Space Weather Economic Forum

May 19, 2009

Technology Tools for Space Weather Advancement

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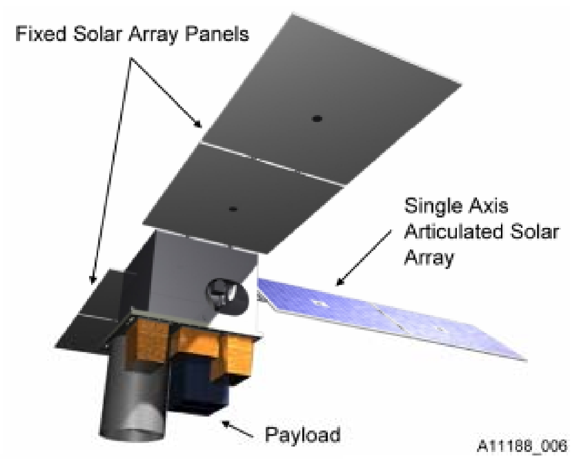
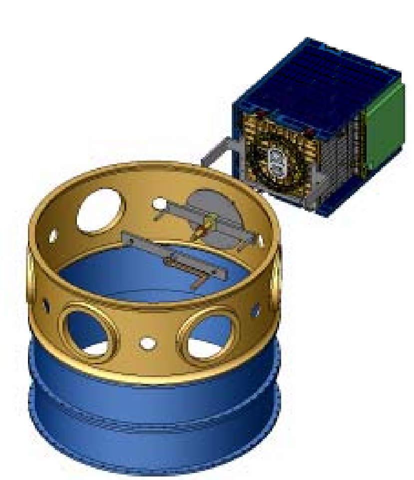
STP-SIV - Standard Platform for Small LEO Payloads





ESPA-Compatible

- **Standard payload-to-spacecraft interface for all experiments designed with AF Kirtland STP**
- **Reduces non-recurring cost for repeat builds**
- **Designed/tested to rigorous requirements (e.g. MIL-STD-1540e)**
- **Robust mounting, electrical, and data interfaces accommodate a wide variety of payloads**
- **Designed for a range of LEO orbits without design changes (including solar array)**
- **Key deliverable is Payload User's Guide (PLUG) that describes the interface for PL providers similar to LV User's Guides**

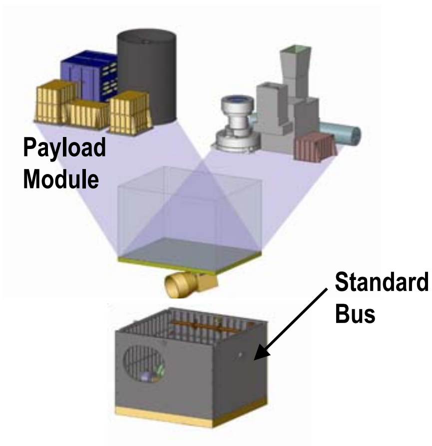
Designed to Support Scientific, Technology Development, and Risk-Reduction Missions

STP-SIV Support for Experimental Payloads

Payload Accommodation Parameter	SIV Payload Support Capability
Payload mass	60 kg
Payload OAP	100 Watts
Payload Volume	0.14 m3
Payload Field of View	Clear 3π steradian
Number of Payloads	Up to Four
Payload Data Handling	Up to 2 Mbps per Payload
Payload Data Storage	7.6 Gbit
Payload Digital Command & Data Interface	RS-422 provides high rate science data, command, and bi-level discrete input/output
Payload Analog Data Interface	8 analog channels per payload for PL health and status
Payload Heat Rejection	100 Watts
Interface Temperature	-20° C to +50° C

Capable Host for Many Small Payloads

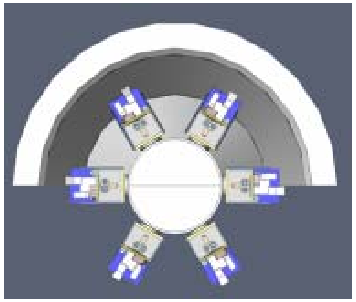
- **SIV accommodates up to 4 payloads**
- **SIV enables smooth payload integration**
  - Standard payload interface defined in STP-SIV Payload User's Guide
  - S/C simulator with payload interface electronics and software available early to payload providers
- **Second SIV#1 payload added after CDR without bus design changes**



