

GLOBAL OSCILLATION NETWORK GROUP

EL TEIDE • UDAIPUR • LEARMONTH • MAUNA LOA • BIG BEAR • CERRO TOLOLO

GONG

John Leibacher & the GONG Team

With the local helioseismology pipeline approaching routine science capability, growing interest in the excellent GONG coverage of the “Halloween Flares” of October–November 2003, and the run-up to the biennial GONG/SoHO/SDO meeting in July, things have been exciting on the GONG science front. The instrument team has its hands full with a bundle of repair projects—including a very promising fix that should reduce quite substantially the uncertainty in the zero point of the magnetograms—and developing plans for the replacement shelter and near-real-time data recovery, in addition to long sought “routine operations.” Meanwhile, the data reduction team has made major strides toward the automation of the pipeline processing and scored big in slashing the calibration backlog.

The fun, however, hasn’t been just in-house, as the quarter was also busy with meetings. A successful Local Helioseismology Comparison (LoHCo) group meeting—number seven in a continuing series—was held in Tucson on February 10–11. Twenty-six participants discussed the latest progress in local helioseismology. See the detailed discussion below.

GONG’s Data Users’ Committee (DUC) met in Tucson on February 12 to evaluate progress and set objectives. The on-site meeting gave the Data Management and Analysis Center (DMAC) staff an opportunity to share their results with visiting DUC members. Highlights included unveiling the first version of the new Web-based software documentation, which includes schematic maps of the global and local pipelines and links to program and data product descriptions, operator instructions, algorithms and definitions, background science, and related data products (gong.nso.edu/DMAC_documentation). The transition from separate-workstation-based processing to automation and shared resources reached a major milestone. The long-awaited announcement that *sneaker net is history* and *the data processing backlog is at its lowest point in history* prompted applause and high-fives from around the table. The DUC gave its blessing, pending a couple of final acceptance tests, for the implementation of the Automatic bad-Image Rejection (AIR) module into the processing pipeline. The automated image reduction package was developed by Richard Clark, and should accelerate this part of the data processing and significantly reduce the time to produce science products. A lot of discussion was devoted to the local helioseismology pipelines, including finalizing angular orientation procedures using MDI and noon drift scans before routine production begins, and finalizing the specifications of the

science products to be added to the data distribution system.

This year’s annual meeting, GONG 2004/SoHO 14, is being organized by Sarbani Basu at Yale University, and will be held 12–16 July 2004 in New Haven, Connecticut (www.astro.yale.edu/sogo04).

In a press release last year, Cliff Toner said, “Success with the Mercury transits sets the stage for next year’s Venus transit, which will allow more accurate calculations because Venus is farther than Mercury from the Sun.” Well, it’s nearly upon us and we are beginning to count down to this year’s transit of Venus. The same three GONG sites that captured last year’s Mercury transit—Learmonth, Western Australia; Udaipur, India; and Tenerife, Spain—will observe the path of Venus as it transits the solar disk on June 8. In addition to the educational and outreach benefits, we hope to be able to verify the absolute angular orientation and image scale for these three instruments. Visit our Web site (gong.nso.edu/venus2004) for history, links to other live sites, information, and education programs.

Site and Instrument Operations

The year began with preparations for a relatively busy schedule of preventive maintenance visits to the sites through the spring. Modifications to the light-feed turret that should help prevent water leakage were underway through January. Testing of the turret and other upgraded hardware to be installed at the field sites took place in February.

The first preventive maintenance trip of the year was in March at Mauna Loa, where the newly modified turret was installed. Other improvements included the replacement of the Lyot Filter/Michaelson interferometer assembly, the uninterruptible power supply, camera power supplies, analog-to-digital converter boards, and implementation of the new optical table earthquake protection. In spite of many cloudy days, all of the work was completed on schedule.

