GONG highlights this quarter include the first meeting of the Magnetogram Users’ Group (MUG), an on-site meeting of the Data Users’ Committee (DUC), the first movie of merged continuous full-resolution GONG magnetograms, the release of the long-awaited first one thousand days of local helioseismology science products, and the arrival of some important new talent.

The GONG instruments routinely obtain magnetograms every minute and the high temporal resolution and moderate spatial resolution of these observations offer a unique resource for the solar physics community. Originally developed to identify areas of possible contamination of the helioseismic signal, the magnetograms are proving exceedingly useful in their own right because of their high cadence, continuity, and sensitivity. GONG’s newly formed MUG met in March to help define the future processing goals of the program (see figure 1). We are currently developing new polarization modulator electronics to reduce the systematic GONG magnetogram instrumental zero point error to 0.3 gauss over time (at least one day) to make them useful for potential field extrapolations and studies of large-scale field changes. Once in place, a routine processing pipeline will be implemented to produce new magnetogram data products. A preliminary list of products and the recommendations from the group can be found on our Web site.

GONG’s DUC met in Tucson May 5 and 6 to review the overall helioseismic data processing, and to “cross the ts and dot the is” on the new Automatic (Bad) Image Rejection (AIR) package and to evaluate the new site-merging geometry algorithm, which uses frequent noon drift-scans from the sites to compute the angles. The group also assessed the progress of the local helioseismology pipelines. As shown in the composite image, we now have over one thousand days of local helioseismology science products (see figure 2). The day-to-day variation in the distribution of horizontal velocities below the surface yields the divergence of the flows. Thirty-seven solar rotations are shown stacked one above another.

GONG’s science team was awarded a three-year NASA Guest Investigator grant to investigate the dynamics of the convection zone using SoHO/MDI and GONG data and local helioseismology techniques. In particular, the focus will be on the shear layers at the top and bottom boundaries. The expected scientific impact of this work will include: 1) testing the validity of models of the convection zone, 2) constraining models of the solar dynamo mechanism, 3) determining the properties of the deep meridional circulation, 4) investigating longitudinal structure in the tachocline (the transition zone between rigid and differential rotation), and 5) searching for subsurface precursors of solar activity. All work will be done in collaboration with the MDI science team.

By addressing the specified scientific objectives, we should significantly increase our understanding of the physical processes controlling the solar cycle, as well as contribute to a number of broader areas, including astrophysical fluid dynamics (testing the validity of numerical models of the convection zone), the generation of astrophysical magnetic fields (constraining models of stellar dynamos), and space weather predictive capabilities (searching for subsurface precursors of solar activity). The proposed research will also provide new tools for analysis of current SoHO/MDI and provide new research paths for SDO.

The Solar Physics Division of the American Astronomical Society has undertaken the organization of a series of summer schools to cover various aspects of solar physics. The first in the series, scheduled for summer 2005, will focus on helioseismology. The school is being hosted at the High Altitude Observatory in Boulder, Colorado, and is sponsored jointly by the NSF and NASA/ILWS. Visit the SPD Web site (spd.aas.org) for more information. The applications significantly exceeded our resources.

The program welcomes the newest GONGster, Tim Purdy, as the team’s real-time programmer in charge of the remote instrument and data computers control systems. After the four-month vacancy
in that position, there’s a lot to keep him occupied. We were fortunate to get Chirag Shroff back for two days to help Tim through the intricacies that lurk below the surface. We also welcome Kirin Jain who will be working with us as a long-term visitor comparing MOTH data with GONG, and extend a welcome to Harry Jones who is coming out of his one-month retirement to work with us on developing methods to improve the merging of the magnetograms.

Network Operations
During the first quarter of 2005 two preventative maintenance (PM) trips took place. The first was to Mauna Loa in February where only routine tasks were anticipated, however, upon inspecting the optics, a flaw in the filter/interferometer was discovered. It appeared that the grease between optical elements had failed, allowing air to creep into the grease and causing the solar image to be obscured. An on-site fix was attempted but resulted in only partial success and it was necessary for Jeff Sudol to bring a replacement assembly from Tucson to correct the problem while the PM was underway.

