National Network of Total Solar Eclipse High Altitude Balloon Flights

*Edge of Space Eclipse Project*

Academic High Altitude Conference

June 26th, 2014
Overview

• Background: dancing and physics
• Big picture: perfectly poised
• Project details: ideas
Eclipse Science History

- Chinese 2800 BC
- Kepler 1605
- Helium 1868
- Einstein’s theory of general relativity 1919
Eclipse geometry: rarity and types
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Diagram A:
- Ecliptic Pole
- Ecliptic North
- Ecliptic South
- Axis
- Equatorial Plane
- 23.5°

Diagram B:
- Earth
- Moon
- Ecliptic Plane
- The Relative Size and Distance of the Earth and Moon
Eclipse geometry: rarity and types

Closest: 221k mi

Farthest: 253k mi

236k mi

A

B

C
Edge of Space Eclipse
Project: big picture

[Map of the United States with stars marking significant dates]

[Image of a sunset with a hot air balloon]

[NASA logo and text]

[millions]
WHY

• Public engagement
  – Incredible learning moment opportunity
  – Millions can view live from anywhere in world

• Workforce development
  – Highly collaborative, mission-like
  – Multidisciplinary

• Science (solar) and Technology (space communications)

• Collaborations and partnerships
  – Inter-agency
  – Industry
TIMELINE

• 2014 – 2015: fundraise, organize, develop common camera payload, advertise and select teams
• December 2015: distribute primary common camera payload kits and assembly instructions
• Summer 2016: virtual/regional workshops to verify each primary payload functionality; testing
• AY 2016 – 2017: build and test secondary payloads
• Summer 2017: June: dry run, at least one flight for each launch location. August: Eclipse totality starts in Oregon at 1:20 PM Eastern on August 21\textsuperscript{st}, 2017 and ends at 2:50 PM Eastern in South Carolina.
• Fall 2017: Students present at national meeting
COSTS – very rough estimates

• Primary payload with camera, satellite modem/communication device: $1,500 - $2,500
• Secondary payload: $50 - $1,000
• Balloons, helium/hydrogen, basic flight supplies (some times two including dry run): $1,500 - $3,000
• 2016 regional/virtual workshop: $0 – $3,000
• Travel to launch and recovery sites (some x2): $2,000 – $10,000
• Data download fees: $500 – $5,000

Total estimate for supplies, travel, and fees: $6,000 - $25,000 over two years. **WORKING ON SUPPORT!**
Planning teams

• Primary payload and kit design
• Launch cites
• Participating teams
• Science
Primary payload (kit)
Duration and timing (local)

10:16 AM
2 m
25 sec

11:32
2 m 17 sec

1:00
2 m 36 sec

1:22
2 m 40 sec

2:46
2 m 32 sec
Flight path predictions

Path is about 50 mi wide
Good viewing zone (actual)
Good viewing zone (predicted)
Path is about 50 mi wide
25 sec
2 m 17 sec
Long duration flights

- Stretch...
- Max altitude 84,017 feet
- Float time 15 minutes
- 2 minutes
Live images
Live video…?

- Wide bandwidth and large amounts of data required
- How to transmit? Much discussion: analog vs. digital (all or nothing; compression algorithms key)
- 1 or 2 live video with dozens of live images, quickly uploaded video?
- Fun challenge
Due to the difficulty in making reliable and timely four-dimensional observations of atmospheric temperature in the vicinity of the path of the total solar eclipse, direct measurements of temperature changes from the troposphere to the stratosphere during a total solar eclipse still haven’t been reported before.”

Hmm...
Signing up and next steps

• Register this academic year
• In progress: funding for primary payload kits
• *Participating teams* team will define application process
• High level of partnering with other teams (payloads, launch cites, etc.)
• In progress: seeking partnerships with other federal agencies, industry
• Let me know if want to be part of organizing teams
Fall 2017 National Space Grant Meeting, HI

• Total solar eclipse theme with student presentations of ballooning results
• Invited talk by a solar physicist who observed the event
• Tours of telescopes
Don’t forget

*8-21-2017*

Watch for updates as we move forward