

GONG

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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 related software tools to the community, and to coordinate analysis of the resulting rich data set. Information on the status of the project, the scientific investigations, as well as access to the data, is available at gong.nso.edu.

The very successful GONG+ upgrade has sparked an increased interest in GONG data. Fourteen posters and presentations that focused on GONG+ results were given at this year's Spring SPD/AAS Meeting, and during the last quarter, 340 gigabytes of data have been distributed in response to 41 requests. Katrina Gressett's AAS poster demonstrated that the GONG+ data will easily support global p-mode analysis at ℓ 's (out to 1200) that are much, much higher than the current $\ell < 150$! Cliff Toner, Thierry Corbard, Frank Hill, Deborah Haber (University of Colorado at Boulder), and Rick Bogart (Stanford University) showed a very reassuring comparison of inversions of subsurface flows from SoHO/MDI and GONG (see figure 1), and Doug Braun and Charlie Lindsey showed similar excellent agreement with their farside imaging.

In order to support the new data format and the sheer amount of it, we will complete the GONG++ hardware system to produce local helioseismology and high- ℓ global helioseismology products for the community within the next several months. Significant progress has already been made on the software side with Thierry Corbard's implementation of the GONG++ local helioseismology area extraction package, Deborah Haber's ring-fitting package, Charlie Lindsey's farside imaging application, and various GONG+/MDI comparisons. A programmer will soon be joining the project to work on the GONG++ data handling system and the implementation of the continuous, full-Sun, local helioseismology pipeline.

Don't forget that this year's annual meeting, GONG+ 2002/SOHO 12—"Local and Global Helioseismology: The Present and Future"—is being organized by the Big Bear Solar Observatory and will be held at Big Bear Lake, California, October 27 to November 1. Full information is available at www.bbso.njit.edu/gong02.

Network Operations

The first scheduled preventive maintenance visits since the completion of the GONG+ network installation occurred during the second quarter of 2002, at CTIO and El Teide. Mauna Loa and Big Bear have experienced DLT-drive failures, but thanks to site staff, the tape drives were swapped and no data were lost.

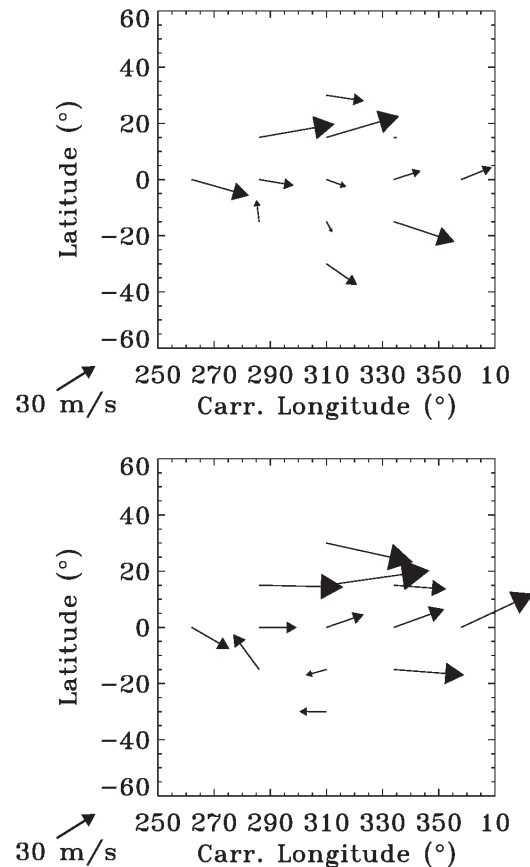


Figure 1. Deborah Haber and Rick Bogart have produced the first comparison of the direction and magnitude of subsurface flows at selected depths inferred from ring diagram analysis of 11 hours of data from MDI (top) and the GONG+ Big Bear instrument (bottom). Independent analyses were performed for a set of thirteen 15° regions centered at the Carrington coordinates of the bases of the arrows representing the flows. These results are from 1-dimension RLS inversions at a depth of 7.1 Mm. The results have shown excellent agreement in the flow maps at depths below 2 Mm, but discrepancies near the surface. These variations are currently thought to arise from the differing optical distortions in the two instruments, which mostly affect the high- ℓ modes that sample just below the surface.

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In late May, the Learmonth instrument began to show signs that the waveplate rotator system was experiencing anomalies. However, attention soon focused on the turret as the primary origin of the problem. The same symptoms had been seen at Mauna Loa at the end of last year and were eventually traced back to a leaky turret, which in turn caused electronics components inside the shelter to fail. The Learmonth staff determined that water had indeed entered the turret, and extensive electrical tests and component inspections further revealed the extent of the failure. The turret from the Tucson engineering station was removed and rushed “down under” with a repair team to bring the system back on-line early in July. A great deal of gratitude and thanks are extended to the Learmonth staff who spent many hours to help verify the nature and extent of the problem. Because of the recent damage at Mauna Loa and Learmonth due to leaky turrets, we decided to shut down and cover the Udaipur turret until the heavy monsoon rains have passed.

Data Management and Analysis

During the past quarter, the DMAC produced month-long (36-day) velocity, time series, and power spectra for GONG+ months 66, 67, and 68 (ending 17 January 2002) with fill factors of 0.68, 0.86, and 0.83, respectively. These fill factors are approaching the average fill factors obtained during the GONG Classic program and reflect the completion of the GONG Classic to GONG+ transition. The DSDS distributed 340 gigabytes in response to 41 data requests as opposed to 5 gigabytes in response to 19 requests in the same quarter of the previous year, which reflects both the larger image size and the increased interest in GONG data as a result of the GONG+ upgrade.

