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Argus — A Next-generation Omnidirectional Powerful Radiotelescope

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Abstract

This is the abstract submitted for an invited paper to be presented at the International Astronautical Congress to be held in Graz, Austria in October 1993. It will be given at the session entitled SETI Science and Technology.

The time has come to seriously consider a fundamentally different approach for radiotelescopes. Compared to a conventional dish, an **Argus** timed array provides many advantages, including simultaneous omnidirectional sky coverage (no scanning), high sensitivity (arbitrarily long integration time), high resolution, variable beam size and shape, low and adjustable sidelobes, wide bandwidth, detection and tracking of transient and moving sources, adaptive and retroactive observations, interference rejection and high efficiency (Arecibo has about .0001% omnidirectional efficiency). An **Argus** array is less expensive since it takes advantage of mass-production, has no large or moving parts and is unaffected by gravity, sunlight or wind. The construction cost of a dish increases with time (since labor costs dominate), whereas the construction cost of an array decreases with time (since computing costs dominate). Hence an array must become less costly at some time, even if its other advantages are ignored. We have successfully constructed and operated a prototype eight element circular **Argus** array at 162 MHz. It achieved a resolution five times greater than its classical resolution, through application of the CLEAN super-resolution technique. The elements of an Argus array should have hemispherical coverage, aimed straight up. They should have nulls at the horizon (for rejection of terrestrial interference), have dual circular polarization, be broadband and mass-produceable. The best candidates are from the helix family. A multifilar contrawound conical helix can achieve these requirements over a forty to one bandwidth. The **Argus** array geometry should have approximately circular symmetry (for uniform sky coverage), not have uniform spacings (to avoid grating lobes), and be spatially and frequency tapered from the center outward (to achieve frequency independence). Placing the elements along the arms of a multi-arm logarithmic spiral achieves these requirements. An appropriate computing architecture for **Argus** consists of one small computer for each element and one small computer for each beam (the number of beams is greater than the number of

elements), all joined together by a token-ring network. The computational power required for an **Argus** array of equivalent size to a large dish is greater than can be reasonably achieved today in the microwave region. But future developments in computing will make this possible, and today modest arrays at lower frequencies are possible. One fully-implemented **Argus** array can simultaneously carry out all the observations now being done by other comparable radiotelescopes, not only for astronomy but for all scientific and commercial monitoring of the electromagnetic environment. Examples include monitoring all radio sources (including pulsars), aircraft and spacecraft, detecting new phenomena such as supernovae and other unknowns, accommodating all visiting observers simultaneously without interaction, and carrying out reoptimized retroactive studies of phenomena recognized later. The universality and versatility of the Argus approach, together with its riding the crest of mass-production computing, make it inevitable for some time in our future.

3/6/93 MEETING NOTES

The meeting began at roughly 10am. Those in attendance were Barnhart, Dixon, the Ayottes, James, Childers, Janis, Brown, Campanella, VanHorne, and Bolinger.

Dixon reports that he is busy moving, now that he has purchased property on the east side of the Scioto river.

Childers reports that he has installed a new printer ribbon, so that the continuum program's reporting of source detections will be easier to read. He is also thinking of ways to adapt this automatic recognition program to the LOBES program. A general discussion ensued regarding whether to stick to 1950 epoch coordinates or switch to 2000.

Brown reports that he has worked out a solution to the heterodyning question. A general discussion of various Argus configurations which could be built today ensued.

James reports that he has acquired an A to D card for the PC, which will be used in the digital strip chart recorder project. He needs to acquire a dot matrix printer next.

VanHorne reports that a study he recently read indicates the possibility that our moon may have stabilized the Earth's orbit, which infers the possibility that life may

be unique to such systems.

Bolinger reported on his work on writing a printer based chart recorder program.

The meeting broke at roughly 11:30am, with most going off to their respective tasks.

ed. note: These meeting notes were compiled by Tom Hanson, as I was away during the meeting. Thanks Tom!

3/20/93 MEETING NOTES

The meeting began at roughly 10:03am. Those in attendance were Barnhart, Phillips, Dixon, VanHorne, James, Brown, Huck, Janis, Hanson, and Campanella.

Phillips announced a used computer equipment sale at **Perkins** optical Observatory, where it may be possible to acquire a dot matrix printer for the digital strip chart recorder project.

Brown reports that the flat is at declination +61 degrees, a position of interest to VanHorne as an area of study. **Brown** has attained the **Masters of Science** degree from **OSU**. **Congratulations Steve!**

Dixon reports that he has written an abstract for the **Argus** project (included in this issue). **Carol Abbott** has called him regarding the possibility of some of her students tackling the horn cart tracking project. He also brings a report from **JPL** on a radio camera they considered constructing some time ago.

Hanson continues on the card to tape project.

James brought a parallel port board for the digital strip chart recorder project.

