



Multiple Experiment Facility

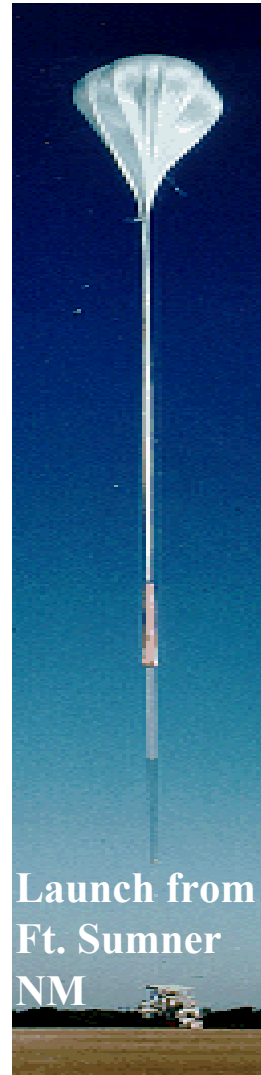
Balloon Workshop Aug 2007

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Test Flight June 2005



**Launch from
Ft. Sumner
NM**

DSTB Background

- **The DSTB was developed for Exploration Systems Mission Directorate to support research and technology developments**
- **The DSTB was developed to use LDB flights at the poles to provide access to the interplanetary GCR environment for investigations concerning crew exposures during Lunar and Mars missions**
- **Planned investigations include radiation transport code validation, development and maturation of radiation instruments, characterization of radiation shielding materials, simulate Martian surface environment, and proposed science investigations**
- **Investigations were reviewed based on relevance to program objectives and included NRA solicitations and program directed investigation**
- **With further definition of the exploration mission program the emphasis on crew radiation exposure shifted to Solar Energetic Particles (more important for short Lunar missions of <3 months), and the DSTB project was moth-balled**