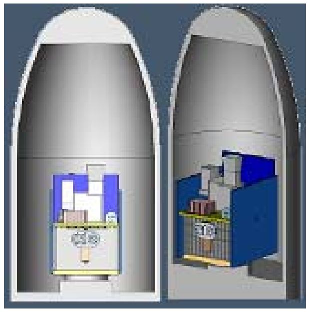
SIV Provides Mission Flexibility

Spacecraft Parameter	SIV Capability
Orbit Altitude	400 – 850 km
Orbit Inclination	40° – 98.8°
Launch Mass	≤ 180 kg
SV Dimensions (cm)	60.9 x 71.1 x 96.5
SV Lifetime	1 year
Stabilization Method	3-axis
Pointing Modes	Nadir, Solar, Inertial
Attitude Knowledge	0.022° 3σ
Attitude Control	0.1° 3σ (nadir mode)
Bus Voltage	28 V ± 6 V
Comm Frequency	Secure SGLS
Command Rate	2 kbps uplink (via AFSCN)
Telemetry Rate	2 Mbps downlink (via AFSCN)

- Accommodates multiple altitudes and inclinations without design modification
- Compatible with numerous launch vehicles
  - ESPA
  - Minotaur I & IV
  - Pegasus/Raptor
  - Other Commercial Launch Vehicles



