

INES: The Next Generation Astronomical Data Distribution System

R. González-Riestra, E. Solano, A. Talavera¹, F. Rodríguez, J. García, J. Martínez, B. Montesinos, L. Sanz

*Laboratorio de Astrofísica Espacial y Física Fundamental (LAEFF),
P.O. Box 50727, 28080 Madrid, Spain*

A. de la Fuente, I. Skillen², J. D. Ponz, W. Wamsteker

*Villafranca Satellite Tracking Station (VILSPA), P.O. Box 50727,
28080 Madrid, Spain*

Abstract. The IUE Archive was the first astronomical archive to be made accessible on-line, back in 1985, when the World Wide Web didn't even exist. The archive stores more than 110000 spectra which span nearly two decades of Ultraviolet Astronomy. The IUE Newly Extracted Spectra System (INES), a complete astronomical archive and its associated data distribution system, was developed with the goal of delivering IUE data to the scientific community in a simple and efficient form. Data distribution is structured into three levels: a Principal Centre at LAEFF (Laboratory for Space Astronomy and Theoretical Physics, owned by the Spanish National Institute for Aerospace Technology) and its Mirror at CADC, a number of National Hosts (currently 22), and an unlimited number of end users. The INES Principal Centre can be reached at <http://ines.vilspa.esa.es>.

1. Introduction

Archives are essential components of all astronomical space observatories. Their holdings are in most cases unique, and they allow the re-use of the data for many different scientific purposes. Astronomical space archives are excellent tools for the study of variable phenomena, and provide reference information for the planning and calibration of new missions. Moreover, archives are a precious source of data for many didactic purposes.

From its beginning, the ESA-IUE project at VILSPA has made special efforts to define the mission archive and to distribute data to the scientific community worldwide. In 1985 the IUE ULDA (Uniform Low Dispersion Archive) became the first on-line astronomical archive.

¹Presently at the XMM Science Operations Centre, VILSPA

²Presently at the Isaac Newton Group, La Palma

Taking advantage of the expertise gained with ULDA and the distribution system for IUE Final Archive data, the ESA-IUE Observatory began to develop INES in early 1997. INES is a complete astronomical archive and the associated mechanism for data distribution. Its goal is to make accessible the complete dataset obtained by the International Ultraviolet Explorer during nearly twenty years of operations to the scientific community in a simple, user-friendly and efficient form (Wamsteker et al. 2000).

In early 1998, ESA decided to put an end to its involvement in the IUE project, and to deliver the IUE archive to the scientific community. In May 1998 the Science Programme Committee of ESA selected LAEFF (Laboratory for Space Astrophysics and Theoretical Physics, owned by the Spanish Institute for Aerospace Technology INTA) to become the INES Principal Centre. During the period January 1999–June 2000, ESA and LAEFF developed jointly the “INES Transfer Programme”, after whose completion LAEFF assumed full responsibility for the maintenance and development of the INES system. Thus, in the coming years, LAEFF will be the repository of the largest and most complete set of data in the ultraviolet domain.

2. The INES System

The INES system has the following design goals:

- to deliver **fully calibrated data** in a form that does not require a detailed knowledge of the instrumental characteristics,
- to decrease the volume of information in the archive, excluding intermediate products and technical information without direct relevance to the user,
- to apply state-of-the-art technology in terms of data distribution techniques, but minimizing the development effort by using tools already available,
- to reduce the costs associated with the archive support.

2.1. The Distribution System

The distribution system has a three-level structure to avoid single points of failure in the system and to reduce the chances of “network bottlenecks” impacting performance:

- A **Principal Centre** at LAEFF, with a **Mirror Site** at the Canadian Astronomical Data Centre (CADC). Both sites contain the master archive and provide the data not available at the National Hosts (high resolution and spatially resolved low resolution data, see below). The Principal Centre is responsible for new software releases and the update of the catalogues.
- A number of **National Hosts**, containing the access and publications catalogues and the full set of low resolution and re-binned spectra. At the time of writing, INES is installed at the following National Hosts: Argentina, Austria, Belgium, Brazil, Canada, China (P.R.)³, ESO, France,

³Local access only

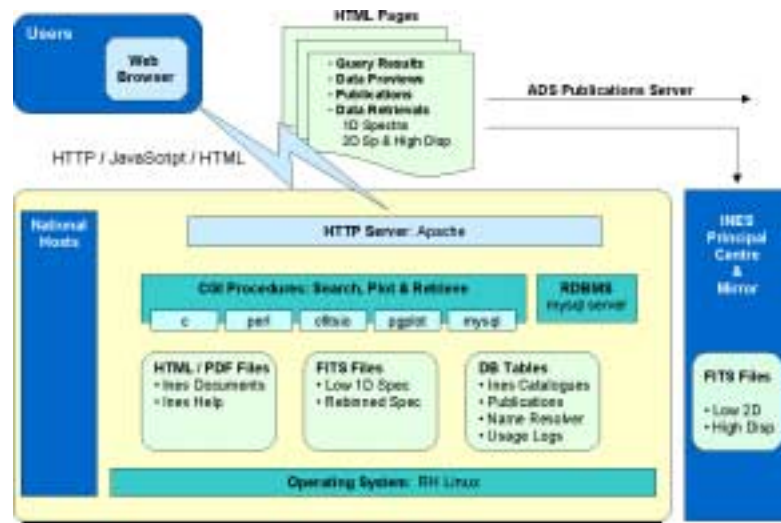


Figure 1. Implementation Scheme of the INES System.

