CLRC

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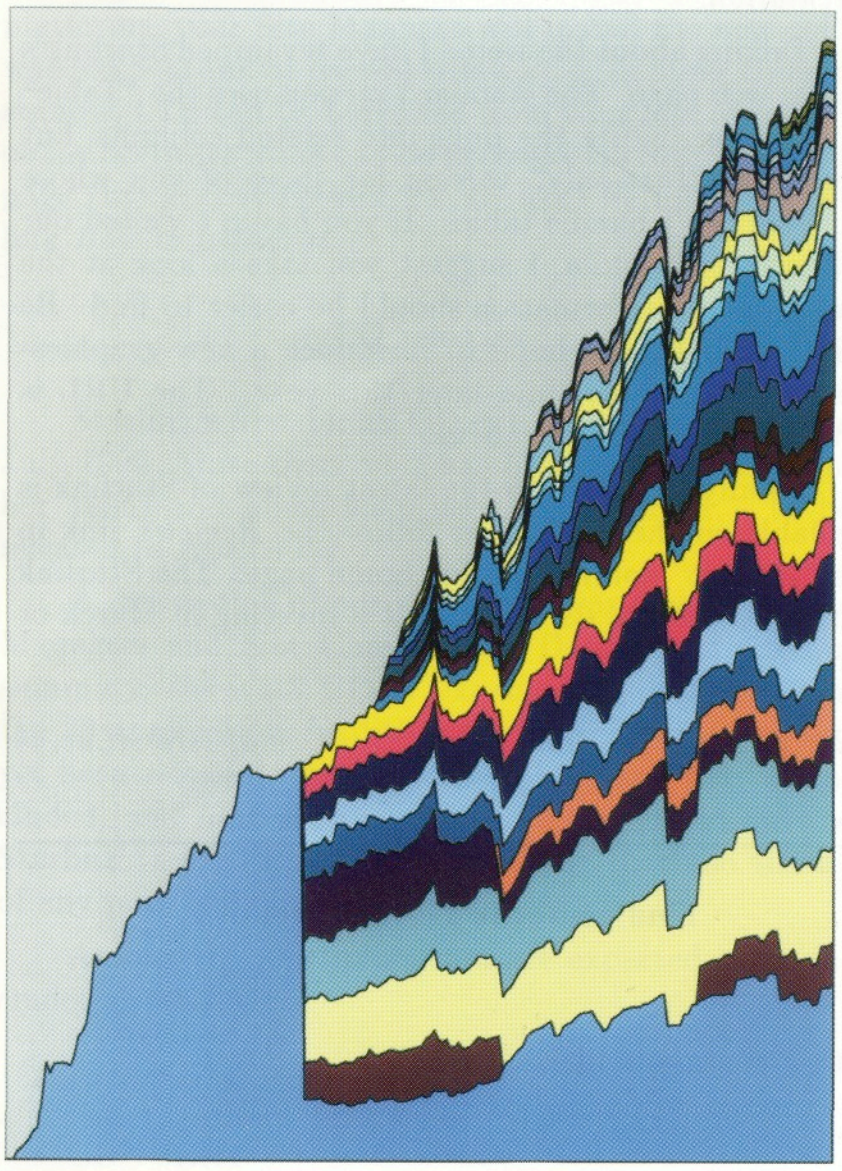
Rutherford Appleton Laboratory



2000 Starlink Users

Starlink reached another milestone in its 16 year history when, in October 1996, the number of registered users of its facilities exceeded 2000. This growth in users parallels a growth in the number of Starlink sites.

The graph on the left shows the growth in user numbers since 1980. Each colour represents a specific site and the width of the band represents the number of registered users at that site. As time goes on, new sites are added on top of the old ones. (Monthly records for individual sites are not available before 1986.)

The number of users exceeded 1000 in October 1988. There is a reason for October being mentioned twice – it is the month when the influx of students for the new academic year causes an increase in registrations. It should be stressed that Starlink's username lists are constantly pruned, revised, and audited.

The growth in user numbers is approximately linear. The first 1000 users took 8 years to accumulate (1980-88), and the second 1000 users also took 8 years to accumulate (1988-96). If this rate of growth continues, the entire population of the United Kingdom will be registered as Starlink users in October 441980.

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Editorial

Starlink has recently released several major enhancements to its software. Those reported on in this issue are: GAUFIT (page 6), which can analyse data from the new SCUBA detector on the JCMT; GAIA (page 3), an image analysis tool; CAT/CURSA (page 16) which analyses star catalogues; and FIGARO (page 3), mainly used for spectroscopy. (The other articles on software in this issue – DIFMAP on page 12, and FTOOLS on page 18 – are not associated with releases of Starlink software, but are included because of their general interest to Starlink users.)

The release of Starlink software on CD-ROM for PCs running the Linux operating system (which was first done last July) has proved to be very popular. A second, expanded, version was released last November, and a third version which will contain most of the Starlink packages is due for release in April. This is reported on in more detail on page 3.

Starlink's software has been, or will be, displayed at various astronomical gatherings. The first was at *The Astronomer* AGM in Basingstoke on 28th September 1996. The next was at European AstroFest '97, *Astronomy Now* magazine's annual convention and exhibition which took place at Kensington Town Hall on 31st January and 1st February 1997. The third will be at NAM97 (National Astronomy Meeting) at Southampton University on 7-11 April 1997.

Starlink software is, of course, fully documented. However, if you would like a more personal introduction to its capabilities, such as a demonstration of some of our packages at your site, please mention this to your Site Manager who will do his best to make it happen. Starlink's programmers can show off the software which they support.

Starlink's software plans for 1997 were finalised at a special meeting of the *Starlink Panel* in London on 29th January. These will be published shortly in a revised issue of SGP/48. Like other Starlink documents, this one is available on our web site under the link *Documentation*.

Talking about the web – I have revamped Starlink's central web page. The standard version uses the "Table" facility to structure the links into related columns, but there is a "Text-only" version for those of you whose browsers can't handle tables. If you haven't visited our web site for a while, I suggest you take a look at the new version – information should be easier to find. Be quick, though, as I hope to introduce a new graphics-based design some time later this year. The URL is `http://star-www.rl.ac.uk/`.

Finally, a report on the latest review of Starlink is available on the web – just follow the *Reviews* link in the "Project" column on our home page. The Starlink Panel will discuss its findings at a meeting in March or early April.

Mike Lawden, Starlink, RAL *mdl@star.rl.ac.uk*

Did you know?

...That you can

Look at a Starlink document

with a command like:

```
% showme sun188
```

Just type the code of the document you want in place of `sun188`. The document will be displayed in a separate window by a web browser. (Another way is to follow the *Documentation* link on our web page.)

Search Starlink documents for keywords

with a command like:

```
% findme echelle
```

Just type the word you want to look for in place of `echelle` – case is not significant. Once again, information will be displayed in a browser window. (Another way is to follow the *Topics* link on our web page.)

Find someone's e-mail address

with a command like:

```
% email Smith
```

Replace `Smith` with the name of the person you want to contact. The information is displayed on your screen. (Another way is to follow the *People* and *Unixnames* links on our web page.)

Well, did you know?

If so, you must have read the *Starlink User's Guide* – a handy little A5 booklet available at all good Starlink Sites.

Mike Lawden, Starlink, RAL *mdl@star.rl.ac.uk*

Starlink software for PC/Linux

The previous Bulletin (September 1996) contained several articles on Starlink's support for the PC/Linux platform and on the software that Starlink has provided for it. This article is a brief update which describes the progress that has been made in porting and distributing Starlink software for PC/Linux.

The software is available on CD and can also be obtained from the Software Store. Where a site has decided to use the PC/Linux platform, in addition to the original SPARC/Solaris and/or Alpha/DEC-Unix platforms, your Site Manager will install the new software on Starlink or part-Starlink PCs. In other circumstances, CDs can be borrowed from your Site Manager, or the Software Store can be accessed via Starlink's web page (`http://star-www.rl.ac.uk/`) by following the link *How to obtain it.*

CD releases

Starlink's first Linux CD (v1.1) was distributed in July 1996. Since then, v1.2 has been released (November 1996) and plans have been made for v1.3, to be released in April 1997.

A description of our v1.3 plans was sent to all Site Managers and Site Chairmen in December 1996. In summary, the v1.3 CD is expected to contain 29 of the 39 applications/utilities. Of the ten that have not yet been released, five are "possibles", and may be included, and four are maintained or developed outside Starlink (*e.g.* SPECX, JCMTDR), so that the timing of any port to Linux is out of our hands.

Among the new items that are expected to be included in v1.3 are:

- CCDPACK
- CONVERT
- ECHOMOP
- GAIA
- PHOTOM
- PISA
- PONGO

With the v1.3 CD, most of Starlink's porting work to this platform will have been completed. In future, new versions of the PC/Linux software will become available automatically at the same time as versions for our other platforms.

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FIGARO for IRAF

Work has been continuing on the system described by David Terrett in the December 1995 issue of the Starlink Bulletin which allows Starlink applications to be run from IRAF. The system is in two parts:

- Tools to assist programmers in the production of the necessary IRAF files.
- An 'adaptor' which handles communication between IRAF and Starlink programs.

Preliminary implementations of both these are now in place.

The main thrust of recent work has been towards making Figaro available from IRAF, handling IRAF images transparently by means of the automatic data-conversion facilities of the Starlink NDF library. The aim is to provide a look and feel which will be familiar to IRAF users.

A trial version of Figaro for IRAF has been made available for selected volunteers to comment upon, and it is proposed to make a beta-test version more generally available at sites in the near future.

If Figaro for IRAF proves popular, it is hoped to make other Starlink application packages available in the same way.

Alan Chipperfield, Starlink, RAL *ajc@star.rl.ac.uk*

GAIA – Graphical astronomy and image analysis tool

GAIA is a new image display tool based on ESO VLT software. What's really "new" about it is that it can be extended to provide new functions and can also be used to control other programs. These abilities make it an ideal tool for visually enhancing the ways in which you work, hopefully resulting in more productive, creative, exploratory (and enjoyable?) analyses.

The way that GAIA is presented at the moment resembles the well known image-display tool SAOimage, and indeed it offers much the same functionality (except perhaps for control via pipes). However, the current release should only be viewed as a preliminary one. It's really just intended to exemplify the type of tasks that may be integrated into GAIA. Typically these follow the principle of being controlled by a "toolbox" that defines a single well-defined activity or a set of very closely related ones.

What does it do?

Among the many functions that GAIA offers are the following:

Aperture photometry – a highly interactive environment for controlling the positions, sizes, and orientations of circular and elliptical apertures, with sky estimates from annuli or other apertures. The measurements can be in either instrumental magnitudes or mean counts (actually this is based on the PHOTOM package).

Image patching – you can select arbitrarily shaped regions on an image and replace them with a surface fit to other regions, together with some artificial noise that makes the whole thing look natural. An ideal way to remove unwanted defects from an image for cosmetic reasons.

Image blinking – allows you to blink through a stack of displayed images, or if your CPU is really sad you can cycle through them by hand.

Image regions – lets you define arbitrarily shaped regions on your image. These can then be extracted or blanked-out, or you can see some simple statistics about them.

Real time slicing – a profile of the data along a line can be displayed and adjusted interactively. The slice is updated in real time.

Image annotation – using this facility you can draw coloured lines, arrows, circles, ellipses, boxes, polygons, and text over your images and then print a representation to a PostScript file. Line graphics are re-drawn at printer resolution (*i.e.* this is not a screen dump).

Other – pan, zoom, colour table manipulations, continuous data and position readout (for R.A. and Dec if your images have suitable FITS WCS headers), and display of multiple images.

GAIA will also read NDF and FITS data files; in fact since it uses NDF this also allows it to read other data types (such as IRAF and old FIGARO formats) using "on-the-fly" conversion. Rather than go on any more about GAIA, I'll leave the rest of the talking to the accompanying figures.

Sample screen shots

Figure 1 shows GAIA with the photometry toolbox in action. The apertures it creates can be elliptical or circular. You can also have sky regions in associated apertures rather than in the annuli. Many different apertures can be created at the same time. They can be picked up and moved about the image, resized, rotated *etc*. Clicking on an image shows the measurement associated with it (naturally you can save and restore all the measurements using text files).

Figure 2 shows a slightly different configuration (the pan and zoom windows have been disabled), while displaying a slice through an object. The slice can be moved around the image by dragging the little boxes on the ends of the line (the "grips") and it will be updated in real time (if your hardware is fast enough!).