The network sites continued to run well. Interruptions of data acquisition occurred because of a failure of a signal generator card at Cerro Tololo and during troubleshooting at Learmonth when a nonfunctional guider card was discovered. The Udaipur instrument failed to guide for a few days in January, but began working again in the midst of troubleshooting. Mirror fogging at Big Bear continued to appear during particularly cold mornings. This issue should be

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resolved by next fall when a modification to heat the mirrors in the turret will be installed.

Jack Harvey, George Luis, Chirag Shroff, and Ed Stover have installed a new modulator-driver circuit that equalizes the switching time between polarization states of the modulator. This has reduced the amplitude of the low-spatial-frequency magnetic field instrumental background by more than an order of magnitude. This greatly improves the quality of the once-per-minute magnetograms obtained by GONG, and should lead to enabling their use for potential field calculations. More breadboard testing is required before a prototype will be developed.

Data Processing, Analysis, and Management

We have completed processing the data for ring diagram analyses covering October and November 2003—the time period of the so-called “Halloween Flares,” which were among the most energetic ever observed. The goal is to map the subsurface horizontal flow field before and after the flares and search for possible systematic changes.

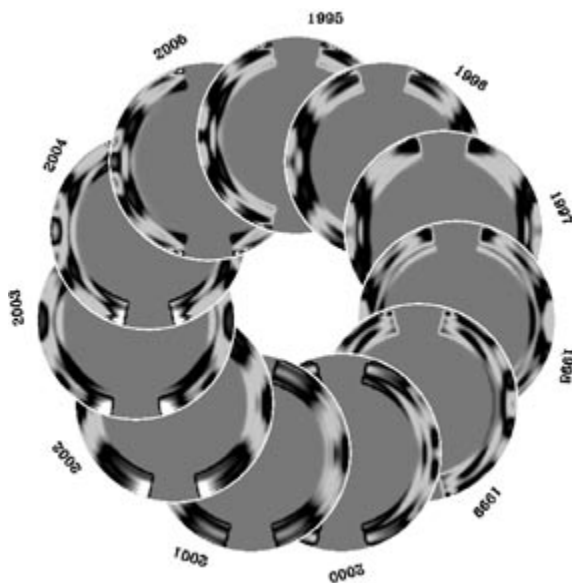
The GONG/SOI research team was well represented at the recent Living With a Star (LWS) meeting in Boulder in late March. The group presented a total of five posters. Rachel Howe showed the latest results from modeling the torsional oscillation as a 11+11/3-year sinusoid, and boldly predicted the pattern for the next three years. Rudi Komm showed the vertical vorticity computed from the flow maps. Irene Gonzalez-Hernandez presented a large-aperture ring diagram analysis designed to image the tachocline. John Leibacher showed recent progress by Jean Goodrich, Charlie Lindsey, Doug Braun, and Anna Malanushenko

in implementing the near real-time farside imaging capability. Frank Hill’s poster contained Rachel’s localized mode parameter variations, Rudi’s divergence images, and Shukur Kholikov’s time-distance results. All of the posters are on line at gong.nso.edu/Images/posters.html.

GONG was awarded a NASA LWS Targeted Research & Technology (TR&T) grant to develop near-real-time compression and transmission of the images needed for farside imaging from the six GONG instruments, and to produce and distribute farside proxy images on a regular and timely basis. GONG is also seeking a postdoc to calibrate the farside “bounce” signal in terms of the real physical changes of the Sun.

The advent of the strong spike in solar activity last fall has motivated a fresh look at the response of the GONG measurement to magnetic fields. A numerical model of the observations, starting from the nickel spectral line and proceeding through the prefilter, Lyot, Michelson interferometer, and modulators has been constructed. We will use this model to study the response of the instrument when strong fields distort the spectral line shape.