Campanella has sent for information on a fancy Dicke switch, and passed it around for perusal today. He reports that he is awaiting an A to D board and related software from **George Jones**.

VanHorne has a position and frequency of an interesting object at our current declination he'd like to collect data on.

Barnhart reports that he will be on sabbatical leave from Otterbein the next couple of months, and will therefore miss the meetings. He also has a possibility of a couple of summer interns for the RO. He received a letter from **Melinda McKay**, regretting the fact that she has been unable to attend the last couple of meetings, but still remains interested in the RO.

The meeting broke at roughly 11:27am. A contingent went to the used equipment sale and purchased an Epson FX-85 dot matrix printer for the digital strip chart recorder project.

COORDINATOR'S CORNER

By Phil Barnhart

Tasks are building into the good weather. A number of exciting things are beginning to cook. The current shift to declination +61 degrees is to provide data on **Tom VanHorne's** mystery cloud (*found while scanning old archived data for SETI-like signals*) to give two of **Chuck Klein's** special project students something to work with in image convolution and post observation processing.

Plans are shaping up to perform a number of site tests having to do with evaluating various parameters such as antenna aperture efficiency, system sensitivity and effectiveness of the curved edge horn-blinders. These projects and a reinstatement of the **RFI** survey will provide opportunities for interns who have shown an interest in spending meaningful blocks of time at the **RO** this summer.

Operations in **Dreese 805** have been greatly curtailed the past few weeks and will be non-existent through the middle of April while hooded crews remove asbestos from the wall and ceilings on the eighth floor. Limited operations and communications will be carried out from **Caldwell 282**. Tuesday evening staff meetings will be held in the cavernous area behind 282 at the regular 5:00pm meeting time.

CAUGHT IN PASSING.....

During the lecture **Bob Dixon** gave at **Ames** last month **Barney Oliver** commented that they considered the name **Argus** for the project which came to be called **Cyclops** but they rejected it because **Argus** was the name of a cheap 35mm camera. He then turned to **Bob** with the comment relative to the proposed multi-element all sky camera we have come to call **Argus** and said, "*Boy, you sure took care of the cheap part!*"

The OSU Radio Observatory Card Transfer Project

[Note. Click on graph to obtain a larger image.]

The OSU Radio Observatory Card Transfer Project is intended to make data recorded 20 and 10 years ago available for use today.

There are 783 boxes of cards and 200 trays to be processed. Stages of processing include:

A: Storage in Dreese Hall:

Boxes: 783 Trays: 200

B: Transfer from Dreese

Hall to Baker Hall (where the card reader is located): Boxes: 500 Trays: 200

C: Reading through card reader. (Cards must be passed twice): Boxes: 500 Trays: 100

D: Post Processing. Using TSO facility, insure the two read passes match: Boxes: 214 Trays: 0

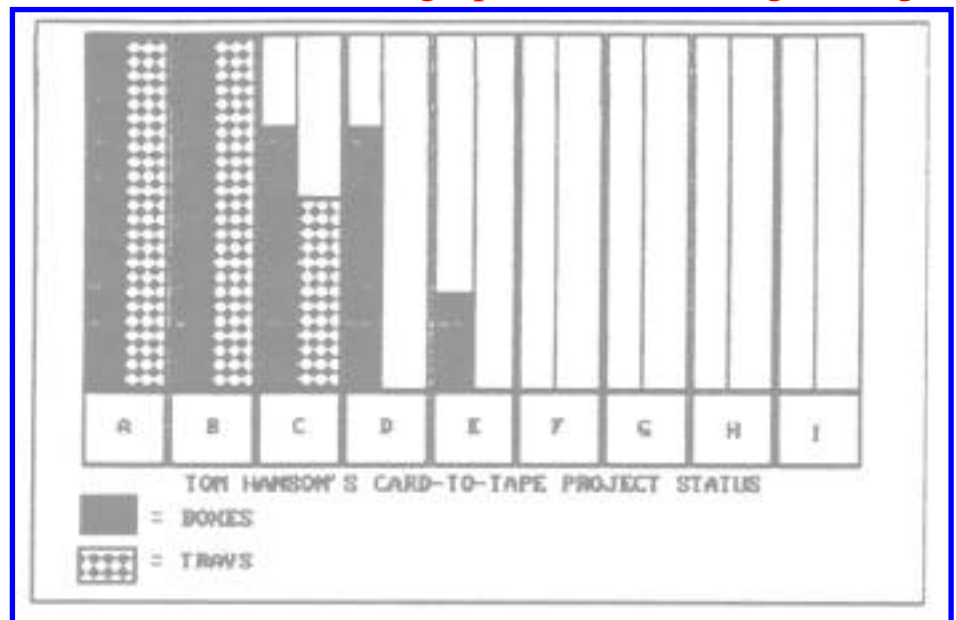
E: Transfer processed and verified data to VAX style magnetic tape: Boxes: 214 Trays: 0

F: Copy data into VAX for transfer to PC diskette: Boxes: 0 Trays: 0

G: Copy data from VAX to PC diskette: Boxes: 0 Trays: 0

H: Edit PC diskette data to identify format and use (Dr. Dixon required): Boxes: 0 Trays: 0

I: Put data to use (Grad. students, volunteers, etc): Boxes: 0 Trays: 0



Current status is "on hold" for all areas, due to a combination of asbestos removal at

Dreese Hall, and limits on volunteer time.

ed.note: The data for the above graph, and explanatory text, was supplied by Tom Hanson. Graphics by Earl Phillips.

