

The INES Archive in the era of Virtual Observatories

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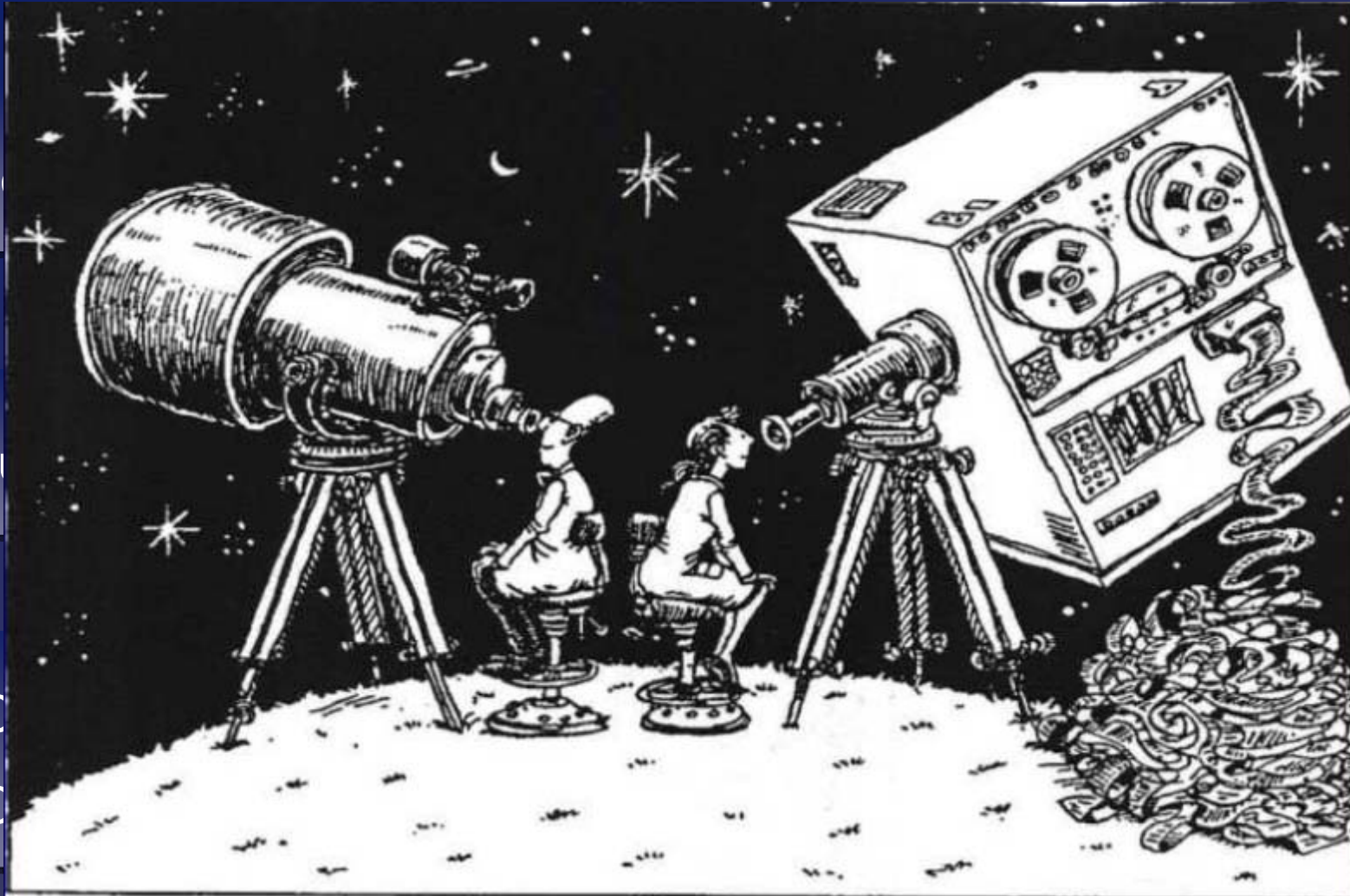


Outline



- Introduction: Archives in Astronomy
- The IUE Archive
 - Curation and preservation
 - Added-value products
 - Catalogues
 - Virtual Observatory
- Conclusions

Astronomy: a communal organisation



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- C

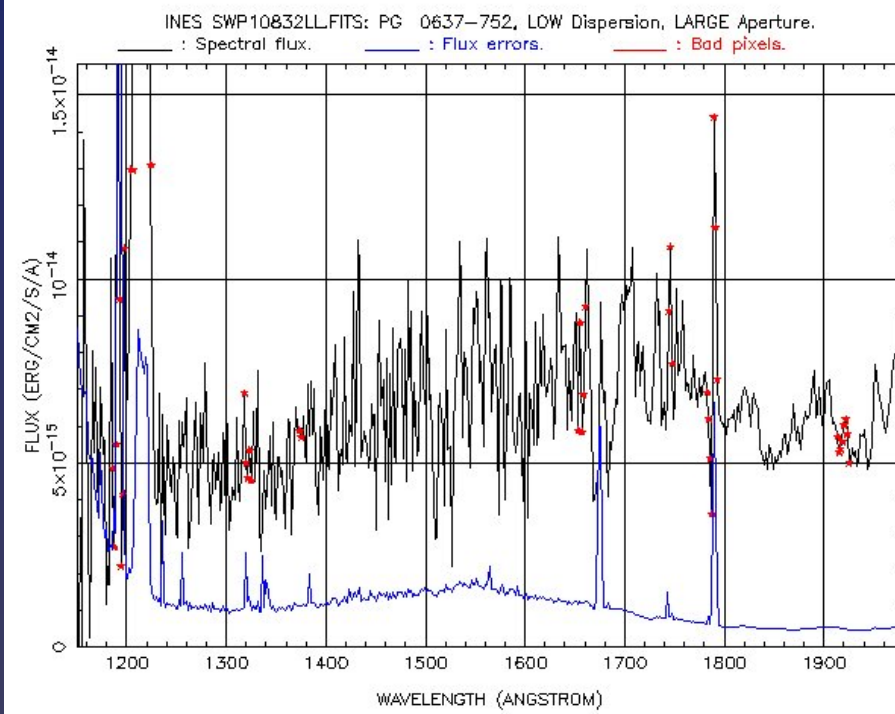
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- Archives have become a fundamental tool for modern astrophysics

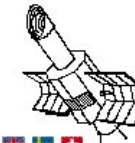
Archives in Astronomy



- **Efficiency:** One set of observations can serve many different scientific purposes, including some not considered when the observations were made.



