The AstroWeb Database of Internet Resources

H.-M. ADORF[1], *D. EGRET*[2], *A. HECK*[3], *R. JACKSON*[4], *A. KOEKEMOER*[5], *F. MURTAGH*[1] *and D. WELLS*[6]

[1] *ST-ECF, Garching, Germany;* [2] *CDS, Strasbourg, France;* [3] *Strasbourg Astronomical Observatory, France;* [4] *CSC/STScI, Baltimore, U.S.A.;* [5] *MSSSO, Canberra, A.C.T., Australia;* [6] *NRAO, Charlottesville, U.S.A.*

Introduction

The Internet has succeeded – and with it the World Wide Web. This model of hypertext information with embedded pictures and hyperlinks to other local or remote information pages – as well as to other Internet services – greatly facilitates public near-realtime participation of astronomical events, such as the observations of the Shoemaker-Levy-9 comet crash on Jupiter (Murtagh & Fendt 1994, West 1994, Whitehouse 1994). The World Wide Web, or WWW for short, is also increasingly used for scientific communication and information dissemination in all natural sciences, and astronomy is one of the most active communities in this respect.

With the success of the Internet, a mechanism better than individual "hotlists" for organizing useful collections of astronomical Internet resources is clearly needed. This is where the "AstroWeb" database (Adorf *et al.* 1994, Jackson *et al.* 1994, 1995a, b) enters. It aims at being the most complete and useful on-line collection of Uniform Resource Locators (URLs) for astronomical Internet resources, pointing to entities as diverse as societies, observatories, databases, preprint servers, telescopes, telescope schedules, weather information or individual astronomers. As such the AstroWeb database complements the recent annotated compilation of astronomical Internet resources (Andernach, Hanisch & Murtagh 1994).

Organization

The AstroWeb database, which is maintained by the "AstroWeb Consortium", currently comprises more than 1100 records of FTP, Gopher, Telnet, News, WAIS and WWW resources. Each record minimally consists of a headline and an associated URL. Many records are augmented by a paragraph of descriptive text. If known, the e-mail address of the resource's maintainer is stored along with the record. As added value, the AstroWeb consortium has classified each record according to one or more of about 25 categories, such as observatory, radio, optical, infrared, telescope, database or software.

The AstroWeb database is actually a distributed system of databases maintained at five different sites (CDS, MSSSO, NRAO, ST-ECF, and STScI) on three continents. The master copy is currently kept at the Space Telescope Science Institute, Baltimore. There the aliveness of all URLs (except of Telnet records) is verified three times a day, and "unreliable" or "dead" URLs are flagged. Once a day each site automatically fetches a copy from the master, and formats a local rendition of the AstroWeb database.

Each site offers the AstroWeb database in a different style of presentation. The ST-ECF rendition, for instance, is terse and suitable for quick reference, whereas the STScI or NRAO renditions are more verbose and particularly suitable for browsing. Some sites even offer more than one rendition for the convenience of the users.

