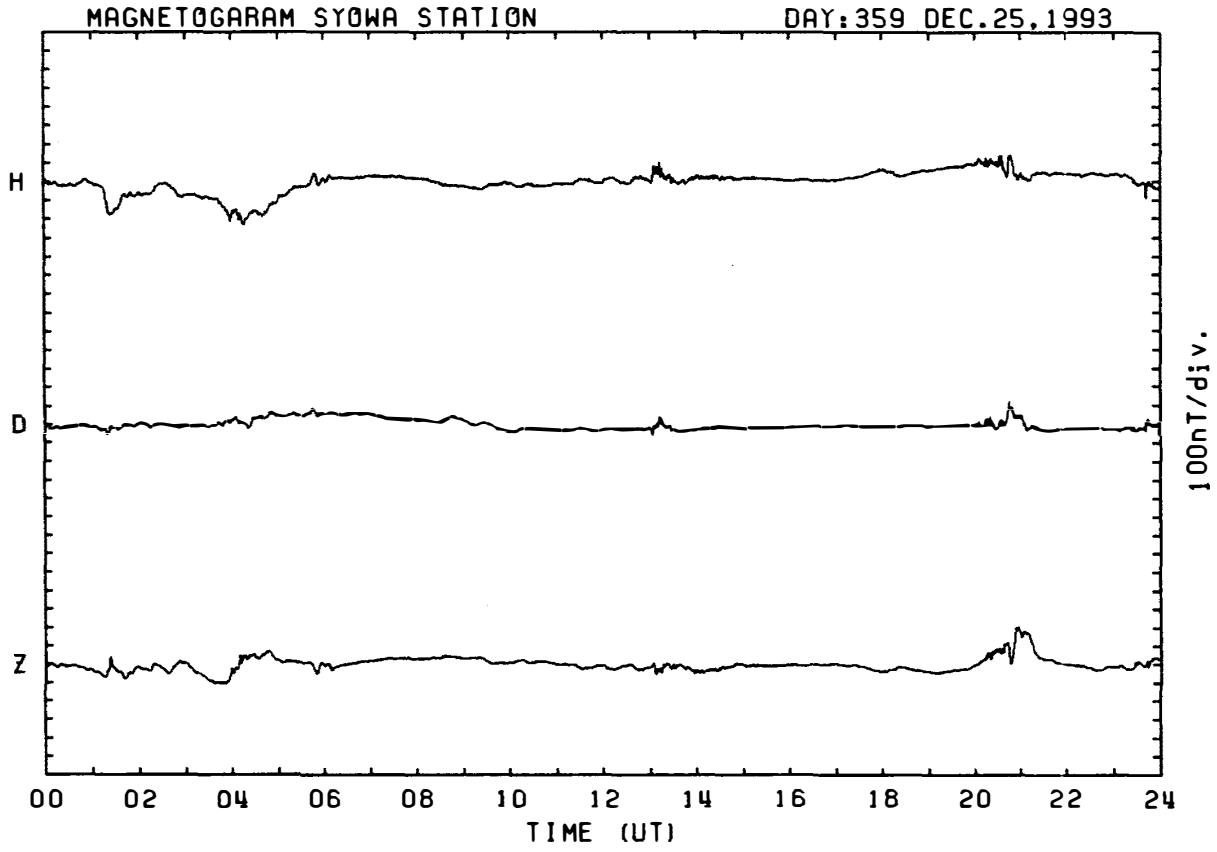
TIME (UT)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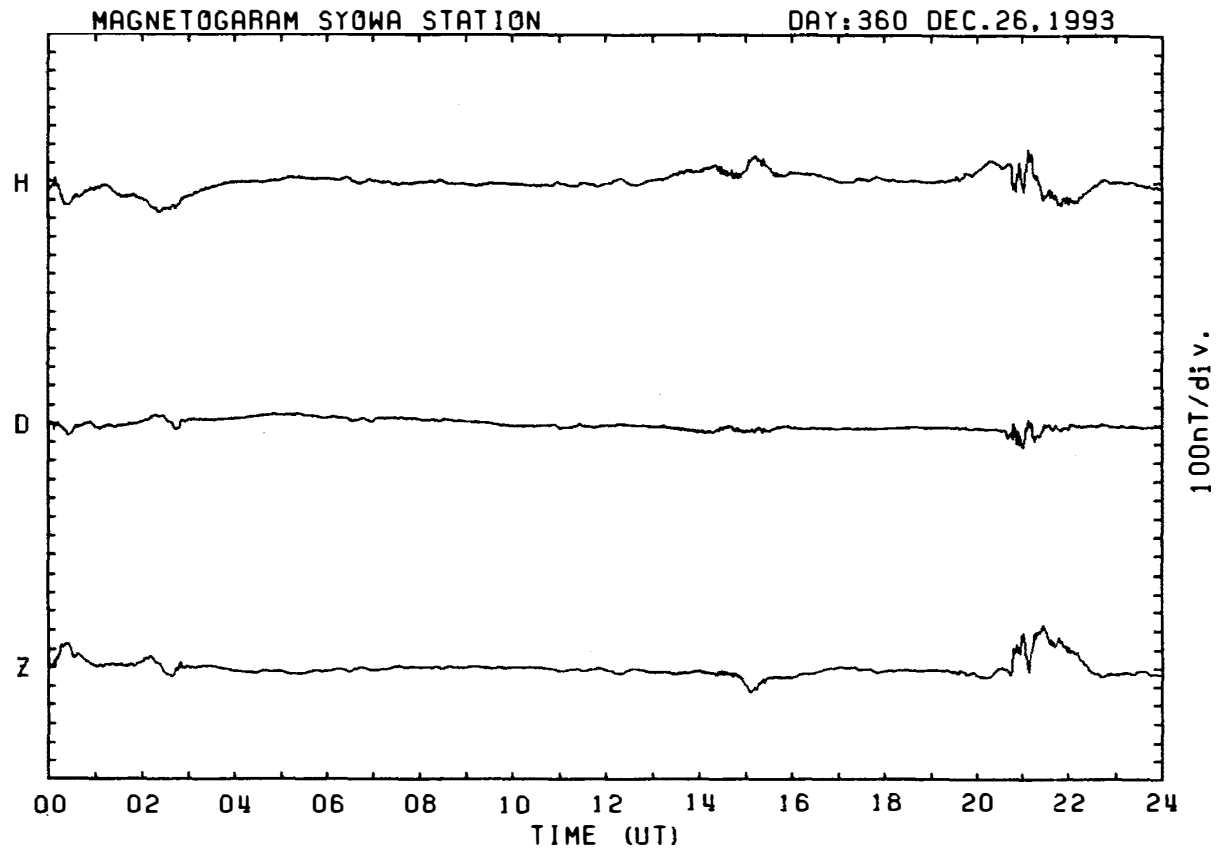