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The INES Archive Data Server

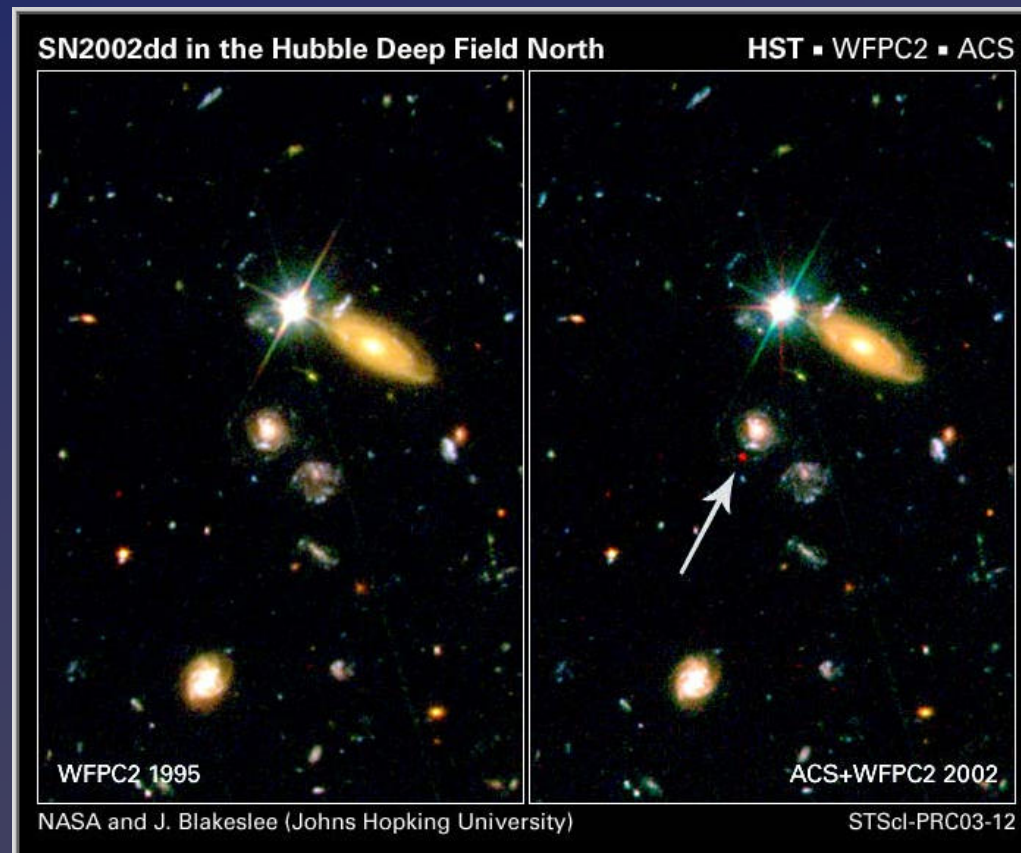
its

age	Year	Journal	Vol.	Page	Bibcode	
832	1984	APJ	280	0091	1984APJ...280...91	
832	1988	MNRAS	233	0801	1988MNRAS.233..801	
832	1988	MNRAS	233	0845	1988MNRAS.233..845	
832	1989	MNRAS	237	0739	1989MNRAS.237..739	
832	1992	APJS	83	1	1992APJS...83...1	
832	1992	ESASP	1153	A.	1992ESASP1153A	
832	1993	A&A	268	86	1993A&A...268..86	
832	1993	APJS	84	109	1993APJS...84..109	
832	1995	APJ	440	435	1995APJ...440..435	
832	1995	APJ	449	488	1995APJ...449..488	
SWP	10832	1996	APJ	467	61	1996APJ...467...61

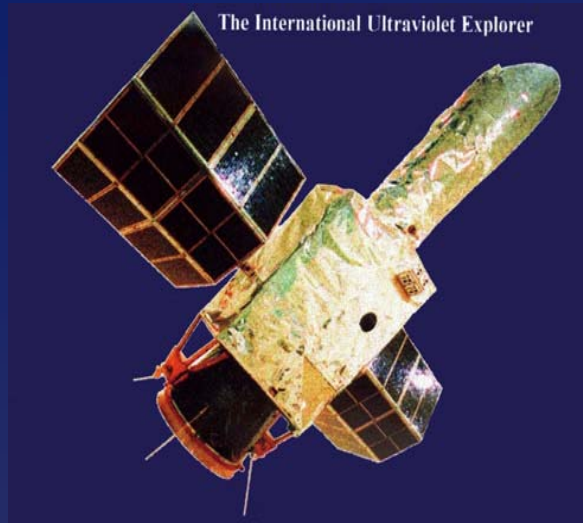
Archives in Astronomy



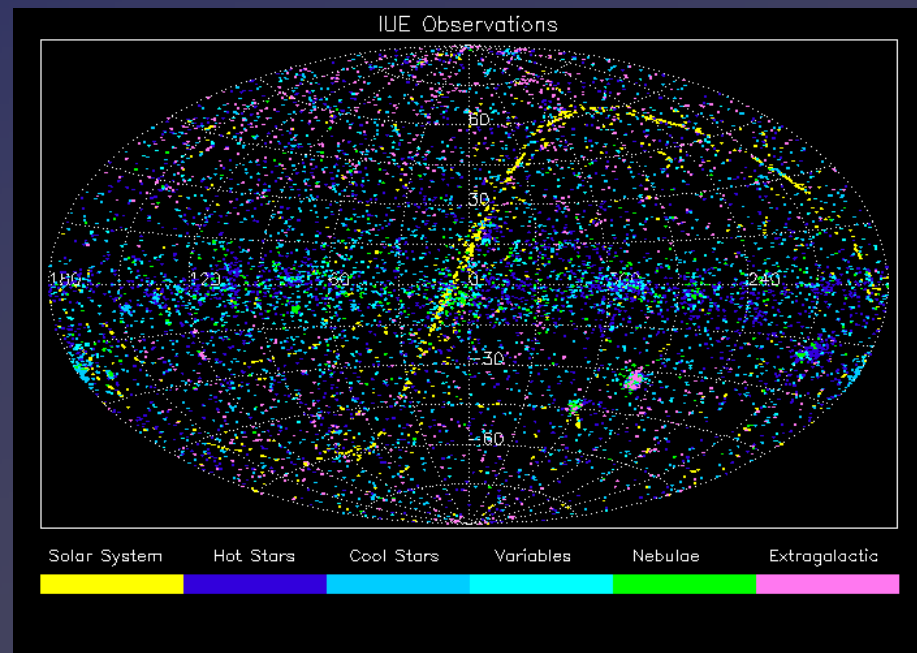
- **Exploitation of the time domain:**
 - Periodic phenomena: Variable stars
 - Transient phenomena: SN, GRB



