

# INES NEWSLETTER

March 2000

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## FOREWORD

With the release of the INES (IUE Newly Extracted Spectra) system for distribution of the data archive of the International Ultraviolet Explorer (IUE) project to the community, the involvement of the European Space Agency (ESA) during a quarter of a century in the support for the IUE Project comes to an end. We are very grateful for the positive attitudes of the Principal Centre at the LAEFF (INTA), its associated Mirror Site at the CADC in Victoria, as well as the National Host Institutes in so many countries, for their willingness to share in this exploration of Astronomical tools for the future.

The current INES Newsletter really represents a User Guide for the IUE Archival data and the INES system. Both the INES system and this User Guide have been made with the idea that the data can remain available for all future astronomers. Although we have striven to make it unnecessary to return to the original data, we are not perfect and I am sure that at some stage someone in the future will find something that could have been done better. However, with such a large amount of directly interpretable information, the law of diminishing returns has to take over.

The INES system (archive contents and distribution system) has not been designed to be a standing pillar in the passage of time to be worn out by the effects of erosion and weathering. It has been developed to bring new tools to a major problem for the Astronomy of the future: digestion of the possible information flow from future, even more efficient facilities. We hope that this will stimulate the search for a different solution than the obvious one: if you have too much information, cut the flow. These type of problems present a challenge in Astronomy for the future.

We hope that ESA has completed its contribution to Space Astrophysics in a way that does credit to all the colleagues in NASA and PPARC, who I would like to thank for their contributions, all of which lead to the INES System, which represents the result of 25 years of work of highly motivated people in all areas associated with a major Space Science project. I would specially highlight here the contribution of all staff at VILSPA, without whose support during the last few years, the completion of the INES system would not have been possible.

I hope that the result of all these efforts, the INES System, will be found by the astronomical community to be useful, and will therefore become a dynamic part of all astronomical archival systems. I want to thank LAEFF/INTA for their willingness to take up the important tasks associated with the Principal Centre and hope that the National Hosts will continue their support with the same spirit of collaboration which we have had over the previous years.

Willem Wamsteker  
IUE Project Manager

# THE IUE Newly Extracted Spectra SYSTEM

Archives are fundamental components in any space project because they contain information with very high value, based on observations that cannot be repeated. If archives are properly planned and implemented, they represent a minimal fraction of the cost of the mission.

In Space Astronomy, archives are unique tools that allow the study of variable phenomena, and provide reference information to calibrate instruments of new missions. In addition, new technologies in data storage and networking, together with algorithms developed in the last years, are opening new research areas. The correlation of the information in different archives and new statistical methods make it possible to analyse large, homogeneous, data sets. Therefore, archives are essential sources of information that must be preserved for future generations of scientists.

In the context of the IUE project, these ideas were identified at an early stage, and a special effort was dedicated to the definition of the mission archive and to the distribution of the spectra to the scientific community worldwide. More than ten years ago, the ULDA project pioneered scientific archive access and data distribution via networks.

During the 18.7 years of operation, IUE has produced a large collection of spectroscopic data, containing about 110000 spectra of nearly 11600 different objects. The goal of the INES (IUE Newly Extracted Spectra) data distribution system, a new generation archive, is to deliver these IUE spectra to the community in a very simple and efficient form.

The design principles -open source, open data and minimalist design-, have proven to be a good choice to implement an ambitious system with limited resources. The facts demonstrate that these concepts have been well accepted by the community. INES has been operational for more than two years at VILSPA, during this period the system has been used continuously: on average, one spectrum is retrieved every 15 minutes. Despite this high level of usage, the amount of reported problems, an interesting parameter to estimate the quality of a service, is really small.

In the fall of 1999, a total of 30 scientific institutions have received the distribution package and, at the time of writing, there are 14 of them as fully operational National Hosts. This implementation, as a collaborative scheme based on a network of national hosts distributed world-wide, insures that IUE data will be always accessible to the scientific community, as a permanent facility. In addition, the archive concept could act as a seed for future projects at national levels, promoting international collaboration. Finally, it is worth to indicate that the users community is growing; new scientists are accessing the archive. At this stage, the main goal of the project has been fulfilled: to ensure that IUE spectra will be studied by a new generation of scientists.

The Science Programme Committee of ESA approved in May 1998 the transfer of the Archive of IUE to the Laboratorio de Astrofísica Espacial y Física Fundamental (LAEFF) of INTA. As a consequence, a Transfer Programme was started at LAEFF under contract to ESA with the goal of passing the responsibilities for the maintenance of the Archive and the associated distribution system, the INES System, from the ESA IUE Project to the LAEFF.

Further information about the INES Project can be found at the Principal Centre Home Page:

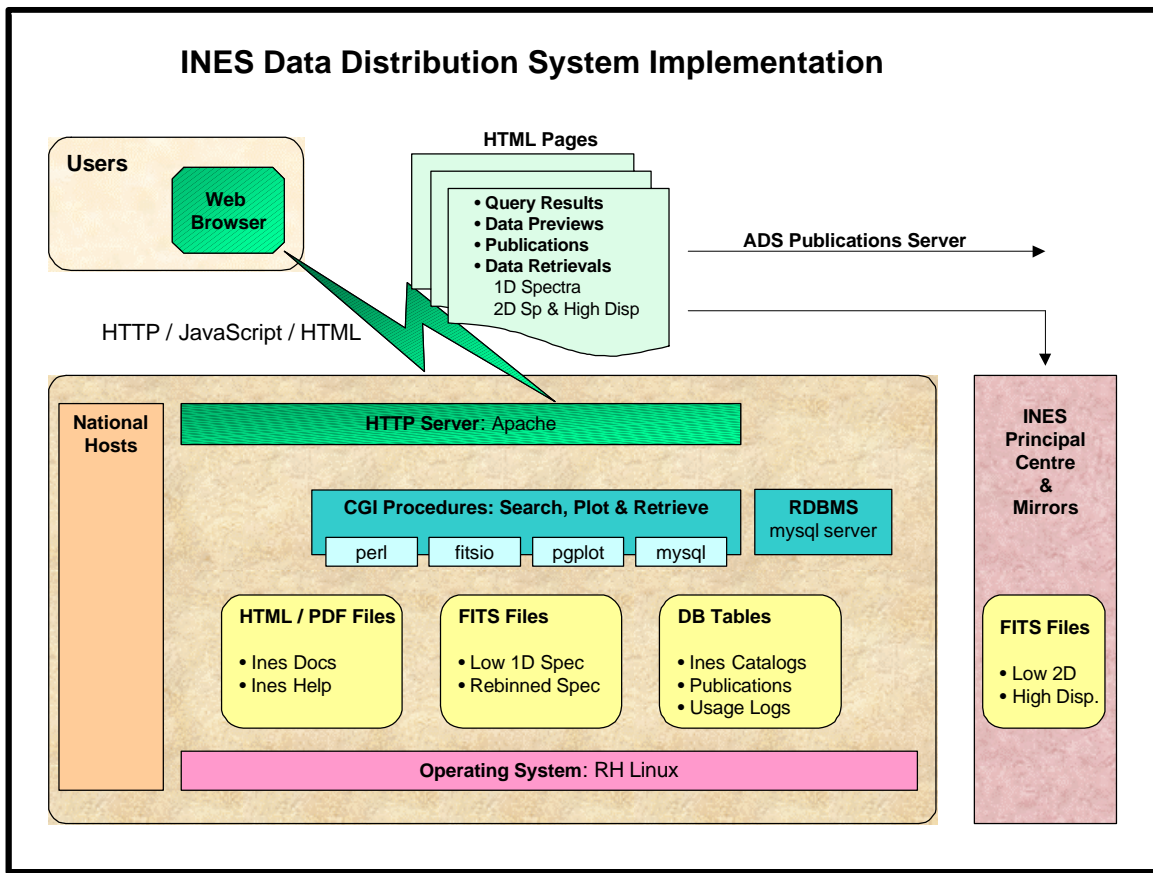
<http://ines.vilspa.esa.es>

For question or comments, please contact the INES HelpDesk at:

[ineshelp@iuearc.vilspa.esa.es](mailto:ineshelp@iuearc.vilspa.esa.es)

or at the URL:

[http://iuearc.vilspa.esa.es/ines\\_jb/HelpDesk](http://iuearc.vilspa.esa.es/ines_jb/HelpDesk)



## THE INES DATA DISTRIBUTION SYSTEM

### ON-LINE INFORMATION ITEMS

The on-line information items have been defined according with the principles indicated in the previous section, so that the format is simple, easy to use with standard software packages, and the size of the distributed set has been reduced to the essential information required by scientists. Instrument details, like spectral order numbers, have been eliminated from the archive set.