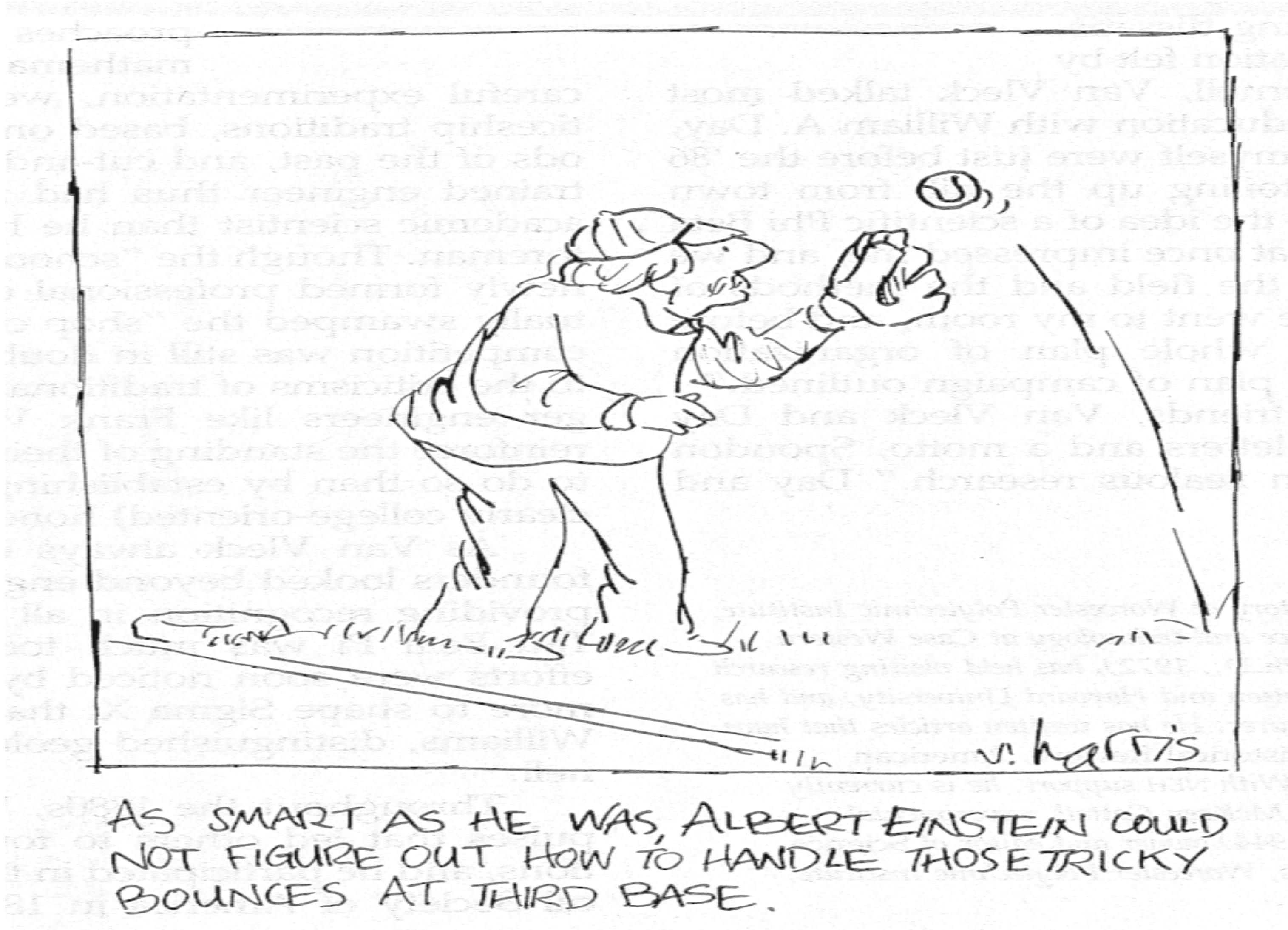
ESPA



Minotaur 1

Adaptable to Many Missions With Standard Bus Design

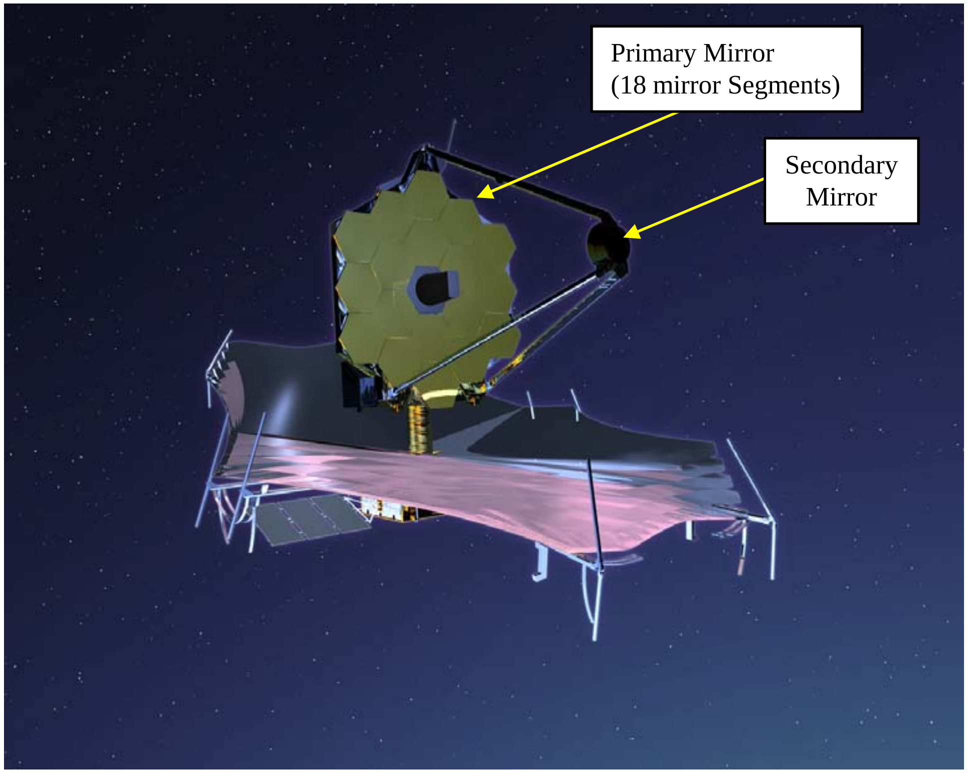
STP SIV should make the Space Weather Game more Fun: Fewer Tricky Bounces



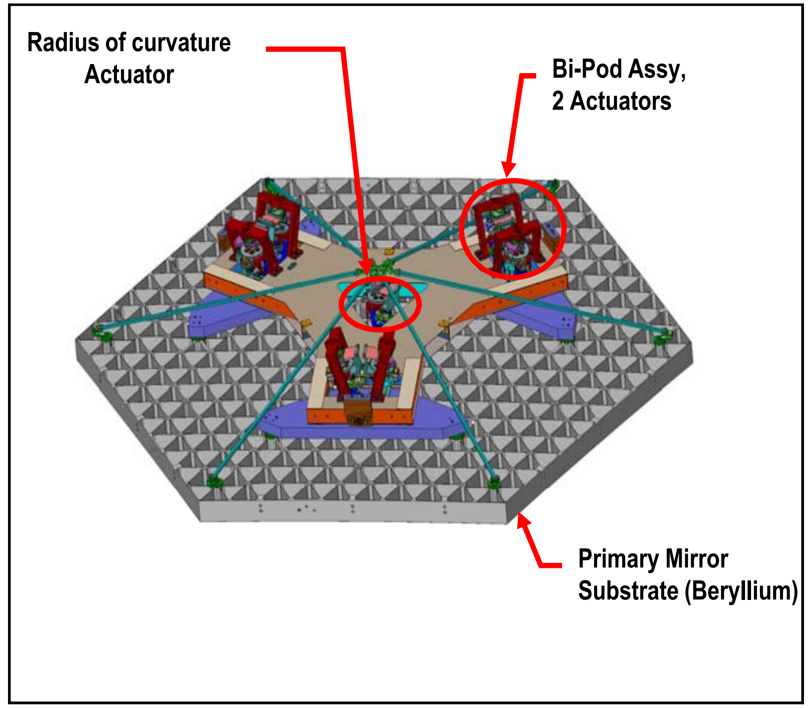
On the Questions of Support for Improved SW Warning & Prediction

