AIPS MEMO NO. 40

The AIPS Workshop

Alan H. Bridle

National Radio Astronomy Observatory
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This memo attempts to capture the main points that were brought out at the AIPS Workshop held in Charlottesville on Thursday, October 31 and Friday, November 1 1985. It is gleaned from notes I took on the spot, so it may not be fully comprehensive. I hope it will nevertheless serve as a reminder of the main issues raised at the Workshop.

There were 35 "official participants" (Appendix 1). The outside user groups represented were NASA/GSFC (5 participants), NRL (3), CSIRO Radiophysics (2), Boston U., Brandeis, Center for Astrophysics, Dwingeloo, Illinois, Laval, Onsala, Penn State, Sachs-Freeman Associates, and Space Telescope (all 1 each). There were also 4 participants from the VLA, 11 from Charlottesville, and about half a dozen others who attended some but not all of the sessions.

The workshop agenda (Appendix 2) scheduled four sessions of contributed talks and two "free format" discussions.

SESSION 1

The first session dealt with AIPS in applications other than connected-element interferometry.

Jim Condon (NRAO) described how he had used AIPS to process a whole sky survey from the 300 ft telescope at 1.4 GHz, a data base with some 10 million data points. The single dish scans were preprocessed (baseline removal, calibration, editing) outside AIPS, then written to tape as (right ascension, declination, intensity) data in UVFITS format on the Charlottesville IBM. They were read in to AIPS using the tasks UVLOD and SELSD, then sorted with UVSRT and convolved and gridded with a task GRIDR that is in essence UVMAP without its Fourier transform step. The rest of the AIPS software was then used for image display, profile plotting, map comparisons and map statistics (e.g. intensity histograms), comparison with other source catalogs, and final output of the survey in FITS format for worldwide distribution. Jim concluded that AIPS is useful for large scale single dish mapping projects because it gives access to a wide range of analysis tasks; also that the flexibility of POPS in

AIPS was adequate for single dish work.

Jim also itemised several limitations whose removal would make AIPS still more attractive for such work:

- the lack of an AIPS standard "front end" for bringing in one-dimensional data,
- the lack of list handling in AIPS,
- inability to return adverb values from ephemeral displays other than as entries in the message file (could they be written to a disk file ?),
- lack of a source searching program to generate lists of positions and flux densities in a field.

In discussion of Jim's talk, Mike Kesteven noted that beam switched maps can be processed using CLEAN (but the standard CLEANS in AIPS presently assume that the beam is symmetrical). Eric Greisen noted that some of Jim's suggested improvements will occur as the AIPS Tables software is developed.

Lee J Rickard (Sachs-Freeman Associates) described the use of AIPS to process IRAS data. He gave examples of the removal of zodiacal emission with a user-coded AIPS task for multiplying standard wedges together for "background" subtraction, of converting map ratios to temperatures using a task coded on the TAFFY template, of edge enhanced displays using NINER, and of image destriping by editing in the Fourier transform domain. While stressing that AIPS is a useful tool for IRAS analysis, he pointed out that TAFFY is cumbersome to deal with, and he suggested numerous enhancements to AIPS that would particularly benefit its non-radio users:

- a "FITS disk" task to write AIPS data files out to disk so they could be accessed by other imaging systems (e.g. IRAF) without going through a scratch tape, and for transfer between display and mass storage,
- an "inverse UVMAP" task to create an (amplitude, phase) UV data file format by Fourier transforming an image,
- enhanced editing facilities in the Fourier transform domain, including blanking to nonzero values, simultaneous blanking of real and imaginary parts, clipping the transform, and inverse transforming directly to amplitude and phase instead of real and imaginary parts,
- a task to make pixel-weighted averages of several maps,
- other coordinate geometries,
- a co-ordinate controlled cursor,

- a task to make map versus map scatterplots,
- a generalised COMB task to derive arbitrary user-specified functions of two or more maps,
- the ability to fit nonlinear baselines.

He also urged that AIPS should bear in mind how other imaging systems are developing, and suggested that AIPS should concentrate on its areas of greatest advantage, namely those that exploit the Fourier transform relationship.