Figure 3 shows GAIA in another configuration while patching an image (the controls for zooming and showing the data values *etc* are now in another window that is not shown). The image on the left is the original and the image on the right is the result of replacing the region within the white polygon by a fit to the data in the annulus about it (plus some noise). Using this tool you can replace arbitrarily shaped parts of your image using other arbitrary bits of it to define a fit.

Figure 4 demonstrates GAIA being used to estimate the statistics of an arbitrary region of an image. Using this tool you can also remove and extract such regions. Auto-cropping is useful for removing any large regions of blank pixels about an extracted image. Modified images are displayed in a new window or in the existing window.

How do I use it?

GAIA is documented in SUN/214, which you can view using the command `showme sun214`. You can start it up now (if available on your system) using the command:

```
% gaia [image_file]
```

Where next?

It is hoped that development of GAIA will continue and that the next area to be tackled will be the integration of the new Starlink astrometry library. This is expected to provide the overlaying of astrometric grids, add support for the full range of FITS WCS systems, and allow astrometric systems to be interactively fitted to existing data.

Other areas which have been recommended for development are: better support for photometry in data units such as Janskys, the inclusion of routines for automated object detection, galaxy surface photometry, and object identification via catalogues on the WWW. If you have any suggestions to add to this list, please send them to: `P.W.Draper@durham.ac.uk`.

Acknowledgements

GAIA is an extension of the RTD (Real Time Display tool) which was written at ESO as part of the VLT project and released as free software under the terms of the GNU copyright. Many thanks are extended to the development team at ESO (in particular Allan Brighton).

RTD (for those of you who wonder about such things) is a collection of Tk canvas widgets for displaying images and many [incr Tcl] classes for building up useful applications. It is also used as part of the ESO SkyCat tool (`http://archive.eso.org/skycat`).

Peter Draper, Durham *P.W.Draper@durham.ac.uk*

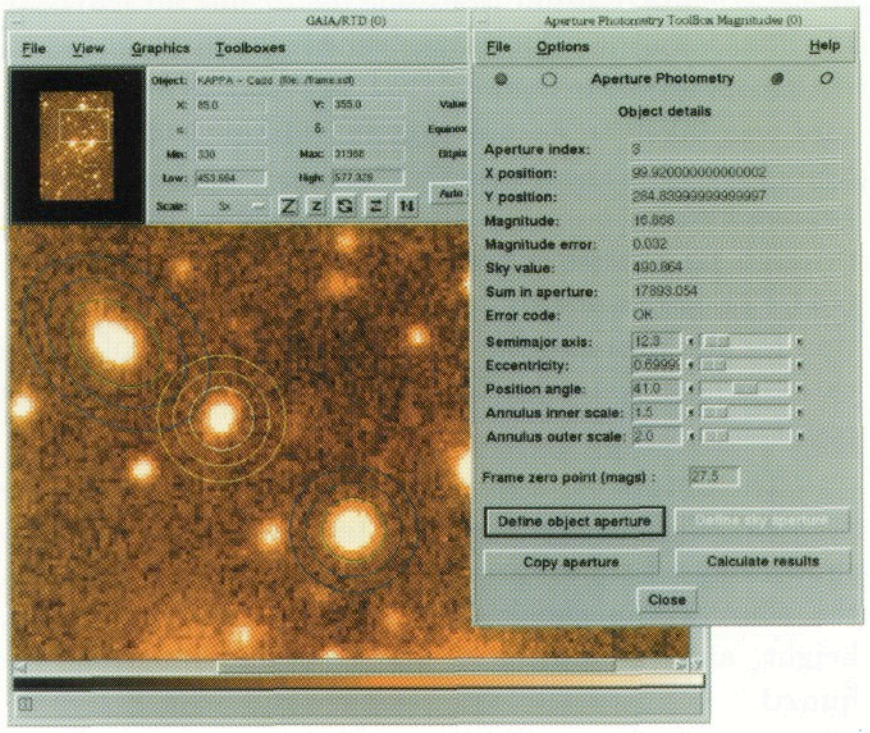

Figure 1. *The GAIA photometry toolbox.*

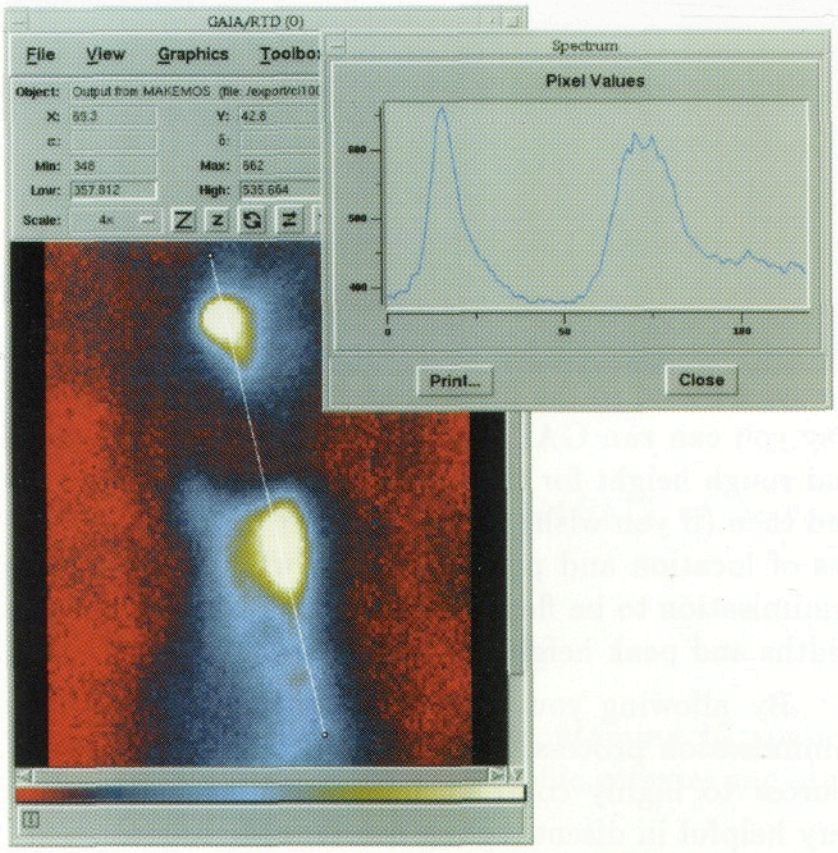

Figure 2. *Displaying a slice through an object.*

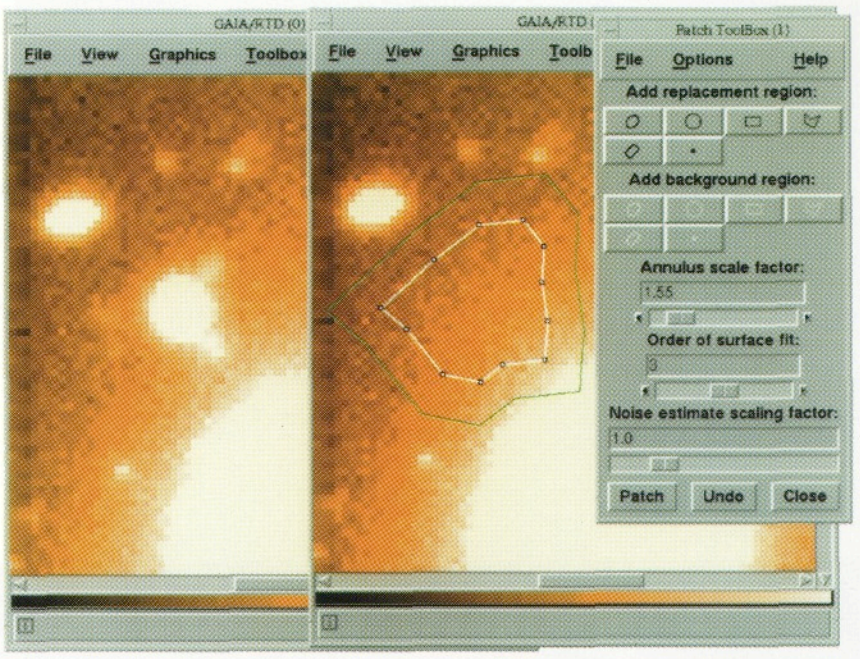

Figure 3. *Using GAIA to patch an image.*

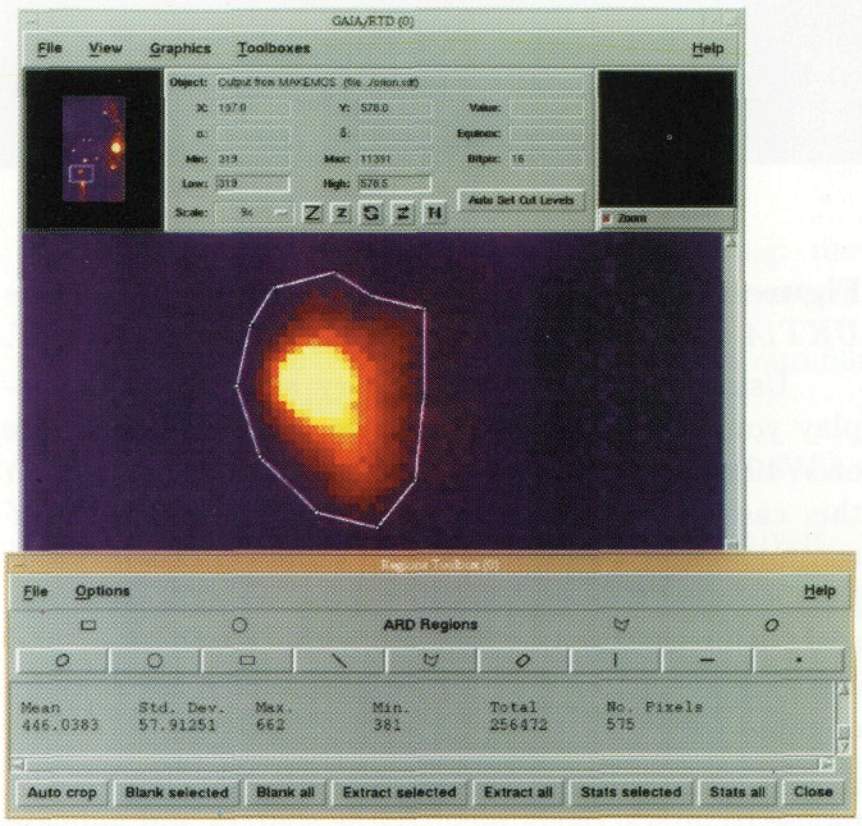

Figure 4. *Estimating the statistics of an arbitrary region of an image.*

GAUFIT – 2D Gaussian source profiling

Last year a new bolometer camera was installed on the James Clerk Maxwell Telescope (JCMT) in Hawaii. It is called SCUBA (Submillimetre Common-User Bolometer Array) and operates at millimetre and sub-millimetre wavelengths.

Observers aiming to work on mapping data generated by SCUBA may be pleased to hear that the latest release of the ESP (Extended Surface Photometry) software package from Starlink will make analysis of JCMT submillimetre continuum images much easier. This is because GAUFIT, the latest addition to ESP, employs a robust minimisation routine which examines Gaussian parameter space to determine 2-D Gaussian profiles of up to 10 sources simultaneously in an NDF-format image.