The GONG Classic month 62 images and the GONG+ month 62 images were processed separately producing month-long time series and ℓ - v spectra. They were then used to produce a GONG Classic/+ blended version of these time series. A similar procedure was applied to months 61 and 63 to improve the fill factors of all three months. These results (in particular, the mode frequencies from the three-month-long time series assembled from these months) produced better fill factors and improved mode frequencies. The archived mode frequency products for these months are from the blended time series (the three-month-long time series centered on months 61, 62, 63, and 64). The various versions of the one-month-long time series (Classic, +, and blended) will be archived in the near future.

The development and implementation of the GONG++ ring-diagram application is proceeding rapidly. Cliff Toner now has an image-merge code that restores velocity images before averaging them together, and it is fast enough to allow its use in the GONG++ pipeline. The restored merged images have been run through Thierry Corbard’s dense-pack ring-diagram code, and then through Deborah Haber’s ring-fitting code, which is now installed and running in Tucson. Joy Chavez, a GONG Research Experiences for Undergraduates (REU) student from the University of Houston, is pushing a substantial amount of data through the entire pipeline all the way to flow maps. So far, there are no indications of any problems in the processing. We will be performing comparisons with SoHO/MDI to further validate the processing.

Charlie Lindsey is working with REU student Anna Malanushenko on implementing farside imaging on the GONG++ system. Along with Jean Goodrich’s plan for near-real-time processing at the sites, this could ensure the continued availability of this valuable Space Weather product.

A fit of the mode frequencies to orthogonal polynomials as defined by Ritzwoller and Lavelly has been added to the suite of mode frequency data products for GONG months 2–67.

Rachel Howe has developed code to use the leakage matrix in the low-degree regime with a bootstrap approach that includes the effects of m - and n -leaks (see figure 2). Simon Kras has taken on the job of running the GONG Classic data through the procedure, which will provide greatly improved estimates of low-degree mode parameters that should improve inversions of the deep solar interior.

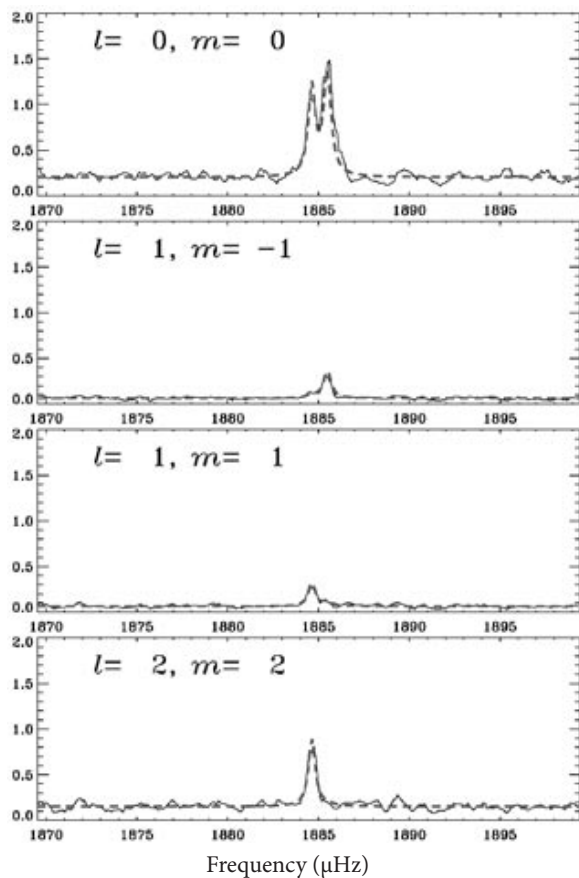
Rudi Komm has been working with Bernard Durney on estimates of the angular momentum in the solar convection zone. While this is a difficult measurement, there are hints that the angular momentum in the tachocline may be varying over the solar cycle. If so, this could be an indication that the tachocline is indeed the location of a dynamo. However, it would be nice to have more than a 0.5 cycle to examine.

Caroline Barban has succeeded in implementing the V-I multispectral fitting method and has fitted a number of m -averaged peaks around $n = 16$. There are already

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indications of a frequency dependence of the various noise background components, which will provide new insights into the excitation of the modes. The next steps are to extend the analysis to cope with leaks, install more accurate statistical models, and fit modes as a function of m .

Finally, Richard Clark and Jack Harvey have been working on the correction of the GONG+ magnetogram zero point. We hope to have this working shortly and to be able to turn on the magnetogram pipeline.

Figure 2. This plot illustrates a simultaneous fit of a GONG low-degree mode and its m -leaks using several spectra and the leakage matrix. For the example here, we show the target mode at $l=1, m=1, n=13$, its m -leak at $l=1, m=-1$, and their appearance in the $l=0, m=0$ and $l=2, m=2$ spectra. The solid lines are the data, and the dashed lines are the fit. The simultaneous fit uses much more information than a fit in a single spectrum, and the leakage matrix provides a constraint on the relative amplitudes of the peaks across the spectra. The net result is a greatly improved estimate of the mode parameters for the low-degree modes.