In discussion of Lee J's talk, Ray Norris noted that CSIRO had developed a "FITS disk" task, and Alan Bridle pointed out that (map-map) scatterplotting is also needed for several radio astronomy applications, especially for multi-frequency image analysis.

John Benson (NRAO) discussed the special requirements of VLBI AIPS processing, with particular reference to the plans for the VLBA. He noted the following needs of VLBI processing :

- ability to process 16 independently settable IF channels.
- ability to handle antennas with different sizes and polarization characteristics,
- delay and fringe rate fitting,
- visibility calibration and flagging,
- extensive accounting and history of models applied to the data during calibration,
- phase correction within the primary beam, and
- special-purpose VLBI spectral-line software.

John then outlined the major software development projects that are being undertaken as part of the VLBA project, including a modified database structure with multi-source files, calibration and flagging tasks, and an extended tables structure to carry index records, source data, IF channelisation information, flagging information, and external calibration data in addition to the usual AIPS gain table.

In discussion of John's talk it was noted that the VLBA data formats could also provide the tools for a "single dish front end" into AIPS. There was also extensive discussion of the problems of using FITS as a real-time data format, particularly of the problem of not knowing in advance how much data will be taken and written. The need to be able to write real numbers in FITS format was emphasised.

SESSION 2

The second session dealt with two areas in which AIPS development is desirable. (The order of speakers was reversed from that on the agenda due to Ron Ekers' involvement in an unexpected meeting.)

Pat Moore (NRAO) described the motivation for an AIPS design review begun recently and aimed at making it easier for people outside the core AIPS group to read and write AIPS applications tasks. Motivating factors include

- the AIPS group does not have enough manpower to develop all the applications code that is now clearly needed, so a wider pool of people needs to become involved with applications programming,
- if AIPS code could be made easier to read and to write, bug reporting could become more precise (people might suggest cures as well as diagnose ailments) and bug fixing could be made easier,
- users should be able to code their own special-purpose AIPS applications quickly without burdensome overhead in, e.g., I/O details.

Pat outlined a design effort recently begun by himself, Don Wells and Tim Cornwell aimed at improving AIPS in three specific areas: (a) language and coding standards, (b) modularity and (c) easier I/O ("son of WAWA"). He emphasised that this design review was in its very early stages, and for this reason concentrated on the general direction in which it was heading rather than on technical details (which are still under discussion and will be described in future AIPS memos). Don Wells is leading the study of a new language standard for AIPS, that would incorporate more features of Fortran-77, such as IF-THEN-ELSE constructs, CHARACTER variables, PARAMETER statements, extended array and loop bounds. Pat referred to further attractions of Fortran-8X, but noted that it was unlikely that Fortran-8X could be supported portably in the near future. Tim Cornwell is leading a study of improved modularity in AIPS, including: a subroutine library with in-place operations for image processing; cleaning up existing subroutines to achieve a uniform, simple programmer interface; making the error system more coherent; hiding underlying structure in the I/O (e.g. unit numbers, catalog numbers) from the programmer; and other tools which would make it easier to develop new algorithms.

Pat then characterised the AIPS I/O structure as the main cause of the "activation energy" barrier to easy programming in AIPS by users. He noted that the ideal I/O would be efficient and portable to new architectures while providing a simple programmer interface that should cater to novices and experts alike. He stressed that the design effort would seek to make a new "son of WAWA" I/O package that could live in parallel with the present AIPS database and POPS language so that existing AIPS tasks could be left in their present

form while new ones could be added using the new package. He suggested that there would be a different, transparent I/O package for each type of data in AIPS, and that buffers could be looked after semi-automatically.

Discussion of Pat's talk showed general agreement with the goals of this redesign, particularly if it could be implemented in parallel with the present system so that old code would not need to be rewritten extensively. (Eric Greisen emphasised that the AIPS group shared this concern, as AIPS was now 400,000 lines of code !). The need for a graphics standard for astronomy was discussed; it was pointed out that GKS is co-ordinate-oriented rather than pixel-oriented, making it awkward for images and TV-like systems. Craig Walker noted that the development of the VLA Pipeline display system might provide an opportunity to explore new graphics options for AIPS.