The IUE mission



- Jan 1978 – Sep 1996
- > 11000 objects and > 110000 spectra.
- **Data archiving** was considered a fundamental activity from the very beginning of the IUE project.

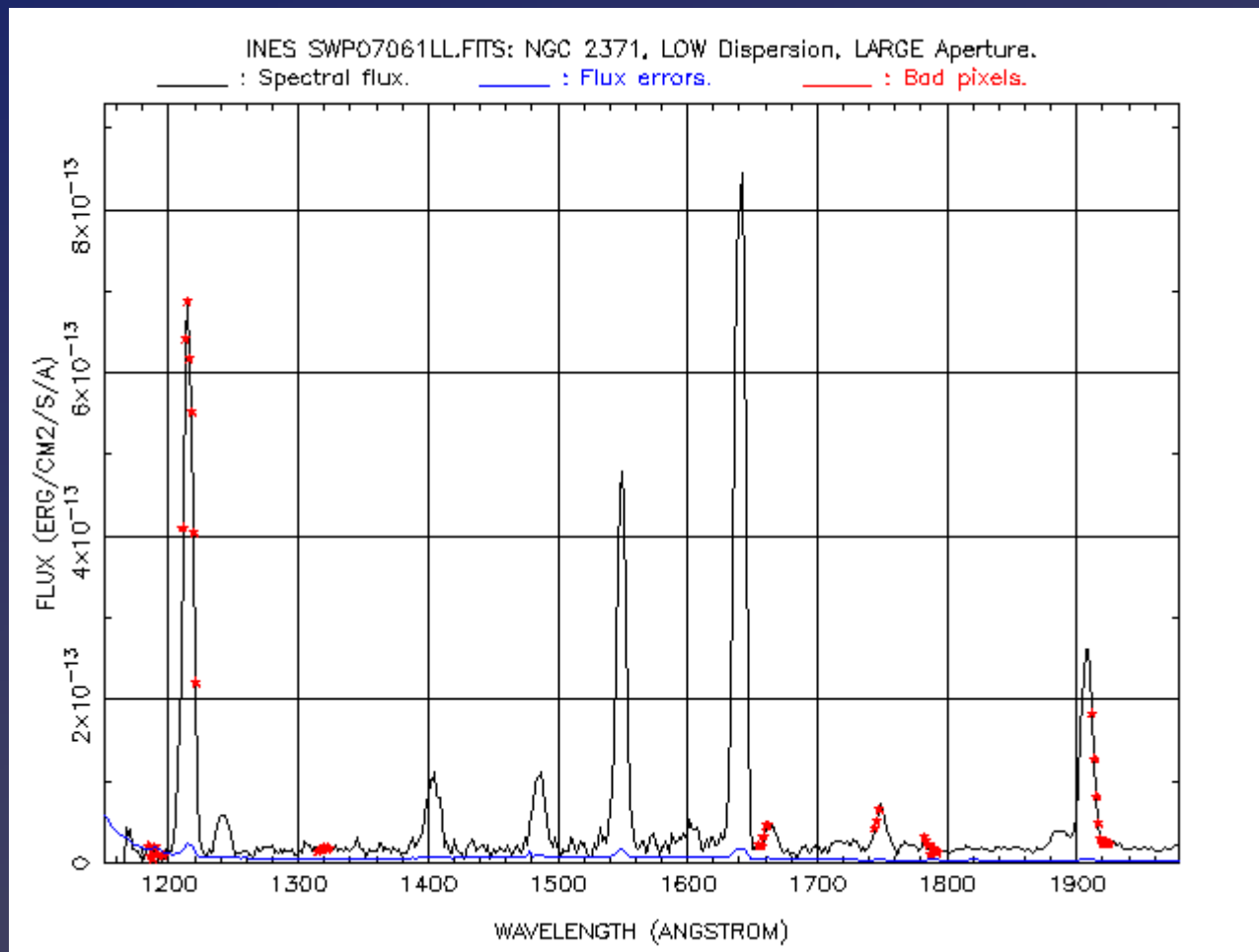


The IUE archive: a thirty years' history



- 1978: First astronomical archive with fully calibrated data.

→ “Science-ready” data.





The IUE archive: a thirty years' history

- 1986: ULDA: First astronomical archive in the Internet (data access and data distribution via e-mail).

A practical example of using ULDA at LAEFF

A Query: Search

MAIN MENU

- 1 - SEARCH FOR A SET OF SPECTRA (... with full explanation, examples, etc)
- 2 - SEARCH FOR SPECTRA - SHORT PROMPT
- 3 - DISPLAY WHAT WAS FOUND BY SEARCH
- 4 - SELECT SPECTRA FROM THOSE FOUND BY SEARCH (FOR DOWNLINK)
- 5 - SAVE DESCRIPTORS OF WHAT LAST SEARCH FOUND (FOR DOWNLINK)
- 6 - DISPLAY & SAVE DUBIOUS INFO.FOR WHAT LAST SEARCH FOUND
- ? ?N - HELP ME, N = ONE OF ABOVE ANSWERS

(... enter number 1 or 2 for a search...)

1 TO 6, ? (HELP) OR E (END) >1

At this point the four possible "AND/OR" search criteria will appear

1. Camera, Image Number and Aperture
2. R.A. & Declination
3. Object Class
4. Homogeneous ID.

The example below concerns a search for IUE-ULDA spectra of globular clusters (class=83) observed with a certain RA (17h) in all declinations.

