North American
AstroPhysical Observatory

NAAPO (North American AstroPhysical Observatory)

"Signals"
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COORDINATOR'S CORNER
By: Phil Barnhart

Good weather has smiled upon us for the fall season. As a result much has occurred at the RO in outside projects as well as interesting and useful milestones on the search program.

The sky survey passed the 33% mark right at the first anniversary of the start — right on schedule. The continuum record has remained clean and sources show up with regularity and seem for the most part well behaved. A notable departure was the one-time 'flare-up' of OH+519 in the spring of 1994. (See SIGNALS *Vol. 10, No. 2 April 1994*). Designated the "**WHOA**" signal by Russ Childers, it seems a sudden enhancement (*at least in the decay time of less than two minutes*) of the intensity of OH+519 occured without an evident, easy explanation. This emphasizes the importance of programs seeking transient events in a world where traditional astronomy has rejected transient events as being too hard to examine in detail.

The **SETI** search has run with a few glitches — mostly hardware — without major events. A few 'hits' per day, (*some as simple as an OH maser, others ascribable to earth satellites*) indicates the problems raised by increasing **RFI** and the incursion upon the waterhole of local commercial and governmental users.

The fall has seen an increase in favorable publicity for the program with a feature article in the *Cleveland Plain Dealer* magazine section Sept. 18. TV coverage (*once without warning, once with big fanfare*) came our way and people again are looking at the project with renewed interest.

Cement patching, step building, storage shelf construction and the greening of the telescope all near completion. The 'greening' project is the start of a campaign to paint the entire telescope and amounted to volunteer time and donated paint to paint all non-metallic parts of the telescope. The green color was kindly suggested for the project by the present owner/landlord of the property upon which the telescope rests.

The new mark of the **NAAPO** volunteer is green hands, except for Cindy Brooman who maintained spotless hands and wears her insignia over her left eye, and Bob Dixon who wears green hands and whose blue denim overalls are now Muirfield

Green!

Proposals for support of the **Argus** project are out and more are being prepared. It seems there is some difficulty in communicating the uniqueness of the concept to the scientific funding community. We really have an educational project on our hands.

A final reminder: 'Tis the season to consider the **IRS**. What better way than to remember the **SETI** Search with your encouragement and what financial support you can manage. We have on-going needs and ever dwindling finances. There are very few scientific programs where your support is more far reaching or sees further into the future (and past for that matter). We are stewards of one portion of a universal commodity — intelligence. Let's make the connection with our other 'self'. We are not alone.

Computer Needed

The SETI program needs another PC. There are multiple tasks involving the **SERENDIP** receiver and the **LOBES** program that can not be handled conveniently by the two PCs running those programs. A control interface also needs to be constructed in conjunction with the DEC 11/23. All these tasks could be handled by a '486-based machine, and if no lower speed machines can be found to be donated to us we will have to consider buying one. This would greatly reduce our liquidity. If donations in the next few weeks approach $2500 all worry will dissipate. We will not be required to paint the computer Muirfield Green. Also, we are still in need of big memory devices. Let's think hundreds of megabytes.

Attention Argus Gurus

There follows (*in this issue*) a brief paper that Jim Bolinger would like some feedback on. Read it and send in your comments.

(ed. note: The following comments are regarding articles elsewhere in this newsletter.)

Reprinted from Oct. 31, 1994 Wall Street Journal:

Strange, which volunteers show up in the pages of the *Wall Street Journal! (For newcomers, Dick and Rick have been long time **NAAPO** volunteers. In fact we are storing their cement mixer at the **RO** right now.*)

Reprinted from the Oct. 1, 1994 NRAO Newsletter:

Comment: Could this be the same cause as the sinking of the focus room steps? Or are New Mexico groundhogs just bigger than Ohio groundhogs?

Reprinted from the Third Quarter, 1994 SETI News.

Comment: And we thought the cost of re-cabling the focus room was large!

Saturday Meeting Report
By: Tom Hanson

Paint sloshing had come to an end by the time I arrived this Saturday. From the administration building, the newly decorated concrete pilings look pretty good, in their bright coats of Muirfield Green. Drs. Barnhart and Dixon, Mark Sundstrom, Jerry Ehman, Dan Fleisch, Marilyn McConnell-Goelz, Steve Brown, Don James and Phil Schumacher were in attendence.

The meeting was underway, and Steve Brown was reporting that in his efforts to tighten a loose belt on Bay 8, Russ Childers discovered the molecular bonding limits of a couple of bolts on the electric motor. This discovery was followed by a similar discovery on the strength of a flange on the motor. Steve responded to an inquiry by reassuring us that this failure is not similar to the infamous failure of Bay 7 years ago, but he did indicate that repair of the broken flange may be less than simple.

Dr. Dixon inquired about progress on the parallel RF chain initiative, and learned there is no significant news. There is no news on the lease renewal. Two more contractors have been interviewed about painting the telescope. Dr. Dixon then gave us a reprise of his trip to Hawaii. The trip out took about 5 hours to reach California, and another slightly longer stretch to reach the islands. He visited Oahu, Hawaii and Maui, and commented on the experience of seeing a fresh flow of lava. He discussed the wildlife, with mention of the absence of snakes, and presence of plentiful deer, pigs, wild domestic cats and mongooses. His observations of the interactions of cats and mongooses were humorous and surprising.

Don James has installed an electric fuel pump in the truck, but it still does not run. Don received congratulations from the group, after announcing he would be 75 on Sunday.