Low-dispersion spectra have been re-extracted from the master archive to improve on NEWSIPS algorithms for certain cases, like emission line objects or spectra with low exposure levels. To this aim, the extraction algorithm uses a correct noise model extrapolation, and a new background estimator has been implemented. Other improvements include estimation and removal of solar contamination in long-wavelength spectra and uniform sampling domain for LWP and LWR cameras.

Finally, high-dispersion spectra have been concatenated and, in addition, they have been resampled at the low-dispersion wavelength step.

The complete on-line archive set consists of the following information items:

- **Access Catalogue:** with the parameters required to query the archive and to evaluate the quality of the spectra. Entries in this catalogue are defined by camera, image number, dispersion and aperture. The number of entries is estimated in 110000.
- **Publications Catalogue:** contains references to publications. Entries in this catalogue are defined by camera and image number. Current number of entries is about 45800.

- **Low-dispersion 1-D spectra:** contains the flux, associated error estimator and quality flags for low-dispersion spectra and high-dispersion spectra converted to the low-dispersion sampling domain.
- **High-dispersion 1-D spectra:** contains flux, associated error estimator and quality flags for high-dispersion spectra with orders concatenated.
- **Low-dispersion 2-D spectra:** contains the spatially-resolved images for low-dispersion spectra.

This provides a hierarchical structure, distributed world-wide. Requests for retrieval low-dispersion 1-D spectra are directly resolved at the National Host level, while requests for high-resolution spectra and low-dispersion 2-D images are passed to the Principal Centre server or Mirror site, from where the data are returned directly to the client. All data products are delivered as FITS files that can be imported into standard image processing packages such as IDL, IRAF and MIDAS.

## ARCHITECTURE OVERVIEW

The INES archive distribution system has been defined as a “minimalist” design along the following principles:

- To provide fully calibrated spectra in a form that does not require detailed knowledge of the instrument.
- To reduce the volume of information in the archive, excluding all intermediate files and technical information without direct significance to the scientist.
- To apply state of the art technology in terms of data distribution techniques, but minimise the development effort by using tools already available as much as possible.
- To follow the open source methodology as much as possible, in terms of both operating system and applications.
- The open source principle is complemented with the open data approach followed in the design of the archive, so that scientific information is directly accessible to users, without restrictions.

Following these design principles, and based on the previous experiences with ULDA (the Uniform Low Dispersion Archive), the distribution system is structured in three levels corresponding to a Principal Centre, several National hosts and unlimited End User Nodes, as shown in the Figure.

The **Principal Centre** is the core of the distribution system. It contains the on-line master archive and provides information not available at the National Hosts. In addition, the Principal Centre coordinates and monitors archival activities and it is responsible for new software versions and updates of the relevant catalogues. A Mirror Site allows for redundancy in some of the functions and contributes to an optimal data access worldwide.

**National Hosts** are located in different countries to provide easy access to the archive, possibly implementing different versions of the software to access the archive with tools tuned with a national flavour. National Hosts contain the Access and Publications catalogues and the 1-D low-dispersion spectral set. Requests to retrieve spectra are resolved locally or forwarded to the Principal Centre (or Mirror site). Archive data, catalogues and the basic package to implement the access methods are provided to National Hosts in a set of CD-ROMs that also includes selected project documentation.

**End User Nodes** access National Hosts -and Principal Centre or Mirror site- via the World Wide Web. No special software is required to access the archive other than standard Web browsers.

An essential point in the archive architecture is that each single observation has a concrete URL, which is uniquely defined. This open architecture allows to easily inter-operate with other data archives so that, for instance, related bibliographical references can be retrieved from NASA Abstract Data System.

## FUNCTIONALITY

Following the design principles indicated above, the resulting system has minimised the software development process, while implementing powerful capabilities. Special attention was given to the graphical users interface, tuned for the occasional users of the archive, so as to display useful scientific information in a simple form, with special care to avoid disorientation during the navigation steps. The INES data distribution system in the current version, v2.0, provides the following functionalities:

- Search INES archive access catalogue,
- Integration with publications catalogue,
- Display FITS headers,
- Visualisation of spectra,
- Retrieval of individual spectra,
- Retrieval of multiple spectra, with choice of compression schemes,
- Retrieval of multiple high resolution spectra by wavelength interval,
- On-line access to project documentation,
- A centralised Help Desk facility, and
- A data retrieval log mechanism.

All these functions are described in full detail in the INES Users Guide section of this Newsletter. Below, we include a summary of their main features.

### Archive Searches

An access catalogue query is made by means of an HTML fill-in form, and permits query by object name, coordinates, object type, observing date, instrumental parameters and image list.

Four predefined output fields are available, emphasising respectively General, Observation, Variability and Pointing information and each may be output in HTML, ASCII or as tab- or comma-separated values. The output fields may be ordered by date and time of the observation, coordinates, camera and image number, IUE object class and object name.

In the HTML output format, links are provided which display the FITS header of each low resolution or rebinned spectrum, plot each spectrum, refer to publications which have used this spectrum and download individual spectra. Groups of spectra can be retrieved, with group selection defined according to file type, e.g. low dispersion, or fine-tuned by marking individual spectra.

### Data Previews

A browse plot of a spectrum can be generated by clicking on the corresponding link. A panel summarising the spectrum is displayed next to the plot, and the full FITS headers can be listed from there. For a high-resolution observation zoom plots of selected regions of the concatenated high resolution spectrum may be generated transparently on the Principal Centre/Mirror server by entering the desired central wavelength.

### Data Retrieval

Spectra may be retrieved individually or in groups, and multiple retrieval of concatenated, high resolution spectra can be restricted to a specific wavelength interval. Spectra are delivered as FITS files. Single spectra are retrieved uncompressed, from the appropriate repository: Principal Centre or Mirror Sites, and National Hosts.

For multiple retrieval, it is possible to include/exclude files by type, and to fine-tune the selection further by checking/unchecking individual spectra. It is also possible for multiple download of high-resolution spectra, to select a specific wavelength interval. Multiple spectrum retrieval generates a packed file in either tar or ZIP format. Compression of packed files is recommended for network efficiency, in particular when downloading large data sets.

## IMPLEMENTATION

As it has been described before, the INES system utilises a distributed architecture, which comprises the Principal Centre, located at LAEFF in Villafranca, Spain, optional Mirror Sites, and a series of National Hosts around the world. End users only need a moderately modern Web browser, with JavaScript 1.2 support, to access the INES system. Their catalogue queries and data requests are resolved either by the National Host servers or passed transparently to the Principal Centre server or its mirrors.

The current INES Software distribution, v2.0, has been developed for National Hosts running Linux on Intel x86 machines. The suggested baseline hardware configuration for the National Host nodes is quite modest:

- CPU: Intel Pentium or similar,
- RAM: 32 Mbytes,
- Disk: 4 to 5 Gbytes,
- permanent Internet connection,
- and a CD-ROM reader.

