

A I P S L E T T E R

Volume XXIII, Number 1: June 30, 2003

A newsletter for users of the NRAO
Astronomical Image Processing System

Written by a cast of *AIPS*

Edited by

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General developments in *AIPS*

Linux news: bad and better compilers

Instructions for fetching and installing the GNU 2.95.3 compiler are given on the *AIPS* web page. The tar file is directly available from NRAO. This is needed since the 2.96.x compiler, shipped with some versions of Linux, does not optimize code properly. Users of more recent Linux versions, *e.g.*, RedHat 9, will probably want to use the GNU 3.3 compiler which comes with it. Setting OPT2 simply to ‘-O2’ in `$SYSLOCAL/FDEFAULT.SH`, produces code as fast on the DDT test as 2.95.3 with its complex OPT2. On the larger Y2K test, 3.3 is about 5% slower in real time and 13% slower in cpu on a RedHat 7.2, Pentium IV 1.3 GHz computer. The 2.95.3 libraries are very dated compared to the more recent operating systems, suggesting that it is finally time to update despite the modest loss in performance.

Current and future releases

We now have formal *AIPS* releases on an annual basis with binary releases only for Solaris and Linux. All architectures can do a full installation from the source files. The next release is called 31DEC03 and remains under active development. You may fetch and install a complete copy of this version at any time. This *AIPS Letter* is intended to advise you of developments to date in this new release. Having fetched 31DEC03, you may update your installation whenever you want by running the so-called “Midnight Job” (MNJ) which uses transaction files to copy and compile the code selectively based on the code changes and compilations we have done. We expect users to take the source-only version of 31DEC03 *AIPS* over the Internet (via *anonymous* ftp); there is a guide to the install script and an *AIPS* Manager FAQ page on the *AIPS* web site.

The MNJ has been changed. It now serves up *AIPS* incrementally using the Unix tool `cvs` running with *anonymous* ftp. Linux sites will almost certainly have `cvs` installed; other sites may have installed it along with other GNU tools. Secondary MNJs will still be possible using `ssh` or `rcp` or NFS as with previous releases. We have found that `cvs` works very well, although it has one quirk. If a site modifies a file locally but in an *AIPS*-standard directory, `cvs` will detect the modification and attempt to reconcile the local version with the NRAO-supplied version. This usually produces a file that will not compile or run as intended.

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under certain conditions. The full text of the GPL can be found in the 15JUL95 *AIPS Letter*.

Patch Distribution for 31DEC02

As before, important bug fixes and selected improvements in 31DEC02 can be downloaded via the Web beginning at:

<http://www.aoc.nrao.edu/aips/patch.html>

Alternatively one can use *anonymous ftp* to the NRAO server `ftp.aoc.nrao.edu`. Documentation about patches to a release is placed on this site at `pub/software/aips/release-name` and the code is placed in suitable subdirectories below this. As bugs in 31DEC03 are found, they are simply corrected since 31DEC03 remains under development. Corrections and additions are made with a midnight job rather than with manual patches. Remember, no matter when you received your copy of 31DEC02 *you must* fetch and install its patches if you require them.

The 31DEC02 release had a few important patches including new ones in June. These were:

1. KNTR to handle LTYPE not 3 for polarization vectors *2003-01-03*.
2. FITLD to handle multiple data types in one tape *2003-01-03*.
3. IRING to correct the centering *2003-01-10*.
4. LWPLA to use ASPMM for new GREYS, KNTR, PCNTR plots *2003-01-16*.
5. FILLM and PRTP to read short records in VLA archive disk files *2003-03-20*.
6. INDXR to fill VLBI CL table properly *2003-05-21*.
7. RedHat 9 to link edit requires fixed Z routines *2003-06-24*.
8. SETFC to format field numbers > 999 correctly *2003-06-27*.

Recent *AIPS* and related Memoranda

The following new *AIPS* Memorandum is available from the *AIPS* home page.

108 Weights for VLA Data
Bryan J. Butler (NRAO)
January 21, 2003

A method for calculating the properly calibrated weights for VLA data in *AIPS* (or AIPS++, or any other package) is presented, along with some related information on the “nominal sensitivity” quantity stored in the VLA archive data. A method of determining the quantity T_{sys}/η_a for each antenna using the properly calibrated weights is also presented.

AIPS Distribution

We are now able to log apparent MNJ accesses and recently acquired a tool to log downloads of the tar balls. The software that managed the registration database is broken and appeals to have it fixed have fallen on deaf ears. There appear to be about 71 sites/machines that have run the MNJ on 31DEC03 at least occasionally. In the period May 19 — July 1, there have been downloads to 30 sites of the 31DEC02 tar ball and downloads to 91 sites of the 31DEC03 tar ball. This is at a rate of 0.7 and 2.0 download sites per day.

Improvements of interest to users in 31DEC03

We expect to continue publishing the *AIPSLetter* approximately every six months along with the annual releases. There have been a number of changes in 31DEC03. A package of *AIPS* procedures, called *VLARUN*, to reduce VLA data in a pipeline, similar to the one in use for VLBA data, was added. Two experimental display tasks were created; *SCLIM* scales images to be used as inputs to *LAYER* which creates a colored image “layering” up to 10 input images. The new task *SHADO* determines the loss in sensitivity due to shadowing for prospective array designs. New task *DQUAL* gets rid of all qualifier numbers on sources in a *uv*-data file. The new verb *IMDIST* determines the angular distance between two image pixels and new procedure *TVDIST* uses the TV to select the two pixels for *IMDIST*. New verb *IM2TV* converts image pixel to TV pixel coordinates, while new verb *TVILINE* draws a line on the TV between two image pixels.

AIPS has been ported to the Apple Macintosh OS/X operating system and its use on the latest RedHat (version 9) has been established. The Mac performance needs to be improved, but awaits compiler studies.

Other than relatively minor differences, 31DEC03 is compatible in all major ways with the with the 15OCT98 and later releases. There are significant incompatibilities with older versions.

UV data calibration

CLCAL, SNSMO, CLSMO

The subject of the smoothing of calibration tables received significant attention. The calibration routines depended on flagging records in SN and CL tables and then adding new records. The routine that re-references phases for *CLCAL* and *CALIB* was found to ignore the flagging of records, restoring them to full status. *SNSMO* also had this problem. They were fixed, but, to avoid similar problems elsewhere, *CALSEL* (used in *CLCAL*, *CALIB*, *FRING* and *KRING*) was changed so that tables are re-written with no flagged records. The smoothing routines previously used went to great lengths to return values at all times, even if the times were very distant from any valid data. They were replaced with a wider variety of functions that strictly honor a support size and return blanked values when appropriate. The new routines offer the choice of smoothing data from different sources together or keeping them separate. They also understand about blanked values; some of the earlier functions did not.

Tasks *SNSMO* and *CLSMO* were changed to smooth larger data sets, to offer the new smoothing functions, to set the support size and function parameters, to control smoothing between sources, and to control what data in the tables are replaced by the smoothed values. The last has already been a source of user confusion: if $\text{DOBLANK} \geq 0$, then previously blanked solutions are replaced by smoothed values and if $\text{DOBLANK} \leq 0$, then previously good solutions are replaced by smoothed solutions. Thus the user can choose to keep or replace failed solutions and can choose to smooth the good data or not.

