

GONG Newsletter

Number 24

The Global Oscillation Network Group

August, 1994

Well, we finally did it! On June 2, Ray Lindsey of Australian Asset Services had the singular honor of breaking ground (actually sand) at the Learmonth site, and just a month later Michael Akau on Mauna Loa undertook the rearrangement of the top of the volcano to better accommodate GONG's presence there. The Project's deployment teams have been staffed, and the Data Storage and Distribution System has completed its development phase. Access to cargo ships has even become a factor in the granularity of the deployment. The end game has truly begun!

We enjoyed a very successful annual meeting in Los Angeles with 145 participants and a well attended workshop in Sydney, Australia to encourage helioseismology research in our host nation.

With less than a year to go before the full network is up and running, we are warming up definition of the scientific programs and the first listing appears on page 12. We are experimenting with tools to assure the timely communication of the status of the various scientific investigations, in order to implement the publication and data policy, and we have implemented a breadboard World Wide Web server - described on page 8 - to explore its usefulness for this application. In addition, we are developing the capability of submitting membership and program forms via the www, and other more interactive functions are likely to arise. David Hathaway and John Beck have submitted papers using GONG data for the Project's technical review, and they are included in the listing on page 17, as well as being available electronically via the www server. Christensen-Dalsgaard Jørgen has made his eigenvalue code and solar models available for community use through *GONG*, and the Inversions Team is working furiously to help us develop new mechanisms for encouraging collective exploitation of the data.

Finally, we are working with the *NSF* to encourage the establishment of a program to support research in helioseismology to capitalize on the investment in acquiring the *GONG* data, and we are hopeful that it can be in place by early next Spring when the *GONG* data will begin to flow. We really are in the home stretch!!

John Leibacher

Sites

We are continuing to press forward on the preparation of all six sites. If all goes well, much of the site work will be performed with funds committed during the current fiscal year so that the sites will be ready for deployment of the *GONG* instruments beginning this Winter. The sites are currently in various stages of readiness, with Learmonth, Australia, and El Teide in the Canary Islands leading the charge.

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The first official ground breaking for GONG took place during the third week in June at the IPS Radio and Space Services' Learmonth Solar Observatory. John Leibacher, Jim Kennedy, and Frank Hill were in attendance representing the Project - see the photographs on page 3. The neck of a champagne bottle was lopped off with the blade of a shovel and work was allowed to "officially" get under way. Since then, Asset Services has proceeded with the grading of the site and the foundation excavations. Arden Project's Petri. the mechanical designer, has traveled to the site to perform the tasks of the Project's "Advance Team", the first of three teams involved in the deployment of our instruments. He witnessed the concrete pour, and supervised the placement of the critical instrument mounting fixtures. If the contractor remains on schedule, this site will be ready to receive an instrument in September, well in advance of the February target date.

The first site to receive a station (excluding Tucson, of course) will actually be El Teide in the Canary Islands. That site will also be ready well in advance of the arrival of the station, slated for December. The permitting and licensing process is now well in hand, and we expect to be able to select a contractor by the end of August, or early September. The current schedule predicts that our Advance Team will be visiting the Canaries in the latter part of September, and site preparation will be complete by mid-October.

Jim Kennedy visited Mauna Loa in mid-July to oversee the "leveling of the lava" at and around the *GONG* site. With sleet and rain spinning off of a hurricane hovering less than two hundred miles away, he witnessed a classic "cut-and-fill" job as the machinery prepared the site in conjunction with the land preparation for *NOAA*'s new *LIDAR* facility, and again we have the photo on page 4 to show it.

The Project has obtained the services of an engineering firm to help us prepare the bid packages for site preparation at Big Bear Lake. Core samples have already been obtained along the causeway to allow a detailed specification for the dredge-and-fill operation required to make a pad for the instrument. Things are also proceeding smoothly on the permitting front, although one critical permit application cannot be submitted until the preliminary engineering study has been completed, and drawings prepared. Nevertheless, it now appears unlikely that these obstacles will keep us from beginning work this Fall.

In India we have now established that the Udaipur Solar Observatory itself will be our general contractor. Work on their new campus on which our instrument will be located is now under way and progressing well. A package of updated prints was recently released to them to facilitate their planning.

In Chile, our colleagues at *CTIO* are in the process of putting together detailed cost estimates for our site preparations. Here again, the observatory staff will provide us with general contracting services. Since *NSO* and *CTIO* are part of the same observatory system, the act of "letting the contract" is here just a relatively simple transfer of funds within the organization.

The GONG Project was pleased to host Cristina Soares, from the IAC in Tenerife, as the most recent GONG scientific site visitor. Cristina spent three months with us in Tucson, and reduced a set of Taiwanese Oscillation Network (TON) data. The Project is very happy to congratulate Jesús Patrón on the completion of his thesis entitled "Tridimensional Distribution of Horizontal Velocity Flows under the Solar Surface". Jesús has returned to Tenerife and will defend his work in September.

fim Kennedy and Frank Hill

Calendar		
Event	Date	Location and Contact
VI th Canary Islands Winter School The Structure of the Sun	December 5 - 16, 1994	Tenerife (Teo Roca-Cortés)
Astrophysical Applications of Stellar Pulsation	February 6 - 10, 1995	Cape Town (Don Kurtz)
4 th SOHO Workshop Helioseismology	April 2 - 6, 1995	Monterey(California) (Todd Hoeksema)
GONG First Results Symposium	April, 1996	Tucson (John Leibacher)

Instrument

Supplementary help from three additional instrument makers, and continuing overtime from project staff, has just about put our mechanical production effort over the top. During the last three months we benefited from help from Duane Miller, Martin Robertson, and Russ Cole. This has allowed us to complete all of the remaining camera rotator parts, and to complete the assembly of all of the light-feed turrets as well as three of the six remaining production Lyot/ Michelson ovens. Once certification of the ovens and light-feed turrets has been completed, we will have enough of the major mechanical instrument elements to start bringing up the Doppler analyzers in the first three shelters. This allows us to commence end-to-end tests of the Doppler imagers as soon as electronic systems are available. Camera rotators are currently being assembled, and instrument cover parts are still in production; these items will be added to the systems as they become available during the course of testing.

The electronics group has now finished building and checking out the cables in the field shelters. With that huge task behind us, our efforts are now concentrated on component and systems certification. All of the production data-system boards have been certified and are being installed in their chassis for system tests. The balance of the instrument-control boards are at various stages in the production process. At the time of this writing, the last four boards are about to be released for full production. Populated and tested versions of these last boards should be available to us by mid August when testing of the first three integrated systems is scheduled to get under way.

In the last Newsletter we noted that we had experienced an "anomalously



low yield" in our production dual memory boards. At that time, we had reason to believe that the problem was likely bad components rather than any sort of fundamental board-manufacturing problem. In the end our worst fears were realized when we discovered serious flaws in the production boards. After considerable consultation with the vendor, and eventually a plant visit, we were able to identify the problem and have 50 more memory boards made quickly. We are pleased (and relieved) to report that the new lot has recently arrived and all of the boards passed the certification tests.

The two real-time programmers assigned to the instrument group have basically completed the data acquisition software. This code is now under strict configuration control; the majority of changes being made are bug fixes, or relate to minor items such as the comment fields of the data headerblock parameters. This has provided a

The Mauna Loa site as we level the lava.

"resource wedge" for the component certification activities discussed above. With the help of Jean Goodrich, on temporary loan to us from the *DMAC*, certification code has been written to test all of the electronic boards which are directly accessible via the *VME* bus.

We have also made a start on the development of the instrument's user interface. Shane Walker, a student at the University of Arizona, has been hired to help us implement the graphical user interface for the instrument control software. This interface will be the "window on the GONG instrument" for our hosts at the field sites. allowing the status of the instrument and data systems to be evaluated at a glance. The display will also show the most recent intensity and magnetogram image, a running "strip chart" of the mean velocity signal, and log message window. A second "strip chart" window can be opened on demand to display selected instrumental parameters as a function of time. An IRAF window will also be available for other custom reductions and displays, such as velocity and modulation images. Good progress has been made on this work, and we hope to run a beta-test version in early August.

On the optics front, assembly of Lyot Filters has resumed. Two units are already available (one of which is in service at the prototype), and Jack Harvey and Roberta Toussaint are committed to having three more assemblies finished and tuned by mid August when field integration begins. The last looming concern with optics is the 4.5-Å interference prefilters: we have still only received two of the ion-assisted filters from the vendor. Another production run is in progress, but attempts to move the passband during annealing destroyed one filter and caused uniformity problems in another. We are continuing to work closely with the vendor. Our backup plan calls for going into integration with conventional (temperature sensitive) interference filters.

Much of the month of June, as well as the first few days of July, was taken up with an extended observing run at the prototype [See the box on page 11]. Typically the prototype instrument's time has been divided between software development and engineering checkout, punctuated every ten days to two weeks by a four-day observing run. With development winding down, and with the long, clear spring days in Tucson during June, we suspended that schedule and let the instrument run. As the accompanying chart shows the run lasted 24 days, 11 June through 4 July. Of these, we were able to obtain data worth reducing on 20 days. We had two days of instrumental down time. The first of these was due to a software problem: eleven days into the run, the instrument was no longer able to acquire the Sun without manual intervention. This was traced to an error in the time used to make ephemeris calculations. An inaccurate clock was inadvertently being read, rather than the precision GPS-derived time that provides the time base for the rest of the instrument. The second day of down-time was self-inflicted: we chose to use a clear day to reinstall and align the magnetogram modulator and associated electronics, which had been unavailable when the run began.

Rob Hubbard and Jack Harvey

Data System

The baseline pipeline algorithm development phase of the Project is drawing to a close as the deployment nears. The big merging test is still underway; as of mid-August all of the images from the first realization of 108 artificial site days had been processed to time series, leaving the actual merging to be done. Work also continues on the subtle issue of calibrating the modulation transfer function to degree ℓ .

The last major algorithm task is the installation of an *a*-coefficient expansion into the determination of the frequencies in some regions of the spectrum. This matter was discussed in LA, where it was decided that it was pointless to attempt to fit every peak in the region of the spectrum where the modes are essentially local rather than global. Current observations indicate that this transition takes place around l = 190, so the current plan is to fit every peak below that point, and to fit *a*-coefficients to entire ridges above.

Spatial aliasing is visible at $300 \le l \le 350$, the upper range of the degrees for which the *GONG DMAC* will routinely produce power spectra.

The *GONG* instrument's clean *l* response (spatial Nyquist frequency) is about 350 under the sharpest focus conditions. Spurious responses above 350 are therefore not surprising nor a problem. However, the aliasing at lower *l* values is a significant, anticipated problem. The design of the instrument allows the response to high-*l* features to be reduced by a combination of spherical aberration and defocus.

In order to reduce the effects of the aliasing (but at the expense of attenuating the power in the affected degrees), the *GONG* instrument will probably be defocussed by a small amount.

There will be a region of overlap in which both methods are used. In addition, year-long time series and power spectra will be produced for modes with $\ell < 20$, where the lifetimes are long.