The INES National Host specific functions are implemented as CGI procedures written in Perl or C language. These procedures interface with the underlying data structures, FITS files and/or DB tables, using public domain software libraries. In addition to these software modules, developed at Villafranca, the mayor software components used in the INES National Hosts are:

- Linux operating system: The installation procedures were tested on RedHat Linux 5.2, 6.0 and 6.1 distributions (<http://www.redhat.com>)
- Apache, the most widely used HTTP server on the Internet (<http://www.apache.org>)
- PERL, the Programmable Extraction and Reporting Language (version 5.004\_04) together with the Data Base Interface (DBI) and Data Base Driver (DBD for MySQL) modules. Also the Common Gateway Interface (CGI) module is needed (<http://www.perl.org>)
- MySQL a free, fast and capable relational database management system (version 3.21.30) (<http://www.mysql.com>)
- CFITSIO a machine-independent library of routines for reading and writing data in FITS format (<http://heasarc.gsfc.nasa.gov/fitsio>).
- PGPLOT version 5.2.0, a graphic subroutine library needed for the INES on-line plotting package (<ftp://astro.caltech.edu/pub/pgplot>)

In a typical session, the user contacts his nearest/favourite INES National Host with a standard Web browser using the HTTP protocol. There, the user can browse the INES documentation in HTML and PDF format as well as specific information provided by the National Host. The catalogue search is done by filling in an HTML form. Upon the submission of this form to the National Host, the http daemon triggers the execution of the appropriate CGI procedure. This program queries to the MySQL server daemon, and returns the results as HTML pages.

Following the links in these pages, the user can plot the spectra, find the publications related to any observation, and retrieve selected data. These HTML pages include some JavaScript functions which simplify the selection of items for data download, and redirect the data requests to the appropriate server, Principal Host/Mirrors or National Host, depending on the data type selected. All data retrievals are logged, and this information is stored into MySQL DB tables. Usage statistics can be generated in a simple way using SQL utilities included in the software distribution kit.

The software at the Principal Centre and Mirror Site includes similar modules with the same functions. The actual implementation at VILSPA re-uses existing hardware environment based on Digital AlphaServer, with Oracle acting as master repository for the database. Other Mirror sites can select a different implementation since the software is easily ported within the Unix operating systems. National Hosts can be directly connected to the Internet or protected behind a firewall. In the first case, it is recommended to restrict the allowed network services to the minimum required by this scientific facility: http and mail servers. Special instructions are provided in the security guide available in the distribution kit.

## **THE INES DISTRIBUTION PACKAGE**

The INES v2.0 distribution packages sent to the INES National Hosts consist of two CD-ROMs written in ISO-9660 format, with Rock Ridge extensions, and an introductory booklet. The first CD-ROM includes access and publications catalogues, the documentation set and the data-access software. The second one contains the low 1-D spectra, including both low-dispersion and rebinned high-dispersion. Spectra are stored as compressed tar files, grouped by camera and image numbers.

The first CD-ROM also holds detailed installation instructions for Intel machines running RedHat Linux 5.2 or 6.X. Although these are the only Linux distributions currently supported, and for that, strongly recommended, some National Hosts have reported successful installations in other Linux distributions as Slackware, Mandrake and SuSE.

The distribution package includes some additional tools to help in the administration of the National Hosts in a distributed and collaborative form. The tools, implemented as a set of Perl scripts, allow to generate access statistics for the National Host, with different views and selection of the time period, and to monitor the status of the network by using “ping” and “traceroute” in an interactive form.

Finally, the Principal Centre includes a Help Desk facility, based on “jitterbug”, to channel questions and to provide continuous support to users of the archive.



**INES publications' database - Netscape**

| camera | image | year | journal | vol  | page | bibcode                               |
|--------|-------|------|---------|------|------|---------------------------------------|
| SWP    | 30522 | 1987 | A&A     | 177  | L021 | <a href="#">1987A&amp;A...177L_21</a> |
| SWP    | 30522 | 1987 | A&A     | 177  | L025 | <a href="#">1987A&amp;A...177L_25</a> |
| SWP    | 30522 | 1987 | A&A     | 177  | L029 | <a href="#">1987A&amp;A...177L_29</a> |
| SWP    | 30522 | 1987 | A&A     | 177  | L033 | <a href="#">1987A&amp;A...177L_33</a> |
| SWP    | 30522 | 1987 | A&A     | 177  | L037 | <a href="#">1987A&amp;A...177L_37</a> |
| SWP    | 30522 | 1989 | APJ     | 336  | 0429 | <a href="#">1989APJ...336_429</a>     |
| SWP    | 30522 | 1993 | A&A     | 276  | 103  | <a href="#">1993A&amp;A...276_103</a> |
| SWP    | 30522 | 1996 | APJ     | 464  | 924  | <a href="#">1996APJ...464_924</a>     |
| SWP    | 30522 | 1997 | APJ     | 477  | 848  | <a href="#">1997APJ...477_848</a>     |
| SWP    | 30522 | 1995 | ESASP   | 1189 | .    | <a href="#">1995ESASP1189</a>         |

Home | HelpDesk | Overview | LAEFF

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Retrieve Marked Data    Mark:  High    Mark:  SILO    Retrieval format: tar.gz    HiRes wavelength ranges(Å)    SWP: 1150 - 1980    Principal Centre

Reset Wavelengths    LWP/R: 1850 - 3350

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Retrieve Marked Data    Mark:  Rebin    Mark:  Low    Retrieval format: tar.gz    Found 184 records, displaying page 2 of 4    National Host

| Camera | Image | Disp | Aper  | Object   | RA(1950)   | Dec(1950) | ObsDate    | Obs Time | Exp Time  | Class | ECC | Pubs               | Plot | Header | Fetch | Mark                                | Fetch | Mark                                |
|--------|-------|------|-------|----------|------------|-----------|------------|----------|-----------|-------|-----|--------------------|------|--------|-------|-------------------------------------|-------|-------------------------------------|
| SWP    | 30472 | Low  | Large | SN 1987A | 05:35:50.2 | -69:17:59 | 1987-03-09 | 05:16:35 | 10799.793 | 56    | 402 | <a href="#">8</a>  | Low  | Low    | Low   | <input checked="" type="checkbox"/> | SILO  | <input checked="" type="checkbox"/> |
| SWP    | 30512 | Low  | Large | SN 1987A | 05:35:50.2 | -69:17:59 | 1987-03-13 | 12:03:28 | 14399.638 | 56    | 406 | <a href="#">6</a>  | Low  | Low    | Low   | <input checked="" type="checkbox"/> | SILO  | <input checked="" type="checkbox"/> |
| SWP    | 30522 | Low  | Large | SN 1987A | 05:35:50.2 | -69:17:59 | 1987-03-14 | 04:17:09 | 10859.595 | 56    | 401 | <a href="#">10</a> | Low  | Low    | Low   | <input checked="" type="checkbox"/> | SILO  | <input checked="" type="checkbox"/> |
| SWP    | 30547 | Low  | Large | SN 1987A | 05:35:50.2 | -69:17:59 | 1987-03-16 | 12:38:58 | 14399.768 | 56    | 407 | <a href="#">6</a>  | Low  | Low    | Low   | <input checked="" type="checkbox"/> | SILO  | <input checked="" type="checkbox"/> |
| SWP    | 30551 | Low  | Large | SN 1987A | 05:35:50.2 | -69:17:59 | 1987-03-17 | 05:21:06 | 5219.813  | 56    | 301 | <a href="#">6</a>  | Low  | Low    | Low   | <input checked="" type="checkbox"/> | SILO  | <input checked="" type="checkbox"/> |

## INES USERS GUIDE

### ARCHIVE QUERIES

The access catalogue query is made by means of a fill-in form, and permits query by object name, coordinates, object type, observing date, instrumental parameters and image list. Four output options can be selected, and each may be output in HTML, ASCII or as tab- or comma-separated values. The output fields may be ordered by date and time of the observation, coordinates, camera and image number, IUE object class and object name.

The following keywords can be given as input parameters for catalogue queries. At least one keyword must be chosen, and selecting more will further constrain the query.