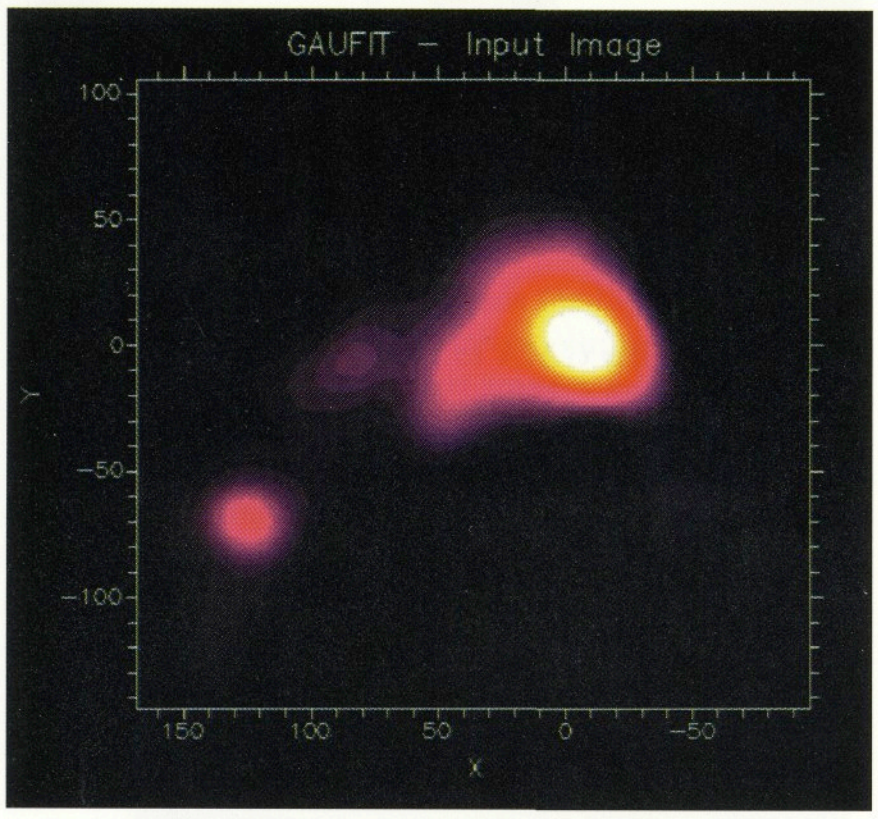

Figure 1. *A 450-micron image of W49 taken with the UKT14 bolometer receiver and displayed by GAUFIT.*

Using the application is very simple. First display your image. Figure 1 shows a 450-micron image of W49, taken with the UKT14 bolometer receiver in this case, as displayed using the KAPPA DISPLAY command and a suitable lookup table (in this instance LUTHEAT). You can see that there are at least 4 separate sources standing out from the continuum, and a strong suspicion that the brightest of these may be double.

When you run GAUFIT, you are asked to use the mouse to interactively identify the sources and indicate a radius within which each source is likely to have a significant signal-to-noise value. To maximise the speed of the application, only those pixels within the prescribed distance from each source will be involved in the minimisation.

Once this is done, you are asked to provide a little information about the background value of the image and its associated standard deviation (values can be supplied by ESP's HISTPEAK application), the number of minimisation iterations that must be undertaken, and a few other simple parameters.

The program then runs, showing you its progress with each iteration. When GAUFIT was written, great care was taken to ensure that it combined two important factors – these were *robustness*, and *an ability to avoid 'false' minima* that would cause the wander through parameter space to stall. As a result of this, GAUFIT is reasonably quick (a few minutes per iteration for the problem shown), but not the sort of application where you want to hang around waiting for the result.

The output is supplied in two forms, the most important of which is a simple text file (such as that shown below) containing important information about the sources you chose – *i.e.* position, position angle, height, and the widths of the Gaussian functions required.

Here is a listing of an ESP/GAUFIT 1.0 output file:

```
Sigma:
10
Background:
12
Source Parameters:
X       Y       Angle    Sa    Sb    Peak

173.9   146.6   150.0    10.4  8.5   576.5
 44.1    75.5   164.7     8.6  7.9   104.1

 86.2   138.6    21.7    14.9  10.1   47.0

215.4    82.2   123.3     8.4  7.7    26.1

END
```

One important thing to remember about the output text files is that, with slight modifications, they can always be used as the basis of an input text file. In this way you can run GAUFIT once to give you a position and rough height for the sources you are interested in, and then (if you wish) run it again with predefined values of location and position angle, while allowing the minimisation to be flexible with the Gaussian function widths and peak height.

By allowing you this degree of control over the minimisation process, GAUFIT is capable of 'fitting' sources to highly complex images, and should prove very helpful in disentangling overlapping sources.

The other form of output from GAUFIT is an NDF file of the source(s) model created (*i.e.* what GAUFIT thinks the image would look like if only the sources were present) or a 'residuals' image obtained by subtracting the model image from the source image. An example of

a sources model is shown in Figure 2, which was derived from an analysis of the W49 data shown in Figure 1.

Figure 3 shows what the W49 image looked like after the modelled image, shown in Figure 2, was subtracted from it. To make features easier to see, the contrast on this image has been boosted slightly, showing that the source models were quite accurate, and also that there was indeed another source merged with the largest source.

For those interested in learning more about this source and the results of the above analysis, see Buckley & Ward-Thompson (1996, MNRAS 281, 294).

Bearing in mind that some users may have lots of images they need to process, GAUFIT will also accept input from a simple text file which describes the sources. An input file must contain the x and y coordinates of the sources, and may, in addition, contain estimates for the position angle, Sa, Sb (standard deviation of the Gaussian functions in 2 directions – major axis, then minor) and the peak values.

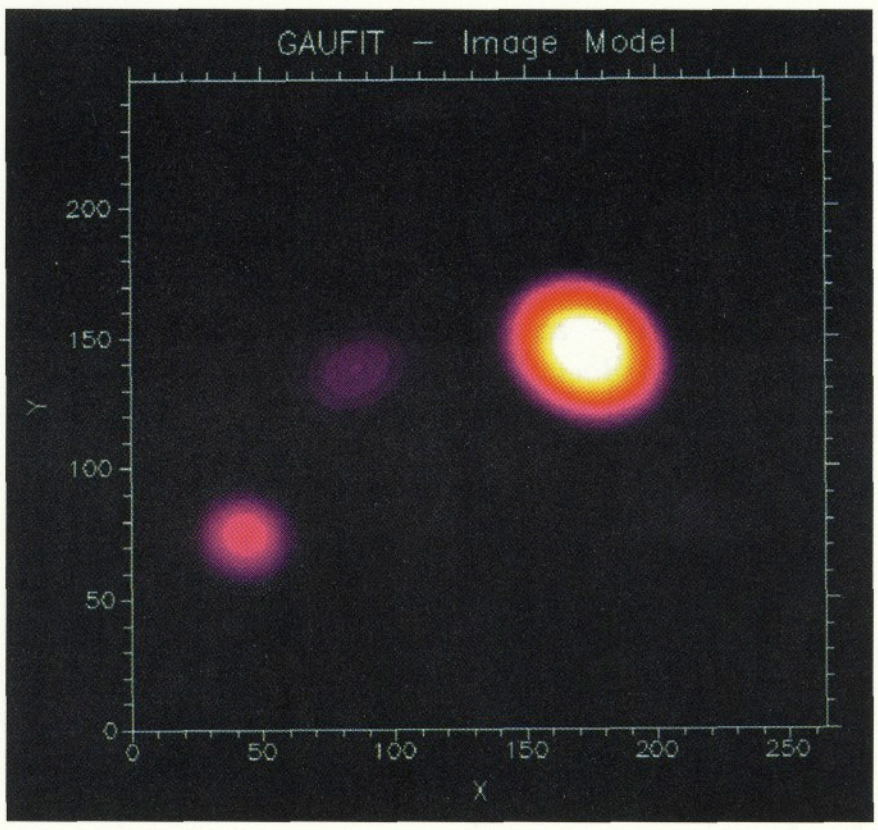

Figure 2. *A model, derived by GAUFIT, of the image of W49 shown in Figure 1.*

What is ESP?

ESP is a Starlink package containing 12 applications that help astronomers to profile galaxies and other extended sources.

It was first released at the end of 1994. The next release will contain the recently developed GAUFIT application, will be NAG-free, and will appear on the Starlink Linux CD-ROM.

The package has a full help system, a substantial document – SUN/180 (including cookbook examples) – user support, and hypertext documentation.

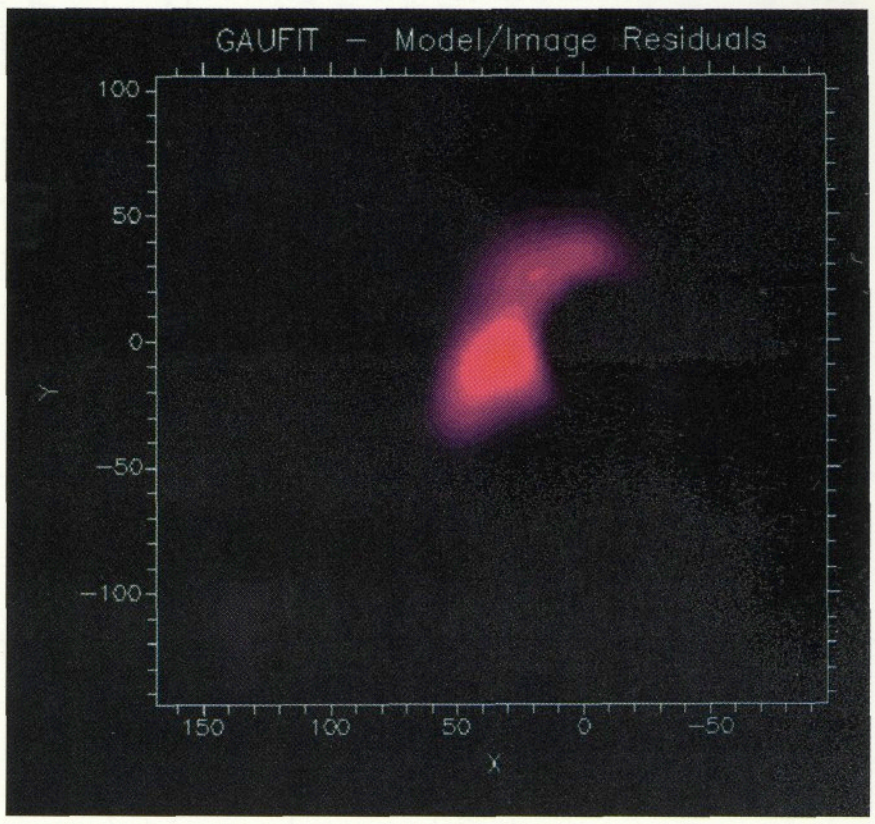

Figure 3. *The residual image of W49 obtained by subtracting the model image shown in Figure 2 from the original image shown in Figure 1.*

What does ESP do?

Used together, the 12 applications in ESP allow you to perform the following actions:

- Detect/identify flatfielding faults.
- Remove cosmic ray events.
- Median flatten images on a defined scale.
- Determine whole image statistics, including: median count, modal count, kurtosis, and skewness.
- Determine the local background value at a number of different points on an image.
- Perform galaxy profiling using intensity analysis.
- Perform galaxy profiling using contour analysis.
- Perform source profiling assuming a 2-D Gaussian – NEW!
- Generate galaxy pie slice cross-sections.
- Display graphs showing the profiling/cross-section results.
- Help detect faint diffuse objects in an image.

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Derek Ward-Thompson, ROE dwt@roe.ac.uk

New products

The products released as part of the Starlink Software Collection (SSC) during the period 7th September 1996 to 19th February 1997 inclusive (releases 177 to 186) are summarised in the Table shown opposite.

The left and centre panels show the names and descriptions of the software items that have been affected by these releases, together with codes indicating the newly released documents (if any) associated with those items. In the right panel, an alphabetical list of the affected items is shown under the heading *Items Released*, followed by a classification code which is a cross-reference to the sub-headings in the left and centre panels.

Some newly released documents are not associated with any of the listed software items. These are shown separately under the heading *Other Documents*.

In the Table, the names of software items and documents which are completely new (rather than just updates of previous versions) are shown in bold type. For software items, "new" means that the item is a new addition to the Unix version of the Starlink Software Collection. Some of these items may be "old" from a user's perspective in that they may have existed previously in the old VMS version of the Collection, or they may have been imported from external sources.

New item

The only new item that has been released in the time-frame of this report is:

ECHWIND – this can help you plan observations with either the Utrecht Echelle Spectrograph (UES) or the UCL coudé echelle spectrograph.

Package updates

Five existing Starlink packages have been updated (the sixth, JCMTDR, just had a bug fix).

PISA – had just a minor upgrade which eliminated its dependence on NAG routines. There are no significant functional changes.

ECHOMOP – has been speeded up by about 35%. You can now check individual-order profiling and set the fraction of each order to be used. Input and trace frames are now checked for bad-pixel values. Also, it is now much faster to check through all the orders of an echelle spectrum.

FIGARO – the changes were described in the article *What HAVE they done to Figaro?* in the last issue of this Bulletin.

SPECX – now includes command-line editing (Emacs-style) and exception handling (for cntrl-C).

CGS4DR – has also had its dependence on NAG routines removed. Improvements have also been made to the GUI.

Utility updates

The only items that have been affected by changes that are significant to the user are:

TPOINT – the plotting scales in the G, GDIST, GSCAT and GAM routines were designed to work best with cases where the overall pointing accuracy is in the 1-20 arcsec RMS class. To cope with telescopes with less demanding pointing goals, or which are in the earliest stages of analysis, the maximum plotting ranges have been increased from about 100 arcsec to about 10,000 arcsec.