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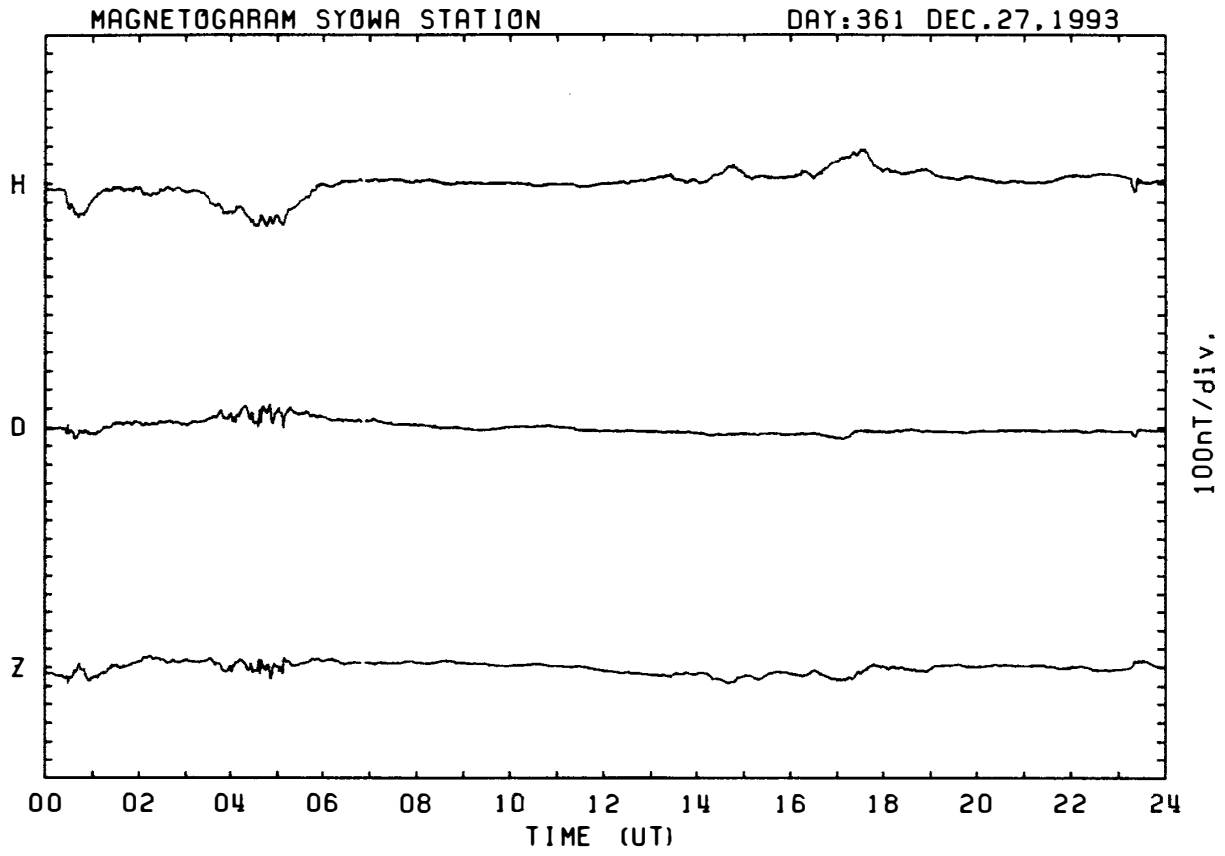
