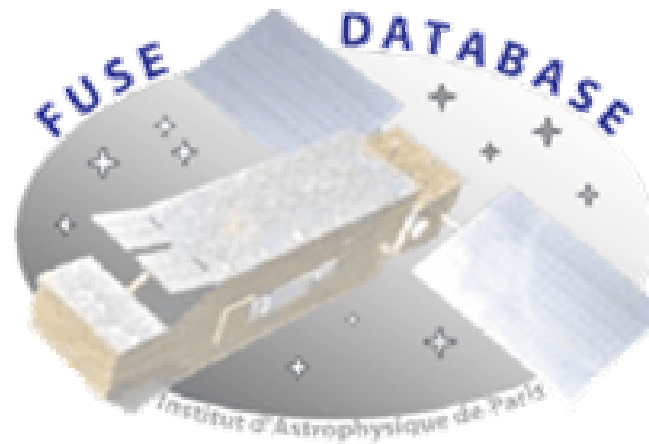


La base de données FUSE à l'IAP dans l'observatoire virtuel

<http://fuse.iap.fr>



Jean-Michel Désert
Institut d'Astrophysique de Paris

07-09 Nov 2005, Obernai

FUSE

Far Ultraviolet Spectroscopic Explorer

PI Français: Alfred Vidal-Madjar

(NASA-CNES-ASC)



Mission réussie!

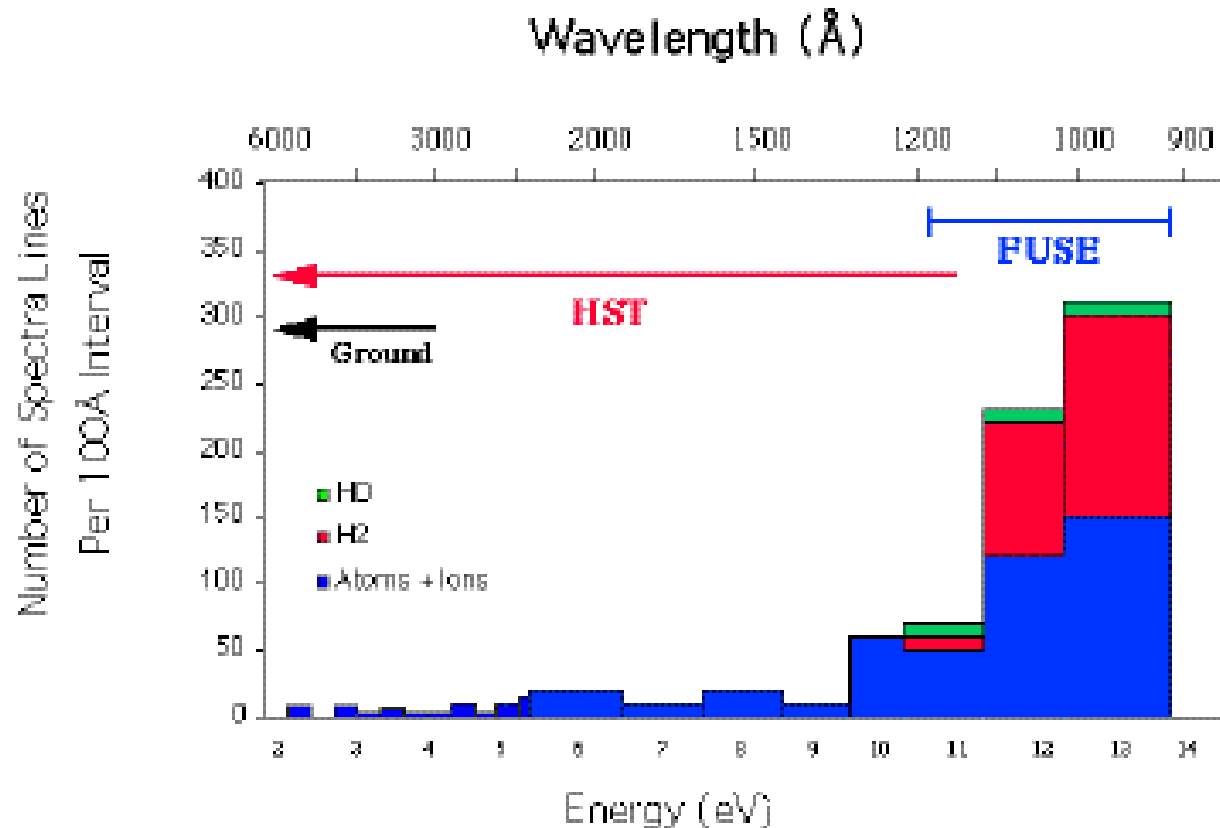
- Lancé le 24 juin 1999
- Près de 4000 observations publiques
- R ~ 17 000
- 90 – 120 nm

Domaines d'études:

- Extragalactique
- IGM / ISM
- Stellaires
- Circumstellaires
- Systèmes planétaires

