// A I P S L E T T E R

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A newsletter for users of the NRAO
*A*stronomical *I*mage *P*rocessing *S*ystem

Written by a cast of *AIPS*

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Happy 47th birthday *AIPS* and FITS

The FITS format was devised in a meeting at the VLA site on March 27 and 28, 1979. Don Wells (then of NOAO) and Eric Greisen (still of the NRAO) were the primary authors while Barry Clark and other NRAO staff members provided valuable suggestions. The FITS format, enhanced by later extensions, is still in wide spread use in astronomy and is the envy of other scientific fields. The FITS format then colored the design of the *AIPS* internal formats. The *AIPS* project was begun officially on July 1, 1979 and has stood the test of time remarkably well.

Your editor does find times when he would like interesting things to do. If you find any problems with *AIPS* or have any suggestions for new or improved functions, please do not hesitate to e-mail `daip@nrao.edu`. Do note that the *AIPS* web site has become a secure (`https:`) web site.

R.I.P.

We are saddened to report that Tony Willis, our friend and colleague, died at the end of 2025. He was instrumental in getting the `ALBUS` software to its present state. It is the best ionospheric TEC and rotation measure software according to our studies. Future development of `ALBUS` is now problematical.

On a less serious note, the computer used to create the `MACINT` binary version of *AIPS* died in January. This means that there is no `31DEC26` binary version for `MACINT` and that the `31DEC25` `MACINT` binary version has not been updated for most of the "patches" listed later in this *AIPSLetter*. Do remember that all operating systems can still compile *AIPS* locally using `gfortran` and `gcc`. The computer used to create the `31DEC26` binary version for Apple Mac computers with the M1 through M5 cpu chips will have to have its operating system updated later this year. We hope that that will not have any bad consequences. At that time the `31DEC25` release will be frozen with no more bug fixes so that that version will not be affected.

Current and future releases

We have formal *AIPS* releases on an annual basis. While all architectures can do a full installation from the source files, Linux (64-bit only), and MacIntosh OS/X (ARM only) systems may install binary versions of recent releases. The last "slushy" release is called `31DEC25`. It gets occasional bug fixes until changes in operating system versions force it to be frozen. `31DEC26` remains under active development. You may fetch and install a copy of these versions at any time using *anonymous* `ftp` for source-only copies and `rsync` for binary copies. This *AIPSLetter* is intended to advise you of improvements to date in `31DEC26`. Having fetched `31DEC26`, you may update your installation whenever you want by running the so-called "Midnight Job" (MNJ) which copies and compiles the code selectively based on the changes and compilations we have done. The MNJ will also update sites that have done a binary installation. There is a guide to the install script and an *AIPS* Manager FAQ page on the *AIPS* web site.

The MNJ for binary versions of *AIPS* now uses solely the tool `rsync` as does the initial installation. For locally compiled ("source") installations, the Unix tool `cvs` running with anonymous ftp was used for the MNJ. That has been replaced with `rsync` to download any changed text files. The only installations to still use `cvs` are the four machines inside the Socorro Array Operations Center. Do not modify *AIPS* text files (*e.g.*, Fortran tasks) in the standard locations since `rsync` will over-write them. For local versions, use a copy of the task and its help file in a private disk area instead.

`31DEC20` contains a change to the TV display program `XAS` that makes it incompatible with previous releases when characters are displayed. `31DEC14` contains a change to the "standard" random parameters in *uv* data and adds columns to the `SN` table. Note, however, that the random parameters written to FITS files have not been changed. Older releases of *AIPS* cannot handle the new *internal uv* format and might be confused by the `SN` table as well. You are encouraged to use a relatively recent version of *AIPS*, whilst those with recent VLA data to reduce should get release `31DEC25` or, preferably, the latest development release.

We have discontinued paper copies of the *AIPSLetter* entirely. The *AIPSLetter* will be available in PostScript and pdf forms as always from the web site listed above. New issues will be announced on the bananas and MNJ list server. Readers are encouraged to subscribe to one of these low volume mail lists at `https://listmgr.nrao.edu/mailman/listinfo`.