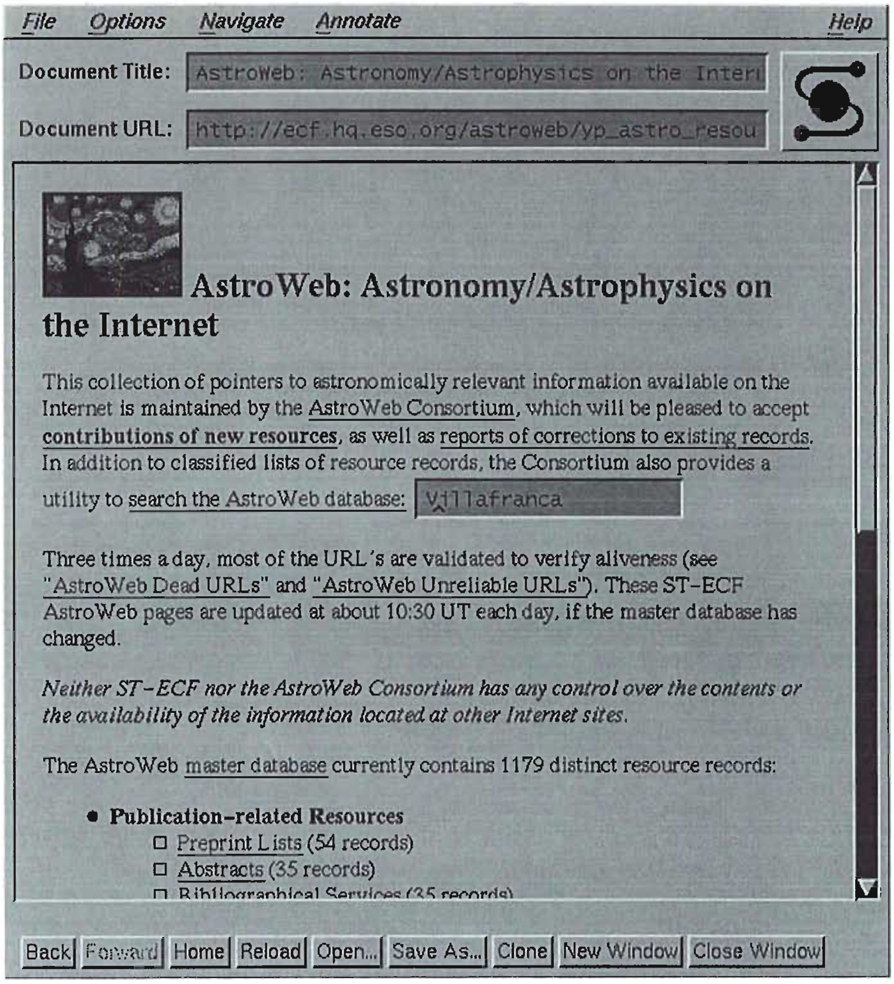
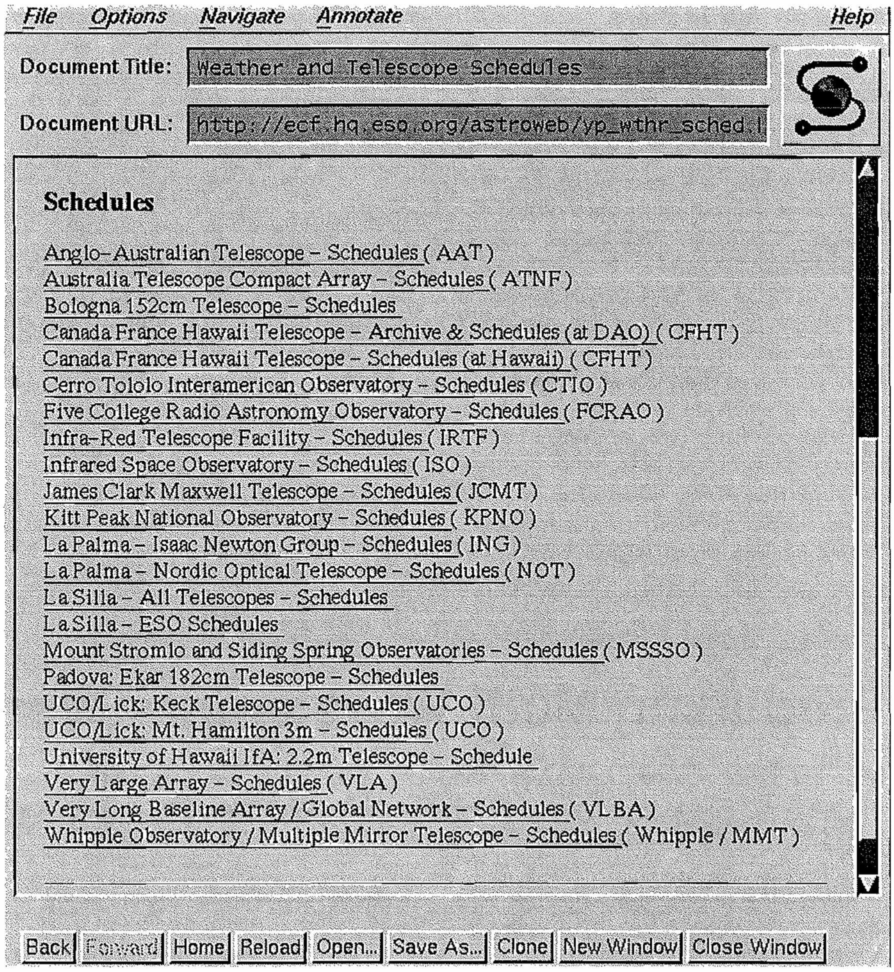


