

# The 20-20-20 Airships NASA Centennial Challenge

Jason Rhodes (Caltech/JPL)

with the Airships Challenge Development Team:

Ernesto Diaz (JPL), Alina Kiessling (JPL), Sarah Miller (UCI)

# What is an airship?

---

An airship is a powered, maneuverable, lighter-than-air vehicle



# Airships:

## Keck Institute Study a New Horizon for Science

**Co-Leads:** S. Miller (UCI/Caltech), J. Rhodes (JPL),  
L. Hillenbrand (Caltech), R. Fesen (Dartmouth)



NORTHROP GRUMMAN



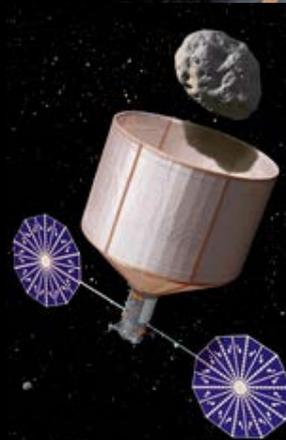
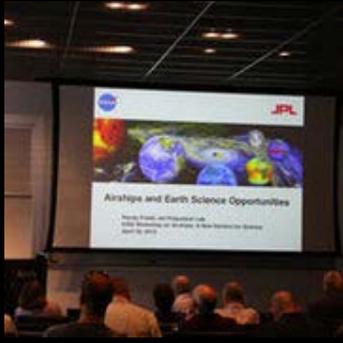
- Geoffrey Blake - Caltech
- Jeff Booth - JPL
- David Carlile - Lockheed Martin
- Frederick Edworthy - Aeros
- Brent Freeze - Sorlox Corp.
- Randall Friedl - JPL
- Paul Goldsmith - JPL
- Jeffery Hall - JPL
- Scott Hoffman - Northrop Grumman
- Scott Hovarter - Lockheed Martin

- Rebecca Jensen-Clem - Caltech
- Ross Jones - JPL
- Jens Kauffmann - Caltech
- Alina Kiessling - JPL
- Oliver King - Caltech
- Timothy Lachenmeier - Near Space Corporation
- Steven Lord - Caltech
- Jessica Neu - JPL
- Gregory Quetin - UofW
- Alan Ram - Northrop Grumman

- Stanley Sander - JPL
- Marc Simard - JPL
- Steve Smith - Southwest Research Institute
- Sara Susca - JPL
- Abigail Swann - UofW
- Eliot Young - Southwest Research Institute
- Thomas Zambrano - AeroVironment, Inc.



# Keck Institute for Space Studies





At 20 km, you're above 95% atm

# Stratospheric



60,000 - 75,000 ft

# Intermediate

# Hybrids



16,000 - 40,000 ft

# Low Altitude

heavy cargo



< 12,500 ft

OPERATIONAL  
ALTITUDE

# HIGH-ALTITUDE AIRSHIP RESEARCH STATION

Multi-wavelength Astrophysics and Cosmology

Planetary Science from Earth and Beyond

Multi-vantage Earth-sensing and Atmospheric  
Studies

Interferometry  
of proto-  
planetary  
disks or black  
holes

*Persistent*  
stare on any  
part of sky  
or Earth

Molecules  
hidden  
from  
ALMA

Discover  
THz  
sky

Vertical  
profiles  
of the  
carbon-cycle

<http://adsabs.harvard.edu/abs/2014arXiv1402.6706M>

# Study Outcomes: Consensus!

- **A stratospheric roadmap:**

- ✓ Demo via challenge/prize
- ✓ Consortium-build
- ✓ Site survey for planning and tech demo
- ✓ Stratospheric Observatory



CENTENNIAL  
CHALLENGES

- **Stratospheric Tethers** to be immediately followed-on through KISS and NASA JPL
- **Low-to-Mid Altitude Near-Term:**
  - ✓ Many Earth & Atmospheric Opportunities
  - ✓ Consortium-build
  - ✓ Existing ships to be leveraged

# Centennial Challenges Call

Nov 2013

## BACKGROUND:

The Centennial Challenges program ( <http://www.nasa.gov/challenges>) provides prize purses to stimulate innovations and demonstrations of technologies that addresses a NASA technical challenge and has future application beyond NASA, or develops a new aerospace industry market. There have been 24 NASA Centennial Challenges competitions since 2005, with NASA awarding more than \$6 million to 16 different winning teams. Competitors include private companies, student groups and independent inventors working outside the aerospace industry. Centennial Challenges are targeted at external competitors—NASA employees and centers do not compete in the competitions themselves but may manage or host challenge competitions. See the program webpage (above) for details on completed and current Challenge competitions.

