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AstroPhysical Observatory

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"Signals"
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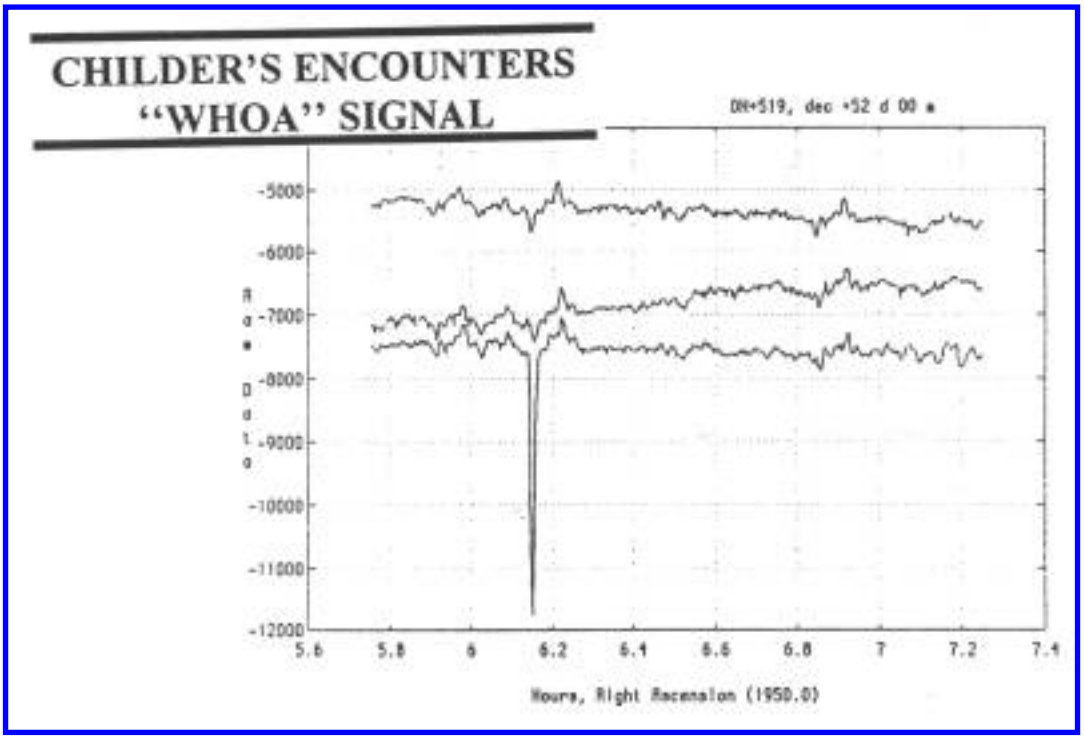
Note From Webpage Editor:

There are 3 graphics in this newsletter. For each one, click on the graphic shown here to obtain a larger version.

CHILDER'S ENCOUNTERS "WHOA" SIGNAL



What would account for a short term flare-up of a radio source like OH+519? The figure shows a record of three consecutive days of raw data in the continuum near 1420 MHz. Weak sources on either side of OH+519 (RA 6 hr 11 min, Dec +52) are evident on the traces. One is at about 5 hr 57 min, the other at about 6 hr 54 min.

In the lower trace OH+519 displays an enhancement of the negative going part of the signal (the overall dual horn signal is the difference between the signal strength in the two horns — first going negative, then positive as the source moves successively through the two horns) by a factor of over 10.

The enhancement is evident only while OH+519 is in the west horn so is probably not a, result of local RFI. It also dies out before reaching the east horn — a very rapid decline to "normal" intensity. There is some evidence it is dropping off even before the source is completely out of the west horn. This seems to be a time variation of the order of seconds. This makes the enhancement much harder to explain. We will continue monitoring the continuum output for similar 'events'. Stay tuned!

USE OF THE KARHUNEN-LOEVE TRANSFORM FOR SETI SIGNAL DETECTION

- By Dr. Chuck Klein -

Signal detection is an important aspect of **SETI** searches. Implicitly analyzing data into narrow bins is equivalent to using the *Fourier Transform* to convert time domain samples into a new search space. However, the *Fourier Transform* is only one of a number of transform methods that is mathematically available.

