東北大学における
惑星・宇宙物理学データベース構築への取り組み

Planetary and Space Physics Database of the Tohoku University

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東北大学惑星プラズマ・大気研究センター(PPARC)では、2009年度より始まった大学間連携プロジェクトIUGONET（超高層大気長期変動の全球地上ネットワーク観測・研究）に併せて、惑星宇宙物理データベースの構築を進めている。本データベースの中核を成すのは、福島県飯舘観測所における太陽惑星HF-UHF帯の電波観測と、ハワイハレアカラ観測所における惑星光学観測である。今回はこれらの中から特に、
(1)飯舘惑星電波望遠鏡を用いた太陽電波バーストの高時間分解能観測
(2)ハレアカラ観測所における惑星高分散分光観測
に焦点を当てて発表を行う。

Planetary Plasma and Atmospheric Research Center (PPARC) of the Tohoku University is now in progress to build a planetary and space physics database under collaboration with the Inter-university Upper atmosphere Global Observation NETwork (IUGONET). The core data of the database are solar and planetary radio observation in HF-UHF range at Iitate observatory, Fukushima, and optical observation of planets at Haleakala observatory, Hawaii. In the presentation, we will particularly present solar radio burst observation with high time resolution using the Iitate Planetary Radio Telescope (IPRT) and high-dispersion spectroscopy of the planets at Haleakala observatory.

太陽HF-UHF帯電波　データベース

太陽電波バーストの中でもType-Iバーストは、他の太陽電波バーストに比べて強度が2桁以上小さい微弱な電波現象であるが、その時間―周波数特性から、コロナ中で小規模な粒子加速が頻繁に生じていることが示唆される。

しかしながら、微細なスペクトル構造と複雑な偏波特性をもつメートル波帯の太陽電波を連続して観測できる設備は、これまで世界的にも欠如していた。そこで飯舘惑星電波望遠鏡に新開発のデジタル分光器を組み合わせることで、160-500MHzの帯域において、10msの時間分解能、61kHzの周波数分解能、0.7s.f.u.の最小検出感度を実現し、2009年12月より連続観測を実施している。

観測データは、時間分解能を1秒にリダクトしたものをfits形式のデータとして公開することを予定しており、SolarSoftWare(SSW)にて取り扱うことができる。またIUGONETプロジェクトで整備されるメタデータ・データベースにも登録が予定されており、地球・惑星・惑星間空間での研究への応用が期待される。

Type-I is one of the solar radio phenomena frequently observed in a meter wave length. The flux density of type-I is very weak compared to other solar radio bursts so that it is thought to be emitted by some small scale particle acceleration phenomena in the solar corona. However, the acceleration processes of the non-thermal electrons are not understood well. PPARC have newly developed a radio observation system to observe solar radio bursts with IPRT. This system enables to observe solar radio bursts in the frequency range between 100 MHz and 500 MHz. Minimum detectable sensitivity in the observation frequency range is better than 0.7 S.F.U. with 10 ms time resolution and 61 kHz frequency resolution. This system also enables to observe left and right polarization components simultaneously. The observation system is one of the best equipment for solar radio bursts in the world at present. We have started continuous observations of the Sun from the end of 2009. The observation data will be released in the FITS format, thus, we can easily analyze the data using SolarSoftWare (SSW).

VHF~UHF solar radio spectrometer

The system consists of wide-band polarimeter and high-speed FFT spectrometer installed on the IPRT, Tohoku University. The system enables to observe the solar radio bursts in 100~500MHz with world-eminent specifications; i.e., with the sensitivity of 0.7s.f.u(solar flux unit) and time resolution of less than 10msec. The observations have been made everyday.