CAMERA, IMAGE NUMBER AND APERTURE SEARCH CRITERIA

- ENTER - LIST OF CAMERA &/OR IMAGE NUMBER &/OR APERTURE SETS SPARATED BY BLANKS OR COMMAS. LIST ELEMENTS WILL BE CONNECTED BY "OR" S - SEE EXAMPLE BELOW
- <CR> ONLY WHEN FINISHED.
- "X" TO CANCEL SEARCH REQUEST.
- "R" TO CANCEL (AND POSSIBLY REENTER) ALL CAM/IM.NO./APERTURE REQUEST

- More than 235 000 spectra since 1987 to 1995.




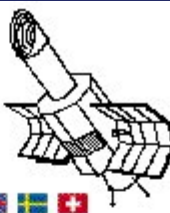



The IUE archive: Data curation

- The IUE Final Archive (1990's):
 - **The problem:** Along the years of the mission, different reduction systems and calibrations were used making unreliable the comparison among data observed at different epochs.
 - **Goal I:** Produce a uniformly processed, fully-intercomparable archive.
 - Improve photometric accuracy and S/N ratio by applying new image processing algorithms. Quality info. at pixel and spectrum level.
 - Quality control on metadata. Cross-match with previous catalogues and hand-written observing logs.
 - **Goal II:** Deliver IUE data to the community in a simple and efficient way.

Accessing IUE data: The INES system



The INES Archive Data Server

Summary

The INES Archive Data Server

Archive Search

[Resolved names: 1](#)

Retrieve Marked Data
Mark: High
Mark: SILO
Retrieval format:
HiRes wavelength ranges(Å) SWP: 1150 1980
Reset Wavelengths
LWP/R: 1850 3350

Principal Centre

Retrieve Marked Data
Mark: Rebin
Mark: Low
Retrieval format:

Found 15 records, displaying page 1 of 1

National Host

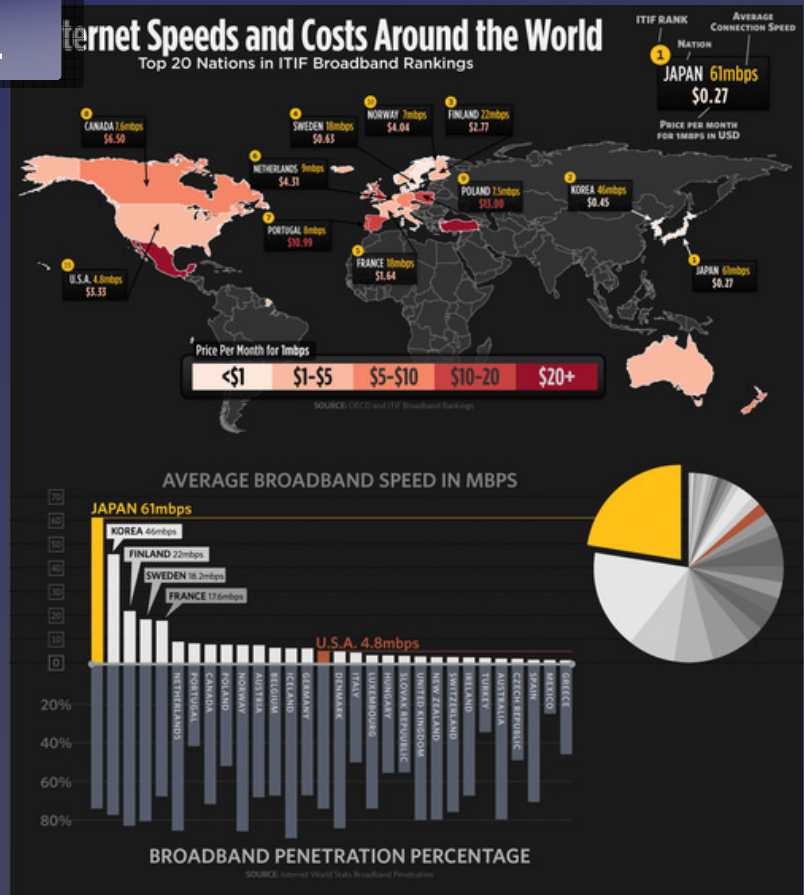
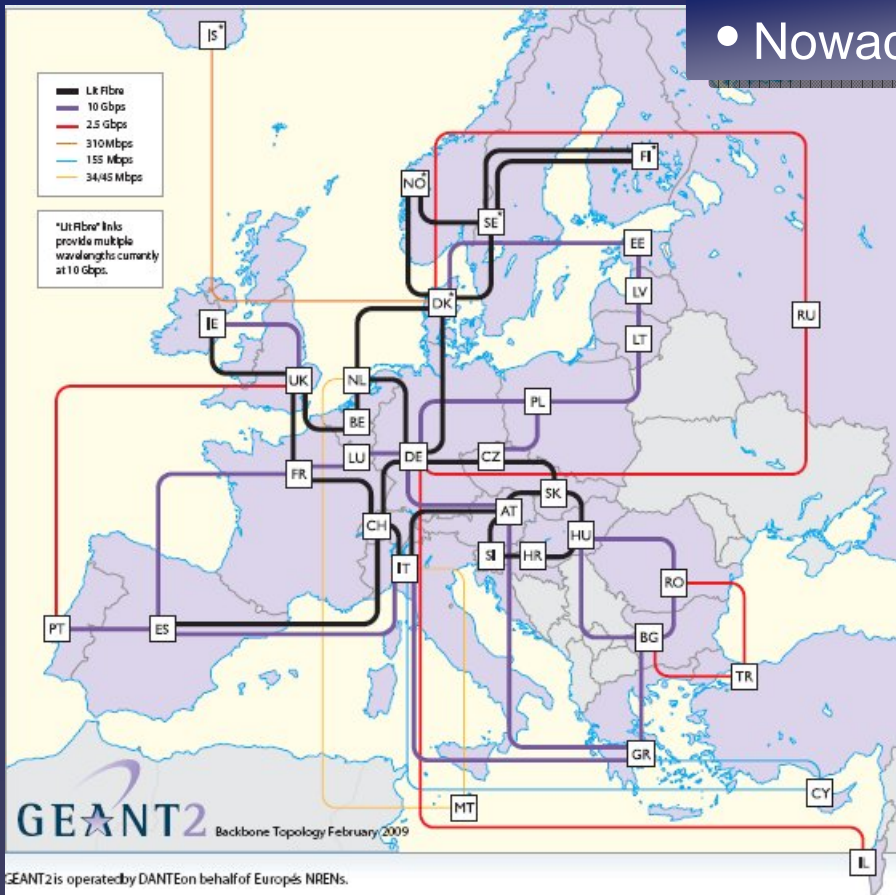
Camera	FL			Mark
SWP	2×10^{-13}	ABNBEADSC= 'NO	/ LWP bad scans	<input type="checkbox"/>
LWR		ABNHTRWU= 'NO	/ LWR heater warmup	<input type="checkbox"/>
SWP		ABNREAD = 'NO	/ Read at other than 20 KB	<input type="checkbox"/>
LWR		ABNUVC = 'NO	/ Non-standard UVC voltage	<input type="checkbox"/>
SWP		ABNHISTR= 'NO	/ History replay	<input type="checkbox"/>
		ABNOTHER= 'NO	/ Other abnormality	<input type="checkbox"/>
		POSANGLE= 168.38	/ Pos angle of the large aperture (deg)	<input type="checkbox"/>
		ABNMINFR= 'NO	/ Bad/missing minor frames	<input type="checkbox"/>
		CC-PERCN= 97.8	/ Cross-correlation % successful	<input type="checkbox"/>
		ITF = 'SWP85R92A'	/ ITF identification	
		COMMENT BY RA:	WAVELENGTH (ANGSTROM)	