Improvements of interest in `31DEC26`

We expect to continue publishing the *AIPSLetter* approximately every six months, but the publication is now primarily electronic. There are three new user tasks and 1 new verb already in `31DEC26`. The new tasks include `SPLOT` to plot various table parameters with each page devoted to all antennas for one parameter, IF, and polarization or all IFs for one antenna and polarization. New task `TUVCP` copies a multi-subarray data set correcting times of each subarray and task `POLTS` is used to study the biases in measurement of total polarization. The new verb `VGLIST` provides information on available `VGET` tasks.

Display

The tasks which generate plots with time as the horizontal axis were revised to offer the option to plot the time in only a semi-linear fashion with gaps in the data closed up. This is similar to the time axes in `TVFLG` and `SPFLG`. Multiple options are offered to control how the tic marks in gaps are labeled. Tasks that support this option are `TEPLT`, `SNPLT`, `VPLOT`, `WETHR`, `SNBLP`, `BPPLT`, `ANBPL`, and the new `SPLOT`. These tasks also received minor corrections and changes to the coloring option. In particular, `VPLOT` can now color by source instead of by IF.

`BPLOT` was given the option of plotting a labeled color wedge on the right hand side of the plot. The antennas are now displayed in the order specified by the `ANTENNAS` adverb, allowing the user to juxtapose related antennas rather than on simple numerical order. The new task `SPLOT` is similar to `BPLOT` but plots all the parameters supported by `SNPLT` from `SN`, `CL`, `TY`, `SY`, and `PC` tables. Each page of the plot shows 1 IF and polarization for a list of antennas or 1 antenna and polarization for a sequence of IFs. The antennas or IFs are separated by an interval vertically. The plots can be colored by the parameter values or by the vertical sequence. Examples are shown on the last real page of this *AIPSLetter*.

Several plot tasks were changed to allow the user to choose how the plots are done. The choices are (1) direct lines between the data points, (2) a step function with flat tops through the data points rising half-way between the data points, and (3) the step function with lines to the plot minimum half way between the data points. `GREYS` and `PRPLT` offer this choice for plots of the "profile" averaged along 2 axes of the image cube and plotted along the third. `ISPEC`, `RSPEC`, and `IMEAN` were provided similar options.

LISUN now offers the printer plot of VLA antenna locations from `PRTAN` and the integration time like `GETITIME`.

IMAGR TV display was corrected to label the step wedge with the current display range and to show spectral channel number and facet number but only when relevant.

PRTAN can plot the antenna locations on a simple linear scale or, for VLBI, on a partial or full globe in an Aitoff projection. The printing can now be suppressed and now only requires one call to `GETANT` rather than reading the `AN` table multiple times.

TVMENU subroutine used by most interactive tasks was changed to enlarge the TV display if allowed and needed to hold the task's menus. When this is not allowed, better error messages are now generated.

PLOTR added `PIXRANGE` to control the vertical plot range and changed 2 `APARM`s to control the horizontal range used in fitting the data.

LWPLA was enhanced to allow `evince` to be used as the "preview printer" since it can handle pdf, PostScript, and text files and ghostview is now not present on some computers.

TVDATA and `TVFACTS` verbs now display the number of pixels on each side of the display in addition to the corner coordinates.

Spectral analysis

The spectral fitting tasks `XGAUS` (Gaussian fitting), `ZEMAN` (Zeeman splitting), `RMFIT` (Rotation measure fitting), `AGAUS` (Gaussian fitting in absorption), and `ZAMAN` (Zeeman fitting in absorption) were substantially revised in the last few months. All of these tasks were changed to compute the spectral rms when initially reading the data cubes and then revise it at each pixel for which a fit is attempted. The rms image(s) can be displayed and used in the edit stage and written out when exiting under control of `DOOUTPUT`. The right-hand portion of the edit menu was changed to check the display height and then offer all `SHOW IMAGE` *xxxn* options for the number of components that will fit while showing the remaining components as `CHOOSE COMP` *n* options. Selecting one of the latter changes which components are available with the full `SHOW IMAGE` *xxxn* options. The option(s) to show the rms image(s) and, in `RMFIT`, the gain always appear. On writing output images, all these tasks now copy the large `XG`, `ZE`, or `RM` tables only to the residual image cubes. All potential output images are written when they contain at least one valid pixel, fully blanked images are deleted. All output images are marked as magic-value blanked if appropriate.