## THE CHALLENGE:

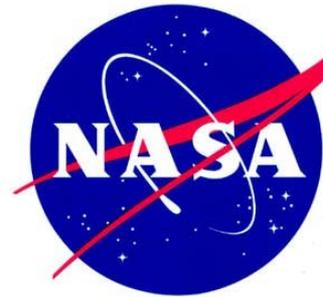
This NASA@work competition is for formulation of new prize competitions with prize purses up to \$10M. Technology advancement is a key requirement; technology advancements in any area that improves NASA's ability to perform future missions will be considered. However, not all technology advancement efforts fit well under the construct of a prize competition – please see the characteristics of a perfect challenge concept below. One area of particular interest is technology advancement that addresses the Asteroid Grand Challenge ( [http://www.nasa.gov/sites/default/files/files/AGC\\_FS\\_508\\_2.pdf](http://www.nasa.gov/sites/default/files/files/AGC_FS_508_2.pdf)). We are specifically not seeking ideas that are primarily educational or for public engagement.

## SPECIAL AWARD:

**Up to five selected winners will be eligible for 0.5 FTE for FY 14 to develop a detailed Concept of Operations and draft competition rules to fully address the following questions to support approval of a new Centennial Challenge topic. Submissions that do not adhere to solution and submission requirements will not be considered. Please read below for specific requirements!**

0.5 FTE awarded to JPL (Rhodes) in April, 2014

# NASA Centennial Challenges



- “NASA Centennial Challenges were initiated in 2005 to directly engage the public in the process of advanced technology development”
- The program offers incentive prizes to generate revolutionary solutions to problems of interest to NASA
- The **20-20-20 Airships Challenge** is currently under development and we are in the process of raising public awareness of the challenge

# The 20-20-20 Airship Challenge



## Motivation

- There are few opportunities for space missions in astronomy and Earth science.
- *Airships* (powered, maneuverable, lighter-than-air vehicles) could offer significant gains in observing time, sky and ground coverage, data downlink capability, and continuity of observations over existing suborbital options at competitive prices.
- We seek to spur private industry to demonstrate the capability for sustained airship flights as astronomy and Earth science platforms.
- Technology is also desirable to industry for telecommunications, oil and gas industry (alarm monitoring, asset tracking, field communication), and transport companies (satellite tracking in remote regions).