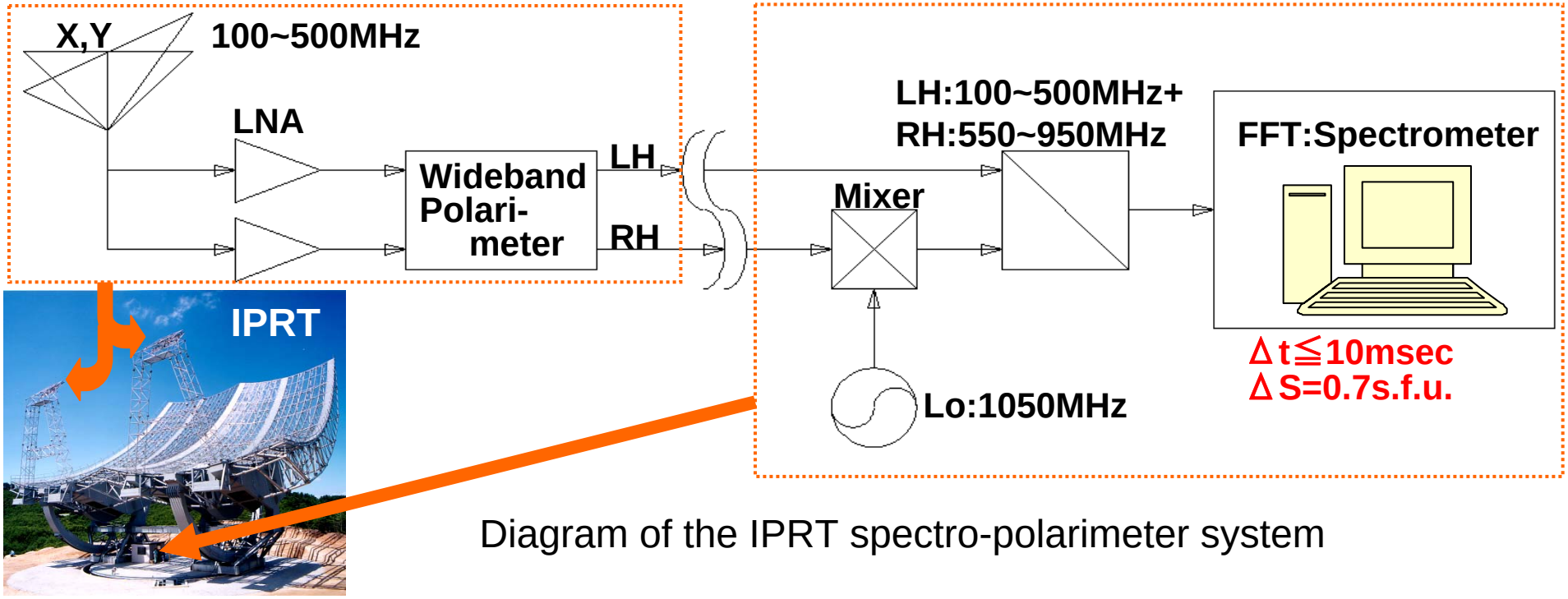


Diagram of the IPRT spectro-polarimeter system

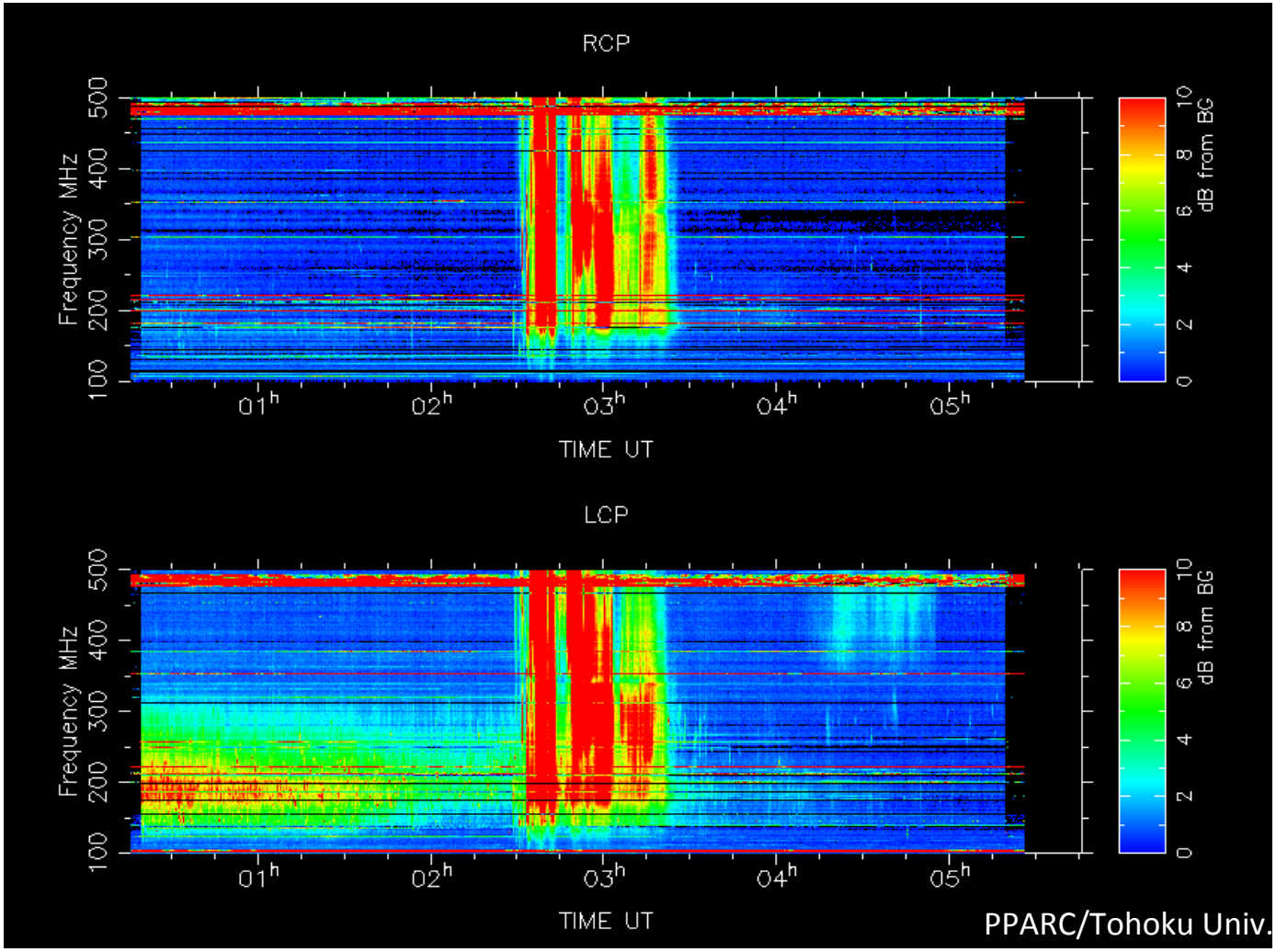
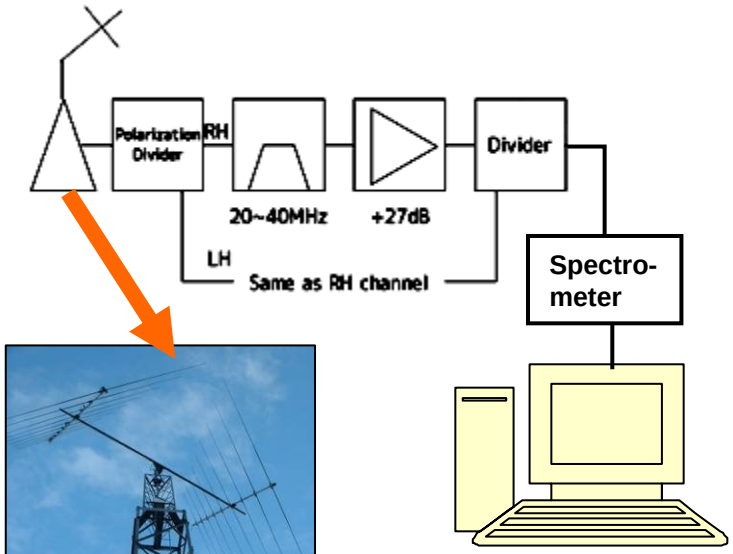