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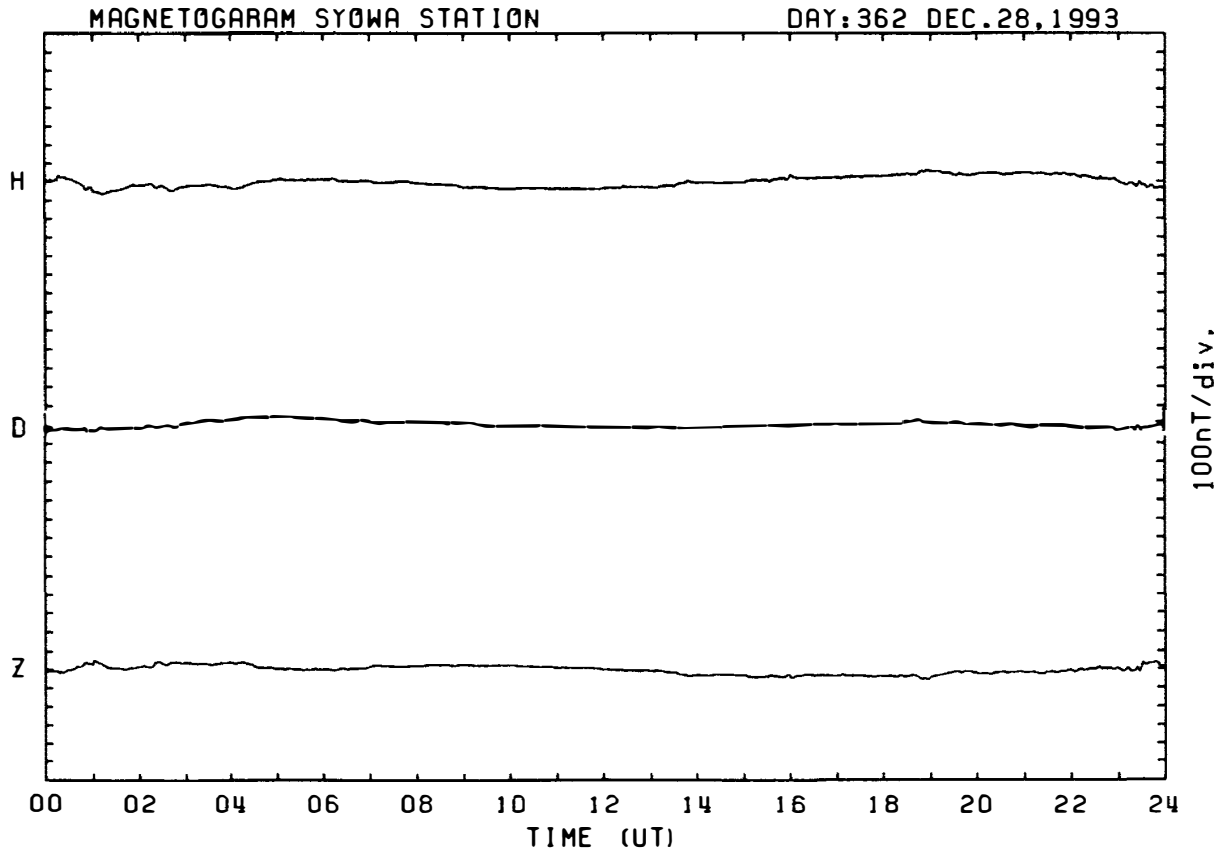
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