As the baseline development work winds down, resources will become available to allow the Project to address issues that had to be skipped over to assure functionality of the minimum pipeline processing. Items include temporal filters, the lowfrequency analysis, spatial aliasing, non-spherical harmonic decomposition, and feature tracking. The choice of directions will be made with the input of the *DMAC* User's Committee (*DUC*).

The membership of the *DUC* changed at the LA meeting. Tuck Stebbins, Roger Ulrich, and Jørgen Christensen-Dalsgaard rotated off the committee as their two-year terms ended. They provided an invaluable service to the Project. Tuck is especially to be commended for his yeoman work as the Chair of the *DUC*, and he was awarded one of the coveted Hero Of *GONG* (*HOG*) awards in LA. Stepping into Tuck's shoes is Dave Hathaway, who has agreed to chair the *DUC* for the next 2 years. Also joining for two-year terms are Sylvain Korzennik, and Mike Thompson. Tim Brown and Todd Hoeksema will continue for the last year of their three-year terms. The *DUC* met again on July 26 in Boulder, in conjunction with a mini-workshop on inversions.

Last fall, the Data Storage and Distribution System (DSDS) embarked on a major project to upgrade its computer systems and software. This effort was completed as planned in June. The DSDS now consists of two SUN SPARC10's running Solaris 2.3 using Oracle's database management system with a new design for the file catalog. The users' machine was upgraded to a DECstation5000. The number of possible simultaneous users has been increased from two to eight. The anonymous 'ftp' disk area and space available for network distributions of data products was also increased significantly. The database on the SPARC10's that supports the cartridge volume and file catalogs was converted from Ingres to Oracle. The redesign of the file catalog provided a significant increase in performance beyond that derived from the workstation upgrade.

At this point the *DSDS* is operational. Future *DSDS* software activities will be maintenance and enhancements. One of these enhancements will provide a mechanism for reporting the errors that may occur when the data products are produced, communicating this information to the scientific community, and providing a systematic solution for managing the reprocessing that will replace the affected data products.

The project anticipates that during the next year as the community increases its use of the *DSDS* for obtaining data products additional enhancements and modifications may be required.

During the previous quarter, the *DMAC* calibrated and produced siteday ℓ -v spectra and 4-minute averages for 13 prototype data days: March 29,

This *m*-v diagram, for l = 300, demonstrates the spatial aliasing that is present in the *GONG* data resulting from the undersampling of the high-degree modes by the 8-arcsec pixels of the instrument. The spatially aliased (strongly curved) ridges can be seen superimposed on the unaliased (nearly straight) ridges. The visibility of the aliased ridges can be enhanced by tilting the page and sighting along the straight ridges.

The instrument was set to sharpest focus during this observation. The unwanted aliases can be greatly reduced with only a small reduction of the response to the desired signals by defocussing the image. Some of the aliasing may be due to the use of non-optimum remapping interpolation. The best tradeoff between defocus and alias reduction is under study.

April 24, 30, May 27, 31, and June 11-16, 18, 22. In addition, there are eleven days of raw data beginning on June 23 that are currently being reduced. The interval from June 11 through July 4 was a continuous observing run during which the prototype operated routinely. It was cloudy from June 17 through June 21; however, raw data was recorded each day. Also during the quarter, the Field Tape Reader processed nine raw data cartridges from the prototype instrument that contained 37 site-days. The offsite copy and storage facility copied

ten cartridges containing data products.

The *GONG* Project now has a Mosaic/World-Wide-Web home page including links to sample images, documentation regarding *GONG* membership, and general information about the project. There is a box on page 8 with the electronic access details along with the usual notice about the anonymous 'ftp' area on page 7.

The development of the data reduction pipeline is proceeding. Those involved spend their time writing software, reducing data, and diagnosing various problems which range from software bugs through functional problems with the reduction algorithms to problems with the raw data.

To explore the spatial frequency range of the instrument, an ℓ -v spectrum to $\ell_{max} = 500$ was produced. It is shown on page 5. Two features are clearly evident: the ridges are visible well beyond the nominal range used by the project ($\ell_{max} = 250$) and spatial aliasing can be seen beginning at $\ell = 250$. (The first traces of spatial aliasing can be seen at $\ell = 200$ with a very sensitive examination of the spectra.) This is also quite apparent on the m - v spectrum [Shown on this page].

The Project also made some progress in understanding the low-l noise in the l-v spectra. It was discovered that at least for $\ell = 0$, the noise could be suppressed by discarding mode coefficient time samples whose magnitude was greater than 3.5 times the 'rms' of the time series. Subsequent investigation revealed that most of the anomalous samples can be associated with guider faults (signals from the instrument that the guider was not functioning for some period of time during the one-minute recording interval). Combining anecdotal evidence from observers at the prototype site led to the conclusion that birds which seem to congregate in large numbers in the fields near the prototype cause most of the guider faults by occasionally flying between the Sun and the light feed. The guider trips when the intensity falls below a threshold. This was confirmed by a video tape of the signal sent to the video monitor in the prototype. This tape also included a remarkable series of frames showing part of an airplane as it approached the runway at a nearby airport.

The data reduction stage that will produce the site-day mode coefficients from the calibrated velocity images (the software is a *GRASP* package called *DNSPIPE*) and the status of the development of this reduction stage was discussed at the *DUC* meeting on July 26. While, the software is in good shape, there are several items

GONG's anonymous *FTP* disk area consists of 1.8 gigabytes of disk space that is installed on *helios.tuc.noao.edu* (140.252.8.105), the *DSDS* Users' Machine.

It is readable via *INTERNET* using *FTP* by an anonymous user.

To access the on-line storage area execute *ftp* at the command prompt with

host:	helios.tuc.noao.edu or 140.252.8.105
login:	anonymous
password:	<your address="" email=""></your>

followed by: cd pub/gong.

Access via *NSI-DECNET* is no longer supported, but *WWW* access (see the box on page 8) is now supported.

Questions should be addressed to Mark Trueblood.

that need to be resolved so that the baseline version of the reduction stage is completely defined.

In view of the large amount of work facing project personnel, that needs to be completed before the startup of network operations, and due to the press of higher priority items, the project decided against spending additional resources at this point to analyze the few remaining open items further, and we are proceeding as follows:

1) 2- or 21-point temporal filter? Cliff Toner's 21-point filter will be used.

2) 16- or 32-bit mode coefficient time series?

Mode coefficients will be converted to 16-bit integers using a fixed scale factor during the conversion to *FITS* prior to writing the mode coefficients to tape.

3) latitude or sin(latitude) gridding?

The velocity images will be registered using a sin(latitude) grid.

Frank Hill and Jim Pintar

DMAC Users Committee Meeting

The *DMAC* Users Committee, affectionately known as the *DUC*, met

at the Holiday Inn Crowne Plaza in downtown Los Angeles on Tuesday May 17, 1994 from 7:00 to 9:00 PM. In attendance were committee members Tuck Stebbins (Chair), Tim Brown, Jørgen Christensen-Dalsgaard, Todd Hoeksema, and Roger Ulrich, GONG representatives Ed Anderson, Frank Hill, Jim Kennedy, John Leibacher, Jim Pintar, Roberta Toussaint, Mark Trueblood, and Winifred Williams. and new committee members David Hathaway, Sylvain Korzennik, and Mike Thompson.

Tuck Stebbins opened the meeting by introducing the new members. David Hathaway will replace Tuck Stebbins as Chair, Sylvain Korzennik and Mike Thompson will replace retiring members Roger Ulrich and Jørgen Christensen-Dalsgaard. To date the *DUC* has issued 13 epistles. These have been published in the *GONG* Newsletter but the new members asked for copies for their own information and amusement.

Frank Hill presented the current baseline process for merging data from the different sites. (No merging will be done for the Nearly Steady Flows/Low Frequency image pipeline.) The Modulation Transfer Function (*MTF*) will be determined for images from each site and then used to correct the Spherical Harmonic Transform

(*SHT*) spectral coefficients. The *SHT*s from each site producing data will then be averaged together using the *MTF* for each site as a weighting function. The *MTF* calibration procedure is currently under refinement, and testing is planned using artificial data.

Jim Kennedy gave an update on the status of the project. The first field instrument will be the *BBSO* instrument which will be sited in Tucson by 1 October 1994. This will be followed by the Tenerife instrument on 1 February 1995 and the Learmonth instrument on 1 March 1995. Each instrument will be operated side-by-side with the *BBSO* instrument in Tucson for characterization before shipping.

Jim Pintar reported on the current status of the DMAC. The computer systems used by the Data Storage and Distribution System (DSDS) have been upgraded from DECstations running Ultrix to SPARC10s running Solaris/ Oracle. The DMAC expects to hire two more operators this Fall who will perform various tasks in the data reduction pipeline and DSDS. The DMAC has been routinely making back-up copies of the cartridges archived in the DSDS for about one year. Recently, the off-site storage facility (the collection of cartridges, cabinets, etc.) moved from a temporary location in the basement of the NOAO building to a permanent location in the Kitt Peak Vacuum Telescope. Other items included a GONG homepage for Mosaic via the internet and new data being obtained with the prototype instrument using a new and improved cube. Jim Pintar also commented on progress with the pipeline processing. He expects that by this Fall the project be able to run calibrations on one siteday per day, run temporal averages on five site-days per day, and merge one network-day per day. He assured the committee that he did not foresee any problems keeping up with the network data as it becomes available.

Much of the meeting was devoted to discussing "Data Events." These are events that indicate possible problems

GONG gets caught up in the Web

GONG is now serving Project information to the World Wide Web (*WWW*) via an Http server on the *DSDS* Users' Machine, helios.tuc.noao.edu (140.252.8.105). The *GONG* "Homepage" may be accessed through hyperlinks in the *NOAO* Homepage, the *NSO* Homepage, or directly at

http://helios.tuc.noao.edu/homepage.html

The *GONG* homepage provides links to introductory documents describing the instrument, *GONG* sites, the *DMAC*, and the *DSDS*. There are additional documents available containing up-to-date project status, meeting announcements, information on scientific programs and members of the *GONG* community, papers submitted for *GONG* review and access to documents in the *GONG* anonymous *FTP* archives.

Optimal access to the *GONG WWW* server is *via WWW* and *NCSA* Mosaic for users with X, however access through *Lynx* seems to work just fine for users without access to an imaging display. Browsers for Macintoshes and *PC*s are available from *NCSA* as well.

We welcome your comments and suggestions on how we can best utilize this nifty new tool. For more information or assistance, contact Jean Goodrich.

with the data. Two recent Data Events were associated with sign errors on the latitude at disk center, B_0 , and the position angle of the Sun's rotation axis, the P angle. As a result of these Data Events, prototype data that had passed through the SHT was corrupted. The committee decided that there could be three different kinds of Data Events: nasty ones, like these, which would require correcting the pipeline process and reprocessing previous data, bad ones which would require correcting the pipeline process but not reprocessing previous data, and minor ones that would be reported but not corrected.

