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July 1992

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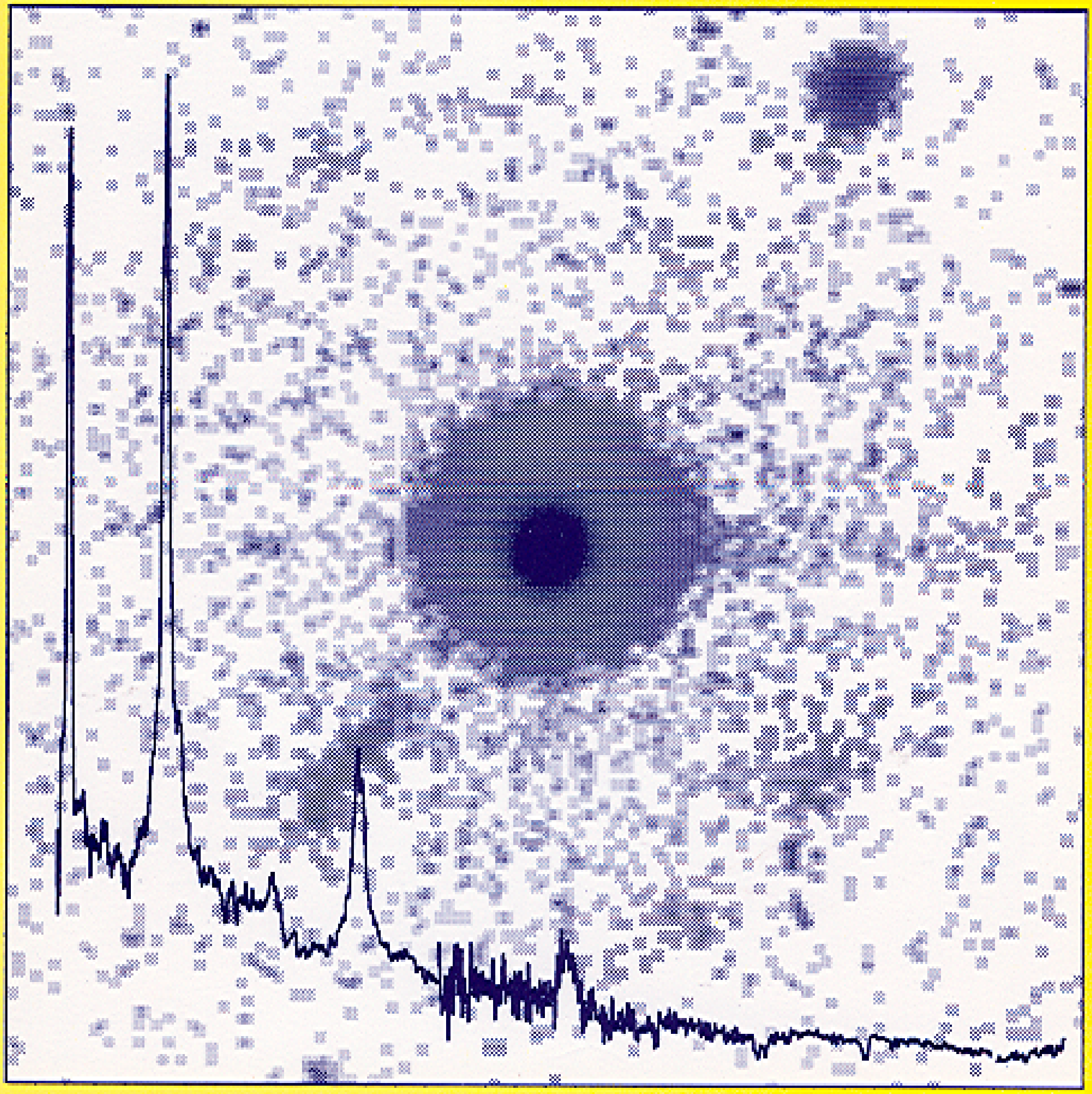

International Ultraviolet Explorer — Uniform Low Dispersion Archive

Active Galactic Nuclei

Volume A

esa
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July 1992

IUE — ULDA Access Guide No. 4 A

International Ultraviolet Explorer — Uniform Low Dispersion Archive

Active Galactic Nuclei

Volume A

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FOREWORD

THE IUE ULDA/USSP ACCESS GUIDES

The International Ultraviolet Explorer (IUE) Satellite project is a joint effort between NASA, ESA and the SERC. The IUE Spacecraft and instruments are operated in a Guest Observer mode and are designed for Ultraviolet Spectrophotometry at two resolutions in the wavelength range from 115nm to 320nm. The low resolution is R=300 (1,000 Km/sec.) and the high resolution mode R=10,000 (19 Km/sec.). The IUE S/C, the scientific instruments, the data acquisition and reduction procedures are described in "Exploring the Universe with the IUE Satellite", Part I, Part VI and Part VII (Astrophysics and Space Sciences Library volume 129, Y. Kondo, Editor-in-Chief, Kluwer Acad. Publ. Co.) and references therein. From the very beginning of the project (launched on 26 January 1978) it was expected that the archival value of the data obtained with IUE would be very high. This expectation has been borne out in full after 14 years of orbital operations. The average IUE Archive data retrieval rate, during the 14 years of operations, is some 50,000 spectra per year. This compares with a new data collection rate of 5,500 spectra per year. Taking into consideration that the demand for observing time still exceeds the available time by a factor of 3, this clearly illustrates that the IUE Archive is an important part of the IUE Project. The IUE ULDA/USSP, which was specifically developed by ESA to make IUE spectra available in a way which would not involve the project staff and thus simplify the process of consulting IUE data, has over the last few years supported 49% of all data retrieval from the IUE Project. This illustrates that the ULDA/USSP has fulfilled, through remote unassisted dearchiving, an existing need in the access to IUE Data. The low resolution data set was chosen since it represented a data set excellently suitable for remote dearchiving processes and it allowed a design which would not overload the facilities available in 1987 at the -currently 17- National Host Institutes.

The subset of the IUE Spectral Archive contained in the ULDA and accessible through the USSP consists of the low resolution IUE spectra in a form directly applicable to modern Scientific Analysis techniques. Version 4.0 of the ULDA/USSP is released in July 1992 and contains all -98.7% complete- low resolution spectra obtained with IUE before January 1st, 1991 (about 53,000 spectra). The details of the construction of the ULDA and the design of the USSP can be found in Wamsteker et al. (Astronomy and Astrophysics Supplement Series, Vol. 79,pg 1-10, 1989) and in ESA IUE Newsletter #30, which also contains a users guide. The design and software coding of the USSP has been a coordinated effort between the ST-ECF, R.A.L.,Trieste Observatory and the ESA IUE Observatory. The production of the ULDA and the overall coordination of the ULDA/USSP has been done at the ESA IUE Observatory at VILSPA. New developments include a UNIX version of the USSP (USSP Version 4.0), developed in collaboration with the Canadian Astronomical Data Centre (CADC) and the Trieste Observatory.

The quantity of data in the IUE Archive is sufficiently large that it is not necessarily simple to address the data efficiently in the context of an astrophysical problem, even under the IUE Uniform Low Dispersion Archive (ULDA) and its ULDA Support Software Package (USSP),with access to the data extremely easy. The purpose of the series of ULDA Access Guides is: To facilitate the use of the ULDA/USSP for scientists with a specific astrophysical problem in mind.

The series consists of a number of -subject oriented- books such as this one, for which a specialist in the field has been invited to take the scientific responsibility. ULDA Access Guide No. 4 (Volumes 4a and 4b) treats the data of ACTIVE GALACTIC NUCLEI and has been compiled by Thierry J.-L. Courvoisier of the Observatoire de Genève, Geneva, Switzerland and Stéphane Paltani, Institut d'Astronomie, Lausanne, Switzerland. In this issue they present an overview of the spectra of all Active Galactic Nuclei, from Narrow Line Emission Line Galaxies to Quasars and BL Lac objects observed with IUE. It illustrates the sample of such objects presently included in the IUE Archive and the variability characteristics of the objects. They have also collected information on the data obtained of these objects with the various X-Ray satellites which have operated in conjunction with the IUE Science Observing program. Due to the large amount of work involved in such compilation and the dynamic nature of the ULDA, it is not possible to make both the existing version of the ULDA, and the auxiliary information cover exactly the same period. It was judged to be preferable to collect all information available at the time of preparation, rather than artificially make the time periods covered in the ULDA Guides and the current Version of the ULDA coincide. In volume 4a and 4b the auxiliary information is included for all data in ULDA Version 3.0, extending to January 1st, 1990.

Further volumes of the ULDA Access Guides (see also page 5) will be published whenever the necessary data compilation has been completed by the authors. For details of the access to the ULDA through the National Hosts for 22 countries we refer to the details supplied regularly in the ESA IUE Newsletters (especially Driessen, Pasian and Talavera, 1988, IUE Newsletter #30, containing the ULDA/USSP Users Guide). Any inquiries on the access to the ULDA and the use of the USSP should be directed to the National Host Managers (see page 3). Inquiries about the specific data content of the ULDA should be directed to ULDA Manager at the ESA IUE Observatory at VILSPA, Madrid, Spain.