CLCAL suffered from an attempt to combine operations involving the smoothing of the merged SN table with operations applying that smoothed table to the CL table. These operations are now specified with a variety of additional adverbs. The smoothing is controlled by the adverbs also used in *SNSMO*. The default CL table versions have been changed and, if $\text{GAINUSE} = 0$, the input CL table is copied as a whole to the new output table before the interpolation operations. Smoothing for phase now uses the real and imaginary parts rather than a somewhat modified smoothing of actual phases. *CLCAL* was given the option to do its things for a range of SN table versions, rather than using only one or all. The ‘SMO0’ operation was dropped — ‘MERG’ will do fine with the separated smoothing control adverbs. The use of *CLCAL* for single-source files was corrected. Previously it had odd bits that seemed to limit it to a single input SN table with no smoothing.

VLARUN

VLARUN is a RUN file that consists of a collection of procedures allowing straightforward calibration and simple imaging of continuum and spectral-line VLA data. It is particularly useful for a quick look, *e.g.*, to decide whether particular VLA archive data are useful for the intended science without spending too much time calibrating and imaging. It will apply the calibration scheme as outlined in Appendix D of the *AIPS*

Cookbook, *i.e.*, it will calibrate the visibility phase first which makes it suitable for high-frequency data as well.

VLARUN assumes that flagging has been performed. If flagging in the line data is needed, it is assumed that these flags are copied to the "channel-0" file flag table before VLARUN is started. Furthermore, only a single frequency ID should be present in the file(s). The observations must include at least one of the default VLA flux calibrators (as known by SETJY); for other flux calibrators a simple edit of the procedure is necessary.

The procedure will automatically calibrate the continuum or "channel-0" and line part of a spectral-line data set. At several stages during the process, VLARUN creates plot files which can be viewed to assess the calibration. The user may also opt to perform simple imaging, *e.g.*, to obtain a first model of the targeted sources for self-calibration.

Current practice suggests calibrating the data, assessing the calibration, and including additional flagging in flag table number one. Then re-run the procedures. Note that for scientific purposes, it is assumed that the user will flag and re-image the data properly instead of using VLARUN's output.

Other matters

CLCOR now has a new `OPCODE='ATM0'`. Using an input text file, this option corrects the data for excess zenith path delays.

TECOR was corrected to handle a change in the format of IONEX input files.

LOCIT is now in production use finding antenna locations at the VLA. As a consequence, bugs revealed "by odd circumstances in the data were found and fixed.

EDITR tried to avoid extra work too much and so failed to flag data under some crowded circumstances. The task now copies the input FG table to a new one and adds the new flags to that version.

WIPER was given defenses against bad windows and the `DOCENTER` option to control placement of the menu.

UV data handling

FILLM

FILLM received considerable attention over the last few months. Its disk reading handled the case in which there were short physical records in a logical so long as the first physical record was not short. But the first (and only) physical record in a logical can easily be short (continuum with < 26 antennas in the sub-array), so the reading could get off and find no more data. The signal was a read error at the end with fewer than 13×2048 bytes, but "error code" 0. The last physical record could also be short, which required smarter "error" handling to report only real errors. PRTP was also corrected for these issues. The channel 0 frequency increment was corrected.

FILLM, at the VLA and AOC, is able to load data to AIPS as it is observed. This on-line FILLM has depended on a second process to be running to read the data from the VLA and pass it on as if it were the tape device. For a variety of reasons, including when the VLA ModComps would go down, this process would disappear and the on-line FILLM would quit or be left sitting there not getting any data. The second process was revised to make it more robust and various re-try methods were added to the on-line portion of the FILLM tape routines. After that, on-line FILLM ran for over a week surviving a 2-day shutdown and numerous other "irregularities." During this period a new plan was devised which will probably soon be put in place. Under this plan, the archive data will be written to disk at the VLA and to a mirror disk in the AOC. A new file will be written each day. Then on-line FILLM will simply read the current day's disk file and, when it reaches the end-of-file, it will go into a special mode to read data as they are added to the file and even to switch to the next day's file when appropriate.

New options were also added to FILLM. An option to use the data weighting described in AIPS Memo 108 was added (`DOWEIGHT = 10`). This weighting has a better scaling than that present in FILLM since 2000.

Another new option was added to choose to omit visibilities for which one of the antennas failed its last reference pointing attempt (bit 10 of CARM(2)). The default is to do as it does now — load all the data — but then it makes an OF table which holds the reference pointing information along with the antenna shadowed bit. We should construct a task to use this table for editing.

Other matters

UVFIX was revised to do multi-source files (with no position shifting), to recognize GMRT data with its different sign convention (they believed *AIPS*' documentation!), to do a more accurate phase shift on position shifts, and to make a more consistent interpretation of the data epoch and array identity.

DBCON did correct phase shifts only for rather small position shifts. It has been corrected to do full-accuracy phase shifts and to recompute (u, v, w) for the new reference coordinate.

INDXR failed to initialize VLA CL tables correctly when the weather table was not being used, such as when the user specifies the opacity or only wants antenna gain corrections. Similarly, it failed to initialize VLBA CL tables with data from the IM and MC tables under most cases. This initialization used the dispersive delay from the IM table. That is now blocked since *AIPS* applies the dispersive delay in calibration and the delay in the IM table has already been applied. A similar blocking was added to FITLD. This has not mattered since the dispersive delays seem always to be zero in the IM tables.

UVCOP was changed to copy all sources to the SU table since it copies all references to sources in CL tables. CLCOR had trouble with missing sources otherwise. Flagging was not done when the flag table entry specified the FQ number, but all FQs were being copied.

LISTR was corrected to average phases always with vector methods; it previously scalar-averaged phases literally. Changed the display of the MATX average to include the vector average of all the data as well as the literal average of the printed values given previously. Fixed the formatting for flagged gain solutions.

weights assigned to combination polarizations, *e.g.*, Ipol, were incorrectly computed as the simple average of weights. The correct weights have been implemented using the real formula.

DQUAL is a new task to remove all qualifiers from a source table, renumbering the sources in the *uv* data and source table.

Data display and analysis

SCLIM and LAYER

SCLIM is a new task which creates images scaled from 0 to 1 using corners, function types, pix-ranges, etc. Clipped values — even at the top — may be set to 0 on output. It was written to create inputs to the new and experimental task LAYER. That task reads as many as 10 images letting each “absorb” the current image and add to that image by emission with optical depths scaled from the input image values, all optionally colored. This will be tricky to use, but good results should be possible.

Other matters

MOMNT was overhauled to handle blanked pixels correctly. Smoothing with zeros is not correct and MOMNT did not even check for magic blanks. Buffer sizes were raised. The option to adjust the cutoff level for the primary beam was added. This allows MOMNT to work on the output of PBCOR which is required since the primary beam is a function of frequency. a bug affecting the history file was corrected.

IMDIST is a new verb to compute the spherical distance between two pixels in two images. TVDIST is a new procedure to read two pixels from the TV and then invoke IMDIST on them.