DOCFIND – a pointer to the hypertext utilities *findme* and *showme* have been added to the display of the results of a search. This brings alternative methods of finding information to the user's notice.

EMAIL – the data files containing the email addresses have been updated.

Subroutine library updates

MAG – this set of routines to help you access magnetic tapes in your programs now has its own Programmer's Manual, published as SUN/171.

In the pipeline

Several new items should have been released by the time you get this Bulletin, but had not appeared before SSC186. These include:

GAIA – a graphical astronomy and image analysis tool, described in the article on page 3.

GAUFIT – an addition to the **ESP** software package which does 2D Gaussian source profiling. It is described in the article on page 6.

Software releases

For the last 16 years the standard method of releasing Starlink software has been to issue "Starlink Software Releases" to Starlink sites over the network at frequent intervals. In recent years these have averaged about 40 per year. A major change is on its way. In future, it is likely that there will be only 2 releases per year (March and September on CD-ROM). More information in the next Bulletin.

Future plans

Starlink's software plans for 1997 were discussed at a Starlink Panel meeting on 29th January. They will be published eventually as a revised version of Starlink document SGP/48. You can also keep an eye on the *Development plans* link in our web page (see below).

You can keep in touch with the latest Starlink software and document releases by following the links *New products* or *News and Jobs* in the Starlink Project's web page (`http://star-www.rl.ac.uk/`).

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Martin Bly, Starlink, RAL *ussc@star.rl.ac.uk*

Name	*Description*	*Documents*

Packages

P2: Image Processing & Photometry

PISA	Position, intensity & shape	SUN/109

P3: Spectroscopy

ECHOMOP	Echelle data reduction	SUN/152
FIGARO	General data reduction	SUN/86

P6: Specific Wavelengths

SPECX	mm-wave spectral data	

P7: Specific Instruments

CGS4DR	UKIRT (CGS4)	SUN/27
JCMTDR	JCMT (UKT14)	

Utilities

U1: Astronomical Utilities

COCO	Coordinate conversion	
ECHWIND	**Echelle observation planning**	SUN/53
TPOINT	Telescope pointing analysis	SUN/100

U2: General Utilities

DOCFIND	Starlink document search	SUN/38
EMAIL	E-mail help	SUN/182

U3: Document Preparation

HTX	Hypertext utilities	

U4: Programming Support

GENERIC	Generic Fortran routines	
MESSGEN	Error message generation	

Name	*Description*	*Documents*

Subroutine Libraries

S2: Data Access & Management

ARY	Access ARRAY objects	
IMG	Simple image data access	SUN/160
MAG	Magnetic tape handling	**SUN/171**
PAR	Parameter system	
PRIMDAT	Process primitive data	

S3: Graphics

GKS	Low-level graphics	

S4: Other

CHR	Character handling	
PCS	Parameter/communications	

Infrastructure (I)

ICL	ADAM command language	
INIT	Starlink initialisation files	

SSC 177 - 186

Items Released

ARY	**S2**	**ICL**	**I**
COCO	**U1**	**IMG**	**S2**
CGS4DR	**P7**	**INIT**	**I**
CHR	**S4**	**JCMTDR**	**P7**
DOCFIND	**U2**	**MAG**	**S2**
ECHOMOP	**P3**	**MESSGEN**	**U4**
ECHWIND	**U1**	**PAR**	**S2**
EMAIL	**U2**	**PCS**	**S4**
FIGARO	**P3**	**PISA**	**P2**
GENERIC	**U4**	**PRIMDAT**	**S2**
GKS	**S3**	**SPECX**	**P6**
HTX	**U3**	**TPOINT**	**U1**

The codes used above (S2, U1 etc.) refer to the sub-categories shown in the left and centre panels).

Other Documents

1. Associated with software items:

NDPROGS - n-D image manipulation 3.2, UG	SUN/19
ADAM - Unix version 3.2-1	SUN/144

2. General:

Starlink document styles	**SGP/50**
Starlink benchmarking utility 0.9-1, UM	SSN/23
Unix security cookbook	**SSN/67**
Starlink Linux software CD-ROM 1.2	SUN/212

MUON'S

GUIDE TO GETTING ON IN ASTRONOMY

CONFIDENTIAL

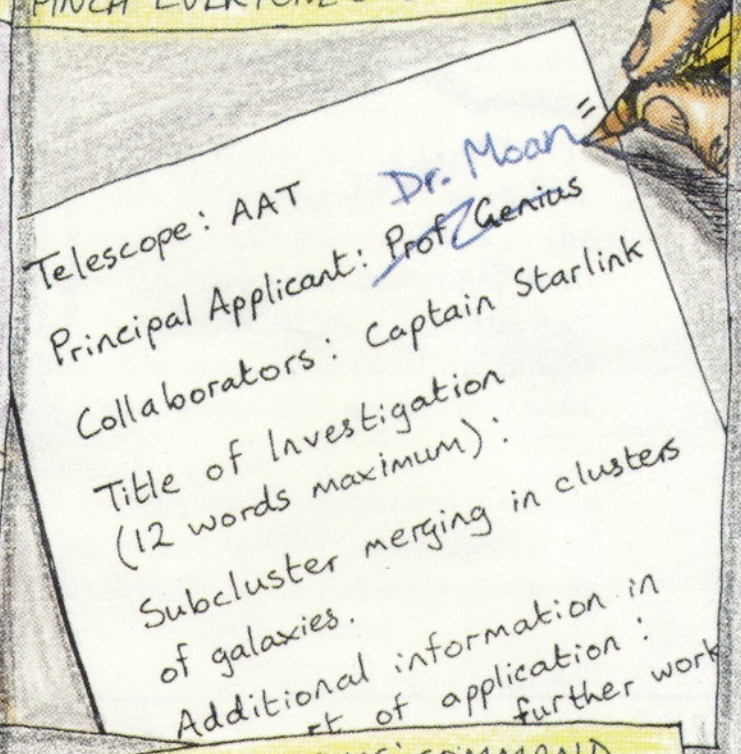
DON'T TELL ANYONE I DID THIS, BUT...

THANK YOUR RIVALS IN THE ACKNOWLEDGEMENTS OF YOUR PAPER

DR. MOAN HAS ACKNOWLEDGED PROF. GENIUS

THEN WE CAN'T ASK HIM TO REFEREE IT

GET ONTO PATT SO THAT YOU CAN PINCH EVERYONE'S BRILLIANT IDEAS



FORGE THE OBSERVING LOG SO THAT NO-ONE KNOWS WHAT YOU'VE BEEN LOOKING AT

IT SAYS HERE THAT DR. MOAN HAS BEEN OBSERVING.. MAGRATHEA!?!

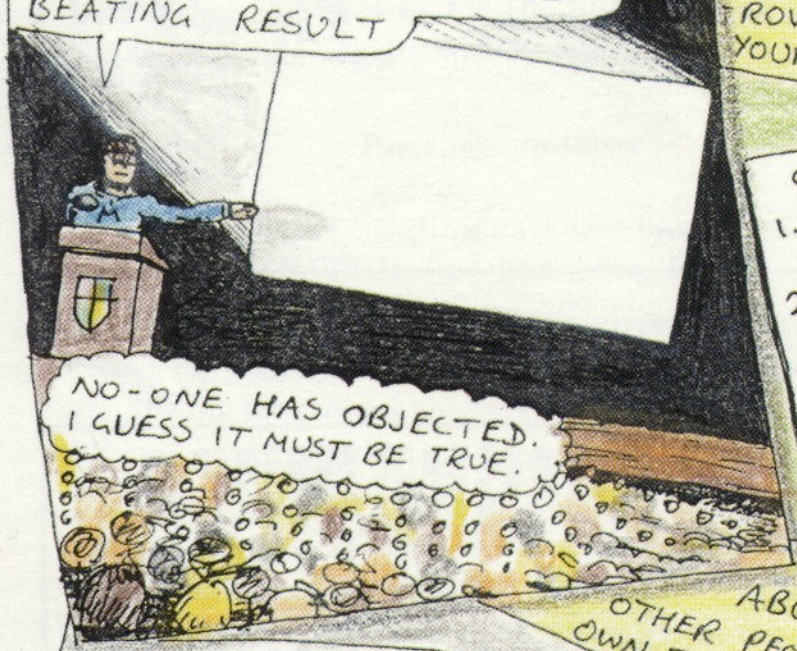
LEARN HOW TO USE THE STARLINK 'FINDME' COMMAND (SUN/188)*

JUST TYPE 'FINDME ECHELLE' TO GET TO ECHELLE-RELATED HYPERTEXT DOCUMENTATION

*GRATUITOUS PLUG FOR STARLINK SOFTWARE

HYPE EVERY RESULT YOU GET

THIS FLATFIELD IS A WORLD-BEATING RESULT



NO-ONE HAS OBJECTED. I GUESS IT MUST BE TRUE.

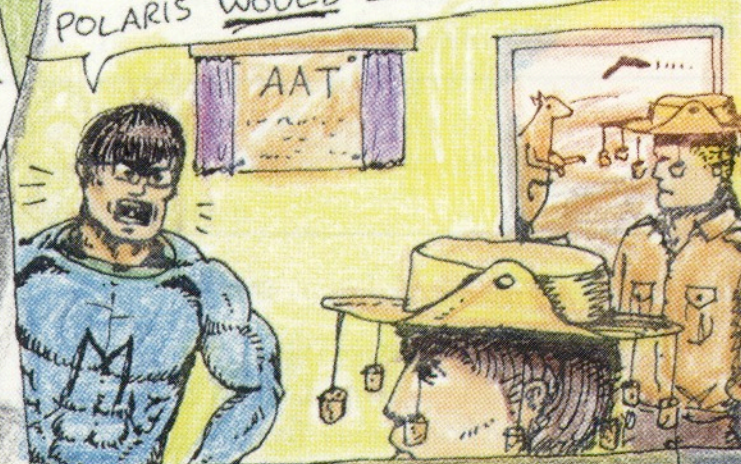
WRITE RIDICULOUS AND CONTROVERSIAL PAPERS TO INCREASE YOUR CITATION RATE

CITATION INDEX TOP 10

1. GRAVITATION LENSING - AN INSTRUMENTAL EFFECT
2. STARLINK - TIME FOR ANOTHER REVIEW?
3. INFLATION IN THE EARLY UNIVERSE - COSMOLOGY OR PARTY POLITICS?
4. MEASUREMENTS OF TEMPORAL VARIATION IN THE GRAVITATIONAL CONSTANT

ALWAYS BLAME OTHERS FOR YOUR ERRORS

BUT IF YOU HAD BUILT THIS TELESCOPE ON LA PALMA, POLARIS WOULD BE ABOVE THE HORIZON



DON'T FEEL GUILTY ABOUT PRESENTING OTHER PEOPLE'S WORK AS YOUR OWN

HE'S ONLY A STUDENT. JUST DROP HIS NAME OFF THE PAPER.

THE LAD WORKED FOR 3 YEARS ON THAT PROJECT!

BUT, IF YOU REALLY WANT TO GET ON IN ASTRONOMY...

THANKS FOR YOUR HELP, C.S.

...BUY YOUR STARLINK SITE MANAGER A BOX OF CHOCOLATES

Likeness of the above activities to those of any astronomer you know, alive or dead, probably isn't coincidental.