- CME and solar flare warnings could be provided by a train of interplanetary monitoring platforms in the inner solar system (e.g. 0.7 AU)
  - Logical extension of SIV rationale
  - More time than a L1 based mission
  - Orbit is like a proposed near Earth asteroid avoidance system
- Ambient on site temperature radiation monitoring electronics for Moon and Mars
  - Electronics developed for JWST mirror positioning operates at room temperature and at 40 K
  - Using silicon detectors could provide ambient radiation monitoring on surface of Moon and Mars
- Understanding physics of magnetic instabilities at Sun vital to develop models to better predict Space Weather
  - Provide high spatial, temporal and QE resolution of the Sun in the near IR

Recent Development of Cryogenic Electronics: Apply to other Extreme Environments for Space Radiation Monitoring

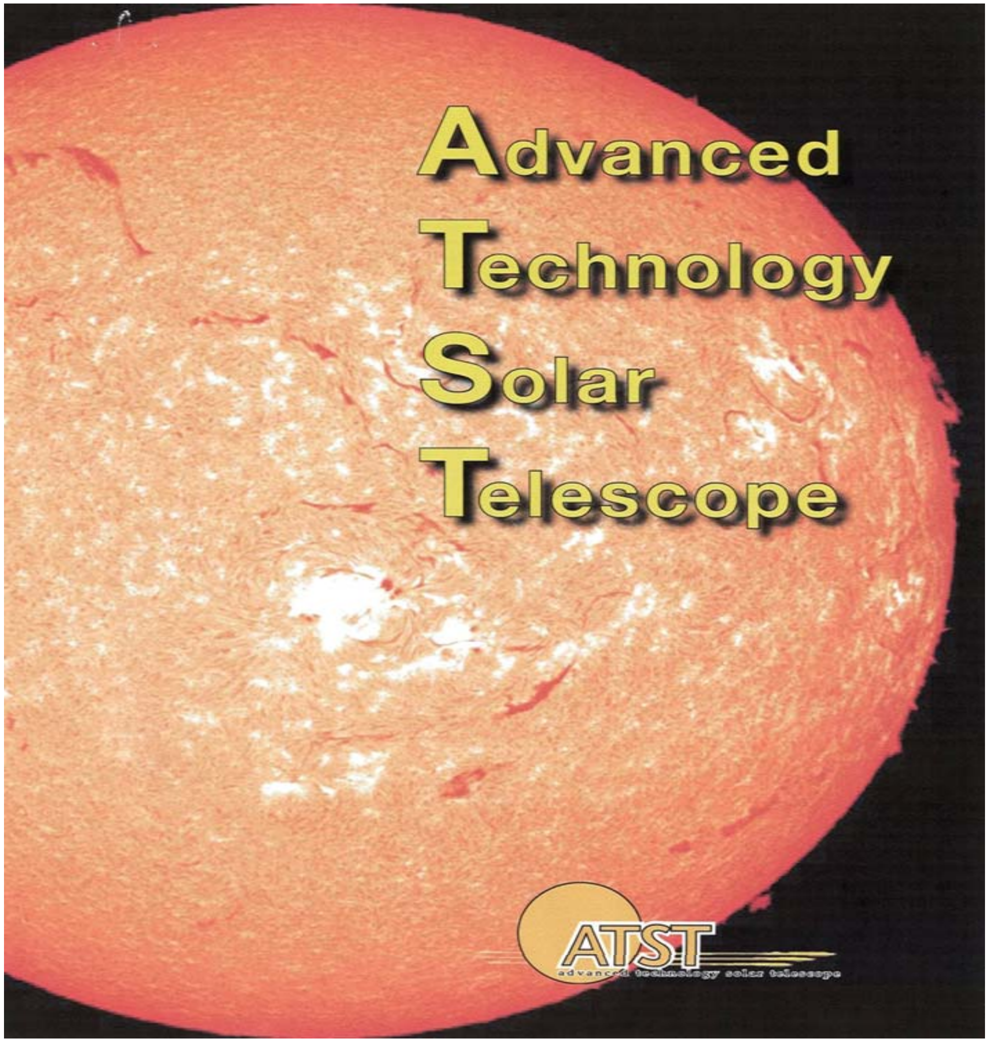


Primary Mirror Segment (7 Actuators)