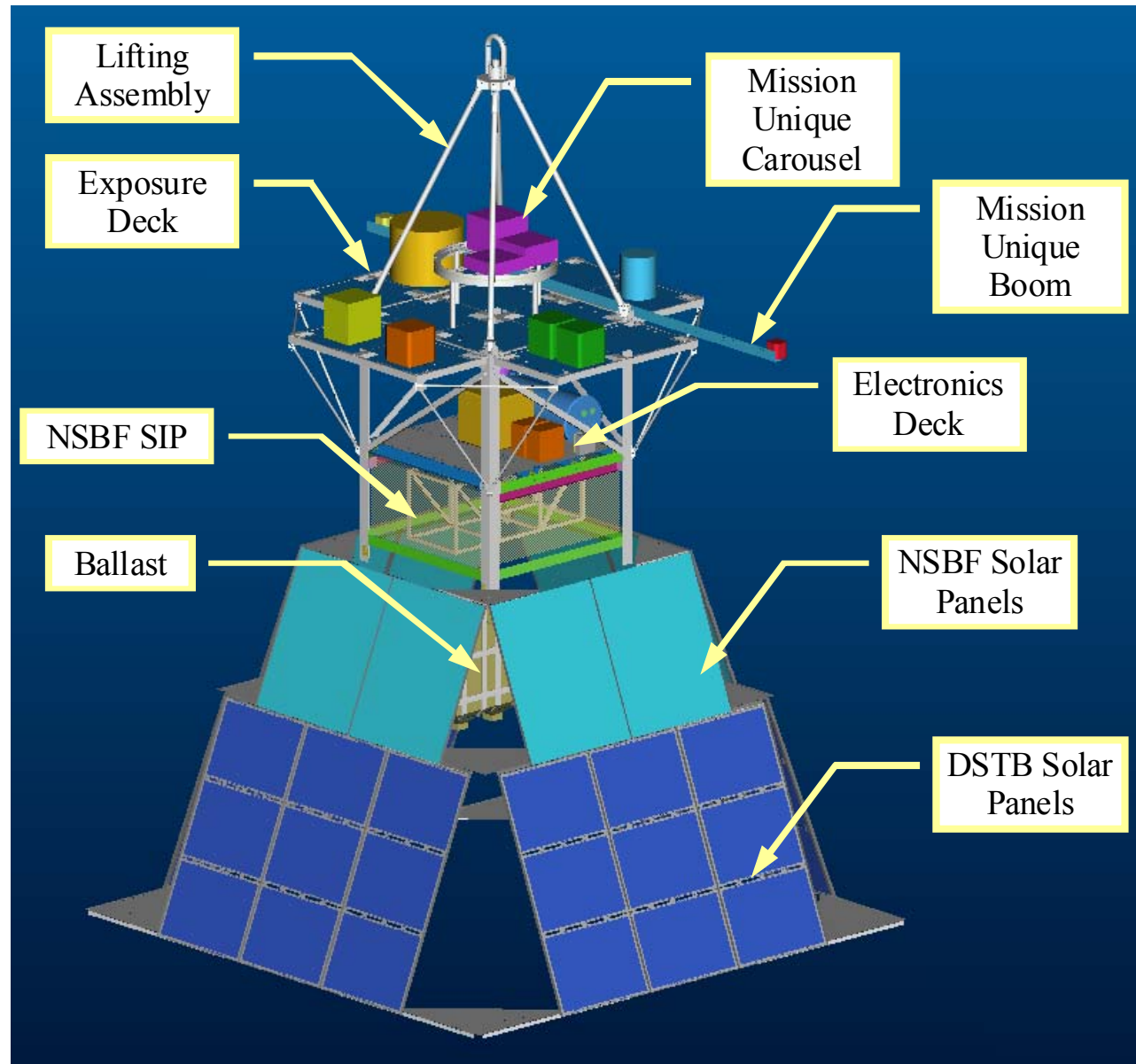
DSTB Design Goals

- **Purpose : DSTB was designed to conduct multiple measurements and science investigations on single balloon flights and to support annual campaigns**
- **Assumed maximum science payload at any current launch site**
- **Share/protect available resources among instruments**
- **Used standard interfaces between testbed and instruments, and current CSBF equipment**
- **Used an integration strategy that accommodates multiple investigations with varying degrees of complexity and ballooning experience**
- **Required 2 flight gondolas and associated support equipment**
- **Measure relevant exposure parameters with a standard instrument suite (charged particle fluxes, dose, temperature, position, altitude)**
- **Developed a flexible architecture to meet the wide range of requirements gathered from the user community**
- **User science and instrument expertise remained with investigator team**

DSTB: LDB Configuration

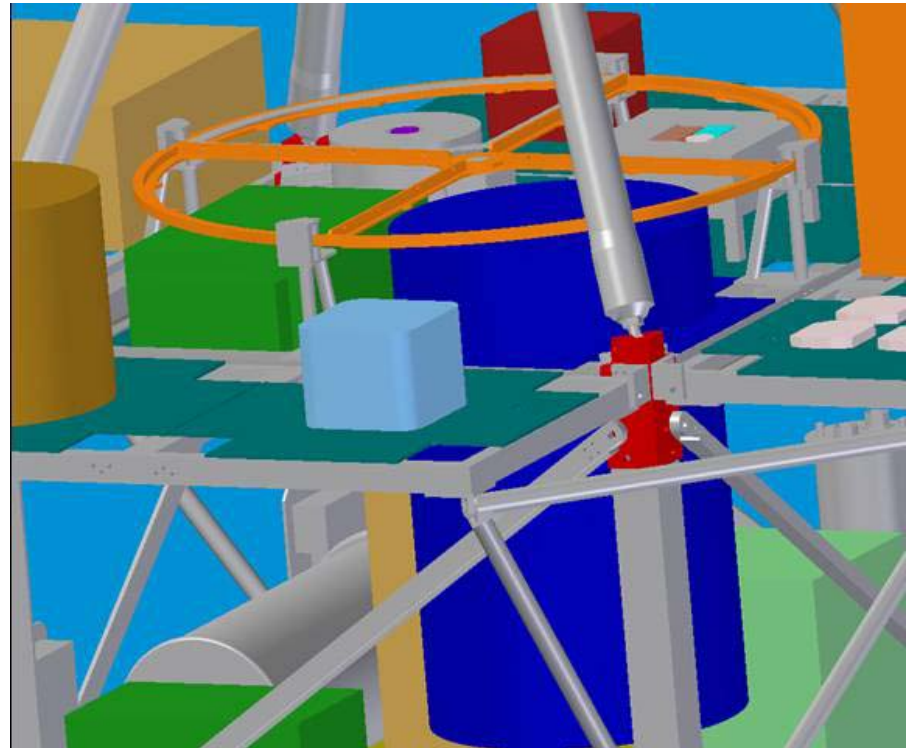
Resources

- **Mass: 4000 lbs**
- **Power: 600 watts**
- **Telemetry:**
 - 6kbs OTH
 - 300 kbs LOS
- **Data Stream: Standard communication protocol**
- **Instrument Field of Views: Skyward, Nadir, Horizon**
- **Envelope (w/solar arrays) 19.6×11.7×11.7ft³**