Eric Greisen noted that it would not be easy to design a buffer system that would work well over a wide dynamic range. He also emphasised that the conversion to solely floating point images would simplify the I/O project and the attempt to improve the AIPS programmer interface. John Dickel stated that even though his AIPS installation at Illinois was tight on disk space, he supported the transition to all-floating point images because of the advantages it would confer. No dissenting opinions were voiced.

Ron Ekers (NRAO) discussed the needs of interactive image processing. He began by noted that the term "interactive" means different things to different people when applied to image processing. In the image processing community at large, it means that the system response time to a user input is less than 0.1 second, so that biological response times dominate the user's interaction with the processing system. At the other extreme, some people equate "interactive" with "non-batch" ! Ron gave examples where truly interactive processing would be desirable: rapid cursor movement, control of tasks according to their progress (e.g. continuously controlling deconvolutions according to whether they are converging or diverging, changing windows, etc.), prompting users in case of invalid or poorly-chosen inputs instead of crashing the task or the system. He noted that very interactive image processing may require either brute force compute power (e.g. a Cray) or full exploitation of specialised hardware. He pointed out that one often has choose between portability and exploiting specific hardware fully, citing the present under-utilisation of the IIS by AIPS as an example. He also questioned the need for AIPS' distinction between verbs and tasks.

Ron also pointed out the need to support the user who wishes to interact with the programs, e.g. by putting coding modules together in nonstandard combinations, and argued the need for user-oriented modularity as well as the programmer-oriented modularity advocated earlier by Pat Moore. He also emphasised the value of an "astronomical compiler" such as had been implemented in GIPSY, i.e.

a facility for the user to code operations in which the variables refer to images. John Broderick noted that a similar capability exists in the ANALYSE package at Arecibo.

In discussion of Ron's talk, Louis Noreau pointed out that small institutes cannot afford expensive displays such as IIS so cannot benefit from specialised tasks developed to exploit their unique capabilities. He urged that NRAO also support a less expensive display. Ron Ekers countered that small system users must also consider whether it is reasonable to impose their limitations on the rest of the AIPS community. Don Wells noted interactive advantages that could be gained by requiring the ANSI 3.64 terminal standard for AIPS terminals, e.g. windowing for message output and command input, spreadsheets, etc. Thijs van der Hulst supported more versatile use of AIPS terminals. There was widespread support for a more versatile command language for image combination and manipulation within AIPS (i.e. Ron's "astronomical compiler").

SESSION 3

The third session dealt with the use of AIPS at several non-NRAO sites that are applying it mainly to radio interferometry.

Mike Kesteven (CSIRO) described the experience with AIPS at CSIRO Radiophysics, a site without standard NRAO peripherals (DeAnza TV, no AP) and writing its own code. He noted that AIPS was used for image processing at CSIRO mainly because :

- AIPS was a working package when the choice was made,
- AIPS was designed for synthesis processing, and was thus relevant to the Australia Telescope project, but could also handle non-synthesis data, and
- AIPS was distributed to a large pool of users who would be debugging it, and thus augmenting the CSIRO effort.

He noted that AIPS at CSIRO attempted to support VLA, Fleurs and Molongolo synthesis processing, but that only the designated computing group actually programmed in AIPS. He divided the CSIRO software effort into three areas:

- writing tasks of specific interest to CSIRO, e.g. processing for the Molongolo telescope (about 50 AIPS tasks or verbs had coded in 2 years),
- modifying AIPS tasks to suit local needs better, e.g., KONTR for an HP plotter (about 20 AIPS tasks had been adapted, mainly by using the I/O segments from related tasks distributed by NRAO and replacing or adapting their algorithms; the resulting tasks do not follow AIPS coding standards and are often VAX-specific), and

o making temporary fixes to buggy AIPS code.

He noted that "gutting" working AIPS tasks for use as I/O templates had proved easier than using the AIPS paraform tasks such as TAFFY.