#### Object ID

The Object ID can refer to either the Homogeneous Object Identifier (HOI) or to the target name as specified by the Guest Observer. Searches are case independent, and are made via an OR condition. Wildcards are permitted, using the '%' or '\*' characters, e.g. NGC%40% or \*jupiter\*. The hierarchy adopted for HOI is shown in Table 1.

#### Position

A search by object position may be made by specifying coordinates and an equinox, and optionally, a search radius around this position:

**Table 1.** Adopted hierarchy for Homogeneous Identifiers

| HOI  | Description            | Example          |
|------|------------------------|------------------|
| IUE  | IUE specific           | IUE NULL         |
| HD   | Henry Draper Catalogue | HD 219749        |
| BD   | Bonner Durchmusterung  | BD +28 5211      |
| CD   | Cordoba Durchmusterung | CD -26 1340      |
| CPD  | Cape Durchmusterung    | CPD -69 2698     |
| V*   | Variable Stars         | V* BF CYG        |
| WD   | White Dwarfs           | WD 2034-53       |
| GD   | Giclas WD              | GD 323           |
| NGC  | New General Catalogue  | NGC 4151         |
| IC   | Index Catalogue        | IC 2003          |
| PK   | Perek-Kohoutek         | PK 059+09 1      |
| MC   | Magellanic Clouds      | MC SK 80         |
| MRK  | Markarian Galaxies     | MRK 509          |
| ESOB | ESO (B) Atlas          | ESOB113-IG45     |
| MCG  | Catalogue of Galaxies  | MCG +08-11-0011  |
| PG   | Palomar Green          | PG 0108+101      |
| QSO  | Hewitt Burbidge        | QSO 0414-060     |
| ABCG | Abell clusters         | ABCG36           |
| ZZ   | Solar System           | ZZ COM 1982J     |
| NOVA | Novae                  | NOVA MUS 1983    |
| SN   | Supernovae             | SN 1983N         |
| AOO  | Any Other Object       | AOO PKS 1543+091 |

**Right Ascension:** The object Right Ascension in the format hh:mm:ss.s.

**Declination:** The object Declination in the format (+)/-dd:mm:ss.

**Radius:** The search radius around the specified RA and Dec, in the format dd:mm:ss. The search radius upper-limit is 10 degrees. If the radius is either unspecified or is less than 1 arc minute, a tolerance of 1 arc minute is assumed for the input position.

**Equinox:** The equinox of the input coordinates can be either B1950 or J2000, and the equinox of the output coordinates is always B1950.

A search by position which includes RA,Dec=0,0 (B1950) will return more than 2300 calibration images which were assigned these coordinates.

### *IUE Object Class*

The IUE Object Classification is a two-digit code describing the type of target, as defined in Table 2.

### *Observing dates*

A date range can be specified in ascending or descending order. If only one date is specified, the query is made for that date only. The mission lasted from 23 Jan 1978 to 30 Sep 1996.

### *IUE Camera names*

The IUE camera names and wavelength ranges are:

**LWP** : Long Wavelength Prime (1850-3350Å).

**LWR** : Long Wavelength Redundant (1850-3350Å).

**SWP** : Short Wavelength Prime (1150-1980Å).

By default, all cameras are selected, and if none is selected, all are assumed.

**Table 2.** IUE Object Classification Codes

|                            |                               |                                      |
|----------------------------|-------------------------------|--------------------------------------|
| 00 Sun                     | 33 A4-A9 III-I                | 66 Interacting Binaries              |
| 01 Earth                   | 34 Ae                         | 67                                   |
| 02 Moon                    | 35 Am                         | 68                                   |
| 03 Planet                  | 36 Ap                         | 69 Herbig-Haro Objects               |
| 04 Planetary satellite     | 37 WDA                        | 70 Planetary Nebula+Central Star     |
| 05 Minor planet            | 38 Horizontal Branch Stars    | 71 Planetary Nebula-Central Star     |
| 06 Comet                   | 39 Composite Spectral Type    | 72 H II Region                       |
| 07 Interplanetary medium   | 40 F0-F2                      | 73 Reflection Nebula                 |
| 08 Giant red spot          | 41 F3-F9                      | 74 Dark Cloud (absorption spectrum)  |
| 09                         | 42 Fp                         | 75 Supernova Remnant                 |
| 10 W                       | 43 Late-Type Degenerate Stars | 76 Ring Nebula (shock ionised)       |
| 11 WN                      | 44 G IV-V                     | 77                                   |
| 12 Main Sequence O         | 45 G III-I                    | 78                                   |
| 13 Supergiant O            | 46 K V-IV                     | 79                                   |
| 14 Oe                      | 47 K III-I                    | 80 Spiral Galaxy                     |
| 15 Of                      | 48 M V-IV                     | 81 Elliptical Galaxy                 |
| 16 SD O                    | 49 M III-I                    | 82 Irregular Galaxy                  |
| 17 WD O                    | 50 R, N or S Types            | 83 Globular Cluster                  |
| 18                         | 51 Long Period Variable Stars | 84 Seyfert Galaxy                    |
| 19 Other UV-strong sources | 52 Irregular Variables        | 85 Quasar                            |
| 20 B0-B2 V-IV              | 53 Regular Variables          | 86 Radio Galaxy                      |
| 21 B3-B5 V-IV              | 54 Dwarf Novae                | 87 BL Lacertae Object                |
| 22 B6-B9.5 V-IV            | 55 Classical Novae            | 88 Emission Line Galaxy(non-Seyfert) |
| 23 B0-B2 III-I             | 56 Supernovae                 | 89                                   |
| 24 B3-B5 III-I             | 57 Symbiotic Stars            | 90 Intergalactic Medium              |
| 25 B6-B9.5 III-I           | 58 T Tauri                    | 91                                   |
| 26 Be                      | 59 X-ray                      | 92                                   |
| 27 Bp                      | 60 Shell Star                 | 93                                   |
| 28 sd B                    | 61 Eta Carinae                | 94                                   |
| 29 WDB                     | 62 Pulsar                     | 95                                   |
| 30 A0-A3 V-IV              | 63 Nova-like                  | 96                                   |
| 31 A4-A9 V-IV              | 64 Other Stellar Objects      | 97                                   |
| 32 A0-A3 III-I             | 65 Misidentified Targets      | 98 Wavelength Calibration Lamp       |
|                            |                               | 99 NULLS and Flat Fields             |

### ***Dispersion***

The dispersion is specified for the IUE spectrograph dispersion modes, as follows:

- Low** : low resolution spectrograph,  $\sim 6 \text{ \AA}$ .
- High** : high resolution spectrograph,  $\sim 0.2 \text{ \AA}$
- N/A** : not applicable (e.g. NULL and flat field images).

By default, all dispersion modes are selected, and if none is selected, all are assumed.

### ***Aperture***

The values for the aperture used in the exposure are:

- Large**: large aperture, oval 10x20 arcsec
- Small**: small aperture, circular 3 arcsec diameter circle
- N/A**: not applicable (e.g. NULL and flat field images)

By default, all apertures are selected, and if none is selected, all are assumed.