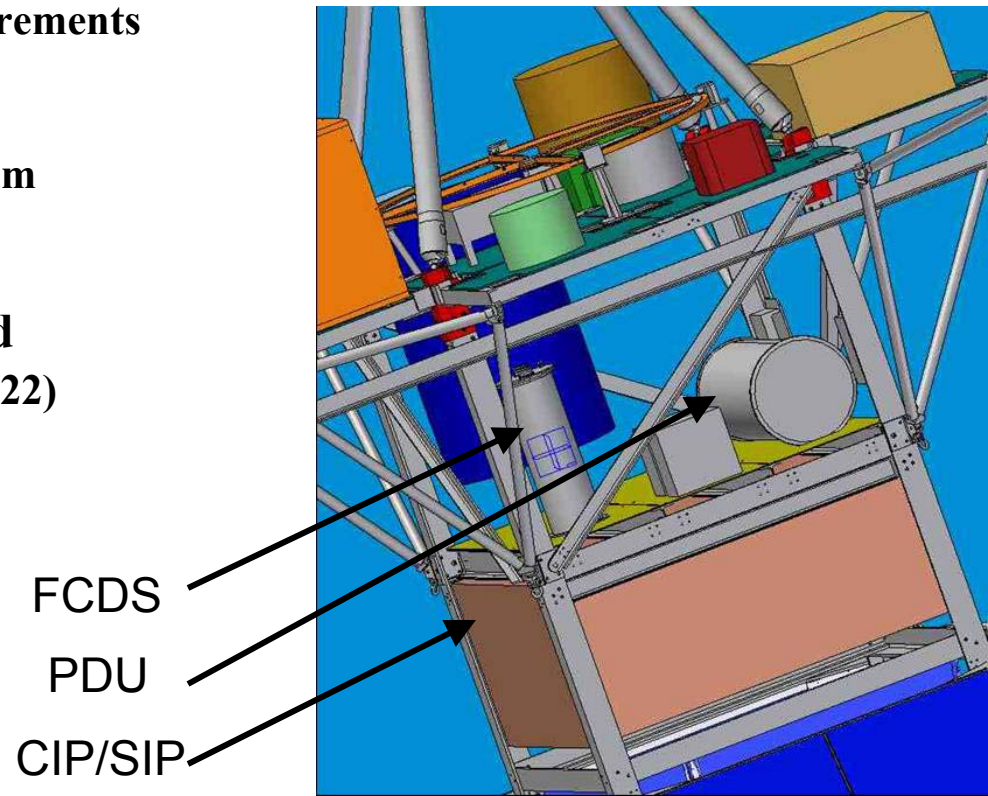
Experiment Attachment

- Gondola was designed for maximum payload mass for launch in Antarctica: 4000 lbs (1820 kgs) total “science” payload
- Typical attachment trays 150 lbs (68 kgs) and up to 2×2 ft² (61 × 61cm²)
 - 12 attachment trays on the exposure deck
 - Neighboring locations can be combined to support 2× and 4× the mass and footprint
- Electronic deck supports experiments up to 1000 lbs (455kgs)
- Special attachment points:
 - Boom: length(ft)×mass(lbs)
 - 4×87, 8×50, 10×36
 - Carousel: 40” diameter
 - 240 lbs load mass
 - program control of rotation
 - Suspended experiments
- Other gondola configurations requires new stress analysis



Flight Data System

- **Three components:**
 - **Flight Control and Data Storage (FCDS)**
 - **Smart Data Connector (SDC)**
 - **Balloon Flight Equipment (Science or Command Instrument Package)**
- **FCDS stack uses PC104 bus**
 - **Command (uplink) and data stream (downlink) parsed for individual instruments: bandwidth allocation based on instrument requirements**
 - **Existing Solid state disk 20-40 GBytes:**
 - allocation based on instrument requirements
 - **20 Tbase-100 ports (interface to SDCs)**
 - **ADC/DAC IO cards**
 - **Telemetry card for OTH/LOS data stream**
 - **PDU controller/monitor**
- **SDC based on Netburner controller board**
 - **2 standard interface port (RS-232, RS-422)**
 - **Data rate regulated**
 - **5/6 digital inputs/outputs**
 - **8 temperature sensors**
 - **4 Analog inputs**
 - **3 latching relays**
 - **2 momentary switches**