Fig. Example of RH&LH spectra observed with the solar radio spectrometer (Type-I & III bursts).

HF Solar/Jovian Radio Spectrometer

The system is wide-band spectrometer installed on the Iitate Observatory, Tohoku University. The system enables to observe the solar/Jovian radio bursts in 20-40 MHz with a sensitivity of -190 dBW/m^{2}Hz (Galactic noise level) and time resolution of 0.5 sec. The observations have been made everyday.



f: 20-40 MHz
Δf: 50kHz
Δt: 0.5sec

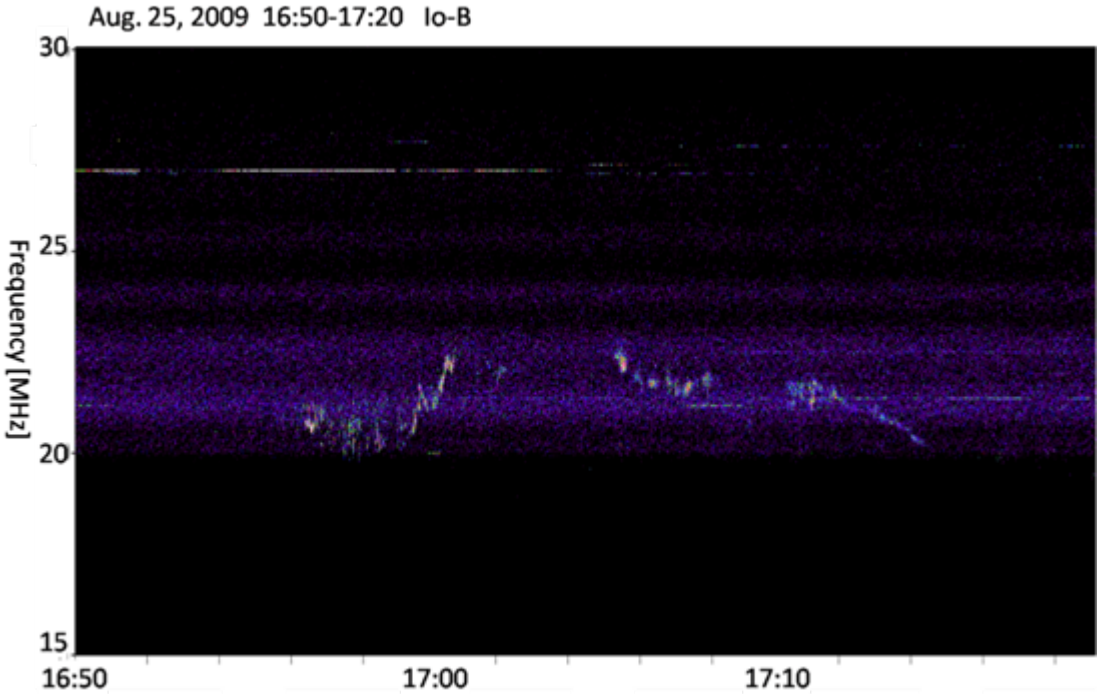


Fig. Example of spectrogram observed with this system (Jovian radio bursts, Io-B source).

