Solar Splinter Group

Summary Report

Team members

Leader:

Brian Dennis	Code 682, GSFC

Members:

David Rust	JHU/APL
Bob Lin	UC Berkeley
Derek Buzasi	Valdosta State
Graham Murphy	JHU/APL
John Macri	UNH
Philip Dunphy	UNH
Larry Twigg	Code 916, GSFC
Carol Crannell	Code 682, GSFC

Strawman Payloads

X-ray/Gamma-ray Instruments:

1. Solar High Energy Imaging Spectroscopy

• Presenter:	• Bob Lin
• Science:	• Particle acceleration and energy release in solar flares
• Observations	• Imaging spectroscopy in hard X-rays and gamma-rays from 15 keV to 20 MeV
• Instrument:	• Modified HIREGS germanium spectrometer already flown in the Antarctic
• Weight:	• Instrument ~1100 lbs, integrated payload ~2000 lbs
• Altitude:	• 125 -130 kft
• Power:	• 400 watts operating, 300 watts non operating
• Thermal:	• Detectors 0 - 20 degrees C, electronics 0 - 40 degrees C
• Pointing:	• Within 6 arcminutes of Sun-center (provided by integrated payload)
• Latitude:	• Open
• Data:	• High priority - 2 kbps, total ~10kbps (or recovery of data bank)
• Commanding:	• ~100 bytes/6 hrs preferred, autonomous operations OK
• Operations:	• PI mode much preferred
• Min. Science	• At least ~50 days at solar maximum (1999 - 2004)
• Flight profile	• Daytime observing (solar)
• Drivers:	• Detector cooling, imaging system
• Recovery:	• Highly desirable

Payload is mostly ready now as a result of the development of the HIREGS instrument now being flown on several Antarctic long-duration balloon flights. The solar science could readily be combined with non-solar night-time observing of cosmic gamma-ray sources.

2. High Energy Solar Flare Gamma Rays & Neutrons (>20MeV)

- Presenter: Philip Dunphy
- Associates: Aprile, Bertsch, Chupp, Ramaty, Rieger
- Science: Solar flare particle acceleration to the highest energies
- Observations Gamma-ray and neutron spectroscopy and time histories
- Instrument: Position sensitive track detector with coded-aperture mask
- Weight: 1,500 kg
- Altitude: ≥115 kft
- Power: 500 W
- Thermal: Nominal
- Pointing: Accuracy & stability ~10 arcmins, knowledge ~0.5 arcmin.
- Latitude: High latitude with maximum daylight
- Data: ~40 kbps (~4 kbps with compression)
- Commanding: 300 bps 4 times per day
- Operations: PI mode
- Min. Science One flare with significant fluence above 20 MeV
- Flight profile 50 - 100 days at float
- Drivers: LN_2 for cryogen (cool LXe) or mechanical cooler or gas-filled track detector
- Recovery: Highly desirable

Prototype liquid Xenon counter being test flown next spring.
Long observing time is required to "catch" the infrequent large gamma-ray flares.

3. High Resolution X-ray and Gamma-ray Spectroscopy and Polarization

- Presenter: John Macri, UNH
- Associates: Ryan, McConnell, Vestrand, UNH
- Science: Particle acceleration in solar flares
- Observations Hard X-ray, gamma-ray, and neutron spectroscopy and polarization
- Instrument: Scintillation fiber tracker, CdZeTe spectrometer, gamma-ray polarimeter, large conventional scintillators
- Weight: <500 kg for science instrument.
- Altitude: <5 g cm^{-2}
- Power: <200 W
- Thermal: 0 to 20°C
- Pointing: Stability ±3°, knowledge ±1°
- Latitude: Low latitude to reduce detector background counting rate
- Data: <1 Gbyte per day stored on board with nighttime or post-flare dumps
- Commanding: Frequent on first days, once per day thereafter
- Operations: PI mode
- Min. Science One flare
- Flight profile Solar observations
- Drivers: New technology detectors under development with SR&T funds
- Recovery: ?