The other PM trip was to Learmonth during the end of March into April. Anticipating the possibility of a problem with the filter/interferometer assembly there too, a spare was taken along and indeed, a similar problem was found and the spare was employed. A camera and modified camera power supplies were scheduled to be changed out, but acceptable camera temperature control using the new supplies could not be achieved and the old power supplies remain installed. Other PM tasks included replacing the turret with a refurbished one that has the more robust weather seals, and considerable maintenance and repair was completed on the instrument shelter.

At Big Bear, a turret mirror heater became operational. The purpose of this device is to prevent condensation on the mirrors, which occurs overnight when the temperature is low and the humidity high, and could result in several hours of data loss the following morning under beautiful skies. The heaters are on only when the turret is stowed and the temperature falls below 18°C. The Tucson site seems to be the only other site with this problem.

An occurrence of the wrong year on the Big Bear data computer CPU caused several days of data to be compromised. If the incorrect year were restricted to only the data computer, then only the image file name would be affected. However, because the instrument computer’s date is corrected to match the data computer, the ephemeris parameters calculated by the instrument computer were incorrect as well. There have been other events where the instrument falls into an inappropriate state, such as when a window cleaning is done while the instrument is taking its calibration. These, along with other unexplained events, are under investigation.

During the last half of March, the Mauna Loa system began to lock up, both during operation and at boot up. Initial brainstorming led down the path of the camera power supply, the DAS boards, and then the CPU board. Swaps were made, but the problem remained intermittent and suspicion turned to the communication between the camera and data computer. After further troubleshooting, the problem was identified at the camera end, and a team was sent to Mauna Loa with a replacement camera.

Data Processing and Analysis
As previously mentioned, we have now completed ring diagram analysis for the period 22 July 2001 to 24 April 2004, which covers 27 consecutive GONG months or 37 consecutive Carrington rotations and provides an unprecedented history of the subsurface flows. Divergence and helicity maps are being produced, along with a movie.

Mode frequencies for GONG months 91 through 93 (ending 5 July 2004) are now available. Month 93 enjoyed a 93 percent fill factor. We had a bit of a glitch processing this month as the Venus transit gave rise to all sorts of little problems! The Data Storage and Distribution System (DSDS) distributed 274 gigabytes in response to nine data requests, in addition to many FTP downloads of a variety of data products.

The data reduction team is maintaining the cumulative backlog for calibrated data products at around 100 days (600 site days). The testing of the automated image rejection module has been delayed after the discovery that the values of the angular orientation of the images were substantially different when compared with the original values. This has been traced to the incorrect handling of a PM trip by the original labor-intensive QA method. We are thus repeating the test on...
GONG continued

a different, more recent time period, which also includes numerous noon drift-scans.

By the time you read this, the new version of our angular registration program will be complete. It has undergone extensive testing, and we have verified that noon drift-scans alone are an acceptable substitute for the use of MDI data as a reference. We are working toward a new release of the GONG Reduction and Analysis Software Package (GRASP), which will include both the new angular registration code and the automated image rejection modules.

The GONG scientific staff has been working on several projects. These include testing the sensitivity of global inversions to modern dynamo models, investigating the relationship between subsurface kinetic helicity and flare characteristics, time-distance measurements of the solar radius and the deep meridional flows, determination of the near-surface meridional flow from uninterrupted rotations, and comparisons of frequencies derived from rings obtained in intensity and velocity as a function of disk position. In addition, we now have some 30-second cadence data that we will use to investigate high-frequency oscillations, and we are starting a comparison of flow fields derived from GONG and Stuart Jeffries’ MOTH South Pole experiment.

As mentioned, the new Magnetogram Users’ Group (MUG) held its first formal meeting in Tucson on March 2-3. It was a very productive meeting, resulting in a detailed list of specifications and actions for GONG magnetic field data processing and products. We are now in the process of planning the development of the magnetogram-processing pipeline, while we continue to work on reducing the zero-point uncertainty. We have produced a nice movie of 36 days of six-site merged GONG magnetograms, which even with the zero-point fluctuations is an exciting new scientific capability for the non-helioseismic community.

Notable Quotes

“They say there are two ways to get famous [in astronomy]. One is to make a very big discovery. The other is to break a very big mirror.”

—Freelance photographer Joe McNally, speaking about the challenge of doing a helicopter photo shoot over Kitt Peak National Observatory; the resulting panoramic image and accompanying guide to all of Kitt Peak’s telescopes was published in Discover magazine’s May 2005 issue, with the cover headline “Kitt Peak: Telescope Heaven.”