Willem Wamsteker

The IUE ULDA is accessible through the National Hosts:

```
BELGIUM:
Koninklijke Sterrewacht, Brussels,
         serving: Belgium.
Host Manager: MARIJKE@ASTRO.OMA.BE (Marijke Burger).

BRAZIL:
Instituto Astronomica e Geofisico (IAG-USP), Sao Paolo.
         serving: Brazil.
Host manager: 47556::LUIS (Luis Arakaki & Ronaldo E. de Souza).
              IAGUSP%FPSP.HEPNET@LBL.BITNET

CANADA:
Canadian Astronomical Data Center (DOA/CADC), Victoria.
         serving: Canada.
Host Manager: NCF::PSI%DAO::CRABTREE (Dennis Crabtree).
              CRABTREE@NRCDAO

CHILE:
Cerro Tololo Inter-American Observatory (CTIO), La Serena.
         serving: Chile
Host Manager:SHEATHCOTE@CTIO.NOAO.EDU (Steve Heathcote)

FRANCE:
Centre de Donnees Stellaire (CDS),Strassbourg
         serving: France.
Host Manager:  CDSXB2::JASNIEWICZ  (Gerard Jasniewicz)
               JASNIEWI@FRCCSC21

GERMANY:
Astronomisches Institut Tuebingen (AIT),Tuebingen.
         serving: Germany.
Host Manager: AITMVX::SCALES  (Dominic Scales)
              PSSC001@DTUZDV5A

ITALY:
Osservatorio Astronomico di Trieste (OAT),Trieste.
         serving: Italy.
Host Manager: ASTRTS::FRANCHINI (Mariagrazia Franchini)
              FRANCHINI@ASTRTS.INFNET
```

JAPAN
National Astronomical Observatory, CACAD, Tokyo.
serving: Japan
Host Manager: RNISHIM@C1.MTK.NAO.AC.JP (Shiro Nishimura)
A32404@JPNKUDPC

the NETHERLANDS:
Sterrekundig Institute, Utrecht,
serving: the Netherlands
Host Manager:VERBUNT@HUTRUU51 (Frank Verbunt & Ed van der Zalm)

PEOPLES REPUBLIC of CHINA:
Center for Astrophysics, (USTC), Hefei.
serving: Peoples Republic of China.
Host Manager: (Wang Ting-gui)

SPAIN:
ESA IUE Observatory (VILSPA), Madrid.
serving: Spain,Portugal.
Host Manager: 28843::CD (Cornelius Driessen & Antonio Talavera)

SWEDEN:
Uppsala Astrophysical Institute,
serving: Sweden,Norway,Denmark,Finland.
Host Manager: KE@LABAN.UU.SE (Kjell Eriksson).
ASTKE@SEUDAC21

SWITZERLAND:
Institut d' Astronomie, Lausanne.
serving: Switzerland
Host Manager: BERTHET@OBS.UNIGE.CH (Stephane Berthet).
20579::UGOBS::BERTHET

TAIWAN:
National Central University,IPA, Chung-Li
serving: Taiwan.
Host Manager: [0487]230035::WHSUN (Sun Wei-Hsin).
NCUT037@TWNMOE10