Mark Trueblood presented a document that outlined how the project intends to treat Data Events. Prospective events would be reported to the *DMAC* Manager. The event would be investigated to determine its nature, its impact on the data, and possible corrective measures. When a Data Event is identified its description and diagnosis will be entered into the database, affected data products will be identified, reprocessing flags will be set if required, and data users will be notified. Notification will be by e-mail if possible or by snail-mail if necessary for all users who have requested tainted data. All users of the *DSDS* will be notified via the Message-Of-The-Day upon login.

The remainder of the meeting consisted of a discussion of testing procedures for the pipeline modules and possible end-to-end tests of the pipeline itself. The artificial data was identified as one source of testing material and comparison with other pipelines was also suggested. One procedure unique to *GONG* is the calibration procedure which will require its own validation techniques.

David Hathaway

Management

After initial indications that the total, current year budget for *GONG* might be as low as \$2.3M, the news just kept getting better and better. Although March brought us word that our "final" budget would be \$2.6M, our allocation was further increased to \$2.75M in May. Though less than the \$2.85 we had requested for FY94, this will allow us to pursue our site preparation activities aggressively while purchasing adequate computing power to support the three-station network we expect to have running as soon as March 1995.

This good budget news has also allowed us to move forward to fill two open positions presently on our books. We are currently recruiting a Senior Associate in Research to work closely with Jack Harvey with activities relating to assembling, testing, and evaluating the six field instruments, and performing quality assurance checks on the incoming data and diagnosing instrumental problems in the field during the operation of the network. The second position we hope to fill is that of an electrical engineer with a strong background in programming to assist with integration and deployment of the field instruments. This second position ultimately derives from the position vacated by our friend and colleague Warren Ball, whose untimely stroke deprived us of his skills and experience back in April 1993. Since then, we have been forced to keep these funds in reserve in the event that the worst budget predictions had been realized. The research associate job is currently posted and we are accepting applications.

With all of the usual budgetary caveats, the schedule for the deployment remains unchanged with the Big Bear instrument being brought on-line in Tucson early this Fall, and the Tenerife and Learmonth stations being shipped late this year, and becoming operational early in 1995. The Udaipur, Mauna Loa, and Cerro Tololo stations would be deployed during the Spring and finally the Big Bear would be relocated from Tucson to *BBSO*.

Rob Hubbard and Jim Kennedy

As we rapidly approach the beginning of network operations, scientific preparations are accelerating as well. The program for the *GONG '94* meeting presented starting on page 11 and the theses coming out recently are excellent indicators of the vigor of the community. The Inversions Team held a *real workshop* this Summer in Boulder, and they are agitating for new mechanisms to enhance their collective work.

The 1995 Annual GONG Meeting to be held in conjunction with the SOHO Workshop - will be organized around panels to be organized by the participants beforehand. We encourage you to use this opportunity to get together with those working on closely related problems to prepare your analysis of the first GONG results which will just be beginning to arrive at the time of the workshop. We are working on the possibility of a presentation of the first GONG results at the January 1996 meeting of American Astronomical Society in San Antonio. Texas and the GONG '95 meeting has to be the springboard for the collective work to make that possible.

To facilitate your participation in the analysis of the GONG data, we have made the description of the approved scientific programs available on the World Wide Web, where you can also fill in membership and scientific program forms. This rapidly developing tool provides very simple mechanisms for cross referencing investigations, data requests, and the various scientific programs being undertaken by an individual or group of investigators. This "mosaic" server will also provide up to the minute status of the project, and we are considering means of announcing data availability on this bulletin board as well. For those of you who still feel more comfortable

with a pen and paper, we are also enclosing current versions of those forms at the end of this newsletter.

We are really geting close now folks!

A Program for Analysis and Theory in Helioseismology

In early June, Jacques Beckers (NSO Director), Goetz Oertel (AURA President), Juri Toomre (GONG Scientific Advisory Committee chair), Jim Kennedy, and John Leibacher met with officials of the National Science Foundation to discuss means to achieve the optimal scientific return on the investment made in acquiring the GONG data. Senior representatives from Mathematics and Physical Sciences, Astronomy, Atmospheric Sciences, and International Programs participated in a lively two hour presentation of the need to have a program in place to provide support for timely and effective scientific analysis of the GONG data, and for development of

related theory. The final program should also include researchers in terrestrial seismology and mathematics, to encourage them to apply their methodologies to helioseismology.

The community must characterize the data promptly following the commencement of network operations, if we are to assure that the network data and its pipeline processing are achieving our objectives. We argued that what is needed is a multi-year program, at a level of 1.5 to 2 M\$ per year, with annual opportunities for new investigators to join in.

While we have no official word yet, the message was received with interest, and – bearing in mind the vagaries of future federal budgets – we believe that there is a real possibility of significant support, on a timescale that can make an immediate impact. We hope to have a program announcement in place very shortly for proposals to be submitted by the end of the year, so that selection and funding would be accomplished by next Spring, **so put on your proposal**

Countdown to First Light

First Field Station in Operational Test Pre-Deployment Review Tiede shipped	September 1994 October 1994 November 1994
Learmonth shipped	December 1995
Udaipur shipped	February 1995
Learmonth operational	March 1995
Mauna Loa shipped	April 1995
CTIO shipped	May 1995
Udaipur operational	May 1995
Mauna Loa operational	June 1995
Big Bear shipped	June 1995
CTIO operational	July 1995
Big Bear operational	July 1995

writing caps folks this could really happen and there will likely be only a relatively narrow window of opportunity.

In addition, our ideas on the desirability of an extended data acquisition run (beyond the baselined three years now that the solar cycle variation of the *p*-mode frequencies has been well established) were presented and well received. It is therefore essential that we pursue the initial data analysis as vigorously as humanly possible, to enable the *GONG* community to determine the scientific merit of extended operations and – if the outcome is indeed as we anticipate – to make the case for the extension in a timely manner.

Bibliography

It has been five years since the last *GONG* bibliography was released and the field has continued to expand *very rapidly*. We are in the process of working up our courage to put out a new version - this time with some help - and we would like to enlist general community support as well. In addition to a printed version, which necessarily remains frozen for some significant period of time, we are

The 4th SOHO Workshop: Helioseismology [a.k.a. *GONG*-95] 2-6 April, 1995

The *SOHO* workshops are intended to familiarize the scientific community with the specific scientific goals and unique capabilities of the Solar and Heliospheric Observatory (*SOHO*), a joint *ESA-NASA* mission scheduled for launch in July, 1995. An important goal of the workshops is to stimulate collaborations among experimenters, analysts, and theorists.

The 4th workshop, planned for 2-6 April, 1995, will focus on the planned scientific analyses and measured prelaunch performance of *SOHO*'s three helioseismology investigations: *VIRGO*, *GOLF*, and *SOI*; additionally, the workshop will serve as the 1995 *GONG* Meeting. The program will also feature a complement of review talks, status reports from other ground-based helioseismology networks, and poster presentations of the latest scientific results.

The meeting will be organized around a number of small working groups. These group sessions will focus on topics selected by the scientific organizing committee from proposals submitted by members of the scientific community. If you are interested in organizing a session (*e.g.* for one of the *GONG* teams), please contact the organizing committee no later than October 31, 1994.

The conference will take place at the Asilomar Conference Center situated beside the Pacific Ocean in Pacific Grove, California, about 175 km south of San Francisco. If you have not received an announcement by early September or would like more information, please contact:

Todd Hoeksema ERL 328 CSSA Stanford, CA 94305-4055 USA THoeksema@solar.stanford.edu proposing to maintain an online version which would be accessible via anonymous ftp and the *World Wide Web*. [For example, you can take a look at Jørgen Christensen-Dalsgaard's compendium on our *www* server under "What's New".] In addition to this semi-formatted version – our html is not very sophisticated with regard to the greek alphabet and symbols in general *yet* – we are considering having the bibliography available in *BibTeX* format or something relatively universal of that sort.

Jørgen has agreed to share his current general collection and help in keeping it up to date, Tim Brown has agree to co-edit the asteroseismology chapter, and Philip Stark the inversions chapter. Frank Hill – who prepared the most recent *GONG* bibliography – will participate as well.

We very much appreciate receiving from you: 1) a list of your own publications that might be appropriate for this collection, and 2) your thoughts on the following table of contexts. [We have had to limit the scope, to limit the size, and our thinking is to limit references to neutrino astrophysics, stellar structure and evolution, opacities, convection and magnetic fields to those aspects that directly impact - or are impacted by - helioseismology. Similarly for the mathematical tools.]

Reviews Conferences and Reports Texts Theses **Global Oscillations** Observations Theory Inversions Gravity Modes Magnetic Effects Atmospheric Oscillations Sound Wave Observations Sound Wave Theory Gravity Waves Magnetic Waves Internal Structure Neutrinos Opacities

Structure Evolution Rotation Mode/Wave Excitation and Damping Long Period Phenomena 160 minute oscillation **Diameter** oscillations Oblateness Convection Dynamos Rotation **Spectral Diagnostics** Tomography / Local Helioseismology Instrumentation **Observing Techniques Terrestrial Atmospheric Effects** Asteroseismology Ap Stars **DA/DB** Pulsators **Classical Pulsators** Mathematical Methods Inverse Theory Statistics / Parameter Estimation Time Series Analysis Power Spectra Numerical Methods

John Leibacher

HELIO- AND ASTERO-SEISMOLOGY FROM EARTH AND SPACE

This year's annual GONG Meeting - Helio- and Astero-Seismology from the Earth and Space: GONG '94 took place in Los Angeles May 16 -20, hosted by UCLA's Roger Ulrich and USC's Ed Rhodes and Werner Däppen. It was extremely well attended as the presentation and participants lists hopefully convey. The proceedings will be published by the Astronomical Society of the Pacific. The 145 participants had the opportunity to enjoy Mt. Wilson in the snow, after which Ed Rhodes was rumored to have expressed eagerness to host the annual meeting again sometime after 2014. One of the high points of the meeting was an impromptu, after dinner recollection of the discovery of the "fiveminute" oscillations by Bob Noyes,



and Franz-Ludwig Deubner's confession of how he first encountered this intriguing phenomenon. The participants all signed the very eye-catching poster which Scott Ulrich had designed for the meeting, and Arvind Bhatnagar later presented it to Robert Leighton, whose seredipitous discovery "enabled" the whole discipline of helioseismology.