## The Challenge

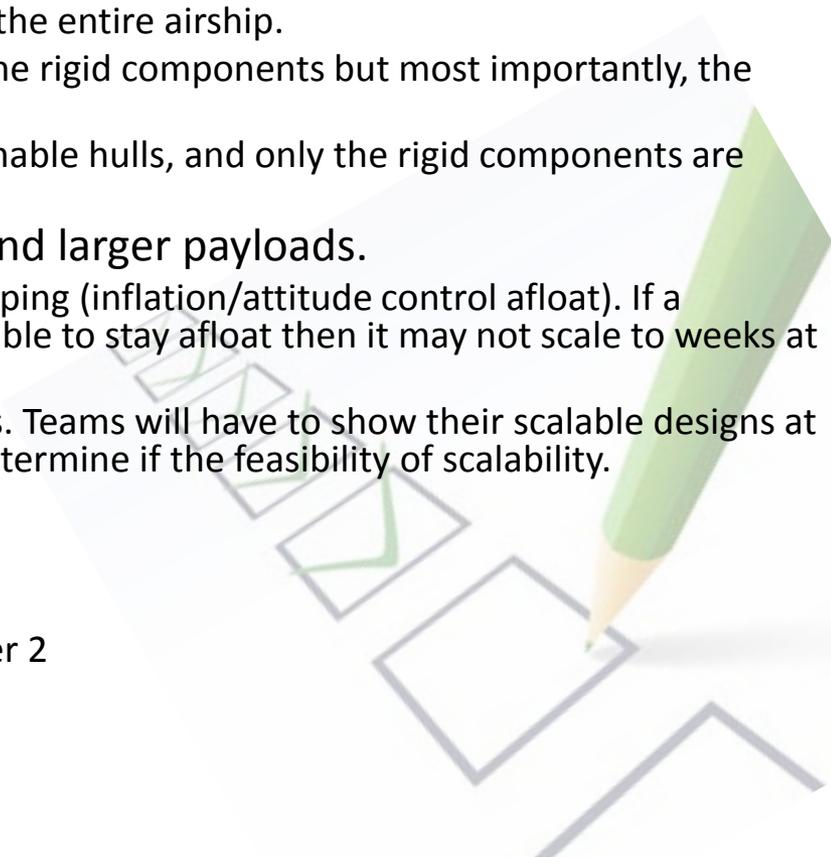
- **NASA Centennial Challenge** in development to build a stratospheric airship as a science platform ([www.centennialchallenges.nasa.gov](http://www.centennialchallenges.nasa.gov))
- Airships Challenge Team:  
Jason Rhodes (PI), Alina Kiessling, Ernesto Diaz, Jeff Booth, Randy Friedl, Jeff Hall (JPL); Sarah Miller (UCI)
- Anticipated \$4M-\$5M prize pool
- Anticipated challenge launch ~2015
- Competitors must fly a powered airship that remains stationary at **20km** (65,000ft) altitude for over **20 hours** with a **20 kg** payload. The design must be scalable to longer flights with more massive payloads

For more information, contact challenge development leads:

Alina Kiessling [Alina.A.Kiessling@jpl.nasa.gov](mailto:Alina.A.Kiessling@jpl.nasa.gov)

Ernesto Diaz [Ernesto.Diaz@jpl.nasa.gov](mailto:Ernesto.Diaz@jpl.nasa.gov)

# Requirements

- Must demonstrate 20 hr at 20 km altitude while carrying a 20 kg payload (Tier 1).
  - Must demonstrate 200 hr at 20 km altitude while carrying a 200 kg payload (Tier 2).
  
  - Must demonstrate controlled descent and successful payload recovery.
    - Originally intended to require controlled descent of the entire airship.
    - Requirement will be for controlled descent of only the rigid components but most importantly, the payload.
    - Most concepts of stratospheric airships have consumable hulls, and only the rigid components are reusable.
  - Airship must be “scalable” to longer durations and larger payloads.
    - Teams are not to rely on expendables for station keeping (inflation/attitude control afloat). If a concept uses too much propellant or other consumable to stay afloat then it may not scale to weeks at altitude.
    - Better option would be replenishable power sources. Teams will have to show their scalable designs at PDR/CDR type review where panel of experts will determine if the feasibility of scalability.
  
    - Must be operable at wide range of latitude
  
    - Must be able to follow a simple course (A to B) in Tier 2
- 
- A green pencil is positioned diagonally on the right side of the slide, pointing towards a checklist. The checklist consists of several square boxes, some of which are checked with a green mark. Below the checklist is a zigzag line, possibly representing a flight path or a course.

# Judging

We define a competition end date and teams are able to demonstrate any time up until the end date.

- Must notify judges at least 1 month prior to demonstration.
- Judges travel to team location (or pre-determined competition location) and allow 1 week of margin for weather constraints
- Judging panel to consist of government and non government personnel.
- Teams may make up to 3 attempts within the competition period and first to demonstrate sets the remaining competition period, 6 mo, 1 yr etc.



# Awards -1



- 1) Seed Money – Pass Scalability Design Review
  - Will be awarded to all teams that pass the scalability design review as seed money
- 2) Tier 1 – Baseline 20 hrs 20 kg 20 km
  - Any team that demonstrates Tier 1 within competition timeframe gets a share of the prize.
- 3) Tier 2 – 200 hrs 200 kg 20 km
  - First to demonstrate Tier 2 wins and the competition is finished.

# Awards -2



From Draft RFI:

- Seed Money: TBD \$ (\$200k to be shared between all successful teams with a maximum of \$20k per team) will be awarded to all teams that pass the scalability design review as seed money.
- Award 1: TBD \$ (\$2M) will be split between all teams who successfully complete Tier 1 within five years of the first successful demonstration or five years after challenge initiation, whichever comes first.
- Award 2: TBD \$ (\$2M) will be awarded to the first successful demonstration of Tier 2 within four years of challenge initiation.