UNITED KINGDOM:
Rutherford and Appleton Laboratories,
serving: United Kingdom & Ireland.
Host Manager:19457::DS (Dave Stickland)

```
U.S.A.:
National Space Sciences Data Centre (NSSDC), Greenbelt,MD.
         serving: U.S.A.,Mexico.
Host Manager: NCF::ULDA  (Charleen Perry & Michael van Steenberg)
              NCF::PERRY

ST-ECF/ESO (Garching/Munich)
         serving: Local use only.
Host Manager: ESOMC1::PASIAN  (Fabio Pasian)
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Earlier issues of the IUE-ULDA Access Guides:

IUE-ULDA Access Guide No.1 ESA SP 1114
C. la Dous : Dwarf Novae and Nova-like Stars

IUE-ULDA Access Guide No.2 ESA SP 1134
M. Festou : Comets

IUE-ULDA Access Guide No.3 ESA SP 1152
G. Longo, M.Cappaccioli: Normal Galaxies

ULDA Access Guide No. 4

1 Introduction

There are different types of activity in the nucleus of galaxies. The most extreme form of activity is that of the quasars. The luminosity of these objects can be as high as several $10^{47} ergs \cdot s^{-1}$, their continuum spectral energy distribution spans most of the known electromagnetic spectrum from the far infrared (or even the radio domain for some of them) to the γ-rays. Prominent and broad emission lines indicating typical velocities of several thousand kilometers per second are observed in the infrared, optical and UV emission of these objects. A very similar, although somewhat weaker, type of activity is observed in the Seyfert galaxies. The broad lines may be hidden in some of these objects. Still weaker activity is seen in the LINERS where only low ionisation lines can be observed. The BL Lac objects also belong to the Active Galactic Nuclei, although they show only very weak emission lines, because of their very strong variability and high polarisation. In fact most if not all the active nuclei of galaxies are variable on a wide range of time scales.

The complex properties of the Active Galactic Nuclei (AGN) are still far from beeing understood. Their continuum emission in the optical and ultraviolet domains is often dominated by a component called the big blue bump. This expresses that the flux in this spectral domain is considerably larger than expected from the extrapolation of the infrared power law. This component is often associated with an accretion disc, the flux beeing emitted either by the gravitational energy released in the disc or by the reprocessing of X-rays generated outside of the disc.

Active Galactic Nuclei (AGN) have been one of the type of objects observed frequently with IUE. IUE studies of AGN were of very different nature, some were concerned with the emission lines of single objects or small samples. These investigations concentrated on emission line ratios, relationship with the ionising continuum, profiles of the lines and possible accretion disc signatures. Other programs were concerned with the continuum emission, the shape of the continuum spectral energy distribution and, also, the possible signs of an accretion disc. Further studies looked at the variations observed in the continuum and/or in the emission lines. These variations are complex, they are observed not only in the observed flux, but also in the line profiles and in the shape of the continuum spectral energy distributions. The data base resulting from these investigations is very inhomogenous, although large campaigns of observations have been organised in recent years. This data base provides a rich source of high quality data that can be used in a context that goes beyond the original aims of the proposers. This happens because our understanding of the physics of AGN has considerably progressed in the last ten years, but also because the richness and the variety of the data collected allows for far more collective studies than could be anticipated. As a result of these considerations and in view of the increased usage of the IUE archive in the astronomical community (not restricted to specialists in UV astronomy) it was deemed useful to provide a summary of those data now in the Uniform Low Dispertion Archive (ULDA) of IUE.

This summary is intended to help researchers find the IUE data relevant for a given problem. It was therefore designed to present the data without giving or suggesting any interpretations. Care was given to provide a complete view of the data (i.e. both spectral and temporal information) with as little processing as possible. The analysis presented here is described below, it was run in an automatic mode. The results should therefore be considered to be a guide line and cannot be expected to replace a personal inspection of the actual data.

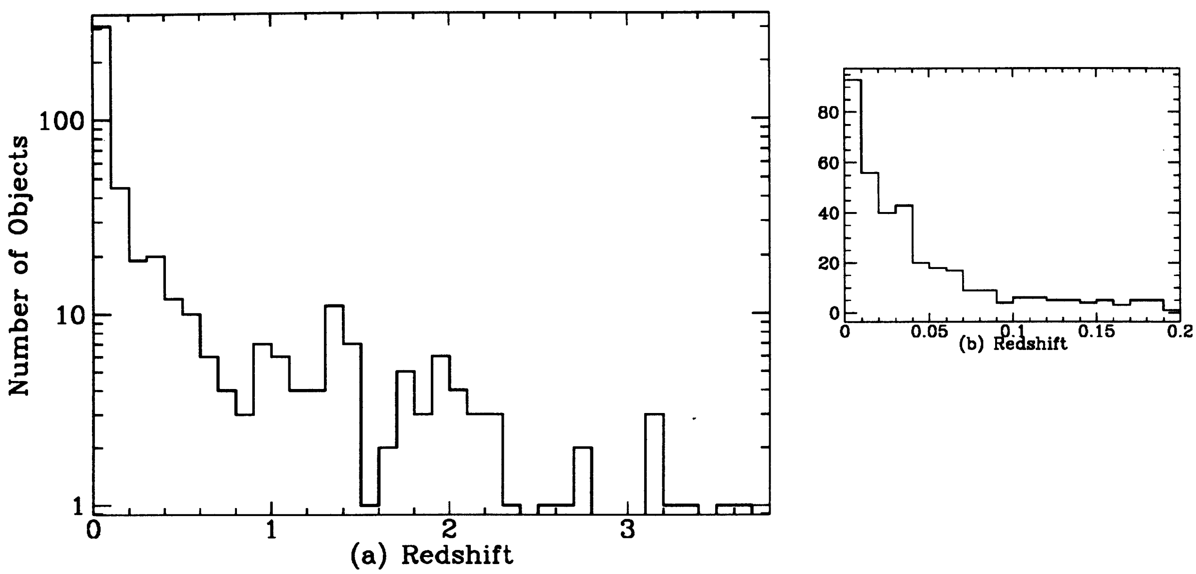

Figure 1: The number of sources as a function of the redshift (a): all sources with known redshift and (b): redshifts less than 0.2. We have been unable to find the redshift of 24 sources (essentially BL Lac sources with no known redshift) which are not included in the figure.

The sample of objects included here is not complete in any sense of the word. It merely reflects the imagination (or lack thereof) of the succession of IUE observers from 1978 to 1988. In total, 522 objects are considered, the objects belong to the ULDA categories 84 (Seyfert galaxies), 85 (quasars), 86 (radio galaxies), 87 (BL Lac objects) and 88 (LINERS). There is, however, a certain randomness in the category attached to the spectra, the same object appearing in several classes. These categories are not used any further in the analysis. The sample is described in the following set of figures: Fig. 1 gives a histogram of the number of sources as a function of their redshift. Fig. 2 gives the histogram of the number of sources as a function of their 1250 Å (observed wavelength) flux. Fig. 3 gives the number of sources as a function of the luminosity at 1250 Å in the source frame (see below for the redshift information; $H_0 = 50 km \cdot sec^{-1} \cdot Mpc^{-1}$). Fig. 4 gives a 2-dimensional

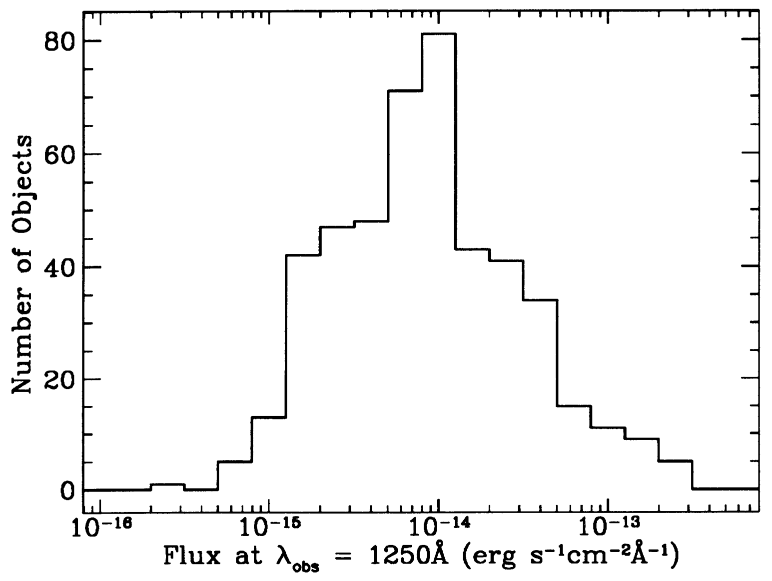

Figure 2: Number of sources as a function of their 1250 Å flux. The flux was averaged over a 50 Å bin centered on 1250 Å in the observer frame.

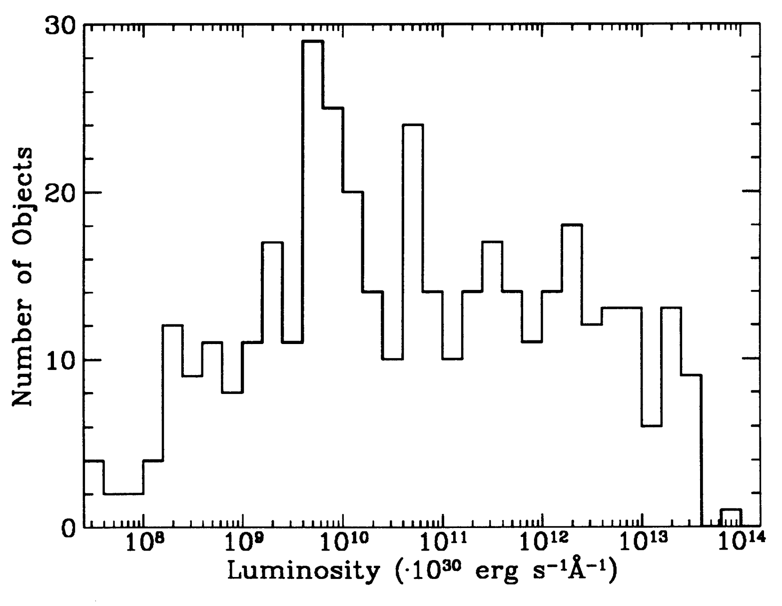

Figure 3: Number of sources as a function of the source luminosity at 1250 Å in the object frame. The luminosity was estimated by averaging the flux over 50 Å and using $H_0 = 50 km \cdot sec^{-1} \cdot Mpc^{-1}$.

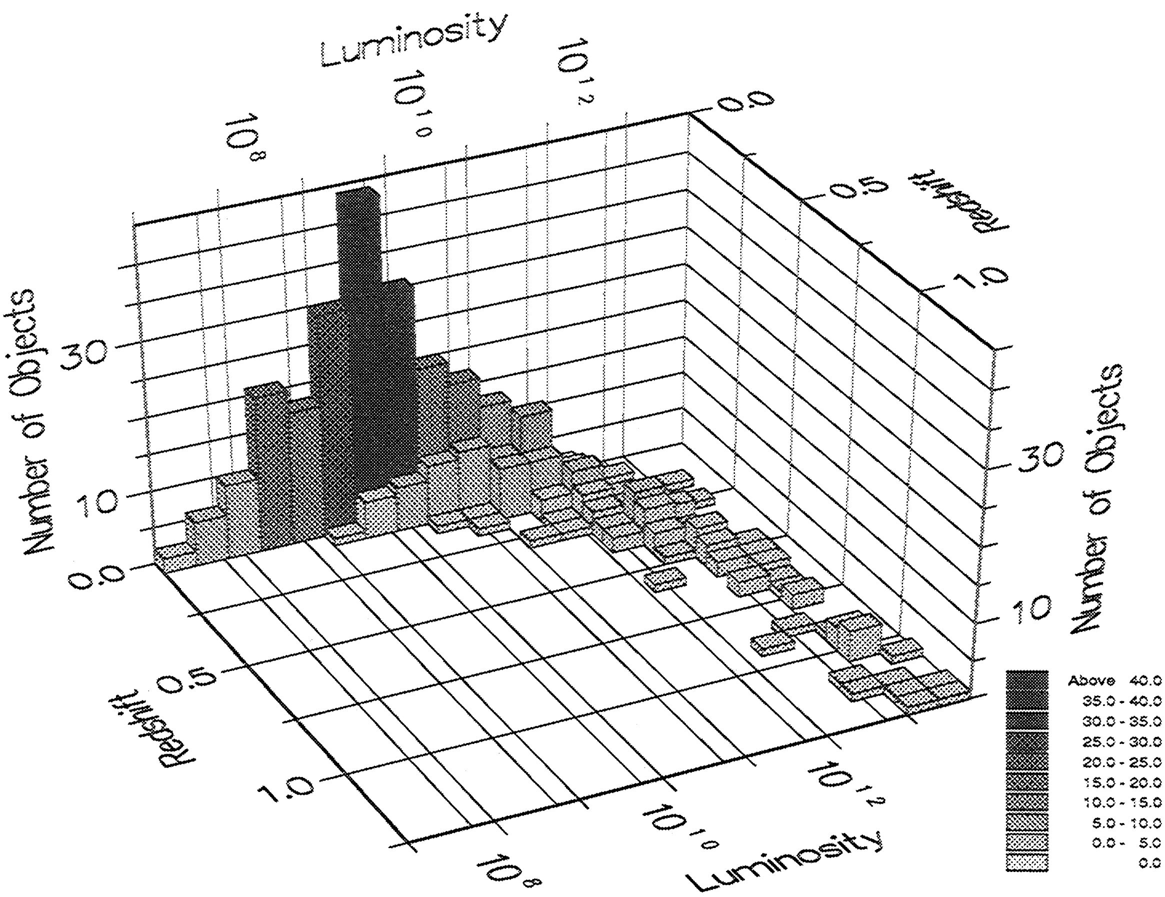

Figure 4: The information of figures 1 and 3 is repeated here in a two dimensional histogram of the number of sources as function of redshift and luminosity. Luminosity is expressed in unit of $10^{30} erg \cdot s^{-1} \cdot \AA^{-1}$

histogram of the number of objects as a function of their redshift and luminosity. 3486 spectra of the 522 objects are described in the following pages. The number of objects with a given number of SW observations, i.e. with a given quality of temporal information is given in fig. 5.

2 Data Processing

All data presented here have been taken from the ULDA version 3.0 complete until December 1988 and read into a series of tables. ULDA is described in Wamsteker et al. (1989), and a concise description of IUE and its data can be found in "Exploring the Universe with the IUE Satellite" Ed. in Chief Y. Kondo Reidel 1987. Driessen and Pasian (1988) have written a detailed USSP user's guide (ULDA Software Support Package) which helps

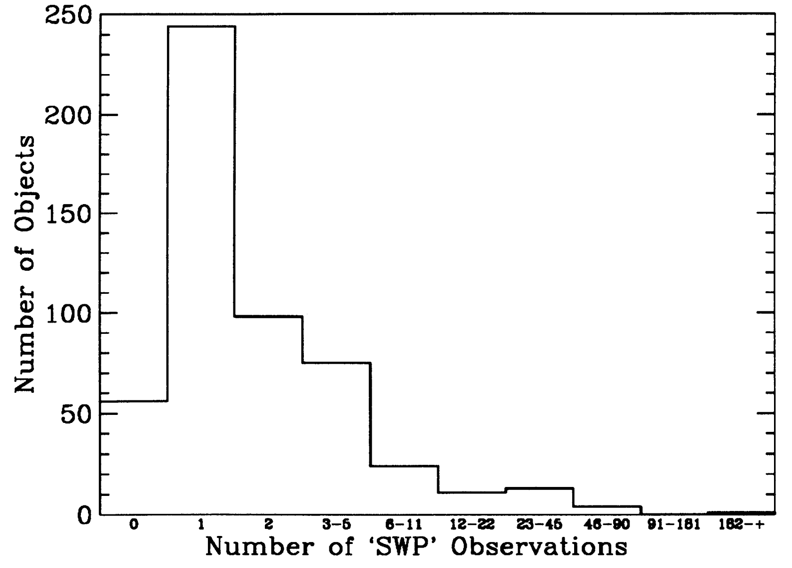

Figure 5: Number of sources as a function of the number of their SW observations.

to gain an easy access to ULDA. All the data from the ULDA classes 84 to 88 have been used. We did not, however, attempt to find those few observations of AGN misclassified in other object classes.

The ULDA spectra have been re-binned to bin-widths of 1 Å before being joined together. The SW spectra have been cut above 1950Å and the LW cut below the same wavelength. Observations performed with the small aperture have been excluded from all computations. The spectra in both wavelength domains have been averaged (where observations have been repeated) to display a better signal to noise spectrum of the object.