The Starlink Family - October 1996

This photograph was taken on 31st October 1996 at the 9th Starlink Annual General Meeting which was held at The Cosener's House, Abingdon. Left to right:

Back Row

Dave Berry, *Contract Programmer, Manchester;* **Phil Herridge**, *Site Manager, Cambridge;* **Steff Watkins**, *Site Manager, Bristol;* **Richard Frewin**, *Site Manager, QMW;* **Nick Eaton**, *Site Manager, Imperial College;* **Andrea Roberts**, *Operations, RAL;* **David Rawlinson**, *Operations, RAL;* **Paul Collison**, *Site Manager, Oxford;* **John Deacon**, *Site Manager, UCL*; **Barry Smalley**, *Site Manager, Keele;* **Tim Gledhill**, *Site Manager, Herts;* **Subhash Rehan**, *Site Manager, Kent*; **John Barrow**, *Site Manager, Edinburgh;* **Martin Bly**, *Software Librarian, RAL;* **Barry Kellett**, *Site Manager, RAL (Astrophysics).*

Middle Row

John Palmer, *Site Manager, Manchester;* **Malcolm Currie**, *Programmer, RAL;* **Roger Stapleton**, *Site Manager, St Andrews;* **Jonathan Smoker**, *Site Manager, Cambridge*; **Andrew Batey**, *Site Manager, Cambridge;* **Shashi Kanbur**, *Site Manager, Glasgow;* **Paul Brown**, *Site Manager, Belfast;* **John Sherman**, *Head of Operations, RAL;* **Martin Murphy**, *Site Manager, Armagh*; **Patrick Wallace**, *Project Manager, RAL;* **Chris Clayton**, *Operations, RAL;* **Brian McIlwrath**, *Programmer, RAL;* **Claudio Moreno**, *La Palma;* **Andy Adamson**, *Site Manager, Preston;* **Mike Lawden**, *Document Librarian, RAL;* **Stuart Keir**, *Site Manager, Sussex;* **Mike Hill**, *Site Manager, Southampton*; **Mark Buckley**, *Programmer, RAL;* **Alan Lotts**, *Site Manager, Durham;* **Bill Wilson**, *Site Manager, Birmingham.*

Front Row

Rodney Warren-Smith, *Head of Software, RAL;* **Geoff Mellor**, *Site Manager, Leicester;* **Grant Privett**, *Contract Programmer, Cardiff;* **Rodney Smith**, *Site Manager, Cardiff;* **Alan Scott**, *Site Manager, Liverpool;* **Jon Lockley**, *Contract Programmer, Southampton*; **Dave Terrett**, *Systems, RAL;* **Clive Davenhall**, *Contract Programmer, Edinburgh;* **Hiten Patel**, *Site Manager, RAL;* **Kevin Duffey**, *Operations, RAL;* **Anne Charles**, *Operations, RAL;* **Jackie Moon**, *Operations, RAL;* **Ray Riggs**, *Site Manager, Jodrell Bank;* **Alan Chipperfield**, *Programmer, RAL;* **Martin Clayton**, *Contract Programmer, UCL;* **Peter Draper**, *Contract Programmer, Durham.*

Remote access to the Digitised Sky Survey

The *Digitised Sky Survey* (DSS) is a set of 102 CD-ROMs produced by the Space Telescope Science Institute (STScI). It contains microdensitometer scans of an all-sky collection of Schmidt telescope photographic plates.

The southern plates were obtained with the UK Schmidt Telescope at Siding Spring and the northern plates with the Oschin Schmidt Telescope on Palomar Mountain. The southern data, comprising some sixty-one disks, were mostly constructed from the SERC Southern Sky Survey, the SERC J Equatorial extension, and some short V-band exposures at low Galactic latitudes. The northern data, comprising some forty-one disks, were mostly constructed from the 1950-55 epoch Palomar Observatory Sky Survey red plates. The plates were digitised at the STScI.

Normal web access

The DSS has proved to be a powerful and widely used resource in many branches of astronomical research. Some institutions have bought their own copies, but for others the cost is prohibitive. An alternative to buying a copy is to access the data remotely. A couple of sites in the United States provide unrestricted remote access to the DSS. The STScI itself provides access to a copy, and the data are also available as part of the *SkyView* interactive atlas at the Goddard Space Flight Center. The URLs for these services are:

STScI: `http://stdatu.stsci.edu/dss/`

SkyView: `http://skyview.gsfc.nasa.gov/`

Experimental access from Leicester

Obviously, from the UK these services must be accessed across the transatlantic computer networks and reports of the adequacy of the speed of access are uneven. Some users find the speed of response to be adequate whereas others find it unacceptably slow. Consequently, Starlink is investigating whether it is worthwhile providing a publicly available copy of the DSS in the UK.

As part of this exercise, and to gauge likely demand, the X-ray Astronomy Group at the University of Leicester have agreed to make their copy of the DSS available to users at all Starlink sites on a temporary, experimental basis. The usage will be monitored and, if there is sufficient demand, Starlink will investigate providing a permanent service.

It must be emphasised that the Leicester service is using capacity on a CD-ROM jukebox which is currently spare, but which may later be required for expansion of the data archives of the ROSAT and GINGA X-ray astronomy satellites.

The copy of the DSS at Leicester is accessed from URL:

`http://ledas-www.star.le.ac.uk/DSSimage`

You then fill in a simple form to specify the region that you are interested in. You enter the central coordinates and size of the field. In the case where you are looking for a named object you may be able to supply the object name rather than the central coordinates.

The specified region can be returned in one of a number of formats:

- FITS image.
- Standard Starlink NDF.
- Asterix-style SDF file.

There are, of course, several different ways of displaying FITS and NDF format images. *The 2-D CCD Data Reduction Cookbook* (SC/5) includes a simple tutorial introduction to several of the more common ones. Asterix is described in *ASTERIX – X-ray Data Processing System* (SUN/98).

Help

If you have trouble accessing the Leicester service, contact Richard West (e-mail: `rgw@star.le.ac.uk`). More general comments on the accessibility of the various copies of the DSS and the desirability of Starlink providing access to a copy should be sent to Clive Davenhall (e-mail: `acd@roe.ac.uk`).

Thanks are due to the X-ray Astronomy Group of the University of Leicester for agreeing to make their service publicly accessible for an experimental period.

References

D.J. Allan and R.J. Vallance, 1995, SUN/98.6, *ASTERIX – X-ray Data Processing System* (Starlink).

G.J. Privett, 1997, SC/5.1, *The 2-D CCD Data Reduction Cookbook* (Starlink).

Clive Davenhall, Starlink, Edinburgh *acd@roe.ac.uk*
Clive Page, Leicester *cgp@star.le.ac.uk*

Difference mapping using DIFMAP and AIPS SCMAP

Radio aperture synthesis imaging, using sparse arrays such as MERLIN and VLBI systems, and to a lesser extent the VLA, often requires an iterative combination of deconvolution (usually in the form of the CLEAN algorithm) and self-calibration. Successively better models of the image (in the form of CLEAN components) are used iteratively to improve the calibration of the raw data.

Traditionally, the individual stages of this process are usually confined to separate programs; *e.g.* in the

AIPS package, the task CALIB is used for calibration and self-calibration, while imaging (*i.e.* Fourier transformation and deconvolution) is performed by tasks such as MX or IMAGR. This approach is fine where only one or two iterations are required for convergence, but initial calibration can be poor for a variety of reasons, particularly on long baseline arrays such as MERLIN and the VLBA, and so many iterations may be necessary to achieve the high dynamic ranges required to obtain noise-limited images of bright objects.

The technique of difference mapping

In the early 1980s at Jodrell Bank, Roger Noble and Pat Moore (whom some will remember as an early manager of the Manchester Starlink node) devised and implemented a *difference mapping* algorithm as part of the Jodrell OLAF package. The basis of this technique is the fact that the brightest parts of the image model, obtained in the early deconvolution stages (*i.e.* the brightest CLEAN components) are reliable, and don't change as calibration improves. Successive stages of calibration produce further model components which are reliable at lower levels. Thus, in conventional iterative imaging, the CLEAN algorithm has to find these components repeatedly. Difference mapping subtracts the most reliable components at each iteration, and thus the next iteration only works on the residual data - hence the term *difference mapping.* Only the data which represent the difference between the most reliable model components and the data are processed further.

Apart from the obvious improvement in speed which arise because of savings in calculations, working with residuals often makes problem data or artefacts in the map more obvious, and the user can intervene between iterations to edit data or set CLEAN boxes to suppress spurious features. The latter becomes particularly easy since bright components are effectively subtracted from an image, and weak extended structure is thus more apparent.

More recently, difference mapping has been reproduced in two new implementations:

DIFMAP - a stand-alone DIFMAP program, developed at Caltech by Martin Shepherd (formerly of Jodrell Bank) and Tim Pearson.

SCMAP - an AIPS task, developed by Bill Cotton of NRAO.

DIFMAP

DIFMAP is a very flexible program which permits close control over the whole imaging and self-calibration process, following closely the spirit of the original Jodrell implementation. Parameters such as the CLEAN loop gain may be varied at each stage via a powerful command-line language which also allows users to write scripts to perform mapping tasks. A particularly important feature is the ability to display and interactively edit visibility data during this procedure, including diagnostic data such as cumulative calibration corrections. The most recent release of DIFMAP works with visibility data in FITS data files, allowing easy transport to other packages such as AIPS.

An illustration of the various stages in a DIFMAP session is show in Figure 1 (see pages 14 and 15).

DIFMAP is supported on several Unix variants including Solaris, Digital's OSF, and Linux, and is available via anonymous ftp from `astro.caltech.edu` in directory `pub/difmap`. Documentation, including a cookbook, is available in the same location.

SCMAP

SCMAP is a task which is part of the standard AIPS distribution but which often goes unnoticed. It offers many of the same features as DIFMAP, although the level of interaction is somewhat restricted by the AIPS model of the user interface. In particular, data inspection and editing have to be performed using other tasks, the number of user keystrokes required is much greater, and thus the implementation feels less friendly. However, SCMAP incorporates support for wide-field imaging and fine control over some of the more subtle "handles" on the imaging process which experts may wish to fiddle with.

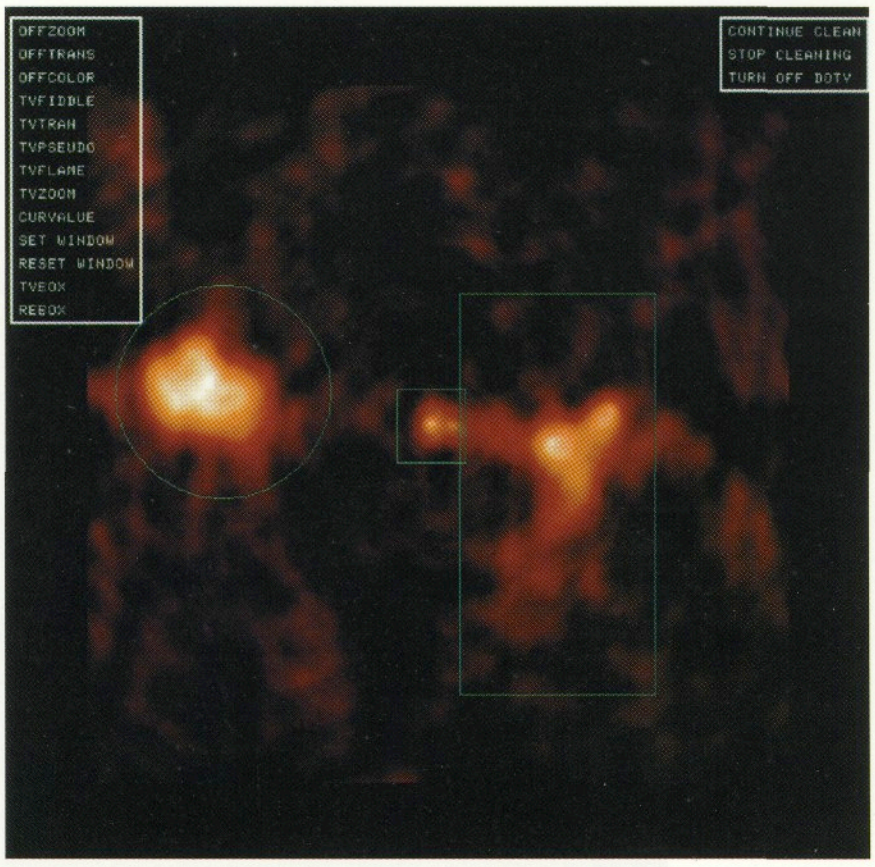


Figure 2. *An SCMAP interactive display, showing CLEAN windows set interctively – even circular ones!*

Synthesis imaging is one of the most challenging areas of astronomical data reduction; these programs are excellent examples of ways to streamline the process.