1. Use case:

- Solar radio activity monitor with the wide-band (20-40&100-500MHz)
- Jovian radio activity monitor with the wide-band (20-40MHz)
- Researches of particle accelerations by comparative studies with X-ray～UV～VIS solar images, micro waves etc.

2. Function of the database (minimum requirement):

- Providing spectra by direct input of required date. (今回相談に含めうるもの)

3. Function of the database (for extended use):

➔ Linkage of other solar/Jovian data such as,

Jovian aurora(UV): HST (今回相談に含めうるもの)

Wave observations

ground-based: Wide band data (Culgoora, Australia: 18M-18GHz)
Radio interferometer (NoRH, Japan: 17, 34GHz)
HF~VHF data (Nancay, France：10～70MHz)
Wide band data (ETH, Switzerland： 0.1～4GHz)

satellite: LF~HF: WIND(～14MHz), STEREO(～16MHz)

Others: Hinode, RHESSI(X-ray), SOHO(UV), VIS(Hα), Magnetograph

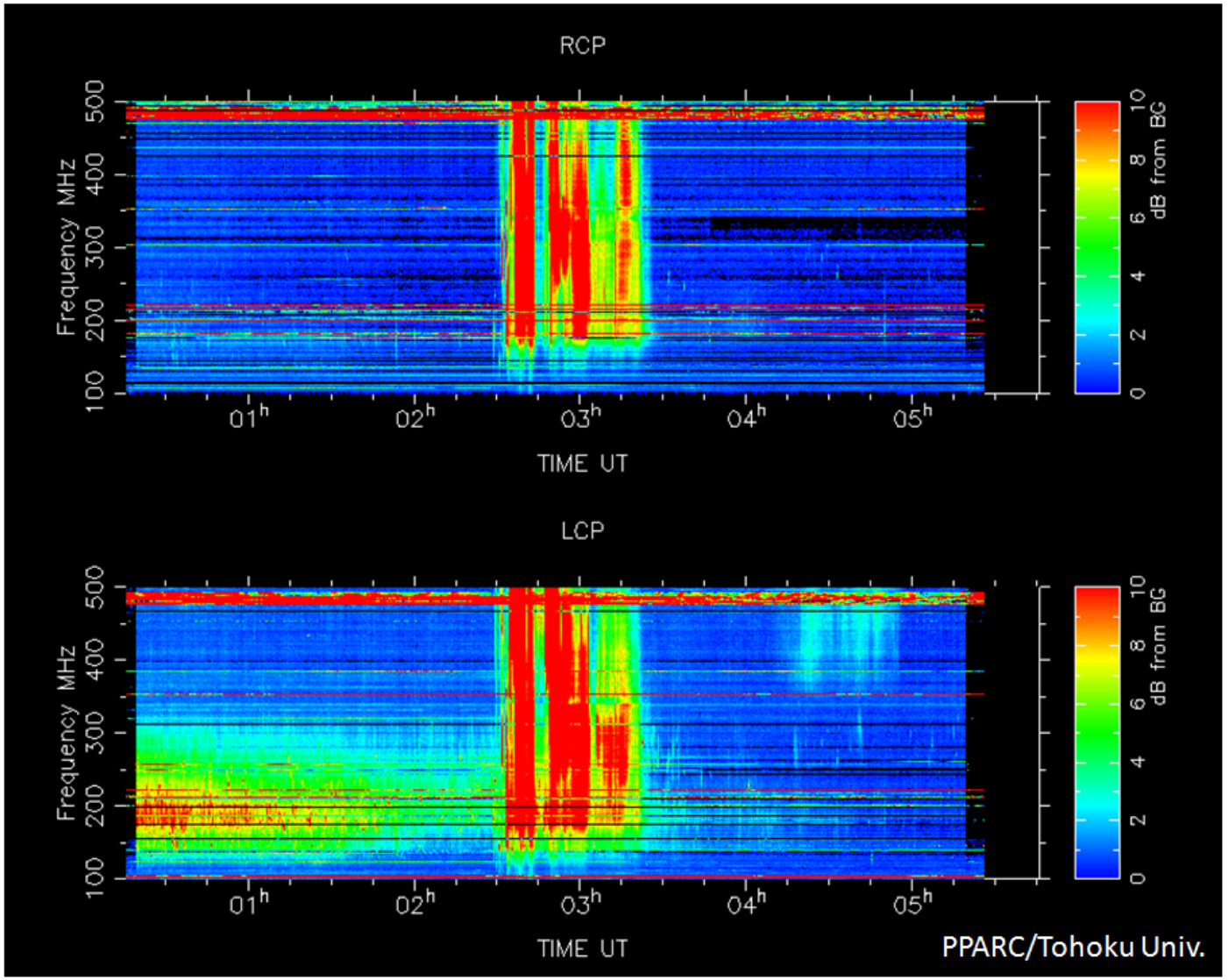
4.Data size

- Image data (UHF/VHF) ~50KByte/day
- Binary data (UHF/VHF) ~23MByte/day
  (observation: 8hrs/day@Δf=1MHz, Δt=1sec)
- Image data (HF) ~300KByte/day
- Binary data (HF) ~250MByte/day
  (observation: 24hrs/day@Δf=50kHz, Δt=1sec)