Eléments: H₂, OVI, D/H

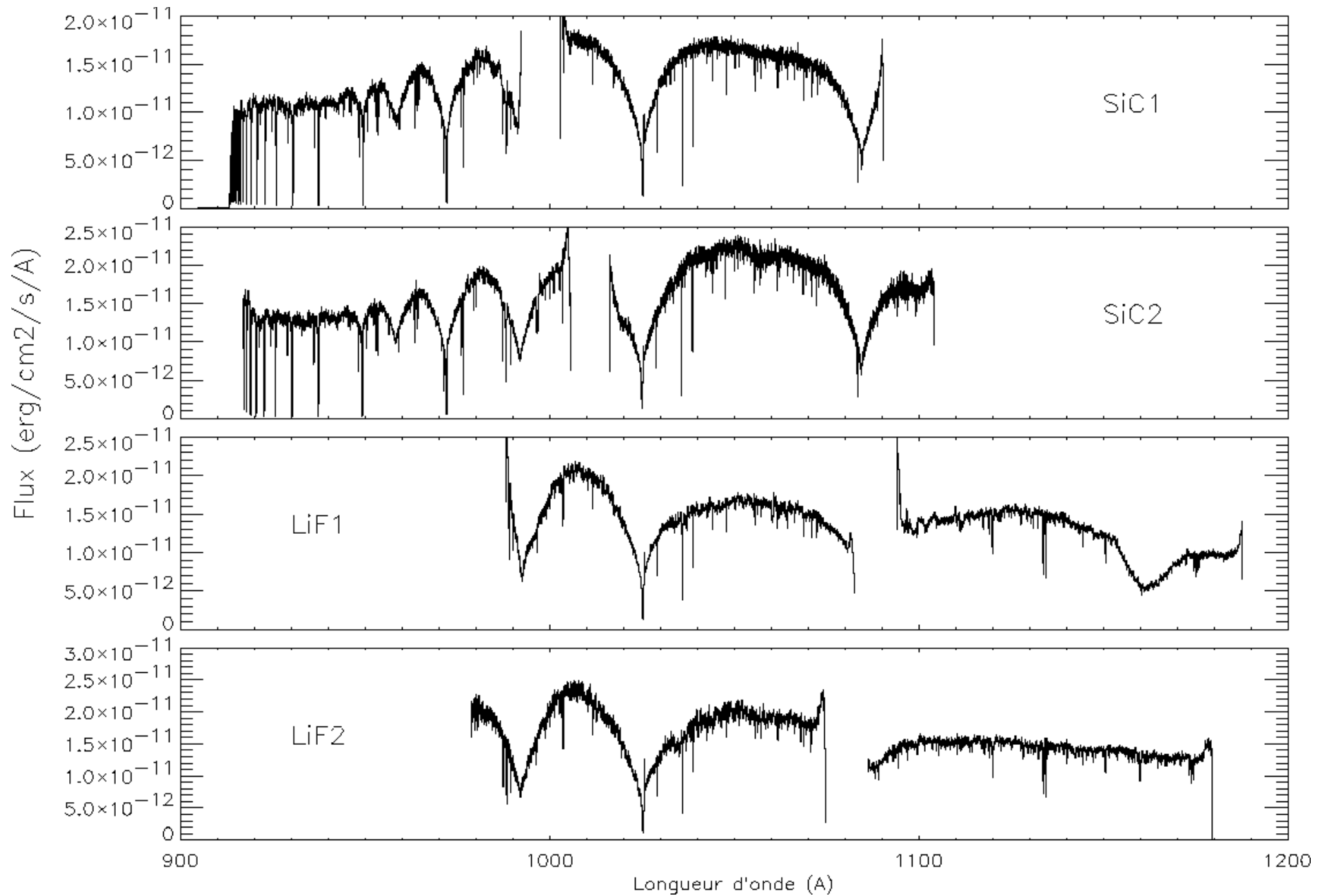
FUSE science main objectives

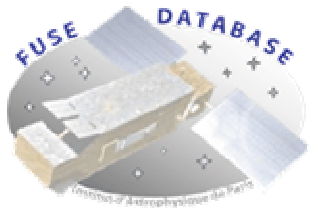


Number of spectral lines per 100Å interval for transitions from the ground states of abundant species in the interstellar medium

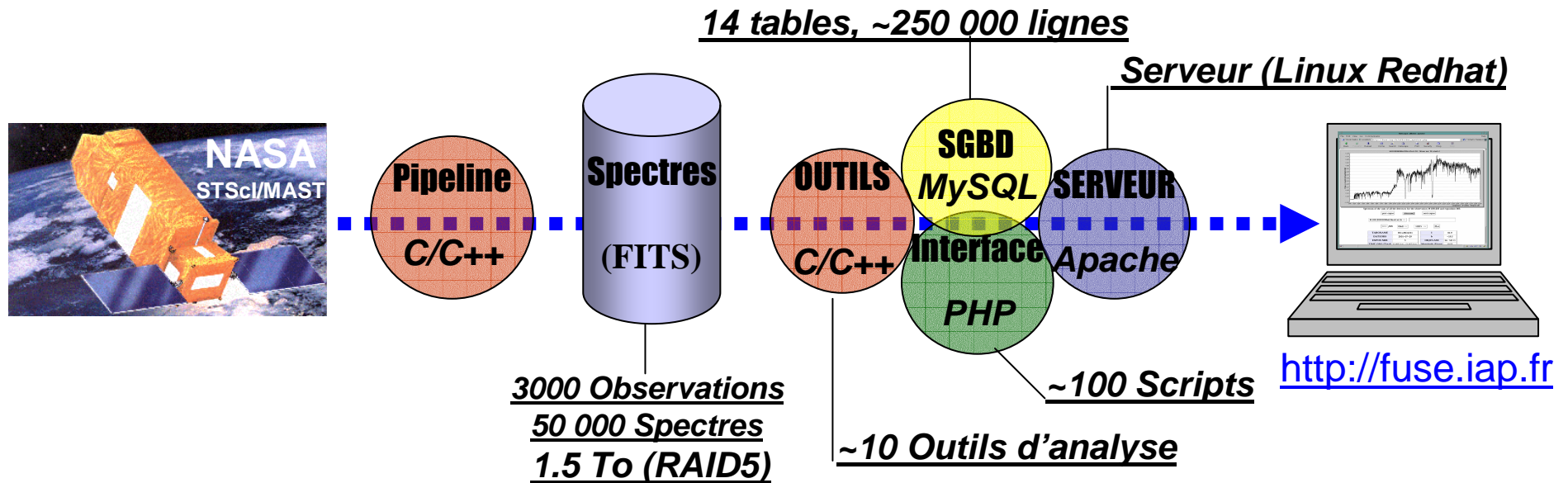
Accessing Elements: H₂, OVI, D, H, Ar, etc...

Bande passante de FUSE





Base de données **FUSE IAP** Spécifications techniques

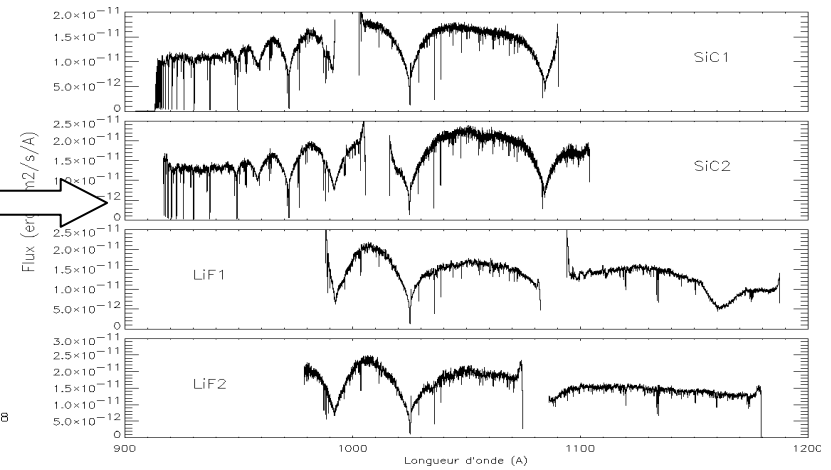
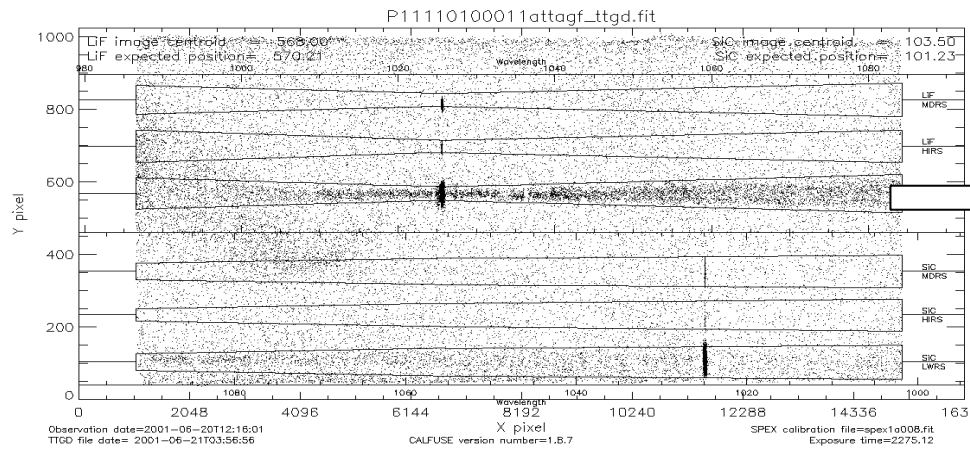


