GONG

Global Oscillation Network Group

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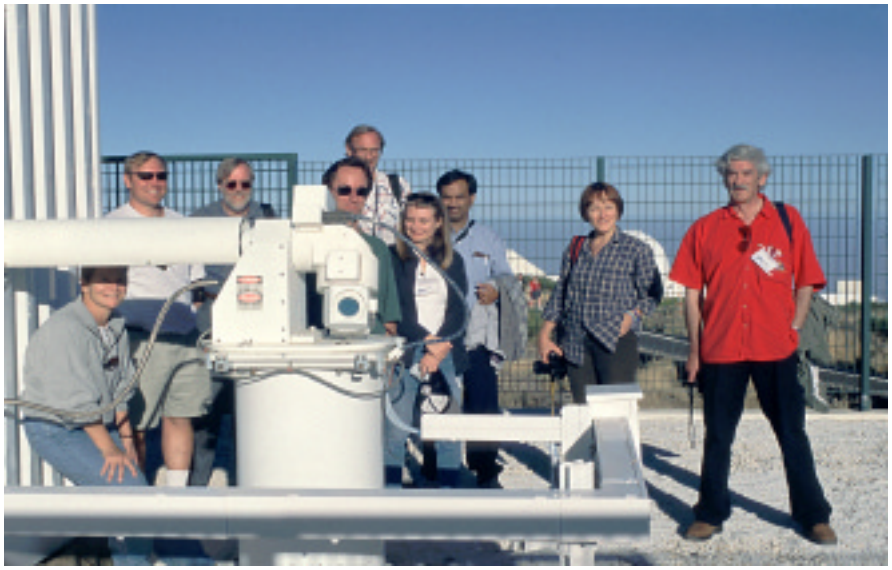
The Global Oscillation Network Group (GONG) Project is a community-based activity to operate a six-site helioseismic observing network, to do the basic data reduction and provide the data and software tools to the community, and to coordinate analysis of the rich data set that is resulting. GONG data are available to any qualified investigator. Information on the status of the project and the scientific investigations, as well as access to the data, are available on our WWW server (http://www.gong.noao.edu).

The Sun continues to develop the most spectacular magnetic active regions of the solar cycle, and the GONG+ team is working to put the finishing touches on the new, high-spatial resolution GONG+ camera system. Solar maximum seems to be on our side, and in spite of some delays, it looks as though the new system will be on-line in time to capture much of the excitement. The project held two reviews of GONG+, an "End-to-End Functional Test and Review" and a "DMAC Readiness Review," August 23 and 24, respectively. During these reviews, community members provided a careful scrutiny of the system's performance and concurred with our plans for deployment.

Following a "Deployment Readiness Review," the first GONG+ system will be shipped to Big Bear after the New Year. In addition to installing the first new system, we will demonstrate there that we can continue the GONG Classic low- to medium-ℓ p-mode program using the GONG+ system, and start merging of the GONG+ high-resolution data. Deployment to the other five sites will follow the Big Bear installation; we should complete the effort by the end of May.



GONG site representatives enjoying a beautiful sunset at the El Teide instrument.

GONG 2000 was held in conjunction with SOHO 10 in Tenerife, Spain, 2–6 October, hosted by the Instituto Astrofísica de Canarias and organized by Peré Pallé. The 140 attendees enjoyed the hospitality of the municipalities of Santa Cruz and La Laguna, and had an opportunity to visit the GONG site on El Teide. The workshop focused on the results from continued GONG operations and the helioseismic experiments aboard SOHO (MDI/SOI, GOLF, and VIRGO). Results from other ground-based multi-

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site projects (BiSON, IRIS, ECHO, and TON) were also included. All of the helioseismic projects have contributed a wealth of data of unprecedented quality from which new insights on the structure and dynamics of the Sun continue to be inferred. Representatives from five of the sites attended, providing a special opportunity for us to discuss site issues together.

The DMAC Users Committee and the Project's Scientific Advisory Committee also met and had very productive meetings. The GONG+ deployment and possible strawman GONG++ scenarios dominated the discussions, resulting in several ideas for helping to move the efforts forward.

Operations

Despite some lingering problems and a novel malady, the GONG network of telescopes performed well during the third quarter of 2000. Again no preventive maintenance (PM) trips were made during this time, which reduces the hours of network downtime, but the absence of PM is beginning to take its toll and causing system deficiencies to accumulate and making the telescopes more susceptible to failure.

Specifically, the lingering deficiency is the weak batteries in the uninterruptible power supplies (UPS). The batteries are so weak in some cases that they will not support the system during power outages on the order of minutes. This has been particularly troublesome at the Udaipur site where the utility power is problematic during the monsoon season. Since usable spans of data are sparse during the monsoon anyway, the frequent power dropouts resulted in a decision to shut the site down. At least 11.5 days of downtime resulted during the third quarter, and more downtime may still be recorded as tapes from this period arrive. The Udaipur site staff are waiting for delivery of the batteries and will install them in the near future, which should improve the situation considerably. Other sites are showing symptoms of UPS failure, and new batteries are ready for installation once the PM teams arrive.

Winter weather has been the source of downtime at CTIO. Occasionally water will get between moving parts of the turret and then freeze during the night. When the turret tries to locate the Sun in the morning, the motors draw more current than the breaker is meant to carry and the system shuts down until someone can visit the site and restart data acquisition. Nearly five days have been lost due to this problem. Fortunately, this happens when the weather is typically poor and little data can be used anyway.