The **Karhunen-Loeve Transform** (*KLT*) is a method that has been proposed for use in **SETI** but had not been previously explored extensively. One of its key features is that the basis set of orthogonal functions is not determined ahead of time but is determined from the data itself. Therefore, the **KLT** can adapt to data in a way that the *Fourier Transform* cannot. Because of this property, it should be possible to examine only the largest eigenvalue which greatly reduces the computational cost.

To explore these possibilities, Prof. Charles Klein directed Fai Yeung on a Master's thesis in the department of Electrical Engineering.

Figure 1 shows one important result from Yeung's thesis. (*FIGURE 1*: c.d.f. of detection measure for a chirp function at signal noise ratio of 0.5.)

A chirp function is a sinusoidal source whose frequency varies with time. Since the frequency is not constant, a *Fourier Transform* would not contain the function in a single bin. Therefore, a chirp is the ideal test

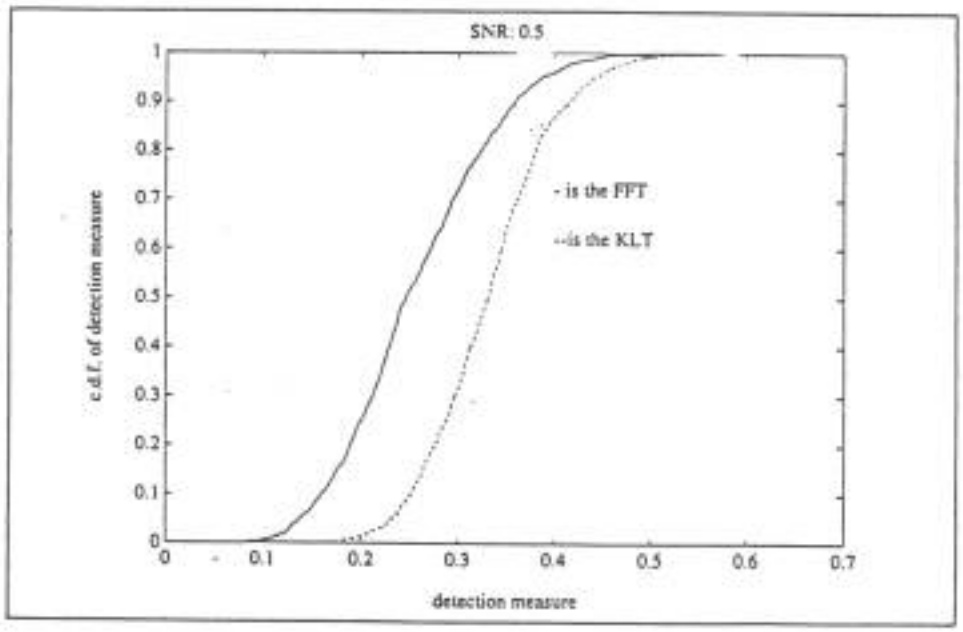


FIGURE 1 c.d.f. of detection measure for a chirp function at signal noise ratio of 0.5.

signal for the **KLT**. To compare the **KLT** and the *FT*, it is necessary to normalize the output of both methods in a compatible way described as a detection measure for each. For a large sample of mixtures of chirp signal and a fixed amount of noise, Figure 1 shows the probability distribution of the detection measure for both methods. Suppose one chooses a detection measure threshold of 0.2. A vertical line through the detection measure value of 0.2 shows a probability of only 70% of correctly detecting the chirp for the *FT*, but a 97% probability of detecting it with the **KLT**. Alternatively, there is only a 3% chance of missing the chirp source with the **KLT**, but a 30% chance of missing the source with the *FT*.

It is well known that a fast algorithm exists for calculating *FT* results and that the computational cost only rises at a rate of *n* log *n*. A second key result of this work is that the **KLT** detection problem can also be calculated at a rate of *n* log *n*.

Figure 2 shows the computational rate of three ways of calculating the **KLT**. (*FIGURE 2*: Computational rate of the KLT algorithm. The symbols (-) and (*) denote the SVD method, (--) and (*) the power method, and (...) and (o) the fast KLT algorithm.)