GONG '94 Papers

SOLAR INTERIOR ROTATION

- E.N. Parker: The Solar Dynamo How can Helioseismology Improve Models?
- S. G. Korzennik: Determination of Solar Internal Rotation

Eric Fossat, Said Loudagh, Gabrielle Berthomieu, Janine Provost, and the IRIS Group: *Possibly Rapidly Rotating Core: IRIS Results*

- T. Toutain: Possible Rapidly Rotating Core, IPHIR Results
- Y. Elsworth, R. Howe, G.R. Issak, C.P. McLeod, B.A. Miller, S.J. Wheeler and R. New: *Rotational and Other Splitting of Low-l Solar p Modes*
- A. Eff-Darwich, F. Pérez Hernández,
 P. Pallé, T. Roca Cortés and H.B. Van der Raay: *Results from Mark-II* Spectrophotometer. Measuring Odd (l+m) Low Degree p-Modes
- Y. Elsworth, R. Howe, G.R. Issak, C.P. McLeod, B.A. Miller, S.J. Wheeler and R. New: Separation of Nearly Degenerate Low-& Solar p Modes
- D.O. Gough, A.G. Kosovichev and T. Toutain: Constraints on Oblique Rotation of the Solar Core from Low-Degree Modes
- T. Sekii, D.O. Gough and A.G. Kosovichev: *Inversions of BBSO Rotational Splitting Data*

- D.O. Gough and A.G. Kosovichev: Seismic Effects of the North-South Asymmetry of the Sun's Rotation
- T. Sekii: How Regularization Influences Rotation Inversions
- Jørgen Christensen-Dalsgaard, Rasmus Munk Larsen, Jesper Schou and Michael J. Thompson: *Optimally Localized Kernels for 2-D Helioseismic Inversion*
- V.A. Kotov, V.I. Haneychuk and T.T. Tsap: Summary of the Crimean 20-Year Observations of Solar Oscillations

SOLAR INTERIOR STRUCTURE

John Bahcall: Solar Neutrinos

- A.G. Kosovichev: Inversion Determination of Interior Structure
- W. A. Dziembowski, Philip R. Goode, A.A. Pamyatnykh and R. Sienkiewicz: *Seismic Solar Model*
- V.A. Baturin and S.V. Ajukov: Standard Solar Model: Effect of Opacity on Helium Content and the Specific Entropy in the Envelope
- M. J. P. F. G. Monteiro, J. Christensen-Dalsgaard and M. J. Thompson: *Helioseismic Constraints on Theories of Convection*

Sushant C. Tripathy and Jørgen Christensen-Dalsgaard: A Study of Solar Structure Based on Opacity Modifications

Jørgen Christensen-Dalsgaard and Johann Reiter: A Comparison of Precise Solar Models with Simplified Physics

Johann Reiter, Edward J. Rhodes, Jr., Werner Däppen and S.G. Korzennik: Applications of Massively-Parallel Computing in Solar Modeling

Jørgen Christensen-Dalsgaard and Michael J. Thompson: SOLA Inversions for the Radial Structure of the Sun

Sarbani Basu and Michael J. Thompson: On Constructing Seismic Models of the Sun's Radial Structure

Sarbani Basu, Jørgen Christensen-Dalsgaard, Fernando Péres Hernández and Michael J. Thompson: A Self-Consistent Approach to Filtering Out Near Surface Uncertainties from Helioseismic Inversions

- I. Lopes and S. Turck-Chièze: A Second Order Asymptotic Expression for the Solar and Stellar Low Degree Acoustic Mode Predictions
- H. M. Antia and S. M. Chitre: *Central Temperature of the Sun?*
- M. Gabriel: Influence of the Equation of State on the Solar p-Mode Spectrum

Approved GONG Scientific Programs

- 1 John Beck: *Magnetic Proxies*
- 2 Colin Rosenthal: The f Mode and the Solar Cycle
- 3 Kurt T. Bachmann: p-mode Frequency Variation during Solar Cycle
- 4 Matthew Penn: P-mode Interactions with Magnetic Fields
- 5 Jesper Schou: *Mode Parameters*
- 6 Jesper Schou: Rotation Inversions
- 7 Jørgen Christensen-Dalsgaard: Structure of the Solar Interior
- 8 Frank Hill: Convection Zone Flow Mapping via Ring Diagram Analysis
- 9 Frank Hill: Inversions of the Solar Internal Rotation Rate
- 10 Frank Hill: Search for g-Mode Sidebands in the p-Mode Spectrum
- 11 Maurice Gabriel: Internal Solar Models
- 12 Maurice Gabriel: Mode Excitation
- 13 Joyce Ann Guzik: Solar Interior and Evolution Modeling
- 14 R. Kariyappa: Heating of the Solar Chromosphere and Corona
- 15 V. A. Kotov: Long-period Oscillations of the Sun
- 16 Carl A. Rouse: Sensitivity Studies of Solar Models
- 17 Sydney D'Silva: Data-gap filling
- 18 David H. Hathaway: Nearly Steady Photospheric Flows
- 19 Shaohua Liu: Mode Physics
- 20 Sushanta Chandra Tripathy: Deterministic Detrending
- 21 Frank Hill: Power Spectrum of the Solar Magnetic Field
- 22 Frank Hill: Raw Data Reduction Algorithms
- 23 David B. Guenther: Structure of the Surface Layers of the Sun
- 24 Scott Evans: Supergranulation Influence on the Detection of g-Modes
- 25 Jørgen Christensen-Dalsgaard: Rotation of the Solar Interior
- 26 Jørgen Christensen-Dalsgaard: Convective Excitation of the Modes
- 27 Shaohua Liu: Reduction and Analysis Techniques
- 28 John Leibacher: Mode Parameters and Gap Filling
- 29 John Leibacher: Gravity Mode Signatures
- 30 Peter Wilson: The Internal Rotation Profile of the Sun
- 31 Peter Wilson: The evolution of the large-scale solar magnetic fields.
- 32 Douglas C. Braun: P-Mode Scattering from Sunspots & Subsurface Magnetic Fields
- 33 Robert Stein: Convection and P-Mode Oscillations
- 34 Eric Fossat: IRIS GONG Comparisons
- 35 Pierre Gouttebroze: Wave propagation above the photosphere
- 36 Philip B. Stark: New Methods for Inversion and Inference from GONG Data
- 37 John Harvey: Critical Assessment of Instrument Performance
- 38 S. M. Chitre: Inversions
- 39 H. M. Antia: Excitation mechanism for solar oscillations
- 40 D. Narasimha: Nearly steady flows and magnetic fields
- 41 Pierre Demarque: Rotation in the Solar Interior
- 42 Pierre Demarque: Structure of the Superadiabatic Layer in the Sun
- 43 J. Todd Hoeksema: Low Frequency Merging
- 44 J. Todd Hoeksema: Evolution of Photospheric and Coronal Magnetic Fields
- 45 J. Todd Hoeksema: Data Intercalibration
- 46 Gabrielle Berthomieu: Internal Structure of the Sun by Helioseismic Inversion
- 47 Janine Provost: Internal Rotation of the Sun by Helioseismic Inversion
- 48 Sylvain G. Korzennik: Determination of the Solar Internal Rotation
- 49 Sylvain G. Korzennik: Study of the Oscillations V-I Phase Relation
- 50 Sylvain G. Korzennik: Local Helioseismology: Time-Distance Analysis
- 51 Sylvain G. Korzennik: Local Helioseismology: Acoustic Power Deficit
- 52 Juri Toomre: Global shearing flows and jets within convection zone dynamics
- 53 Juri Toomre: Local-area analysis with ring diagrams of convective flows and structures
- 54 Michael J. Thompson: Global magnetic fields in the Sun's deep interior
- 55 Michael J. Thompson: Radial and latitudinal dependence of the Sun's internal rotation
- 56 Michael J. Thompson: Radial variation of the Sun's internal structure
- 57 Michael J. Thompson: Asymmetries of the Sun's internal structure
- 58 Robert W. Noyes: Solar Cycle-Scale Variations in Oscillation Properties

Julian Elliott: Seismological Constraints on the Truncation of the Internal Partition Function H. Dzitko and S. Turck-Chièze: On the Accuracy of the Screening Formalism in Solar and Main Sequence Star Conditions

- D.O. Gough, A.G. Kosovichev and T. Toutain: *Determination of Low-Degree Mode Frequencies and the Solar Core Structure*
- A.G. Kosovichev and E.A. Gavryuseva: *Prediction of g-Mode Frequencies*
- Arthur N. Cox and Joyce A. Guzik: Solar Mass Loss, Solar Lithium, Solar Oscillations
- V.A. Baturin and S.V. Vorontsov: Parameters of the Solar Convection Zone Estimated with the Phase-Shift Function
- Nicholas H. Brummell, Juri Toomre and Neal E. Hurlburt: *Convective Structures and Mean Flows in Turbulent Compressible Convection Constrained by Rotation*
- Keith Julien, Douglas Gough and Juri Toomre: Analysis of Phase Distortions in Two-Dimensional Wave Fields in Search of Localized Convective Structures
- Gary A. Glatzmaier and Juri Toomre: Global-Scale Solar Turbulent Convection and its Coupling to Rotation
- B. Chaboyer, P. Demarque, D.B. Guenther and M.H. Pinsonneault: *Rotationally Induced Mixing and Thermal Diffusion in the Sun: Combined Effects on Structure and Oscillation Frequencies*
- David H. Hathaway: Nearly Steady Flows in the GONG Prototype Data
- J. Patrón, F. Hill, E. J. Rhodes, JR. and S. G. Korzennik: *Ring Diagram Analysis* of Mt. Wilson Data: Velocity Fields within the Solar Convection Zone
- Jørgen Christensen-Dalsgaard, Jesper Schou, Michael J. Thompson and Juri Toomre: *Hunting for Azimuthal Jets and Shearing Flows in the Solar Convection Zone*
- K. Petrovay and M. Marik: *On the Existence of a Discontinuity at the Lower Boundary of the Solar Convective Zone*
- V.A. Kotov: A Cosmological Origin of the P_{o} Oscillation of the Sun

SOLAR ACTIVITY

- E.J. Rhodes, Jr.: Solar Cycle Dependencies of Frequencies and Amplitudes at High l
- P.L. Pallé: Solar Cycle Frequency Shifts at Low l
- Douglas C. Braun: Sunspot Seismology: New Observations and Prospects
- P.S. Cally, T.J. Bogdan and E.G. Zweibel: Umbral Oscillations in Sunspots: p-Mode Absorption and Active Region Heating by Mode Conversion

Newly Received or Updated GONG Memberships

- Manuel Alvarez H. M. Antia Kurt T. Bachmann John Beck Gabrielle Berthomieu Douglas C. Braun Debi Prasad Chaudhary S. M. Chitre Jørgen Christensen-Dalsgaard Sydney D'Silva Pierre Demarque Scott Evans Eric G. Fossat Peter A. Fox Chistopher Genovese Pierre Gouttebroze David B. Guenther Joyce Ann Guzik John Harvev David H. Hathaway
- Rony Keppens, Thomas J. Bogdan and Marcel Goossens: Multiple Scattering and Resonant Absorption of p modes by Fibril Sunspots
- Colin S. Rosenthal: *p-Mode Frequency* Shifts in Fibril Magnetic Fields
- K.T. Bachmann, T.L. Duvall, Jr., J.W. Harvey, and F. Hill: *Frequencies of High Degree Solar p-Mode Oscillations*
- Alan Johnston, B. Roberts and A.N. Wright: *High Frequency Waves* and Chromospheric Magnetism
- S.G. Korzennik, R.W. Noyes and V. Ziskin: Local Helioseismology: Analysis of Localized Time-Distance Diagrams from Quiet and Active Regions
- Frank Hill, Deborah Haber, Juri Toomre and Douglas Gough: *Ring Diagram Analysis of High-l Helioseismometer Oscillation Data*
- Sydney d'Silva: Acoustic Mode-Mixing in Sunspots
- Hiromoto Shibahashi and Yutaka Nishizawa: Implication of Long-Term Frequency Variation
- A. Jiménez, F. Pérez Hernández, A. Claret, P.L. Pallé, C. Régulo and T. Roca Cortés: *Does the Solar Core Rotation Change with the Activity Cycle?*
- P.L. Pallé, A. Jiménez, I. Martin, F. Pérez Hernández, C. Régulo, T. Roca Cortés and L. Sánchez: *The Observed Background Solar Velocity Spectrum over the Solar Activity Cycle*