Phil Schumacher said he believed he might have some of the missing boxes of cards which Herb Johnson has mentioned in his postings, and Phil and Steve Brown spent some time look at boxes after the meeting.

Marilyn has completed re-registration of **NAAPO** as a non-profit corporation, and *IRS Tax-Exempt* status renewal is in progress. Marilyn will also look into renewal of tax exempt status with the *State of Ohio*. The federal exemption is significant for donations, and the state exemption is primarily significant for exemption from sales tax.

Dan Fleisch commented on Dr. John Kraus' **Big Ear** book, and drew our attention to the historical significance of a photograph which includes Dr. Heisenberg of Germany. Dan also found the reference to the failure of Bay 7, during the discussion of the current problem with Bay 8.

Jerry Ehman discussed his efforts to obtain a video tape of a television program involving **Big Ear**.

PUBLICATION UPDATE
By: Earl Phillips

As mentioned above, Dr. Kraus has released an updated version of his earlier book **Big Ear**, called **Big Ear Two**. I read my copy in one sitting, and found it extremely interesting. It contains much more historical and biographical information than the original release.

A new magazine has hit the newsstands; **SetiQuest**. Edited by Larry Klaes, former editor of the *Electronic Journal of the Astronomical Society of the Atlantic*, this magazine fills a long standing void in **SETI** literature. Volume 1, Number 1 was recently released, containing articles on detectability, **OSETI**, and increasing public awareness, among other topics. ***SetiQuest*** may be subscribed to by writing to: Helmers Publishing, 174 Concord St., Peterborough, NH 03485, or e-mail to: larryk@pixelacres.mv.com. Currently, the Charter Subscription rate is $29.00 (US) per year. Future issues may contain updates on **Big Ear**, as the editor has asked me to contribute a quarterly column.

Saturday, 12/3 Meeting Report
By: Tom A Hanson

The work sessions are still underway as this report is prepared. Ang Campanella is standing on a table, fixing rolldown blinds. Phil Schumacher is working with the Magnus archive on his 486 system. Jerry Ehman and Cindy Brooman are deep in conversation about computer systems, software and various unusual events which they have observed. Bill Brown, a visitor, is down at the Focus Room. Bill is a grad student in the EE department, who is interested in doing a project for the Observatory. Dr. Dixon is said to be here (his car is certainly here), and I think Steve Brown is here. We received a call from Computer Security, located in the far west, informing us that they had received a telephone call from the security system, complaining about a low battery. This news was forwarded to the Focus room. I have another meeting to attend, starting at 12:30 PM, so I'll close with the report that Bill Brown, Ang Campanella and Jerry Ehman assisted in mounting two rolldown curtains in the Observer Quarters living room and bed room. Steve Brown has just arrived, along with Russ Childers.

Mercury Ice Mission Proposed

SAN FRANCISCO (AP) — NASA

Scientists want to send an unmanned spacecraft to look for ice inside craters on Mercury, the solar system's hottest planet.

The presence of ice could suggest the possibility of life on Mercury. While the planet's temperature reaches 800 degrees at its equator, readings inside the craters at Mercury's poles are 235 below zero.

"Mercury is intriguing to scientists because it is the least understood of the solar system's terrestrial planets," said astronomer Robert M. Nelson, who discussed the plans for the **Hermes** mission on Monday at a meeting of the *American Geophysical Union*.

He is the project's principal investigator at *NASA's Jet Propulsion Laboratory* in Pasadena.

The proposal, which received preliminary **NASA** funding in 1991, is among 18 suggested by **JPL** scientists for a **NASA** program of missions that can be developed for less than $150 million each and launched by 1999. **NASA** received 28 entries in all.

"We're going to select one to three of them by the end of January for further study. We would hope to pick one or two for full development," said Douglas Isbell, a **NASA** spokesman in Washington.

With Hermes, **NASA** scientists want to probe the chilly craters shaded from the sun. **NASA** hasn't explored the planet closest to the sun since 1974.

The Hermes mission would yield a map of the planet's magnetic field, which together with a gravity map would help scientists discern whether the planet has a liquid or solid core.

The Mariner 10 spacecraft found more than 20 years ago that Mercury has many unusual properties: It's unexpectedly dense, and it has a strong magnetic field

second only to Earth's, Nelson said.

"Understanding why Mercury is so dense and why it has a strong magnetic field is of fundamental geophysical importance," he said.

UA SCIENTIST & TEAM DISCOVER SURFACE FEATURES COVER TITAN

(Science contacts: Peter H. Smith, (602) 621-2725. Mark Lemmon, (602) 621-1485. UA Lunar and Planetary Laboratory)

Scientists for the first time have made images of the surface of Saturn's giant, haze-shrouded moon, Titan. They mapped light and dark features over the surface of the satellite during nearly a complete 16-day rotation. One prominent bright area they discovered is a surface feature 2,500 miles across, about the size of the continent of Australia. Titan, larger than Mercury and slightly smaller than Mars, is the only body in the solar system, other than Earth, that may have oceans and rainfall on its surface, albeit oceans and rain of ethane-methane rather than water. Scientists suspect that Titan's present environment — although colder than minus 289 degrees Fahrenheit, so cold that water ice would be as hard as granite — might be similar to that on Earth billions of years ago, before life began pumping oxygen into the atmosphere. Peter H. Smith of the *University of Arizona Lunar and Planetary Laboratory* and his team took the images with the *Hubble Space Telescope* during 14 observing runs between Oct. 4 - 18. Smith announced the team's first results last week at the 26th annual meeting of the *American Astronomical Society Division for Planetary Sciences* in Bethesda, Md. Co-investigators on the team are Mark Lemmon, a doctoral candidate with the UA