- ~4000 accès (depuis Janv. 2003) / ~5 accès par jour (Avril 2005)
- Status actuel:
 - Utilisation spécifiques
 - Développement OV (VOtable, SSA, webservice, etc...)
 - Maintenance (données, matériels, logiciels)



Traitements des spectres FUSE

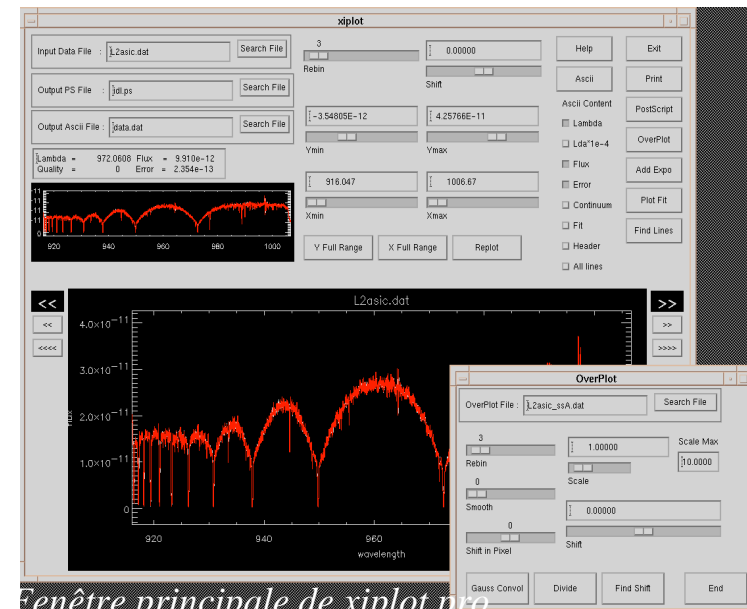
Intégration du pipeline publique FUSE *CalFUSE* (C/C++)



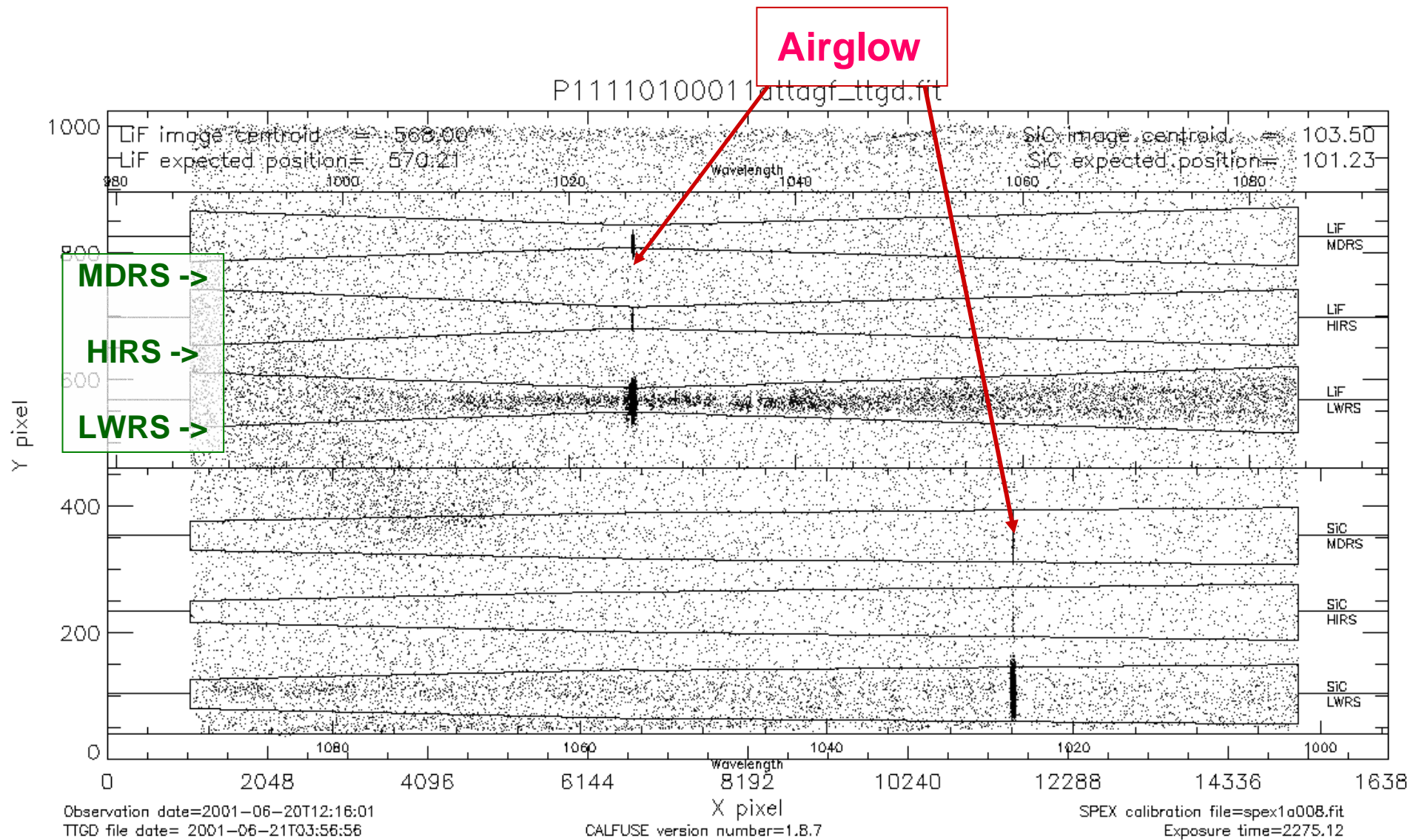
Développement d'un logiciel de manipulation de spectres *Xiplot* (IDL)

Développement d'un logiciel d'affichage des observations par accès au serveur *http* (Utilisation de sockets) (IDL)