The connectivity problem in the nineties

- Goal II: Deliver IUE data to the community in a simple and efficient way.

• Nowadays...



INES: The IUE Distribution System in the nineties



- ... but in the nineties

- No Youtube, Google, Wikipedia or Facebook
- Only a few newspapers and magazines have begun to put their articles online.
- Your computer at home takes about 20 seconds to load each page using a modem.

- Costa Rica

- First link to the Internet in 1993.
- Only 12 nodes (research institutes).
- Speed: 64 Kbps

INES: The IUE Distribution System in the nineties



Summary information of INES National Host Institutes and URL addresses

Argentina: Observatorio Astronómico, Univ. Nacional de La Plata, Buenos Aires	* http://www.fcaglp.unlp.edu.ar/
Austria: Kuffner-Sternwarte, Vienna	http://www.kuffner.ac.at/ines/
Belgium: Royal Observatory of Belgium, Brussels	http://ines.oma.be/
Brazil: Instituto Astronomico e Geofisico, Sao	http://ines.iagusp.usp.br/ines/
Canada: CADC/DAO, Victoria B. C	http://204.174.103.197/
Chile: AURA/CTIO, La Serena	* http://www.ctio.noao.edu/
China,P.R.(National) : Centre for Astrophysics - USTC, Hefei	http://iue.cfa.ustc.edu.cn/ines/
Costa Rica: University of Costa Rica, San Jose	* http://www.efis.ucr.ac.cr/
Egypt: NRIAG - Helwan Observatory, Cairo	* http://www.frcu.eun.eg/
France : CDS - Observatoire de Strasbourg, Strasbourg	http://cdsweb.u-strasbg.fr/
India : Space Science Data Centre - ISRO HQ, Bangalore	* http://www.isro.org/
Indian Institute of Astrophysics - VBO, Alangayam	* http://www.iiap.ernet.in/
Israel : Wise Observatory, Tel Aviv University, Tel Aviv	http://wise-iue.tau.ac.il/
Italy : Osservatorio Astronomico di Trieste, Trieste	http://ines.oat.ts.astro.it/
Japan : National Astronomical Observatory, Tokyo	http://iue.mtk.nao.ac.jp/
Korea : Department of Astronomy and Space Science, Chungbuk	http://star91.chungbuk.ac.kr/ines/
Mexico :INAOE, Puebla	* http://www.inaoep.mx/
Netherlands : Sterrenkundig Instituut, Utrecht	* http://www.fys.ruu.nl/
Nordic countries : Uppsala Astronomical Observatory, Uppsala	* http://www.astro.uu.se/
Poland : Torun Center for Astronomy, Nicholas Copernicus University, Torun	http://ines.astri.uni.torun.pl/
Portugal : Centro de Astrofisica da Universidade do Porto, Porto	* http://www.astro.up.pt/
Russia : Institute of Astronomy of Russian Acad. Sci., Moscow	http://ulda.inasan.rssi.ru/
South Africa : South African Astronomical Observatory, Cape Town	* http://www.sao.ac.za/
Spain : LAEFF/VILSPA, Madrid. INES Principal Centre (also serving Germany)	http://ines.vilspa.esa.es/
Switzerland : Inst. d'Astronomie de l'Université de Lausanne, Chavannes-des-bois	* http://obswww.unige.ch/
Taiwan : Inst. of Physics and Astronomy, Chung-Li	* http://www.phy.ncu.edu.tw/
Turkey : Physics Department - METU, Ankara	* http://www.physics.metu.edu.tr/
United Kingdom : Rutherford Appleton Laboratory, Chilton	http://iuepc.bnsc.rl.ac.uk/ines/
USA : STScI, Baltimore	http://ines.stsci.edu/ines/