Mike then presented a number of criticisms of AIPS, prefacing them with the comment that they came from a baseline of being grateful for a system that worked overall and was widely distributed free of charge ! He noted that it was important at CSIRO to be able to transfer the extensive local software effort into new AIPS releases. While this was not difficult in principle, he noted that AIPS releases which changed the AIPS "environment" (meaning the user interface, catalogs, data structures, data access utilities) forced major modifications of their increasing body of local code. This introduced temporary loss of function while changes were made and debugged. He added that CSIRO lacked the disk space to be able to maintain old AIPS releases alongside a new one, so that AIPS was effectively "broken" at CSIRO for the entire time needed to bring up and debug a new release. He urged that future AIPS releases change the "environment" as infrequently as possible (suggesting once every two years) and asked for advance warning of changes that would affect homebrew code. He noted that this was the opposite of the release requirements for new applications code and bug fixes, which should be distributed as rapidly as possible.

Mike also asked if we could build the equivalent of the OPEN/READ/CLOSE utilities in AIPS Fortran.

In discussion of Mike's talk, it was noted that the move towards shareable load modules in AIPS and a more hierarchical directory structure should make it easier to isolate changes required by new releases. Also, that the new I/O system and modularity now under study for AIPS should not impact the "environment" as Mike had defined it, but that changes to the language standards might create more of a problem (e.g. the old MSGWRT capabilities may need to be carried forward in parallel with implementing the CHARACTER data type).

Colin Lonsdale (Penn State) described the implementation of AIPS under UNIX on a Charles River Systems micro-computer with a 4-bit ESI 1024 by 1024 color display, a Motorola 68000 cpu achieving about 100 kflop effective, and AP with about 1 Mflop effective. The system presently runs a subset of AIPS supporting about three dozen tasks of particular interest to continuum radio astronomy, presently supporting one user at a time. It provided performance roughly equivalent to a VAX 11/780 with the floating point accelerator, at a cost of only 70,000 dollars. He anticipated that adding a Sky Warrior AP with about 15 Mflops effective would give performance similar to that of the standard VAX/AP combinations used at many other sites. Colin related that his main problems in bringing up this system were:

o working with a flavor of UNIX that was different from that

supported by NRAO AIPS,

- a variety of compiler irritants (bugs, difficulty talking to C, no library facility),

- VAX-isms and VAX extensions to Fortran that were discovered in some AIPS code distributed by NRAO (i.e. nonstandard elements in some AIPS code).

Colin emphasised that the Penn State AIPS system provided an example of how portability under UNIX could make VAX-like AIPS performance accessible to people at small institutions without VAX-like budgets, and urged NRAO AIPS development to emphasise portability over efficiency. He stressed that gains in AIPS performance could come by hardware improvements as well as by optimising the code for specific devices. He also noted that portability of AIPS under UNIX should allow us to use faster hardware as it becomes available and urged this approach rather than reliance on features of cpu-specific operating systems such as VMS. Finally, he supported the effort to make AIPS code more modular.

In discussion of Colin's talk, Ron Ekers asked whether the problems Penn State had experienced in obtaining upgraded hardware on schedule were typical of the micro-computer world. Colin responded that he did not think so, and that some of the problems were peculiar to Penn State itself.

Richard Simon (NRL) described an AIPS site whose strategy was the opposite strategy of that adopted at Penn State. He characterised NRL as a site where hardware was easier to acquire than people, and which had therefore maximised its compatibility with NRAO hardware. He outlined a series of VMS-dependent procedures he had implemented to make AIPS "friendlier" in a VAX running VMS. These included:

- use of AIPS from separate user accounts, facilitating system accounting, imposition of hard disk quotas, and some file ownership protection,

- quick access to DCL via a new AIPS verb ('VAX'), providing better editing facilities for RUN files as well as other benefits from VMS system utilities,

- ability to run AIPS as a VMS command file, and thus to run it from VMS batch (saving costs in a system with real dollar charges and making batch easier to run for novice users (though foregoing the use of the AIPS batch checker).