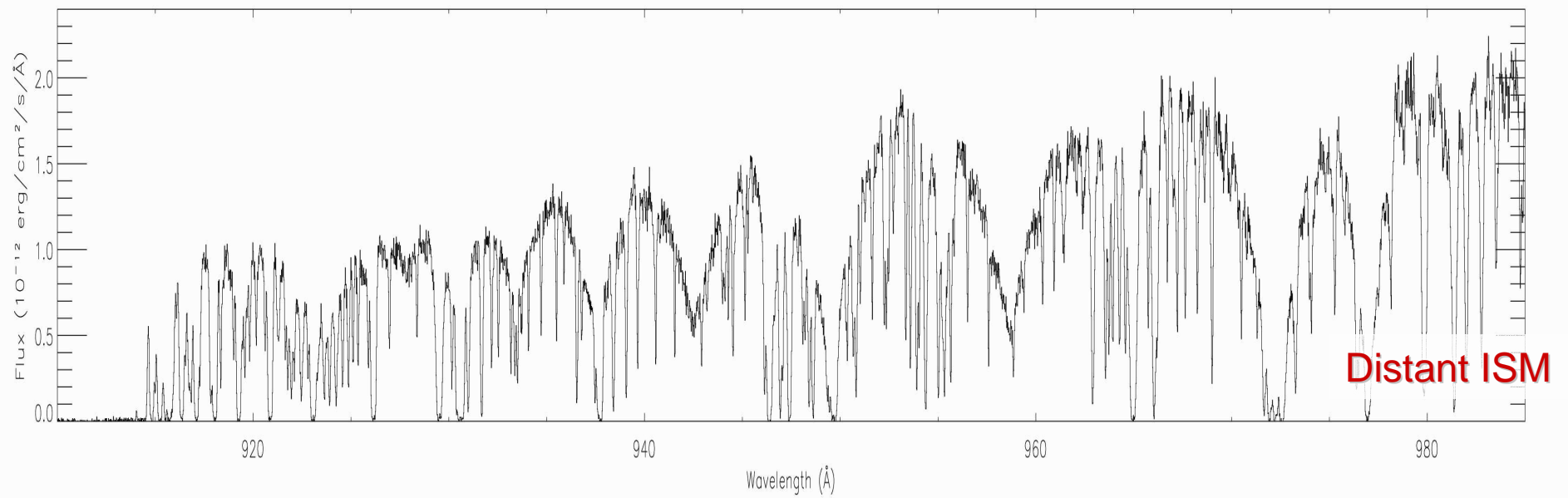
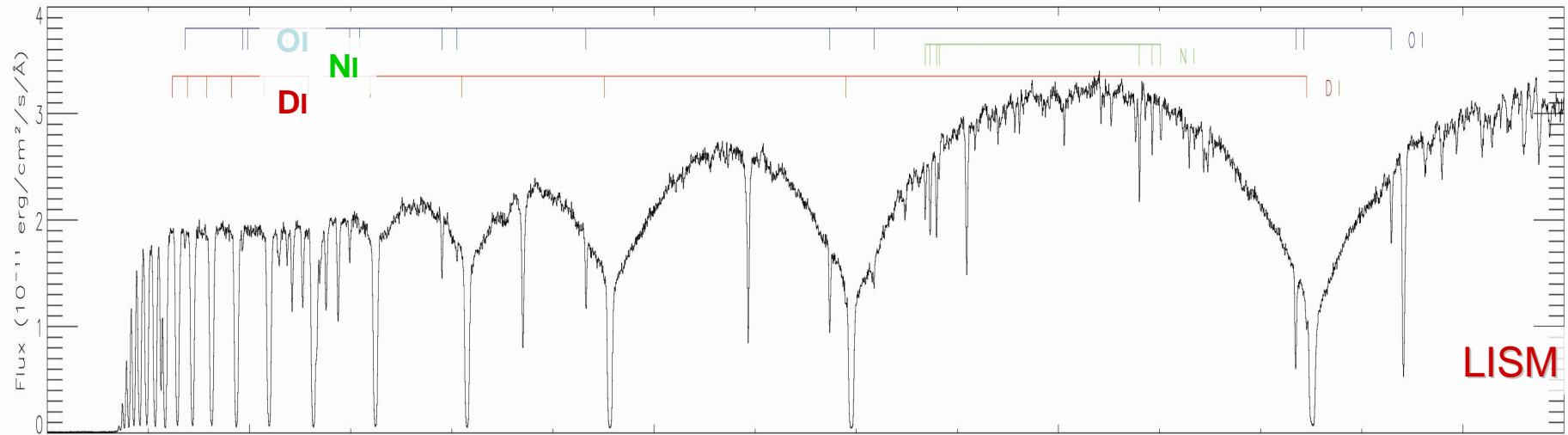
MIME type : *application/fits*



Pipeline CalFUSE



Bandes Lyman *FUSE*



Processing FUV Spectral Data

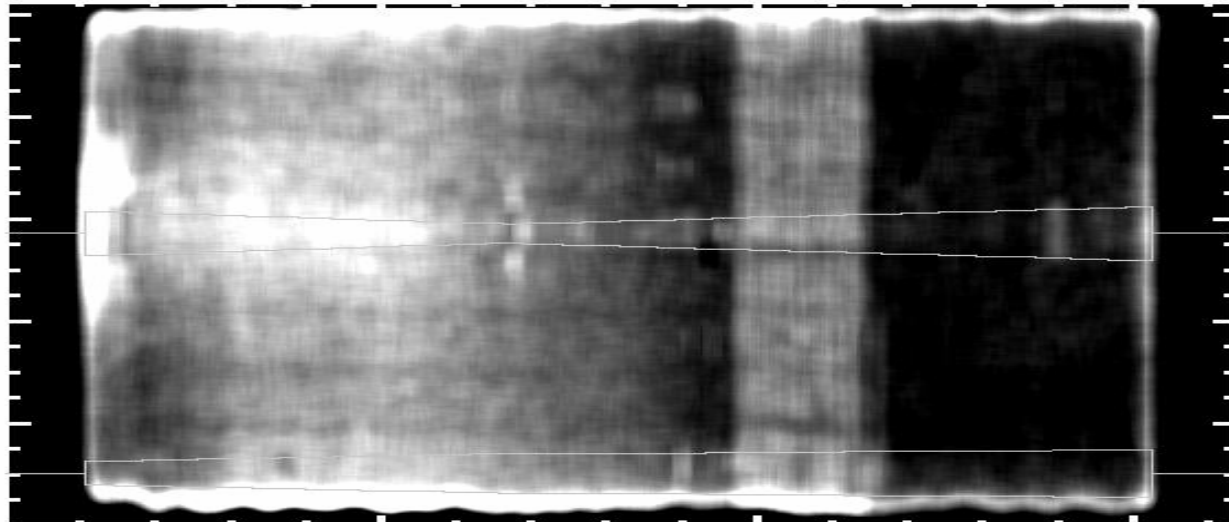
FUSE calibration pipeline:

- **Data screening** (removes low quality or unreliable data);
- **Grating shift correction**
- **Drift correction** (calculates image stretch/shift due to thermal effects);
- **Background subtraction**
- **Flat-field correction**
- **Geometric distortion correction**
- **Astigmatism correction**
- **Doppler correction**
- **Spectral extraction**
- **Wavelength calibration**
- **Walk correction** (corrects for pulse-height dependent errors in the photon location).
- **Dead-time correction**
- **Flux calibration** (counts/second into $\text{erg cm}^{-2} \text{s}^{-1} \text{\AA}^{-1}$)
- **Channel co-addition** (for quick look analysis).
- **Science Data Oversight Group performs quality check**

Quelques difficultés...

➤ **Detector Background**

- *background intrinsèque.*
- *Lumière diffusée (Géocouronne)*



- *Image of the 1A detector obtained from a long (>200 ksec) exposure of empty sky taken early in the mission. The data has been smoothed by 200 pixels in the dispersion (X) direction and 20 pixels in the cross dispersion (Y) direction.*

➤ **Le « Worm »**

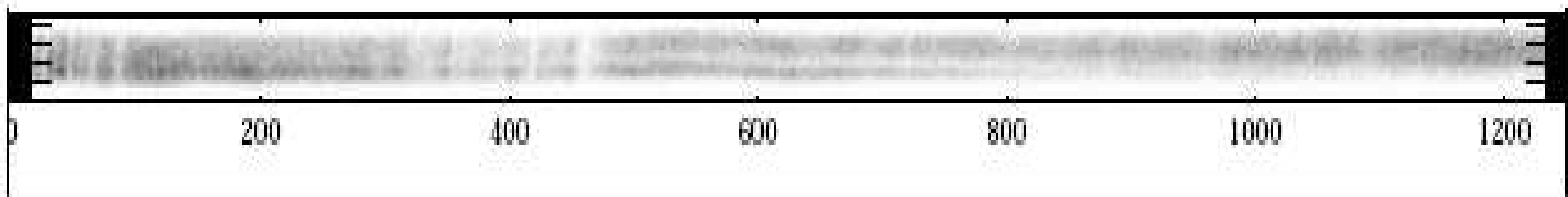
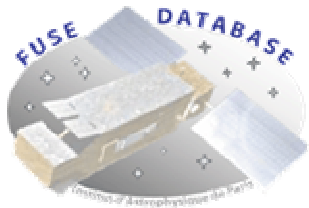


Figure 1 The worm in segment 1B. The region shows includes pixels 7000 - 12000 in x, and 460 - 640 in y.

