

**CO-OP WORK REPORT**

**SCHOOL OF AERONAUTICAL AND ASTRONAUTICAL ENGINEERING  
PURDUE UNIVERSITY**

**WORK PERIOD**

**# 1  
Summer 2001**

**AT**

**Ball Aerospace & Technologies Corp.  
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Boulder, CO 80301**

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## **Introduction**

This report was written to provide an overview of Ball Aerospace & Technologies Corp., the Co-op program at BATC, and my experience during my first work period. Included is a description of BATC's location, some of the major projects and products they have worked on, and a brief description of the Co-op program at BATC. As a final note, there is a summary of the duties I performed during my first work period.

## **Ball Aerospace & Technologies Corp.**

Ball Corporation, which makes glass jars and food/beverage cans, is the parent company of BATC. The main BATC campus is in Boulder, Colorado. There are also satellite campuses in Broomfield (near the Ball Corporate Headquarters) and in Westminster. These locations are all within ten miles of each other. BATC also has multiple marketing offices around the country. The Boulder campus is home to BATC's machine shops, test facilities, and most of the engineering/design offices.

BATC has played a vital role in the development of space technologies for the past 45 years. BATC built seven of the instruments on the Hubble Space Telescope, the aspect camera and the science instrument module for the Chandra X-Ray Observatory, the OSSE and two star tracking devices for the Compton Gamma Ray Observatory. BATC also built the Spaceborne Imaging Radar used in the Shuttle Topography Missions, Deep Impact (which will collect data as it impacts a comet), and the CTA for SIRTf. BATC is currently developing the NGST in partnership with TRW. Along with these major highlights, BATC has been and continues to be a part of many other NASA and commercial space endeavors ranging from Earth observing satellites to formations of space borne telescopes that use lasers to communicate with one another.

Along with participation in many spacecraft programs, BATC manufactures products for the more down to Earth corporation. BATC manufactures antennas that mold to almost any surface, including an aircraft fuselage. BATC also makes advanced night vision video cameras that are ideal for military or commercial use, vacuum safe

lubricants, portable fuel cell power supplies, astronomical pointing and tracking devices, cryogenic coolers, and fast steering mirrors.

As a Co-op at BATC, the students are placed in one division of the company, I was placed in the spacecraft subsystems group. While working as a Co-op, a student has a functional manager and a mentor. The functional manager is the formal boss. They assign where the student will work for each work session. The mentor is whom the student works with on a daily basis. They give you specific projects to work on. So, through out the five work sessions it is probable that the student will have the same mentor and functional manager. Functional manager and mentor will change if the student decides to change the division that he/she works for.

## **Work Experience**

During my first work period at BATC, my major responsibility was to design and assist in the fabrication of GSE cables. These cables are designed for use during the thermal vacuum test that the CTA will undergo (see appendix B-1). I began this process with an overall block diagram of the electrical system that I was dealing with (see appendix B-5). This diagram consisted of the cables from the CTA cold electronics (near the telescope) to the CTA warm electronics (in the spacecraft bus) to the GSE (see appendix B-2 & B-3). After completing the block diagram, I reviewed the drawings for the GSE cables that were currently in use and I redesigned the cables with 37-pin connectors in the middle of them, so they could feed through the thermal vacuum wall (see appendix B-6).

After the preliminary design was complete, I worked with the production team to correct any fabrication specifications, i.e. workmanship specifications and parts, and made the applicable changes to the drawings. Once the cables were built, I officially released the cable drawings. The process of releasing a drawing requires the signature of multiple people including the responsible engineer, the production manager, quality control, and the applicable systems engineers. Although it is not typical to build from an unreleased drawing, time requirements forced us into doing so. Once the cables were built, I assisted in directing proper installation into the thermal vacuum chamber.

Since the GSE cabling was complete, I got assigned to assist the optical test crew for the thermal vacuum test. During the thermal vacuum test, a mirror assembly (named ART) sits on top of the CTA (see appendix B-4). This assembly reflects light from

sources inside the electronics module (see appendix B-3) back down to the telescope.

This is used to make sure that the telescope is aligned correctly. My duty was to run the software that controls the tilt of the mirror (named OSCAR) which is part of the ART assembly.

## **Appendix A – Abbreviations**

ART – Articulated Test Flat Assembly

BATC – Ball Aerospace and Technologies Corp.