`XGAUS` was given the option to display spectra on a non-linear intensity axis with log10, square root, and cube root plotting. The log10 is problematical since negative intensities cannot be displayed. The other two take the square or cube root of the absolute value and then restore the initial sign to the result. The non-linear plots are useful when the dynamic range of the spectrum is large, *i.e.*, in maser fields. The user may switch the choice of linear and the non-linear form from menu options and also with TV button D while setting the initial guess. `AGAUS` has a similar non-linear option but only while setting initial guesses on spectral plots of optical depth. The non-linear options are not available (or useful) when plotting absorption, Zeeman, and rotation measure spectra. `RMFIT` now displays the residual rms on plots of Q and U rms.

AIPS memos 118 and 122 were revised to explain the new options and to show the new and revised displays. Task `XG2PL` was corrected to handle the maximum number of components (now 32) and other table format changes. The print portion also required changes to formats and to data scaling.

UV data

The scheme by which EDITA, EDITR, and, SNEDT extend any time range received attention. Adverb EXTIME was added to limit the size of these time extensions and to determine whether the time interval backwards and forwards is based on the times only of the current antenna or of all antennas. The dummy times added at the start and end times and any time gaps were changed to scale by DETIME rather than SOLINT which is usually much smaller. The "expert" mode available in these tasks was deleted. It was hard to use and is no longer needed on modern, much faster computers.

Because total polarization and visibility amplitude are computed with the square root of a sum of squares, they are fundamentally positive even when the Q, U, real, and imaginary contain only noise with zero mean. To test the correction for polarization in COMB and POLCO a new task POLTS was written. It generates one million random numbers with *AIPS* random number generator. Then it loops over numerous signal-to-noise ratios and the million random numbers to determine the mean and median measured "polarization". The results are written into a text file in the PLOTR format. That task was then used to determine a best fit polynomial and a new subroutine was written to use the polynomial to correct the measurements. After a few iterations, the routine converged as well as it could. That new subroutine was added to COMB and POLCO. The good news is that all of them work rather well with an error of about 0.004 sigma for the original routines in COMB and POLCO and a bit less (0.001 sigma) for the new routine. The Ricean bias (error) gets rather larger for S/N less than 5.

TECOR and ALBUS were changed to define each entry in the TE table as applying to all antennas or to a specific antenna. This greatly reduces the size of the TE table for the VLA but allows the user to request separate values for each antenna. This may be appropriate for the VLA in A configuration. These tasks had a number of minor corrections and TEPLT and RIFRM were adjusted to handle the new table format.

CLCOR was corrected to examine the CT table and apply the default handling for all dates zero only when they are all zero. The five day numbers in CT tables can start with 0, -1, and even -2.

RLDIF had Rick Perley's functions for 3C286 and 3C138 changed with a new fit and an option to print all "expected" values used was added.

FITLD was changed to accept the new 16- and 256-level data which will appear with the VNDA enhancement of the VLBA. The option to scale the visibilities but not to do the FFT correction on auto-correlation data was added.

TUVCP is a new task which copies a data set adding a separate user-specified time to each subarray. Multiple subarray data sets that have passed through CASA may require this,

General

VGLIST is a new verb which lists how many tasks are available for VGET under each of the 35 possible VNUMBERs.

CookBook and other documentation was updated in February.

AIPS code was revised to eliminate warnings from gcc and gfortran. In particular, an incorrect usage of common (external in gcc) in the *AIPS* TV (XAS.SHR) code was corrected and an option was added to the Makefile for new compilers which make -fno-common the default.

Ecliptic longitude and latitude are no longer included in the list of supported coordinate types and are simply replaced by longitude (LONG) and latitude (LATI) with no adjective.

TRANS was changed to avoid copying Clean Component (CC) and Model Fit (MF) tables. They can be quite numerous and are not useful on the transposed image cube.

SUBIM was changed to handle old image headers that have zeros for the size of some of the 7 axes. It was given adverb DCODE to suppress copying of CC and/or MF tables optionally.