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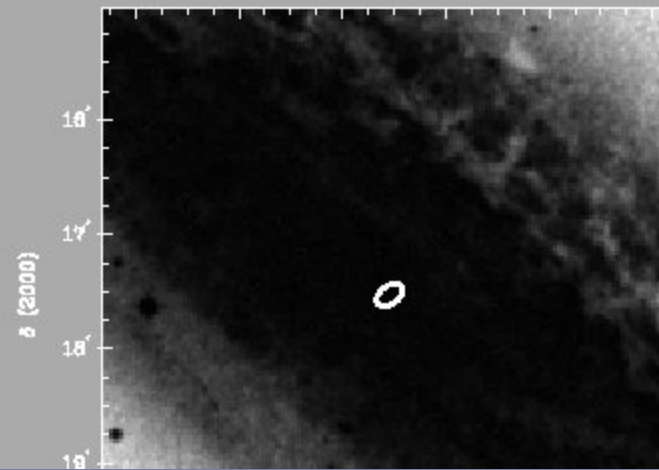
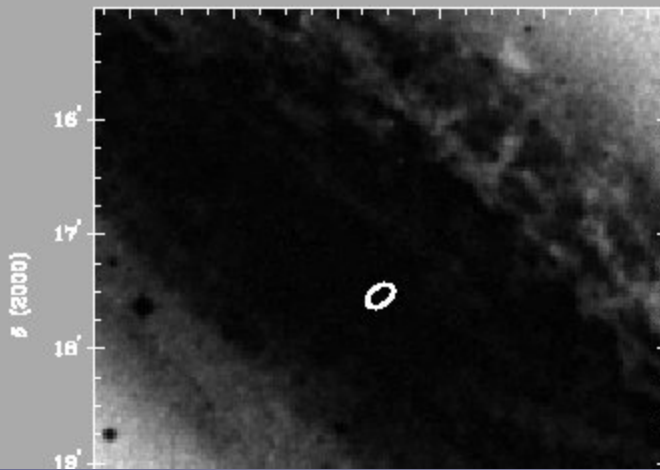
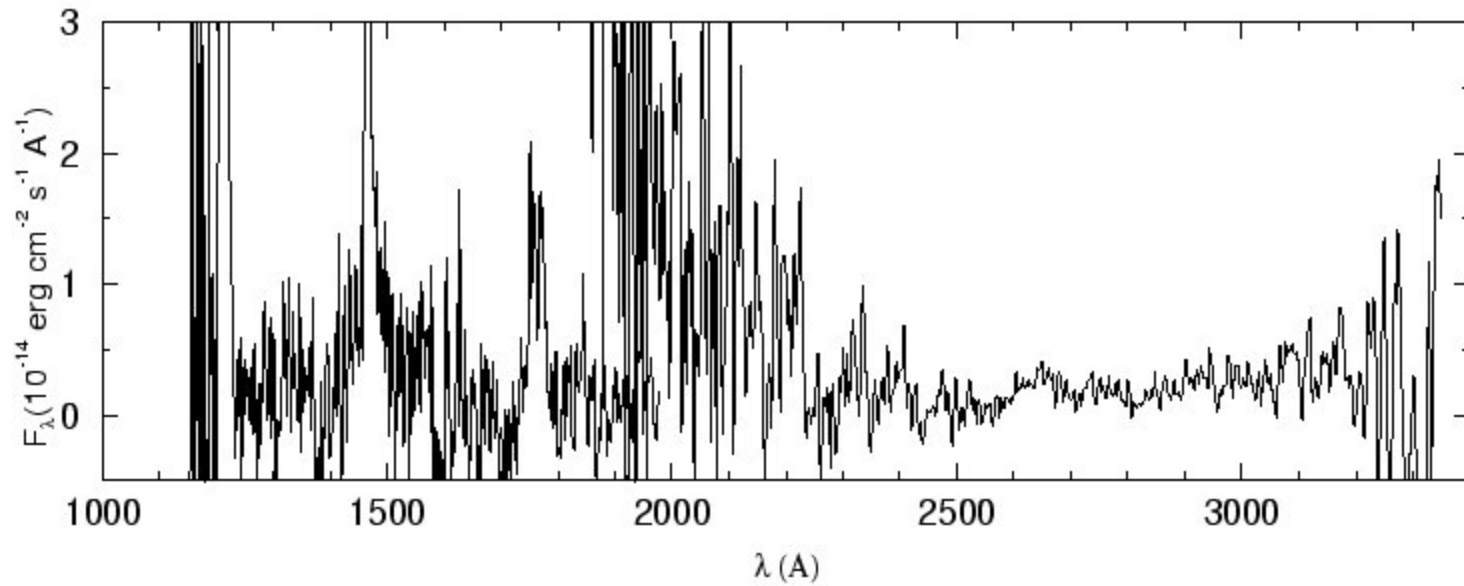
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Data preservation in the INES system



- Master Archive (all): 429 GB (DVD's 3.9 GB)
 - Fire/water proof safe.
- On-line archive: 129 GB. (disk) + backup (tapes)

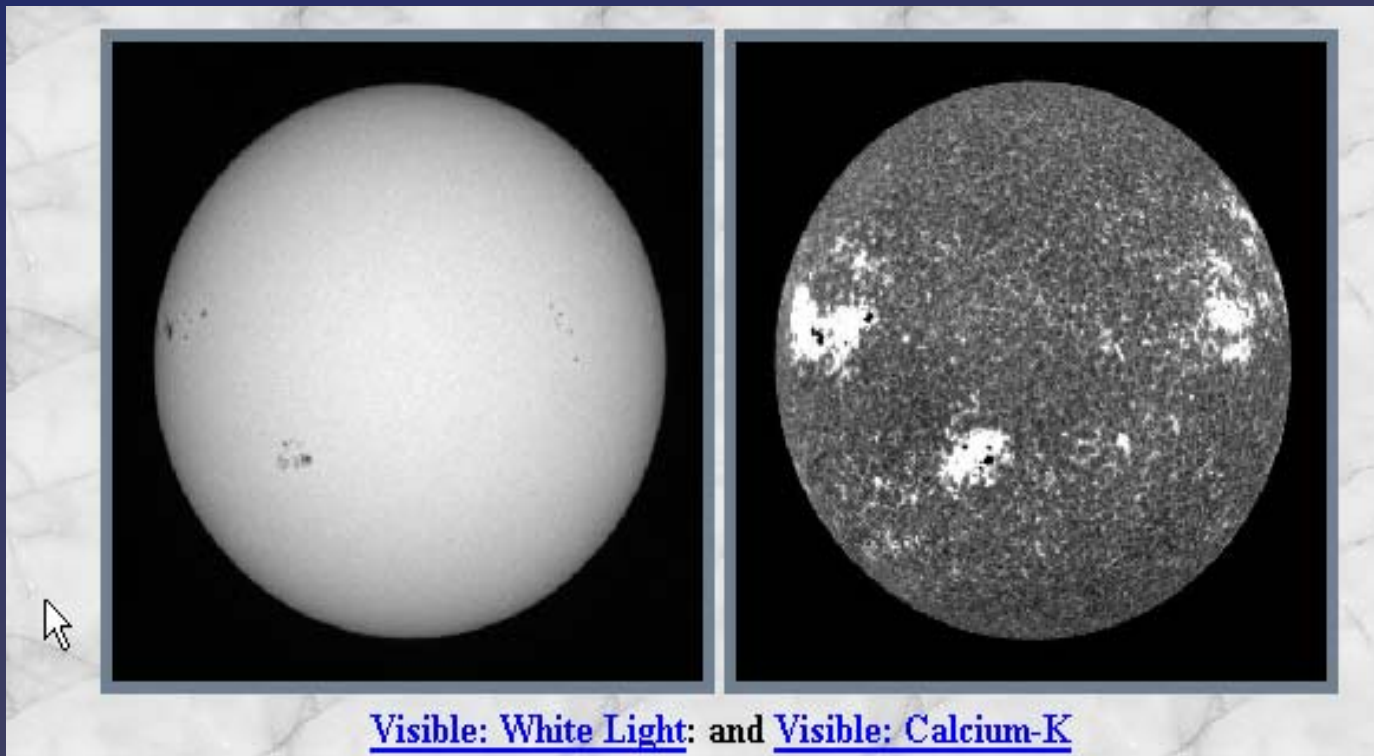
Adding value to the archive: The INES guides