CTA – Cryogenic Telescope Assembly

GSE – Ground Support Equipment

NGST – Next Generation Space Telescope

OSCAR – Optical System Cryogenic Alignment Reference

OSSE – Orientated Scintillation Spectrometer Experiment

SIRTF – Space Infrared Telescope Facility

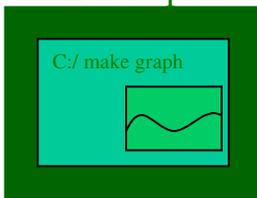
## **Appendix B – Drawings**

1. Pictorial Thermal Vacuum Setup (Page 10)
2. CTA Diagram (Page 11)
3. SIRTf Cross Section (Page 12)
4. ART Schematic (Page 13)
5. CTA, SI, PCRS Electrical Test Setup Block Diagram (5 pages)
6. Cable Assy, Test DMS/Vac Chamber (5 pages)

# Pictorial Thermal Vacuum Setup

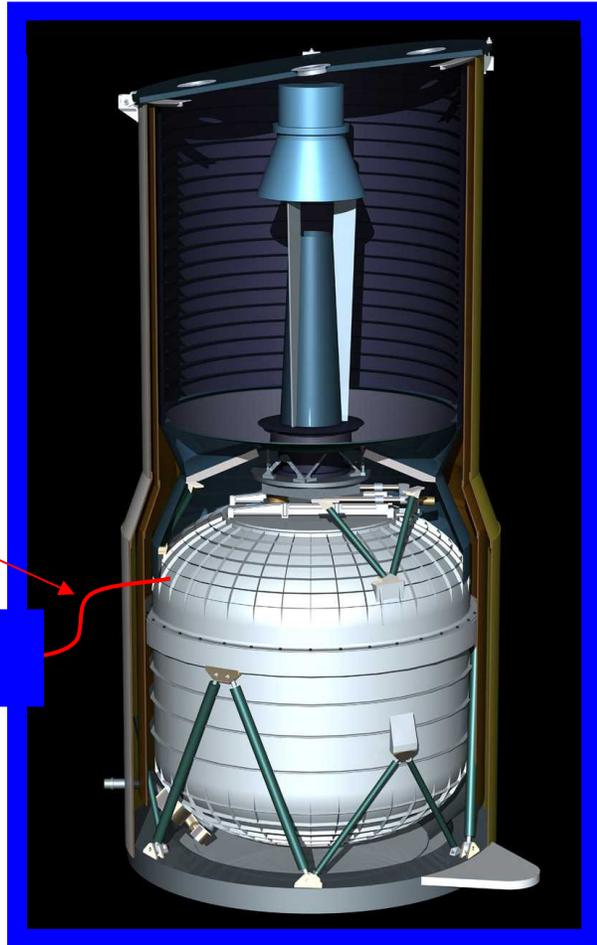
## Thermal Vacuum Chamber

Science Instrument  
GSE Computers

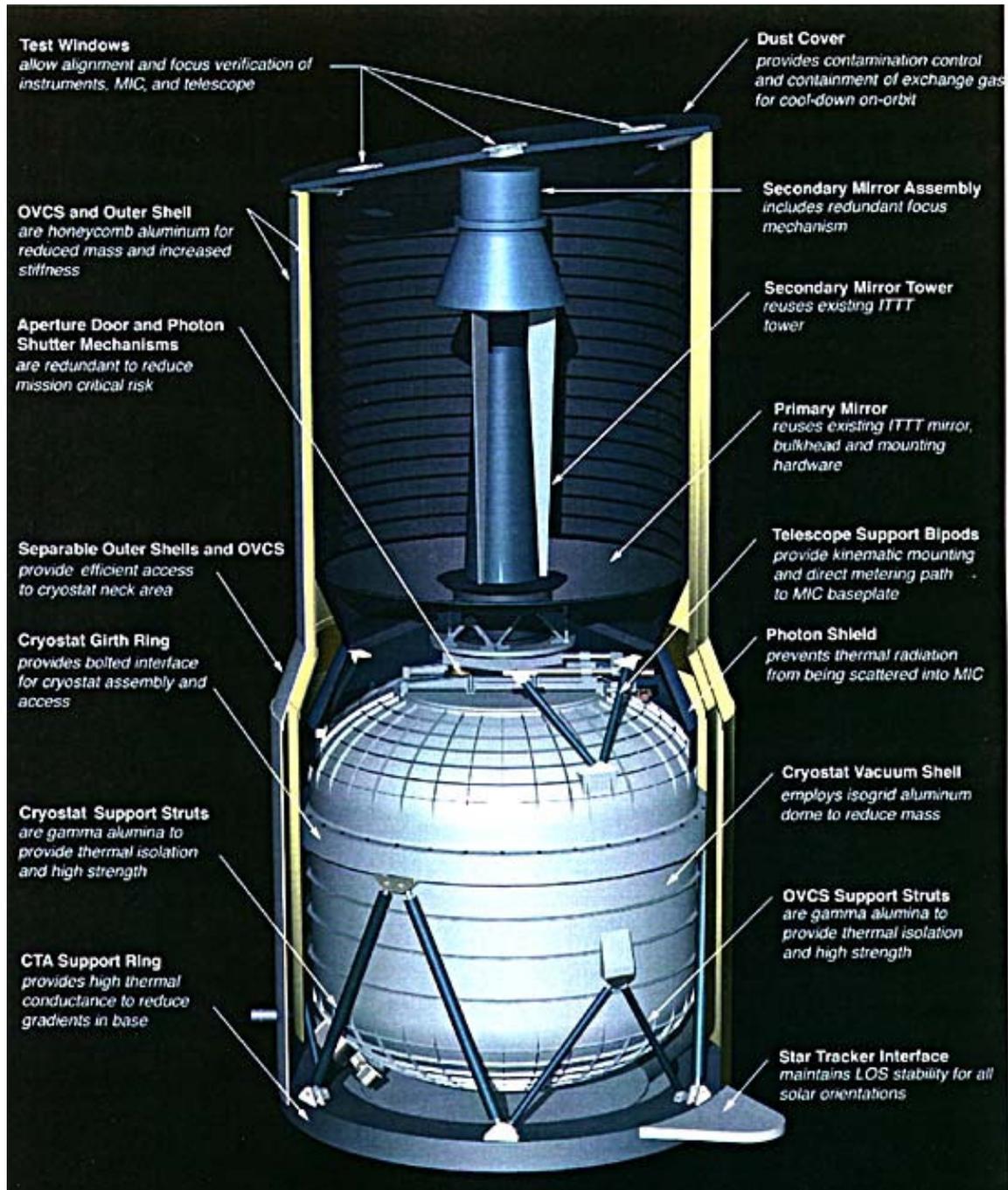


GSE Cable

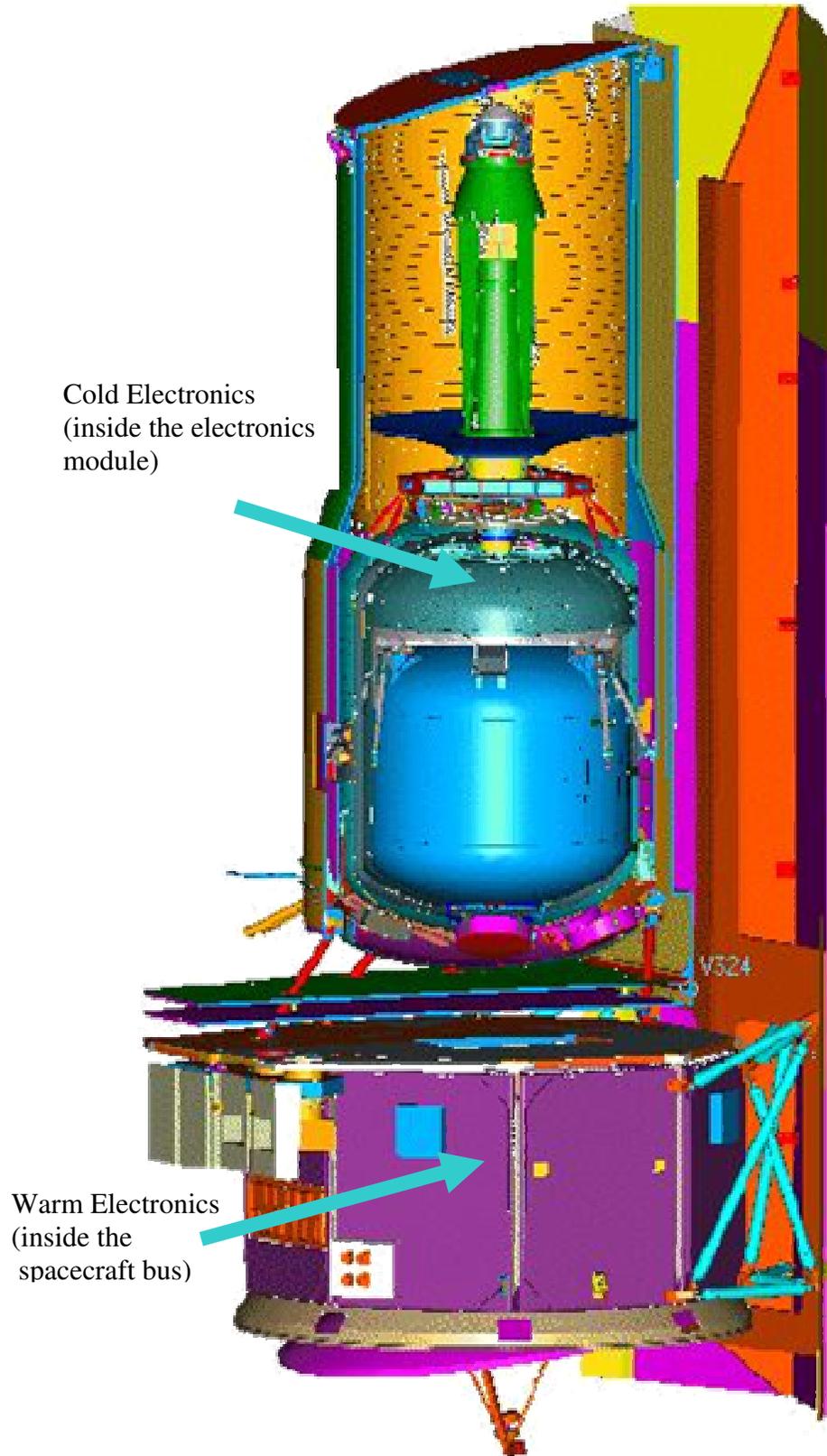
Feed Through Plate



# CTA Diagram



## SIRTF Cross Section



**ART Schematic  
(inside thermal vacuum chamber)**