PATGN was given the option to add noise to the pattern images it generates and had an elliptical Gaussian pattern added.

Patch Distribution for 31DEC25

This section lists the patches that have been released for 31DEC25. The "Midnight Job" ($HOME/do_daily.*hostname*) will update your locally-compiled and binary installations. Major bug corrections are moved to 31DEC25 as they occur and users should use the MNJ on occasion on both the NEW and TST versions of *AIPS*. The 31DEC25 release has had a number of these "patches":

1. ALBUS did not read all of its adverbs. *2026-01-14*
2. KNTR read an extra plane when the Clean beam was plotted in a separate panel. *2026-01-16*
3. VLBARUN and VLBAPIPE tried to write to a directory not properly created when OUTFILE was blank. *2026-01-20*
4. TABED wrote confusing summary messages. *2026-02-03*
5. RLDLY did not handle REFANT=0 well when DETIME was 0. *2026-02-06*
6. VLBARUN and VLBAPIPE had hard failure caused by the patch listed above. *2026-02-13*
7. $APLUNIX/ZTKOP2.C and $APLLNX64/ZTQSP2.C had missing includes required by modern systems. *2026-02-19*
8. XAS.SHR did not define XLink as int and assumed that commons were okay by default. *2026-02-19*
9. FTFLG did not handle short rows in expanded displays when flagging. *2026-03-25*
10. PRPLT had small errors in plotting coordinates corrected and new plot types added with control of data outside the user's PIXRANGE. *2026-04-29*
11. IMAGR mis-labeled the step wedge. *2026-05-18*
12. IMHEAD needed changes in formats. *2026-05-21*
13. TRANS copied CC and MF tables uselessly. *2026-05-21*
14. ZLASCL and PRDEVS.LIST were changed to add evince as a possible preview "printer". Added explain to PRINTER help file. *2026-05-27*
15. XGAUS, AGAUS, ZEMAN, ZAMAN, and RMFIT were changed to only copy the XG or ZE or RM large tables to the output residual cube. Changed them also to mark output images as blanked when needed. Also changed them to write output images of any size if there are any valid pixels. *2026-05-28*
16. SPLIT and SPLAT tried to extract frequency offsets from a CL table without making sure there was one. *2026-06-24*

Recent Memoranda

Most *AIPS* Memoranda are available from the *AIPS* home page and essentially all are available from the NRAO Library (https://library.nrao.edu/aips.shtml). Memo 118 and 122 were substantially revised to describe and display the new capabilities described above. A related VLBA Memo has also appeared and is available from the NRAO Library (https://library.nrao.edu/vlbas.shtml).

118 **Modeling Spectral Cubes in *AIPS***
Eric W. Greisen, NRAO
June 2026 revision, describing XGAUS, ZEMAN, and RMFIT

122 **Modeling Absorption-line Cubes in *AIPS***
Eric W. Greisen, NRAO
June 2026 revision, describing AGAUS and ZAMAN