Adding value to the archive: Accessing other archives



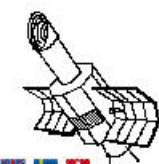
- Many astrophysical projects require the analysis of data covering different wavelengths of the electromagnetic spectrum.





Interoperability

The ability of diverse systems p
images, catalogues, bibliographi



[NASA ADS Astronomy](#)

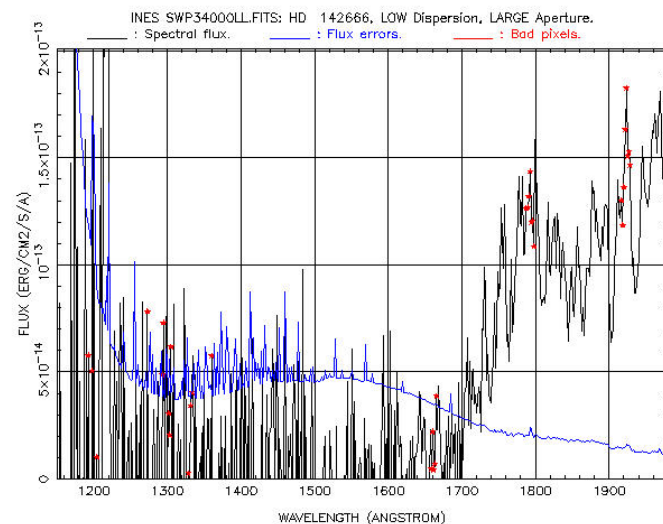
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Affiliation: AA
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Journal: The
Publication Date: 07/
Origin: UC
ApJ Keywords: Ac
Abstract Copyright: (c)
Bibliographic Code: 200



The INES Archive Data Server

SWP34000LL.FITS Browse Plot



Summary	
Object	HD 142666
RA(1950)	15 53 43.3
Dec(1950)	-21 52 59
Obs Date	01/08/88
Obs Time	02:05:48
Exp Time(s)	299.697
Dispersion	LOW
Aperture	LARGE

[Home](#) | [HelpDesk](#) | [Overview](#) | [LAEFF](#)

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sciences
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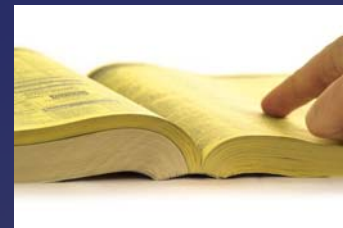
Principal
Centre

National
Host

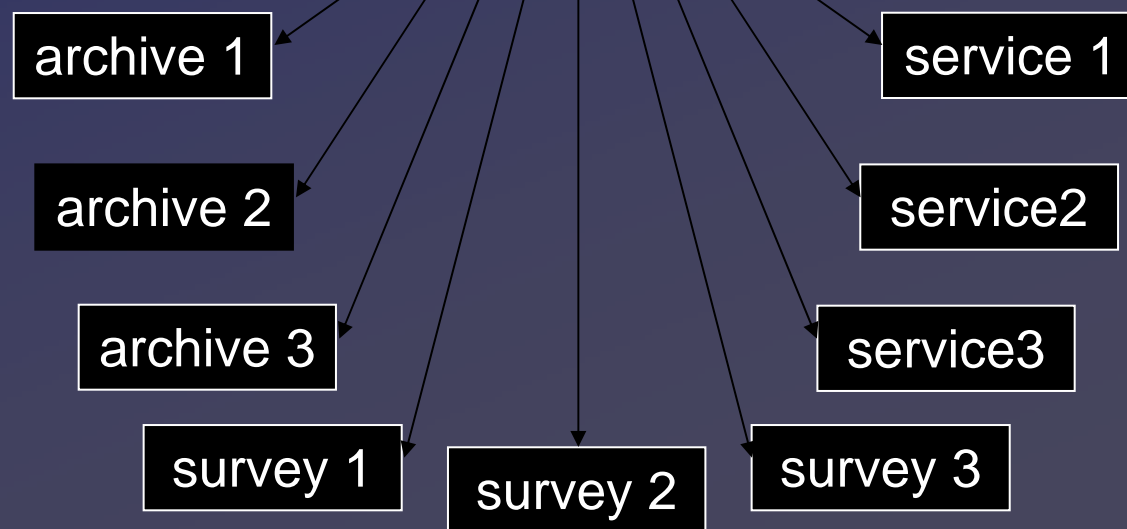
Fetch	Mark
SILO	<input type="checkbox"/>
SILO	<input type="checkbox"/>
SILO	<input type="checkbox"/>
SILO	<input type="checkbox"/>

The Interoperability problem in Astronomy

- **Data Discovery:** How can astronomers find the relevant data to their scientific needs?



- **Data access & transfer:** Astronomers need to learn about different user interfaces, access and download procedures.



The Interoperability problem in Astronomy

- **Data characterisation:** lack of Data Models to describe similar observations in the same way.