An example of image data of the solar radio spectrometer

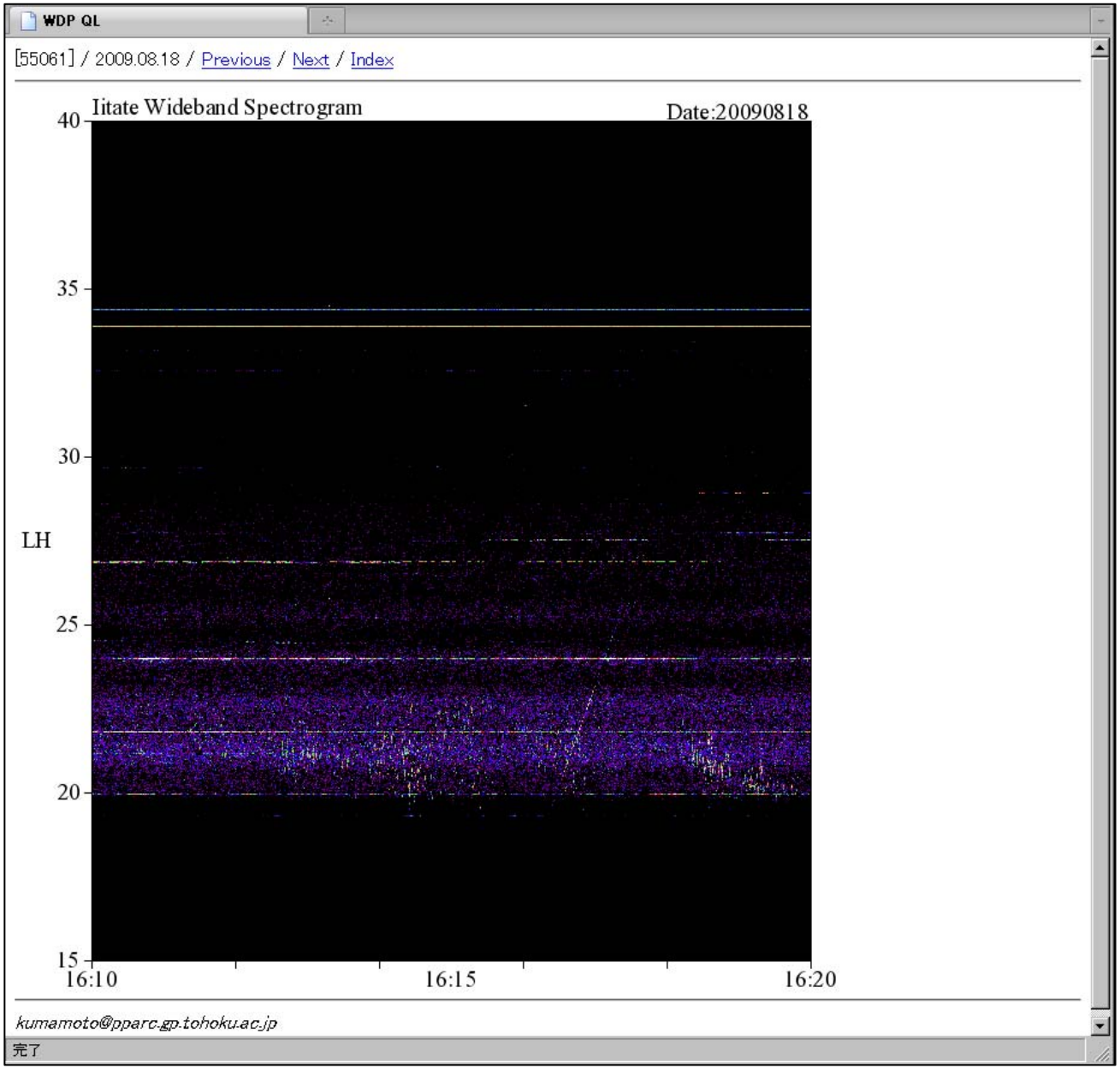
IPRT Wideband Dynamic Spectrum QL Form

Date 2010 / 02 / 08 Incr. non Excute Back to Home



IPRT

An example of image data of the solar/Jovian radio spectrometer



DAM

An example of the header part of the binary data of VHF-UHF Solar Radio Spectrometer (TBR)