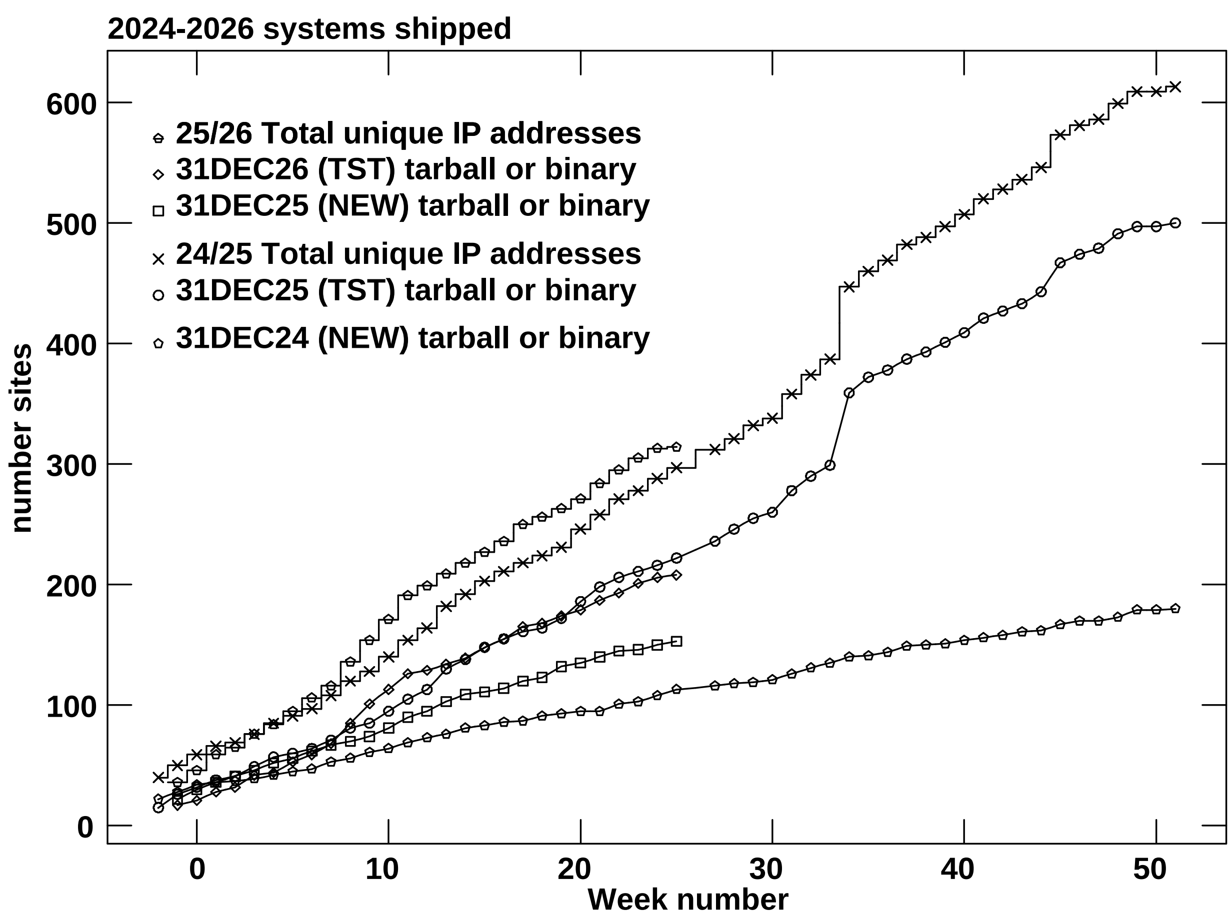
43 **VLBA Scientific Memo: On scaling of VLBA data**
Eric W. Greisen, NRAO
April 27, 2026
Issues with the FITS-IDI data file and the scaling of visibility data by `FITLD` are discussed. Changes to `FITLD` are described and potential calibration issues are also mentioned.