Frank Hill J. Todd Hoeksema R. Kariyappa V. A. Kotov Sylvain Korzennik Shaohua Liu **Gabriel Maurice** Peter Milford D. Narasimha A. Satya Narayanan Matthew Penn Janine Provost Colin Rosenthal Carl A. Rouse Jesper Schou Philip Stark Robert F. Stein Michael J. Thompson Sushanta Chandra Tripathy Peter Wilson

- Ciro Marmolino, Maurizio Oliviero and Giuseppe Severino: *Flux and Velocity Fluctuations Produced by Solar Active Regions in the Na I D Lines*
- Timothy M. Brown: On the Suppression of p-Mode Surface Amplitudes in Magnetic Active Regions
- A.A. Ruzmaikin, A.C. Cadavid, G.A. Chapman, J.K. Lawrence and S.R. Walton: Singularity and Power Spectra of Small-Scale Solar Magnetic Fields
- John G. Beck, Roger K. Ulrich and Frank Hill: A Study of the Magnetic-Darkening Velocity Using GONG Modulation Images

MODE PHYSICS

- Peter Goldreich and Norman Murray: The Effects of Scattering on Solar Oscillations
- R.K. Ulrich: Energy Transport and Chromospheric Heating
- F.-L. Deubner: Atmospheric Waves
- T. Appourchaux, T. Toutain, D.O. Gough and A. Kosovichev: *Testing of the Statistical Significance of the Asymmetries of p-Mode Line Profiles: Application to the IPHIR Data*
- Y. Elsworth, R. Howe, G.R. Isaak, C.P. McLeod, B.A. Miller, S.J. Wheeler and R. New: *Statistical Distribution of Solar p-Mode Amplitudes*

- M.P. Rast and D.O. Gough: High–Frequency Oscillations of a Polytropic Layer
- Yuzef D. Zhugzhda and Michael Stix: Acoustic Waves in Structured Media and Helioseismology
- D.O. Gough: Asymptotic p-Mode Inertia
- S.C. Tripathy and Frank Hill: Detection of Chromospheric Oscillations in High-l Data
- Jürgen Staude, Yuzef D. Zhugzhda and Namig S. Dzhalilov: Radiation–Hydrodynamic Waves and Solar p Modes
- Jürgen Hofmann, Franz-Ludwig Deubner and Bernard Fleck: *He 10830 Confirms Non-Propagation Component of Chromospheric Oscillations*
- Zhengzhi Wang and R.K. Ulrich: Rediscussion of the Linearized Dispersion Relation for Atmospheric Waves Including Non-Stationary Solutions
- Zhengzhi Wang and R.K. Ulrich: Non-Linear Propagation of Acoustic Waves Near the Cut-Off Frequency
- L. Bertello and R.K. Ulrich: *The Heating* of the Solar Chromosphere and Corona by Non-Stationary Acoustic Waves

- R.K. Ulrich and L. Bertello: Measurements of the Energy Flux of Non-Stationary Acoustic Waves in the Solar Atmosphere
- R. T. Stebbins, T. R. Rimmele and P. R. Goode: *Photospheric Wave Behavior*
- Hiromoto Shibahashi and Yutaka Nishizawa: Asymptotic Inversion of the Solar Oscillation Frequencies: Cut-off Frequency of the Outer Reflecting Region
- I.W. Roxburgh and S.V. Vorontsov: Synthetic p-Mode Power Spectra with an Elementary Excitation Source

ASTROPHYSICAL APPLICATIONS OF STELLAR PULSATION

Cape Town, 6 - 10 February 1995

Stellar pulsation is of fundamental importance to our understanding of the internal structure and atmospheres of stars and forms one of the cornerstones in the distance scale of the universe. This is one of a series of ongoing conferences in this topic and the first in the Southern Hemisphere. This conference promises to be especially interesting because of several recent advances in the field.

The recent revision of opacities and other atomic data has completely changed our understanding of the nature of many pulsating stars and has greatly improved the diagnostic power of stellar pulsation. This became evident at the last pulsation meeting (Victoria, 1992) in which early successes in resolving longstanding problems were presented. The wider implications of the revised opacities are now even more apparent. Several reviews will explore these advances in the context of stellar evolution and the properties of several types of pulsating stars.

Another area of rapid progress is the modelling of atmospheres in pulsating stars. This is a key step to our understanding of mass loss in these stars and the chemical enrichment of the interstellar medium.

Photometric techniques, especially *CCD* photometry, have advanced to a stage which permits detailed studies of star clusters in the Magellanic Clouds, identification of variables in increasingly more distant galaxies and the search for pulsating stars with very low amplitudes in galactic clusters. Recent detections of large numbers of pulsation modes in white dwarfs, roAp, Delta Scuti and slowly-pulsating B stars have greatly increased the potential for using the pulsations as a probe of the internal structure of these stars.

Finally, a variety of ground-based and spacecraft facilities such as *HIPPARCOS*, the Sydney University Stellar Interferometer and the *MACHO* project (to name only a few) are poised to provide new insights into the properties and processes in pulsating stars.

The conference will consist of a series of invited talks of 35-min duration followed by a 15-min discussion period. Poster papers are strongly encouraged; provision will be made for displaying these in a comfortable setting and adequate time will be made available for viewing them. The *SOC* is still considering the possibility of inviting a few oral presentations which are particularly relevant to the topic of the meeting, and which complement the invited reviews. This matter will be finalized in the coming months. The invited reviews, discussion and summaries of the poster papers will be included in the Proceedings. A preliminary list of invited speakers includes:

	A. Maeder (Switzerland)	Population I Stellar Structure and Evolution		
	C. Waelkens (Belgium)	Observations of Stellar Pulsation and Evolution		
	A. Gautschy (Germany)	New Developments in Pulsation Theory		
	P. Moskalik (Poland)	New Results on Pulsating OB Stars		
	D. Kurtz (South Africa)	Pulsating Ap Stars		
	M. Breger (Austria)	Asteroseismology of Delta Scuti Stars		
	R. Gilliland (USA)	Helioseismology		
	S. Kawaler (USA)	Pulsation and Evolution in Degenerate Stars		
	P. Wood (Australia)	Theory of Miras and OH-IR Stars		
	J. Chapman (Australia)	Observations of Miras and OH-IR Stars		
	P. Cottrell (New Zealand)	Yellow Supergiants and RCB Stars		
	P. Whitelock (South Africa)	Cool Stars and Galactic Structure		
	D. Fernie (Canada)	Cepheids, Related Stars, and Galactic Structure		
	C. Chiosi (Italy)	Population II Stellar Structure and Evolution		
	A. Walker (Chile)	The Population II Distance Scale		
	D. Welch (Canada)	Pulsating Stars in the Magellanic Clouds		
	J. Baldwin (UK)	Interferometry of Cool Pulsating Stars		
	R. Shobbrook (Australia)	The Sydney University Stellar Interferometer		
	C. Turon (France)	HIPPARCOS Data on Pulsating Stars		
	K. Cook (USA)	The MACHO Project and Pulsating Stars		

For further information, e-mail ${\tt pulsation@saao.ac.za}$

- Bradley W. Hindeman and Ellen G. Zweibel: *The Effects of a Hot Outer Atmosphere on Acoustic-Gravity Waves*
- I.W. Roxburgh and S.V. Vorontsov: Quasi-Asymptotic Description of Adiabatic Acoustic Oscillations
- D.O. Gough and T. Sekii: Asymptotic Signatures of Jovian Discontinuities

EXPERIMENTS

John Leibacher: The Global Oscillation Network Group Project

E. Fossat: IRIS

Y. Elsworth, R. Howe, G.R. Issak, C.P. McLeod, B.A. Miller, S.J. Wheeler and R. New: *Performance of the BISON Newtork 1981-Present*

Phil Scherrer: MDI/SOI

- Alan Gabriel: GOLF
- T. Appourchaux and C. Frölich: VIRGO the Solar Monitor Experiment on SOHO
- A. Jones: STARS Seismic Telescope for Astrophysical Research from Space
- J. Harvey and GONG Instrument Team: The GONG Instrument Michelson Interferometers
- Yuzef D. Zhugzhda, V.N. Oraevsky, N.I. Lebedev, I.M. Kopeav, R.I. Kostyk, I.G. Keselman and S.N. Osipov: *The Space Helioseismology Experiment DIFOS*
- Steven Tomczyk: Spatially Resolved Observations of Low-Degree Solar Oscillations
- Jesper Schou and Steven Tomczyk: Preliminary Results from Observations with the LOWL Instrument
- J.A. Fussell, R.I. Brazier, A.R. Davies, C.P. McCleod, S.C. Morgan-Vandome, G.R. Isaak, C.C. Speake: *Observations* of Global Solar Oscillations in Moonlight
- P.H. Scherrer, R. Bogart, R. Bush,
 J.T. Hoeksema, P. Milford, T. Pope,
 W. Rosenberg, L. Springer, T. Tarbell,
 A. Title, J. Wolfson and I. Zayer: *Status* of the Solar Oscillations Investigation–Michelson Doppler Imager
- I. Zayer, R.S. Bogart, J.T. Hoeksema, P. Milford, P.H. Scherrer, J. Schou, W. Rosenberg, T. Tarbell, A. Title and J. Wolfson: *SOI-MDI Performance Characteristics*

DATA ANALYSIS TECHNIQUES

- Philip B. Stark: Alternative Methods for Analyzing Normal Mode Splitting Data
- Frank Hill: Local Helioseismology via Ring Diagrams and Trumpet Surfaces
- Thomas L. Duvall Jr.: *Time-Distance Helioseismology*
- T. Appourchaux and T. Toutain: *Maximum Likelihood Estimators for Helioseismology*
- V.N. Strakhov, S.V. Vorontsov and T.Sekii: Linear Inversions in Helioseismology: Testing New Regularization Techniques for Solving Large Systems of Linear Algebraic Equations
- Alain Pantel and Eric Fossat: IRIS Data Merging and Deconvolution
- W.E. Williams, C. Toner and F. Hill: *Tests* of a GONG Merging Algorithm Based on the Modulation Transfer Function
- Peter Milford and Rakesh Nigam: Search for Sources of Acoustic Power Using Wavelet Analysis
- Phillipe Delache and the IRIS Collaboration: Are There ''Natural'' Wavelets in Solar Five-Minute Oscillations ?
- H.-Y. Chang and D.O. Gough: Measuring Solar Frequency Variation
- Yuzef D. Zhugzhda: Analysis of Gapped Time Series by a Nonuniform Transformation of Time
- Bo N. Andersen, Alfred Hanssen, Torben Leifsen and Thierry Toutain: *Wavelet Analysis of IPHIR Data*
- E. Gavryuseva and V. Gavryusev: Direct Way to Determine Solar p-Mode Line Structure
- Jesper Schou, Jørgen Christensen-Dalsgaard and Michael J. Thompson: On the Adequacy of a Coefficients for 2-D Inversions, and other Time-Series Analysis Questions
- R. Toussaint, J. Harvey and R. Hubbard: GONG Calibration Procedure
- C.G. Toner, S.M. Jefferies and T.L. Duvall, Jr.: *Restoration of Full-Disk Solar Images*
- L.V. Didkovski, O.A. Andreeva, P.I. Borzyak, A.I. Dolgushin, E.J. Rhodes, Jr., N.M. Johnson, P. Rose and S.G. Korzennik: Compensation of Large-Area Non-Linearities in Solar Velocity Maps Obtained with a Sodium Magneto-Optical Filter