The Interoperability problem in Astronomy



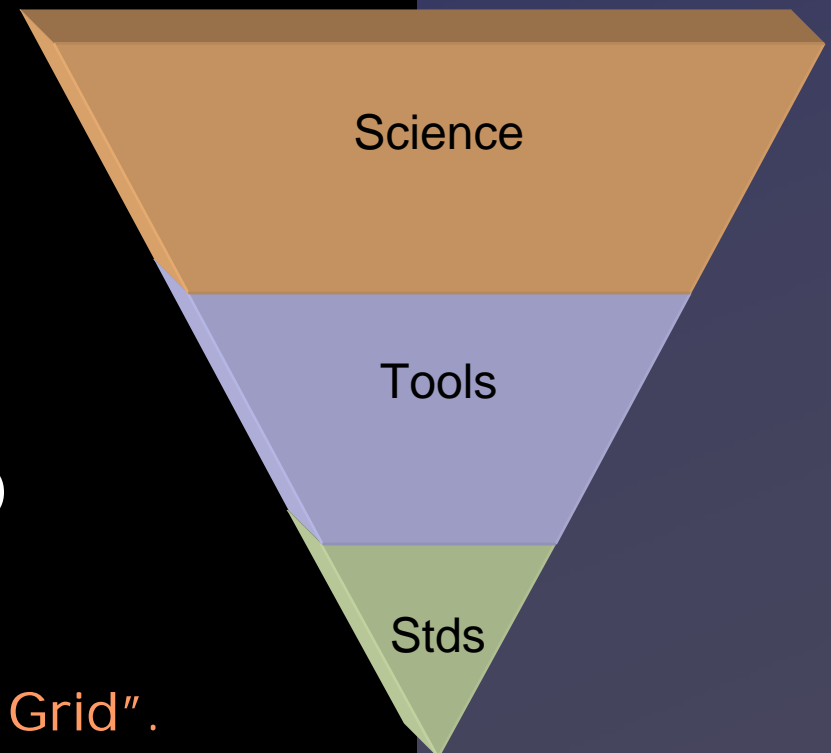
The solution: The Virtual Observatory



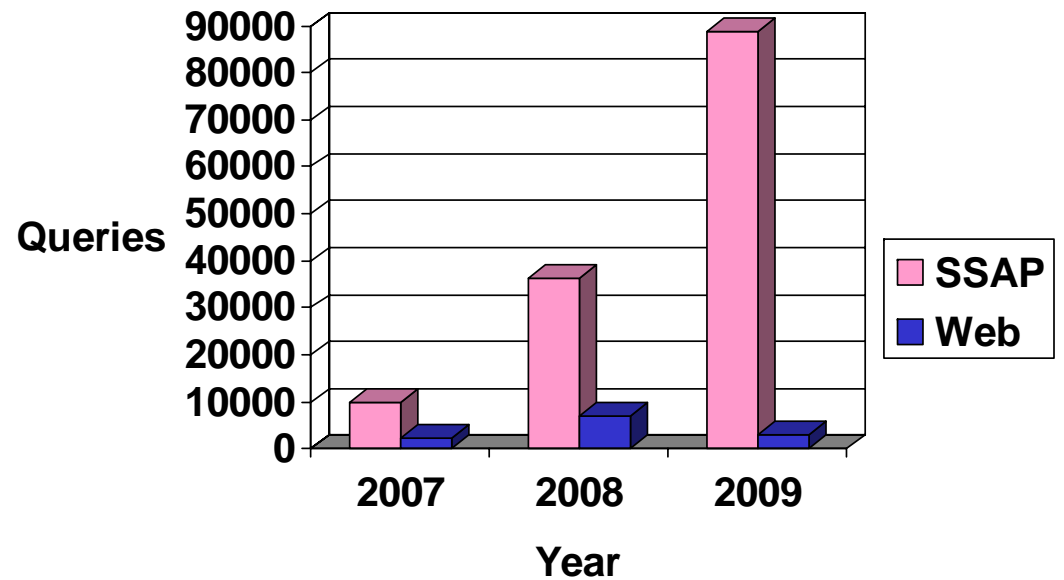
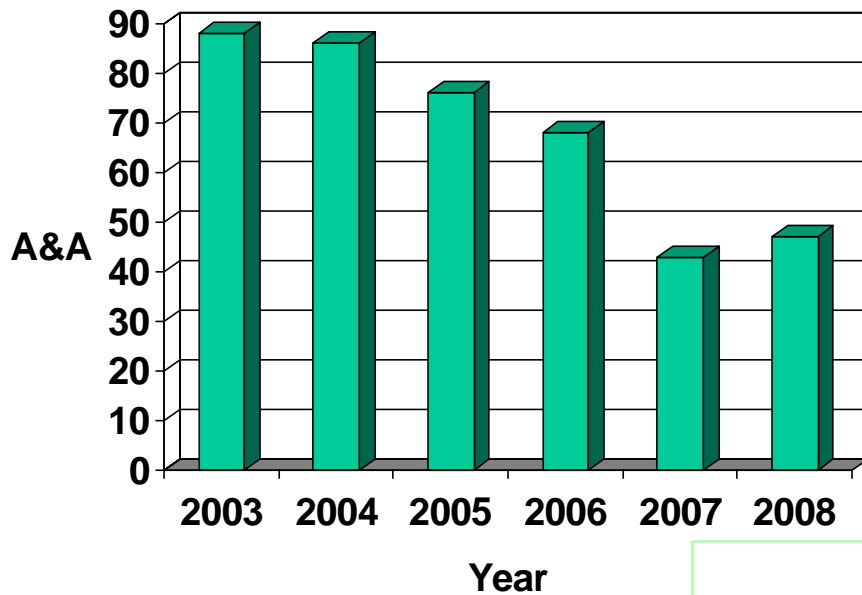
- INES was one of the first spectroscopic archives in the world to become VO-compliant.

*feel like it sits on the
'desktop'*

- International agreement on standards.
- Standard semantic: UCDs
- Standard access protocols
- Standard output format
- Standard data models
- Automated discovery tools (registries)
- Uptake by the Data Centres → "Data Grid".



What's the result of all these efforts?



Summary



- Astronomical archives represent a fundamental tool in modern Astrophysics. IUE, a pioneer project in this field.
- The Virtual Observatory is a consolidated international initiative that constitutes the framework where to develop archive-related activities.
- INES, the IUE Archive System, is being intensively used more than 30 years after launch and more than ten years after the end of operations. In particular, VO accesses are growing every year.
- INES is an excellent example of how archives can extend the projects' effective lifetime reducing very considerably the “euro per observation” cost.