- IM2TV** is a new verb to convert an image pixel coordinate to a TV coordinate.
- TVILINE** is a new verb to draw a line on the TV between to image pixel coordinates. (TVLINE uses TV coordinates.)
- IMVAL** as well as **QINVAL**. **MAXFIT**, **TVFLUX** and **TVMAXFIT** now return **COORDINA** as an output adverb.
- IMEAN** and **IMSTAT** can return the statistics of a circular aperture in an image as well as a rectangular one.
- plots** on the TV that have waited for 30 seconds before showing a new page may now be held indefinitely by pressing button A, while B and C go on immediately, and D exits.
- POSSM** had a variety of bugs fixed including one that could hang AIPS itself. Bugs triggered by missing data in multiple plots, by plotting amplitudes, and by position shifting were corrected.
- TVCPS** now has the **CMYK** (printer colors) option in addition to the usual **RGB**. Different gamma corrections must be used for the two color schemes.
- LWPLA** now allows for gamma corrections so that the needs of **RGB**, **CMYK**, and various printers may be addressed. The scaling options (**DPARMs**) were made more intuitive.
- PLCUB** now has an option to omit the frame axis labeling entirely.
- TVRGB** has new adverbs to control separately the sub-image for the interactive TV portion and the sub-image to be written out at the end. The limitation to the maximum TV size has been eliminated along with bugs handling **TXINC** and **TYINC**.
- TVHUI** also had its adverbs changed and bugs fixed in scaling the hue and saturation images and reporting the final pix-ranges.

Imaging and miscellaneous

- IMAGR** had only a few changes. It defends itself now against bad **BOX** values. It writes out the peak residual left in each field to its history file. It allows beams for Cleaning to be made up to 16384 on a side if **IMAGRPRM(10)** is actually set suitably.
- WISH** survey data (southern Westerbork, -25 to -15 or -9 degrees declination) have been inserted into the **WENSS** source lists used in imaging interfering sources.
- SETFC** was corrected to use a suitable format for facet numbers > 999.
- TASAV** now copies all extension files (including plot files) for images as well as *uv*-data files.
- output** adverbs from verbs and tasks are now viewed with the verb **OUTPUTS** rather than **INPUTS**.

Array and data modeling

- CONFI** was revised substantially. The topography file may now be in free format. The definition of worst side-lobe was changed as well as the technique for finding it. This allows some optimization of the main lobe shape. The gain in the optimization loop was made adaptive under user control. Bugs affecting or caused by user input were corrected or prevented.
- SHADO** is a new task to estimate the loss of sensitivity due to shadowing of the antennas by each other.
- UVSIM** was changed to use true IAT times when possible, *i.e.*, when the user provides the array location. The observing date and coordinates were changed to 2000 from 1950. This allows **UVFIX** to be run on the output file.
- UVCON** was also changed to compute correct IAT times, allowing **UVFIX** to work on the data. Random antenna-based phase and amplitude errors may be added to the data.

Improvements of interest to *AIPS* managers in 31DEC03

MacIntosh OS/X

AIPS now works on Apple MacIntosh systems running the OS/X operating system. Details of how to prepare a Mac to install *AIPS* are given on a page of the main *AIPS* web page. Basically, one has to acquire a C compiler, a Fortran compiler, and X Windows. The port was relatively simple. One of the major "gotchas" was the fact that OS/X is case insensitive at some, but not all, times. Thus, *AIPS* procedures AS, GREP, PWD, and WHICH had to be renamed by prepending AI to the name. Numerous procedures had to have references to these (primarily PWD) corrected. Architecture case statements required addition of the MACPPC architecture. The Mac uses Z routines in \$APLMAC, then \$APLLINUX, and so forth up the tree. There are only a few Z routines in the Mac area, including stubbed routines for magnetic tapes.

The performance achieved was less than was hoped. An 800 MHz iBook laptop (the G3 chip) achieved an AIPSMARK⁽⁰⁰⁾ of 18. For comparison, a 1 GHz Intel laptop is about 40. When *AIPS* was then installed on a 800 MHz PowerBook laptop (G4 chip), the performance was identical! For the moment, we are unable to get the g77 compiler to optimize properly for Macs, especially the powerful G4 chip. GNU is making progress on their compiler; the latest will at least make on Macs, but the optimization so far fails. Wes Young is looking into this for us.

install.pl

The installation script `install.pl` was modified in a number of ways in the past six months. An error in dealing with the question about unpacking the tar ball was corrected. The page about TV sockets was removed; it confused people and did nothing. For the Mac port, it was corrected to use AIPWD rather than PWD, to recognize the MACPPC architecture, and to look for readline in the usual place on Macs. For installations on systems already having an *AIPS*, it now renames the TEXT directory before starting. Otherwise, the load of that directory failed. The MNJ corrected this but at considerable expense. Registration no longer works, so it was commented out of the script. The default \$AIPS_ROOT was moved to the current directory.

Other matters

startup procedures were changed to get the host name by calling new scripts SETNAME and SETUNAME. The main use is for laptop computers since they often get a new name every time they connect to the LAN. The LOGIN files may set the variable LAPTOP to YES in this case.

RedHat 9 forced a few changes to Z routines. These were in the nature of removing direct references to system external variables such as errno. They are replaced with includes or subroutine calls.

ZLPCL2 was changed to work with the ghostview previewer to convert print files to PostScript and then display them correctly.

FDEFAULT was changed for Linux to specify the correct OPT2 option for GNU 3.2+ compilers. The older 2.95.3 options are present but commented out; 2.95.3 will also work with the new option.

Preview of coming attractions

Subtle colors used to indicate polarization vector angles, channel number in contouring, IF number, etc.

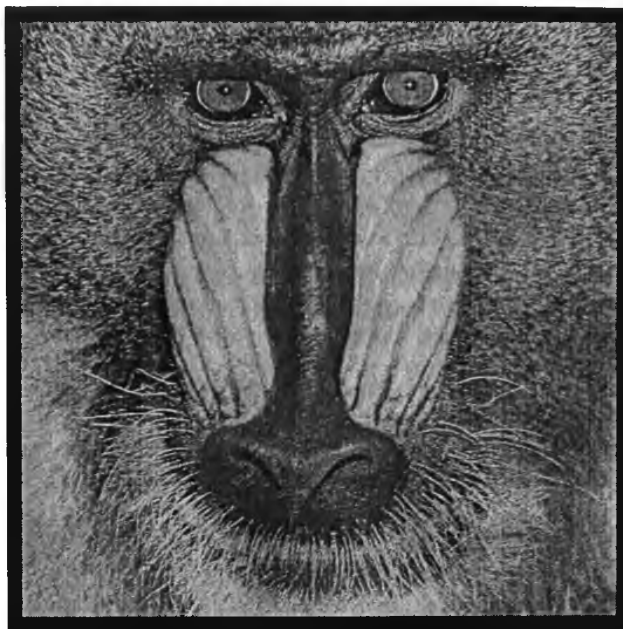
Multiple overlapping solution intervals

Corrections for atmospheric delay and the troposphere

Calibration for the VLA on VLBA data tapes

Improved real-time VLA data filling and improved performance on MacIntosh OS/X systems

Mosaicing in IMAGR



June 30, 2003



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A I P S L E T T E R

Volume XXIII, Number 2: December 31, 2003

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General developments in *AIPS*

Spam and e-mail

We receive on the order of 100 offers each day, many to enlarge portions of daip's anatomy or to reduce the rest, to tranquilize aipsmail while exciting some portions, to make money fast from home, to get out of debt "legally," to cheat producers of DVDs and other entertainment, to add to our PhD degrees presumably to avail ourselves of the many government grant programs, and, of course, to help wealthy widows and orphans in Africa. And then there are those that are totally gibberish or in some unknown foreign language. Please, if you need to reach us via e-mail, put a subject line that will be obviously concerned with AIPS installation or execution difficulties. If you do not hear from us in a few days, send the e-mail again with an improved subject line. We hit the "d" key all too rapidly these days.