Optical Instruments

1. Flare Genesis Experiment

- Presenter: David Rust, APL/JHU
- Associates: Graham Murphy APL/JHU
- Science: Magnetic energy and helicity build up before flares and CMEs
  Helioseismology of active regions
- Observations Vector magnetograms, filtergrams with 0.2 arcsec. resolution
- Instrument: Flare Genesis Experiment already flown in the Antarctic
- Weight: 3300 lbs currently, can be reduced with money and time
- Altitude: >105 kft
- Power: Currently 800 W constant, more if pointing is unstable
- Thermal: Already LDB qualified, sleeps at night
- Pointing: 20 arcsec p-p over seconds, knowledge 20 arcsec., stability 20 arcsec.
- Latitude: Maximum daylight hours
- Data: 10 Gbytes per day - can easily be increased but not easy to decrease
- Commanding: Medium level of autonomy now, more intended on next flight
- Operations:
- Min. Science
- Flight profile
- Drivers:
- Recovery: Critical to retrieve data and very expensive telescope

Interested in longer flights in the near future with conventional balloons launched from the South Pole itself.

2. Balloon-launched Asterioseismology Telescope (BLAST)

- Presenter: Derek L. Buzasi, Valdosta State University
- Associates: Graham Murphy, JHU/APL
- Science: Asterioseismology of solar-like stars to understand their internal structure
- Observations Detect stellar oscillations of multiple stars in a open globular cluster
- Instrument: Images of several stars defocused onto CCD to obtain S/N >4
- Weight: Defined by pointing system and power, could be ~2000 lbs
- Altitude: >90 kft
- Power: Depends on pointing and processing, ~300 W at night
- Thermal: Stable to avoid disturbing/bending optics too much
- Pointing: 5 arcsecs stability & accuracy, 39 arcsec. Knowledge
- Latitude:
- Data: <10 Mbytes per day
- Commanding: Minimal (safety and such)
- Operations: Nighttime viewing only
- Min. Science
- Flight profile
- Drivers:
- Recovery:

3. Solar Disc Sextant

• Presenter:	Larry Twigg, GSFC Code 916	
• Associates:	Sabatino Sofia, Yale	
• Science:	Solar g-mode oscillations, solar oblateness	
• Observations	High-accuracy measurements of the solar diameter	
• Instrument:	Solar Disc Sextant with optical wedge and solar limb detectors	
• Weight:	Current payload 800 lbs	
• Altitude:	≥115 kft, 125 kft desired	
• Power:	300 watts max. (day/night mission)	
• Thermal:	Good history, no day/night test yet	
• Pointing:	Accuracy	1.5 arcmin.
	Knowledge	~0.1 arcsec (calculated onboard)
	Stability	7 arcsec.
	SDS provides its own pointing signal	
• Latitude:	Polar trajectory maximizes science	
• Data:	Flexible schemes, ultimate desire 80 kbps	
	Download every 20 days is a good compromise	
	Needs payload status downloads	
• Commanding:	Seldom needed except near launch, mainly autonomous	
• Operations:	Prefer strong PI involvement	
• Min. Science	20 days, best science needs 40 - 60 days	
• Flight profile		
• Drivers:	Need a second beam-splitting wedge	
• Recovery:		

Joint payloads already fly with SDS. This is a good candidate for a joint mission with other experiments.

Other Concerns

1. **The balloon craft**
    - Should be unique for each mission.
    - It could use the same designs but not the same hardware as the craft for other missions.
2. **NASA vs. PI Mode**
    - Use the SMEX approach
    - The PI should be responsible for selecting what he/she wants to use.
3. **Pointing System**
    - The PI should choose the pointing system from among the existing designs
    - It must be customized for each mission
    - Don't try to share any hardware between missions unless there is an overriding cost savings
4. **Balloon Vehicle**
    - Consider the balloon itself like a SMEX launch vehicle
    - NASA will provide the balloon vehicle
    - NASA will be responsible for the interface between the balloon craft and the balloon vehicle