Lunar and Planetary Laboratory; John Caldwell of *York University*, Canada; Larry Sromovsky of the *University of Wisconsin*; and Michael Allison of the *Goddard Institute for Space Studies*, New York City. Titan's atmosphere, about four times as dense as Earth's atmosphere, is primarily nitrogen laced with such poisonous substances as methane and ethane. This thick, orange, hydrocarbon haze was impenetrable to cameras aboard the *Pioneer* and *Voyager* spacecraft that flew by the Saturn system in the late 1970s and early 1980s. The haze is formed as methane in the atmosphere is destroyed by sunlight. The hydrocarbons produced by this methane destruction form a smog similar to that found over large cities, but is much thicker. Smith's group used the **H**ubble **S**pace **T**elescope's *WideField/Planetary Camera 2* at near-infrared wavelengths (between .85 and 1.05 microns). Titan's haze is transparent enough in this wavelength range to allow mapping of surface features according to their reflectivity. Only Titan's polar regions could not be mapped this way, due to the telescope's viewing angle of the poles and the thick haze near the edge of the disk. Their image-resolution (that is, the smallest distance seen in detail) with the WFPC2 at the near-infrared wavelength is 360 miles. The 14 images processed and compiled into the Titan surface map were as "noise" free, or as free of signal interference, as the space telescope allows, Smith said. Titan makes one complete orbit around Saturn in 16 days, roughly the duration of the imaging project. Scientists have suspected that Titan's rotation also takes 16 days, so that the same hemisphere of Titan always faces Saturn, just as the same hemisphere of the Earth's moon always faces the Earth. Recent observations by Lemmon and colleagues at the University of Arizona confirm this is true. It's too soon to conclude much about what the dark and bright areas in the Hubble Space Telescope images are — continents, oceans, impact craters or other features, Smith said. Scientists have long suspected that Titan's surface was covered with a global ethane-methane ocean. The new images show that there is at least some solid surface. Smith's team made a total 50 images of Titan last month in their program, a project to search for small scale features in Titan's lower atmosphere and surface. They have yet to analyze images for information about Titan's clouds and winds. That analysis could help explain if the bright areas are major impact craters in the frozen water ice-and-rock or higher-altitude features. The images are important information for the **Cassini** mission, which is to launch a robotic spacecraft on a 7-year journey to Saturn in October 1997. About three weeks before Cassini's first flyby of Titan, the spacecraft is to release the *European Space Agency's Huygens Probe* to parachute to Titan's surface. Images like Smith's team has taken of Titan can be used to identify choice landing spots — and help engineers and scientists understand how Titan's

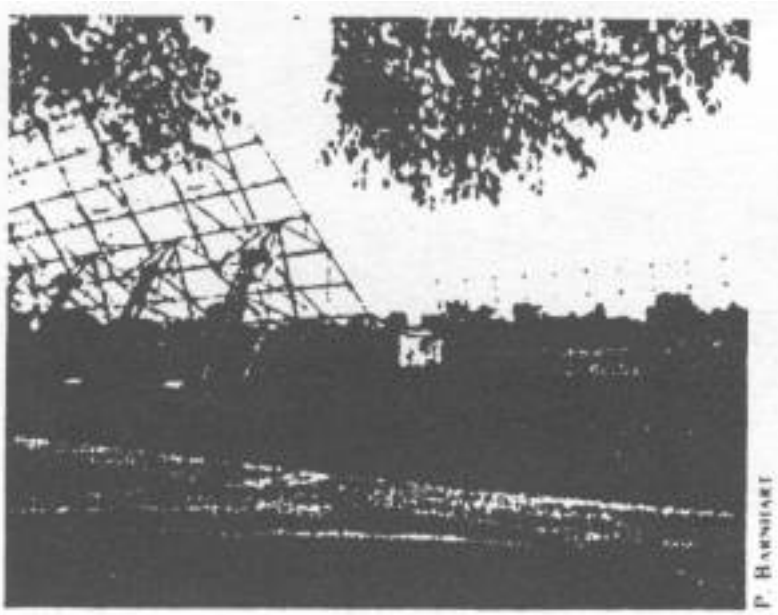
winds will blow the parachute through the satellite's atmosphere. UA scientists play major roles in the Cassini mission: Carolyn C. Porco, an associate professor at the Lunar and Planetary Laboratory, leads the 14-member Cassini Imaging Team. Jonathan I. Lunine, also an associate professor at the lab, is the only American selected by the European Space Agency to be on the three-member Huygens Probe interdisciplinary science team. Smith is a member of research professor Martin G. Tomasko's international team of scientists who will image the surface of Titan in visible light and in color with the Descent Imager/Spectral Radiometer, one of five instruments in the Huygens Probe's French, German, Italian and U.S. experiment payload. Senior research associate Lyn R. Doose is also on Tomasko's team. Lunine and LPL professor Donald M. Hunten are members of the science team for another U.S. instrument on that payload, the gas chromatograph mass spectrometer. Hunten was on the original Cassini mission science definition team back in 1983.

New Search Started

Improved experiment in Columbus, Ohio

Robert Dixon

Reprinted from the Third Quarter issue of SETI News



Ohio State 110 Meter Kraus-Type Radio Telescope

An upgraded SETI search at the Ohio State University's 110 x 21 meter radio telescope utilizing real time follow-up of signals was begun September 29, 1993. Tracking of detected sources is now possible, using a computer controlled movable feed system.