Current and future releases

We now have formal *AIPS* releases on an annual basis with binary releases only for Solaris and Linux. All architectures can do a full installation from the source files. The current release is called 31DEC03 and is now frozen. If you took a development copy of this version at some earlier date, you may use the "Midnight Job" (MNJ) to bring it up to date. You need to run a MNJ only once in 2004 to convert your copy of 31DEC03 into the now frozen version. This *AIPS Letter* is intended to advise you of developments in this release.

We have begun a new version, called 31DEC04, which is now under development by the *AIPS* Group. You may fetch and install a complete copy of this version at any time. Having fetched 31DEC04, you may update your installation whenever you want by running the MNJ which uses transaction files to copy and compile the code selectively based on the code changes and compilations we have done. We expect users to take the source-only version of 31DEC04 *AIPS* over the Internet (via *anonymous* ftp).

The MNJ has been changed. The secure shell, with all its fragile complexities, is no longer required. Instead mnj.aoc.nrao.edu will serve up *AIPS* incrementally — or as a whole — using the Unix tool *cvs* running with *anonymous* ftp. Linux sites will almost certainly have *cvs* installed; other sites may have installed it along with other GNU tools. Secondary MNJs will still be possible using *ssh* or *rcp* or *NFS* as with previous releases. We have found that *cvs* works very well, although it has one quirk. If a site modifies a file locally but in an *AIPS*-standard directory, *cvs* will detect the modification and attempt to reconcile the local version with the NRAO-supplied version. This usually produces a file that will not compile or run as intended.

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Installing a new version

New releases must be installed from the tar ball for that release. The cvs system requires this. When installing a new *AIPS* release in a system that already has a previous release, we recommend that `install.pl` be used and that the previous release be left in place, at least until the installation has been seen to work. If you do this, then you will not have to re-edit the disk, printer, and tape lists and can simply skip all those pages in the `install.pl` menus. The old `$HOME/.AIPSRC` file may be left in place, but it will need to be edited. The lines giving the `DOWNLOADED` and `UNPACKED` parameters should be deleted and the `CCOMOPT` line should be changed to point to the current release rather than the previous one — the `-I` parameter really should be `-I$INC` but that seems to confuse `install.pl`. Therefore, for now, the `$INC` has to be given in its full path name, which forces a re-edit with each release. If you have made special versions of `UPDCONFIG` and `do.daily.host`, you should preserve them under new names and restore them after the install. The `$AIPS_ROOT/AIPSPATH.*SH` files will need to be edited after the install if you wish to run multiple different versions of *AIPS*.

For Linux and Solaris Ultra systems only, a binary installation is available from CDrom, supported by `install.pl`. Alternatively, there are binary files which may be downloaded from

`ftp://ftp.aoc.nrao.edu/pub/software/aips/31DEC03`.

With a modern computer, it will be faster to recompile the programs locally using `install.pl`.

Patch Distribution for 31DEC02

As before, important bug fixes and selected improvements in 31DEC02 can be downloaded via the Web beginning at:

`http://www.aoc.nrao.edu/aips/patch.html`

Alternatively one can use *anonymous* ftp on the NRAO CPU `ftp.aoc.nrao.edu`. Documentation about patches to a release is placed in the anonymous-ftp area `pub/software/aips/release-name` and the code is placed in suitable subdirectories below this. Information on patches and how to fetch and apply them is also available through the World-Wide Web pages for *AIPS*. As bugs in 31DEC04 are found, they are simply corrected since 31DEC04 remains under development. Corrections and additions are made with a midnight job rather than with manual patches. Remember, no matter when you received your copy of 31DEC02 or 31DEC03 *you must* fetch and install its patches if you require them.

The 31DEC02 release had a few important patches including a new one in September. These were:

1. KNTR to handle LTYPE not 3 for polarization vectors *2003-01-03*.
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6. INDXR to fill VLBI CL table properly *2003-05-21*.
7. RedHat 9 to link edit requires fixed Z routines *2003-06-24*.
8. SETFC to format field numbers > 999 correctly *2003-06-27*.
9. OPTIMIZE.LIS needs to be updated for GNU gcc 3.2.2 to prevent errors in imaging and bandpass calibration application *2003-09-11*.

Improvements of interest to users in 31DEC03

We expect to continue publishing the *AIPSLetter* approximately every six months along with the annual releases. There have been a number of changes in 31DEC03. In the last edition, we reported on a port to the Macintosh OS/X (“Darwin”) operating system. We also reported on a new pipeline reduction package for VLA data called VLARUN and four new tasks, SCLIM to scale images, LAYER to combine images into a color display, SHADO to determine the loss in sensitivity due to shadowing in proposed array designs, and DQUAL to eliminate unwanted qualifiers from a data set. Four new verbs were also described: IMDIST determines the angular distance between two image pixels, TVDIST uses the TV to select inputs for IMDIST, IM2TV converts between image and TV pixels, and TVILINE draws a line on the TV between two image pixels.

In the last six months, we have developed a new verb COODEFIN to set the celestial coordinates in an image header and a new procedure TVCOLORS to set the PLCOLORS adverb to emulate the TV display. There are four more tasks as well: DSTOK to eliminate cross-hand polarizations from a data set, DELZN to determine the residual clock errors and atmospheric delay and to correct the CL table accordingly, DFCOR to correct a CL table for differential atmospheric delay between the target and phase-reference sources, and FIT2A to convert a FITS image to an ASCII table primarily for use with site masks for array modeling.

The development version 31DEC04 contains everything to be described for 31DEC03. In addition, it already contains a few new things thought to be a bit risky for a soon-to-be-frozen version. These include correct self-scaling for binned plots in UVPLT, flagging based on data weights and other options in CLIPM, new options for the times for which DELZN computes corrections, and improved instructions for editing Clean boxes on the TV. You should consider getting 31DEC04 and keeping up with new developments using the MNJ.

Other than relatively minor differences, 31DEC03 is compatible in all major ways with the 15OCT98 and later releases. There are significant incompatibilities with older versions.

Plotting

Using full color in line drawings

In 31DEC02 *AIPS* plot files began to contain color concepts. They were allowed to have pseudo-colored and true-color images and to have lines and characters of different “types.” These types then can be colored differently when the plot files are interpreted to output devices such as PostScript printers. These concepts have now been extended in 31DEC03 to include lines of explicit color determined by the plot task. The implementation is really quite simple — the plot task puts a color into the plot file and then all “color lines” drawn until the next color will be of that color. We have probably only begun to scratch the surface of what can be done with this tool, but the new capabilities are already very useful.

