

January 15, 2003

**Final Report**

**For NASA Grant NAG5-11028**

(1997 through 2001)

**Solar/Stellar Irradiance Comparison Experiment — (SOLSTICE)**

On the

**Upper Atmosphere Research Satellite (UARS)**

**Laboratory for Atmospheric and Space Physics (LASP)**

**University of Colorado — Boulder**

Principal Investigator: Gary J. Rottman

Laboratory for Atmospheric and Space Physics  
University of Colorado  
Campus Box 590  
Boulder, Colorado 80309-0590  
Telephone: 303-492-8324  
Fax: 303-492-6444  
Gary.rottman@lasp.colorado.edu

Co-Investigators:

Thomas N. Woods  
Laboratory for Atmospheric and Space Physics  
University of Colorado  
Campus Box 590  
Boulder, Colorado 80309-0590  
Telephone: 303-492-4224  
Fax: 303-492-6444  
Thomas.woods@lasp.colorado.edu

Julius London  
APAS Department  
University of Colorado

Thomas R. Ayres  
APAS Department  
University of Colorado

## **OVERVIEW of the Support of the UARS SOLSTICE, 2001 through the present**

NASA Grant NAG5-11028 was placed at the University of Colorado, and became effective on July 1, 2001. This grant supported the operational activities related to the UARS Solar Stellar irradiance Comparison Experiment (SOLSTICE). There has also been a concurrent NASA grant (NAG5-97145) with the University of Colorado that supported the scientific activities of SOLSTICE. The UARS SOLSTICE originated at the University of Colorado in 1981 (under contract NAS5-27750). One year after the UARS launch in 1991, the operations and research support activities for SOLSTICE were moved to the High Altitude Observatory (HAO) of the National Center for Atmospheric Research (NCAR). The SOLSTICE program continued at HAO under a NASA Contract S-87289-E with the National Science Foundation, and after four years it was moved once again back to the University of Colorado. At the University after 1997 this subject grant was issued to further extend the operations activities from July 2001 through September 2002. Although this is a final report for one particular NASA grant, in fact the SOLSTICE operations activity — first at the University, then at HAO, and now again at the University — has continued in a seamless fashion.

### **SOLSTICE Description**

The SOLSTICE is one of the nine instruments on the Upper Atmosphere Research Satellite. The primary scientific objective of SOLSTICE is to obtain full disk solar irradiance measurement in the ultraviolet between 120 and 440 nm. The instrument uses a set of stars as calibration standards and tracks changes in its sensitivity by repeated observations of these stellar targets. To achieve this goal the SOLSTICE must be Sun pointed during about 2/3 of the available observing time. The remaining time is used to conduct specific calibration experiments with special emphasis given to the stellar observations. Due to the degradation in the UARS SSPP open loop tracking the stellar observations were abandoned in late 2001.

### **Data Processing**

Following the announced decommissioning of the Central Data Handling Facility (CDHF) at the NASA Goddard Space Flight Center (GSFC), the production processing system originally written for, and executed at the CDHF has been converted to execute within the UNIX computing environment at the Laboratory for Atmospheric and Space Physics (LASP). Spacecraft and instrument Level 0 data produced prior to September 2001 have been transferred to, and are managed locally at LASP; Level 0 data produced after September 2001 are received daily via the NASA PACOR-A system and incorporated into our local mission data archive. Routine data processing activities take place at the LASP scientific computing facility. Under this new data processing system, Level 0 data from our local archive are processed under strict configuration management into scientific Level 3 products, which are subsequently delivered to the GSFC DAAC, and also made available to the UARS science team and the scientific community as a whole via a WWW interface. These changes have been implemented, tested, and executed at LASP.

### **Planning, Scheduling, and Sequencing**

Instrument activities have been conducted according to an established observing policy endorsed and supported by the UARS Science Team. During the normal scheduling cycle, the SOLSTICE staff at LASP prepare and forward the daily activity plan, consisting of the instrument operational configuration and selected targets, to the Mission Planning Group at the GSFC. When necessary during the course of normal operation, minor modifications to the daily plan have been submitted. The targets are determined using planning data coupled with preliminary analysis of the most recent observations.

The SOLSTICE planning and scheduling system has: 1) accepted requests for science experiments, 2) generated error free commands and experiment sequences, 3) managed the instrument microprocessor memory, 4) interfaced with the UARS POCC, 5) maintained an image of the microprocessor memory for verification, and 6) maintained a record of all planned and completed experiments.

### **Instrument Control and Monitoring**

The SOLSTICE configuration has been monitored at the LASP Ground Support Facility in Boulder to identify and, when necessary, we have responded to problems or anomalies. The capability to perform this task was developed at the University of Colorado as the SOLSTICE OASIS system, was validated during the instrument test and integration, and has now successfully operated during the 11 plus years of flight operations.

## **Remote Operations from the LASP Facility in Boulder**

The SOLSTICE flight operation facility located at LASP in Boulder has carried out the long-term planning, instrument performance analysis. Communication lines transfer planning requests from the LASP remote facility to the POCC and they transfer the instrument data to the remote facility. The remote facility has carried out quick-look analysis to assure the correct instrument performance and also to enable members of the science team to support the ongoing planning and evaluation activities at the POCC.

## **Instrument Performance Analysis**

The performance of the SOLSTICE has been monitored at all times to insure that the instrument and its calibration are understood and documented. This has allowed the SOLSTICE team to anticipate and react to any performance changes that occurred during the extended mission. This analysis was used to assess status and to predict long-term trends in the instrument behavior. Relevant data are archived at the LASP facility and access tools have been maintained at both LASP and GSFC.

## **Performance**

The LASP provided the facilities, materials, services, and personnel necessary to support UARS and to conduct science analysis using data from the SOLSTICE instrument (developed by the University of Colorado under contract NAS5-27750). The SOLSTICE Operations complied with the University of Colorado proposal to NASA Headquarters entitled, "UARS SOLSTICE Continued Operations" with a start date of July 1, 2002, the UARS Instrument Definition Phase Technical Report dated June 1981, the NASA Headquarters selection letter, Calio to Rottman, dated November 27, 1981.

## **Software**

Data Processing Software - The LASP maintained and upgraded, as required, the SOLSTICE batch data processing software that was resident in the UARS CDHF at the GSFC. The resident software produced calibrated and validated Level 1, 2 and 3A data products. Documentation control of the processing software was updated as changes are made. These activities were migrated to LASP in 2001.

Data Analysis Software - The LASP prepared and maintained data analysis software to support SOLSTICE science activities.

## **UARS Operations and Project support**

The LASP, through the Principal Investigator and Program Manager, participated in the activities of the UARS Operations Team, attending meetings when appropriate

## **Status and Financial Reporting**

Reports were provided to the UARS Project that set forth the technical and cost status of the SOLSTICE program.

Weekly Report - Summary of SOLSTICE activities for the week.

## **Specific Activities:**

Educational Outreach: Numerous presentations were conducted for Elementary through High School level students, as well as presentations to Adult Organizations.

Undergraduate and Graduate Student involvement:

Undergraduate Students were involved in all aspects of UARS/SOLSTICE operations activities.

Two Graduate Students completed Ph.D. work, utilizing SOLSTICE Scientific data.

## **Publications developed through UARS SOLSTICE Research:**

There have been over 50 publications authored by LASP scientists and directly supported by this Operations Contract and by the Science Grant. In addition, there are innumerable other publications and scientific investigations that use the SOLSTICE data.

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