A spectrum of 3,000 channels in the frequency range 1.4 to 1.7 GHz is analyzed in real time to allow immediate follow-up. A pattern match algorithm is used to determine when a celestial radio source has passed through the two antenna beams. When a detection occurs, the feed horns arc moved ahead of the source, allowing reobservation of the source.

Bob Dixon

The starting declination of the search was +62 degrees, and as of May, 1994, the declination was +47 degrees. Data are analyzed in real time 24 hours a day. The half power beam size is 40 x 8 minutes of arc (declination times right ascension). The new search will cover 100 degrees of declination and is estimated to last 33 months.

The receiving system is of the Dicke type, where the reference and signal sources are identical feed horns. The receivers are a bank of fifty 100 kHz filters and phase sensitive detectors that determine which horn is receiving radio power. The center frequency of the fifty channel receiver is hopped every 0.33 second, allowing a 20 second coverage of 300 MHz in sixty 5 MHz hops.

Radio frequency interference is rejected by the subtraction effect of the switched beams, by the shielded ground location of the feed horns. by electric and magnetic shields on the edges of the horns, and by the pattern match algorithm. Some channels with consistent terrestrial interference are constantly ignored.

Results

Many artificial satellites broadcast within the 1.4 to 1.7 GHz passband, and are occasionally detected by the system. They are generally quickly rejected as interference.

As of May, 1994, no signals have been detected which can be considered candidates as celestial narrowband point sources. The maximum number of follow-up moves made by the feed horns on a single source to date is 5, or a total of 10 minutes follow-up time.

Receiver Upgrade in Progress

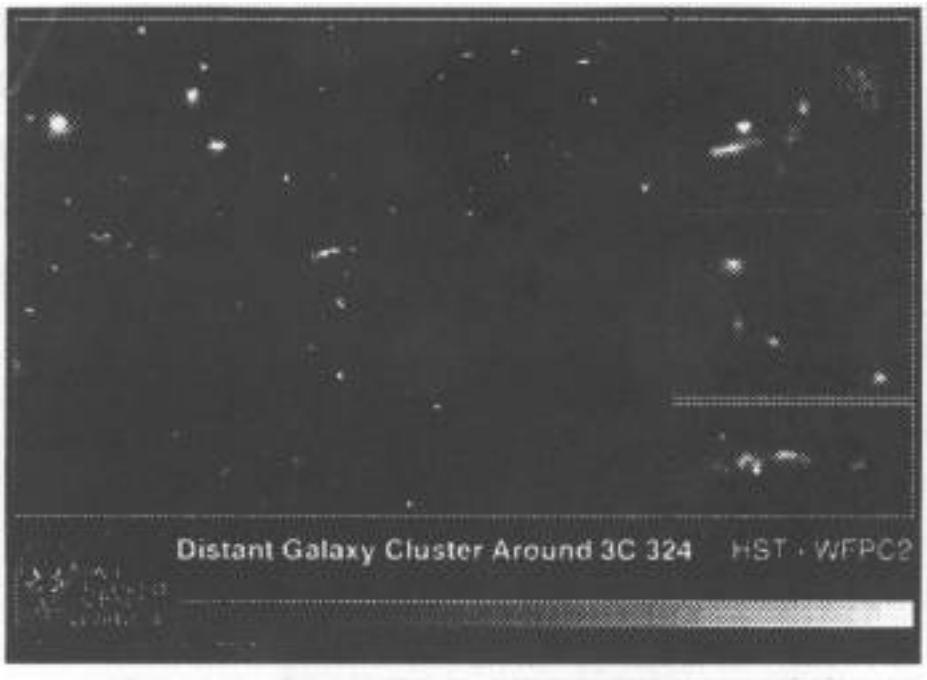
A four million channel receiver has been constructed for OSU by the UC Berkeley (SERENDIP) group, and it will be placed in operation this summer. It will drastically increase our sensitivity to very narrowband signals. It is likely that this receiver will also be hopped in frequency to cover some multiple of four million frequencies, and that it will use the two horn method already in operation to reject RFI.

Two low-noise HEMT amplifiers (from Tap Lum at UC Berkeley) are now being assembled and will be installed this summer. They will increase the sensitivity of the telescope for all signals by a factor of two.

Career Move

John Billingham, an important SETI pioneer and one of the discipline's most effective and tireless champions, retired from NASA in April. Until the cancellation of the HRMS, he was Chief of the SETI Office at the Ames Research Center. Fortunately for SETI, Billingham's expertise will now benefit Project Phoenix; he volunteers nearly forty hours a week as Senior Scientist for the SETI Institute.

DISTANT CLUSTER OF GALAXIES [*left*]



One of the deepest images to date of the universe, taken with **NASA's Hubble Space Telescope** (*HST*), reveals thousands of faint galaxies at the detection limit of present day telescopes. Peering across a large volume of the observable cosmos, Hubble resolves thousands of galaxies from five to twelve billion light-years away.