PCNTR was changed to offer full-color lines in one of two fashions both of which are illustrated on the color pages (10 & 11) at the end of this *AIPSLetter*. One choice allows you to plot contours of multiple spectral channels in colors representative of the relative velocities. The other choice allows you to plot polarization vectors in colors representative of the polarization angle. It is difficult to see the angles of short lines, so this option lets you see regions of similar or changing angle that might not otherwise be apparent. KNTR was also given these options, but KNTR will draw the contours of different spectral channels in different frames rather than overlaying them.

VPLT was re-written to allow multiple IFs in a single plot and to use full-color to distinguish them if desired. BPLT can now use full color to distinguish the antennas or times appearing on each plot. UVPLT can use full color to distinguish multiple spectral channels and IFs. SNPLT uses color similarly (see page 9) and can also use color to distinguish antennas in the SUM mode. PLOT allows a color for each symbol to be read and plotted.

Other changes

TVCOLORS is a new procedure that captures the current color setting of the TV graphics planes and sets adverbs to LWPLA to make a plot resemble that seen on the TV.

EXTLIST was overhauled to be current with the many plot tasks whose inputs have changed in the last year. It was restructured to give us a better chance of keeping it current.

Tick labeling can now go down to micro-arcseconds. The code was made more centralized to simplify maintenance. Overlapping strings are less likely to get plotted.

POSSM had its usual share of egregious errors corrected. One of these was rather peculiar handling of fully-flagged IFs. The other was the plotting of cross- and auto-correlations. In that case, the buffers destroyed their contents and then didn't plot the right thing anyway. The plots are now more sensible.

GREYS was given the option to plot antenna panels on top of the grey-scale from holography.

UV data handling and calibration

APCAL

APCAL was improved substantially in its ability to estimate and correct for atmospheric opacity. The weather table (WX) which comes attached to the data is now used rather than requiring the user to provide some external table. Note that FITLD did not write the WX table correctly until mid-November 2003; data loaded prior to then may have incorrect WX data. The user may input initial estimates of the opacities and receiver temperatures, but new routines allow the task to estimate these parameters for the user. Errors that arose when a **TIMERANGE** or a limited set of **ANTENNAS** were specified have been corrected. APCAL was also changed to do standard plot things, such as support **GRCHAN** including multiple graphics channels and pause for user input on page full. The right hand plots are now apparent zenith opacity versus time to allow the user to find and edit bad data.

VLA Calibration Transfer in VLBI experiments

Since the summer of 2003, we have been working on calibration transfer of the VLA in VLBI experiments. Beginning in mid-November 2003, we are distributing the VLA gain curve, VLA system temperature and VLA weather information available for VLBI experiments which use the VLA. These data are in the form of tables attached to the correlated data. That is, the *AIPS* calibration path for the VLA single-dish antenna in a VLBI experiment will be the same as for a VLBA antenna and can be done in one go using the **VLBAUTIL** procedures described in Appendix C of the *AIPS Cookbook*. When the VLA phased array is used in the observation, the user must insert the source flux density in the **SU** table before calibration. This will work okay as long as one uses the latest **sched** version to make the schedule and as long as the VLA antenna(s) do not change frequency setups too often. In the rare cases in which multiple setups in the same frequency band are used, this may not work fully and observers will be required to use the previous **ANTAB** method to get proper calibration. However, for most users, the extra calibration burden of using the VLA in a VLBA experiment is a thing of the past.

Between June 2003 and November 2003, the **ANTAB** input files deposited for the VLA on the aspen server were modified to include a best guess for the **INDEX** line. This means that most users will have to check, but not actually edit, the **ANTAB** files from that period. They can simply import them directly with **ANTAB** in *AIPS*.

Currently we are also looking into updating and attaching the GBT gain curves.

DELZN and DFCOR

VLBI correlators remove some estimate of the atmospheric delay at the elevation and frequency of the observation from the data. These a priori models are usually fairly good, but careful observations can improve upon them. Beginning with the 31DEC03 release, *AIPS* offers a number of options to deal with this problem. The task **DELZN** will use the delays in an **SN** table to fit for both clock and atmosphere (at zenith) delays as functions of time. It works best if the observations include data on a variety of calibrators well distributed around the sky. **DELZN** applies its calibration to a new **CL** table and also writes a text file. Task **CLCOR** has a new option ('**ATMO**') which can read this text file and update a **CL** table if needed.

There is also a new task in 31DEC03 to deal with the effects of zenith delay in phase-referencing observations. Phases for the target source in phase referencing are corrected by the phases at the calibrator which usually is at a different elevation. Task DFCOR is a special version of CLCOR which applies the 'ATMO' operation to correct the CL table for the difference in elevation between the target source and adjacent calibration sources without applying the full atmospheric delay correction.

Other VLBI-related changes

FITLD was fixed to correct antenna numbers as weather tables are appended to existing ones. Previously, WX tables from the VLBA Correlator could contain data with erroneous antenna numbers. FITLD was also changed to allow the reading of multiple disk files in one execution, which simplifies the antenna renumbering among other things.

MSORT was overhauled to keep it from going into nearly infinite loop states. Larger buffers and an alternative, brute-force sort scheme now make this task competitive or better than UVSRT in most cases.

GPHAS was dropped from *AIPS* since FRING does what it was supposed (and failed) to do.

VLBAUTIL procedures were upgraded to eliminate "hidden" options.

FRING bugs related to large numbers of channels and negative channel increments were squashed.

VLA archive data

The archive of raw VLA data is being placed on-line by the e2e project at the NRAO. The information to select which data you need is available from NRAO's web site and methods to select all data from a specific project have been developed. Most data in the archive are public, available to anyone, while recent data are within a proprietary period and passwords are required to access them. From the *AIPS* perspective, this development made it desirable to read archive data from disk as well as tape. PRTTP and FILLM have both been revised to read one or more data files from a user-specified disk directory. The file names must all be the same except for an appended "tape-file" number. This capability received some corrections and improvements during 2003.

The main improvements to FILLM in 31DEC03 concern the on-line reading of data as they are observed and the movement of those data into the archive. The data are now mirrored to disk files at the VLA and AOC and it is these mirror disk files that on-line FILLM reads. This allows on-line FILLM to back up to the beginning of an experiment to acquire the data already observed and then to continue to read new data as they are observed. The new system appears more reliable than the old tape-based one and allows the data to be available in the official archive almost immediately after the end of each day. The VLA uses a different position for the antenna when the Pie Town antenna is included in the array; a correction for this was put into FILLM to avoid the output of "empty" antenna files.

Other changes

UVFIX had significant errors dealing with multiple subarrays. It would not recognize the start of a new subarray and had trouble remembering the epoch and coordinates it should be using.

SNSMO did not handle the clipping of solutions properly, requiring among other things both polarizations to be present or the one remaining would be retained when it should be clipped. The attempt to deal with phase wrapping was corrected to handle an intervening failed solution.

SNFLG was generalized to handle two polarizations and an unlimited number of IFs. It allows options to flag one or all IFs and/or polarizations when one is flagged. It was corrected to recognize missing antennas as antenna flags and otherwise to try to keep the number of flags reasonable.

CLCOR was given the option to write a new CL table when performing its operation.