# Request for Information (RFI)

---

- Draft is under review by HQ/Centennial Challenge Office
- Expect release in late September
- 45 day response period
- Development team has a list of contacts to inform/ask for responses
- Seek responses from:
  - Astronomy/Astrophysics/Space Science
  - Earth & Atmospheric Science
  - Potential Competitors
  - Potential Commercial Community (e.g. telecom and Google)
  - Allied Organizations (want to sponsor and/or administer the Challenge)
  - Partners for Tier 2 Payload Development

# Summary

- Ultimately HQ will decide whether to run the Challenge
- We have sensed much support in the science community
- We have had numerous calls from potential competitors
- We anticipate a strong response to the RFI
- Airships capture the public's imagination!

## Forbes

## The New York Times



**TECH** 7/29/2014 @ 5:23AM | 3,335 views

### Astronomy From High Altitude Airships

[+ Comment Now](#) [+ Follow Comments](#)

Sometimes the edge of space can almost be as good as space itself — that is, when it comes to telescopes riding airships at the top of Earth's tenuous and rarefied stratosphere.

High Altitude Airships (HAAs), until now largely the purview of defense-related research, may ultimately find their rightful place as vehicles of science and industry.

**UNITED**  
Earn 30,000  
+ Free Checked Baggage  
+ Priority Boarding  
+ No Foreign Transaction Fees

**Bruce Dorminey**  
Contributor

[FOLLOW](#)

*I cover over-the-horizon technology, aerospace and astronomy.*  
[full bio](#)

**SCIENCE**

### Modern Research Borne on a Relic

Airships That Carry Science Into the Stratosphere

By JOSHUA A. KRISCH AUG. 25, 2014

[EMAIL](#)  
[FACEBOOK](#)  
[TWITTER](#)  
[SAVE](#)  
[MORE](#)

Airships are dusty relics of aviation history. Lighter-than-air vehicles conjure images of the Hindenburg, in its glory and destruction, and the Goodyear Blimp, a floating billboard that barely resembles its powerful predecessors.

But now engineers are designing sleek new airships that could streak past layers of cloud and chart a course through the thin, icy air of the stratosphere, 65,000 feet above the ground — twice the usual altitude of a jetliner. Steered by scientists below, these aerodynamic balloons might be equipped with onboard telescopes that



---

# BACKUP

---

Competitors will provide a scalability design review package 3-6 months after the challenge initiation. This review will determine if airship designs can be scaled to payloads of greater than 200kg, durations of longer than 200 hrs, and an ability to navigate the airship along a defined course. The competitors must pass this review in order to be eligible to compete in the Tier 1 competition. Competitors who fail or do not submit to the initial design scalability review may still compete in the Tier 2 competition. However, a scalability review at the time of the Tier 2 demonstration will be required to win prize money.

Competitors must contact the challenge administrators *at least* one month prior to their desired demonstration date.

**Tier 1:** Judges will travel to a competitor's chosen demonstration location and provide the 20 kg payload for integration with the airship. The competitor will then be given 5 days from the judges' arrival to launch their airship to 20 km for 20 hours, within a 20 km diameter area with the 20 kg payload provided. The payload must also be successfully recovered by the competitor, and the design of the airship must show a defined scalability to larger payloads, longer durations and an ability to traverse moderate scale areas.

**Tier 2:** Judges will travel to a competitor's chosen demonstration location and provide a 20 kg payload for integration in to the airship. A competitor will be required to provide the additional 180 kg, which should be made available to the judges on arrival for weight verification. There is no requirement on what should make up this 180 kg. The competitor will then be given a 5 day launch window, beginning when the judges arrive, to launch their airship to 20 km for 200 hours with the 200 kg payload. The airship will also be required to traverse a specified path as part of the demonstration and maintain a 20km diameter station at all other times. The payload must also be recovered intact by the competitor, and the design of the airship must show a defined scalability to larger payloads and longer durations.