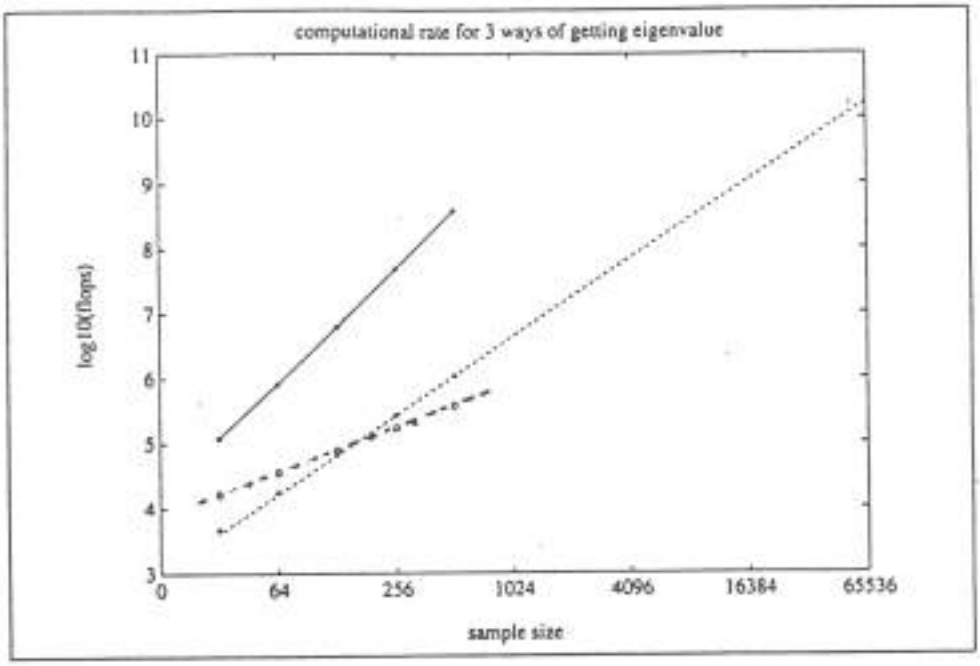


FIGURE 2 Computational rate of the KLT algorithm. The symbols (-) and (*) denote, the SVD method, (--) and (*) the power method, and (...) and (o) the fast KLT algorithm.

The one with the smallest slope, the one we call the fast **KLT**, is the one with the same rate of cost as the *FFT*.

Ongoing and future work is to apply the **KLT** to measured data from the **OSU Radio Telescope** and to compare results with the standard *FT* methods.

COORDINATOR'S CORNER

The weather begins to break. Melting snow uncovers jobs around the **RO** site. Recent work sessions and continuing efforts on the part of the site crew have filled a dumpster with trash and dismantled Mark I horn cart. Up-coming events include the all-important spring open house. On May 14 we will again throw the observatory open to the public. We anticipate a big crowd and can use a variety of volunteers to help with crowd control and general maintenance of order and calm.

Bill Miller has started a publicity campaign and we hope to have thorough media coverage prior to the event. All friends of the observatory are encouraged to attend and share this day of showing the accomplishments of the past few years.

The staff is generating great interest in a project to re-examine archived data from the radio telescope to try to salvage some of the information discarded during the **Ohio Survey**. Evidence of transient events is beginning to show in current survey scans. (*See the accompanying article from Russ Childers illustrating a fascinating continuum event in OH+519 obtained this winter.*) Such events were largely ignored in the compilation of the **Ohio Survey**. We hope to go to the original data to try to find similar occurrences during the survey in the '60s and early '70s.

We continue to face the formidible task of re-painting the entire telescope. It appears to be a job requiring many tens of thousands of dollars. We seek suggestions as to how the clearing to bare metal and re-priming and re-finishing might be accomplished without breaking the bank. If anyone has had experience with strange paint jobs, let us know. We are not eager to send volunteers 80 feet into the air to do the job with sandpaper and household brushes and rollers.

We look forward to seeing many of our friends at the **Open House** on May 14, 1:00 pm to 4:00 or 5:00.

Keep those checks coming.