Models are supposed to be scaled when the source table has a total flux for a source. A subroutine was created to scale a Clean components model to match the flux in the source table and, incidentally, to scale an image model from JY/BEAM to JY/PIXEL while complaining about the use of Clean images for modeling. This subroutine is now called everywhere that source models are used.

DSTOK is a new task to drop the cross-hand polarizations from a data set.

VPFLG was changed to offer the option of flagging all IFs when any one is flagged.

CLCAL in interpolating the SN to the CL table applied CUTOFF to require both calibrators to be within the specified range, forbidding the case where one was close and the other too far away.

ELINT was changed to write its corrections directly to a CL table. Use of an SN table instead made it hard to avoid having CLCAL interpolate incorrectly between sources.

Calibration adverbs were missing from many tasks that allowed some of the calibration options. BLVER and DOPOL were missing quite commonly and DOBAND was also often overlooked. All have been added rather universally even though they are not always perfectly relevant.

FIXWT was completely rewritten. It now determines apparent weights from the noise in the data using all spectral channels but separating IFs and polarizations. Previously one small part of the data was used and applied to everything. It is not clear that the output is any more correct than that produced by standard use of FILLM and FITLD weights with DOCAL = 2.

Imaging, modeling, analysis

Imaging

VTESS and the other tessellation tasks were changed to use the standard primary beam routines. The default is now to apply a beam correction.

Primary beam calculations were made more general to encompass defaults for other telescopes and a full set of parameters was added for the Australia Telescope.

SMOTH was cleaned up and corrected so that it deals sensibly with blanked pixels.

IMAGR was changed to combat a tendency to Clean too deeply in a major cycle near the beginning of high dynamic range cases. This resulted in numerous erroneous "sources" that had to be removed in later major cycles.

Modeling

CCEDT was corrected to handle circular windows and to record its actions fully in the history file.

JMFIT and **IMFIT** put the deconvolved Gaussians into the CC file in arc seconds rather than degrees. The displays for small cell sizes were improved.

UVCON was provided with standard VLA configuration files in the \$AIPSTARS area.

FIT2A is a new task to convert an image plane in FITS format to a simple text-file in tabular form. This allows conversion of the format for site masks used by CONF1 and other array optimization programs.

CONF1 was changed to read either FITS or ascii forms of the topography data.

General items

MacIntosh OS/X

AIPS now works on Apple MacIntosh systems running the OS/X “Darwin” operating system, both the Jaguar (10.2) and Panther (10.3) releases. Details of how to prepare a Mac to install *AIPS* are given on a page off the main *AIPS* web page. Basically, one has to acquire a development form of a C compiler, a Fortran compiler, and X Windows. These instructions have changed recently, partly because the Panther release is now standard, partly because our old friend fink appears now to be doing something incompatible, partly because GNU has caught up to the Mac, and partly because IBM seems to be giving away a good compiler for Macs.

The base C and X Windows should come with Panther and are readily available from Apple. After that, one downloads from NRAO the GNU readline and gcc 3.3.2 tarballs and, following simple instructions, installs them. It is important to compile 3.3.2 with itself following a “bootstrap” option and then to compile readline with the resulting 3.3.2 compiler. One may then choose to install the IBM compiler as well — our web page sends you to theirs and they provide the instructions. Then *AIPS* installation proceeds just about normally.

Performance numbers on Macs have varied considerably. On 800-MHz iBook (G3 cpu) and PowerBook (G4 cpu) laptops, we found an AIPSMark⁽⁰⁰⁾ of 18. On an 866-MHz desktop with a G4 cpu, we obtained an AIPSMark⁽⁰⁰⁾ of 24 using the GNU compilers and 36 using the IBM compilers. On a new 1.8-GHz desktop with a G5 cpu, an AIPSMark⁽⁰⁰⁾ of 103 was obtained on the Y2K test using the IBM compiler and 65 using the GNU 3.3.2 compiler. We are still experimenting with IBM compiler options, but so far have found that the simpler -O3 works better with *AIPS* than the more complicated sets of more aggressive optimizations. For comparison, a 2.8 GHz Pentium IV, dual-headed and threaded box from Dell achieves an AIPSMark⁽⁰⁰⁾ of 104 with the GNU 3.2.2 compiler under RedHat 9.

Miscellaneous matters for users

CookBook chapters were updated for OUTPUTS, DEFAULT, FITS and VLA disk files, VLARUN, CLCOR, color plotting, PBCOR, DELZN, SNSMO, APCAL

COODEFIN is a new verb to define the celestial coordinates in an image header.

FITTP and FITAB offer to write a range of catalog slot numbers. Empty extension files have to be written to support modeling with multiple facets, some of which may have no Clean components.

FITLD can now read multiple disk files in a single run, so long as they are properly named (post-fixed number from 1 through NCOUNT). FITLD and IML0D will now read all possible extension files.

FITS readers were improved to understand the official coordinate keywords CD*i,j* and PC*i,j* and to convert them as much as possible into the *AIPS* coordinate forms. This will help in the importation of images from IRAF in particular.

Miscellaneous matters for programmer types

install.pl continues to receive attention as user sites encounter problems. It now copies the MAKE.MNJ script and edits it to use the declared C compiler. Skipping the tar-ball download is now the default; this may reduce multiple downloads from the same site. A page (5a) was added to set the LAPTOP variable, fix the host name, and edit LOGIN.*SH. The initial date for the MNJ was changed to be taken from other files if the tarball is missing. UNSHR is no longer build and used to unpack SHR files. They are now correctly created and sh is all that is needed. The special code for PP.FOR on HPs was corrected.

MAKE.MNJ was corrected to allow the compiler to be set during installation and to make a more reliable do_daily script.

SHR files need to be created with quotes around the “magic strings” which start and terminate each file. When this is done, unpacking can be done with sh rather than a special *AIPS* program.

XAS was changed to determine the order of colors in the most general possible way. Byte order on the display host is not the only predictor of that order, but X Windows does provide the needed information if one only knows how to extract it.

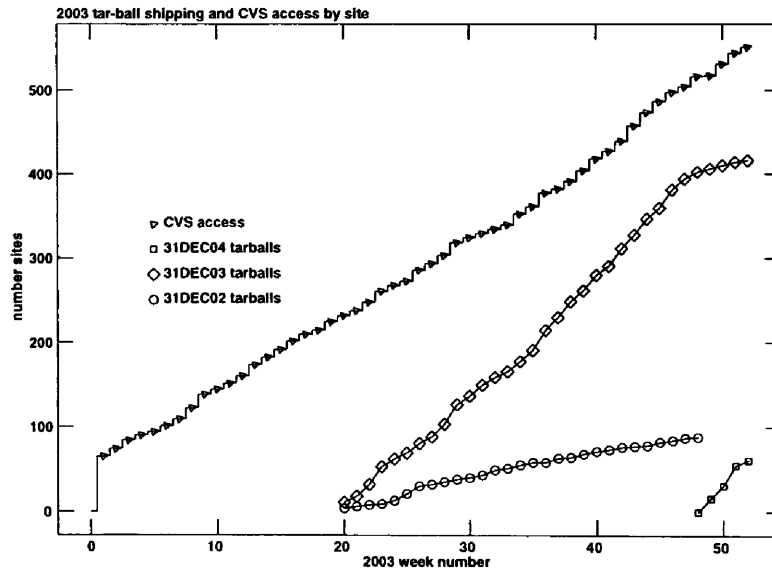
START_TVSERVERS was changed to avoid passing for example `$DISPLAY = localhost:11.0` to **XAS** since this really refers to some machine other than the local one. It now sends `$DISPLAY = $(tvdisp):0` where *tvdisp* is the machine on which **XAS** is supposed to run. This seems to cause problems when loop-back is not properly installed, but works better than the old way on most computers.

