

SPACE PORTABLE SPECTROREFLECTOMETER (SPSR)

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JUNE 1998



INTRODUCTION

- SPACE PORTABLE SPECTROREFLECTOMETER (SPSR) IS A PORTABLE, HAND HELD EVA INSTRUMENT USED TO MEASURE SOLAR ABSORPTANCE (ALPHA) OF MATERIALS' SURFACES**
- ALPHA IS ONE OF THE KEY THERMAL CONTROL PROPERTIES FOR MATERIALS USED ON SPACECRAFT EXTERNAL SURFACES**
- SPSR WAS UTILIZED IN A JOINT USA/RUSSIAN EXPERIMENT TO DIRECTLY MEASURE ALPHA OF EXTERNAL MIR THERMAL CONTROL SURFACES**

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APPLICATION OF SPSR ON MIR

- DIRECT MEASUREMENT OF MIR SURFACES' SOLAR ABSORPTIVITY**
 - » RUSSIAN THERMAL CONTROL MATERIALS VERY SIMILAR TO USA MATERIALS**
 - » SOME MIR SURFACES EXPOSED TO SPACE ENVIRONMENT FOR 12 YEARS**
 - MEASUREMENT OF DIFFERENT MODULES CAN PROVIDE DATA ON SURFACES EXPOSED FROM 2 TO 12 YEARS**
- DATA DIRECTLY APPLICABLE TO PREDICTIONS OF LONG TERM DEGRADATION FOR ISS FROM COMBINED ENVIRONMENTAL EFFECTS**
- SPSR AVAILABLE FOR LATER USE ON ISS, HST OR OTHER MISSIONS**

SCIENCE OBJECTIVES

- **PROVIDE FLIGHT TESTING OF SPACECRAFT MATERIALS BY MEASURING TOTAL HEMISPHERICAL REFLECTANCE FROM 250 TO 2500 NM**
- **PROVIDE DATA TO VALIDATE GROUND TEST FACILITIES AND PREDICTION MODELS FOR MATERIAL BEHAVIOR IN SPACE**
- **DEVELOP AND TEST A REUSABLE FLIGHT INSTRUMENT FOR STUDY OF THE BEHAVIOR OF MATERIALS IN THE SPACE ENVIRONMENT**
- **DETERMINE EFFECTS AND DAMAGE MECHANISMS OF THE MIR SPACE ENVIRONMENT ON MATERIALS**

FUNCTIONAL OBJECTIVES

- **DURING EVA, TAKE REFLECTANCE MEASUREMENTS OF MIR'S EXTERNAL SURFACES**
- **TRANSFER REFLECTANCE DATA TO THE MIPS LAPTOP; DOWNLINK TO GROUND**



OPERATION WITH SPSR ON ORBIT

- SAMPLE WITH KNOWN REFLECTANCE CURVE AND SOLAR ABSORPTANCE INSIDE APERTURE COVER**
 - » DATA OBTAINED ON THE GROUND BEFORE LAUNCH, ON ORBIT AFTER ASSEMBLY OF SPSR, AND POST EVA WERE EXTREMELY REPEATABLE**
- ALL HOUSEKEEPING DATA OBTAINED FROM SPSR INDICATE THAT IT OPERATED WITH NOMINAL TEMPERATURES, BATTERY VOLTAGES AND THAT NO ANOMALIES WERE NOTED**
- IN POSTFLIGHT DISCUSSIONS WITH ASTRONAUT DAVE WOLF HE INDICATED THAT:**
 - » THE UNIT WAS EASY TO HANDLE**
 - » THE DISPLAY WAS EASY TO SEE AND THAT THE FEEDBACK CLEARLY INDICATED THE POSITION OF SPSR RELATIVE TO THE SURFACE**
 - » AND THAT OVERALL THE INSTRUMENT WAS EASY TO UTILIZE**



OPERATION WITH SPSR ON ORBIT (CONTINUED)

- THERE WERE TWO PROBLEMS UTILIZING SPSR**
- IN ORDER TO HOLD SPSR STEADY A RIGIDIZING TETHER ATTACHED TO SPSR AND THEN WAS TO CLAMP TO THE RADIATOR HANDRAIL**
 - » THE HANDRAIL WAS TOO LARGE FOR THE CLAMP AND IT COULD NOT BE FASTENED TO THE HANDRAIL. COSMONAUT ANATOLY SOLOVYEV TRIED TO HOLD IT STEADY**
 - » AFTER HAVING THE MLI REMOVED AND THE SPSR POWERED UP ONLY A MINUTE OR TWO THE DISPLAY FADED OUT OVER A 30 SECOND INTERVAL AND NEVER CAME BACK**
 - » WITHOUT THE DISPLAY DAVE WOLF COULD NOT DETERMINE THE POSITION OF SPSR ON THE SURFACE**
 - » HE HAD TO REMEMBER THE BUTTON SEQUENCE AND TIME THE MEASUREMENT**

EVALUATION OF SPSR DATA FROM KVANT II

- POSITION DATA INDICATES CONSIDERABLE MOVEMENT OF SPSR DURING MEASUREMENT**
- REFLECTANCE DATA INDICATES EFFECTS OF MOVEMENT**
- SOME RECOVERY OF DATA POSSIBLE DUE TO GEOMETRICAL NATURE OF LIGHT LOSS AND POSITION DATA AVAILABLE THRU MEASUREMENT**
- LABORATORY EXPERIMENTS PERFORMED WITH Z93 TO DETERMINE CALIBRATION CURVE**
 - » WITHIN ANGLES OF OUR MEASUREMENT, AZIMUTH AND TILT ANGLES NOT A FACTOR**
 - » REFLECTANCE MEASURE VERY DEPENDENT ON DISTANCE APERTURE OFF SURFACE**
- CORRECTION TERMS APPLIED TO SPSR DATA YIELDING QUALITATIVE RESULTS**
 - » ALL DATA INDICATE SHARP CUTOFF AT SHORT WAVELENGTH INDICATING MINIMAL CONTAMINATION ON SURFACES**
 - » SOME DEGRADATION OF SOLAR ABSORPTANCE BUT NOT QUANTIFIABLE AT THIS TIME**



NEXT STEPS

- RETRIEVE SPSR FROM KSC**
- DOWNLOAD DATA, VERIFY CALIBRATION OF FOUR POSITION INDICATORS**
 - » PRODUCE FINAL ANALYSIS OF DATA**
- CONDUCT STUDY TO DETERMINE WHY DISPLAY FADED**
- MODIFY DISPLAY AS NECESSARY TO CORRECT THE PROBLEM**
- PLAN FOR SPSR APPLICATION ON FUTURE MISSIONS**