**Table 3.** Output Fields Options

| Output Column            | General | Observation | Variability | Pointing |
|--------------------------|---------|-------------|-------------|----------|
| Camera                   | x       | x           | x           | x        |
| Image                    | x       | x           | x           | x        |
| Dispersion               | x       | x           | x           | x        |
| Aperture                 | x       | x           | x           | x        |
| Object (HOI)             | x       | x           |             | x        |
| Object RA (B1950)        | x       | x           |             | x        |
| Object Dec (B1950)       | x       | x           |             | x        |
| Observation Date (UT)    | x       | x           | x           |          |
| Observation Time (UT)    | x       | x           | x           |          |
| Exposure Time (sec)      | x       | x           | x           |          |
| HJD mid-exposure         |         |             | x           |          |
| Target                   |         |             | x           | x        |
| Target RA (B1950)        |         |             | x           | x        |
| Target Dec (B1950)       |         |             | x           | x        |
| Exposure Mode            |         | x           |             |          |
| FES2 Counts              |         | x           | x           |          |
| FES2 Mode                |         | x           | x           |          |
| Position Angle           |         |             |             | x        |
| IUE Object Class         | x       |             |             | x        |
| Exposure Classification  | x       | x           | x           |          |
| Abnormality Code         |         | x           |             |          |
| Publications             | x       | x           | x           | x        |
| Browse Plots             | x       | x           | x           | x        |
| FITS Header              | x       | x           | x           | x        |
| Fetch (National Host)    | x       | x           | x           | x        |
| Mark for Retrieval (NH)  | x       | x           | x           | x        |
| Fetch (Principal Centre) | x       | x           | x           | x        |
| Mark for Retrieval (PC)  | x       | x           | x           | x        |

### ***Image List***

The catalogue can be queried by a specific list of images (maximum 50). The Image ID's (camera and image number) may be either typed or pasted into the input box, and must be entered as a column list (one image per row) in either upper- or lower-case, with or without blanks, e.g. SWP45467, LWR 11223, lwp03852. Wildcards are not permitted. Image numbers must have five digits.

### ***Select Output***

The output menus provide the means to select the output columns to be displayed, and the format of the output form. To enhance readability, the heading is repeated after every 15th row of table output. Grey-shaded columns in the output form refer to data stored at the Principal Centre or its Mirror.

### ***Output fields***

Four output options are available, emphasising respectively General (the default), Observation, Variability (timing) and Pointing information. The combinations of output columns in each field are summarised in Table 3.

### ***Output Format***

The output table may be generated in four formats, selected from the pull-down menu as HTML (default), ASCII, CSV and TSV:

**HTML:** This format provides the links for listing FITS headers, plotting and retrieving individual spectra, and referencing publications. It also provides links embedded in the table heading to explanations of each column, and for convenience, the table heading is repeated after every 15th row of output. HTML format is memory intensive on the client- and server-sides, and so the number of “hits” displayed is limited to 500. Larger outputs automatically default from HTML to ASCII format.

**ASCII:** Output is formatted in plain ASCII text, with columns left justified.

**CSV:** Comma-separated values, an output format in ASCII which may be imported into most spreadsheet applications.

**TSV:** Tab-separated values, an output format in ASCII which may be imported into most spreadsheet applications.

### ***Order By***

The output records (all formats) matching the input query may be sorted by:

**Date :** UT date and time of start of exposure (default)

**Coordinates :** equinox B1950 HOI coordinates

**Image ID :** camera plus image number

**IUE Class :** IUE object classification

**Object ID :** Homogeneous Object Identifier

### ***Show***

The output page size (i.e. the number of “hits” displayed) can be selected in all formats. The total number of records matching the input query is indicated, but only the number specified by *Show* is listed in the output page (default 50). For HTML format, if a query returns more than 500 records, and the page size is not limited (*Show*="all"), the output format automatically defaults to ASCII. In this event, *Show* should be set to a convenient value (50, 100, 250 or 500), and the user must navigate HTML output in pages of this size, either by specifying a *Page #* in the query form, or using the *Previous Page and Next Page* buttons located at the foot of the output form. For HTML output, it is generally more efficient to page large queries into several small pages (*Show* set to 50 or 100 records) than into fewer large pages (250 or 500 records).

### ***Page #***

If the total number of records matching the input query exceeds the page size specified by *Show*, specific pages may be listed with this option. For example, if *Show* is 50 and there are 293 records matching the input query, then setting *Page #* to 4 will list records 151 to 200. It is also possible to navigate incrementally between output pages by using the *Previous Page* and *Next Page* buttons.

### ***Show SQL***

If this option is selected, the SQL command corresponding to the input query to the catalogue will be displayed at the top of the output form.

### ***Principal Centre and Mirror Site***

Low resolution and rebinned high resolution spectra are stored at the National Host, but 1-D high resolution and 2-D low resolution SILO files are stored at the Principal Centre, LAEFF, which is also mirrored at CADC in Canada. The sizes of high resolution and SILO files are ~300-350 Kbytes and ~240-250 Kbytes respectively, so the effective network bandwidth is an important consideration when retrieving groups of such spectra. The fastest of the Principal Centre or its mirror must therefore be selected as the server for retrieval of high resolution and SILO files.

## OUTPUT TABLE DESCRIPTION

Help on a specific output column can be obtained by clicking on its link in the output table heading (HTML format only). The *Previous Page* and *Next Page* buttons at the foot of the output form enable to navigate incrementally between output pages when the total number of records returned by a query exceeds the page size as set by the parameter *Show* in the Query Form. The Query Form button returns to the default query form, and the arrow icon returns to the top of the output form. Grey-shaded columns of the output form refer to data stored at the Principal Centre and its mirror (HTML format only).

|                                     |   |
|-------------------------------------|---|
| <b>Camera</b>                       | The camera names and wavelength ranges:<br><b>SWP</b> : Short Wavelength Prime (1150-1980Å).<br><b>LWP</b> : Long Wavelength Prime (1850-3350Å).<br><b>LWR</b> : Long Wavelength Redundant (1850-3350Å).  |
| <b>Image Number</b>                 | The sequential image number which, combined with the camera name, gives the image identification.   |
| <b>Dispersion</b>                   | The dispersion mode of the observation:<br><b>Low</b> : low resolution, ~ 6.Å.<br><b>High</b> : high resolution, ~ 0.2 Å.<br><b>N/A</b> : not applicable (e.g. NULL and flat field images).   |
| <b>Aperture</b>                     | The aperture used for the exposure:<br><b>Large</b> : large aperture, 10x20 arcsec oval.<br><b>Small</b> : small aperture, 3 arcsec diameter circle.<br><b>N/A</b> : not applicable (e.g. NULL and flat field images).  |
| <b>Observation Date</b>             | The U.T. date of the start of the exposure.   |
| <b>Observation Time</b>             | The U.T. of the start of the exposure.  |
| <b>Object Name</b>                  | The Homogeneous Object Identifier for the target.   |
| <b>Right Ascension</b>              | The Homogeneous Right Ascension of the object for equinox B1950.  |
| <b>Declination</b>                  | The Homogeneous Declination of the object for equinox B1950.  |
| <b>Target Name</b>                  | The target name as provided by the Guest Observer.  |
| <b>Target Right Ascension</b>       | The target Right Ascension as provided by the Guest Observer.   |
| <b>Target Declination</b>           | The target Declination as provided by the Guest Observer.   |
| <b>IUE Object Class</b>             | The IUE Object Classification Code for the target, as defined in Table 2.   |
| <b>Exposure Classification Code</b> | The exposure classification code for continuum, emission lines and background, derived from the raw image immediately after read-down, ranging from 0 (weakest) to 9 (heavily saturated) for each category. Before mid-1979 the ECC referred only to continuum and emission lines. The meaning of the codes is described in Table 4 (raw pixels value range from DN=0 to DN=255). |
| <b>Abnormality Code</b>             | This column holds any abnormality flags for the observation. If abnormality codes are present it is advisable to check carefully the COMMENTS section of the FITS primary header. The meaning of the characters in the abnormality code are described in Table 5.   |