Figure 1: *View of the top-level page of the AstroWeb database at the ST-ECF. Hyperlinks to forms for entering new records, and for error corrections are provided.*

Figure 2: *The list of "telescope schedules" accessible from the AstroWeb information pages.*



Accessing the AstroWeb Database

The natural place for offering the AstroWeb database is the WWW. The ST-ECF rendition can be accessed either through hyperlinks originating from the ESO web (http://www.hq.eso.org/eso-homepage.html), or from the ST-ECF web (http://ecf.hq.eso.org/), or directly via the "yellow pages" URL http://ecf.hq.eso.org/astroweb/yp_astro_resources.html (Fig. 1), from where links to the other AstroWeb renderings are provided. The AstroWeb database is an excellent starting point for browsing topics on the astronomical Internet (Figs. 2 and 3), as well as for finding other resources of potential interest to astronomers.

At a size of well over 1000 records, it is mandatory that the database is also *searchable*. To this end one may use the simple text matching facility built into most, if not all, WWW clients. A more powerful search mechanism, however, is offered by the AstroWeb WAIS index, which can be queried using natural (English) language from all AstroWeb sites. Since complete records are indexed, queries may include categories and URLs, which are usually hidden in HTML-comments. The results are returned as WWW-pages with ready-to-use hyperlinks to interesting resources found.

Submission of New Records

The AstroWeb Consortium, consisting of the authors above, *welcomes* submissions of new records from the astronomical community; WWW forms have been put in place to facilitate this process. Submissions are reviewed by Consortium members and entered manually into the database to ensure a minimum quality. Those recent submissions not yet entered into the main database may be viewed (and used).

The Consortium also encourages corrections to existing records (e.g. via e-mail to astroweb@noao.edu). AstroWeb Consortium members can globally edit the database, in order to better respond to change requests.