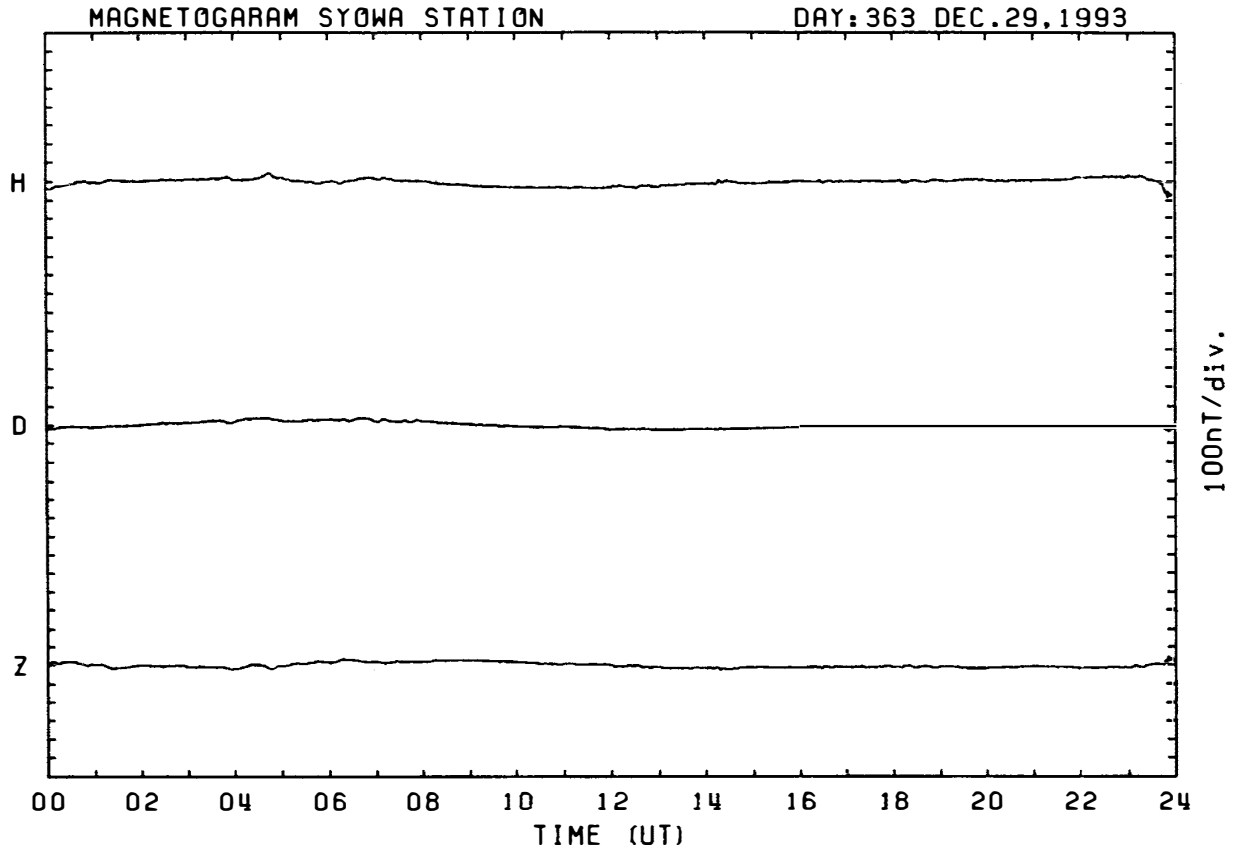
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