➤ **Mais aussi, Le « jitter », Sensibilité, etc...**



Fichiers obtenus après traitements:

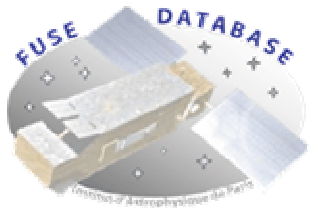
- Photon event files (TTAG only)
- Spectral image files (HIST only)
- **Extracted spectra**
- **Combined extracted spectra**
- Raw FES image files
- Calibrated FES image files
- Engineering snapshot files

Base de données **FUSE** de l'IAP

Archive **MAST**

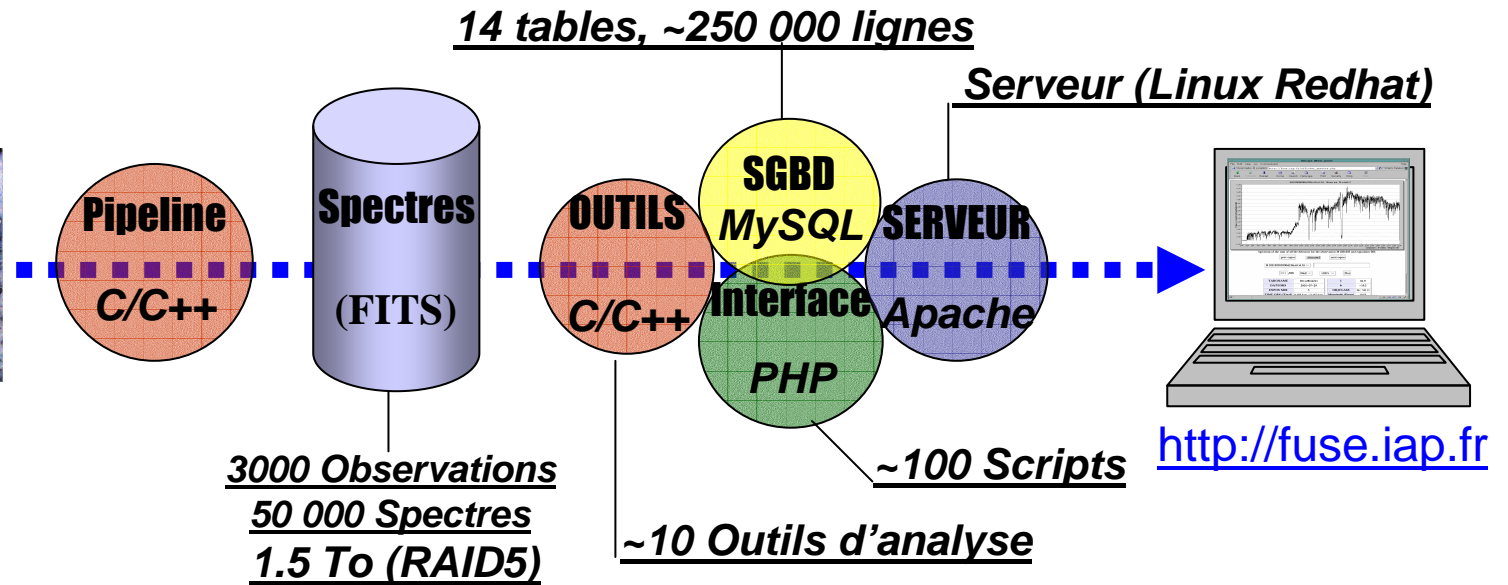
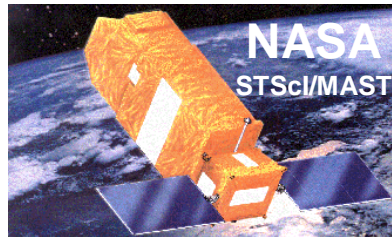
=> Evolution du pipeline en permannance !!!

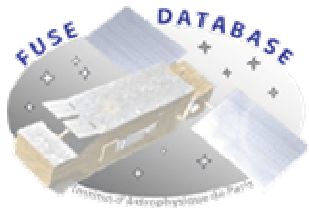
| | TTAG | HIST |
|----|--|-------------------------------|
| | <u>Level Zero Processing in Satellite Control Center</u> | |
| | <u>OPUS gathers packets and converts data to FITS format</u> | |
| 1 | <u>Initialize header</u> | <u>Initialize header</u> |
| 2 | <u>Screen data & compute Doppler</u> | <u>Screen data</u> |
| 3 | <u>Detect and remove bursts</u> | ... |
| 4 | <u>Correct for spacecraft jitter</u> | ... |
| 5 | <u>Apply walk correction</u> | <u>Apply walk correction</u> |
| 6 | <u>Compute grating motion</u> | <u>Compute grating motion</u> |
| 7 | <u>Add grating to other shifts</u> | ... |
| 8 | <u>Convert list to image</u> | ... |
| 9 | <u>Compute image stretch and shift</u> | |
| 10 | <u>Mask bad pixels</u> | |
| 11 | <u>Make background file</u> | <u>Make background file</u> |
| 12 | <u>Subtract background</u> | |
| 13 | <u>Transform flat-field file</u> | |
| 14 | <u>Divide by flat-field</u> | |
| 15 | <u>Compute Y-distortion shifts</u> | |
| 16 | <u>Compute astigmatism shifts</u> | |
| 17 | <u>Compute FPA shifts</u> | |
| 18 | ... | <u>Compute Doppler shift</u> |
| 19 | <u>Apply all shifts</u> | <u>Apply all shifts</u> |
| 20 | <u>Extract 1-D spectra using optimal extraction</u> | |
| 21 | <u>Apply wavelength calibration</u> | |
| 22 | <u>Apply dead-time correction</u> | |
| 23 | <u>Apply flux calibration</u> | |
| 24 | <u>Co-add spectra at exposure level</u> | |
| 25 | <u>Co-add spectra at observation level</u> | |
| | <u>Science Data Oversight Group performs quality check</u> | |
| | <u>Data archived at Multimission Archive at STScI</u> | |



Base de données **FUSE IAP**

Spécifications techniques





Base de données **FUSE IAP**

Deux interfaces d'accès

<http://fuse.iap.fr>

Object name: simbad NED No Program name:

RA: DEC: Radius: Arcmin

Magnitude value: or Range min: max: Spectral Type:

Redshift value: or Range min: max:

E(b-v) value: or Range min: max: Object type:

Operator: or / and

Show all the parameters:

Structure Browse SQL Search Insert Export Operations Empty Drop

Indexes : [Documentation]

| Keyname | Type | Cardinality | Action | Field | Type | Usage | Statements | Value |
|---------|---------|-------------|--------------------------|---------|-------|---------------|------------------------|-----------------------|
| PRIMARY | PRIMARY | 3924 | <input type="checkbox"/> | DATASET | Data | 567,880 Bytes | Format | dynamic |
| | | | | | Index | 58,368 Bytes | Rows | 3,924 |
| | | | | | Total | 626,048 Bytes | Row length \emptyset | 144 |
| | | | | | | | Row size \emptyset | 160 Bytes |
| | | | | | | | Creation | Oct 19, 2004 at 02:50 |
| | | | | | | | Last update | Apr 01, 2005 at 02:14 |
| | | | | | | | Last check | Jan 11, 2005 at 06:10 |

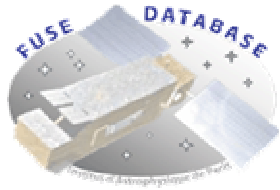
- Print view
- Propose table structure

Run SQL query/queries on database FUSE [Documentation]

Fields: DATASET TARGNAME RA_TARG DEC_TARG

Show this query here again
Or Location of the textfile:

Compression: Autodetect None "gzipped" "bzipped"



Fonctionnalités de la base de données FUSE

- **Accéder à toutes les données publiques**
 - Par cible particulière ou par famille d'objet.
 - Par recherche multiple (cross corrélation).
 - Accès aux spectres et aux métadonnées.
 - Accès par catalogue externe (Vizier).

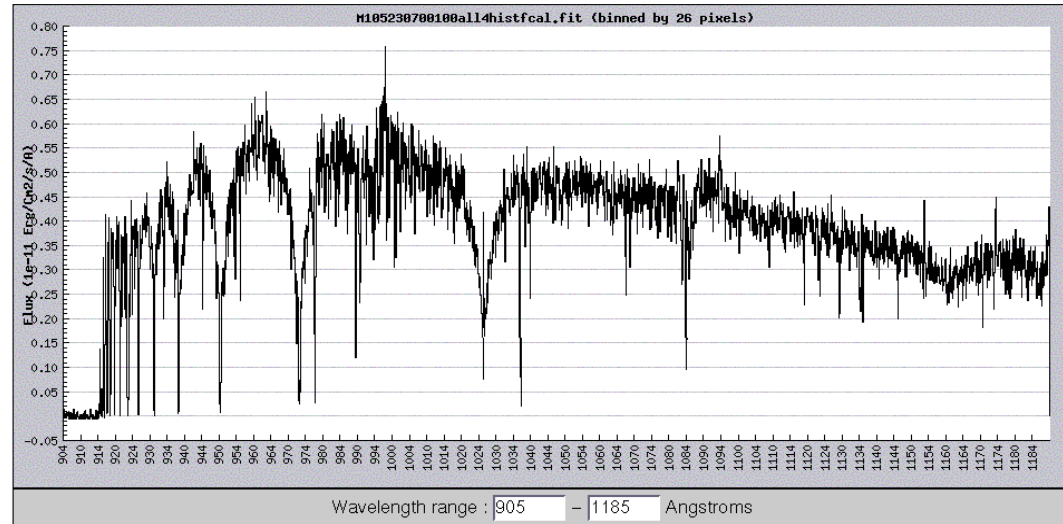
- **Obtenir un spectre pour visualisation « online »**

- **Réaliser des sondages (palette d'outils)**
 - Recherche systématique de raies (DI, OI, etc.)
 - Calculs statistiques

- **Envoyer des requêtes SQL personnalisées**

- **Interopérabilité OV (en cours)**

[<< Back to your selection](#) |
 [<< Home interface](#)



M105230700100all4histfcal.fit: Sum of all the detectors for the observation M1052307 and the exposition 001 with the LWRS aperture.

[prev expos](#) | 001 / 113 | [next expos](#)

[Quick view](#) | [Spectral image](#) | [Spectrum Y Profile](#) | [Count Rate](#) | [FITS header](#)

[Plot lines tools](#) | [Get this FITS file](#) | [Download all this observation](#)
(For ALL spectrum) (Do not use for science) (28 Mo)

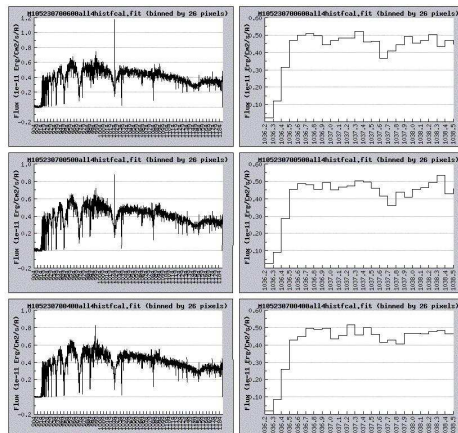
| | |
|----------------|----------------------|
| TARGNAME | WD1202+608 |
| RA | 12 h 4 m 38.64 s |
| DEC | 60 d 32 m 7.08 s |
| EXPOS NBR | 13 |
| TIME OBS/TOTAL | 7.887 / 7.962 (Ksec) |
| EXPNIGHT (Sec) | 0 |
| APERTURE | LWRS |
| EVENTS NBR | 211593 |

| | |
|--------------|--------------|
| MODE | hist |
| I / b | 133.1 / 55.7 |
| OBJCLASS | 37: WDA |
| MAG (Vmag) | 13.61 |
| SP TYPE | DA |
| E(B-V) | 0 |
| Z | 0 |
| CALFUSE VERS | 2.4.1 |

Program M105 (cycle 0): Periodic Flux Sensitivity Monitoring Program
 Observer: Dr. Jean Dupuis (FUSE)

Abstract:

A sample of stars have been selected to monitor the degradation of FUSE's flux sensitivity on a weekly basis. As constraints on RAM angle pointing slowly get relaxed, it is important to prove that FUSE sensitivity is not unduly diminished. Most selected stars are photometrically stable white dwarfs and subdwarfs; most of which were previously observed with FUSE. The vast majority of targets are at high declinations to facilitate the observations.