Dave Shone, Jodrell Bank *dls@jb.man.ac.uk*

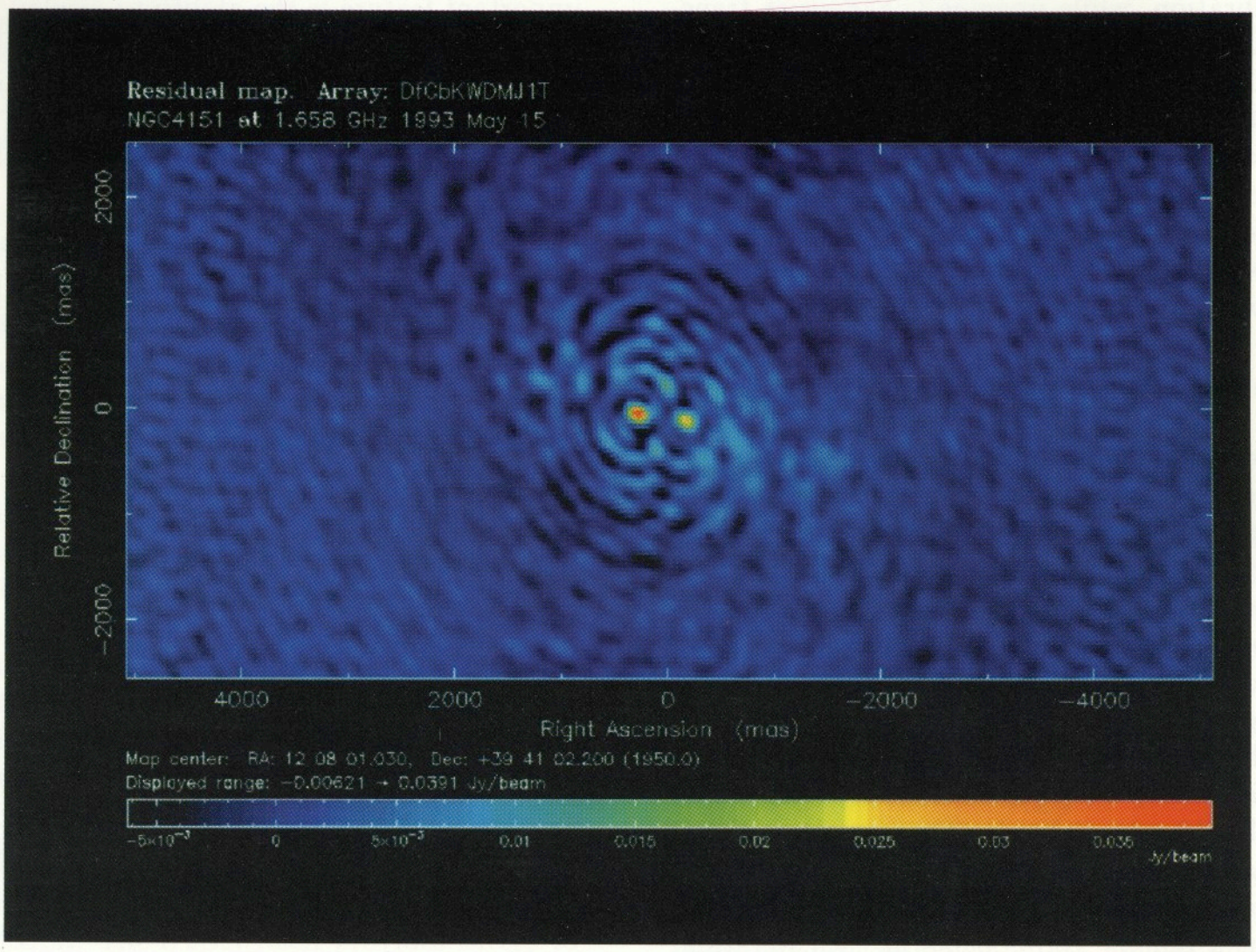


Figure 1a. *This series of figures illustrates the various stages in a DIFMAP session. The image above shows an initial dirty map.*

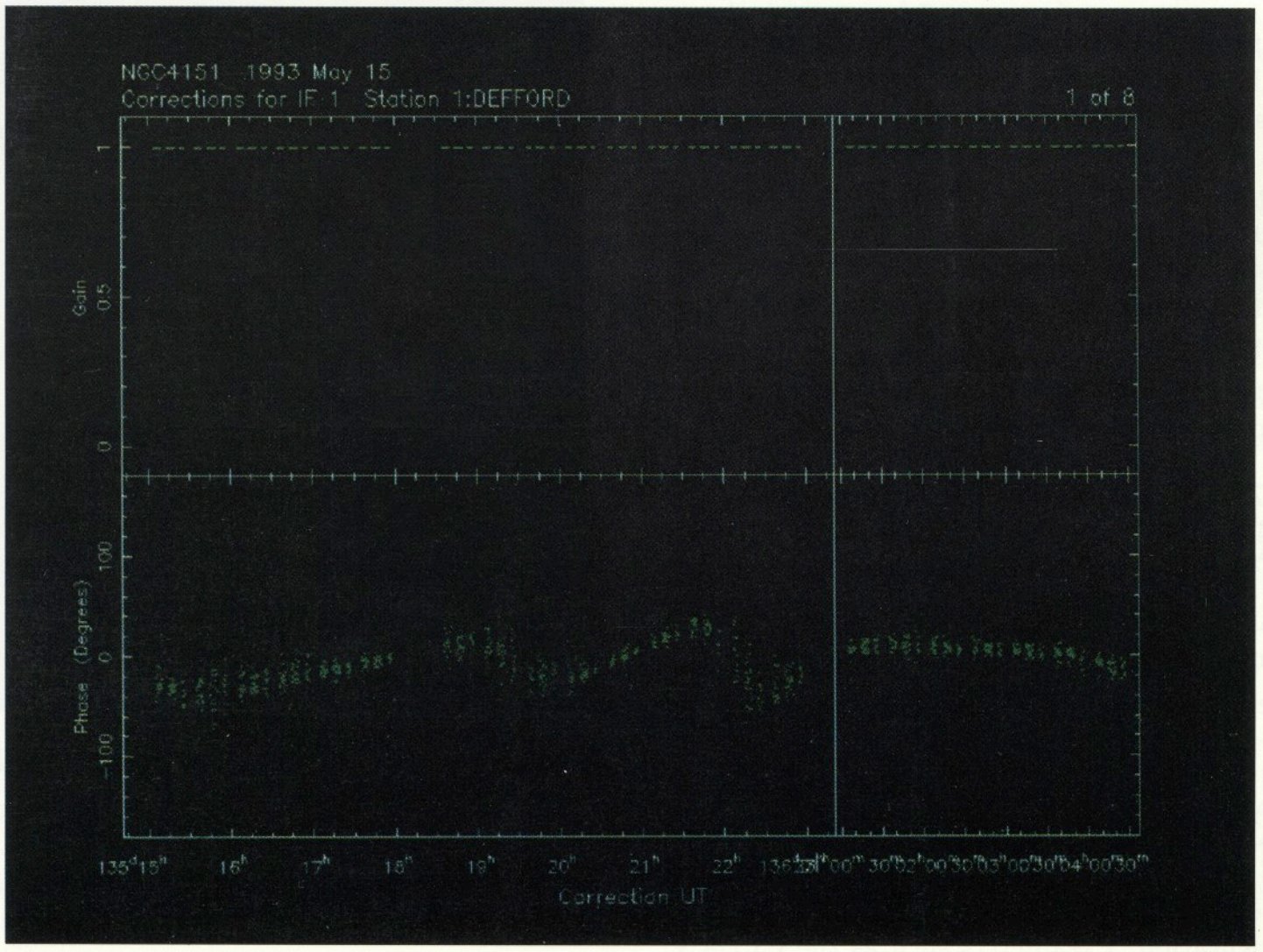


Figure 1b. *This shows an example diagnostic plot, showing the current corrections determined by self-calibration.*

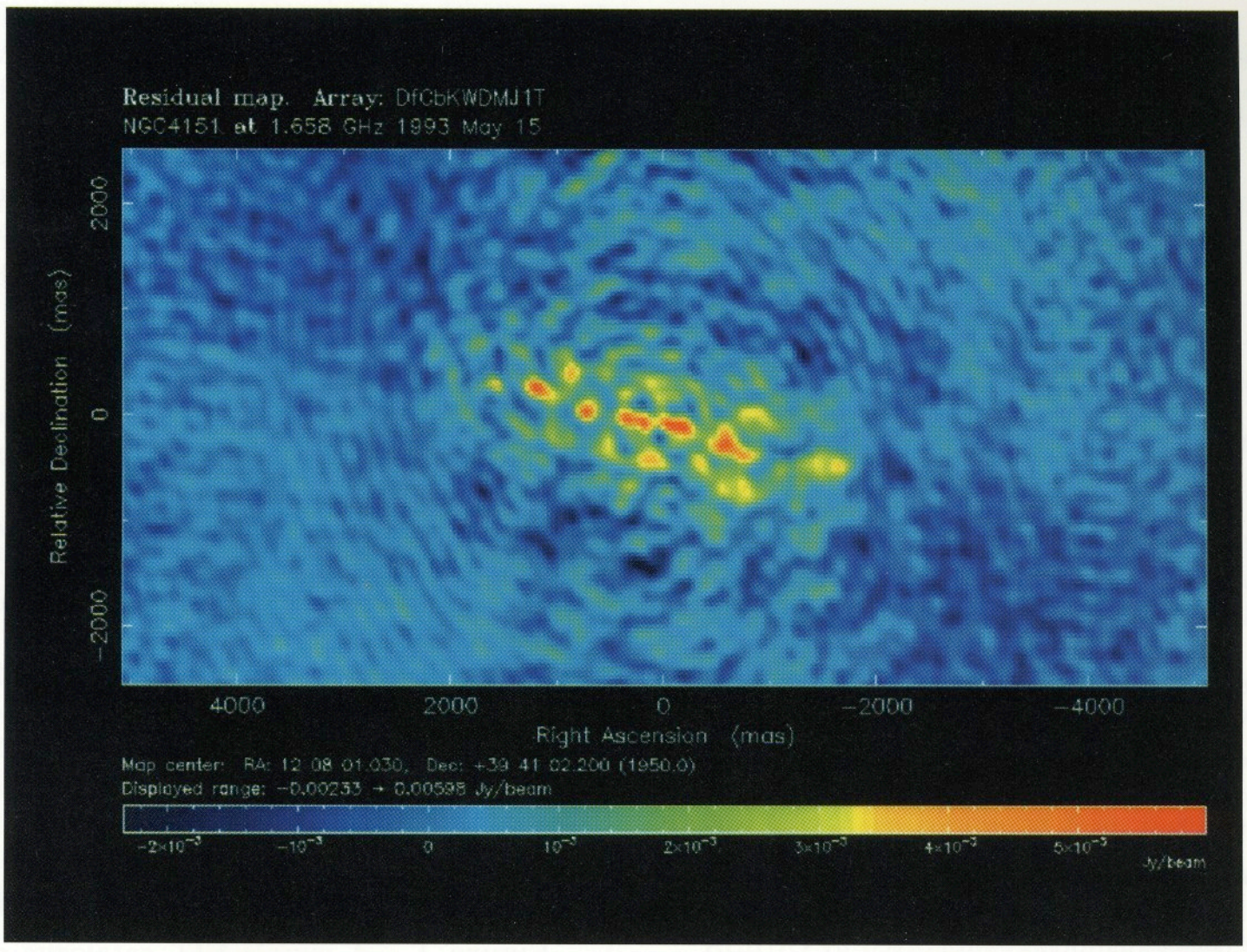


Figure 1c. *This shows a residual map, part way through the difference mapping process.*