He noted that his batch modus operandi at NRL would be made easier if AIPS had an adverb DOEXIT to force an EXIT from AIPS if a task failed. He also noted that he had begun sending Gripes to Charlottesville as text files by telephone link, and that the resulting rapid response had been beneficial.

Thijs van der Hulst (Dwingeloo) briefly described the AIPS use at his site, where they have a DeAnza TV and a CalComp plotter (recently replaced by a QMS laser printer). They have no local AIPS programming effort except for bug fixing and a task WSLOD that is used to put WSRT data into AIPS format. He noted that a new version of WSLOD handles the redundant baseline mode of the WSRT. He pointed out that AIPS assumes that the input polarizations are circular, and that WSRT users have to work around the AIPS Stokes parameter conventions to take account of this.

SESSION 4

The fourth session dealt with two NRAO projects in which AIPS has been transported into architectures very different from the VAX and ModComp environments in which it was developed.

Kerry Hilldrup (NRAO) described the development of AIPS under UNIX and his experiences transporting AIPS under UNIX into (a) VAXes, (b) the Charlottesville IBM 4341 and (c) the Green Bank MassComp. He noted that although transporting AIPS into NRAO's non-VAX hardware under UNIX had not led to production AIPS systems, much had been learned from the experience and many VAX-isms had been exorcised from the AIPS code. He now sends AIPS tapes to about 20 UNIX sites, and expects to support 15JUL85 AIPS under UNIX in the near future. He emphasised how the UNIX port had demonstrated the importance of coding standards -- "standard" code had been much easier to transport and debug than nonstandard code. He remarked that although NRAO's attitude to UNIX was that it should be "just another operating system" (as opposed to a religion), in fact it is still many similar operating systems and was far from being as monolithic as any single-vendor system. Kerry also noted that he had written a preprocessor to convert Fortran-66 to Fortran-77 code and that this preprocessor, which he distributed with the AIPS UNIX tapes, might assist a language upgrade if we do one.

Don Wells (NRAO) reviewed the strategies that the AIPS group has adopted to "escape from the FPS-120B trap" involving the migration of AIPS into vector architectures -- a Cray X-MP under COS, a Convex C-1 and an Alliant FX, both under UNIX. Much of Don's presentation will be the subject of an forthcoming AIPS memo, so it is not repeated here. He emphasised that the performance upgrades achieved in relatively short times by these migrations of AIPS were very substantial. They demonstrate how AIPS performance can be improved through portability as hardware evolves. He stressed the long term benefits of this approach as an alternative to optimising the code for particular hardware and operating systems. He noted however that further gains could be made by moving some machine-dependent code higher in AIPS' hierarchy to exploit vectorization capabilities more efficiently, by minimising scalar overheads, and by exploiting large memory resources when they are available. He emphasised that a key to progress in this area was the use of standard Fortran in a smart compiler.

SESSION 5

Eric Greisen (NRAO) chaired a general discussion session addressing "AIPS problems and new tasks".

Eric restated the desire to implement all-real images in AIPS, in order to simplify the code and to get faster execution, but at some increased cost in disk storage requirements. He emphasised that he had received no negative comments on this strategy at this Workshop, and that the AIPS group would implement it soon unless user sites mounted a strong lobby against it over the disk usage issue. Eric also emphasised that going to shareable load modules would require VMS AIPS sites to upgrade their operating system to Version 4.0 or later in order to run VMS AIPS releases beyond 15OCT85.

Eric then invited discussion of AIPS installation problems. Richard Simon asked if it was possible to design the installation so you could create the new installation beside the previous one. He also objected to the OLD/NEW/TST nomenclature and suggested that a date-based nomenclature would be better. Eric noted that future AIPS installations should be easier due to the new directory structure, in that changes will be more localised and updates in different operating systems will require only updates of the relevant directory segments rather than of all of AIPS.

Discussion somehow migrated to the topic of whether RESTART should be eliminated, and of whether or not EXIT should autowrite the environment to LASTEXIT, or whether or not LASTEXIT should be restored automatically at login. Conflicting preferences were expressed; indeed, some sites have already legislated defaults that others regard with disfavor. An option for the user to specify the default AIPS environment to be restored at login was suggested.