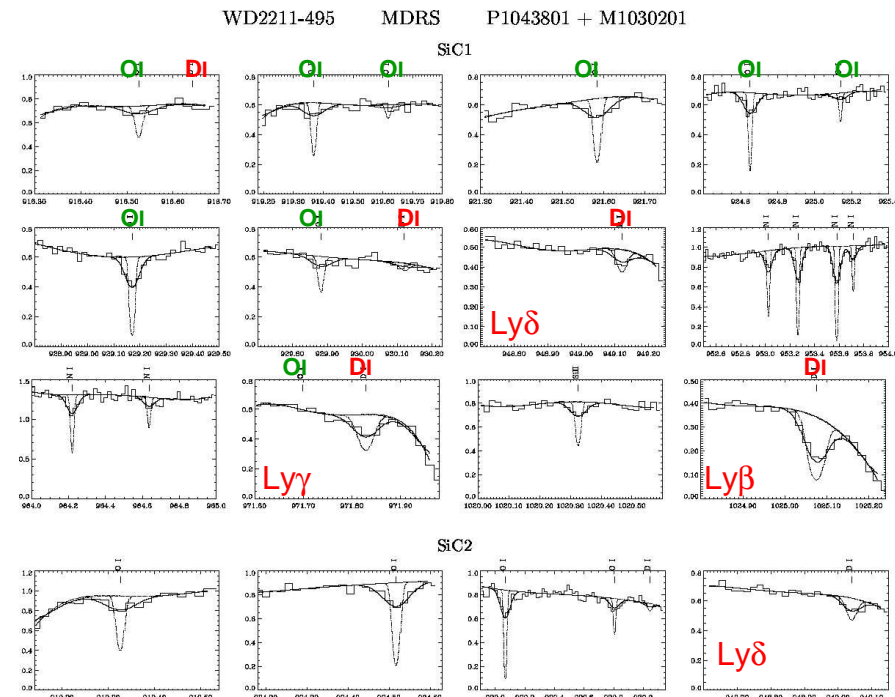
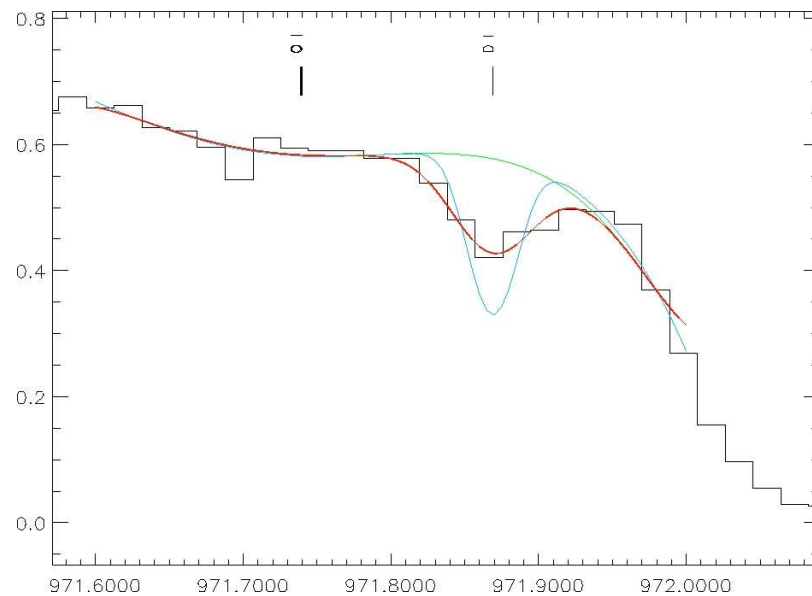


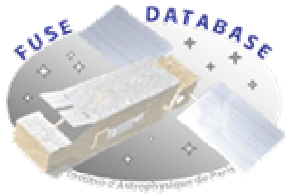
[Ex: L'outil « Plotlines »](#)

[<< Back to your selection](#) |
 [<< Home interface](#)

Ajustements des spectres FUSE

- ❑ « Ajustement de Profil » réalisés avec le programme **Owens** (Martin Lemoine).
- ❑ Nombreuses fenêtres spectrales ajustées simultanément :
 - traite simultanément de nombreuses raies, multicanaux et sur plusieurs fentes,
 - analyse combinée de plusieurs observations / différents instruments (**STIS-HST / FUSE**).
- ❑ Plusieurs paramètres libres :
 - densités de colonne, vitesse radiale, température, turbulence \Rightarrow **mesures**
 - continus stellaires (polynômes), décalages spectrales, LSF, et niveau de zéro.





Base de données FUSE & OV

Une application: le portail « Galaxies - Etoiles » (ObsPM-IAP)

Igor Chilingarian, Pierre Le Sidaner et l'équipe Migale.

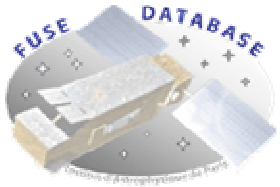
<http://vo.obspm.fr/>

Objectifs scientifiques:

- Accès aux spectres d'étoiles et de galaxies
- Motivations: Hyperleda et FUSE
- Accéder rapidement et simplement aux spectres et aux métadonnées => Catalogues
- Extractions des informations stellaires, ISM, extragalactiques.
- Etudes multi-longueur d'ondes

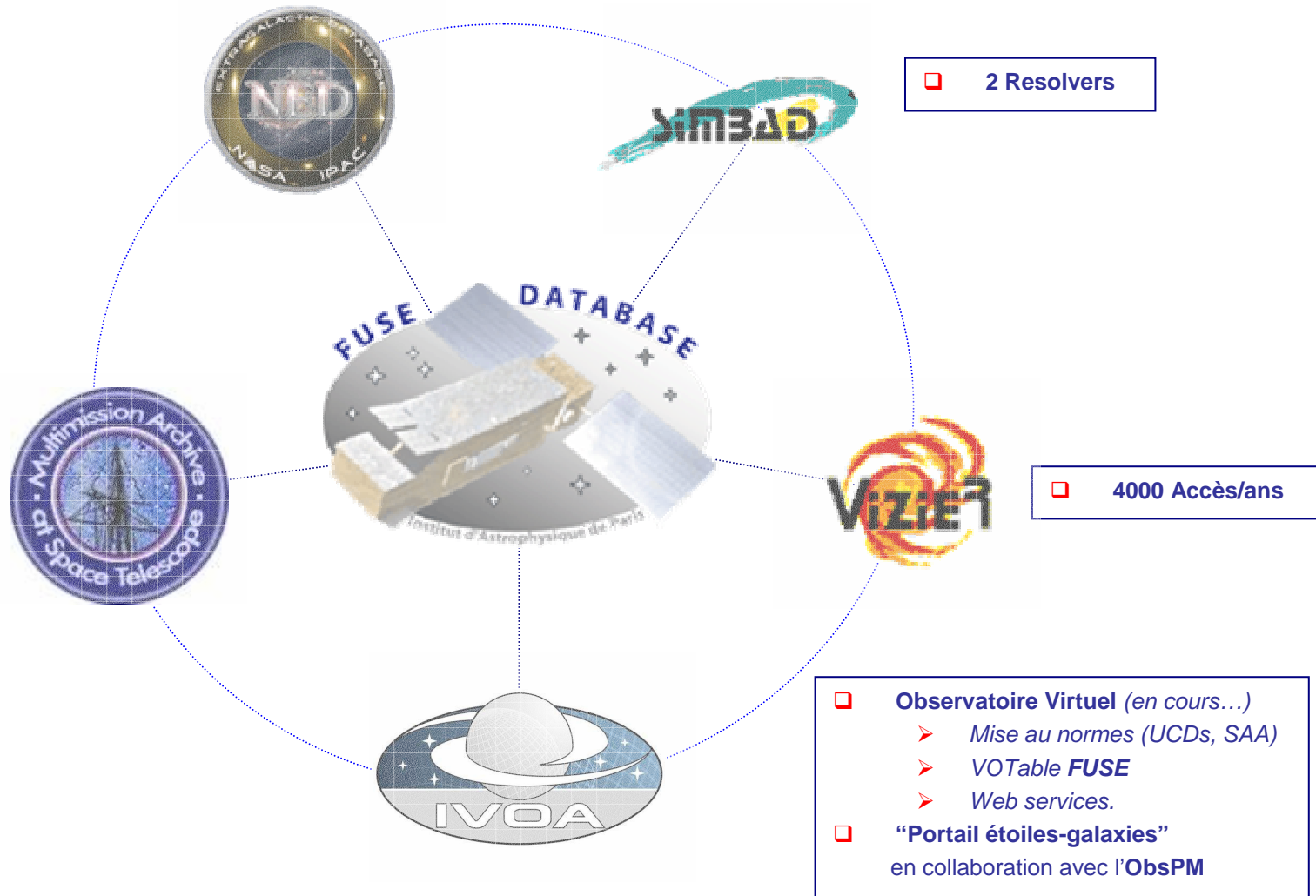
Moyens Techniques:

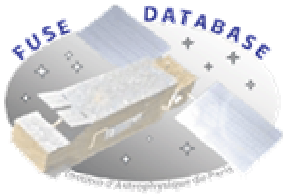
- Collaborations techniques (ObsPM-IAP)
- Etude d'une solution type web-services
- CGI FUSE génère les métadonnées des datasets
- MaJ hebdomadaire de Pleinpot
- SSAP (*Simple Spectra Access Protocol*) prototype mis en place VO-Paris
<http://vo.obspm.fr/ssap/fuse.html>
- Inscriptions dans les « registry » du VO (NVO)



Environnement de la base de données FUSE

- ❑ 4000 Observations publics
- ❑ 50 000 spectres FITS





Base de données FUSE & OV

- Accès SSAP à la base de donnée FUSE (service SSA de VO-Paris)
- Description des observations + URL des spectres dans un fichier VOTable
- => Tables FITS binaires conforme au data-model du VO
ex: Deneb

```
<?xml version="1.0" encoding="UTF-8" ?>
<VOTABLE>
<RESOURCE type="results">
<DESCRIPTION>Spectral Service at ObsPM</DESCRIPTION>
<INFO name="QUERY_STATUS" value="OK" />
<TABLE>
<FIELD ID="ObsId" ucd="OBS_ID" datatype="char" arraysize="*" />
<FIELD ID="Reference" ucd="DATA_LINK" datatype="char" arraysize="*" />
<FIELD ID="Target_Name" ucd="VOX:Image_Title" datatype="char" arraysize="*" />
<FIELD ID="Start_Time" ucd="VOX:OBS_START_TIME" datatype="char" arraysize="*" />
<FIELD ID="End_Time" ucd="VOX:OBS_END_TIME" datatype="char" arraysize="*" />
<FIELD ID="RA" ucd="POS_EQ_RA_MAIN" datatype="char" arraysize="*" />
<FIELD ID="DEC" ucd="POS_EQ_DEC_MAIN" datatype="char" arraysize="*" />
<FIELD ID="AXES" ucd="VOX:Spectrum_axes" datatype="char" arraysize="*" />
<FIELD ID="UNITS" ucd="VOX:Spectrum_units" datatype="char" arraysize="*" />
<FIELD ID="DIMEQ" ucd="VOX:Spectrum_dimeq" datatype="char" arraysize="*" />
<FIELD ID="SCALEQ" ucd="VOX:Spectrum_scaleq" datatype="double" arraysize="*" />
<FIELD ID="FORMAT" ucd="VOX:Spectrum_Format" datatype="char" arraysize="*" />
```

```
<DATA>
<TABLEDATA>
<TR>
<TD>HD197345:C0430102</TD>
<TD>http://fuse.iap.fr/FUSEDATA/C043/C0430102/C043010200000all4histfcal.fit</TD>
<TD>HD197345 FUSE (IAP)</TD>
<TD>2002-08-31 18:33:45</TD>
<TD>2002-08-31 18:33:45</TD>
<TD>310.358</TD>
<TD>45.2803</TD>
<TD>WAVE FLUX</TD>
<TD>A erg/cm^2/s/A</TD>
<TD>L ML-1T-3</TD>
<TD>1.E-10 1.E+7</TD>
<TD>spectrum/fits</TD>
</TR>
</TABLEDATA>
</DATA>
</TABLE>
</RESOURCE>
</VOTABLE>
```



Base de données FUSE & OV Stellaire

- Utilisation d'un client SSA: VOspec (ESA)

Server Selector

- Infrared Space Observatory Simple Spectrum Data Access
 - <http://pma.iso.vilspa.esa.es:8080/aio/jsp/siap.jsp?imageType=spectrum>
- Hubble Space Telescope Faint Object Spectrograph
- Sloan Digital Sky Survey Simple Spectrum Data Access
- HyperLeda FITS Archive Simple Spectrum Data Access
 - <http://vo.obspm.fr/cgi-bin/siap/ssapHFA.pl?>
- Far Ultraviolet Spectroscopic Explorer Simple Spectrum Data Access
 - <http://vo.obspm.fr/cgi-bin/siap/ssapFUSE.pl?>
- INES: The IUE Newly Extracted Spectra

Open Local Data

VOSpec Spectra Extraction Tool

Target: Ra: Dec: Size:

Wave Unit: Log Scale:

Flux Unit:

RedShift:

Graphic Mode

- Points
- Points
- Points

VOSpec Spectra Viewer

| Server | Title | Ra | Dec | Format | Select | Status |
|------------------|--------------|---------------|---------------|---------------|-------------------------------------|----------|
| HyperLeda ... | HD197345 ... | 310.358337... | 45.2802772... | spectrum/fits | <input type="checkbox"/> | ready |
| HyperLeda ... | HD197345 ... | 310.358337... | 45.2802772... | spectrum/fits | <input checked="" type="checkbox"/> | complete |
| HyperLeda ... | HD197345 ... | 310.358337... | 45.2802772... | spectrum/fits | <input type="checkbox"/> | ready |
| Far Ultraviol... | HD197345 ... | 310.358 | 45.2803 | spectrum/fits | <input type="checkbox"/> | ready |
| Far Ultraviol... | HD197345 ... | 310.358 | 45.2803 | spectrum/fits | <input checked="" type="checkbox"/> | complete |

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Wrapper Creator - HowTo - About

SSA client 2: Specview

VO download Registry Help

Object
Name: Resolve Resolver: SIMBAD Names via CADC

Search region
R.A. (hour): Radius (arcmin):
Dec. (degree):

Search results
Downloaded ImageTitle Camera

| Downloaded | ImageTitle | Camera |
|------------|----------------|--------|
| YES | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
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| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |
| NO | IUE/INES Sp... | LWP |

Download Stop

Spectrograms in memory File Help
Spectrogram

- 1 http://fuse.iap.fr/FUSEDATA/P104/P1043801/P104380
- 2 http://sdc.laeff.esa.es:80/cgi-ines/SingleDownload?filer
- 3 Coplot WD2211-491

http://fuse.iap.fr/FUSEDATA/P104/P1043801/P104380100000all2histfcal.fit;http://sdc.laeff.esa.es:80/cgi-in... File Display Coplot Preferences Help

X axis: WAVELENGTH Y axis: FLUX

Grid off Auto

Flux density (erg/s/cm**2/Angstrom)
WD2211-491
 Wavelength (ANGSTROMS)

S Q F M L U

Skype perl Welcome and your

démarrer Courrier ent... 4 Microsof... 2 Java(TM)... copie d'écrâ... Gadwin Prin... PrintScreen ... EN 15:53