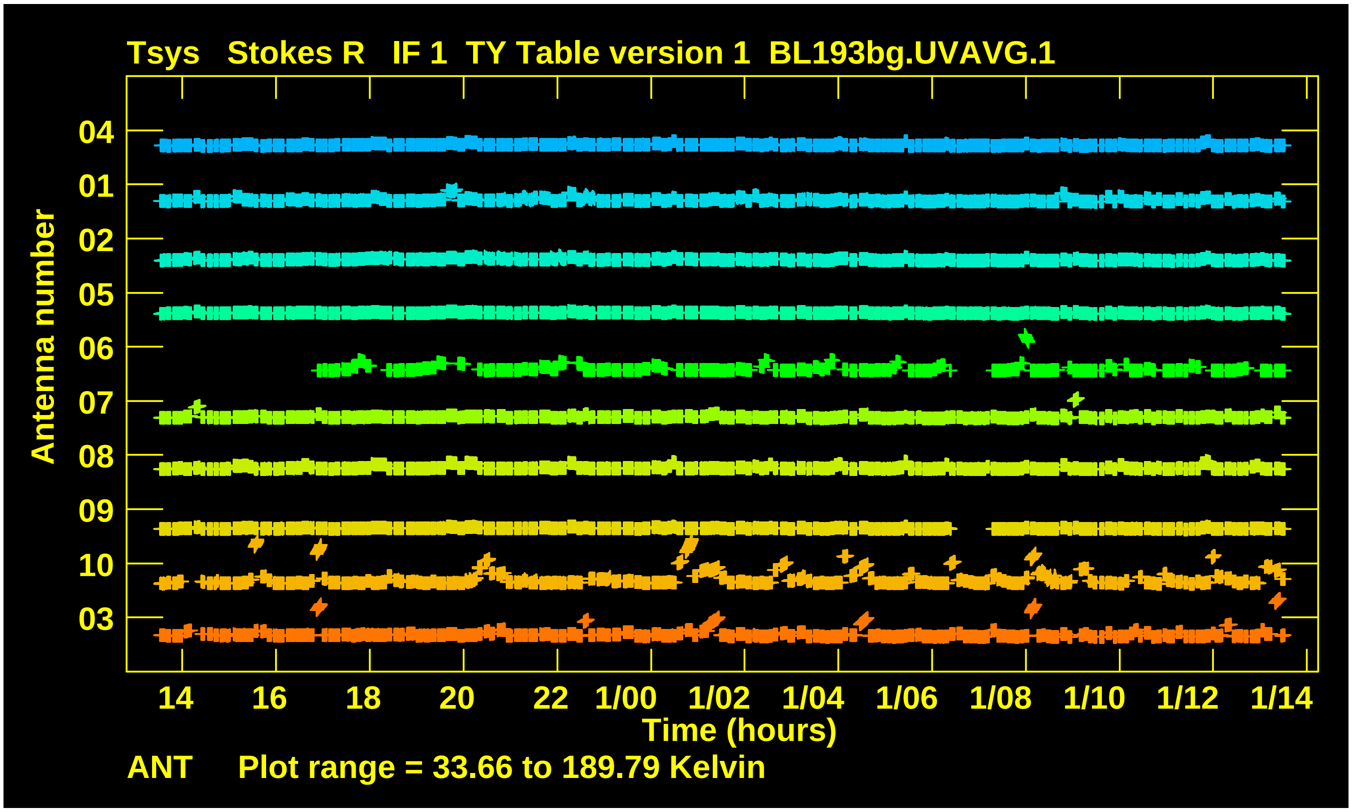
Recent Y2K tests

We have run the Y2K test on an Apple Mac mini with an M4 cpu. It achieved an AIPSMark$^{(00)}$ of 1818 by executing the full test in 22 seconds with correct results. That has now been eclipsed by an Apple laptop with large solid-state disk and an M5 cpu. That machine ran the Y2K test with correct results in 20 seconds, an AIPSMark$^{(00)}$ of 2000!