Eric next invited discussion of problems people had experienced with nonstandard peripherals and homebrew code. Susan Neff (NASA/GSFC) gave examples for the DeAnza TVs, for which some routines did not work as distributed but fixes had been obtained from Walter Jaffe, who had coded them originally. CSIRO had experienced the same problems, and had also communicated with Walter to get them fixed. A generic problem is that updates to later AIPS releases can destroy the fixes because of changes in the AIPS "environment" or because the fixes had not been back-ported to NRAO. Eric emphasised that NRAO could not test routines for peripherals that it did not own, so had to rely on user sites informing the AIPS group of the fixes that were needed. Similar "user undergrounds" were needed for Comtal TV's (Illinois, Goddard, Sandia Labs) and for ARGS displays (Mount Stromlo, Jodrell, and probably many others). Eric also noted that one way to protect homebrew applications code would be to send it back to NRAO so that it could be modified alongside other AIPS code if the AIPS "environment" was being changed at a given release.

There was an extensive discussion of the AIPS template tasks (TAFFY, FUDGE, CANDY). It was clear that the templates were not much in use and were widely regarded as clumsy. In general, homebrew coders had as much or greater success modifying existing AIPS tasks as in coding via the templates. It was noted that not enough types of task were templated, e.g. paraforms were needed for reading more than one image. Craig Walker complained that some bugs in the templates were being reproduced across AIPS. Mike Kesteven commented that the 7-dimensionality made the code hard to read and wondered if it was necessary in the templates, even though one did not really have to read all the pre-coded part in a template in order to use it ! It was generally agreed that the paraforms should be updated, but that there would be less need for them if the design for a simpler I/O system is successful and if a subroutine library for multi-image operations became available as part of improved modularity in AIPS. It was noted that code would become more readable if GTPARM used the HELP file to decode the TD file, so that a task could call for parameters by their names in the HELP file and get back the strings or values associated with them by AIPS.

Richard Simon and Craig Walker discussed the fact that AIPS data are handled differently from user data in disk management. Craig asked for a means of copying AIPS data, perhaps in FITS format, into a private area for long-term residence and for protection from TIMDEST. Richard noted some advantages of the AIPS logins from personal areas that he had implemented at NRL -- he had implemented quotas and time destroys with different limits on different disks, and could monitor disk usage by user name using fast VMS utilities. The combination of individual disk quotas and judicious use of TIMDEST was widely recognised as the means to effective disk management in AIPS systems.

Neil Killeen asked whether subdirectories might be implemented within AIPS user data catalogs. Eric responded that (a) this was not easy to do and (b) it ran counter to the current demand for removing INTYPE wherever possible as, for example, it had confused users into thinking that they had lost all their UV data when INTYPE was set to 'MA'.

The need to extract tabular data from AIPS for use in external plotting or spreadsheet software was discussed. Various users had developed methods for this, but all were highly application-specific and unsuitable for back-porting into AIPS as temporary solutions to the more general problem. Don Wells suggested that AIPS should support writing Tables in the DIF format used by many spreadsheets. Eric noted that general solutions to the exporting of Tables files were indeed on the AIPS Wishlist, and that a public-domain spreadsheet program was in hand and that it might be possible to add this to AIPS.

SESSION 6

Alan Bridle (NRAO) chaired the final general discussion session on the "future of AIPS". He observed that we may all wish that evolution would transform "AIPS" into something more intelligent and more human. Lee J Rickard expressed the hope that this would not again take 2 million years.

Alan urged people to read the Wishlist (AIPS Memo no. 37) distributed at the Workshop. It represents the priorities for short-term AIPS maintenance and development obtained by combining the AIPS group's recurrent activity with priorities for future development. The priorities come from NRAO's bimonthly AIPS Priorities meetings and from suggestions contained in the users' Gripes. He encouraged users to employ the Gripe mechanism to suggest priorities for new tasks and for documentation as well as to report bugs in the code.