TEASER..... TEASER TEASER

Dr. Dixon has generously donated a very large collection of the popular Sci-Fi magazine, "**Analog Science Fact & Fiction**". Venerable **RO** volunteer **Tom Hanson** has offered to donate the time & effort necessary to catalogue the entire collection. Once this daunting task is completed, we will publish the catalogue here in *Signals*. At that time, we will be open to bids on the entire collection to any interested reader. The entire sale amount will go towards the **RO**. It should be noted that we would prefer the entire collection go as a set, so that extra effort is not needed to "fill orders". Stay tuned to upcoming issues for further information!

REQUEST REQUEST REQUEST....

As the editor of *Signals*, I have always been looking for ways to make the publication look better. I have recently acquired a desk-top publisher, which will go a long way towards bettering its appearance. Now, I need a laser printer. Nothing fancy, just functional. If any reader has or knows of a good deal on a used but working laser printer, please let me know! I can be reached at the address(es) on the masthead, or call me evenings or weekends at (614) 764-0476.

Also, if any reader has access to a full page scanner that can read in camera pictures and produce good looking output in .gif, .pcx, or .tiff format, we'd like to use your services occasionally. We would like to begin including pictures in some of our articles to better illustrate things, but the hand-held scanner I have does not produce high enough quality for camera pictures, as it is only a 32 gray-scale scanner, and only 4-inch maximum width. Pictures that are scanned and "stitched" together never look quite the same! The desk-top publisher I have will import 2-bit (black & white, or monochrome) images, so I can accept them in any of the above mentioned formats. Let us know if you can help!

SIDING PROJECT UPDATE

Dick Smith, staunch friend and heavy supporter of **NAAPO**, has come through again. With rotting siding (of the steel variety) threatening the integrity and appearance of the garage/shop at the **RO**, Dick volunteered to replace it with vinyl siding at a cost too good to pass up. We had him bid on two sides of the garage (figuring the other two sides were not in desperate shape) and when he got into the job he decided we were too optimistic. He did the whole garage, donating everything over the original quotation. He also installed sheeting under the siding, which had not been present on the original job. Many thanks to Dick. It is friends like him who allow us to stretch our limited funds to more and better scientific use.

4/3/93 MEETING NOTES

The meeting began at roughly 10:07am. Those in attendance were Phillips, Campanella, Brown, Dixon, James, Huck, Mrs. McKay, Hanson, Janis, Childers, Bolinger, & VanHorne.

Phillips reports that he received a call from **Tom O'Conner**, offering his assistance on the horn blinder measurement project. He also gave us a contact name of someone from **ICOM** who may be able to help us obtain much needed electronics from that company. He also brings an offer from **SigmaPlot Software Co.** for the latest version of their product. He also asked for assistance in acquiring a laser printer for *Signals*.

Campanella reports that the printer acquired after the last meeting is unsuitable for the electronic strip chart recorder project, so **NAAPO** has purchased a suitable one for the job.

McKay reports that the offer of a summer internship for her daughter conflicts with her scheduled trip to Japan, so we will try to rearrange the timing to fit her schedule better.

Huck brings in newspaper article on **SETI** from various ramparts of the USA.

Dixon has received a letter from **John Billingham** regarding the SETI meeting to be held in Austria, which lists the scheduled talks.

Brown has been working on a program to automatically stop the **LOBES** program and take samples from the 50 channel receiver. Currently he & Childers are recording data on VanHorne's mysterious hydrogen cloud, brought up at the last meeting.

Hanson has been working on the *Analog* magazine collection, attempting to catalogue the collection. He has produced a chart that will list the entire collection when completed, which will be included in a future issue of *Signals*.

Janis has reminded the grounds maintenance department at **OSU** to mow our lawn at the site.

VanHorne reports that he will be giving a talk on SETI & our efforts at the upcoming **Marcon** convention.

Childers reports that he has produced hardcopy results of the data sampling done on VanHorne's mysterious hydrogen cloud. The signal he's receiving is at 1420.607 MHz, with a bandwidth of 100 KHz. He plans to continue to receive data for about another week.

James reports that he & Ang have built a parallel cable to interface with the recently acquired A/D board, for the electronic strip chart recorder project.

The meeting broke at roughly 11:03am, with most going off to their respective tasks. A small group had arrived to take a tour of the site.

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Designed by Jerry Ehman

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