- R.K. Ulrich and S.E. Evans: Preliminary Results from a New Multi-Channel Spectroscopic Analyzer at the Mt. Wilson 150-Foot Tower
- C.J. Henney and R.K. Ulrich: Determination of Roll Angle from Magnetic Field Cross-Correlation

ASTEROSEISMOLOGY

- Ronald L. Gilliland: Photometric Seismometers for Asteroseismology
- E. J. Kennelly: Spectroscopic Methods for Seismic Investigation
- Wojciech A. Dziembowski: The Opacity Driven Pulsators
- Michel Breger: Delta Scuti Stars
- Don W. Kurtz: The roAp Stars
- Hiromoto Shibahashi: What's New in the Theory of Stellar Nonradial Oscillations
- T. Roca Cortés, Ph. Delache and the ANTENA Team: A New Technology Network for Asteroseismology
- Rainer Kuschnig, Werner W. Weiss, Pierre Y. Bely, and Helmut Jenkner: Asteroseismology from Hubble Space Telescope Fine Guidance Sensor Data
- Peter Milford, Tim Brown, Ron Gilliland and William Borucki: Asteroseismology with FRESIP, a Proposed 1 Meter Space Telescope for Planetary Detection
- Peter Milford: Defense Conversion: Asteroseismology from a 4-Meter BMDO Space Telescope
- Michal L. Peri and Ken G. Libbrecht: Doppler Seismology of η Cas with the Palomar 200'' Echelle Spectrograph
- Günter Houdek, Jadzia Rogl, Neil J. Balmforth and Jørgen Christensen-Dalsgaard: *Excitation of Oscillations in Main-Sequence Stars*
- Nathalie Audard and Janine Provost: Seismology of Intermediate-Mass Stars in the Presence of Convective Overshooting
- Sarbani Basu and H.M. Antia: Helioseismic Test of Stellar Convection Theories
- Noel Dolez, Gary A. Glatzmaier and Juri Toomre: Spherical Core Convection in Rotating A-Type Stars

GONG '94 Participants

Manuel Alvarez, Institute of Astronomy, Ensenada

Ed Anderson, NSO/GONG

Thierry Appourchaux, ESTEC/ESA **GONG Special Reports** Nathalie Audard, Observatoire de la Côte d'Azur #1 - Proposal, September 30, 1984 #2 - A Selected Bibliography on Helioseismology, April 11, 1985 Kurt Bachmann, NSO #3 - The GONG Site Survey Instrument, March 6, 1987 John N. Bahcall, Princeton University #4 - The CfA Inversion Workshop, April 10, 1987 Sarbani Basu, Queen Mary and Westfield #5 - The 1987 Artificial Data Workshop, October 21-23, 1987 College #6 - A Selected Bibliography on Helio -and Asteroseismology, March 15, 1989 #7 - Prototype Design Review, February 21-23, 1990 Frederic Baudin, Institut d'Astrophysique #8 - Program Review, March 8-9, 1990 Spatiale #9 - 1991 Annual GONG Meeting Abstracts, April 15-17, 1991 John Beck, NSO/GONG & UCLA #10 - 1993 Annual GONG Meeting Abstracts, April 19-21, 1993 Thomas Berger, Stanford University #11 - Inversion Team Report on the 2-D Hare-and-Hound Exercise, November 1993 #12 - Helio -and Astero-Seismology from Earth and Space Abstracts, May 16-20, 1994 Luca Bertello, UCLA #13 - U. S. - Australian Joint Workshop, June 27 - July 1, 1994 Gabrielle Berthomieu, Observatoire de la Côte d'Azur Here is a listing of a number of the more formal reports put out over the years. Arvind Bhatnagar, Udaipur Solar Yvonne Elsworth, University of George R. Isaak, University of Birmingham Observatory Birmingham Joseph Iwanski, University of Colorado Richard Bogart, Stanford University Scott Evans, UCLA Stuart Jefferies, Bartol Research Institute Tom Bogdan, High Altitude Observatory Eric Fossat, Université de Nice Natasha Johnson, USC Department of Douglas Braun, National Solar John Fussell, University of Birmingham Physics & Astronomy Observatory Alan Gabriel, Institut d'Astrophysique Andrew Jones, Bartol Research Institute Michel Breger, University of Vienna Spatiale Mario Jono Monteiro, Queen Mary & Timothy Brown, HAO/NCAR Maurice Gabriel, Université de Liege Westfield College Jo Bruls, Big Bear Solar Observatory Elena Gavryuseva, Arcetri Astrophysical Keith Julien, University of Colorado J. Robert Buchler, University of Florida Observatory Wolfgang Kalkofen, NASA/HQ Jørgen Christensen-Dalsgaard, Aarhus Christopher Genovese, University of Jim Kennedy, NSO/GONG University California, Berkeley Edward Kennelly, University of British Alessandro Cacciani, Universita degli Studi Grec Gerard. Université de Nice Columbia di Roma Mark Giampapa, National Solar Rony Keppens, High Altitude Observatory Heon-Young Chang, University of Observatory Cambridge Vasili Khaneichuk, Crimean Astrophysical Ronald Gilliland, Space Telescope Science Shashikumar Chitre, Tata Institute of Observatory Institute Fundamental Research Sylvain Korzennik, Harvard Smithsonian Peter Goldreich, Caltech Observatory Yung-Ping Chou, National Tsing Hua Philip Goode, NJIT University Alexander Kosovichev, University of Douglas Gough, University of Cambridge Cambridge Oleg Chumak, V. G. Fesenkov Astrophysical Institute Mike Gruntman, USC Space Science Valery Kotov, Crimean Astrophysical Center **Observatory** David Cline, UCLA Yeming Gu, National Solar Obsevatory Don Kurtz, Cape Town University Sydney D'Silva, NSO Deborah Haber, University of Colorado Eugene Lavely, University of Colorado Werner Däppen, University of Southern California Jack Harvey, NSO John Leibacher, NSO Philippe Delache, Observatoire de la Côte David Hathaway, NASA/MSFC Torben Leifsen, University of Oslo d'Azur Carl Henney, UCLA Ken Libbrecht, Big Bear Solar Franz Deubner, AIW Würzburg Observatory Frank Hill. NSO Leonid Didkovskii, Crimean Astrophysical Guenter Lustig, Institut für Astronomie, Bradley Hindman, JILA/University of Observatory Graz. Colorado Thomas L. Duvall Jr., NASA/GSFC Peter Milford, Stanford University Todd Hoeksema, Stanford University Wojciech Dziembowski, Copernicus Romas Mitalas, University of Western Jürgen Hofmann, Institut für Astronomie, Center Ontario Würzburg Herve Dzitko, CEA Saclay Roger New, Sheffield Hallam University Gunter Houdek, Technical University Antonio Manuel Eff-Darwich Pena, Robert Noyes, Harvard Smithsonian Vienna Instituto de Astrofisica de Canarias Center for Astrophysics Rachel Howe, University of Birmingham Julian Elliott, University of Cambridge Pere Pallé, Instituto de Astrofisica de Neal Hurlburt, Lockheed Canarias

Paper in Preparation

Mark Trueblood: "Storing and Distributing GONG Data",

to be presented at the Fourth Annual Conference on Astronomical Data Analysis Software and Systems to be held on Sept. 25-28 in Baltimore, Maryland, submitted to *GONG* on July 29, 1994

Papers Submitted for Project Review

David H. Hathaway: "Nearly Steady Flows in *GONG* Prototype Data" submitted for publication to *GONG '94*, submitted to *GONG* on August 1, 1994

John Beck: "A Study of the Magnetic-Darkening Velocity using GONG Modulation Images"

submitted for publication to GONG '94, submitted to GONG on August 10, 1994

Papers Submitted for Publication

Jack Harvey and the *GONG* Instrument Team: "The *GONG* Instrument Michelson Interferometer",

submitted for publication to GONG '94, submitted to GONG on July 26, 1994,

Roberta Toussaint: "GONG Calibration Procedure"

submitted for publication to GONG '94, submitted to GONG on July 26, 1994,

Winifred Williams, Cliff Toner, and Frank Hill: "Test of a Data Merging Algorithm based on the Modulation Transfer Function",

submitted for publication to GONG '94, submitted to GONG on July 20, 1994.

John Leibacher and the *GONG* Team: "The Global Oscillation Network Group Project"

submitted for publication to GONG '94, submitted to GONG on July 26, 1994

Papers Recently Published

- Hill, F., Fischer, G., Grier, J., Leibacher, J. W., Jones, H. P., Jones, P., Kupke, R., and Stebbins, R. T.: "The Global Oscillation Network Group Site Survey.
 I. Data Collection and Analysis Methods", *Solar Physics* **152**, 321 349
- Hill, F., Fischer, G., Forgach, S., Grier, J., Leibacher, J. W., Jones, H. P., Jones, P., Kupke, R., Stebbins, R. T., Clay, D. W., Ingram, R. E. L., Libbrecht, K. G., Zirin, H., Ulrich, R. K., Webster, L., Hieda, L. S., LaBonte, B. J., Lu, W. M. T., Sousa, E. M., Garcia, C. J., Yasukawa, E. A., Kennewell, J. A., Cole, D. G., Huang, Z., Su-Min, X., Bhatnagar, A., Ambastha, A., Al-Khashlan, A. S., Abdul-Samad, M. S., Benkhaldoun, Z., Kadiri, S., Sanchez, F., Pallé, P. L., Duhalde, O., Solis, H., Sàa, O., and Gonzalez, R.: "The Global Oscillation Network Group Site Survey. II. Results" *Solar Physics* 152, 351 - 379.