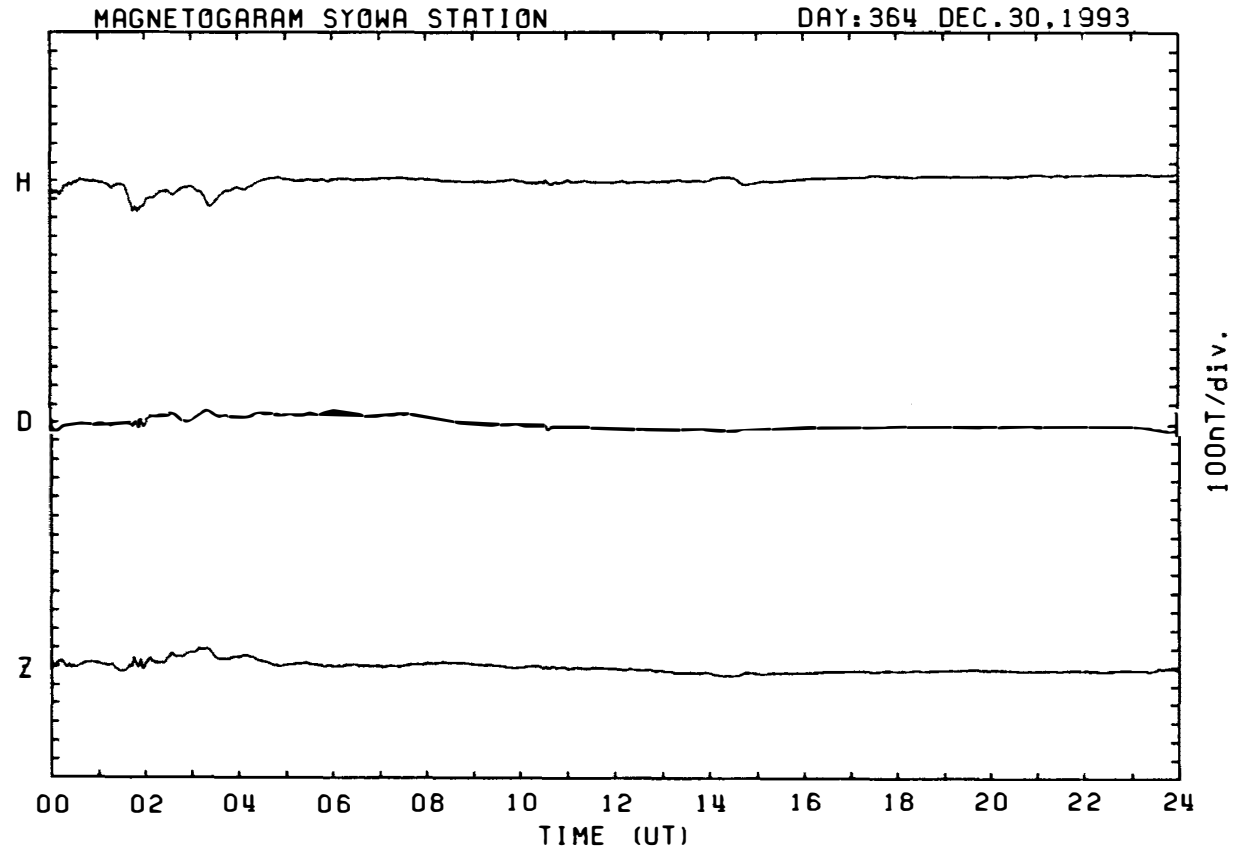
TIME (UT)


MAGNETOGARAM SYOWA STATION
DAY:364 DEC.30,1993
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