## INFORMATION SOUGHT from Competitors

### a. Interest

- Are you interested in participating in this competition?
- Would the requirement that you must gain your own FAA approval for your airship impact you significantly? What about procuring your own launch site and being responsible for recovering the payload?
- Are there other barriers that can be addressed in the formulation of these challenges?

### b. Competition Milestones and Phases

- Would the additional requirement of traversing a specified path for the Tier 2 competition be sufficient to demonstrate the full extent of the airship capabilities?
- Are there other aspects of the challenge competition Milestones and Rules that should be added, modified, or deleted?
- Are there concerns or other considerations regarding technical requirements?
- How could the Milestones and Phases be better structured?

### c. Competition Awards

- NASA anticipates that up to \$4.2M in prizes will be available. How could the award levels and distribution structure best incentivize participation and technical progress?

### d. Competition Name

- Please suggest official names that best, succinctly, characterize this Centennial Challenge. Please provide comments on how the naming could increase the public interest in the prize competition.
- What other actions should be taken to increase public interest?

---

## **INFORMATION SOUGHT from Science Community**

### **a. Technology Development and Utilization**

- Are you interested in using airships as a scientific platform? What scientific goals would you hope to achieve with an airship? What technological requirements must the airship have in order to meet your scientific goals (e.g., altitude, station keeping or event tracking, payload capacity, etc.)?
- Are you interested in potentially including a science instrument for the tier 2 competition?

## **INFORMATION SOUGHT from Commercial Community**

### **a. Technology Development and Utilization**

- Are you interested in using airships as a commercial platform? What commercial goals would you hope to achieve with an airship? What technological requirements must the airship have in order to meet your commercial goals (e.g., altitude, station keeping or event tracking, payload capacity etc.)?
- Are there specific emerging breakthrough technologies that are applicable to the competition?
- Are there specific commercial space and/or non-space related applications for the capability?
- Are there ways to adjust the competition metrics that would assist with the synergy with commercial space and/or non-space applicability?

---

### **INFORMATION SOUGHT from Allied Organizations**

#### **a. Interest**

- Are you interested in partnering with NASA to administer the airships challenge as an “Allied Organization”?

#### **b. Competition Name**

- Please suggest official names that best, succinctly, characterize this Centennial Challenge. Please provide comments on how the naming could increase the public interest in the prize competition.
- What other actions should be taken to increase public interest?

### **INFORMATION SOUGHT from Partners for Payload development**

#### **a. Interest**

- Are you interested in partnering with NASA to develop and build the 20kg payload? What can your organization (educational institute) provide to this partnership (expertise, hardware, public outreach opportunities, etc.)?

# Assembly of RFI contacts:

- **Potential U.S. competitors with known interest in airships:**

Global Near Space Services (GNSS) and Bye Aerospace of Denver (Star Light developers ILC Dover (contact: Gilbert Baird), Lockheed Martin (contact: Stavros Androulakakis, Dave Carlile), Near Space Corporation (contact: Tim Lachenmeier), Northrop Grumman (contact: Blake Bullock, Scott Hoffman), Ohio Airships, Inc. (more concepts in lower altitude heavy lifters, but potentially interested in HA), Raven Aerostar (contact: Mike Smith) SkyHook International / Boeing (also dealing with lower altitude concepts, but potentially interested in HA), Southwestern Research Institute (contact: Steve Smith), TCOM L.P. (aerostats and surveillance systems – potentially developing a HAA), Worldwide Aeros (contact: Fred Edworthy)

- **Aerospace and semi-related companies with possible interest in airships: ex.:**

AeroVironment, Inc., JP Aerospace, OceanLab (contact: Tom Zambrano), etc.

- **Potential “Consultants” or “Reviewers” (ineligible to compete or host): ex.:**

Hybrid Airship Vehicles (technical director, Mike Durham, and various other team members)

- **Potential Hosts (challenge runners) or “Allied Organizations”:** ex.: Adler Planetarium (contact: Geza Gyuk, Director for Astronomy at the Adler Planetarium) Google "scifoo" contacts, recommended for advice and additional contacts: CAFE Foundation (ran NASA Greenflight Challenge)

- *In addition we have compiled dozens of contacts for potential end-users in science and beyond from the Keck Institute study, including ~50 personal/individual contacts, and in the process of compiling many more organizations/institutions/companies/corporations of end-user interest*

# Potential Competitor & Partner Conversations

## **Adler Planetarium**

- Alina spoke to Geza Gyuk (Director for Astronomy at the Adler Planetarium). They have experience in designing, building instruments & launching ~70 high altitude balloons.
  - They are very interested in being involved in some capacity of the challenge and more specifically either as participants or administering the challenge.