|  |  |
|--|--|
| <b><i>Exposure Mode</i></b>            | <p>A three-character code indicating whether the exposure was multiple, segmented or trailed:</p> <p>For <b>multiple</b>, X and Y indicate multiple spectra offset along the FES X-axis and Y-axis respectively, A and O indicate multiple spectra offset along the aperture and another non-standard method respectively, and N indicates not multiple.</p> <p>For <b>segmented</b>, Y and N indicate segmented and not segmented respectively.</p> <p>For <b>trailed</b>, X and Y indicate trailing along the FES X-axis and Y-axis respectively, and N indicates not trailed.</p>   |
| <b><i>Exposure Time</i></b>            | The effective exposure time in seconds, i.e. the commanded exposure time corrected for camera rise time and exposure quantization, and for aperture length and trail rate quantization for trailed exposures.  |
| <b><i>Heliocentric Julian Date</i></b> | The Heliocentric Julian date of mid-exposure.  |
| <b><i>Position Angle</i></b>           | The position angle of the long axis of the large aperture during the observation (North to East).  |
| <b><i>FES Counts and Mode</i></b>      | The FES counts and mode during acquisition of the target. (F,S) denote fast or slow track, and (U,O) denote underlap or overlap mode. The mode and counts give an estimate of the visual brightness of the target in a S-20 photocathode bandpass.   |
| <b><i>Publications</i></b>             | The number of publications which have used the corresponding observation. By clicking the link, the reference to each publication and links to its abstract in the ADS Astronomy Abstract Service are obtained (HTML format only).   |
| <b><i>Browse Plot</i></b>              | A browse plot of the spectrum (quality flags not indicated) can be generated by clicking on the corresponding link in the output table column Plot (HTML format only). A panel summarising the spectrum is listed next to the plot, and the full FITS header may be listed by clicking on " <i>Summary</i> ". For a high resolution spectrum, the initial browse plot is of the rebinned data; zoom plots of 30 Å regions of the parent high resolution spectrum can be generated.   |
| <b><i>HiRes Zoom Plot</i></b>          | For a high resolution observation, a zoom plot (quality flags not indicated) of a 30 Å region of the concatenated high resolution spectrum may be generated on the Principal Centre/Mirror server by entering the desired central wavelength in Angstroms in the grey-shaded panel adjacent to the rebinned spectrum plot, and either pressing Enter/Return or clicking <i>Plot Zoom</i> . A new viewport, centred on the input wavelength rounded to the nearest Angstrom, is created for the high resolution zoom. The viewport is automatically refreshed for subsequent zooms (on the same or a new spectrum). Clicking Reset Panel clears, and returns focus to, the wavelength input box.  |
| <b><i>Save Plot</i></b>                | <p>A copy of a browse or zoom plot can be saved on your local computer placing the mouse cursor over the plot, clicking mouse button three (rightmost), and selecting "Save Image As..." [Source] in Netscape, or "Save Picture As..." [GIF] in Internet Explorer. The resultant disk file can then be re-plotted and printed with an image display utility such as xv. The default GIF file-naming convention is consistent with the FITS file-naming convention:</p> <p><i>CameraImageDispersionAperture.GIF</i><br/>for low resolution and rebinned spectra, e.g. SWP45467RL.GIF</p> <p><i>CameraImageDispersionAperture_lambda1_lambda2.GIF</i><br/>for high resolution spectra, where lambda1_lambda2 is the displayed wavelength cut in Angstroms, e.g. SWP45467HL_1530_1560.GIF</p> |

**FITS Headers**

To list the FITS primary and binary table headers of a low resolution or rebinned high resolution spectrum, click on the corresponding link in the Header column of the query output table (HTML format only). The FITS headers may also be listed for a particular spectrum by clicking on Summary in its browse plot window.

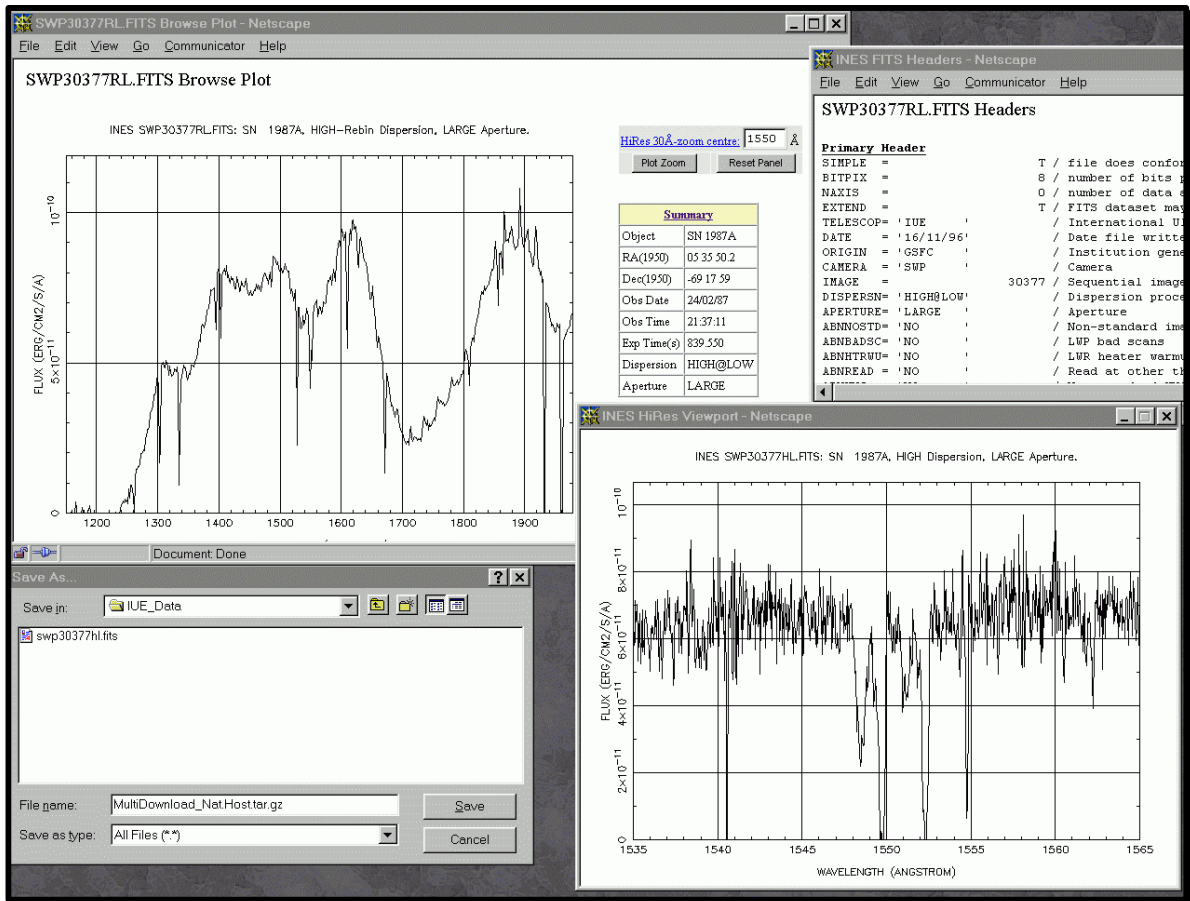
**Table 4.** IUE Exposure Classification Codes

| Code | Continuum and Emission Lines                             | Background    |
|------|--|---------------|
| 0    | not applicable   | DN < 20       |
| 1    | no spectrum visible                                      | 21 < DN < 30  |
| 2    | very faint spectrum: max DN < 20 above background        | 31 < DN < 40  |
| 3    | underexposed spectrum: max DN < 100 above background     | 41 < DN < 50  |
| 4    | weak spectrum: 100 < max DN < 150 above background       | 51 < DN < 60  |
| 5    | good: no saturation but max DN over 150 above background | 61 < DN < 70  |
| 6    | a bit strong: a few pixels saturated                     | 71 < DN < 80  |
| 7    | saturated for less than half the spectrum                | 81 < DN < 90  |
| 8    | mostly saturated but some parts usable                   | 91 < DN < 100 |
| 9    | completely saturated                                     | DN > 101      |
| X    |  | saturated     |

**Table 5.** IUE Abnormality Codes

| Code | Description  |
|------|--|
| A    | Abnormal read                                      |
| B    | Bad scan in the LWP camera                         |
| C    | Data corrupted (DMU anomaly)                       |
| H    | History playback                                   |
| M    | Missing temperature                                |
| N    | Non-standard image acquisition                     |
| O    | Offset from centre or nucleus                      |
| P    | Partial read                                       |
| R    | Remnant of previous spectrum visible               |
| S    | Serendipity exposure                               |
| T    | Track lost during exposure                         |
| U    | UVC voltage other than -5kV                        |
| W    | LWR heater warm-up                                 |
| Z    | Contamination by solar spectrum or extended source |
| 8    | Cross-correlation < 80%                            |





## DATA RETRIEVAL: FETCH AND MARK

Data retrieval is possible only from the HTML output format. Spectra may be retrieved individually or in groups, and multiple retrieval of concatenated high resolution spectra can be restricted to a specific wavelength interval. Spectra are delivered as FITS files.