A fraction of the galaxies in this image belong to a cluster located nine billion light-years away. Though the field of view (*at the cluster's distance*) is only two million

light-years across, it contains a multitude of fragmentary objects. (*By comparison, the two million light-years between our Milky Way galaxy and its nearest large companion galaxy, in the constellation Andromeda, is essentially empty space!*)

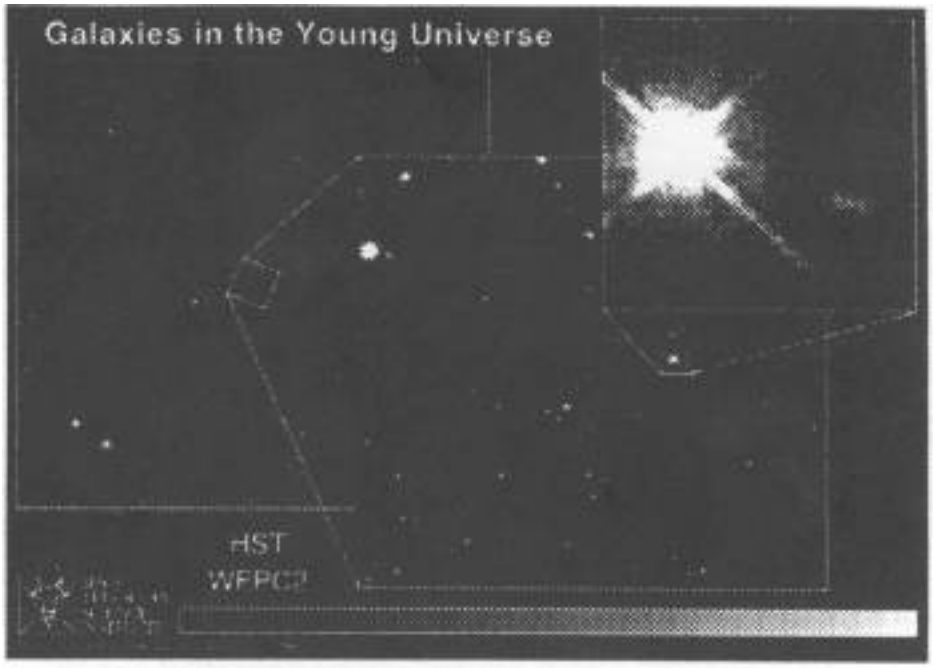
Very few of the cluster's members are recognizable as normal spiral galaxies (*like our Milky Way*), although some elongated members might be edge-on disks. Among this zoo of odd galaxies are "tadpole-like" objects, disturbed and apparently merging systems dubbed "train-wrecks," and a multitude of faint, tiny shards and fragments, dwarf galaxies or possibly an unknown population of objects. However, the cluster also contains red galaxies that resemble mature examples of today's elliptical galaxies. Their red color comes from older stars that must have formed shortly after the Big Bang.

The image is the full field view of the *Wide Field and Planetary Camera-2*. The picture was taken in intervals between May 11 and June 15, 1994 and requiredan 18-hour long exposure, over 32 orbits of HST, to reveal objects down to 29th magnitude.

[*bottom right*]
A close up view of the peculiar *radio galaxy* **3C324** used to locate the cluster. The galaxy is nine billion light-years away as measured by its spectral redshift (*z=1.2*), and located in the constellation Serpens. Based on the colors and the statistical distribution of the galaxies in 3C324's vicinity, astronomers conclude a remote cluster is at the same distance as a radio galaxy.

[*center right*]
This pair of elliptical galaxies, seen together with a few fainter companions, is remarkably similar in shape, light distribution, and color to their present day descendants. This Hubble image provides evidence that ellipticals formed remarkably early in the universe.

GALAXIES IN THE YOUNG UNIVERSE [*left*]



This image of a small region of the constellation Sculptor, taken with a ground-based photographic sky survey camera, illustrates the extremely small angular size of a distant galaxy cluster in the night sky. Though this picture encompasses a piece of the sky about the width of the bowl of the Big Dipper, the cluster is so far away it fills a sky area only 1/10th the diameter of the Full Moon. The cluster members are not visible because they are so much fainter than foreground stars.

[*center*]
A **NASA Hubble Space Telescope** (*HST*) image of the farthest cluster of galaxies in the universe, located at a distance of 12 billion light-years. Because the light from these remote galaxies has taken 12 billion years to reach us, this image is a remarkable glimpse of the primeval universe, at it looked about two billion years after the Big Bang. The cluster contains 14 galaxies, the other objects are largely foreground galaxies. The galaxy cluster lies in front of *quasar* **Q0000-263** in the constellation Sculptor. Presumably the brilliant core of an active galaxy, the quasar provides a beacon for searching for primordial galaxy clusters.

The image is the full field view of the *Wide Field and Planetary Camera-2*, taken on September 6, 1994. The 4.7-hour exposure reveals objects down to 28.5 magnitude.

[*right*]
This enlargement shows one of the farthest normal galaxies yet detected, (*blob at center right*) at a distance of 12 billion light-years (*redshift of z=3.330*). The galaxy lies 300 million light-years in front of the quasar Q0000-263 (*z=4.11, large white blob and spike on left side of frame*) and was detected because it absorbs some light

from the quasar. The galaxy's spectrum reveals that vigorous star formation is taking place.

Credit: *Duccio Macchetto* (ESA/STScl), *Mauro Giavalisco* (STScl), and **NASA**.