Daryl Parker, UCLA Eugene Parker, University of Chicago Jesús Patrón, NSO/SOI Michal Peri, Cal Tech Kristof Petrovay, *Eotvos University, Budapest* James Pintar, *NSOGONG* Gary H. Price, *SRI International* Janine Provost, *Observatoire de la Côte d'Azur* Mark P. Rast, High Altitude Observatory

Gibson Reaves, University of Southern California

Johann Reiter, Technical University, Munich

Edward J. Rhodes, Jr., University of Southern California

Thomas Rimmele, NJIT

Bernard Roberts, University of St Andrews

Jadzia Rogl, Technical University Vienna

Perry Rose, USC Department of Physics & Astronomy

Colin Rosenthal, JILA/University of Colorado

Ian W. Roxburgh, Queen Mary and Westfield College

Mark Rubin, Stanford University

Alexander Ruzmaikin, JPL

Oscar Saà, CTIO

Phil Scherrer, Stanford University

Jesper Schou, Stanford University

Takashi Sekii, University of Cambridge

Giuseppe Severino, Osservatorio Astronomico di Capodimonte

Hiromoto Shibahashi, University of Tokyo

Jürgen Staude, Astrophysikalisches Institut Potsdam

Robin Stebbins, JILA/University of Colorado

Margie Stehle, Stanford University

Ted Tarbell, Lockheed Research Labs

Michael J. Thompson, Queen Mary and Westfield College

Alan Title, Lockheed

Steve Tomczyk, High Altitude Observatory

Clifford Toner, NSO/GONG

Juri Toomre, JILA/University of Colorado

Roberta Toussaint, NSO/GONG

Thierry Toutain, *ESTEC/European Space* Agency

Mark Trueblood, NSO/GONG

Sylvaine Turck-Chièze, CEA Saclay

Roger K. Ulrich, UCLA

Sergei Vorontsov, Queen Mary & Westfield College

Jane Wang, UCLA

Werner Weiss, Institute of Astronomy Vienna

Winifred Williams, NSOGONG

Peter Wilson, University of Sydney

A Solar Model and Adiabatic Pulsation Package

I have put together a package for computing adiabatic oscillations and analyzing the results, as well as a set of solar models. This will be placed on the *DMAC* users' machine *helios*, for acquisition by anonymous *ftp* [see the box on page 7]. Once connected, do *cd pub/gong/commu_soft/jchristensen* to access the files. The contents of the files and the installation procedure are described in a *README* file. We plan to have it ready for access by September 1.

The program package contains a code for computing adiabatic frequencies and eigenfunctions for a stellar model. The code has a large number of options, and allows the computation of precise frequencies by using the variational principle or Richardson extrapolation. Trial frequencies may be obtained from an existing set of modes, or the code can scan in degree and frequency to locate modes of a model differing substantially from existing sets. Detailed output files of frequency information and, if desired, eigenfunctions are produced.

In addition, programs are supplied which may be used to analyze or manipulate the models and the output of the pulsation program; *e.g.* a program for changing the mesh in an existing model, to obtain meshes suitable for computing either *p* or *g* modes; programs for printing summaries of data files; and a program to computed frequency differences between two set of compute frequencies, or between computed and observed frequencies. In addition, a small set of *IDL* procedures are provided for reading the output files. The package is supplemented with detailed documentation on the pulsation code, and some notes on the auxiliary programs.

Three solar models are supplied: two models computed by Christensen-Dalsgaard, Proffitt & Thompson (*Astrophys. J.*, **403**, L75, 1993), and one model using similar physics, but increasing the atmospheric opacity to obtain frequencies that better match the observations (see the Models Team Report starting on page 18 in this Newsletter). Models for input to the pulsation code are provided both on the original mesh used for the evolution calculation and on a mesh optimized for computing p modes. In addition, files containing a more extensive set of variables are included; these are documented by a separate set of notes. Finally, the package contains two sets of mode data for one of the models.

It should be noted that the data is in binary form, using the *IEEE* Fortran binary convention as applicable to, *e.g.*, Sun, Silicon Graphics, *HP* and Convex computers. If a different binary format is required, some translation of the files will be required.

The package, in earlier versions, has been run successfully on a substantial number of different platforms, by several users. Nonetheless, as usual for public domain software, no guarantee is made for the workings of the package on any given installation; nor can I offer to provide support, although users with problems that cannot be solved in a day's work, with reference to the documentation, are welcome to send me a mail.

Jørgen Christensen-Dalsgaard

Yong Xue, Univerity of Southern California Eric Yasukawa, MLSO Yuzef D. Zhugzhda, IZMIRAN, Moscow Hal Zirin, Cal Tech Ellen Zweibel, University of Colorado/JILA

Team Reports

Models

There has been some progress on the comparison of models computed with simplified physics. As reported conference at the GONG '94 (Christensen-Dalsgaard and Reiter 1994) agreement to a level of less than about 5×10^{-6} in relative differences in pressure and density and less than 10^{-6} in sound speed has been achieved between two calibrated models of the

present Sun. This, together with earlier results at a slightly higher level of differences, strongly suggests that models can be computed with the required numerical accuracy; however, further tests are still desirable and are being pursued. Tests of models with realistic physics are at a less advanced stage, largely due to the difficulty of specifying precisely the physics. As discussed at the conference, comparisons of computed neutrino fluxes for models using essentially the same physics and parameters show agreement at a level of a few per cent. While this is very satisfying for the interpretation of the neutrino experiments, it should be kept in mind that the oscillation frequencies are more sensitive probes of differences in the models. Thus tests like that should definitely be extended to oscillation calculations.

On the computation of oscillation frequencies, Christensen-Dalsgaard and Mullan (1994) showed that adiabatic oscillation frequencies of polytropic models can be computed with sub-nanohertz accuracy. In particular, they tested the computed frequencies for the constant-density model (a polytrope of index zero), where the frequencies are known analytically. The sets of computed frequencies for several polytropic indices (which can be made available electronically from the authors) should serve as a useful reference for testing other adiabatic oscillation programs. It must be kept in mind that uncertainties in physics of the superficial layers of the model introduce far larger errors in the computed frequencies. However, these can to a large extent be eliminated if one makes the assumption that their effect on the frequencies is of the form $M_{mode}^{-1}\mathcal{B}(\omega)$ where M_{mode} is the mode mass and, as indicated, \mathcal{B} is a function of frequency alone; this assumption has been confirmed by analyzing the effects of several types of changes near the surface and is furthermore very reasonable on physical grounds. This property allows the effects of the superficial uncertainties to be filtered out in analyses of the frequencies, allowing detection of more subtle effects relating to the interior structure of the Sun and hence placing far higher demands on the accuracy of the computation of adiabatic frequencies.

As an illustration of the effect of superficial changes we may consider the extent to which the discrepancy between observed and computed frequencies can be eliminated by adjusting the opacity in the atmosphere and the uppermost parts of the convection zone. Panel a on this page shows differences between observed frequencies, from the compilation by Libbrecht, Woodard and Kaufman (1990) and adiabatic frequencies from a model Christensen-Dalsgaard, by Proffitt and Thompson (1993) with helium settling and diffusion, assuming no turbulent diffusion. The differences have been scaled by a normalized mode mass Q_{nl} to take out the *l*-dependence of the mode mass (*e.g.* Christensen-Dalsgaard and Berthomieu 1991). It is obvious that the scaled differences are predominantly a function of frequency, as might have been expected if the differences between the model and the Sun were predominantly in the superficial layers. Indeed, inversion of the frequency differences shows that in the interior of the model the sound speed is very close to that of the Sun (Christensen-Dalsgaard et al. 1993). Panel b shows the result of increasing the opacity by a factor 2.3 in the atmosphere. It is obvious that the differences have been very substantially reduced, while remaining predominantly dependent on frequency except at rather high degree. The residual differences show an oscillation which is likely to be associated with the second helium ionization zone, arising from an error in the helium abundance or in the assumed equation of state (see below).

Differences between observed frequencies and frequencies of solar models, in the sense (observations) - (model). The differences have been scaled by the normalized mode mass Q_{nl} . Modes of degree $l \le 50$, $50 < l \le 200$ and 200 < l are indicated by crosses, diamonds and triangles, respectively. Panel (a) shows results for a "standard" solar model, using the Livermore *OPAL* opacities supplemented with data from Kurucz at low temperatures. In panel (b) the atmospheric opacity has been artificially increased by a factor of 2.3.

It should be stressed that this cannot be taken to indicate that the source of the discrepancy between model and Sun is predominantly caused by errors in the atmospheric opacity. Indeed, given recent advances in the computation of low-temperature opacities this is likely to be a relatively modest cause of uncertainty in the model. It was used here as a convenient example

DOUGLAS GOUGH HALED

The Division of Solar Physics is proud to announce that, with the endorsement of the American Astronomical Society, the 1995 Hale Prize is to be awarded to Professor Douglas O. Gough of the University of Cambridge. Gough has contributed with distinction to many aspects of solar physics, astrophysics and fluid dynamics, including nonlinear convection in stars, the coupling of turbulent convection to pulsations, and stellar structure.

Gough's theoretical inquiry has often combined fluid theory and the detailed physics of stellar structure, as when he showed that the core of the sun is unstable to gravity modes. This instability may lead to episodes of mixing, casting some doubt on standard quiescent models.

In recent years, Gough has devoted most of his attention to helioseismology, to which he has made many notable contributions. He has led the way in applying inversion techniques to infer the internal structure and the distribution of angular velocity in the interior, and was the first to use helioseismic data to determine the depth of the convection zone. He has also used helioseismic data to investigate solar opacities, the equation of state, the helium abundance, and the neutrino problem.

Gough has also played a significant role in the development of the *GONG* project, the helioseismological experiments on *SOHO*, and observational programs in asteroseismology.

Congratulations, Douglas!

P. A. Sturrock, Chair, SPD Hale Prize Committee

of an adjustable superficial uncertainty. A far more likely source of error is the structure and dynamics of the strongly superadiabatic region near the top of the convection zone. Mario Monteiro has developed a convenient way of parametrizing the structure of this region, in terms of a simple generalization of mixing-length theory. This allows adjustment of the height and width of the peak in the superadiabatic gradient, while still keeping the model calibrated to obtain the solar radius (see Monteiro et al. 1994). It was found that to improve the agreement between the computed and observed frequencies a steeper and more localized superadiabatic gradient was required than results from a normal mixing-length model. This is consistent with results obtained from hydrodynamical simulations and from non-local mixing-length calculations.

There has been further development of the understanding of the properties of the frequencies and their relation to solar structure. Particularly interesting is the development of a new asymptotic formulation for the small frequency separation between modes differing by two in degree and one in order (Roxburgh and Vorontsov 1994). Unlike the normal Tassoul (1980) formulation, it takes into account the rapid variation of the structure in the core, resulting from the localized depletion of hydrogen by nuclear burning, and gives results that are in good agreement with numerically computed frequencies. This relates the small frequency separation to two 'acoustic potentials' which are determined by the structure of the core.

In the asymptotic description of the frequencies, the effects of the nearsurface region is captured in the function $\alpha(\omega)$, at least for modes of low or moderate degree. This function is affected by the errors in the extreme superficial layers, discussed above, but also contains information about the helium ionization zones. Pérez Hernández and Christensen-Dalsgaard (1994) showed how the effects of the superficial layers could be removed through suitable filtering, leaving a signal which is quite sensitive to the equation of state in the upper parts of the convection zone and to the helium abundance. They showed that the full Mihalas, Hummer and Däppen equation of state gave substantially better agreement with the observed frequencies than did a rather similar but simpler equation of state involving the Debye-Hückel treatment of the

Coulomb effect. These results indicate the potential for using the *GONG* data to probe even quite subtle features in the equation of state.