During the past three months, month-long (36-day) velocity time series for GONG months 79 through 86 (ending 27 October 2003), with an average fill factor of 0.87, were archived into the Data Storage and Distribution System (DSDS). Mode frequency results for the same time period have also been archived. The DSDS distributed 460 gigabytes in response to 30 data requests. The data reduction team continues to reduce the cumulative backlog for GONG+ data products, which is currently down to 141 days.



With nine years of combined observations from MDI and GONG, the pattern of migrating zonal flows in the convection zone can be seen in more detail than ever before. To make the above plot, the rotation-rate residuals after subtraction of a temporal mean from RLS inversions were fitted with 11-year and 11/3-year sinusoids (after Vorontsov et al. 2002), and the fits extrapolated to complete the solar cycle. This combination gives a more stable prediction than other possible choices such as 11/2 years for the second period. The flows can be seen to penetrate deep within the convection zone, and we can begin to make inferences about the possible depth variation of the phase of the flow pattern. The branch that will be associated with the next solar cycle can be seen emerging in the 2003 data.

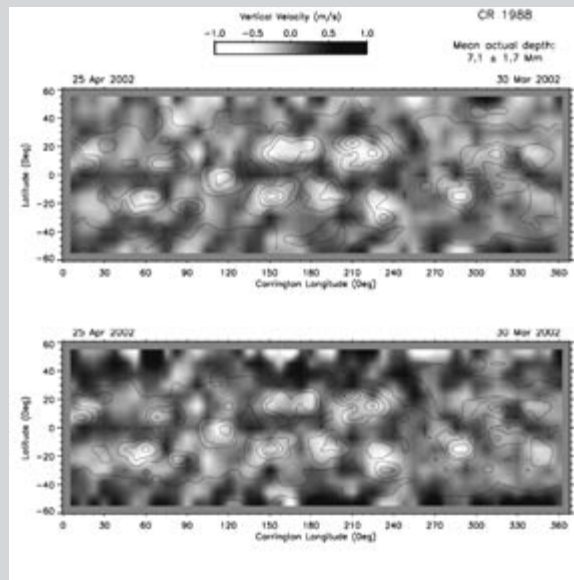
The Local Helioseismology Comparison Group



Local helioseismology makes it possible to study the solar convection zone at small horizontal and temporal scales (in contrast to global helioseismology, which produces

only longitudinal averages and which cannot distinguish between the northern and southern hemispheres). Given the developmental state of the local helioseismology methodologies, and the subtlety of the inferences, the helioseismic community recognized the need for intercomparison of local helioseismology methods and data sets to progress toward achieving the full scientific potential. The Local Helioseismology Comparison (LoHCo) group was formed in February 2003 to establish consistency between different methods of local helioseismology (ring-diagram, time-distance, and holography) and between different data sources (GONG, MDI/SoHO, TON and Mt. Wilson, and building toward HMI/SDO).

The latest LoHCo workshop, number seven, was organized by GONG and held in Tucson on 10–11 February 2004. The group of 26 participants, including one from Taiwan, one from France, and six via telecon from Stanford, focused on the ongoing comparison of GONG and MDI data covering April 2002 (Carrington Rotation 1998). The group concluded that the similarities between different methods and data sets are promising, but that more work is required to understand the nature of systematic and statistical differences. A second point



Vertical velocity at a depth of 7.1 Mm (Top: GONG; bottom: MDI); Positive/negative values indicate upflows/downflows. The contour lines indicate magnetic flux (5, 20, 40, 80, and 120 Gauss) from NSO Kitt Peak magnetograms. Strong downflows (white areas) occur mainly at locations of large magnetic flux. MDI and GONG data show very similar results; differences occur mainly at high latitudes.

centered on the creation of artificial data sets needed to test local methods. These data sets will be similar to the “hare-and-hound” exercises that proved so useful for global helioseismology. The group also discussed the latest results from helioseismology not necessarily related to the comparison effort. You can visit the Web site at gong.nso.edu/lohco/workshop7.html to view pictures, agenda, presentations, and participants.