## **Google**

- Jason has talked to head of Google Loon. Will likely not participate, may want to sponsor. *May buy hundreds or thousands!*

## **Steve Smith from the Southwestern Research Institute**

- Advice on scalability, controlled descent, FAA

## **Tim Lachenmeier from Near Space Corporation (and the new Pacific coast UAS site)**

- Detailed description of the FAA process for airships, advice on scalability

## **Mike Durham of Hybrid Airship Vehicles**

- Not a potential competitor or partner, but has much to gain/lose, advice on scalability

# Potential Competitors

---

**Potential U.S. competitors with known interest in airships:**

**Global Near Space Services(GNSS) and Bye Aerospace of Denver (Star Light developers)**

**ILC Dover (contact: Gilbert Baird)**

**Lockheed Martin (contact: Stavros Androulakakis, Dave Carlile)**

**Near Space Corporation (contact: Tim Lachenmeier)**

**Northrop Grumman (contact: Blake Bullock, Scott Hoffman)**

**Ohio Airships, Inc. (more concepts in lower altitude heavy lifters, but potentially interested in HA)**

**Raven Aerostar (contact: Mike Smith)**

**SkyHook International / Boeing (also dealing with lower altitude conceptual heavy lifters, but potentially interested in HA)**

**Southwestern Research Institute (contact: Steve Smith)**

**TCOM L.P. (aerostats and surveillance systems – potentially developing a HAA)**

**Worldwide Aeros (contact: Fred Edworthy)**

**A dozen more foreign companies exist, but they are ineligible for a NASA prize.**

**Aerospace companies with unknown interest in airships:**

**AeroVironment, Inc. (not sure if they are interested in developing airship)**

**JP Aerospace**

# Payload



- JPL/Caltech will provide the 20 kg payload
  - GPS, Pressure Sensor, Inertial Measurement Unit (IMU), data recorder, software, batteries
  - Will allow for fair judging
  - An Interface Control Document (ICD) will be made available to teams in order to allow for a JPL payload “bolt-on” design with minimal interface to the airship.
- In touch with potential payload developers
  - JPL hardware groups with GPS/ballooning experience
  - CalTech staff/postdocs with ballooning payload experience
  - Expecting to receive concepts/cost estimates soon
  - Researching payload capabilities from off the shelf vendors
- For the Tier 2 prize, teams will be required to provide power to the payload. The 200kg payload will contain the 20kg JPL payload plus additional mass provided by the team.
  - May allow teams to “sell” additional payload as a means to raise funds
- Need to define how many payloads JPL will make and how many are taken to each competition attempt. Also need to define redundancies in the payload to avoid payload failure.

# FAA

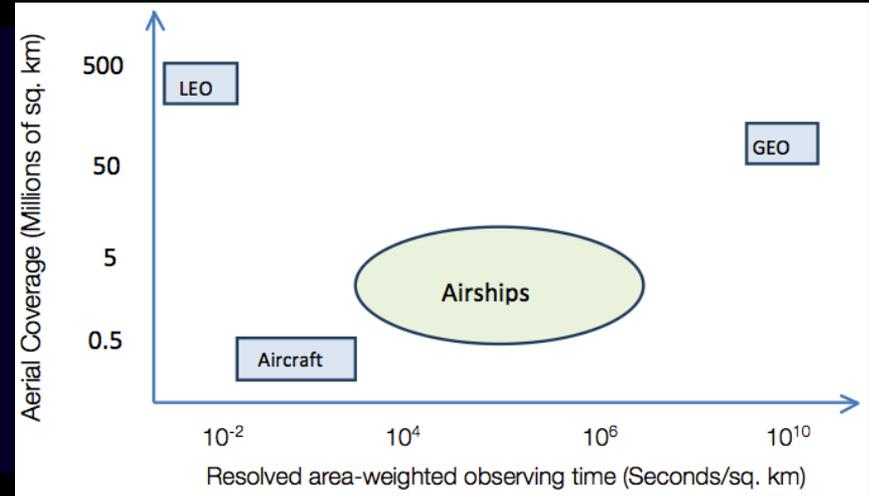
- Competitors will likely need to fill out paperwork for experimental vehicle certification (COA, FAR 101).
  - Question of vehicle certification and process is being investigated.
- UAS (Unmanned Aircraft Systems) “drone” sites potential sites for competition. Might make certification process easier if airspace is already reserved for these types of unmanned efforts.
- Potential Wallops CSBF involvement to provide ground station and range safety support.
- *Still need to refine how much the challenge administrators will support teams to obtain FAA approval*