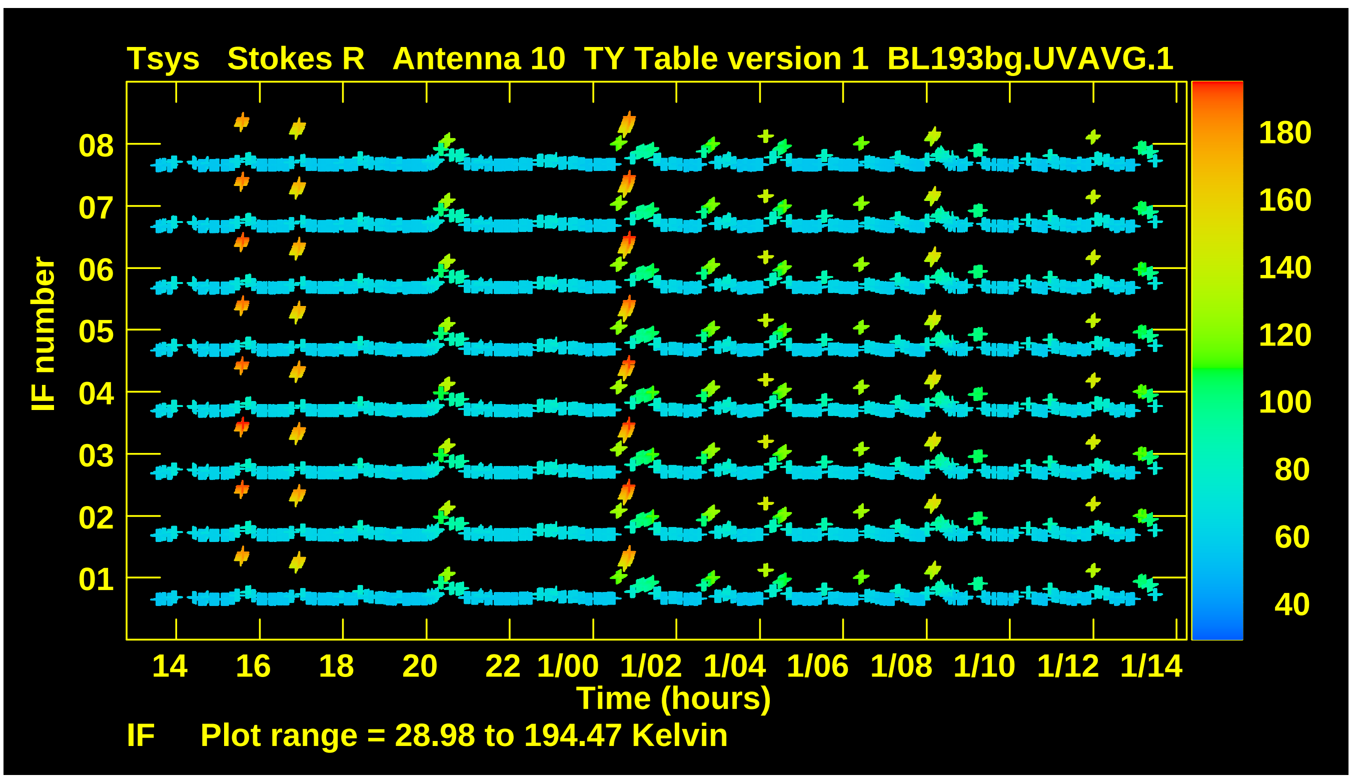
AIPS Distribution

We log apparent MNJ accesses and downloads of the tar balls and binary installations. We count these by unique IP address. Since some systems assign the same computer different IP addresses at different times, this will be a bit of an over-estimate of actual sites/computers. However, a single IP address is often used to provide *AIPS* to a number of computers, so these numbers may be an under-estimate of the number of computers running current versions of *AIPS*. So far in 2026 more than 153 IP addresses have downloaded the now slushy form of `31DEC25`, while more than 210 IP addresses have downloaded `31DEC26`. A total of 314 different IP addresses have appeared in one of our transaction log files. These numbers are rather close to those of last year at this time except those for `NEW` which are 12 weeks ahead of last year.

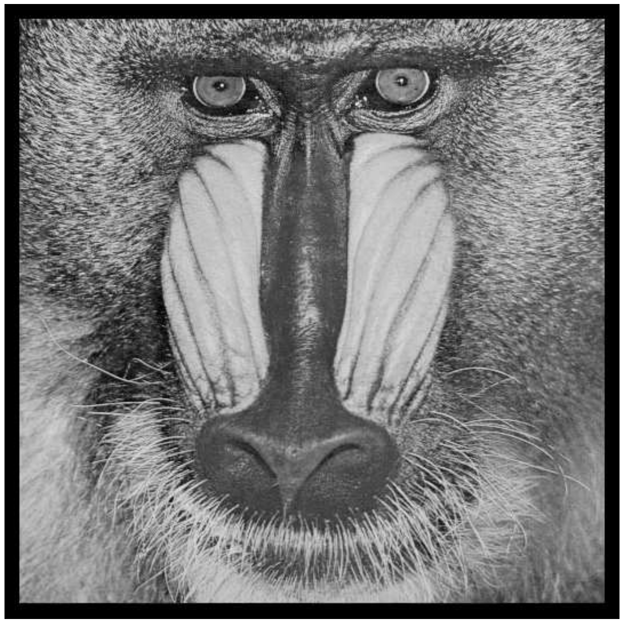




SPLOT sample plots. `OPCODE = 'ANT'; DO3COLOR = 1` to color by sequence.



SPLOT sample plots. `OPCODE = 'IF'; DO3COLOR = 2` to color by intensity.



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