A problem at the CTIO site, symptoms of which had been seen previously at both CTIO and Mauna Loa, has thus far eluded a solution. It involves a runaway rotation of the calibration wheel when it is commanded to move just prior to the acquisition of a daily dark image. Instead of finding its proper location, the wheel rotates to the physical stop and will not respond to commands to reposition it. The problem has been fixed previously by replacing the resolver card, but on one occasion, changing the card made no improvement. Other cards involved in controlling the position of the wheel were replaced, but with similar results. The problem has been sidestepped by using a spare position in the wheel and modifying the commands to move to this port to get the dark image. This has proven to be an acceptable solution until troubleshooting can be done on site. There have been about 22 hours during which the wheel has been lodged at the stop and prevented data from being acquired.

We had hoped to complete the GONG+ deployment during 2000, but as this is not the case, there is some concern about the ability of the old data computers to handle the year change to 2001. A short test was performed at the Teide site, during a brief visit at the end of September, which caused about 1.5 hours of downtime. Results of the test are forthcoming.

Although in general, problems with Exabyte drives are somewhat less frequent than in the past, this generality may not be the opinion of the Big Bear and Teide staff. These sites had more than their share of Exabyte difficulties this quarter, and

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we owe the staff there considerable gratitude for the efforts spent dealing with the problems. The images lost because of Exabyte failures and repairs are difficult to tabulate, but are expected to amount to a few days.

Data Management and Analysis

During the past quarter, the DMAC produced month-long (36-day) velocity, time series, and power spectra for GONG months 48 and 49 (ending March 4, 2000), with respective fill factors of 0.79 and 0.91. Tables of mode frequencies were computed from the power spectra using the three-month-long time series centered at GONG months 46 and 47.

In addition to routine data reduction, the DMAC is actively involved in upgrading systems and applications for the reduction of GONG+ data. To assist in these efforts, an external panel review of the GONG+ DMAC upgrade plan was held on August 24, 2000. The review committee was made up of DMAC User Committee members Jesper Schou, Philip Stark, and Sylvain Korzennik, and SOLIS Data Scientist Carl Henney. The committee offered a number of very helpful suggestions that the Project will implement.

In anticipation of the arrival of GONG+ data, the DMAC began a long overdue replacement of a few of the pipeline workhorses. Incremental changes in the equipment will set the stage for GONG++.

Data Algorithm Developments (and Some Science)

We now have a new version of *peakfind*, implemented in C. This version replicates the algorithm used in the IRAF/SPP version, but is now portable to other platforms. Comparisons with the existing code show no significant differences in either the estimated mode parameters or the execution time.

We can now use the new *peakfind* to develop alternative algorithms to improve the accuracy and precision of the measured mode parameters. More accurate reduction algorithms are crucial to the continuing progress of helioseismology, as detailed comparisons indicate that the dominant source of differences in the inferred conditions inside the Sun as observed by GONG or SOI is a result of the processing of the data and not the data themselves. Some of the modifications planned for *peakfind* include the incorporation of line asymmetries, *m*-leakage, and ridge fitting.

Along these lines, Caroline Barban has joined the project to investigate the possibility of improving the parameter estimates by simultaneously fitting the spectrum obtained in velocity and intensity. A detailed comparison of the spectra, particularly the phase and coherence between the observables, should also shed more light on the physics of mode excitation and damping.

The advent of the new *peakfind* has already produced a new result in helioseismology. During the tests, it was noticed that several multiplets in the 3.3-mHz band were failing to produce converged sets of splitting coefficients. This result was surprising, since this frequency band is a region of very high signal-to-noise, free of severe leakage problems, and has previously not caused fitting problems. Closer inspection revealed the presence of sharp hook-shaped features in the ridges for the nearly sectoral modes, where m is approximately equal to ℓ. These "hooks" are the consequence of the equatorward migration of solar activity, the high correlation between the even splitting coefficients and the surface magnetic field, and the concentration of the sectoral modes near the solar equator. Thus, near solar maximum, it is essential that the determination of the frequency splittings be extended to sufficiently high order (at least 16) to adequately resolve this feature.

A new method for determining the frequency splitting has been developed. The new procedure is superior to the "official" one in that it produces a higher number of more reliable estimates and more accurately represents the splittings with higher order terms. In the near future, splittings from the new method will become the official data product for community use.

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On a somewhat different note, readers may recall that GONG+ will produce a magnetogram at each site every minute. These data should be useful for studies of magnetic field evolution on time scales of 5 minutes and for space-weather studies. In fact, current GONG magnetograms are already available in near real-time for anyone who needs rapid information on the large-scale surface magnetic field. These images are copied to the GONG anonymous FTP area (*ftp://argo.tuc.noao.edu/pub/gong/magnetograms/*) shortly after they are obtained at the sites. The cadence is one per hour at a given site, staggered around the clock so that potentially a magnetogram is available every 20 minutes from the network. These images are already being used for space-weather predictions at SSL/Berkeley (see *http://sprg.ssl.berkeley.edu/~yanli/GONGmags.html*).

GONG+ Camera Development

We are swatting the last few bugs in the camera and high-speed electronics. Software developed to correct for the difficulties will provide enhanced error tolerance in the field. The SMD camera itself operated without flaw during the period that we investigated the fault.

A series of one-week tests of the new instrument components, as integrated systems, has now been concluded at the Tucson GONG engineering site. These tests will be followed by a multi-week reliability demonstration, which will complete our acceptance testing regime. The upgrade kits will soon be prepared for shipment, prior to a "Deployment Readiness Review."

Currently, it is expected that our first deployment will be to the Big Bear observing facility after the New Year. Not only will we verify our installation procedures, but we will also compare the data with that collected at the Tucson site in order to certify proper operation. Deployments to the other sites will follow, and with an estimated three weeks installation at each site, GONG+ should be a reality by the end of May 2001 and local helioseismic data should start becoming available shortly thereafter.

How to Contact GONG

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