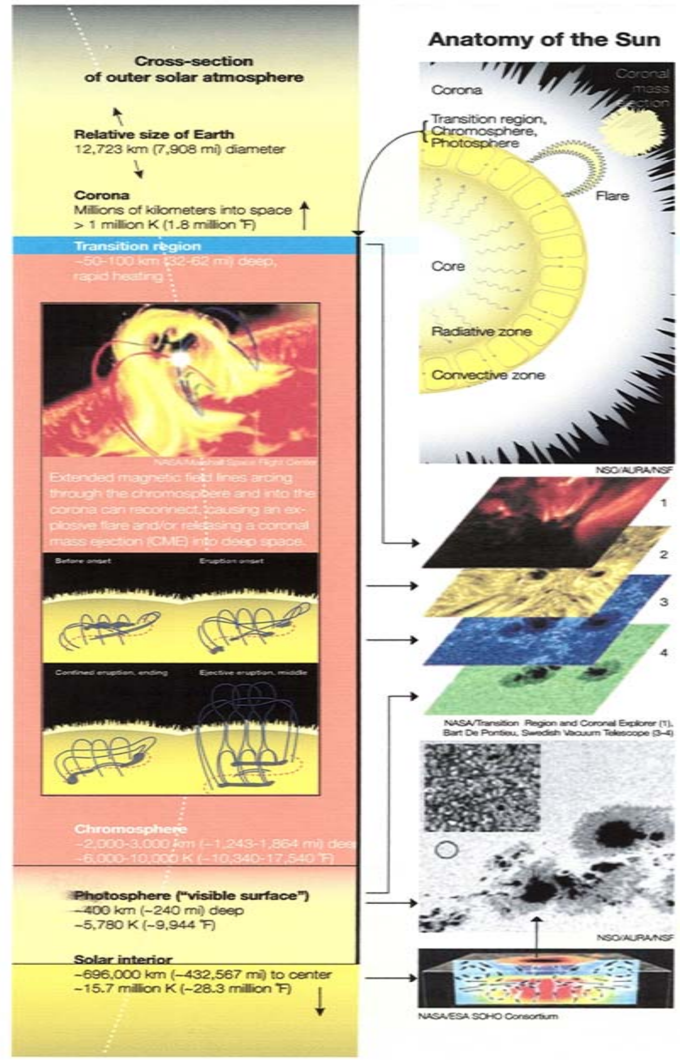
- **BATC is responsible for optical telescope element (OTE) optical hardware**
  - **Telescope is passively cooled to below 50K – actuators and electronics must operate at room temperature and at cryo**

ATST will greatly increase Understanding of Fundamental Solar Physics and Predictability of Space Weather



Specialized CCD technology is Critical for ATST success

- Solar Telescope areal resolution at Sun is equivalent to the size of Texas currently.
  - ATST will use AO and 4 meter off axis telescope to increase resolution to < 70 km fundamental scale lengths
- Temporal resolution is currently several Hz.
  - Goal for ATST is 100 Hz
  - Requires specialized electronics and processing techniques as part of the array
  - Produce a high quality movie to understand the physics and see if your fundamental modeling can reproduce the observed phenomena
- <u>The array technology to meet these goals does not currently exist and may be difficult to leverage other from projects</u>



Backup

SWEF Presentation

Small to Medium Spacecraft

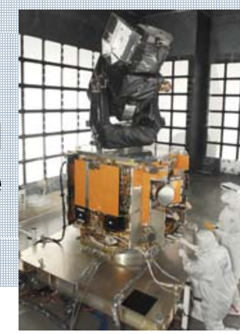
- Imaging satellites with precision attitude control
- Interplanetary spacecraft
- Space science missions
- Autonomous proximity operations