Since AGN are variable objects we present whenever possible light curves. In order to provide data in the same spectral range for objects of different redshifts, we selected 2 rest wavelengths (1250 Å and 2200 Å relatively free from strong emission lines) and display the fluxes averaged over 50 Å centered on the corresponding wavelengths in the frame of the observer. The redshifts of the objects have been taken from Véron-Cetty and Véron (1991). For those liners and radio galaxies not listed in Véron-Cetty and Véron (1991) the redshifts and coordinates are from the revised Shapley-Ames Catalog, the ESO-Uppsala B Catalog (A. Lauberts and E. A. Valentijn, 1989), from Lang (1974) (for radio galaxies) and from the original literature (see e.g. Xu et al., 1988). When the redshift is so large that the 50 Å bin lies outside the IUE range, we give the fluxes (and where appropriate plot the light curves) at 1500Å and/or 3000Å (in the observer frame) respectively. For those objects for which we did not find the redshift we set z=Unknown and we exclude them from figures 1, 3 and 4.

Error bars (one standard deviation of the fluxes measured in a single day) have been calculated for the light curves of those objects for which more than 1 spectrum were obtained at one epoch. When several epochs exist for which several spectra were taken the same day, the average of the standard deviations is used as an estimate of the uncertainty. Note that this approach assumes that the variations within one day are less than the uncertainty. This is probably true for many sources. We do not attempt to estimate the uncertainty for the sources for which there is no epoch with more than one spectrum, as no reliable simple method is available.

In addition to the UV light curve, we also give a measure of the amplitude of the variations as a function of the wavelength for those objects with more than 8 spectra. This was calculated for 50Å bins. We give the sample standard deviation

$$s(\lambda) = (\frac{1}{N-1}\sum_{i=1}^{N}(f_i(\lambda) - < f(\lambda) >)^2)^{1/2}$$

(where $f_i(\lambda)$ is the flux averaged over 50 Å at epoch i, $< f(\lambda) >$ is the same flux averaged over all available epochs and N is the number of epochs, usually different for both ranges SW and LW) divided by the mean flux.

IUE has the property of measuring, for bright enough objects, a broad band flux in the optical domain with the Fine Error Sensor (FES). In view of the interest in correlated UV and optical variations in AGN, we also give the FES light curve and fluxes where available. The sensitivity of the FES has been decreasing with time (Imhoff and Wasatonic, 1986). We therefore show the corrected light curve in the following graphs using the calibration of C. R. Imhoff and R. Wasatonic. We give, however, also the raw FES counts as given in ULDA to allow the user to reconstitute and refine the treatment given here.

For those sources with less than 8 spectra (including SW and LW spectra), we do not give the variability information in a graphical way but only list all the equivalent data in a table.

In some cases, spectra are obtained simultaneously with both camera in order to obtain a good signal to noise sky spectrum from the camera not pointed towards the source. Not all these instances are well documented in the data. We therefore looked at all pairs of spectra with overlapping exposures to find which is sky and which is object. The sky spectra have been excluded from the object computations.

3 Bibliography

In absence of a reasonably comprehensive UV related bibliography we used the SIMBAD data base (see e.g. Egret et al., 1988), selecting all references related to objects contained in the sample studied here. From the resulting about 6000 different bibliographical references, we selected 942 papers. The selection is based on the title of the papers. We selected those references of interest (in our view) to the users of the present compilation. In this selection, we concentrated on papers related to UV data or interpretations closely linked with low dispersion UV spectroscopy. This process is not devoid of a certain arbitrariness and we apologise to those authors whose papers have been mis-represented or omitted.

4 Related X-ray observations

AGN radiate over a very large domain of the electromagnetic spectrum. Many authors have therefore attempted to observe more or less simultaneously in different spectral domains. This has been a particularly successful mode of observations during the life of the X-ray satellite EXOSAT. Also when simultaneous observations are not available, X-ray results can be of importance to the interpretation of UV data. We therefore give 3 tables listing X-ray observations of EINSTEIN, EXOSAT and GINGA. EINSTEIN and EXOSAT having both an imaging instrument, we list all observations for which the ULDA source is located inside the field of view of the imaging X-ray instrument. We selected radii of 30' and 45' arcminutes for the fields of view EINSTEIN and EXOSAT respectively. This should ensure that all observations from these satellites for which useful data for the AGN may have been collected (also serendipitously) are listed. In the case of GINGA we simply list all observations related to AGN. The EINSTEIN and EXOSAT catalogs have been extracted from the EXOSAT data base at ESTEC. The GINGA catalog has been made available by R. Makino of ISAS. We warn that all data may not be completely accurate. Furthermore, in the case of GINGA, inclusion of an observation in the log does not imply that the data can be freely accessed. Access to the GINGA data can only be arranged through direct collaboration with the scientists at ISAS. Prof. R. Makino should be contacted for further information.

5 Description of the displayed information

Title

ULDA name of the object (the spaces are part of the name in ULDA except the one separating the catalog name from the number).

Box

The box contains the 1950.0 source coordinates as provided by the VILSPA station. In cases where the coordinates were not available we used the Véron-Cetty and Véron catalog and the SIMBAD data base.

The object type is from the Véron-Cetty and Véron catalog, the first word refers to the table in this catalog. For HII galaxies we omit the name of the table. For objects not included in the Véron-Cetty and Véron catalog, we state whether the object is a well known radio galaxy, else this field is left empty.

The ULDA type refers to the category number. Note that many objects appear in several categories which are all listed. This category is given to ease the reference in ULDA, not for its physical usefullness.

The sources of the redshifts are given in section 2. "Unknown" implies that we were unable to find the redshift.

The alternative names are denominations found in the SIMBAD data base. The number of names given was limited by space. We selected the most common names when choices had to be made.

Averaged Spectrum

See section 2 for the processing. The spectrum is displayed longward of 1225 Å to avoid the geocoronal Ly_α line.

Standard Deviation

Only when more than 8 spectra are available. See section 2 for a description of the algorithm.

Light Curves

Only when more than 8 spectra are available. See section 2 for a description of the algorithm. The uncertainty is indicated where possible by an error bar. The error bar is not a point of the light curve. It is always located in the upper right part of the graph. The time axis is given by the first and last epoch for which data are available. The same scale is used for the time axis in the three light curves. The FES data displayed has been corrected for the sensitivity decrease of the FES.

Table

A list of the spectra with their numbers is given in chronological order. We also give the modified Julian date (Julian date minus $2.4 \cdot 10^6$ days) together with the civilian date, the exposure time, the FES counts raw and corrected, the fluxes at wavelengths corrected for the redshift (see section 2). The codes are given in the IUE Newsletters, they are repeated here for ease of use: The digits 1 (column C) and 2 (column E) are the exposure level of the continuum and emission lines respectively, and the digit 3 (column B) is the background level.
Digits 1 and 2 are classified as follows:

0 - Not applicable
1 - No spectrum visible
2 - Faint spectrum, max $DN < 20$ above local background
3 - Underexposed, max $DN < 100$ above local background
4 - Weak, max DN between 100 and 150 above local background
5 - Good, no saturation but max $DN > 150$ above local background