He then noted that the Wishlist is very long and that the AIPS group lacks the manpower to implement everything that is suggested to it, even though many suggestions are good ones. Also, that the Workshop had provided numerous examples of how the AIPS community needs support for nonstandard hardware and for homebrew code written at user sites. He suggested that an AIPS Users' Group, whereby users could support nonstandard hardware and software directly to one another using NRAO as a communications channel, might alleviate several of these problems. Such a group might supplement NRAO's role as the the initial source of AIPS code. He suggested that the steps in forming such a group might be :

- carry out an AIPS site survey to identify who has nonstandard hardware or software that they would be willing to support at other sites. The results of the survey could be disseminated in an AIPSLETTER or as an AIPS memo,

- set up an AIPS users' "Bulletin Board" via a computer network and/or the AIPSLETTER. The Bulletin Board would allow users to advertise hardware or software they could support, or to advertise problems for which they need help.

- document routes by which users could distribute software to one another, either via the AIPS tape distribution to and from NRAO, or over computer network links whose pathways could be listed in the AIPSLETTER.

Subsequent discussion centered on the details of how such a Users' Group might be implemented, there apparently being consensus that it would be beneficial. It was suggested that the Users' Group could also act as an AIPS Priorities forum and that the proposed site survey should also survey priorities for the Wishlist. The site survey should also ask which computer nets the sites have access to. Don Wells pointed out that the 15OCT85 AIPSLETTER will contain two network addresses for Nancy Wiener in Charlottesville and that

recipients might try sending her messages at these addresses to test "connectivity" to NRAO. The site survey should also ask which nonstandard tasks each site now has available, so that a preliminary index of "what's out there" could be used to prime the Users' Group activity. It was also suggested that each site should be polled as to the fraction of its AIPS usage that supports VLA data, VLB data, other radio data, and data at other wavelengths, so that the distribution of the AIPS workload over different types of project could be assessed.

It was noted that some discipline might have to be imposed on the Bulletin Board mechanism if it was used extensively, in order not to overwhelm it. Expiry dates were suggested. The desirability of being able to search a computer Bulletin Board by keyword was noted.

The generic problem of how to find things in AIPS was discussed. HELP INDEX files should be current on each system, and it was suggested that the Bulletin Board could assist this. It was also suggested that it would be useful to be able to access the HELP INDEX file selectively, e.g. via keywords.

Alan noted that if an AIPS Users' Group was successful, it might help to maintain the balance between portability and efficiency which had been discussed throughout the Workshop. Some hardware-specific augmentations of AIPS might initially be supported better within their own user subgroup than they could be from Charlottesville.

The discussion then moved to the optimum frequency and impact of AIPS releases. There was general agreement that releases should not generally be slower than every six months, or else the code at non-NRAO sites would be too far behind the code being developed at NRAO. This would prevent them from debugging the code usefully, and would be an unacceptably long lag time in applications where the code is developing rapidly, e.g. VLBI. There was general agreement that the new releases should continue to be distributed by tape on a quarterly schedule as at present, leaving sites the option of taking each release or not according to local priorities.

There was considerable discussion of the desire for bug fixes to be distributed to user sites as rapidly as possible. There was strong support for distributing such fixes over a computer net between AIPS releases, especially if good connectivity to NRAO developed among user sites as a result of Users' Group activity. The AIPS group will look into ways of doing this, perhaps as an extension of the method by which fixes in NEW are intended to be distributed automatically from Charlottesville to the VLA.

There was also widespread sympathy for Mike Kesteven's request that major changes to the AIPS "environment" be infrequent and be announced well ahead of time. After some discussion, most participants appeared to favor designating one AIPS release a year as a "major release" so that effort could be made to concentrate major changes in that release. Advance documentation of the impact of that

release on user sites, via the AIPSLETTER or a Users' Bulletin Board, would also be helpful. This "major release" might also define an annual target date for revisions to AIPS documentation such as the COOKBOOK and "Going AIPS". Eric pointed out that such constraints would create some difficulties for managing code development and for some types of bug fixing.