Character variables in call sequences should always be declared *e.g.*, `CHARACTER X*(*)`. If they are not and the calling routine sends too few or too many characters, bad things can and do happen.

AIPS Distribution

During all of 2003, we have been able to log accesses by IP number to our cvs site. Such accesses imply either an execution of `install.pl` (or more properly `MAKE.MNJ`) or the use of the “midnight job.” Counting each unique IP address as a “site,” there have been cvs contacts from 551 sites in 2003. This will be a bit of an over-estimate of real sites since dial-up connections may be assigned different IP addresses at different times. Nonetheless, it is impressive to us that well over 500 sites installed the 31DEC03 development version of *AIPS*. (Installations of 31DEC02 do not run `MAKE.MNJ` or the `MNJ` and so do not cause a cvs access.)

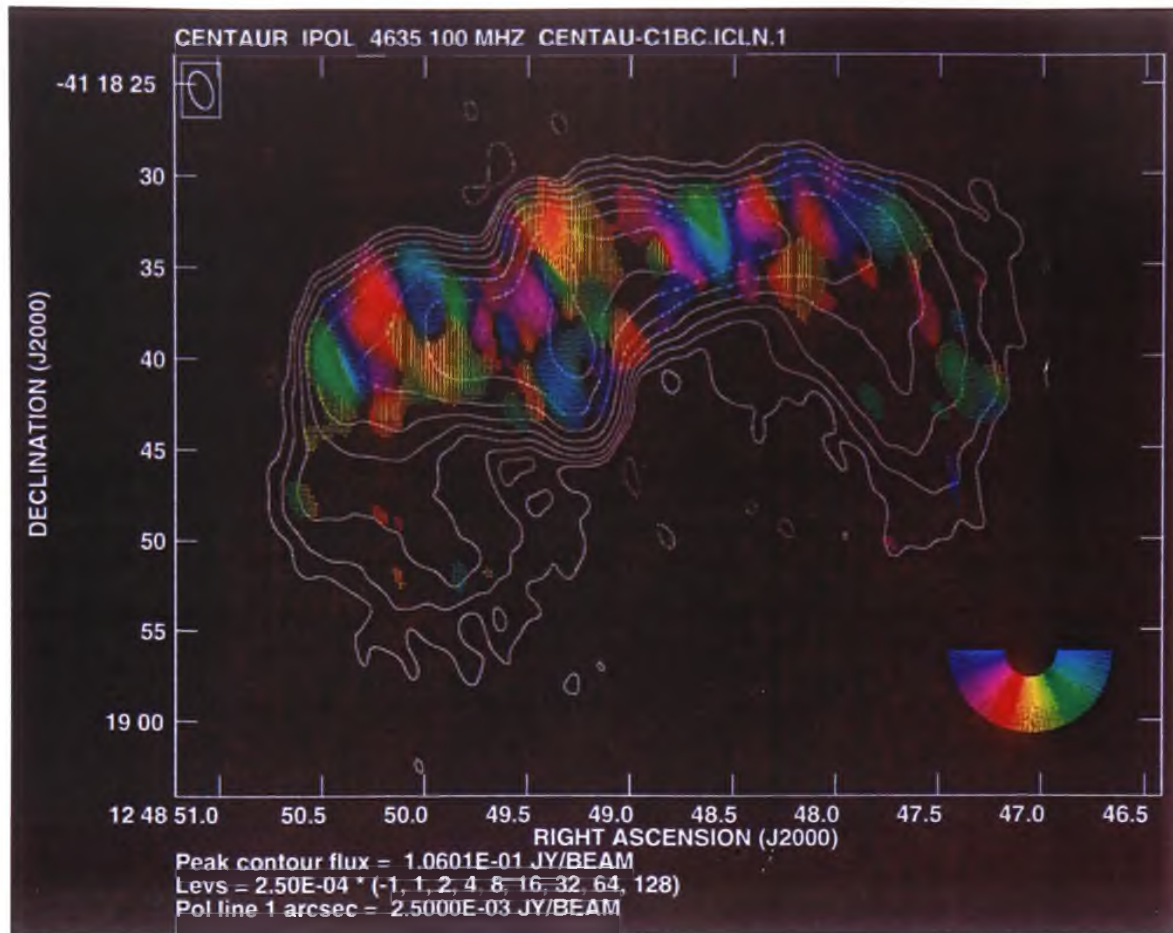
Beginning on May 18, 2003, we have been able to log the sites downloading the *AIPS* tar balls. During the rest of the year 88 separate IP addresses downloaded the 31DEC02 tar ball, while 416 downloaded that for 31DEC03, and 63 have already downloaded 31DEC04.. It is amazing to us how many sites download a tar ball (successfully) more than once. The rate of downloads seems to exceed that of cvs access sites, suggesting — not surprisingly — that not all tar balls get installed. The attached figure shows the cumulative number of cvs access sites and tar-ball download sites known to us as a function of week in 2003.