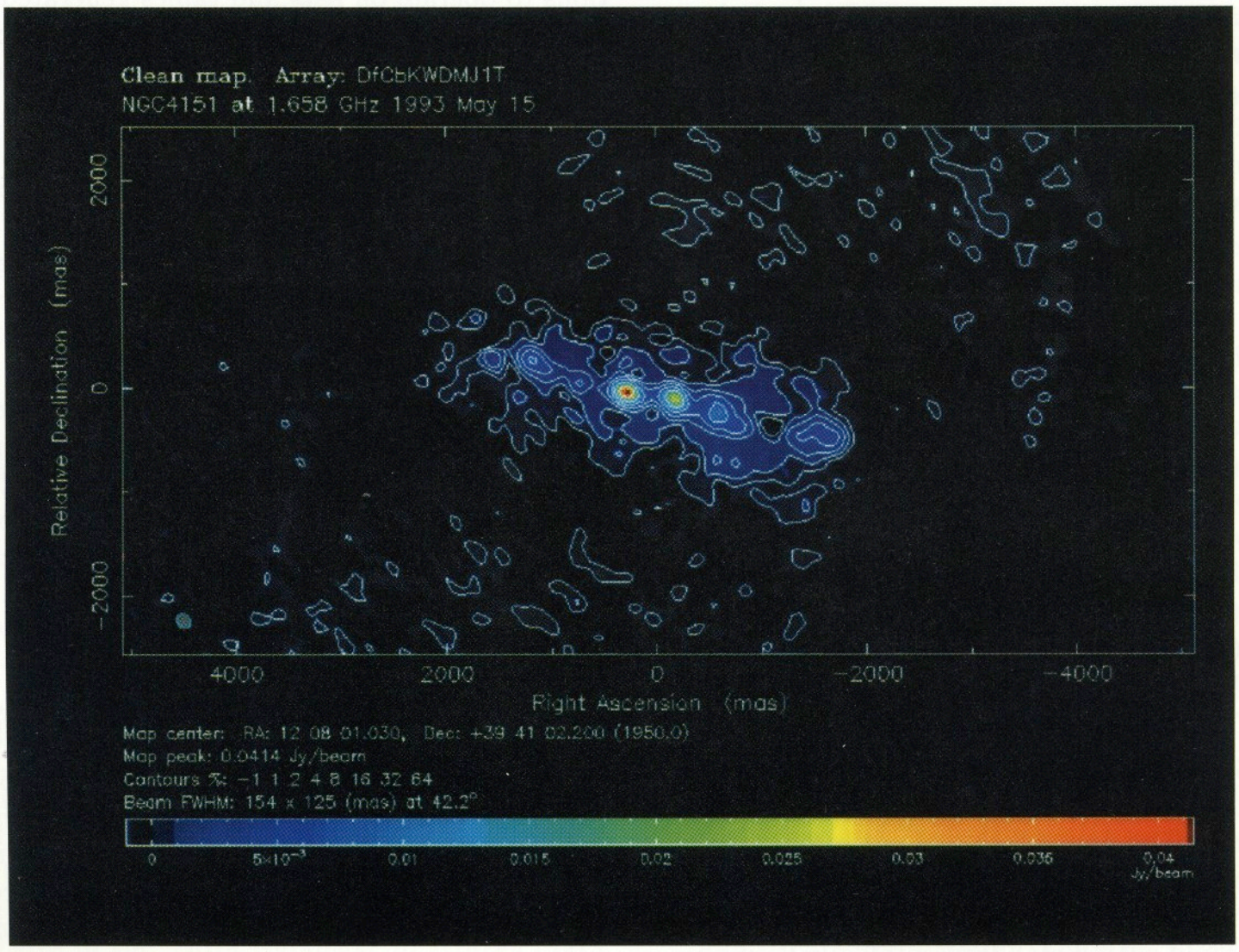


Figure 1d. *This shows a final CLEAN map, the final outcome of the difference mapping process.*

CURSA news

New versions of the CURSA package for accessing and manipulating astronomical catalogues and the associated CAT subroutine library are being released: version 2.1 of CURSA and version 3.1 of CAT. This short article summarises the new features contained in these releases. The major new features in CURSA are:

- Support for a new catalogue format, the Small Text List, which allows easy access to catalogues and lists in simple text files.
- `catselect`, a new application providing several new ways of selecting objects from catalogues.
- An option to compute statistics for individual columns in the catalogue browsers `xcatview` and `catview`.

In addition, there are a number of minor enhancements. Both CURSA and CAT are uniformly available on all three variants of Unix currently supported by Starlink: DEC Alpha/Digital Unix, Sun/Solaris, and PC/Linux.

The small text list catalogue format

The major catalogue format supported by CURSA is the FITS table format. This is popular and widely used internationally, thus allowing CURSA to access an extensive range of catalogues. Nonetheless, there is a requirement to access catalogues formatted as simple ASCII text files. Such catalogues might be private lists of your own results or data, which you have typed into a file using a text editor, or a standard catalogue formatted as a text file which you have obtained from an external source. The Small Text List (STL) format allows you to access such catalogues.

An STL format catalogue comprises a description of the catalogue (details of the columns it contains *etc*) and the table of values. Both are simple ASCII text which is straightforward to create or modify with a text editor. Figure 1 shows an example of a simple STL catalogue which contains equatorial coordinates and *UBV* photometry for a list of stars. The details of the way in which the columns *etc* are defined are not important for this article (and are probably more-or-less self explanatory). However, the format is fully described in SUN/190. The format supports the features usually found in CURSA catalogues, including: columns of vectors, null values, and numerous ways of displaying columns of angles as sexagesimal values.

All CURSA applications can read and, where appropriate, write catalogues in the STL format, as can the CAT library. The new format allows many operations to be carried out much more conveniently than was possible hitherto. For example, if a list of target objects is to be paired with a standard catalogue then an STL catalogue containing the targets can simply be created with a text editor, rather than having to create a FITS table containing them. Also, it is easy to convert catalogues between different formats using the CURSA application `catcopy`. For example, if you wanted to send a list of objects formatted as a FITS binary table to a colleague, you could simply type in the list as an STL format catalogue (or, more likely and even less trouble, convert an existing file to STL format) and then run `catcopy` to convert it to FITS format. This approach is usually much easier than trying to jury-rig your own program to write a FITS table.

```
!+
! Simple STL example; stellar photometry catalogue.
!
! A.C. Davenhall (Edinburgh) 24/1/97.
!-

C RA   DOUBLE  1  UNITS='RADIANS{HOURS}'    TBLFMT=HOURS     ! R.A.
C DEC  DOUBLE  2  UNITS='RADIANS{DEGREES}'  TBLFMT=DEGREES   ! Dec.
C V    REAL    3  UNITS='MAG'    ! V magnitude.
C B_V  REAL    4  UNITS='MAG'    ! B-V colour.
C U_B  REAL    5  UNITS='MAG'    ! U-B colour.

P EQUINOX  CHAR*10  'J2000.0'
P EPOCH    CHAR*10  'J1996.35'

BEGINTABLE
5:09:08.7   -8:45:15   4.27  -0.19  -0.90
5:07:50.9   -5:05:11   2.79  +0.13  +0.10
5:01:26.3   -7:10:26   4.81  -0.19  -0.74
5:17:36.3   -6:50:40   3.60  -0.11  -0.47
...
```

Figure 1. *A simple STL catalogue containing equatorial coordinates and UBV photometry for a list of stars.*

The STL format also allows the CURSA applications to operate on lists and tables generated by applications in the KAPPA image processing package to a limited extent. Again, this facility is fully described in SUN/190.

Selecting objects from a catalogue – `catselect`

The catalogue browsers `xcatview` and `catview` already contain features for selecting objects from a catalogue. However, a new application, `catselect`, has been added to CURSA solely for creating selections from catalogues. Whereas the selection options in the catalogue browsers are oriented towards the interactive display and exploration of catalogues, `catselect` is oriented towards creating 'one-off' selections from a catalogue and saving them as a new catalogue. `catselect` provides all the selection options available in the catalogue browsers, and also some new alternatives:

Circular area – this option, sometimes called a 'cone search', finds all the objects within a given angular distance of a specified point on the celestial sphere. This type of search is often used in astronomy; it is used to select catalogue objects imaged on a photographic plate or CCD frame, and to search a catalogue for potential counterparts to a target object.

Polygonal area – here you supply the coordinates of the corners of a polygon and `catselect` finds all

the objects which lie inside this polygon. The polygon can be of an arbitrary shape and have an arbitrary number of corners. This option might be used to select objects in an irregularly-shaped region of sky, or to find objects with unusual properties in some two-dimensional space. It could, for example, be used to isolate stars in the red giant branch of a Hertzsprung-Russell diagram. Figure 2 shows a striking, but not particularly serious, example. Here, a polygon defining the shape of a large letter 'C' has been used to select objects from the Gliese and Jahreiss *Third Catalogue of Nearby Stars*. The selected objects have then been plotted using PONGO.

Every *n*th object – this option selects every *n*th object from the catalogue, where you supply the value of *n*. This simple option is useful for producing a smaller, but representative, sample from a larger catalogue. Such a sample might then be investigated interactively in the case where the original catalogue was too large for interactive analysis.

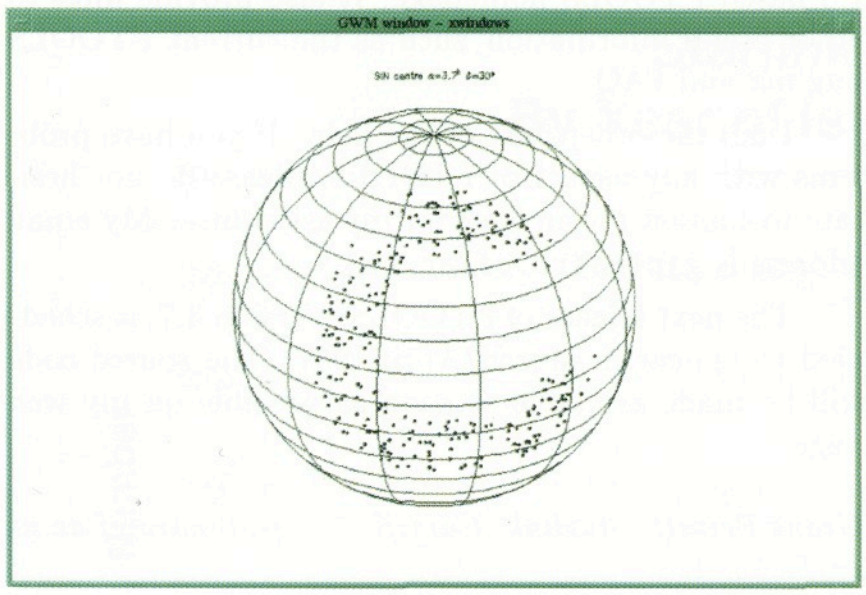


Figure 2. *Objects from the Gliese and Jahreiss Third Catalogue of Nearby Stars selected to lie inside a polygon and plotted using PONGO.*

Statistics for columns

An option has been added to the catalogue browsers `xcatview` and `catview` to compute statistics for one or more columns in a catalogue. The statistics may be computed from either all the rows in the catalogue or from just the rows in a selection. For example, Figure 3 shows the statistics computed for columns listing various parallaxes in the *Third Catalogue of Nearby Stars*. Here, the statistics have not been computed from the whole catalogue, but rather just from the stars brighter than visual magnitude 10.0.

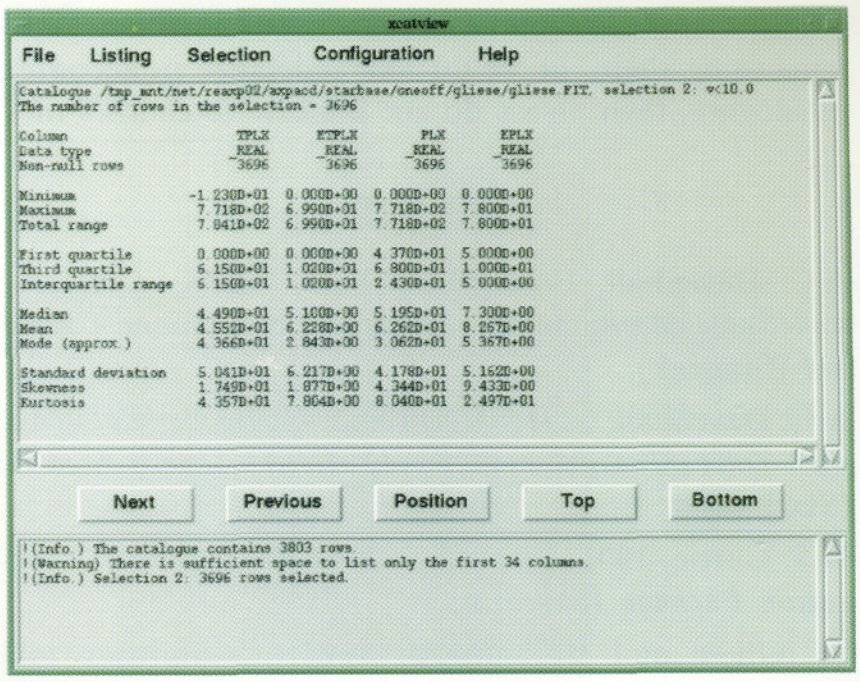


Figure 3. `xcatview` *displaying statistics computed for columns listing various parallaxes in the Gliese and Jahreiss Third Catalogue of Nearby Stars. The statistics have been computed from just the stars brighter than visual magnitude 10.0.*

Minor enhancements

Additionally, a number of minor enhancements and bug fixes have been made to CURSA and CAT. The enhancements include: the much-requested wider display window and horizontal scrolling for `xcatview`, the ability to open a new catalogue without leaving `xcatview`, extra options to display small angles as minutes and seconds of arc and time, recognising `.FITS` and `.fits` as additional file types for FITS tables, and numerous others.

Future enhancements

Development of CURSA and CAT continues. Some enhancements which are likely to become available during 1997 include: the ability to extract subsets from remote archives and databases across the Internet and save them as local catalogues which can then be accessed with CURSA, plotting catalogue objects superimposed on top of two-dimensional images (such as CCD frames), and improved inter-operability with KAPPA.