Jørgen Christensen-Dalsgaard

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Inversions

The Inversion Team met at length during GONG 94, and decided that it would be most important to continue with the development of the Inversion Workbench so that it could serve as a graphical user interface to drive various rotation and structure inversion procedures to be applied to GONG, SOI and other helioseismic data sets. Such an Inversion Workbench would serve as a common tool available to the many scientists working on inverions of helioseismic data, and would especially facilitate collaborative projects carried out by the Inversion Team. A preliminary version of such an Inversion Workbench had been refined by Jørgen Christensen-Dalsgaard, Jesper Schou and Mike Thompson in Boulder last Summer for two-dimensional regularized leastsquares inversions for rotation (see Christensen-Dalsgaard & Thompson in GONG 1992 proceedings, pp. 249-252 for an early description), using IDL to develop the interactive command structure on workstations and extensive scripts to initiate remote processing and file transfers between other platforms, such as a Convex multiprocessor machine at Aarhus, on which the major calculations required for the inversion were carried out at this stage. Based on the GONG 94 discussions of the team, we arranged to work again together in Boulder for about a month from mid-July to mid-August this Summer to develop the Workbench further, so that it could incorporate other inversion procedures quite gracefully. Thus the original implementors (Christensen-Dalsgaard, Schou. Thompson) were joined by Frank Hill,

Alexander Kosovichev, Sylvain Korzennik, and Takashi Sekii to begin including other inversion procedures to be called forth by the Workbench, and that work has been progressing very well. Taking part in the planning discussions have been Douglas Gough and Juri Toomre, and we have been joined by Rick Bogart and Edward Rhodes on briefer visits to Boulder, along with Deborah Haber and Keith Julien who have been concerned with local-area inversion questions.

The Inversion Team has been discussing various approaches for working together efficiently once the GONG and SOI data begin to become available. We propose an approach in which there would be regular team working meetings of about ten days duration approximately every two months. Such working sessions would be scheduled well in advance. They would be augmented by teleconferences using workstations (as the technology allows, using small video images of all participants and common white boards) every week or two to compare notes on scientific progress and challenges. We anticipate that the working meetings (open to all members, including those to join in the future) may typically include six to ten participants, and that all participants during the meetings will have access to workstations or similar platforms so that active collaborative research and experiments on various aspects of rotation, structure and ringdiagram inversion (as examples) can be conducted during these sessions. We foresee these working meetings taking place on some rotating basis variously in Tucson, Stanford, Boulder and Aarhus, if the facilities can be arranged, and at other locations when greater emphasis is to be placed on strategic scientific discussions. We expect that we shall try to meet at Stanford before or after the 4th SOHO Workshop on Helioseismology (2-6 April 95, Asilomar/Monterey, California) for a brief first session, followed further Inversion Workbench by

developments in Boulder in July/August 95, and then another working session in October or November 95 to initiate the 2-month cycling of such meetings. We would appreciate comments and advice on the suitability of such an overall approach to the future workings of the Inversion Team.

Douglas Dough and Juri Toomre

Data Reduction and Analysis Team

Much of the function of the DRAT is currently being served by the actions of the DMAC Users Committee (DUC), because of its more frequent meetings. Tuck Stebbins gave a DUC Annual Report. In the past year, DUC has addressed the following issues: peak finding, the DSDS User Interface, the definition of the GONG month, data sampling for the low frequency and steady flow pipe, quality assurance methods, square pixels, magnetograms, longer data products, coordinated filters for the two pipes of the pipeline, user access to calibration information, ellipse fitting, membership forms, data format for time series storage, deterministic detrending and validation of software. Stebbins described what the issues where, what action had been taken, and what was still outstanding. For more information on DUC's actions, see the DUC meeting reports in this and earlier issues of the GONG Newsletter.

There was some discussion of the software validation topic. One conceivable way to validate *GONG* software would involve members of the *DRAT*.

R. T. Stebbins

Low Frequency and Nearly Steady Flows Teams

As is now traditional, the Low Frequency and Steady Flows Teams met jointly at the 1994 *GONG* meeting. Our main topic of discussion was the status of the pipeline reductions.

In the current baseline, the "Low and Slow" pipeline will provide just four data products: images of velocity, detrended velocity, modulation, and intensity. Time series of these quantities will be constructed individually for each *GONG* site each day. The Project will not merge these data sets.

The maps will be calculated with a four-minute cadence using a 17-point tapered Gaussian filter applied to calibrated data. The contributing oneminute disk images will be registered and remapped onto a square grid prior to averaging using the individually determined ellipse parameters. No correction is made for motion across the disk due to solar rotation during the 17-minute span of the filter. To minimize the effects of missing images, the temporal filter will simply be renormalized to use the available minutes of data.

The detrended velocity input images are individually corrected prior to the application of the temporal filter described above. Calibrated velocity maps are spatially scaled and debiased using constants fit to the site-day of velocity images, the observer's motion is removed, and a velocity correction is applied. The velocity correction, as implemented in the *AVER* module of the pipeline, removes solid body and differential rotation as well as the limb shift. The correction varies slowly due to the change of $B_{.}$

to the change of B_0 . Currently all calibratable images contribute to the averages. The teams felt that additional quality assurance parameters should be considered and that broader criteria must be developed for identifying poor images. The Project will shortly impose additional quality checks, *e.g.* excluding images having a detrended disk-averaged velocity more than 3 σ from the local mean. The Project welcomes guidance in selecting parameters and choosing criteria.

Each site also obtains one magnetogram per hour. The time of observation is staggered 20 minutes from site to site. This introduces an inhomogeneity into the velocity observations that may or may not lead to a regular gap in the time series. The Project is working to eliminate the gap by correcting the magnetic-minute velocities.

The other significant topic of discussion was scientific projects of the team. With network data now less than one year away it seems that more formalized methods of collaboration need to be implemented.

First, a real need exists to identify the questions that must be answered in the "first results" papers, *e.g.* the detection or setting of initial upper limits on *g*-mode amplitudes. The teams should try to generate lists of these questions in the very near future.

Second, regarding individual investigations, the group liked the broad and open communications fostered by the bulletin board approach for announcing research plans that was described by Yohkoh team members. However, most were not comfortable with the "exclusive claim" nature of the Yohkoh model. Various options (such as WWW access) were discussed for notification of team leaders and of all team members, but no consensus was reached. The Project needs to facilitate this effort.

Todd Hoeksema

Australian Workshop

A workshop entitled "Helio- and Asteroseismology" was held at the Women's College of the University of Sydney June 27 - July 1, 1994, under the sponsorship of the *NSF* and the Department of Industry, Trade, and Regional Development (Australia) British Council. and the The Workshop was attended by 12 scientists from the US and the UK, and by 28 staff, graduate, and undergraduate students from Australia and the UK. It was opened by the Chairman of the Academic board of the University of Sydney and by the Vice-Consul of the US in Sydney, with the ringing of the travelling gong, and closed by David Cole, Director of IPS Radio and Space Services, chiming the same.

The program consisted of a series of review papers covering various aspects of helio- and asteroseismology, together with research papers contributed by staff and students from Australian institutions. It was a grueling week for students and lecturers, but we are optimistic about the outcome. The viewgraphs, which were presented, will be collected in *GONG* Special Report #13.

The participants were suitably impressed by the Sydney Opera's selection of Turandot, with the appearance of a truly superb gong in the first act. The Conference Dinner was memorable for - amongst other events - Tim Brown's display of his hitherto littleknown skills as a juggler whilst mercilessly rapping his hosts.

Presenters and discussion leaders included T. Brown, P. Buchen, D. Burtonclay, P. Cally, L. Cram, C. Durrant, P. Fox, D. Galloway, D. Gough, F. Hill, G. Isaak, J. Kennedy, B. Kennett, S. Korzennik, J. Leibacher, D. Lewis, M. Peri, E. Rhodes, J. Schou, P. Stark, and P. Wilson.

Australian participants included Paul Cally, Chris Dyt, Brett Hennig, Paul Hunter, Tony Papenfuss, and Keith Thompson from *Monash University*; Frank De Ruyter, Alister Graham, and Brian Kennett from the *ANU*; Alan Gore, Jonathan Kress, Margaret Ostinger, and Warren Wood from the *University of Newcastle*; Lisa Germany from the *University of New England*; David Cole, John Kennewell, Nigel Prestage, and Phil Wilkinson from the *IPS Radio and Space Service*; and Peter Buchen, Damien Burtonclay, Anne Cannon, Robert Cameron, Lawrence Cram, Chris Durrant, David Galloway, Li Yan, Peter Wilson, and Vlad Zeligovski from the *University of Sydney*.

John Leibacher and Peter Wilson

Theses

Congratulations to the following recent Ph.D.s:

Nathalie Audard, Université d'Aix-Marseille, "Astérosismologie des étoiles de masse moyenne - Sondage du coeur stellaire"

Karine Briand, Université de Paris-Sud (Orsay), "Chromosphère Solaire calme: étude statistique de profils d'émission, modèles d'atmosphère et propriétés dynamiques"

Peter Edmonds, University of Sydney, "Asteroseismology"

Jesús Patrón Recio, Universidad de La Laguna (Tenerife), "Tridimensional Distribution of Horizontal Velocity Flows under the Solar Surface"

Michal Peri, California Institute of Technology, "Asteroseismological Observations of η Cassiopeiae A with the Palomar East Arm Echelle Spectrograph"

Recent Preprints in Helio- and Asteroseismology

- Bahcall, J. N., and Glasner, A.: "Solar Neutrinos: Sensitivity to Pre-Main Sequence Evolution and to the Depth of the Convective Zone"
- Bachall, J. N.: "How Many Solar Neutrino Experiments Are Wrong?"
- Bahcall, J. N.: "Solar Neutrinos: Where We Are, Where We Are Going"
- Gough, D.O., Kosovichev, A.G., and Toutain, T.: "Constrained Estimates of Low-Degree Mode Frequencies and the Determination of the Sun's Interior Structure"
- Gough, D.O., and Roxburgh, I.W. (eds.): "Proceedings of the Sixth IRIS Workshop"
- Gu, Yeming: "The Sun Never Sets An Introduction to the Global Oscillation Network Group" (in Chinese)

The *GONG Newsletter* is a "quarterly" publication which is intended to keep the community abreast of news and progress relating to the *GONG* project and other activities within the field of helioseismology. The current mailing list for the *Newsletter* includes about 400 individuals who have expressed an interest in these topics. We welcome contributions from anyone wishing to disseminate information of general interest to this community. Contributors to this issue include Douglas Gough, Jørgen Christensen-Dalsgaard, Jack Harvey, Frank Hill, Jean Goodrich, Todd Hoeksema, Mark Hanna, Rob Hubbard, Jim Kennedy, Jim Pintar, Tuck Stebbins, Peter Sturrock, Juri Toomre, Roger Ulrich, and Peter Wilson.

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