6 - A bit strong, a few pixels saturated
7 - Saturated for less than half the spectrum
8 - Mostly saturated but some parts usable
9 - Completly saturated
x - overexposure in GSFC records

Digit 3: Background classification

0 - $DN < 20$
1 - $21 < DN < 30$
2 - $31 < DN < 40$
3 - $41 < DN < 50$
4 - $51 < DN < 60$
5 - $61 < DN < 70$
6 - $71 < DN < 80$
7 - $81 < DN < 90$
8 - $91 < DN < 100$
9 - $DN > 101$
x - saturated

A 'D' flag indicates a dubious exposure time. The sky spectra are identified by the word "SKY" in the table.

X-ray spectra

The numbers refer to the EINSTEIN and EXOSAT list of observations on page 811 et seq. and 832 et seq. respectively in volume B. The EXOSAT observations may be referred to directly with the numbers given. This is not the case for the EINSTEIN numbers. The GINGA observations referring to AGN are listed in the corresponding table on page 846 to which the ULDA name has been added where appropriate.

References

The numbers refer to the bibliographic table (volume B, pages 769 et seq.). See section 3 for the selection criteria.

6 Notes on individual Objects

Problems related to few individual objects and encountered in the course of our work are listed here. The list is certainly not exhaustive, it reflects those problems we spotted.

ABCG 85

We found the redshift of this object in Abell et al. (1989). The ULDA coordinates of this object don't match those of A 85-F found in Véron-Cetty and Véron.

3C 277, 3C 227

3C 227 appears in ULDA as AOO 3C 277 while 3C 277 appears as AOO 3C 277.3

NGC 4151

We removed the FES flux given for the June 1 1979 observations (LWR 4463L) in the FES light curve, as it was most certainly erroneous.

AOO 1218+304

There is a confusion in the name of this object. The observation SWP 24936L possibly belongs to the object MRK 180, as suggested by its true coordinates.

GQ COM

The exposure time of SWP 19721L is given as 1.1s in ULDA. The true exposure time given in the IUE log is, however, 9000s. We divided the entire spectrum by this new exposure time.

PG 1718+48

This object is very probably an other name for PG 1718+481. We put the observation SWP 34766L of PG 1718+48 with those of PG 1718+481.

ABCG 1829

The name (or the coordinates) of this object is a mistake. The coordinates of the observations are those of the IRAS object IR 1832-5926, which has approximatly the redshift measured on the ULDA spectrum.

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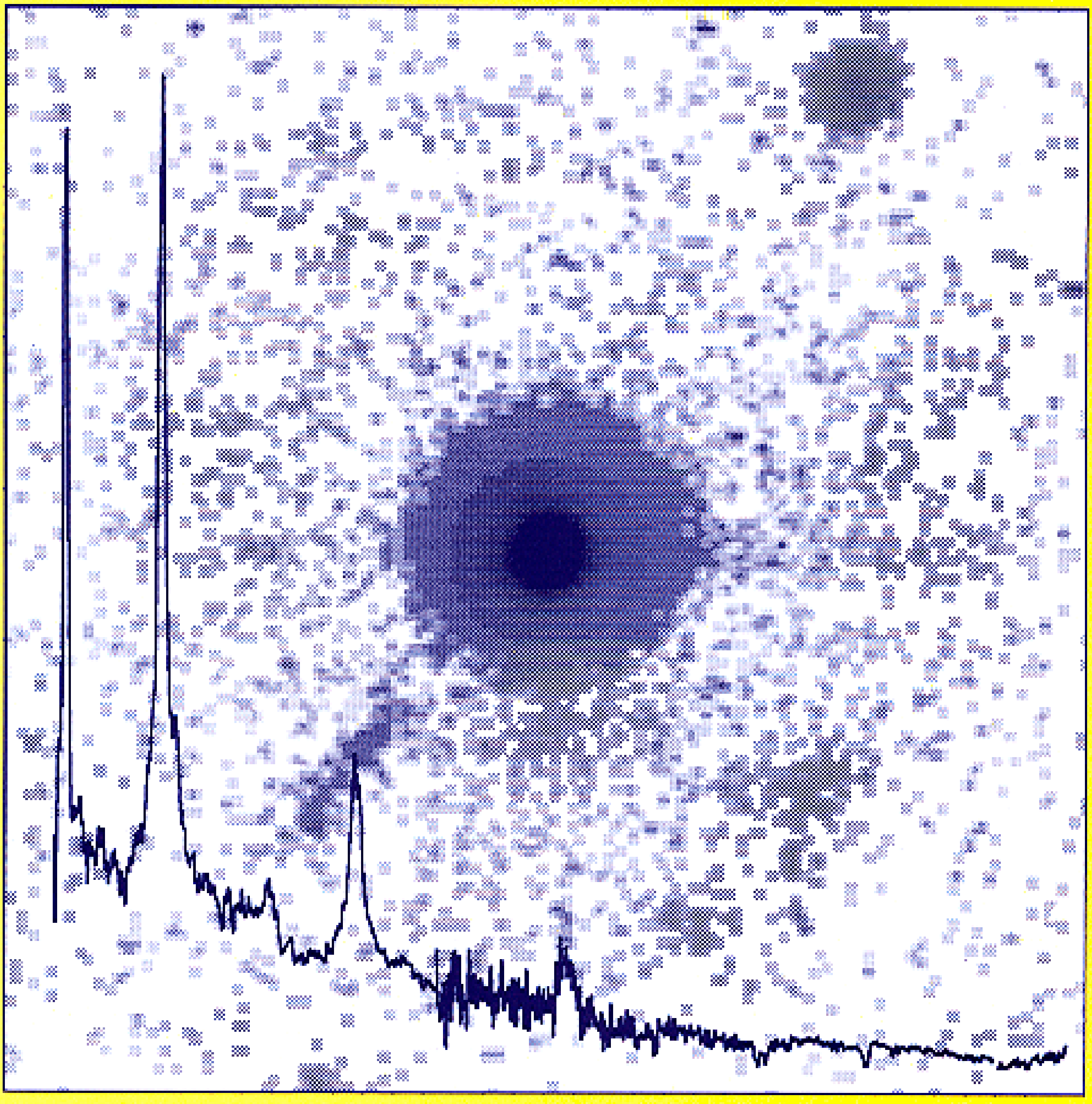

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FOREWORD

THE IUE ULDA/USSP ACCESS GUIDES

The International Ultraviolet Explorer (IUE) Satellite project is a joint effort between NASA, ESA and the SERC. The IUE Spacecraft and instruments are operated in a Guest Observer mode and are designed for Ultraviolet Spectrophotometry at two resolutions in the wavelength range from 115nm to 320nm. The low resolution is R=300 (1,000 Km/sec.) and the high resolution mode R=10,000 (19 Km/sec.). The IUE S/C, the scientific instruments, the data acquisition and reduction procedures are described in "Exploring the Universe with the IUE Satellite", Part I, Part VI and Part VII (Astrophysics and Space Sciences Library volume 129, Y. Kondo, Editor-in-Chief, Kluwer Acad. Publ. Co.) and references therein. From the very beginning of the project (launched on 26 January 1978) it was expected that the archival value of the data obtained with IUE would be very high. This expectation has been borne out in full after 14 years of orbital operations. The average IUE Archive data retrieval rate, during the 14 years of operations, is some 50,000 spectra per year. This compares with a new data collection rate of 5,500 spectra per year. Taking into consideration that the demand for observing time still exceeds the available time by a factor of 3, this clearly illustrates that the IUE Archive is an important part of the IUE Project. The IUE ULDA/USSP, which was specifically developed by ESA to make IUE spectra available in a way which would not involve the project staff and thus simplify the process of consulting IUE data, has over the last few years supported 49% of all data retrieval from the IUE Project. This illustrates that the ULDA/USSP has fulfilled, through remote unassisted dearchiving, an existing need in the access to IUE Data. The low resolution data set was chosen since it represented a data set excellently suitable for remote dearchiving processes and it allowed a design which would not overload the facilities available in 1987 at the -currently 17- National Host Institutes.

The subset of the IUE Spectral Archive contained in the ULDA and accessible through the USSP consists of the low resolution IUE spectra in a form directly applicable to modern Scientific Analysis techniques. Version 4.0 of the ULDA/USSP is released in July 1992 and contains all -98.7% complete- low resolution spectra obtained with IUE before January 1st, 1991 (about 53,000 spectra). The details of the construction of the ULDA and the design of the USSP can be found in Wamsteker et al. (Astronomy and Astrophysics Supplement Series, Vol. 79,pg 1-10, 1989) and in ESA IUE Newsletter #30, which also contains a users guide. The design and software coding of the USSP has been a coordinated effort between the ST-ECF, R.A.L.,Trieste Observatory and the ESA IUE Observatory. The production of the ULDA and the overall coordination of the ULDA/USSP has been done at the ESA IUE Observatory at VILSPA. New developments include a UNIX version of the USSP (USSP Version 4.0), developed in collaboration with the Canadian Astronomical Data Centre (CADC) and the Trieste Observatory.

The quantity of data in the IUE Archive is sufficiently large that it is not necessarily simple to address the data efficiently in the context of an astrophysical problem, even under the IUE Uniform Low Dispersion Archive (ULDA) and its ULDA Support Software Package (USSP),with access to the data extremely easy. The purpose of the series of ULDA Access Guides is: To facilitate the use of the ULDA/USSP for scientists with a specific astrophysical problem in mind.

The series consists of a number of -subject oriented- books such as this one, for which a specialist in the field has been invited to take the scientific responsibility. ULDA Access Guide No. 4 (Volumes 4a and 4b) treats the data of ACTIVE GALACTIC NUCLEI and has been compiled by Thierry J.-L. Courvoisier of the Observatoire de Genève, Geneva, Switzerland and Stéphane Paltani, Institut d'Astronomie, Lausanne, Switzerland. In this issue they present an overview of the spectra of all Active Galactic Nuclei, from Narrow Line Emission Line Galaxies to Quasars and BL Lac objects observed with IUE. It illustrates the sample of such objects presently included in the IUE Archive and the variability characteristics of the objects. They have also collected information on the data obtained of these objects with the various X-Ray satellites which have operated in conjunction with the IUE Science Observing program. Due to the large amount of work involved in such compilation and the dynamic nature of the ULDA, it is not possible to make both the existing version of the ULDA, and the auxiliary information cover exactly the same period. It was judged to be preferable to collect all information available at the time of preparation, rather than artificially make the time periods covered in the ULDA Guides and the current Version of the ULDA coincide. In volume 4a and 4b the auxiliary information is included for all data in ULDA Version 3.0, extending to January 1st, 1990.

Further volumes of the ULDA Access Guides (see also page 433) will be published whenever the necessary data compilation has been completed by the authors. For details of the access to the ULDA through the National Hosts for 22 countries we refer to the details supplied regularly in the ESA IUE Newsletters (especially Driessen, Pasian and Talavera, 1988, IUE Newsletter #30, containing the ULDA/USSP Users Guide). Any inquiries on the access to the ULDA and the use of the USSP should be directed to the National Host Managers (see page 431). Inquiries about the specific data content of the ULDA should be directed to ULDA Manager at the ESA IUE Observatory at VILSPA, Madrid, Spain.

Willem Wamsteker

The IUE ULDA is accessible through the National Hosts:

```
BELGIUM:
Koninklijke Sterrewacht, Brussels,
         serving: Belgium.
Host Manager: MARIJKE@ASTRO.OMA.BE (Marijke Burger).

BRAZIL:
Instituto Astronomica e Geofisico (IAG-USP), Sao Paolo.
         serving: Brazil.
Host manager: 47556::LUIS (Luis Arakaki & Ronaldo E. de Souza).
              IAGUSP%FPSP.HEPNET@LBL.BITNET

CANADA:
Canadian Astronomical Data Center (DOA/CADC), Victoria.
         serving: Canada.
Host Manager: NCF::PSI%DAO::CRABTREE (Dennis Crabtree).
              CRABTREE@NRCDAO

CHILE:
Cerro Tololo Inter-American Observatory (CTIO), La Serena.
         serving: Chile
Host Manager:SHEATHCOTE@CTIO.NOAO.EDU (Steve Heathcote)

FRANCE:
Centre de Donnees Stellaire (CDS),Strassbourg
         serving: France.
Host Manager:  CDSXB2::JASNIEWICZ  (Gerard Jasniewicz).
               JASNIEWI@FRCCSC21

GERMANY:
Astronomisches Institut Tuebingen (AIT),Tuebingen.
         serving: Germany.
Host Manager: AITMVX::SCALES  (Dominic Scales).
              PSSC001@DTUZDV5A