### Single spectrum retrieval

The concatenated high resolution spectra and low resolution SILO images, grey-shaded columns of the output table, are stored at the Principal Centre in VILSPA and the Mirror Site at CADC, and the low resolution spectra and rebinned high resolution spectra are stored at the National Host. To fetch a single spectrum, click on the link (Low, Rebin, High or SILO) in the output table *Fetch* column corresponding to that spectrum. Single spectra are retrieved uncompressed and, depending on the characteristics of your browser, you will be prompted to give the local filename either before or after download. It is recommended that you use the same naming convention as that under which the data are stored on the servers:

*CameraImageDispersionAperture.FITS* for 1D extracted spectra

*CameraImage.SILO* for 2D line-by-line low resolution images

where Camera is SWP, LWP or LWR, Image is the 5-digit image number, Dispersion is L,H or R (rebinned) and Aperture is L or S. The sizes of these data products are:

Low: low resolution 1D spectra: ~18 Kbytes.

Rebin: high resolution rebinned 1D spectra: ~18 Kbytes.

High: high resolution 1D spectra, orders concatenated: ~300-350 Kbytes.  
SILO: low resolution line-by-line images: ~240-250 Kbytes.

### **Multiple spectrum retrieval**

#### ***Spectrum selection***

For multiple retrieval, it is possible to include/exclude all files of a particular type multiple retrieval, e.g. *Mark: High*, will mark/unmark all high resolution spectra, and to fine-tune your selection further individual spectra can be included/excluded by checking/unchecking them in the *Mark* column corresponding to their location (National Host or Principal Centre/Mirror [shaded grey]).

#### ***Wavelength selection***

For faster retrieval from the Principal Centre/Mirror, the multiple download of high resolution spectra can be restricted to a specific wavelength interval. By default, the full camera range is assumed (and displayed for reference), but if you request a wavelength cut (in Angstroms) for a camera, that interval rounded to the nearest Angstrom, is applied to all selected high resolution spectra for that camera. In this case, the naming convention adopted for the retrieved spectra is:

*CameraImageDispersionAperture\_lambda1\_lambda2.FITS*,

where lambda1\_lambda2 is the wavelength cut in Å, e.g. SWP45467\_1400\_1750.FITS.

For a given camera, if one or both input wavelengths is blank, non-numeric or lies out of camera range, the full camera range is assumed. Clicking *Reset Wavelengths* resets the input wavelengths to the default full-camera values.

Compared with retrieval of the full camera range, wavelength selection imposes a server processing overhead of ~0.3 sec/spectrum, but reduces download time by ~100(1-r)%, where r is the fraction of the camera range selected. For current network bandwidths, this results in a considerable net saving of retrieval time for all but the largest wavelength cuts.

#### ***Retrieval format***

Multiple spectrum retrieval generates a packed file in either tar or ZIP format. Compression of packed files is recommended for network efficiency, in particular when downloading large data sets. ZIP files are compressed automatically, and for tar files, three compression schemes are available: bzip2, gzip, and compress. Ensure that the corresponding unpacking and decompression programs are available on your system before selecting the retrieval scheme from the pull-down menu (default tar.gz).

Table 6 may be useful to decide on which packing and compression scheme to use. The National Host table refers to packed files containing only low resolution spectra (Low), only rebinned spectra (Rebin) and equal numbers of low resolution and rebinned spectra (L+R), with the packed file sizes normalised to unit spectrum content, and quoted in Kbytes. The Principal Centre table refers similarly to concatenated high resolution and SILO files.

The most efficient compression is achieved by bzip2, but its compression/decompression cycle is more than ~5 times longer than for the other schemes. This is a small overhead compared to the savings in bandwidth for downloads of SILO images from the Principal Centre/Mirror, but is a consideration for downloads of high resolution, low resolution and rebinned spectra, where the bandwidth savings of bzip2 compared to gzip are marginal. Especially, bzip2 is not recommended when retrieving HiRes wavelength cuts to avoid combining both sets of server overheads. The compress algorithm produces zero compression for a packed file consisting solely of concatenated, high resolution spectra.

Retrieval of the selected spectra from the National Host or Principal Centre/Mirror servers is effected by clicking the corresponding *Retrieve Marked Data* buttons. You will be prompted to assign local filenames for the packed, compressed files from each server either before or after download, depending on the browser you use. Ensure that you choose different filenames for the downloads from each server; it is recommended that you name them according to the standard naming convention for the packing and compression scheme chosen (that is, file.tar.gz, file.tar.bz2, file.tar.Z, file.tar or file.zip).

**Table 6.** Compression Schemes

| Scheme   | National Host |       |      | Principal Centre/Mirror |       |       |
|----------|---------------|-------|------|-------------------------|-------|-------|
|          | Low           | Rebin | L+R  | High                    | SILO  | H+S   |
| Bzip2    | 6.6           | 6.3   | 6.1  | 236.5                   | 61.3  | 150.3 |
| gzip     | 6.5           | 6.4   | 6.5  | 238.9                   | 78.9  | 158.9 |
| ZIP      | 8.4           | 8.1   | 8.4  | 238.3                   | 78.7  | 158.5 |
| Compress | 10.1          | 9.5   | 9.5  | 307.2                   | 93.6  | 203.3 |
| Tar      | 18.4          | 18.4  | 18.4 | 307.2                   | 241.7 | 273.4 |

## CURRENT OPERATIONAL INES NATIONAL HOSTS

Country ***Austria***  
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## USAGE STATISTICS OF THE INES PRINCIPAL CENTRE

The tables and graphs below summarise the usage of the INES Principal Centre during 1998 and 1999 (the latter detailed by month). Included are both the accesses to the Spanish National Host (for low-resolution and rebinned spectra) and to the Principal Centre server (for high resolution concatenated spectra and bi-dimensional SILO images).

**Table 7.** INES Usage Statistics

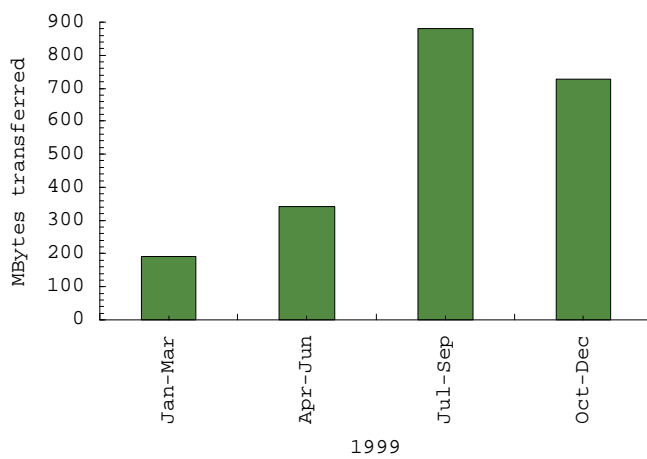
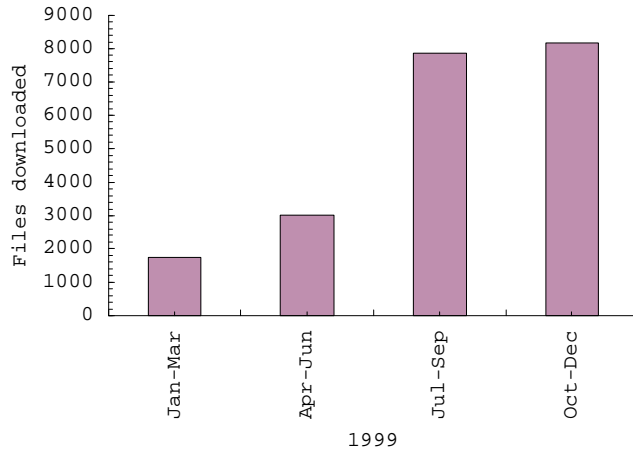
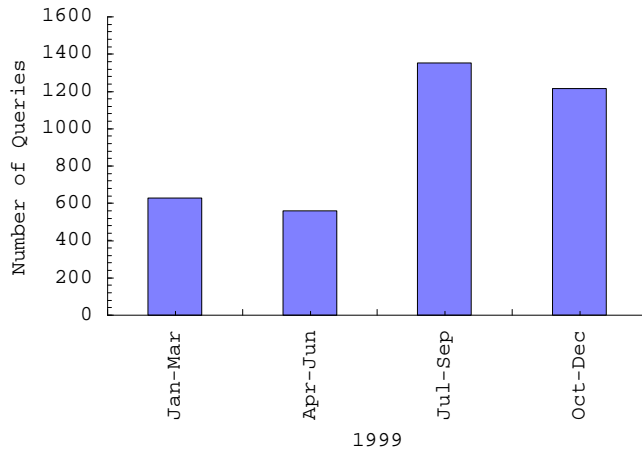
### **Total**