ISIS (Concept: Lockheed Martin)

# Why Airships?

*A current capability gap in science that airships fill...*

Earth and Atmospheric scientists currently lack a platform for high spatial and temporal resolution measurements with local-to-regional spatial coverage, which airships can provide throughout the year.



While high-altitude balloons have been and will continue to be a key asset for a variety of science goals, airships provide complementary capabilities for missions requiring:

- Increased payload capacity/flexibility - the promise is 100s to ~10k lbs of payload and 100s of feet in dimension (needed for interferometric baselines)
- Maneuverability to follow or map phenomena
- Ease and increased flexibility of payload launch and recovery asset protection
- Mission longevity - weeks to months - possibly even years (rather than days)
- Mission timing such as non-summer science and nighttime observations
- Communications and data retrieval

Space scientists need space-like platforms without the rating and cost of satellite missions.

# Why Airships?

## *Why LTA vs. general stratospheric vehicle technology?*

HTA technology has been the clear focus of 20th century flight, so why not consider HTA solutions for a stratospheric platform as well as LTA solutions?

*All solutions should be pursued, but this challenge specifically cultivates LTA.*

*We aim to develop a technology and a platform.*

Logistically running a Challenge for a wide range of vehicle types is unfocused and unnecessarily complicated, however beyond practicalities there are intrinsic values to focusing on LTA vehicle technology:

- 1.LTA promises to solve the persistent stratospheric vehicle gap naturally and sustainably (and thus more cost-effectively than HTA in a late-stage production-mode comparison including operating costs)
- 2.HTA must maintain “lazy-circles” or some active method of station-keeping whereas LTA more naturally and efficiently station-keeps
- 3.Solving the atmospheric vehicle with LTA for Earth provides a long-term investment in more transferrable solutions for interplanetary vehicles than with HTA:
  - LTA is much more compressible
  - LTA provides more atmosphere-type flexibility
  - Maneuverable LTA gives control, station-keeping and stability



*More LTA vs HTA information can be found in: Coustenis et al. (2010), CBO/GAO Airships report (2011), Findings of Balloon-based Planetary Science NASA workshop (2012)*

# Why Airships?

*Given the unique, intrinsic value of airships, why would NASA be best-placed to spur the stratospheric airship market?*

Substantial investment has gone into a new generation of stratospheric airships in the past 20 years, however requirements have been strict and chances have been few:

*The military has funded several attempts to turn “Wright Flyer” stratospheric airship technology into a “Boeing 747” in an extremely aggressive capability jump that was doomed to fail...*

*Details in Miller et al. 2014 (Keck Institute for Space Studies report on “Airships: A New Horizon for Science”)*

## Science-driven (rather than war-driven) vehicle development:

- Provides a relaxed requirement space that the technology *needs* to develop
- Capability development must be stair-stepped yet key technologies *must scale*
- The Challenge’s end goal must be the *beginning* of the useful vehicle specifications space (not the “Pie-in-the-sky” largest scale vehicles, although the path there should be clear)
- An invisible final tier waits in the market that the Challenge spurs, including the largest possible scalings of interest for Big Energy and Telecom, as well as Defense