Reprinted from the October 1, 1994 NRAO Newsletter

And we thought the cost of recabling the focus room was high!!! ($ 0.00 plus labor)

VLA POWER DISTRIBUTION CABLE

The project to replace the buried high voltage power distribution cable at the VLA was completed in August 1994. This project has been a major part of the VLA infrastructure repair. The cable replacement began in 1988 when the VLA was experiencing an increasing rate of failures due to aging of the original cable. Between 1988 and 1994, 630,000 feet of cable were installed along the VLA arms in 38 miles of trench. The project was funded by NSF and NASA (in support of the Voyager Mission). The materials cost was $1.0M and the work was done by the people of the VLA Engineering Services Division. The installation of the new power cable is a major step in maintaining the VLA's reliability as it progresses through its second decade of operation.

R. A. SRAMEK

Is this related to the sinking of the RO focus room steps? Or, are New Mexico groundhogs just bigger than Ohio GH's?

VLA

UNUSUAL MOVEMENT IN VLA PAD W28

Antenna position measurements at the VLA are usually routine, with normal changes of the order of a centimeter or less. Occasionally, much larger changes are seen. During the last B configuration (from May to September of this year), pad W28 (occupied by Antenna 10) was found to have risen by about 10 centimeters

since February 1993, the last time the pad was occupied. Due to operational "snafus," this extraordinary change was not accurately measured, and the changes entered into the Modcomps, until August 3. All data taken between May 10 and August 3 involving Antenna 10 will have large phase winds, and should be corrected. The procedure for this correction is straightforward and is fully described in Chapter 4 of the AIPS Cookbook. Astronomical sources strong enough to be self-calibrated will not require this correction, although it certainly is useful to do it.

Remarkably enough, pad W28 has "jumped" once before. Between March 1989 and May 1990, the pad moved in a nearly identical direction ("up") and by a similar amount. Between May 1990 and February 1993, the pad slowly settled back to its original (pre-1990) position. No other nearby pads showed any similar motion during these time periods. The pad is now empty and will remain so until the next scheduled B configuration — currently scheduled for late 1995. Needless to say, VLA staff will be very curious to see if this pad continues its peculiar motion.

R. A. PERLEY

Reprinted from Oct. 31, 1994 Wall Street Journal:

Strange, which volunteers show up in the pages of the *Wall Street Journal (For newcomers, Dick and Rick have been long time **NAAPO** volunteers. In fact we are storing their cement mixer at the **RO** right now.*)

Two Researchers See Little That's Spooky In Ohio Ghost Towns

But the Helwigs Find Nothing Raises Spirits Like Tracing Vanished Communities

By CLARE ANSBERRY
Staff Reporter of THE WALL STREET JOURNAL

SUNBURY, Ohio – This, being Halloween, is a fitting day to drop by the tiny, cluttered office of the Helwigs, Richard M. and his son, Richard N., who dabble with the departed.

They are discussing Teacup and Ratsville. "Pee Pee is another good one," says the senior Helwig, his son nodding solemnly in agreement about one of their favorite ghost towns. The names are part of a collection dutifully recorded by the Helwigs' Center for Ghost Town Research in Ohio. "I'm Dick," says the 60-year-old father, who looks rather like a disheveled Captain Kangaroo; "he's Rick" – a darker, bearded, slightly tidier Helwig.

Tracing Towns

So far, the research center has recorded about 6,000 ghost towns and figures another 2,000 are lurking somewhere in the state. Or nowhere, as is often the case in Ohio, since old buildings succumb to gravity after a century of Midwestern rain and snow. Shunk is a dip in the road; Munk's Corners is a sign under a freeway overpass, across from a supersized gasoline station with 50 pumps and a convenience store. There is nothing in Climax to get excited about, all of which raises the question: why do they do this?

"It's a service," says Dick. It serves genealogists, historians and even realtors. "Property with heritage can sell for more," he explains. He quit teaching college history nearly 10 years ago to haunt ghost towns. Besides, no one else is doing it.

Not many people know about the Helwigs' work. The center's sign is a piece of paper taped to the front door. The office also serves as headquarters of Richard M, Helwig & Son Auctioneers, plus another enterprise that researches cave men in Ohio and publishes books about local arrowheads and hieroglyphics. Tracing ghost towns alone is not a viable source of income.

The Helwigs don't advertise, although their 1990 Big Walnut parade float displaying tombstones and an old building won Best of Parade and made the front page of the Sunbury News. They promote the center in other ways: Charging $25

plus mileage, the Helwigs have found enthusiastic audiences at the Plains City Lions Club, the Lithopolis Literary Society and Friends of the Birchard Library.

Now the center has 55 members who pay $8 a year — $6 for senior citizens and $10 for the family — which entitles them to the Ohio Ghost Town Gazette, a membership card, a certificate suitable for framing and a 10% discount on publications.

With a little coaching, devotees like Loring Ebersole of Michigan, who collects postmarks from defunct post offices, can become research associates. After reading the Helwigs' nine-part series on Doing Ghost Town Research, which recommended sprinkling dull plat information with adjectives, Mr. Ebersole wrote an article on Worstville for the Gazette.

Mr. Ebersole says, "The Helwigs always try to make things lively," which isn't easy given the inherently inanimate nature of such towns, unless of course they are occupied by ghosts. But more on that later.

The Helwigs approach each ghost town as a mystery. Often going on nothing more than a name where someone's grandparent died, they frequent local libraries and interview anyone living within the town's presumed shadow. They found Florida down the road from Texas, and they discovered that animals figured big in naming Ohio places — even small animals, which explains Fleatown.

"We're like Sherlock Holmes," says Rick, who planned to be an industrial-arts teacher until he became captivated pinpointing when Bogus was real and why Pee Pee is so named. (Someone named Peter Patrick carved his initials in a tree precisely where a town later developed.)

