10 meter Large Balloon Reflector

LBR Selected for Phase I Study

“THz Observatory in Near Space”
**LBR:** Prospecting for Cosmic Origins

*Cosmic Evolution: Probing Lithium abundance (444 GHz)*

*Stellar Evolution & Planet Formation: Probing Water (557 GHz)*

*External Galaxies: Normal, Starburst, High z, etc.*

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557 GHz Water line toward evolved stars

Neufeld et al. 2011
THz Sub-Orbital Large Balloon Reflector (LBR)*

- 20 meter Spherical Reflector
- Incoming Light
- Carrier Balloon
- Parachute
- Service Gondola
- Star Trackers
- Internal Support Curtains
- Transparent Instrument Boom
- Metallized

Legend:
- LLDPE Balloon Fabric
- 100% Transmission
- ~2% Loss @ 670 GHz

Diagram dimensions:
- 100 m
- 15 m
- 15 m
- 4 m
THz Sub-Orbital Large Balloon Reflector (LBR)*

- 20 meter Spherical Reflector
- Carrier Balloon
- Parachute
- Service Gondola

Incoming Light

- 100 m
- 15 m
- 15 m
- 4 m

Echo I Satellite
- 30.5 m sphere
- L band
- ca. 1960

Star Trackers
- Internal Support Curtains
- Metallized Transparent Instrument Boom
THz Sub-Orbital Large Balloon Reflector (LBR)*

- 20 meter Spherical Reflector
- Carrier Balloon
- Parachute
- Service Gondola
- Incoming Light
- Star Trackers
- Instruments
- Boom
- Internal Support Curtains
- Metallized

IAE on STS-77
D = 14 m parabola
σ_{rms} \approx 2\text{mm}
X band
Mass = 856 kg
ca. 1997
THz Sub-Orbital Large Balloon Reflector (LBR)*

- 20 meter Spherical Reflector
- Carrier Balloon: 100 m
- Parachute: 15 m
- Service Gondola: 15 m
- Instrument Boom
- Star Trackers
- Elevation Axis
- Azimuth Axis
- Internal Support Curtains
- Transparent
- Metallized

* LBR will use an adaptive secondary to correct for non-spherical distortion in the reflector surface. Below: similar size adaptive secondary for the Large Binocular Telescope (LBT).

* Laser Scanner used to monitor surface figure.
Spherical Corrector

Reflector Surface (Primary)

Carrier Balloon

1 meter Spherical Corrector (Secondary)

Tertiary Mirror

OpSci Grad Student: Stefan O’Dougherty
Spherical Corrector

Reflector Surface (Primary)

Carrier Balloon

1 meter Spherical Corrector (Secondary)

Tertiary Mirror
Spherical Corrector

1 meter Spherical Corrector (Secondary)

Carrier Balloon

Tertiary Mirror

Reflector Surface (Primary)
LBR Flight Profile

Balloon Launch from McMurdo, Antarctica

- Tow Balloon
- Top Payload
- Carrier Balloon
LBR Ascends ~3 hours
During ascent ambient pressure drops to 3 millibars

Balloon Expands
Looking Out from 120,000 ft...
LBR Deployment

Top Plate

20 meter Balloon

Instrument Boom
LBR Deployment

20 meter Balloon Inflated

Woven Polymer

Blowers

Transparent Film
LBR Fully Deployed

Service Gondola
- Power
- Telecon
Service Gondola

Solar Power ~ 2kW
Telecom ~ 1 Mbps

To Balloon
Antarctic Balloon Flight Trajectories

- ~14 days per orbit
- 48 days demonstrated
- >100 days possible!
Flight Termination

Mortar or Spring launched
Upper Parachute

Carrier Balloon
ordered to tear...

Pyro terminate for release
Lower Parachute
Mortar or Spring launched Upper Parachute Opens …

Balloon Reflector/Instrument is encased in Carrier Balloon material for landing
Lower Parachute Opens … conveying Service Module safely to the surface.
Payload Returning from Near Space....
Safe and Sound......
Payloads Recovered to *Fly Again!*
3 meter plastic sphere

Test Receiver installation

Metallizing Surface with silver spray paint!

LBR 3 meter Rooftop Prototype
LBR Student Team

3- Astronomers
1- Optical Scientist
1- Electrical Engineer
LBR Test Range
Observed Test Tone
Observed Test Tone

Beam Scan

Without Reflector

With Reflector

Beam Narrows
LBR: Ready for the next step....