

GORDON
SCOTT
IN-92-CR
189694
6P

Final Report

NASA Grant NAG 5-944

**SOLAR G-MODE OSCILLATIONS:
COMPARISON OF SMM-ACRIM
AND GROUND-BASED OBSERVATIONS**

February 1989

Performance Period: 7/1/87 - 6/30/88
Awarded Amount: \$17,137.00
SPO No. 4672

Philip H. Scherrer
Center For Space Science and Astrophysics
Stanford University, ERL
Stanford, California 94305
(415) 723-1504

Final Report
NASA Grant NAG 5-944

The proposed research was not completed during the interval supported by this grant. Progress was made in access to the data and in developing programs for its analysis. It is anticipated that most of the objectives of the proposed work will be completed in the near future with support from other sources.

The difficulties in completing the work in the planned time can be traced to several factors.

The correction of the Stanford oscillation data using gridded intensity data was not successful. This was due to a number of causes relating to the selection of an inappropriate (borrowed) detector. The resulting measurement was unable to accurately measure the brightness gradient across the sun with sufficient accuracy to reduce the systematic effect in the oscillations signal. Modeling analyses of the expected results indicated that very little power from the sky transparency variations would be in the p-mode regime and the accuracy required for the g-mode regime was not obtained. We have no immediate plans to repeat this measurement.

Henning (1987) concluded that the 1987 summer season produced by far the best solar oscillation data to date. We concluded that due to the poor continuity of the 1985 and 1986 data due to clouds, we should focus the joint analysis with the ACRIM data on the summer of 1987 observations. We did not receive the summer 1987 ACRIM data until September 1988. Henning completed his Ph.D dissertation in December 1987.

In 1988, Bernard Gelly, a post-doctoral student, continued the analysis of the ACRIM data. He presented a study of the interannual frequency stability of the p-modes at the Symposium on Seismology of the Sun and Sun-like Stars, Tenerife, Spain, September 1988. In the final months of 1988, Gelly completed his first analysis of the ACRIM data for most of 1986 and for 1987. He concluded that the frequency splitting he had provisionally detected in the 1985 data was probably an artifact of the way the data had been prepared. He was able to reproduce his results with the new unrenormalized data for 1985, but the result did not survive into 1986 - 1987. These results are being prepared for publication.

We are presently examining the 1988 Stanford oscillation data and will shortly begin the cross comparison of the ACRIM spectrum with the Stanford spectrum for 1987 in the g-mode regime. This work is beyond the scope of this Guest Investigator Grant and will be reported elsewhere.

My conclusion is that the Guest Investigator Grant did provide an opportunity to begin the task of comparing the low frequency spectrum of the ACRIM observations with the Stanford differential velocity observations. However, a combination of circumstances including the delayed arrival of the later ACRIM data, the failure of part of our measurements (not supported by this Grant), and the return to Germany of Henning (after completing his Ph.D work) all contributed to a less than planned return from the Grant.

References

H. Henning, "An Investigation of Ground-Based Observations of Solar Oscillations at Stanford," CSSA-ASTRO 87-21, Stanford University Ph.D. thesis, December 1987.

B. Gelly, E. Fossat, and G. Grec, "Solar P-Modes Frequency Variations Between 1980 and 1986," *Seismology of the Sun and Sun-like Stars* (ed. by E. Rolfe) ESA SP 286, in press, 1988.

Publications on Helioseismology

Philip H. Scherrer
and
Solar-Terrestrial Physics Group
Center for Space Science and Astrophysics
Stanford University, Stanford, California 94305

The Search for Solar Gravity Modes, H. Henning and P.H. Scherrer, *Seismology of the Sun and Sun-like Stars* (ed. by E. Rolfe) ESA SP 286, in press, 1988.

Solar P-Modes Frequency Variations Between 1980 and 1986, B. Gelly, E. Fossat, and G. Grec, *Seismology of the Sun and Sun-like Stars* (ed. by E. Rolfe) ESA SP 286, in press, 1988.

On the Feasibility of Correlation Tracking at Moderate Resolution, R.S. Bogart, S.H. Ferguson, P.H. Scherrer, T.D. Tarbell, and A.M. Title, *Solar Physics*, 116, pp. 205-714, 1988.

An Investigation of Ground-Based Observations of Solar Oscillations at Stanford, H. Henning, CSSA-ASTRO 87-71, Stanford University Ph.D. thesis, December 1987.

Detection and Identification of Low-Order, Low-Degree P-Modes, H. Henning and P.H. Scherrer, CSSA-ASTRO-87-73, *Technical Report*, December 1987.