Power and Distribution

- **Power is developed from solar arrays for long duration flight; batteries for shorter flights**
- **Solar arrays (600 watts, Antarctica)**
 - **Omni-directional or sun pointed solar array configurations**
 - **Peak power tracking for battery charging**
 - **Regulated 28 volt output for instruments**
- **Battery packs**
 - **4 separate battery carriers**
- **Dual power: Combined payloads on batteries or on solar arrays**
- **Power Distribution Unit (PDU): 20 branch circuits, 1 for each instrument;**
 - **Each branch controlled/protected by a re-settable circuit breaker**
 - **Circuit breakers: 0.5, 1.0, 2.0, 5.0 and 10.0 Amps**
 - **Operate up to 120% of rated load and trip at 125%**
 - **Breakers/Instruments can be commanded on/off from ground station**
 - **Sub-systems have a dedicated circuit**

DSTB Instrument Integration

- **Ground station and support equipment**
 - **Dedicated ground computer/server with large data storage**
 - **Interfaces to CSBF data streams to uplink commands and receive telemetry data**
 - **Parses data stream for individual instruments and sub-systems**
 - **Provides a web-based interface for data access by investigators**
 - **Functions as test station during integration**
 - **Portable mechanical and electrical workstations**

- **NSSTC Integration facility**
 - **High bay facility for complete integration of gondola**
 - **Overhead crane and standalone hoists**
 - **Machine shop co-located**
 - **Standard laboratory equipment and supplies available**
 - **Users work space and office space available**
 - **IT services provided**

DSTB Field Support

- **Balloon Flight Equipment Integration and Compatibility Test**
 - Transportation of integrated DSTB facility to test site
 - Support balloon equipment installation (CIP/SIP) and check-out
 - Compatibility and Hang Tests
- **Flight Support**
 - Transportation to launch site
 - Functional test of DSTB payload
 - Flight requirements and readiness reviews
 - Conduct instrument operations during flight
 - Support investigators access to data in near-real time
 - Recovery operations and return transportation
 - Experiment data set delivered including flight exposure parameters

DSTB Test Flight

- **An 8-hour test flight was completed in June 2005 in NM**
- **Carried Instruments to measure test-bed environment**
 - **Spectrometers: charged particle, gamma-rays, neutrons**
 - **Active and passive dosimeters:**
- **Proto-type instruments of some selected investigations**
- **Student experiments to test operations and integration processes**
- **Exercised power system (including solar arrays), data and command system, carousel and DSTB housekeeping instrumentations**
- **Qualified for polar flights**

Instruments on DSTB Test Flight

- **Charged particle spectrometer- Incident GCR as modified by atmosphere overburden and below shielding:
 Z=1→28 Energy: 0.1 to 5 GeV GF: 500 cm²-sr**
- **Neutron flux and spectra; thermal to >100 MeV at various locations,
 6 He³ proportional counters with/without moderator**
- **Gamma-ray spectra with NaI scintillator**
- **Operational dosimeters – Types presently used in space for dose, LET spectra and neutrons: Tissue equivalent proportional counter; Lulin solid state dosimeter; passive nuclear track detectors**
- **6 student experiments to exercise data system**
 NASA Space Grant/Student Launch Initiative :
 - **Characterize Aerosols/Penn. State Univ**
 - **Thermodynamics of Balloons/UAH**
 - **Characterize Radiation Environment/Montana State Univ.**
 - **Technology development for measuring magnetic fields/Auburn**
- **Venture Crew Nadir Video**
- **eMASS/ 3-axes acceleration measurement during DSTB test flight**

DSTB Test Flight



DSTB Status

- **Design and fabrication completed:**
 - simple interfaces (power, data, mechanical) to minimize integration time, suitable for science teams inexperienced with ballooning**
- **Two gondolas available:**
 - Can support 1 or 2 flights per year**
- **DSTB monitoring instrumentation developed:**
 - charged particle spectrometer, dosimeter, proportional counter, neutron spectrometer**
- **DSTB integration process developed and simple**
- **Development team resides at NASA/MSFC and UAH (NSSTC)**
- **Qualification Flight completed:**
 - all subsystems tested, capable of launching from all current launch sites, test flight payload included 12 independent instruments/investigations**
- **Documentation on DSTB was developed for distribution to potential users for a previous NRA**