Israel, Italy, Japan, South Korea, Mexico, Morocco, The Netherlands, Poland, Russia, Spain, Sweden, Taiwan, the United Kingdom and the United States.⁴

- an unlimited number of **end users**, who access the archive via the WWW using any standard browser.

2.2. The Data

The INES archive contains the following set of IUE data:

- Low dispersion spectra, re-extracted from the IUE Final Archive files with improved algorithms (Rodríguez-Pascual et al. 1999) (1.2 GB),
- High dispersion spectra, re-binned to the low dispersion wavelength scale (González-Riestra et al. 2000) (0.6 GB),
- High dispersion spectra, with orders concatenated and correct wavelength scale (Cassatella et al. 2000, González-Riestra et al. 2000) (12.5 GB).
- Low dispersion spatially-resolved spectra, as available in the IUE Final Archive (16.8 GB).

High dispersion and bi-dimensional spectra reside both at the Principal Centre and its Mirror. Low dispersion and re-binned data are distributed to all National Hosts. Requests for retrieval of the latter types of data are resolved locally at the National Host, and requests for high dispersion or bi-dimensional spectra are forwarded to the Principal Centre or its Mirror, from where the data are delivered to the user in a transparent way. All the data are delivered in FITS

⁴The minimum hardware required for a National Host is: a server with an Intel Pentium or similar CPU, 32 MB RAM, 5–6 GB hard disk, a permanent Internet connection, and a CD-ROM reader. The major software components used in the National Host installation are (see Figure 1): the Linux Operating System (the current installation has been tested in RedHat Linux 6.2. and 7.0), PERL (version 5.005-03) together with the Data Base Interface and Data Base Driver modules, MySQL (version 3.22-32-1), CFITSIO, and PGPLOT (version 5.2.0).

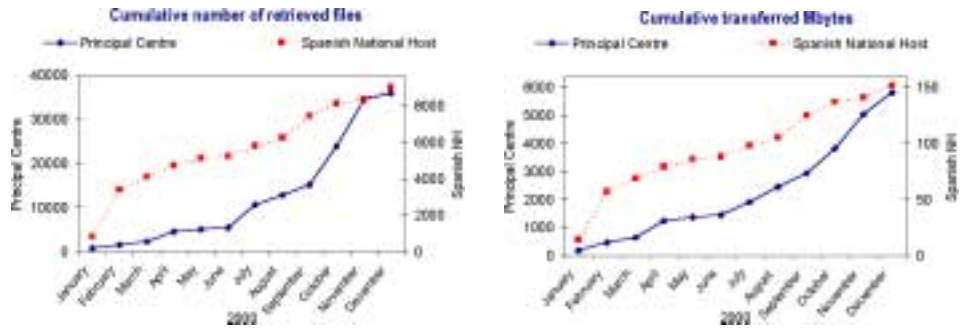


Figure 2. Usage statistics of the INES Principal Centre and the Spanish National Host in 2000.

format and can be read into standard image processing packages (e.g., MIDAS, IDL, IRAF) without special-purpose software.

INES has been operational for three years now. The first release of the system (INES 1.0) was installed in VILSPA in November 1997. INES 2.0, which represented a major upgrade of the system, was installed in August 1999, and distributed to the National Hosts in November of that year. INES 3.0 was installed for testing at the Spanish National Host in August 2000, and is being distributed at the time of writing. The main functionalities of this last release of the system are described by Solano et al. (2001). The usage of the archive has increased substantially along the last year (see Figure 2). The number of files retrieved from the Spanish National Host and the Principal Centre was 26000 in 1999, growing up to 45000 in 2000. The total volume of data transferred increased from 2.3 to 6.0 GB in the same period.

References

Cassatella, A., Altamore, A., González-Riestra, R., Ponz, J. D., Barbero, J., Talavera, A. & Wamsteker, W. 2000, *A&AS*, 141, 331
 González-Riestra, R., Cassatella, A., Solano, E., Altamore, A. & Wamsteker, W. 2000, *A&AS*, 141, 343
 Rodríguez-Pascual, P. M., González-Riestra, R., Schartel, N. & Wamsteker, W. 1999, *A&AS*, 139, 183
 Solano, E., González-Riestra, R., Rodríguez, F., Talavera, A., de la Fuente, A., Skillen, I., Ponz, J. D. & Wamsteker, W. 2001, this volume, 152
 Wamsteker, W., Skillen, I., Ponz, J. D., de la Fuente, A., Barylak, M. & Yurrita, I. 2000, *Ap&SS*, 273, 155