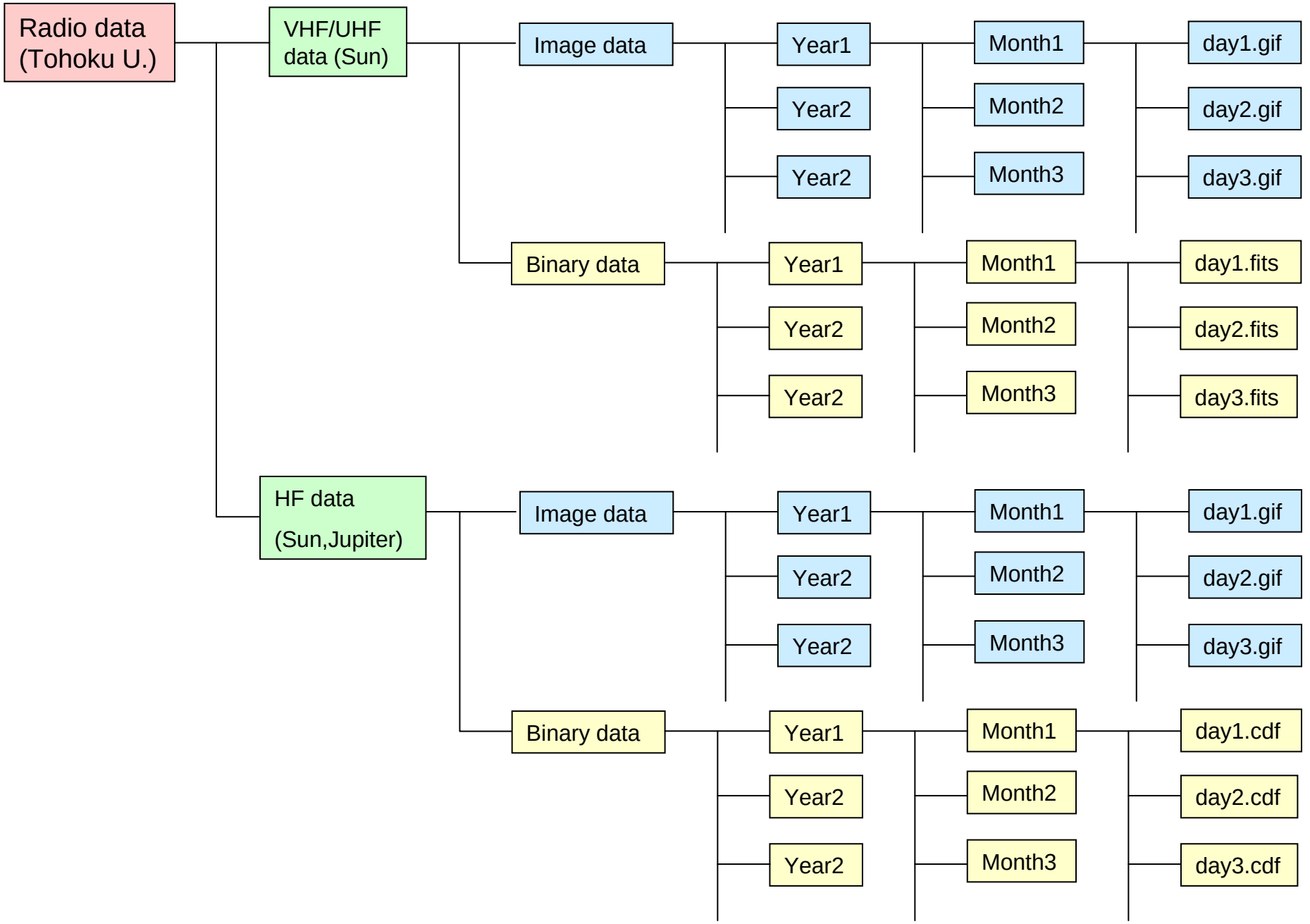
```
SIMPLE  =                    T / Fits standard
BITPIX  =                    8 / number of bits per data
NAXIS   =                    2 / number of data axis
NAXIS1  =                28800 / length of data axis 1
NAXIS2  =                  400 / length of data axis 2
DATE    = '2010-02-08'         /
CONTENT = '2010/02/08 LCP'     /Title of image
ORIGIN  = 'PPARC/Tohoku Univ.' /Organization name
TELESCOP= 'IPRT'               /Name of the telescope
INSTRUME= 'Spectro-Polarimeter'/Name of the instrument
OBJECT  = 'Sun                 /
DATE-OBS= '2010/02/08'         / date observation starts
TIME-OBS= '00:20:00'           / time observation starts
DATE-END= '2010/02/08'         / date observation ends
TIME-END= '05:20:00'           / time observation ends
BZERO   =            -50.00000 / scaling offset
BSCALE  =              1.00000 / scaling factor
BUNIT   = 'Relative Power (dB)'/ z-axis title
DATAMIN =              0.00000 / Minimum element in image
DATAMAX =             10.00000 / Maximum element in image
CRVAL1  =            0.0000000 / value on axis 1 at the reference pixel
CRPIX1  =                    0 / reference pixel of axis 1
CTYPE1  = 'Time (UT)'          / title of axis 1
CDELT1  =             1.000000 / step between first and second elements in axis
CRVAL2  =             100.0000 / value on axis 2 at the reference pixel
CRPIX2  =                    0 / reference pixel of axis 2
CTYPE2  = 'Frequency (MHz)'    / title of axis 2
CDELT2  =             1.000000 / step between first and second elements in axis
COMMENT
HISTORY
END
```

CDF file structure of HF data (TBR)

Variable	Type	Record Variance (=Time)	Dimension Variance (=Frequency)	Category
Epoch	CDF_EPOCH (REAL 8byte)	Var. (0-86399)	Fix	Support Data
Frequency [MHz]	CDF_REAL4 (REAL 4 byte)	Fix (0)	Var. (0-699)	Support Data
RH [dBW/m^{2}Hz]	CDF_INT2 (INT 2byte)	Var. (0-86399)	Var. (0-699)	Data
LH [dBW/m^{2}Hz]	CDF_INT2 (INT 2byte)	Var. (0-86399)	Var. (0-699)	Data