ITALY:
Osservatorio Astronomico di Trieste (OAT),Trieste.
         serving: Italy.
Host Manager: ASTRTS::FRANCHINI (Mariagrazia Franchini)
              FRANCHINI@ASTRTS.INFNET
```

JAPAN
National Astronomical Observatory, CACAD, Tokyo.
serving: Japan
Host Manager: RNISHIM@C1.MTK.NAO.AC.JP (Shiro Nishimura)
A32404@JPNKUDPC

the NETHERLANDS:
Sterrekundig Institute, Utrecht,
serving: the Netherlands
Host Manager:VERBUNT@HUTRUU51 (Frank Verbunt & Ed van der Zalm)

PEOPLES REPUBLIC of CHINA:
Center for Astrophysics, (USTC), Hefei.
serving: Peoples Republic of China.
Host Manager: (Wang Ting-gui)

SPAIN:
ESA IUE Observatory (VILSPA), Madrid.
serving: Spain,Portugal.
Host Manager: 28843::CD (Cornelius Driessen & Antonio Talavera)

SWEDEN:
Uppsala Astrophysical Institute,
serving: Sweden,Norway,Denmark,Finland.
Host Manager: KE@LABAN.UU.SE (Kjell Eriksson).
ASTKE@SEUDAC21

SWITZERLAND:
Institut d' Astronomie, Lausanne.
serving: Switzerland
Host Manager: BERTHET@OBS.UNIGE.CH (Stephane Berthet).
20579::UGOBS::BERTHET

TAIWAN:
National Central University,IPA, Chung-Li
serving: Taiwan.
Host Manager: [0487]230035::WHSUN (Sun Wei-Hsin).
NCUT037@TWNMOE10

UNITED KINGDOM:
Rutherford and Appleton Laboratories,
serving: United Kingdom & Ireland.
Host Manager:19457::DS (Dave Stickland)

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U.S.A.:
National Space Sciences Data Centre (NSSDC), Greenbelt,MD.
         serving: U.S.A.,Mexico.
Host Manager: NCF::ULDA  (Charleen Perry & Michael van Steenberg)
              NCF::PERRY

ST-ECF/ESO (Garching/Munich)
         serving: Local use only.
Host Manager: ESOMC1::PASIAN  (Fabio Pasian)
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Earlier issues of the IUE-ULDA Access Guides:

IUE-ULDA Access Guide No.1 ESA SP 1114
C. la Dous : Dwarf Novae and Nova-like Stars

IUE-ULDA Access Guide No.2 ESA SP 1134
M. Festou : Comets

IUE-ULDA Access Guide No.3 ESA SP 1152
G. Longo, M.Cappaccioli: Normal Galaxies

ULDA Access Guide No. 4

1 Introduction

There are different types of activity in the nucleus of galaxies. The most extreme form of activity is that of the quasars. The luminosity of these objects can be as high as several $10^{47} ergs \cdot s^{-1}$, their continuum spectral energy distribution spans most of the known electromagnetic spectrum from the far infrared (or even the radio domain for some of them) to the γ-rays. Prominent and broad emission lines indicating typical velocities of several thousand kilometers per second are observed in the infrared, optical and UV emission of these objects. A very similar, although somewhat weaker, type of activity is observed in the Seyfert galaxies. The broad lines may be hidden in some of these objects. Still weaker activity is seen in the LINERS where only low ionisation lines can be observed. The BL Lac objects also belong to the Active Galactic Nuclei, although they show only very weak emission lines, because of their very strong variability and high polarisation. In fact most if not all the active nuclei of galaxies are variable on a wide range of time scales.

The complex properties of the Active Galactic Nuclei (AGN) are still far from beeing understood. Their continuum emission in the optical and ultraviolet domains is often dominated by a component called the big blue bump. This expresses that the flux in this spectral domain is considerably larger than expected from the extrapolation of the infrared power law. This component is often associated with an accretion disc, the flux beeing emitted either by the gravitational energy released in the disc or by the reprocessing of X-rays generated outside of the disc.

Active Galactic Nuclei (AGN) have been one of the type of objects observed frequently with IUE. IUE studies of AGN were of very different nature, some were concerned with the emission lines of single objects or small samples. These investigations concentrated on emission line ratios, relationship with the ionising continuum, profiles of the lines and possible accretion disc signatures. Other programs were concerned with the continuum emission, the shape of the continuum spectral energy distribution and, also, the possible signs of an accretion disc. Further studies looked at the variations observed in the continuum and/or in the emission lines. These variations are complex, they are observed not only in the observed flux, but also in the line profiles and in the shape of the continuum spectral energy distributions. The data base resulting from these investigations is very inhomogenous, although large campaigns of observations have been organised in recent years. This data base provides a rich source of high quality data that can be used in a context that goes beyond the original aims of the proposers. This happens because our understanding of the physics of AGN has considerably progressed in the last ten years, but also because the richness and the variety of the data collected allows for far more collective studies than could be anticipated. As a result of these considerations and in view of the increased usage of the IUE archive in the astronomical community (not restricted to specialists in UV astronomy) it was deemed useful to provide a summary of those data now in the Uniform Low Dispertion Archive (ULDA) of IUE.

This summary is intended to help researchers find the IUE data relevant for a given problem. It was therefore designed to present the data without giving or suggesting any interpretations. Care was given to provide a complete view of the data (i.e. both spectral and temporal information) with as little processing as possible. The analysis presented here is described below, it was run in an automatic mode. The results should therefore be considered to be a guide line and cannot be expected to replace a personal inspection of the actual data.

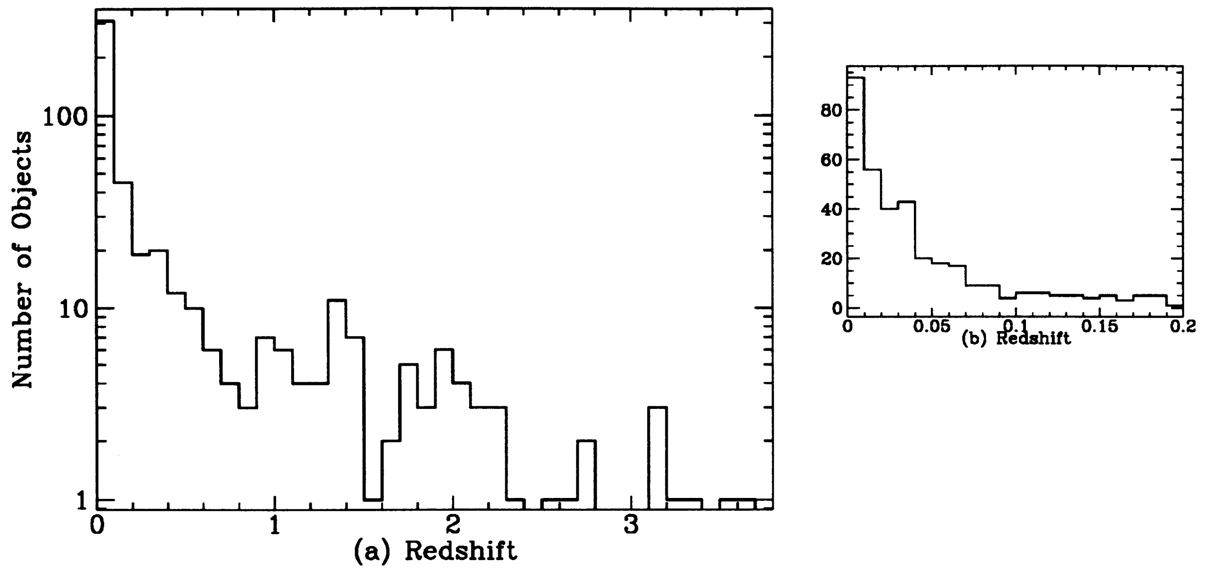

Figure 1: The number of sources as a function of the redshift (a): all sources with known redshift and (b): redshifts less than 0.2. We have been unable to find the redshift of 24 sources (essentially BL Lac sources with no known redshift) which are not included in the figure.

The sample of objects included here is not complete in any sense of the word. It merely reflects the imagination (or lack thereof) of the succession of IUE observers from 1978 to 1988. In total, 522 objects are considered, the objects belong to the ULDA categories 84 (Seyfert galaxies), 85 (quasars), 86 (radio galaxies), 87 (BL Lac objects) and 88 (LINERS). There is, however, a certain randomness in the category attached to the spectra, the same object appearing in several classes. These categories are not used any further in the analysis. The sample is described in the following set of figures: Fig. 1 gives a histogram of the number of sources as a function of their redshift. Fig. 2 gives the histogram of the number of sources as a function of their 1250 Å (observed wavelength) flux. Fig. 3 gives the number of sources as a function of the luminosity at 1250 Å in the source frame (see below for the redshift information; $H_0 = 50 km \cdot sec^{-1} \cdot Mpc^{-1}$). Fig. 4 gives a 2-dimensional

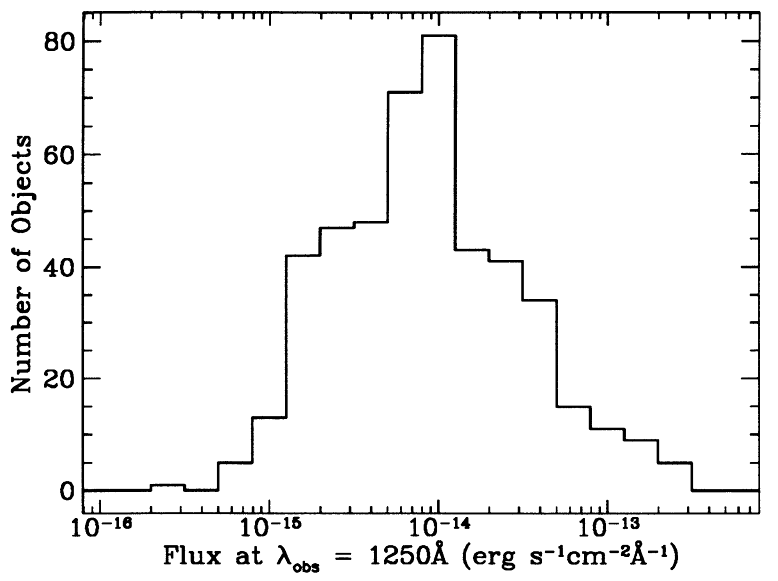

Figure 2: Number of sources as a function of their 1250 Å flux. The flux was averaged over a 50 Å bin centered on 1250 Å in the observer frame.

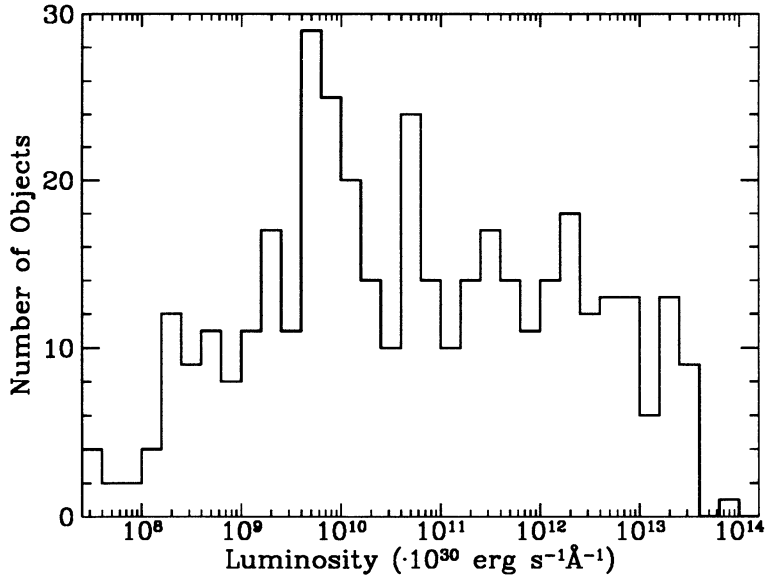

Figure 3: Number of sources as a function of the source luminosity at 1250 Å in the object frame. The luminosity was estimated by averaging the flux over 50 Å and using $H_0 = 50 km \cdot sec^{-1} \cdot Mpc^{-1}$.

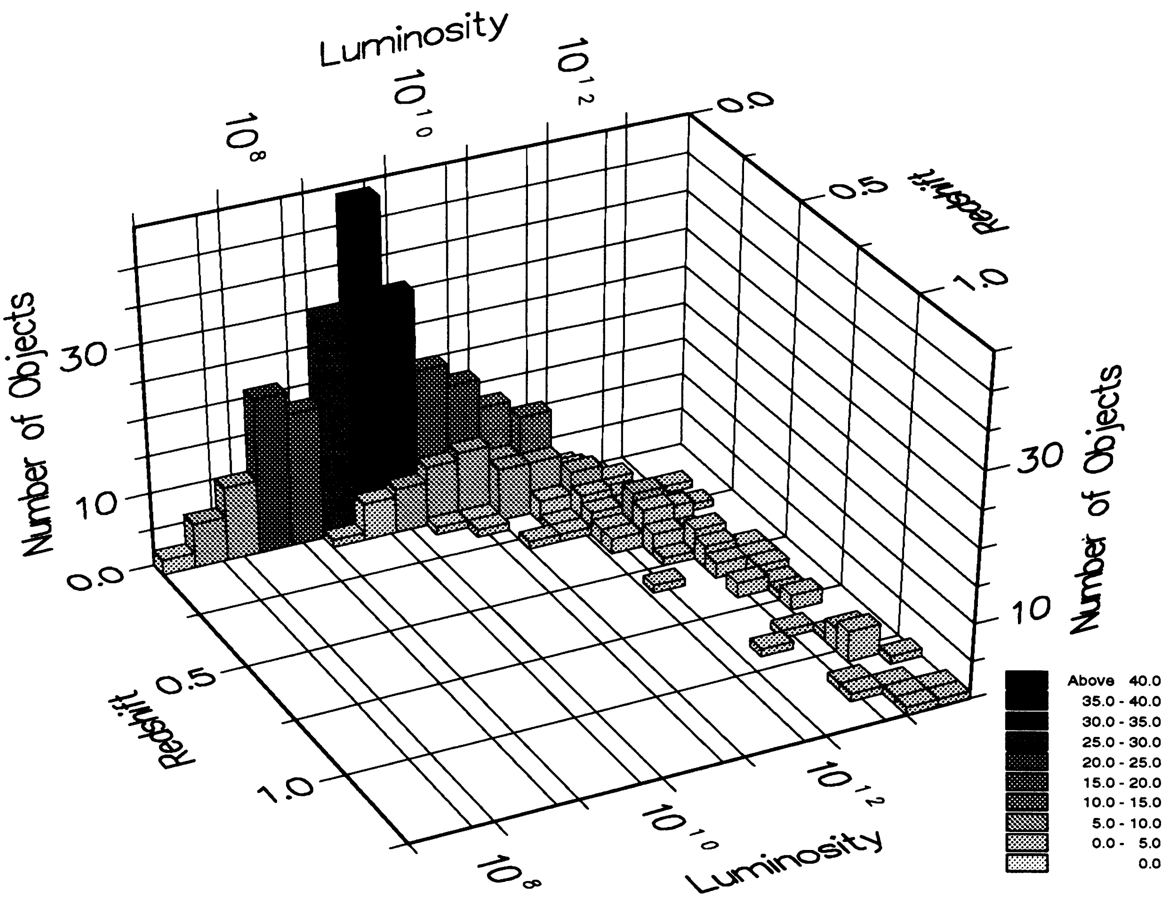

Figure 4: The information of figures 1 and 3 is repeated here in a two dimensional histogram of the number of sources as function of redshift and luminosity. Luminosity is expressed in unit of $10^{30} erg \cdot s^{-1} \cdot \AA^{-1}$

histogram of the number of objects as a function of their redshift and luminosity. 3486 spectra of the 522 objects are described in the following pages. The number of objects with a given number of SW observations, i.e. with a given quality of temporal information is given in fig. 5.

2 Data Processing

All data presented here have been taken from the ULDA version 3.0 complete until December 1988 and read into a series of tables. ULDA is described in Wamsteker et al. (1989), and a concise description of IUE and its data can be found in "Exploring the Universe with the IUE Satellite" Ed. in Chief Y. Kondo Reidel 1987. Driessen and Pasian (1988) have written a detailed USSP user's guide (ULDA Software Support Package) which helps

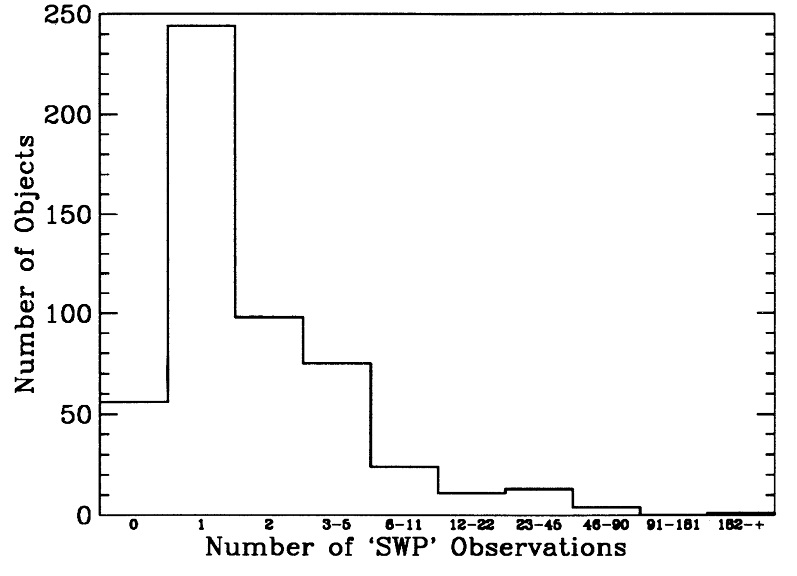

Figure 5: Number of sources as a function of the number of their SW observations.

to gain an easy access to ULDA. All the data from the ULDA classes 84 to 88 have been used. We did not, however, attempt to find those few observations of AGN misclassified in other object classes.

The ULDA spectra have been re-binned to bin-widths of 1 Å before being joined together. The SW spectra have been cut above 1950Å and the LW cut below the same wavelength. Observations performed with the small aperture have been excluded from all computations. The spectra in both wavelength domains have been averaged (where observations have been repeated) to display a better signal to noise spectrum of the object.

Since AGN are variable objects we present whenever possible light curves. In order to provide data in the same spectral range for objects of different redshifts, we selected 2 rest wavelengths (1250 Å and 2200 Å relatively free from strong emission lines) and display the fluxes averaged over 50 Å centered on the corresponding wavelengths in the frame of the observer. The redshifts of the objects have been taken from Véron-Cetty and Véron (1991). For those liners and radio galaxies not listed in Véron-Cetty and Véron (1991) the redshifts and coordinates are from the revised Shapley-Ames Catalog, the ESO-Uppsala B Catalog (A. Lauberts and E. A. Valentijn, 1989), from Lang (1974) (for radio galaxies) and from the original literature (see e.g. Xu et al., 1988). When the redshift is so large that the 50 Å bin lies outside the IUE range, we give the fluxes (and where appropriate plot the light curves) at 1500Å and/or 3000Å (in the observer frame) respectively. For those objects for which we did not find the redshift we set z=Unknown and we exclude them from figures 1, 3 and 4.