Recent *AIPS* and related Memoranda

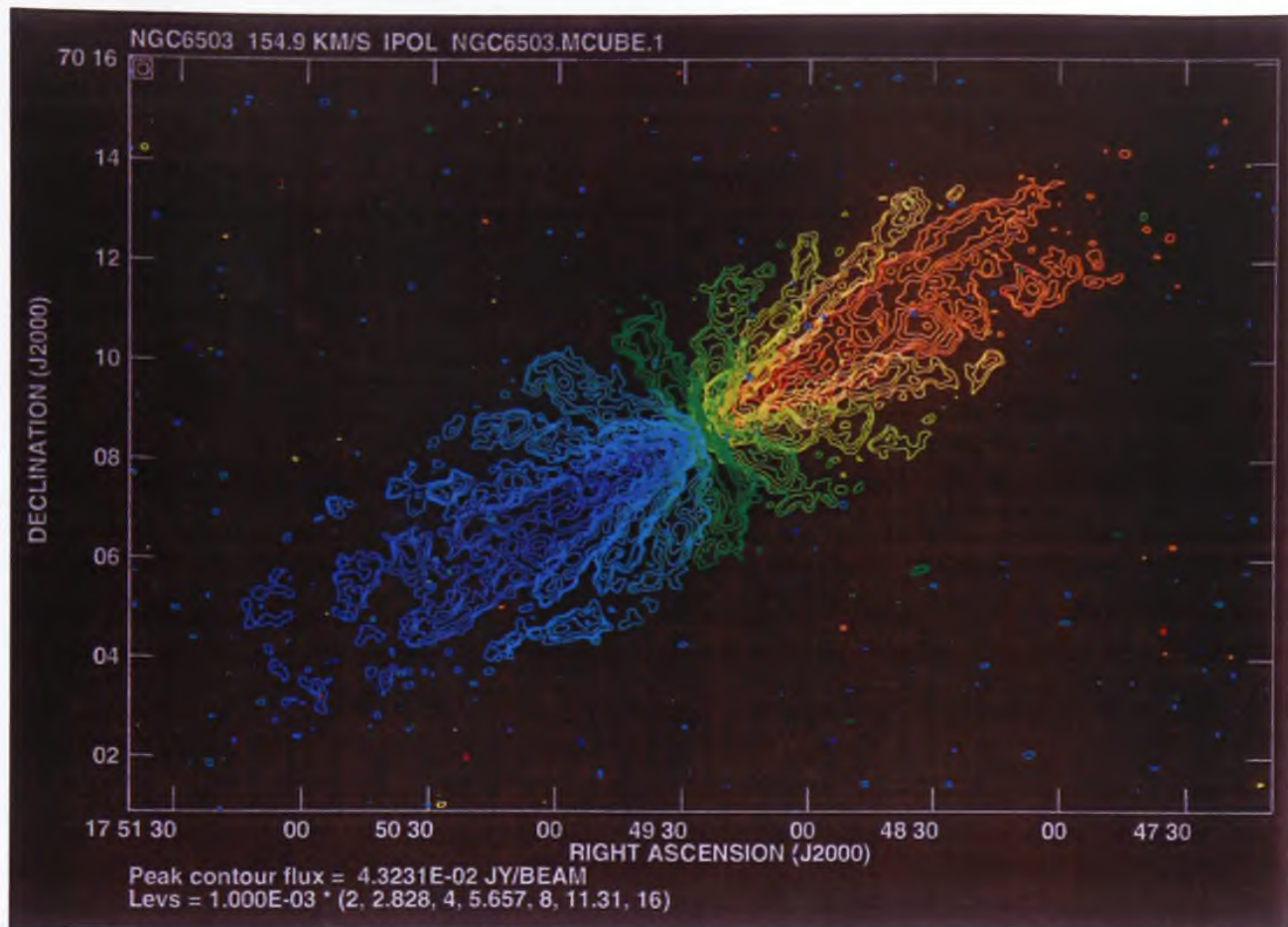
All *AIPS* Memoranda are available from the *AIPS* home page. There are no new memoranda in the last six months. Chapters on FITS and *AIPS* written by Eric Greisen have now appeared in *Information Handling in Astronomy — Historical Vistas* edited by André Heck and published by Kluwer Academic Publishers.

SNPLT plots phases for four antennas with color indicating polarization and IF channel. Stokes 1, IF BIF is pure red changing through yellow, green, and cyan to Stokes 2, IF EIF as pure blue. When all symbols lie on top of each other, the last one (pure blue) will dominate.



PCNTR:	Task to generate plot file for contour plus pol. vectors		ROTATE	0	Angle to rotate Pol vector (in degrees)
DOCONT	1	Draw contours? > 0 => yes	XINC	1	X-inc. of Pol vectors. 0=>1
DOVECT	1	Draw pol. vectors? > 0 => yes	YINC	1	Y-inc. of Pol vectors. 0=>1
DOGREY	-1	Draw grey-scale image?	PCUT	1.250E-04	Pol. vector cutoff. P units.
		Total intensity image:	ICUT	2.500E-04	Int. vector cutoff. I units.
INNAME	'CENTAU-C1BC '	Image name (name)	POL3COL	160	Color polarization vectors value in degrees = red
INCLASS	'ICLN '	Image name (class)	CBPLOT	4	Position for beam plot: 4: upper left
INSEQ	1	Image name (seq. #)			
INDISK	1	Disk unit #			
		Polarization intensity image:			
IN2NAME	'CENTAU-C1BC '	(name) blank => INNAME			
IN2CLASS	'QCLN '	(class) blank => 'PPOL'			
IN2SEQ	1	(seq. #) 0 => high			
IN2DISK	0	Disk drive #, 0 => any	LWPLA:	Sends plot file(s) to a PostScript printer or file	
		Polarization angle image:	RGBGAMMA	1	1 Gamma correction to apply
IN3NAME	'CENTAU-C1BC '	(name) blank => INNAME		2.5	
IN3CLASS	'UCLN '	(class) blank => 'PANG'	DPARM	*all	0 (1,2) Clip recorded grays before FUNCTYPE (0 to 1)
IN3SEQ	1	(seq. #) 0 => high	DOCOLOR	1	Use PLCOLORS ?
IN3DISK	0	Disk drive #, 0 => any	PLCOLORS	0.85	0.85 Line, character, background colors - see HELP.
LTYPE	-3	Type of labeling:		0.9	0.5
		<0 -> no date/time		0.5	0.5
CLEV	2.500E-04	Absolute value for lev		0.5	0.5
LEVS	-1	1		0	0
	2	4		0	0
	32	64		0	0
		128 *rest 0		0	0
FACTOR	1000	Mult. factor for Pol vector (see HELP)		0	0
				0.85	0.85 0.9 *rest 0

PCNTR plots contours and polarization vectors of Centaurus A. Color is used to show the complex changes in polarization position angle since the angles of short lines cannot be seen accurately. Data courtesy of Greg Taylor. For a discussion of this amazing pattern see Taylor, G.B., Fabian, A.C., & Allen, S.W. 2002, MNRAS, 334, 769, astro-ph/0109337 "Magnetic Fields in the Centaurus Cluster."



```

PCNTR: Task to generate plot file for contour plus pol. vectors
DOCONT      1          Draw contours? > 0 => yes
DOVECT      -1         Draw pol. vectors? > 0 => yes
BLC         51         167       Bottom left corner of images
          39          *rest 0
TRC         397        393       Top right corner of images
          89          *rest 0
CON3COL      5          > 0 => overplot contours in
                        color of multiple planes
                        ZINC is CON3COL.
CLEV         0.001      Absolute value for levs
LEVS         2          2.8284   Contour levels (up to 30).
          4          5.6569      8          11.3137
          16          *rest 0
CBPLOT       4          Position for beam plot:
                        4: upper left

LWPLA: Sends plot file(s) to a PostScript printer or file
LPEN         3          Pen width (dots).
RGBGAMMA     1          1          Gamma correction to apply
          2.5
DPARM        *all 0      (1,2) Clip recorded grays
DOCOLOR       1          Use PLCOLORS ?
PLCOLORS     0.6         0.6      Line, character, background
          0.6         0.06275   colors - see HELP.
          1          0          1          0.6706
          1          0          1          1
          0          0          0          0
          0          0          0          0
          0          0          0          0
          0.6         0.6         0.6         *rest 0

```

PCNTR plots contours every fifth plane from a data cube using colors related to the velocity. LWPLA adds coloring to the labeling and background and applies a gamma correction to blue. Data courtesy of Gustaaf van Moorsel and Eric Greisen.

AIPS Order Form

Conscientious readers will note that this issue does not contain a copy of the *AIPS* Order Form. Ernie Allen, who processes these forms, does not remember any of the paper forms being submitted this century. Henceforth, to submit a request for a binary copy of *AIPS* or paper copies of documentation, see

<http://www.aoc.nrao.edu/aips/forms/aipsorder.shtml>

or contact us at daip@nrao.edu.



December 31, 2003



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