** Conversion tool from CDF file to FITS (or converted FITS file) will be also provided from Database.

Structure of the data directory (TBR)



木星内部磁気圏　リモートセンシング　データベース

惑星周辺の希薄大気やプラズマの発光は、太陽風や衛星との相互作用によりダイナミックに変動する惑星磁気圏環境を理解するうえで重要な観測手段の一つである。これらの観測には、惑星本体からの散乱光を低減しドップラー量を測定するために高分散分光が必要なだけでなく、数時間から数年におよぶ様々なスケールの変動をとらえるために連続観測を行うことが求められる。

PPARCではハワイ大学の協力の下、ハワイ・ハレアカラ観測所において口径40cmのシュミットカセグレン式望遠鏡とエシェル分光器(視野角4″x600″、逆線分散2.5pm/pixel、波長分解能約60,000)を組み合わせて、木星、土星、水星、月周辺の中性・プラズマ発光の連続観測を行ってきた。特に木星・土星観測データについては、2013年に打ち上げが予定されているISASの極端紫外望遠鏡(Sprint-A/EXCEED)ミッションとの連携を想定し、PDS(Planetary Data System)に準拠した形でのデータベース構築が進められている。

Observation of plasma and atmospheric emissions around the planets is important to understand dynamics and interactions between solar wind, satellites and magnetospheres. For the observation of these targets, high-dispersion spectroscopy is essential to reduce scattered continuum from the planetary disk, as well as to derive Doppler quantities of the emitting particles. In addition, long-term monitoring is required to investigate variability on time scales of hours to years. Optical emissions from plasma and neutrals around the planets have being made at Haleakala observatory, Hawaii using a high-dispersion echelle spectrograph (FOV=4x600 arcsec, R=60,000, RLD=2.5pm/pixel) coupled to a 40-cm Schmidt-Cassegrain telescope. Particularly, observation data of Jupiter and Saturn is now in progress to build a database complying with the PDS (Planetary Data System) in collaboration with the Sprint-A / EXCEED mission of ISAS.

1. **Tohoku Planetary and Space Physics Database (optical)**

＜Hawaii optical obs.: NaI/SIIスペクトル・イメージングデータ＞

- S+イオン発光強度（→S+イオン密度）
- 6716/6731強度比（→Ne電子密度）
- 動径密度・共回転遅延分布
- 50RJでの中性Na発光強度（→中性Na密度）

＜以下予定（IR Aurora & Io’s volcanic activity monitor）＞

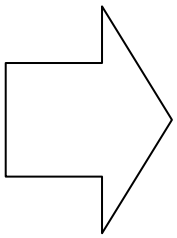
- オーバル全発光強度
- オーバル構造
- IRイオ放射強度（→火山活動）

2. **EXCEED（EUV spectrum）**

- S+,S++,S+++,O+/++発光強度（→イオン密度）
- 輝線強度比→電子温度(分布)・イオン組成
- EUVオーロラ発光強度(→降下電子エネルギ)