They still are tying to crack Lick Skillet, but Knockemstiff is solved. It turns out a preacher told a distraught woman that the only way to get her husband out of a tavern was to ... Apparently, that was relatively common advice a century ago. A second Knockemstiff cropped up a few counties away.

Every once in a while, they luck out and stumble upon people like Max Schaffer. Mr. Schaffer owned the Wood County Oil Museum, which actually was the bathroom of his barbershop; he had a working model of a derrick on the toilet. Mr.

Schaffer hoped to move his museum into an old oil-storage tank but couldn't persuade anyone to drain and donate one, so he retired. It was Mr. Schaffer who helped flesh out the center's "Ohio Ghost Towns. Wood County." 175 pages filled with "the thrill and excitement of life in the more than 20 oil boom towns."

The same can't be said for Dull. Even Harold Dull, whose great-grandfather, Monroe, founded it, say's there was little in Dull to begin with. The only thing left now is the Dull-Robinson Road and a few houses. "There aren't even any Dulls in Dull," says Mr. Dull. He moved out years ago. "I'm as far away as I have ever lived from Dull. Probably a mile and a half."

Not every town gives up the ghost willingly. Clintonville, an expanse of road between Columbus and the suburbs, made the Helwigs' ghost-town cut because it is no longer a government entity, having been swallowed up by Columbus. The Clintonville Area Commission isn't pleased. "We are a very vital neighborhood. We have a McDonald's and Wendy's," says Sierk Braam, a member of the commission. "We have nice lampposts. We're the sort of nostalgic American neighborhood."

There is nothing scary about Clintonville except the traffic, which brings us back to ghosts. Do the spirits of departed locals drift through these deserted towns? Are there creaking steps and slamming doors? Howling wind and apparitions?

Not likely, says Randy McNutt, who is writing a book categorizing Ohio ghost towns according to their proximity to mills and canals. "I didn't hear much about them," he says. Chris Woodyard, who just published her third in a Haunted Ohio series, has better luck finding ghosts in motorcycles, car trunks and department stores than in ghost towns. "Ghosts don't usually go with ghost towns."

Not to quibble, but Moonville had two ghosts, including a railroad signalman who stood eight feet tall before losing his head on a dark and stormy night. Then there was the woman who came up to the Helwigs after a speech at the Chesterville Library and said the town's founder was at her house.

"Oh, he's buried there," said Dick. No, the woman answered. The founder, a ghost, lived in the front room on the second floor. She went on to relate how the ghost got mad and began making a lot of noise when she removed his favorite rocking chair. She returned the chair, and now the ghost is in much better spirits.

Do the Helwigs believe in ghosts? "Hmm," says Dick. "Uhm," says Rick.

"Let's just say it's a fascinating part of history," says Dick, who was in a tractor accident on Friday, the 13th. He leans back in his swivel chair. Obligingly, it creaks.

A Proposed Argus Transmitting Array

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[This is a crude first hack, please review and comment.]

Abstract

The design of a multibeam receiving array, also known as a Radio Camera or Argus array, has been previously demonstrated. Further development of an Argus system is under way at the Ohio State Radio Observatory.

This paper outlines a method by which it is proposed to use a system, similar to an Argus array, for simultaneously transmitting different messages, on the same carrier frequency, each in its own arbitrary beam direction.

The advantages of the proposed system over using, for example, multiple Yagi-Uda arrays, is that the direction of transmission will be arbitrary and can be changed at will and 'instantaneously'. In fact, it should be possible to track multiple moving targets, each with its own message signal, with no moving parts.

1.0 Introduction

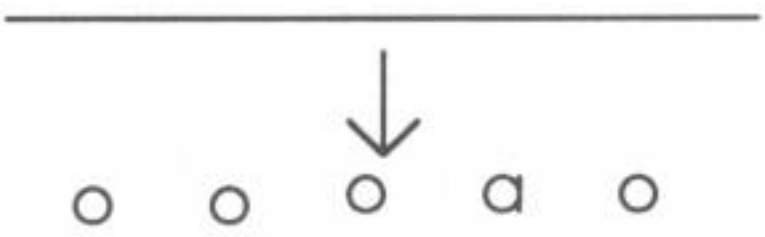

Fig. 1. Signal arriving broadside

The arguments in this paper can be easily extended to a planar or cubic array, but for simplicity consider the linear array of elements shown in Fig. 1. There is an unmodulated sinusoidal wavefront arriving from the broadside direction. The signal,

normalized to unit strength, at each element may be written as:

$$S_n = e^{-j\omega t} \quad (1)$$

where $S_n(t)$ is the signal at element n at time t
ω is the radian frequency

It is clear that the signal arriving at each element is the same. Other than what can be derived from the existence of the signal itself and that it is arriving from the broadside, there is no information content in the signal.

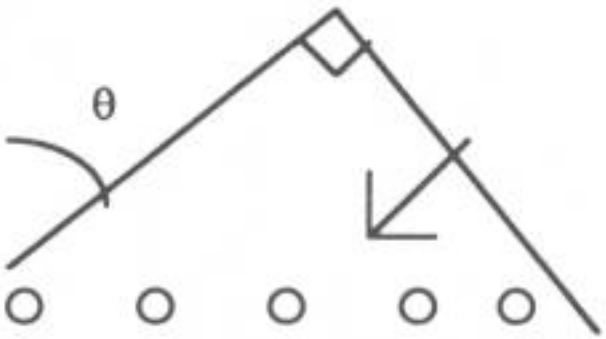

Fig. 2. Signal Arriving from direction θ.