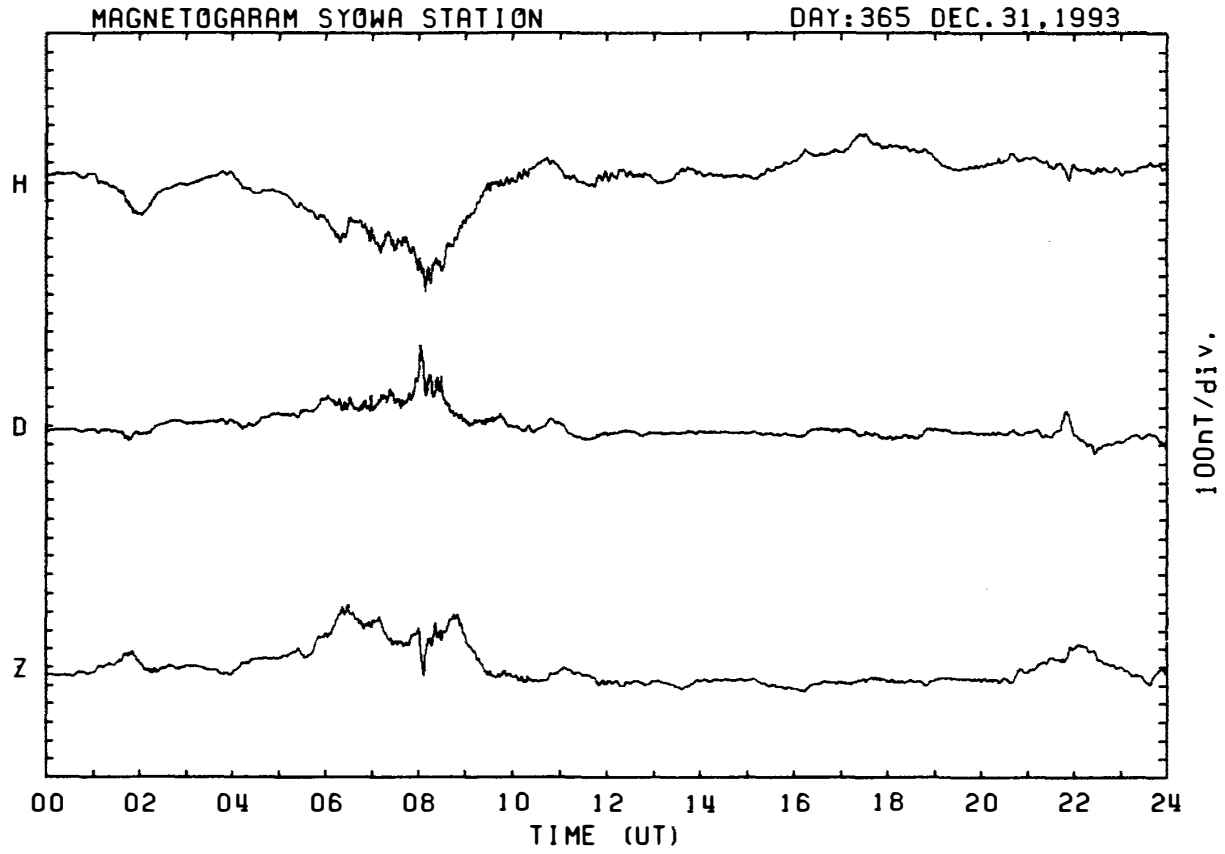
TIME (UT)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TIME (UT)