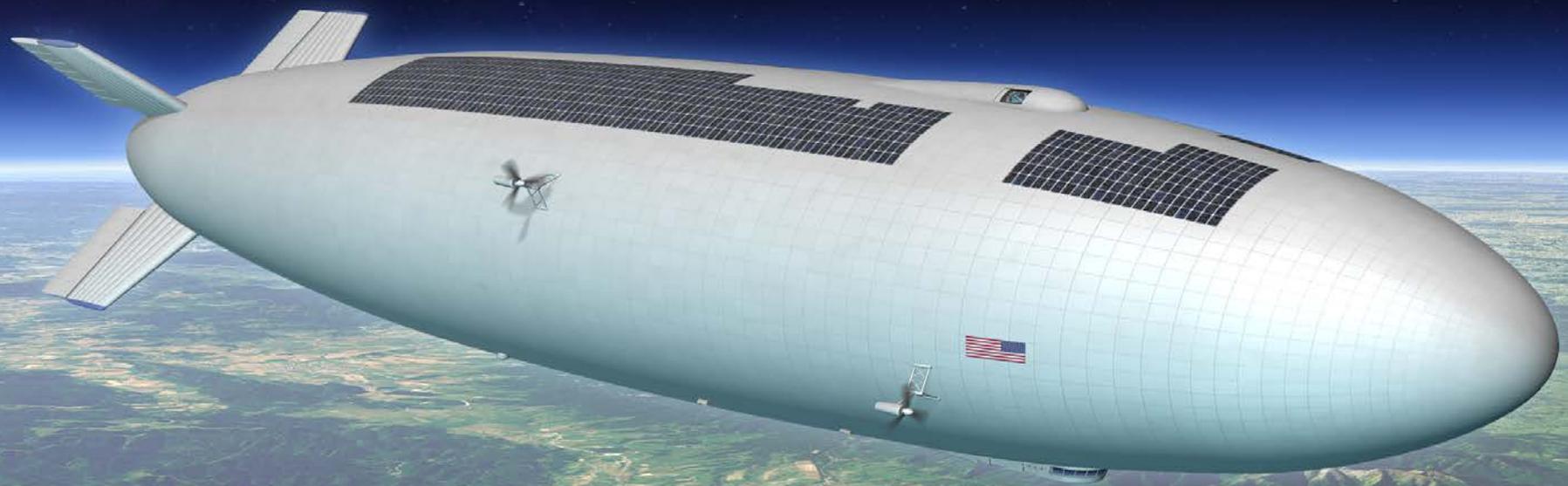
National Aeronautics and Space Administration

# The 20-20-20 Airship NASA Centennial Challenge

Alina Kiessling<sup>1,2</sup>, Ernesto Diaz<sup>1</sup>, Jason Rhodes<sup>1,2</sup>, Sarah Miller<sup>3</sup>, Jeffrey L. Hall<sup>1</sup>, Randy Friedl<sup>1</sup>, Jeff Booth<sup>1</sup>

1: Jet Propulsion Laboratory 2: California Institute of Technology 3: University of California, Irvine

Email: Alina.A.Kiessling@jpl.nasa.gov; Ernesto.Diaz@jpl.nasa.gov



## Introduction

- There are few opportunities for space missions in astronomy and Earth science.
- *Airships* (powered, maneuverable, lighter-than-air vehicles) could offer significant gains in observing time, sky and ground coverage, data downlink capability, and continuity of observations over existing suborbital options at competitive prices.
- We seek to spur research institutes and private industry to demonstrate the capability for sustained airship flights as astronomy and Earth science platforms.
- This technology is also desirable for a wide range of industry applications, including telecommunications, oil and gas (for alarm monitoring, asset tracking and field communication), and transport companies (for satellite tracking in remote regions).

National Aeronautics and Space Administration  
Jet Propulsion Laboratory  
California Institute of Technology  
Pasadena, California

www.nasa.gov

## The Challenge

- **NASA Centennial Challenge** in development to build a stratospheric airship as a science platform ([www.centennialchallenges.nasa.gov](http://www.centennialchallenges.nasa.gov))
- Challenge was recommended as part of the Keck Institute for Space Studies Airships workshop (Miller et al, 2014; arXiv:1402.6706)
- Anticipated \$3M - \$4M prize pool
- Anticipated challenge launch ~2015-2016
- Competitors must fly a powered airship that remains stationary at **20km** (65,000ft) altitude for over **20 hours** with a **20kg** payload. The design must be scalable to longer flights with more massive payloads.
- Tiered challenge structure includes opportunity to demonstrate increased payload mass and flight duration.
- Request for information (RFI) on challenge structure and rules to be released

Background image: Keck Institute for Space Studies / Eagle Interactive