Error bars (one standard deviation of the fluxes measured in a single day) have been calculated for the light curves of those objects for which more than 1 spectrum were obtained at one epoch. When several epochs exist for which several spectra were taken the same day, the average of the standard deviations is used as an estimate of the uncertainty. Note that this approach assumes that the variations within one day are less than the uncertainty. This is probably true for many sources. We do not attempt to estimate the uncertainty for the sources for which there is no epoch with more than one spectrum, as no reliable simple method is available.

In addition to the UV light curve, we also give a measure of the amplitude of the variations as a function of the wavelength for those objects with more than 8 spectra. This was calculated for 50Å bins. We give the sample standard deviation

$$s(\lambda) = (\frac{1}{N-1}\sum_{i=1}^{N}(f_i(\lambda) - < f(\lambda) >)^2)^{1/2}$$

(where $f_i(\lambda)$ is the flux averaged over 50 Å at epoch i, $< f(\lambda) >$ is the same flux averaged over all available epochs and N is the number of epochs, usually different for both ranges SW and LW) divided by the mean flux.

IUE has the property of measuring, for bright enough objects, a broad band flux in the optical domain with the Fine Error Sensor (FES). In view of the interest in correlated UV and optical variations in AGN, we also give the FES light curve and fluxes where available. The sensitivity of the FES has been decreasing with time (Imhoff and Wasatonic, 1986). We therefore show the corrected light curve in the following graphs using the calibration of C. R. Imhoff and R. Wasatonic. We give, however, also the raw FES counts as given in ULDA to allow the user to reconstitute and refine the treatment given here.

For those sources with less than 8 spectra (including SW and LW spectra), we do not give the variability information in a graphical way but only list all the equivalent data in a table.

In some cases, spectra are obtained simultaneously with both camera in order to obtain a good signal to noise sky spectrum from the camera not pointed towards the source. Not all these instances are well documented in the data. We therefore looked at all pairs of spectra with overlapping exposures to find which is sky and which is object. The sky spectra have been excluded from the object computations.

3 Bibliography

In absence of a reasonably comprehensive UV related bibliography we used the SIMBAD data base (see e.g. Egret et al., 1988), selecting all references related to objects contained in the sample studied here. From the resulting about 6000 different bibliographical references, we selected 942 papers. The selection is based on the title of the papers. We selected those references of interest (in our view) to the users of the present compilation. In this selection, we concentrated on papers related to UV data or interpretations closely linked with low dispersion UV spectroscopy. This process is not devoid of a certain arbitrariness and we apologise to those authors whose papers have been mis-represented or omitted.

4 Related X-ray observations

AGN radiate over a very large domain of the electromagnetic spectrum. Many authors have therefore attempted to observe more or less simultaneously in different spectral domains. This has been a particularly successful mode of observations during the life of the X-ray satellite EXOSAT. Also when simultaneous observations are not available, X-ray results can be of importance to the interpretation of UV data. We therefore give 3 tables listing X-ray observations of EINSTEIN, EXOSAT and GINGA. EINSTEIN and EXOSAT having both an imaging instrument, we list all observations for which the ULDA source is located inside the field of view of the imaging X-ray instrument. We selected radii of 30' and 45' arcminutes for the fields of view EINSTEIN and EXOSAT respectively. This should ensure that all observations from these satellites for which useful data for the AGN may have been collected (also serendipitously) are listed. In the case of GINGA we simply list all observations related to AGN. The EINSTEIN and EXOSAT catalogs have been extracted from the EXOSAT data base at ESTEC. The GINGA catalog has been made available by R. Makino of ISAS. We warn that all data may not be completely accurate. Furthermore, in the case of GINGA, inclusion of an observation in the log does not imply that the data can be freely accessed. Access to the GINGA data can only be arranged through direct collaboration with the scientists at ISAS. Prof. R. Makino should be contacted for further information.

5 Description of the displayed information

Title

ULDA name of the object (the spaces are part of the name in ULDA except the one separating the catalog name from the number).

Box

The box contains the 1950.0 source coordinates as provided by the VILSPA station. In cases where the coordinates were not available we used the Véron-Cetty and Véron catalog and the SIMBAD data base.

The object type is from the Véron-Cetty and Véron catalog, the first word refers to the table in this catalog. For HII galaxies we omit the name of the table. For objects not included in the Véron-Cetty and Véron catalog, we state whether the object is a well known radio galaxy, else this field is left empty.

The ULDA type refers to the category number. Note that many objects appear in several categories which are all listed. This category is given to ease the reference in ULDA, not for its physical usefullness.

The sources of the redshifts are given in section 2. "Unknown" implies that we were unable to find the redshift.

The alternative names are denominations found in the SIMBAD data base. The number of names given was limited by space. We selected the most common names when choices had to be made.

Averaged Spectrum

See section 2 for the processing. The spectrum is displayed longward of 1225 Å to avoid the geocoronal Ly_α line.

Standard Deviation

Only when more than 8 spectra are available. See section 2 for a description of the algorithm.

Light Curves

Only when more than 8 spectra are available. See section 2 for a description of the algorithm. The uncertainty is indicated where possible by an error bar. The error bar is not a point of the light curve. It is always located in the upper right part of the graph. The time axis is given by the first and last epoch for which data are available. The same scale is used for the time axis in the three light curves. The FES data displayed has been corrected for the sensitivity decrease of the FES.

Table

A list of the spectra with their numbers is given in chronological order. We also give the modified Julian date (Julian date minus $2.4 \cdot 10^6$ days) together with the civilian date, the exposure time, the FES counts raw and corrected, the fluxes at wavelengths corrected for the redshift (see section 2). The codes are given in the IUE Newsletters, they are repeated here for ease of use: The digits 1 (column C) and 2 (column E) are the exposure level of the continuum and emission lines respectively, and the digit 3 (column B) is the background level.
Digits 1 and 2 are classified as follows:

0 - Not applicable
1 - No spectrum visible
2 - Faint spectrum, max $DN < 20$ above local background
3 - Underexposed, max $DN < 100$ above local background
4 - Weak, max DN between 100 and 150 above local background
5 - Good, no saturation but max $DN > 150$ above local background
6 - A bit strong, a few pixels saturated
7 - Saturated for less than half the spectrum
8 - Mostly saturated but some parts usable
9 - Completly saturated
x - overexposure in GSFC records

Digit 3: Background classification

0 - $DN < 20$
1 - $21 < DN < 30$
2 - $31 < DN < 40$
3 - $41 < DN < 50$
4 - $51 < DN < 60$
5 - $61 < DN < 70$
6 - $71 < DN < 80$
7 - $81 < DN < 90$
8 - $91 < DN < 100$
9 - $DN > 101$
x - saturated

A 'D' flag indicates a dubious exposure time. The sky spectra are identified by the word "SKY" in the table.

X-ray spectra

The numbers refer to the EINSTEIN and EXOSAT list of observations on page 811 et seq. and 832 et seq. respectively in volume B. The EXOSAT observations may be referred to directly with the numbers given. This is not the case for the EINSTEIN numbers. The GINGA observations referring to AGN are listed in the corresponding table on page 846 to which the ULDA name has been added where appropriate.

References

The numbers refer to the bibliographic table (volume B, pages 769 et seq.). See section 3 for the selection criteria.

6 Notes on individual Objects

Problems related to few individual objects and encountered in the course of our work are listed here. The list is certainly not exhaustive, it reflects those problems we spotted.

ABCG 85

We found the redshift of this object in Abell et al. (1989). The ULDA coordinates of this object don't match those of A 85-F found in Véron-Cetty and Véron.

3C 277, 3C 227

3C 227 appears in ULDA as AOO 3C 277 while 3C 277 appears as AOO 3C 277.3

NGC 4151

We removed the FES flux given for the June 1 1979 observations (LWR 4463L) in the FES light curve, as it was most certainly erroneous.

AOO 1218+304

There is a confusion in the name of this object. The observation SWP 24936L possibly belongs to the object MRK 180, as suggested by its true coordinates.

GQ COM

The exposure time of SWP 19721L is given as 1.1s in ULDA. The true exposure time given in the IUE log is, however, 9000s. We divided the entire spectrum by this new exposure time.

PG 1718+48

This object is very probably an other name for PG 1718+481. We put the observation SWP 34766L of PG 1718+48 with those of PG 1718+481.

ABCG 1829

The name (or the coordinates) of this object is a mistake. The coordinates of the observations are those of the IRAS object IR 1832-5926, which has approximatly the redshift measured on the ULDA spectrum.

AOO H 2106 -09, AOO 2107-097

These two names refer probably to the same object, named H 2106-099 in Véron-Cetty and Véron. It appears under different names in SIMBAD. We grouped the spectra of these objects in a single analysis.

QSO 2223-052, QSO 2223-051

The same object, better known as 3C 446, appears under the ULDA names QSO 2223-052 and QSO 2223-051. We put them together under the first name for the entire analysis.

References

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Xu C., De Zotti G., Franceschini A. and Danese L., 1988, Astron. Astrophys., 196, 59.

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