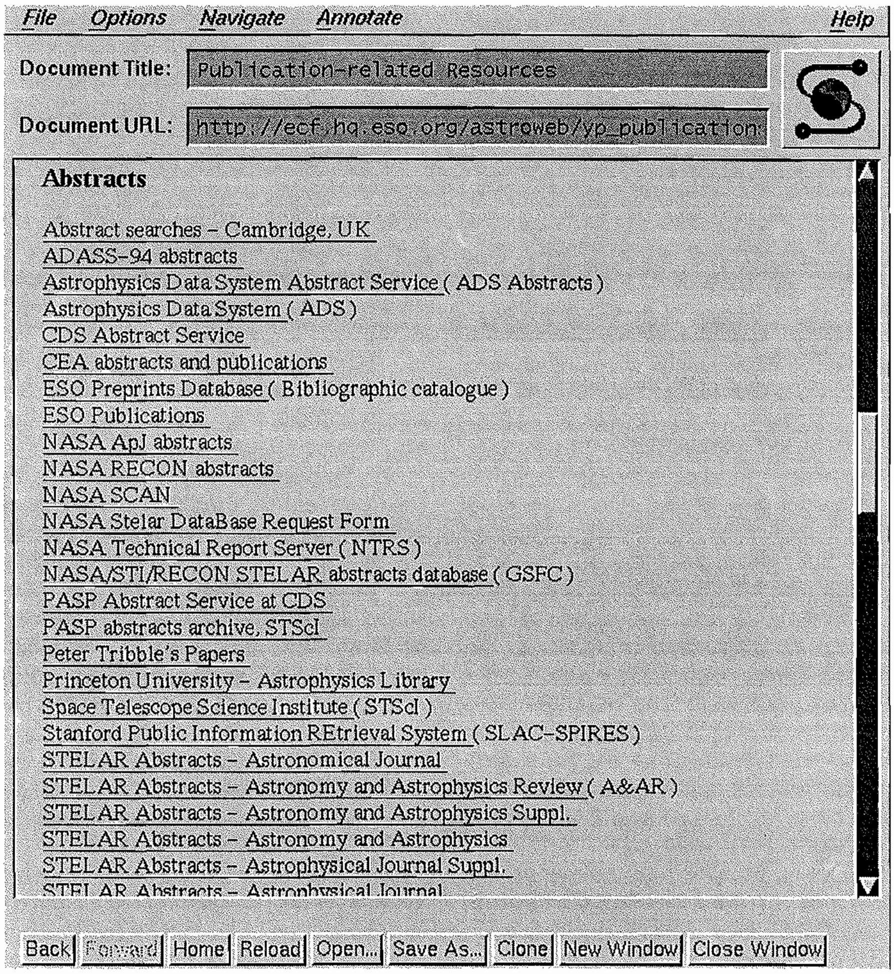


Figure 3: *Portion of the "abstracts" resource listing in the AstroWeb database.*

Possible Future Steps

After a rapid growth, the AstroWeb is currently being consolidated. It is hoped that, with the help of the astronomical community, the degree of completeness and quality of the AstroWeb database can be further improved. Certainly, database internal cross-referencing within the descriptive paragraphs is far from complete. Here the situation can presumably be remedied with an appropriate software tool.

In the future the AstroWeb database might be used as a starting base for indexing all astronomical WWW pages out on the Internet. This would involve a "robot" repeatedly fetching all relevant HTML pages, similarly to how Archie indexes all files in all registered anonymous FTP servers. Such a project is by no means out of question. In fact, general indices spanning the whole WWW already exist, but none thus far is specific to astronomy.

References

Adorf, H.-M., Egret, D., Heck, A., Jackson, R., Koekemoer, A., Murtagh, F., Wells, D.: 1994, "AstroWeb – Internet resources for astronomers", *ST-ECF Newsl.* **22**, (in press).

Andernach, H., Hanisch, R.J., Murtagh, F.D.: 1994, "Network resources for astronomers", *Publ. Astron. Soc. Pacific,* (in press).

Jackson, R., Wells, D., Adorf, H.-M., Egret, D., Heck, A., Koekemoer, A., Murtagh, F.: 1994, "The AstroWeb Database", *Bull. CDS* **45**, 21–25.

Jackson, R., Wells, D., Adorf, H.-M., Egret, D., Heck, A., Koekemoer, A., Murtagh, F.: 1995a, "AstroWeb – A database of links to astronomy resources – Announcement of a database", *Astron. Astrophys. Suppl.* **108**, 235–236.

Jackson, R.E., Adorf, H.-M., Egret, D., Heck, A., Koekemoer, A., Murtagh, F., Wells, D.: 1995b, "AstroWeb – Internet resources for astronomers", in: Proc. *Astronomical Data Analysis Software and Systems (ADASS) 1994,* Baltimore, MD, D. Shaw, H. Payne, and J. Hayes (eds.), Astronomical Society of the Pacific, (in press).

Murtagh, F., Fendt, M.: 1994, "The SL-9/ESO Web Encounter", ESO Messenger **77**, 47.

West, R.: 1994, "Comet Shoemaker-Levy 9 Collides with Jupiter", ESO Messenger **77**, 28–31.