Finding out more

CURSA is fully described in SUN/190 *CURSA – Catalogue and Table Manipulation Applications: User's Manual.* Similarly, the CAT subroutine library is comprehensively documented in SUN/181 *CAT – Catalogue and Table Manipulation Library: Programmer's Manual.* Additional information is available from CURSA's 'home page' on the web. Its URL is:

http://www.roe.ac.uk/acdwww/cursa/home.html

Finally, if you have any suggestions about how CURSA and CAT could be enhanced, run into problems using them, or would like assistance in accessing catalogues, then please do not hesitate to contact me.

References

A.C. Davenhall, 1997, SUN/181.3, *CAT – Catalogue and Table Manipulation Library: Programmer's Manual* (Starlink).

A.C. Davenhall, 1997, SUN/190.3, *CURSA – Catalogue and Table Manipulation Applications: User's Manual* (Starlink).

M.J. Currie, 1995, SUN/95.9, *KAPPA – Kernel Application Package* (Starlink).

W. Gliese and H. Jahreiss, 1991, Preliminary version of the *Third Catalogue of Nearby Stars* available as catalogue V/70A from the Centre de Données astronomiques de Strasbourg.

P. Harrison, P. Rees and P. Draper, 1996, SUN/137.4, *PONGO – A Set of Applications for Interactive Data Plotting* (Starlink).

Clive Davenhall, Starlink, Edinburgh. *acd@roe.ac.uk*

Comings and goings

During the period October 1996 to February 1997 there have been 6 comings and 5 goings. As usual, the latest details about Starlink staff are printed on the back cover of this Bulletin.

Comings

Alan Scott is now the formal site manager of the Liverpool John Moores node. He was previously on a grant-funded appointment.

Paul Kerry is the new manager of the Sheffield node, replacing Phil Thorpe.

Jon Lockley has joined the Project as a programmer at Southampton.

Jane Porter is the new administrative assistant within the Project staff at RAL, replacing Jackie Moon.

Nick Shrine is now acting site manager at Kent, filling in until a replacement for Subhash Rehan can be appointed.

Oliver Keeble is now acting site manager at Imperial College.

Goings

Phil Thorpe was site manager at Sheffield from October 1994.

Subhash Rehan was site manager at Kent from September 1993.

Jackie Moon was administrative assistant at RAL from August 1995. She has been promoted to a post in RAL's public relations department.

Dermot McKay was an assistant to the site manager at Belfast from September 1996.

Nick Eaton was site manager at Imperial College from March 1993.

Mike Lawden, Starlink, RAL *mdl@star.rl.ac.uk*

FTOOLS Help – it's here

Users of FTOOLS will be glad to hear that, at the suggestion of the X-ray SSG, Starlink is now providing help to users who encounter problems while using or installing FTOOLS (the FITS utilities).

One part of the help is provided by a Web page linked to my home page, which has the URL:

http://www.astro.cf.ac.uk/pub/Grant.Privett/

The page contains UK-based copies of the FTOOLS code and documentation. Trials suggest that these can be downloaded more quickly than the copies held on the US-based FTOOLS homepage. It also provide links to other useful information, such as the current FTOOLS bug list and FAQ.

I am the other part of the help. If you have problems with any aspect of FTOOLS, please do not hesitate to contact me and ask for my assistance. My email address is gjp@astro.cf.ac.uk.

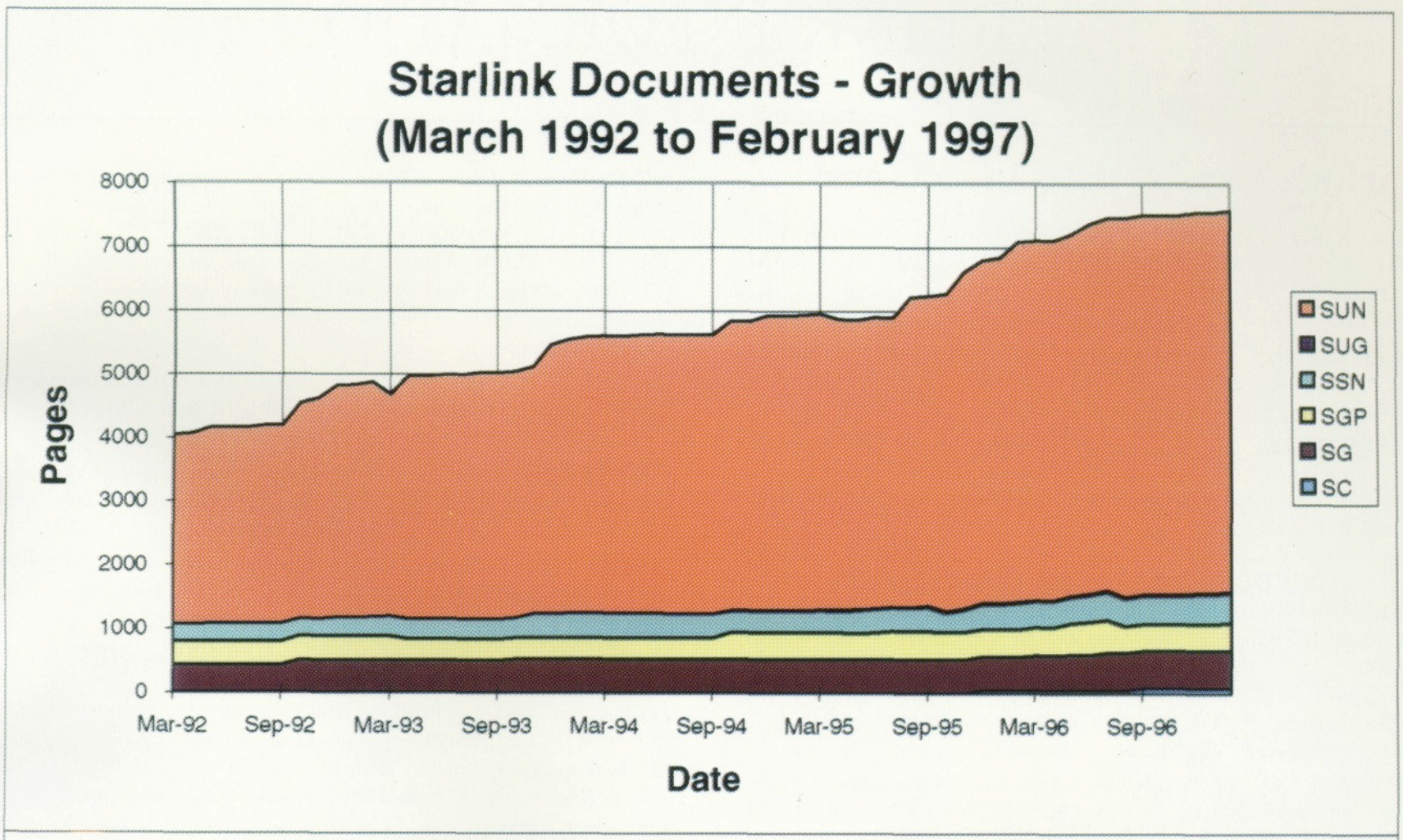
The next release of FTOOLS, Version 3.7, is scheduled to appear in March/April 1997. The source code will be made available as soon as possible on my web page.

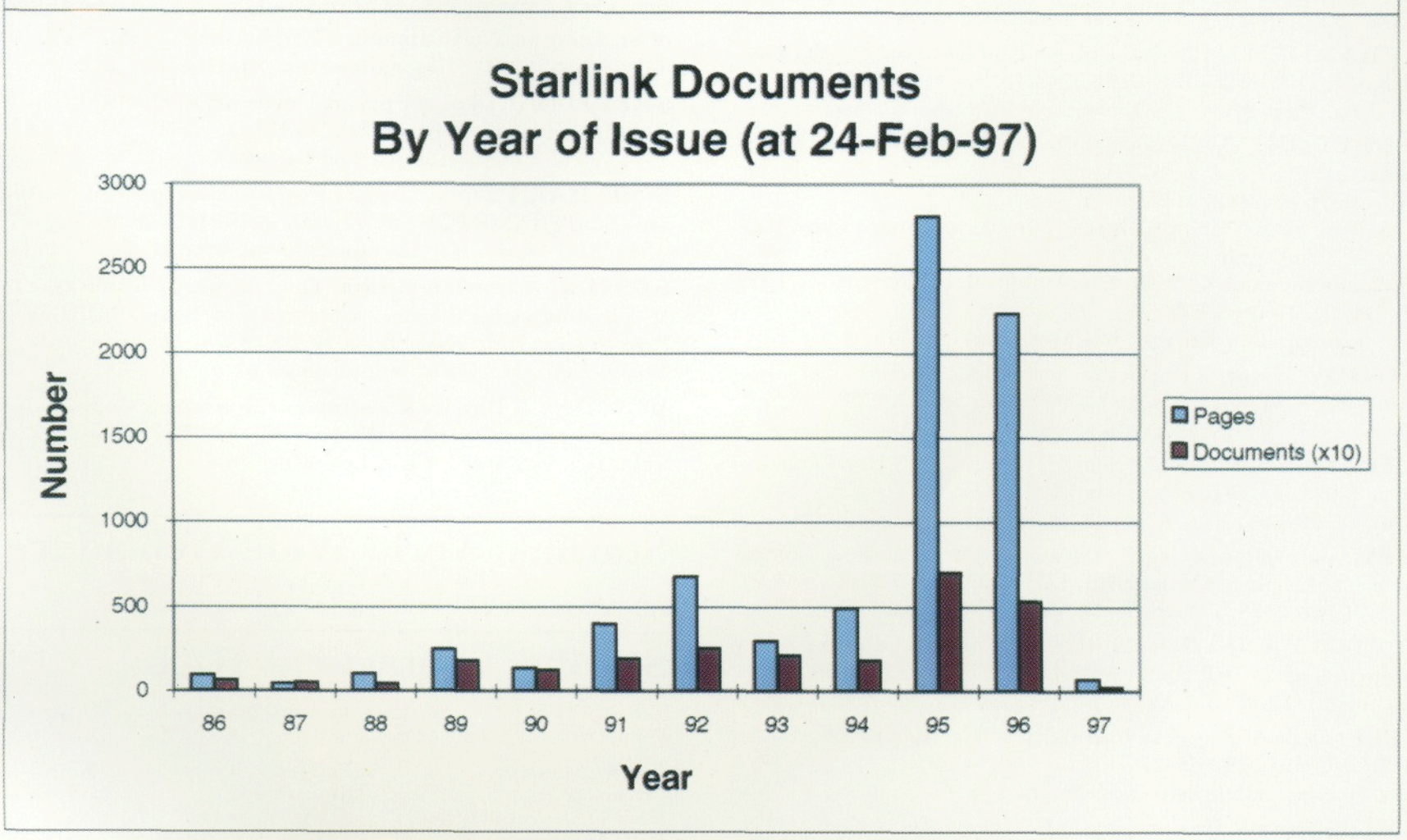
Grant Privett, Starlink, Cardiff *gjp@astro.cf.ac.uk*

Statistician's corner

The graphs on the opposite page show some statistics about Starlink documentation.

The top graph illustrates the growth in the size of Starlink-produced documentation since March 1992 (the date I started recording these figures systematically). It shows that over the last five years the size (as measured by the number of published pages) has nearly doubled. It also suggests that growth spurts tend to be concentrated towards the end of a calendar year. This reflects Starlink's annual productivity cycle in which plans for the production of new or enhanced software are laid at the beginning of the year, and the final products (which include associated documents) are delivered towards the end of the year. The graph also shows the dominance of SUNs (Starlink User Notes). Thus, documentation which is aimed at users is the most extensive, as you would expect in a service provider like Starlink.





The bottom graph analyses the current Starlink documents by year of issue. It shows that most Starlink documents are of recent origin and that, therefore, the document set is generally up-to-date and well maintained. In fact, 49% of our documents and (more significantly) 67% of our pages have been issued within the last two years. (In this context, "document" includes new versions of old documents, as well as brand new publications.)

Keeping documentation up-to-date is a big challenge for large and active projects like Starlink. What the statistics illustrated above don't show are the technical improvements in Starlink documentation, such as better presentation and its availability on the World Wide Web in hypertext form.

Mike Lawden, Starlink, RAL *mdl@star.rl.ac.uk*

STARLINK INFORMATION

Starlink sites & site managers:

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