NPOESS Preparatory Project

WorldView-1

WorldView-2

Space Based Space Surveillance

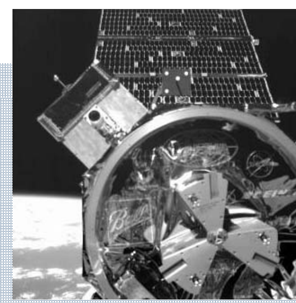


Medium Satellites (~1,000 kg)

Deep Impact

Kepler

Specialty Spacecraft (3,000 kg)

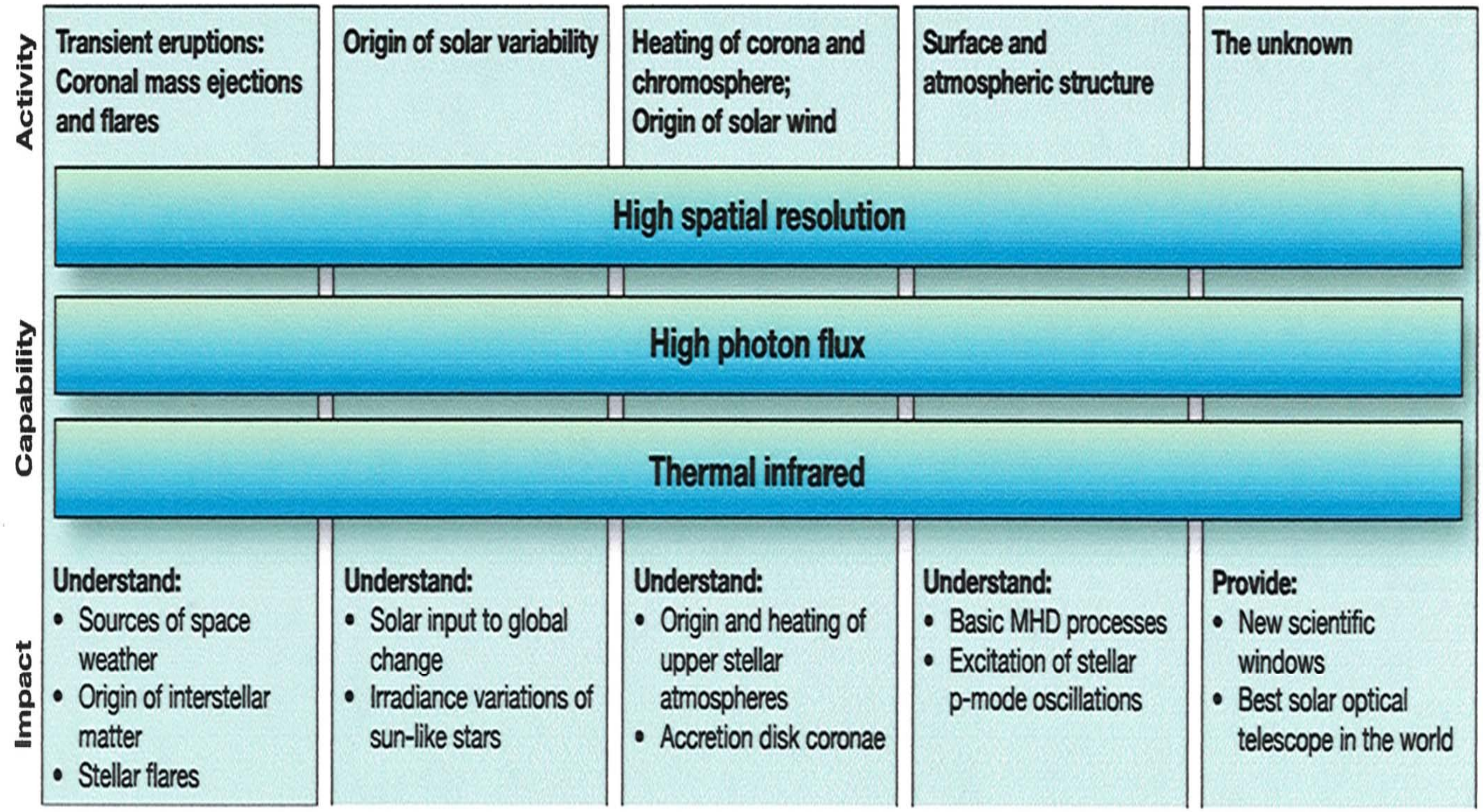


Orbital Express

Small Satellites (100 kg)

STP-SIV

ATST Focus



NSO/AURA/NSF

ATST's capabilities will allow us to probe a broad range of solar activities that have significant social and scientific impacts.

Agility to Innovate, Strength to Deliver

QuickBird image of Ball Aerospace employees