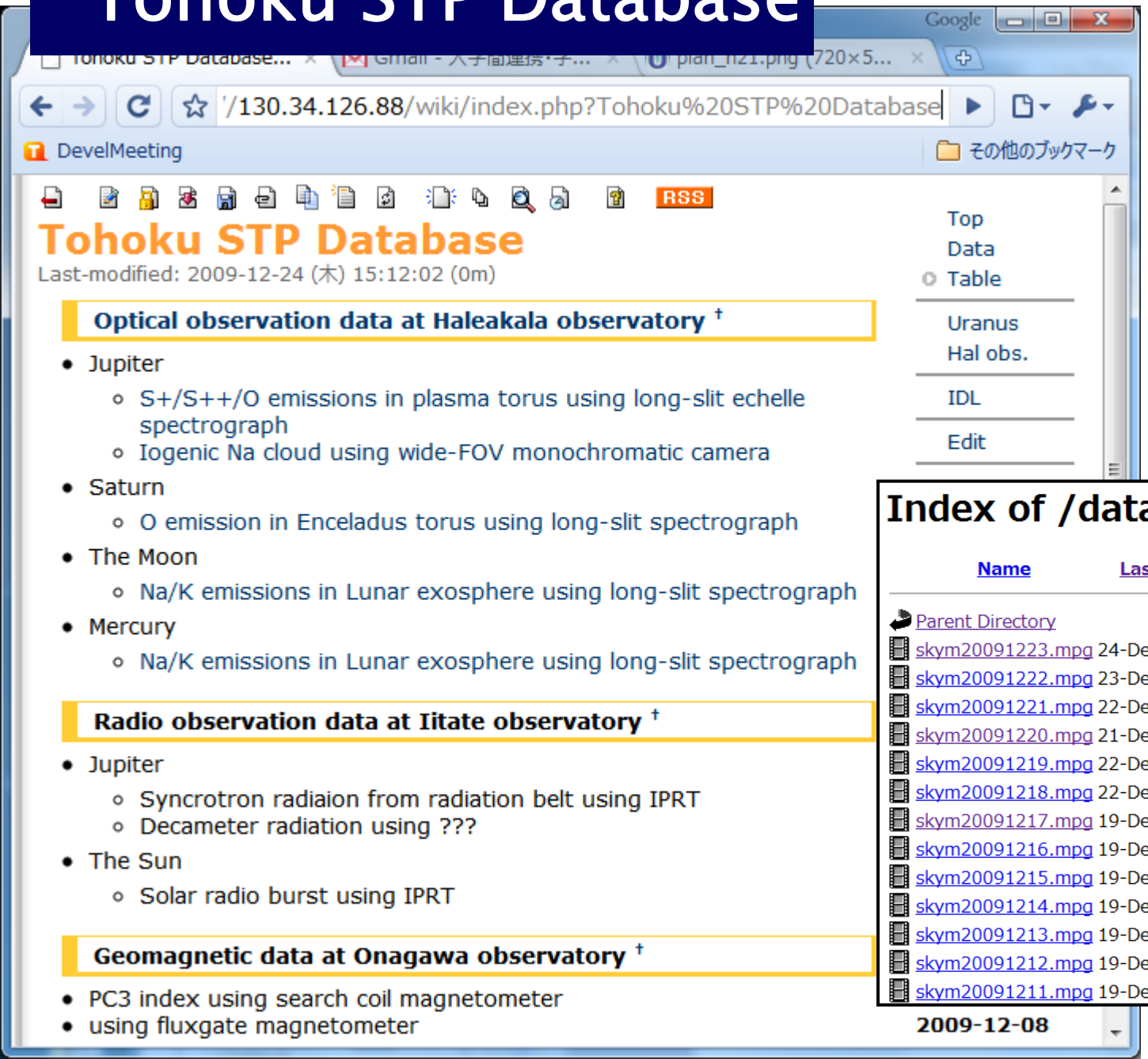
USE CASE

1. イベント解析
   - 太陽風変動
     - 地球近傍太陽風データから木星周辺への外挿
     - オーバルの明るさ、構造
   - イオ火山活動
     - 中性Na強度、IRイオ放射強度
     - EUVスペクトル→電子温度・イオン組成
2. 中・長期的な相関
   - SysIIIによる影響を取り除いた比較→SysIIIによる並べ替え



- 観測時刻でのデータ検索・取得
- Sub-observer lat/lng. Sub-solar lat/lng.でのデータ検索・取得

Tohoku STP Database



Index of /data/hal/skymon

Name	Last modified	Size	Description
Parent Directory		-	
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skym20091222.mpg	23-Dec-2009 04:55	5.5M	
skym20091221.mpg	22-Dec-2009 07:55	5.6M	
skym20091220.mpg	21-Dec-2009 11:18	5.4M	
skym20091219.mpg	22-Dec-2009 08:00	5.6M	
skym20091218.mpg	22-Dec-2009 07:59	5.6M	
skym20091217.mpg	19-Dec-2009 00:28	5.6M	
skym20091216.mpg	19-Dec-2009 00:27	5.4M	
skym20091215.mpg	19-Dec-2009 00:27	5.5M	
skym20091214.mpg	19-Dec-2009 00:26	5.5M	
skym20091213.mpg	19-Dec-2009 00:25	5.5M	
skym20091212.mpg	19-Dec-2009 00:24	5.5M	
skym20091211.mpg	19-Dec-2009 00:23	5.5M	

クリックすると次に進みます。押したまま待つと履歴が表示されます。

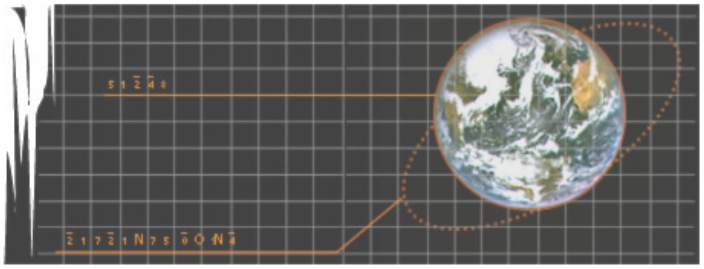
http://130.34.126.75/pdap/index.php?RESOURCE_CLASS=TUHJW_PRODUCT&RETURN_TYPE=HTML

DevelMeeting

その他のブックマーク

Input Parameters

ITEM	VALUE
method	GET
parameters	RESOURCE_CLASS = TUHJW_PRODUCT RETURN_TYPE = HTML
message	



PRODUCT LIST (602 products)

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3	TUHJW_J_LOS_3_V1.0	LOS20090103_03.FITS	JUPITER	VIS_630NM	67.89	1.23	2008-01-03 00:00:00	2008-01-03 00:00:30
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5	TUHJW_J_LOS_3_V1.0	LOS_670_20090729_02.FITS	JUPITER	672NM	75.716511	0	2009-07-29 07:41:00	2009-07-29 08:11:00
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