The final discussion topic was the relation of AIPS to other imaging systems. Is more than a FITS tape/disk interface to other systems needed ? The obvious candidate for more intimate relationships may be IRAF, but it is not yet clear what form such relationships might take. There was some discussion of the fact that AIPS, despite deficiencies that had been aired at this Workshop, was nevertheless the image processing system of choice at a number of institutes where several choices existed. The proposed Users' Group may play a role as a forum for discussing features of other systems that would be desirable in AIPS. AIPS' enduring advantages may be its treatment of data in both Fourier domains, its portability and availability to a wide community.

The good humor and endurance of the participants was further attested to after the Workshop adjourned at 5.45 pm, as several suggested that it should henceforth become an annual event.

Appendix 1

AIPS WORKSHOP PARTICIPANT LIST 10/31/85

	AFFILIATION
Baath, Lars	Onsala, Sweden
Benson, John	NRAO-CV
Bowser, Geoff	NASA/GSFC
Bridle, Alan	NRAO-CV
Burns, Bob	NRAO-CV
Condon, Jim	NRAO-CV
Crane, Pat	NRAO-VLA
Dickel, John	Los Alamos/Illinois
Dugan, Thomas	NASA/GSFC
Ekers, Ron	NRAO-VLA
Fickling, Gary	NRAO-CV
Fomalont, Ed	NRAO-CV
Grayzeck, Ed	NASA/GSFC
Greisen, Eric	NRAO-CV
Hilldrup, Kerry	NRAO-CV
Hon, David	NASA/GSFC
Kesteven, Mike	CSIRO, Australia
Lindahl, Greg	Brandeis U.
Lonsdale, Colin	Penn State
Marscher, Alan	Boston U.
Moore, Pat	NRAO-VLA
Neff, Susan	NASA/GSFC
Noreau, Louis	Universite Laval, Canada
Norris, Ray	CSIRO, Australia
Rickard, Lee J	Sachs-Freeman Assoc.
Rivolo, Rex	Space Telescope Sci. Inst
Rosenthal, Soshana	Center for Astrophysics
Schwab, Fred	NRAO-CV
Simon, Richard	NRL
Snyder, Bill	NRL
van der Hulst, Thijs	Dwingeloo, Holland
Walker, Craig	NRAO-VLA
Wells, Don	NRAO-CV
Wiener, Nancy	NRAO-CV
Yentis, Darryl	NRL

Appendix 2

AGENDA FOR AIPS WORKSHOP

Thursday 31 Oct --- Friday 1 Nov 1985

NRAO Auditorium, Edgemont Road

Thursday October 31

1.30	J.Condon	Using AIPS for single-dish mapping
2.00	L.J Rickard	Special needs for AIPS handling of IRAS data
2.30	J.Benson	AIPS and VLBI/VLBA
3.15	Break	
3.45	R.Ekers	AIPS and interactive image processing
4.15	P.Moore	Easier programming in AIPS
5.15	Pre-dinner wine and cheese (NRAO Lobby)	

Friday November 1

9.00	M.Kesteven	Experience with AIPS at CSIRO
9.30	C.Lonsdale	Experience with AIPS at Penn State
10.00	R.Simon	Friendly AIPS in a Vax at NRL
10.20	T. van der Hulst	AIPS and WSRT data
10.30	Break	
11.00	K.Hilldrup	AIPS under UNIX
11.30	D.Wells	AIPS in vector architectures
12.15	Box lunch available for registered participants (NRAO lobby)	
1.30	Discussion session: "AIPS Problems and new tasks" Chair: E.Greisen	

Installation difficulties
Shareable load modules
Nonstandard AP and TV support
Improving data displays
Extracting tables for analysis outside AIPS
Template tasks

3.30	Break	
4.00	Discussion session: "Future of AIPS" Chair: A.Bridle	

AIPS Wishlist
An AIPS Users' Group -- inter-user support
for nonstandard hardware/software ?
Contributing code to AIPS
Optimum frequency of AIPS releases
AIPS evolution and other imaging systems