NAAPO Saturday Meeting
February 19, 1994

PRESENT: Brown, Campanella, Childers, Dixon, Hanson, Janis. Due to the absence of the chairman, Phil Barnhart, who was unavailable due to family commitments, and the unusally low turnout (due to good weather?), the usual format was dispensed with and Saturday became a working session. Childers and Dixon reviewed the working of **LOBES** in the focus room. The rest of us became an impromptu site group and delved into the garage area once again. Tom Hanson jacked up the tractor and removed the flat tire. After the session, he transported it to *Goodyear* for repair. He also made a run into town to purchase gas for the tractor and filled up the tank. Bob Dixon reminded the group that it helps to turn the gas on when attempting to start the tractor. It was started and the battery charged. Steve Janis inventoried hazardous products slated for disposal. He will deal with *OSU* to pursue safe disposal of the various chemicals. Steve Brown went through the workroom/lab in the office building and marked old chemicals in there for disposal. These were also inventoried by Steve Janis for proper disposal. Russ Childers purchased paint to cover the artwork of a recent "spray-can vandal" who defaced a couple of the telescope bays. Further clean up of the garage and surrounding area finally gave way to the session breaking up around 12:30pm.

NAAPO Saturday Meeting
March 5, 1994

PRESENT: Ken and John Ayotte, Barnhart, Brown, Campanella, Childers, Dixon, Hanson, Huck, Janis, Schultz, Schumacher, Tom Van Horne.

SITE GROUP: (*Barnhart, Brown, Hanson, Janis, Tom Van Horne*). Started demolition of the old horn cart hut which consists of a number of aluminum beams as well as a wooden frame and sheet metal skin. The aluminum beams will be removed and saved in stock or possibly sold as scrap. The rest of the structure will be demolished and disposed of. The group succeeded in removing one of the large aluminum beams. The going is slow with rusted bolts in awkward locations. Some of the wooden framing was removed, but the hut will take at least another session to completely reduce it to disposable components. Tom Hanson brought back the repaired tractor tire and mounted it on the tractor and did further maintenance on the tractor.

SETI/LOBES GROUP: (*Ayottes, Childers*) The voltage-to-frequency converter built by Ken Ayotte was installed in the focus room and tested with an off-line movement of the horn cart. The convertor provides an audio tone to indicate horn cart position offset, useful when signals are recorded on audio tape for further analysis. Childers indicated his desire for a removable data storage medium capable of conveniently storing 12 Mbytes each day so that ALL data acquired by the **LOBES SETI** system can be archived. This upgrade would allow the system to archive transient events which don't normally activate the follow-up and detailed recording capabilities of **LOBES**. Various potential solutions were discussed including the use of an 8-track tape recorder. Russ will investigate further.

SIGNAL PROCESSING GROUP: (*Dixon, Campanella, Schumacher*) The problem of dynamic range for the **Argus** array telescope was raised again, as well as the possibility of iterative subtraction as a sidelobe reduction technique. While no definite solutions were arrived at, the lengthy discussion served to narrow the focus of future investigations.

HANSON CARD GROUP: The card reader has been recently serviced and Janis has successfully read a box and plans to step up the card reading pace with an eye to the May 1st deadline. The VAX 8550 in Dreese 805 has been turned back on now that the construction in the building will not significantly impact its operation. This allows previously read card data to be downloaded to floppy disks for reconciliation with the card boxes and trays themselves.

GENERAL ANNOUNCEMENTS: Barnhart reports that Bill Lonc of **St. Mary's University** in Nova Scotia has a senior Physics student interested in an internship at the Big Ear this summer before he reports to graduate school. He also reminded everyone of the **Big Ear Open House** scheduled for **Saturday, May 14th**. A private tour may be arranged for participants in the annual **MARCON** which happens to be scheduled the same weekend.

The meeting adjourned at 12:10 pm.

(3) ED. NOTES:

(1). The **Dayton Hamfest** will be held on April 29th, 30th, and May 1st. Hope to see many of you there!

(2). Our (now) annual **Big Ear Open House** is scheduled for May 14th. We will need **a lot** of volunteer help, in the way of shuttling groups, parking, giving tours, etc. **If you can help, please let us know!** If you haven't visited the site in a while, come on down! You'll be surprised at the changes that have taken place! Tell your friends! Tell your relatives! Tell your neighbors! Tell your co-workers! Tell everyone!

(3). There will be a partial annular eclipse of the sun as seen from Columbus, Oh, on May 10, 1994, starting at about 11:30am local time. Maximum eclipse will occur at about 1:12pm, and the eclipse will end at about 3pm. This is Saros # 128; the sun/moon ratio is ~94%; and the magnitude = 0.931.

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