On the Feasibility of Correlation Tracking at Moderate Resolution, R.S. Bogart, P.H. Scherrer, S.H. Ferguson, T.D. Tarbell, and A.M. Title, *Bulletin of the American Astronomical Society*, Vol. 19, No. 3, 1987.

Large-Scale Motions on the Sun: An Overview, R.S. Bogart, *Solar Physics*, Vol. 110, pp. 23-34, 1987.

Rotation of the Coronal Magnetic Field, J.T. Hoeksema and P.H. Scherrer, *The Astrophysical Journal*, Vol. 318, pp. 428-436, July 1987.

The Annual Reports of Observatories: Wilcox Solar Observatory, P.H. Scherrer, J.T. Hoeksema, R.S. Bogart, and H. Henning, *Bulletin of the Astronomical Society*, Vol. 18, No. 1, 1986.

The Detection of Global Convective Wave Flows on the Sun, P.H. Scherrer, R.S. Bogart, J.T. Hoeksema and H. Yoshimura, *Seismology of the Sun and the Distant Stars*, D.O. Gough (ed.), ASI Series C: Mathematical and Physical Sciences Vol. 169, D. Reidel (pub.), 1986.

Observations of Low-Degree P-Mode Oscillations in 1984, H. Henning, and P.H. Scherrer, *Seismology of the Sun and the Distant Stars*, D.O. Gough (ed.), ASI Series C: Mathematical and Physical Sciences Vol. 169, D. Reidel (pub.), 1986.

Comments on Techniques for Spectral Deconvolution, P.H. Scherrer *Seismology of the Sun and the Distant Stars*, D.O. Gough (ed.), ASI Series C: Mathematical and Physical Sciences Vol. 169, D. Reidel (pub.), 1986.

Detection of Solar Gravity Mode Oscillations, P.H. Scherrer, *Proceedings of Solar Seismology From Space, Snowmass, Colorado*, August 17-19, 1983, 1985.

Detection of Solar Gravity Mode Oscillations, P.H. Scherrer, *Mem.S.A.It.*, Vol. 55, No.1-7, 1984.

Detection of Solar Gravity Mode Oscillations, Philippe Delache, and Philip H. Scherrer, *Nature*, 306, 651-653, 1983.

Review of Observations Relevant to Solar Oscillations, Philip H. Scherrer, *Proceedings of Pulsations in Classical and Cataclysmic Variable Star Conference at JILA*, Boulder, Colorado, June 1982, pp. 83-98.

Observation of Additional Low-Degree Five-Minute Modes of Solar Oscillation, Philip H. Scherrer, John M. Wilcox, J. Christensen-Dalsgaard, and D.O. Gough, *Nature*, 297, 312-313, 1982.

Detection of Solar Five-Minute Oscillations of Low Degree, Philip H. Scherrer, John M. Wilcox, J. Christensen-Dalsgaard, and D.O. Gough, in *Proceedings of 66th IAU Colloquium*, Crimean Astrophysical Observatory, U.S.S.R., September 1981, *Solar Physics*, 82, 75-87, 1983.

Structure of the Solar Oscillation With Period Near 160 Minutes, Philip H. Scherrer and John M. Wilcox, in *Proceedings of 66th IAU Colloquium*, Crimean Astrophysical Observatory, U.S.S.R., September 1981, *Solar Physics*, 82, 37-42, 1983.

Further Evidence of Solar Oscillations With a Period of 160 Minutes, Philip H. Scherrer, John M. Wilcox, A.B. Severny, V.A. Kotov, and T.T. Tsap, *The Astrophysical Journal Letters*, 237, L97-L98, 1980.

Observations of Solar Oscillations with Periods of 160^m at the Stanford Solar Observatory and at the Crimean Astrophysical Observatory, P.H. Scherrer, John M. Wilcox, V. Kotov, A.B. Severny, and T.T. Tsap, *Nature*, 277, 635-637, 1979.

$2^h 40^m$ Oscillation Observations at Stanford, Philip H. Scherrer, in *Proceedings, Symposium on Large-Scale Motions on the Sun*, Sacramento Peak Observatory, 1978.

An Observational Search for Solar Pulsations at Periods from Seven to Seventy Minutes, P.H. Dittmer, *Astrophysical Journal*, 224, 265-775, 1978.

An Observational Search for Large-Scale Organizations of Five-Minute Oscillations of the Sun, P.H. Dittmer, Philip H. Scherrer, and John M. Wilcox, *Solar Physics*, 57, 3-11, 1978.

Large-Scale Periodic Solar Velocities: An Observational Study, P.H. Dittmer, Ph.D. Thesis, Stanford University, Applied Physics Department, March 1977.