Whitehouse, K.: 1994, "Comet Explodes on Jupiter – and the Web", *IEEE Computer Graphics and Applications*, **Nov. 94**, 12–13.

Producing Multi-Wavelength Overlays with MIDAS

M. PIERRE, CEA/DSM/DAPNIA CE Saclay, France, and Max-Planck-Institut für Extraterrestrische Physik, Garching, Germany

Astronomy is no longer solely a science where data obtained in different wavelength ranges are analysed separately. Astronomers are becoming more and more involved in combined multi-wavelength programmes (optical, radio, IUE, ROSAT and soon ISO ...) for which basic coordinates transformation facilities constitute the starting point for any further data analysis. This contribution describes the method used for making the optical/X-ray/radio overlays, presented in the preceding article "Multi-wavelength study of ROSAT clusters of galaxies".

For each cluster, we have at our disposal ESO 3.6-m EFOSC R images ($\sim 4' \times 6'$: scale: 0.6″/pixel), ROSAT survey images ($\sim$ 1 sq. degree, resolution: $\sim 2'$), MOST images ($70' \times 70'$ cosec(δ), resolution: $43'' \times 43''$ cosec(δ); we thus adopted a final layout where the X-ray and radio contours are superimposed onto the optical pixel image. The latter determines the final overlay size.

Because of the very different processes by which these images are obtained, the production of the overlays is a long and tedious procedure, all the more so since no regridding programmes are available in MIDAS, nor are there commands for converting pixel coordinates into celestial. To summarize the starting situation:

– X-ray ROSAT survey images are routinely obtained by the EXSAS package (MPE) in a J 2000 system, using 25″ pixels; the sky projection can be assumed to be tangential within the overlay field.

– The radio images were initially reduced with the AIPS package, using $\sim$ 15″ (not square) pixels, in a SIN projection (B1950). In order to match the X-ray data, the radio images are in turn regridded into J 2000 and tangential projection using AIPS.

– The accurate sky projection of the optical images is undefined. We stress here that, for our purpose, CCD images are essential (rather than Schmidt plate scans) to provide a detailed description of the galaxy distribution of our distant clusters.

– The MIDAS (EXSAS) and AIPS image header information regarding absolute coordinates, centre of projection, etc., are incompatible.

We therefore wrote a series of MIDAS procedures to cope with the lack of coherence between the systems, knowing that without proper regridding programmes it is not possible to have exact coincidence between the three wavelengths. The method is based on the fact that after the processing, overlays (which cover a small area) will have as "world coordinates" true coordinates, i.e. RA and Dec in decimal degrees aligned with the X and Y axes respectively (owing to the radio and X-ray resolutions, a minimal 2″ accuracy for the three wavelengths is required over a $5' \times 5'$ field). This not only a tractable way to treat the unknown distortions of the optical image, but also enables us to get object positions directly using the command `GET/CURSOR` after the final overlay has been displayed on the screen. We now describe briefly how each image was processed to reach this stage.

– For the purpose of aligning optical images, telescope coordinates are not accurate enough, and thus reference stars are needed. As the GSC does not provide enough objects on such a small field at high galactic latitude, and most objects are too bright and saturated on the CCD image, we make use of the general COSMOS object catalogue. The figure presents a finding chart produced by the NRL/ROE package available at MPE. The brightest stars are referenced with numbers, their coordinates are listed on the right-hand side of the figure, and a corresponding ASCII list is simultaneously produced by the programme; this file is then transformed into a MIDAS table (*TA*). In a second step, the CCD image is displayed on the screen and pixel coordinates of reference stars (at least 5), well distributed over the whole field, are interactively determined using the command `CENTER/GAUSS` with a table as output option (*TB*); selected stars are given the same identifier as in the COSMOS list. Then the two tables, *TA* (celestial coordinates) and *TB* (pixel coordinates), are compared with the command `ALIGN/IMAGE` letting all parameters free (i.e. rotation angle, X and Y scale factors, X and Y translations). In this way, the image is stretched in all directions so that the residuals for the