| <u>Year</u>  | <u>#Queries</u> | <u>#Files</u> | <u>Mbytes</u>  |
|--------------|-----------------|---------------|----------------|
| 1998         | 1838            | 8071          | 738.98         |
| 1999         | 3756            | 20786         | 2142.37        |
| <b>Total</b> | <b>5594</b>     | <b>28857</b>  | <b>2881.35</b> |

### **1999**

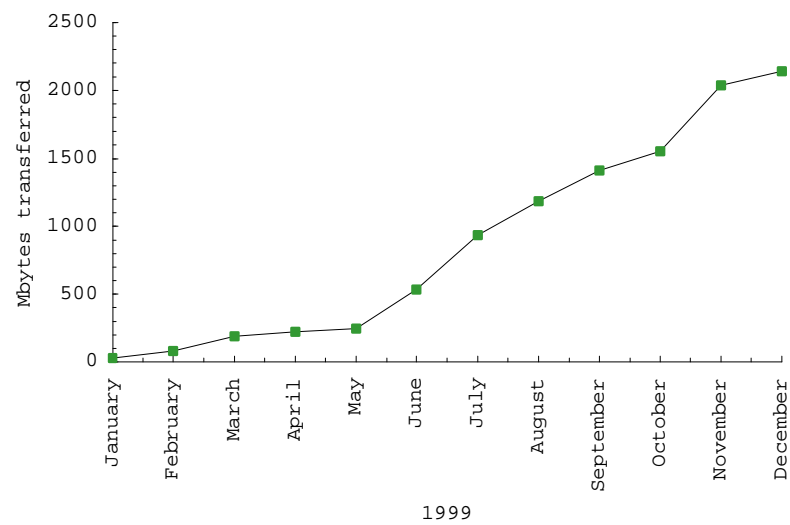
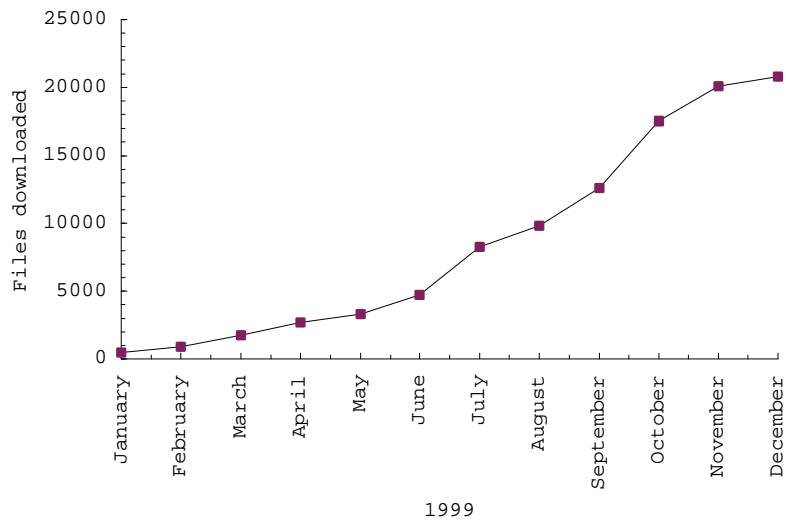
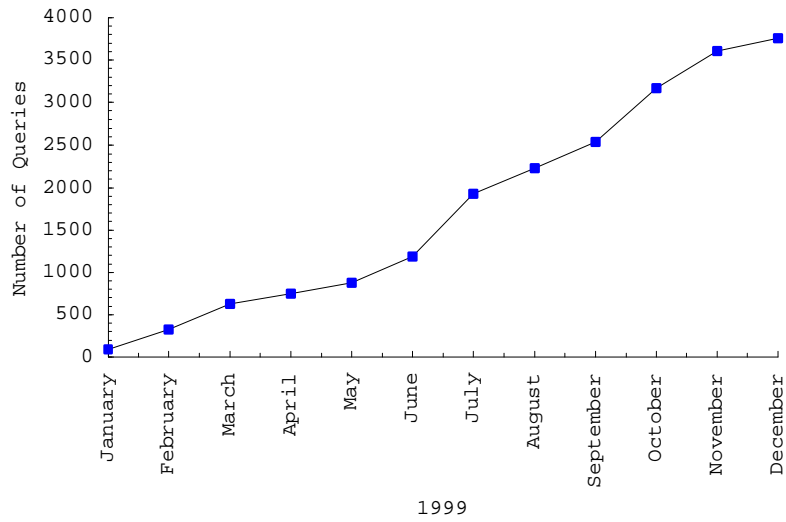
| <u>Month</u> | <u>#Queries</u> | <u>#Files</u> | <u>Mbytes</u>  |
|--------------|-----------------|---------------|----------------|
| January      | 94              | 489           | 28.19          |
| February     | 230             | 405           | 50.34          |
| March        | 303             | 836           | 111.77         |
| April        | 118             | 985           | 30.14          |
| May          | 133             | 610           | 24.64          |
| June         | 307             | 1417          | 287.9          |
| July         | 742             | 3506          | 402.29         |
| August       | 302             | 1595          | 252.19         |
| September    | 310             | 2774          | 226.13         |
| October      | 627             | 4901          | 141.85         |
| November     | 438             | 2579          | 479.83         |
| December     | 152             | 689           | 107.1          |
| <b>Total</b> | <b>3756</b>     | <b>20786</b>  | <b>2142.37</b> |

## QUARTERLY STATISTICS 1999





## CUMULATIVE STATISTICS 1999



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## APPENDIX: INES PAPERS

- “*INES: Astronomy Data Distribution for the Future*”  
W. Wamsteker, I. Skillen, J.D. Ponz, A. de la Fuente, M. Barylak and I. Yurrita (2000)  
Astrophysics & Space Science, in press
- “*The INES System I: Improved data extraction procedures for IUE Low Resolution Spectra*”  
P.M. Rodríguez-Pascual, R. González-Riestra, N. ScharTEL and W. Wamsteker (1999)  
Astronomy & Astrophysics Supplement Series, 139, p. 183
- “*The INES System II: Ripple Correction and Absolute Calibration for IUE High Resolution Spectra*”  
Cassatella, A., Altamore, R. González-Riestra, J.D. Ponz, J. Barbero, A. Talavera and W. Wamsteker (2000)  
Astronomy & Astrophysics Supplement Series, 141, p. 331
- “*The INES System III: Evaluation of IUE NEWSIPS High Resolution Spectra*”  
R. González-Riestra, A. Cassatella, E. Solano, A. Altamore and W. Wamsteker (2000)  
Astronomy & Astrophysics Supplement Series, 141, p. 343