Now, move the source so the signal is arriving from direction θ, as in Fig. 2. The signal at each element can then be written as:

$$S_n = e^{-j\omega t + \phi_n} \quad (2)$$

where ϕ_n is the apparent phase shift caused by the different arrival times at each element, relative to some arbitrary reference.

In most cases the arbitrary phase reference is taken to be the signal at the center of the array or at one end.

2.0 Argus Receiving Array

In an Argus system it is desired to measure the signal arriving from many directions.

To measure the signal from one direction, the current in each element is multiplied by:

$$e^{-\phi_n} \quad (3)$$

where ϕ_n is as in (2)

These values are calculated from the known array geometry and the desired 'look' direction, compensating for the mutual coupling effects.

The resulting values from each element are then summed. This operation, as a single equation, is

$$S_\theta = \sum_{n=0}^{N} e^{-\phi_n} e^{-j\omega t + \phi_n}$$

(4)

where N is the number of elements minus one

This is the same mathematical form as the Discrete Fourier Transform, which is the method used to form beams in the original prototype Argus system. In Argus, however, it is desired to do this calculation for many directions, and all simultaneously. This is accomplished by sampling and digitizing the signal at each element. The set of digitized signals are then feed [sic; "fed"] into a computer, which does the mathematical computations, hence the ability to form multiple simultaneous beams.

3.0 Directional Modulation

If the signal contains some intelligence, that is it is modulated, it can be written as:

$$S_n = Ae^{-j(\omega t+B)+\phi_n+C}$$

(5)

where A is the amplitude component of the modulation
B is the frequency component
C is the phase component
and ϕ_n is as described in (2)

Any modulation component can be a constant or be time varying.

The term ϕ_n was previously described as being due to the direction of arrival of the signal. It is of the same form as, and can be combined with, the phase modulation component. This introduces a new concept of modulation, or information content, and that is Directional Modulation. The direction of arrival can be said to provide information about the signal. A signal arriving from broadside has a directional component of zero, and signals from other directions would have:

$$-\pi<\phi_n<+\pi.$$

(6)

Just as sampling in the time/frequency domain provides information about components A, B, and C, sampling in the time/space domain provides information as to the ϕ component at each element. The ϕ values can be determined from the space/time samples (element currents, compensating for mutual coupling) by use of the Fourier transform, just as the amplitude, phase, and frequency components are derived from the Fourier transform of the time/frequency samples.

Recalling that phase is preserved across a frequency shift (heterodyne and filter), the constant component, namely the 'carrier', can be removed from (5) by multiplying it by:

$$e^{j\omega t} \qquad (7)$$

The result is a baseband signal containing all of the modulation components, including the directional component. In addition, (4), (5) and (7) can be combined to determine the modulation components arriving from any arbitrary direction. Here it is assumed that a single sideband signal is being received. In an Argus system the usual configuration is to have a receiver for each element, followed by a sampling A/D converter. This is, in turn, followed by any of a number of computing network architectures.

4.0 Transmitting Argus

Now we are ready to described the transmitting case. Let us assume that we wish to send a signal in the direction θ. The desired intelligence can be written as:

$$I = A\, e^{-j(B)+C}$$

(8)

where I is the desired intelligence to be sent and all other symbols are as before

By using a Fourier Transform process the set of element phases required to form the beam in the desired direction θ can be determined. These are then applied to the intelligence component, creating an array of intelligence components:

$$\left| I_{\theta n} \right| = \left| A_\theta e^{-j(B_\theta)+C_\theta} e^{\phi_{\theta n}} \right|$$

(9)

where | | indicates a set
I_θ is the set of intelligence components at each element
and all other symbols are as before

The final step is to frequency shift the intelligence from the baseband to the carrier frequency. This is done with a single sideband circuit (heterodyne and filter). Mathematically this operation can be written as:

$$\left| S^*_{\theta n} \right| = e^{-j\omega t} \left| A_\theta e^{-j(B_\theta)+C_\theta} e^{\phi_{\theta n}} \right|$$

(10)

where $|S^*_{\theta n}|$ is the set of element currents in the transmit case
and all other symbols are as before

For the case of multiple intelligence, to be sent in different directions, it would be necessary to form sets of equations, as in (9), with one equation for each element and direction. The equations, corresponding to each element, would first be summed and then shifted to the carrier frequency:

$$\left| S^{*}_{\theta n} \right| = e^{-j\omega t}\left(\sum_{n} I_{\theta n}\right)$$

(11)

where I_θ is from (9)

$|S^{*}_{\theta n}|$ is the set of element currents and all other symbols are as before

For an N element array, there would be N sums of I_θ.

At a far field location the resulting electromagnetic fields from each element would combine, such that the desired intelligence for that direction would be the only one received.

By letting θ vary with time, it is possible to track multiple moving targets, such as a constellation of satellites.

5.0 Conclusion

It has been shown that it is feasible to transmit multiple intelligence simultaneously in arbitrary directions, using an Argus type array and a common carrier frequency.

There are, of course, numerous problems that need to be overcome in order to build a practical system. One of these is minimizing the sidelobe level while maintaining a reasonably sharp main lobe, which would determine the 'adjacent direction', comparable to adjacent channel in the frequency domain, interference. It is also unclear at this time as to whether or not 'super resolution' techniques (such as a Clean algorithm) could be applied. The linearity of the electronics involved is also a

factor in determining the 'adjacent direction' interference.

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