JHU/APL Proposal No. AD-45406

10 meter Sub-Orbital Large Balloon Reflector (LBR)
JHU/APL Co-I

FG4HZ

NNH14ZOA001N -14NIAC-A2

Submitted to:
Dr. John Falker
NIAC Program Executive
Space Technology Mission Directorate
NASA Headquarters
Washington, DC 20546-0001

Submitted by:
Dr. Pietro N. Bernasconi
The Johns Hopkins University
Applied Physics Laboratory
11100 Johns Hopkins Road
Laurel, MD 20723-6099
Tel: (240) 228-8970
(443) 778-8970

TABLE OF CONTENTS

page

STATEMENT OF WORK

1. SUMMARY OF LBR PROJECT

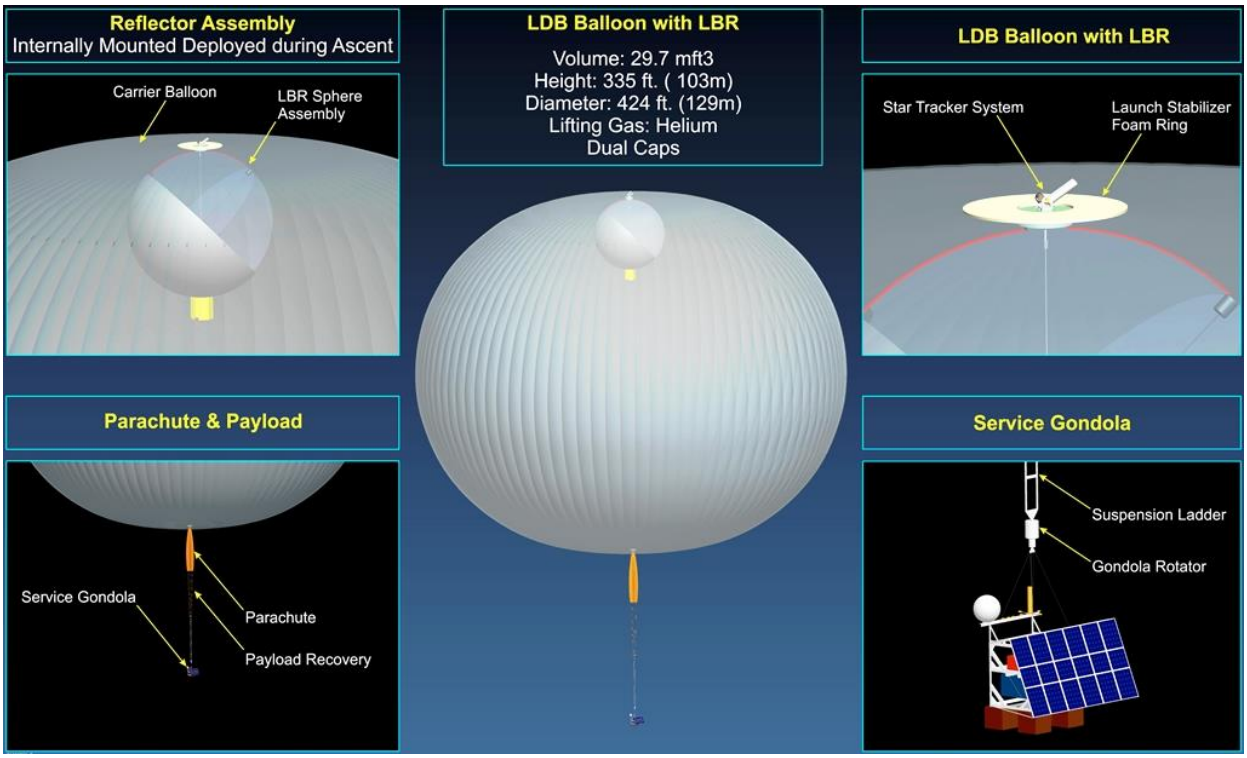
This is a collaboration Co-I Institution proposal for the proposal "10 meter Sub-Orbital Large Balloon Reflector (LBR)" whose lead proposal is submitted by the University of Arizona with Christopher Walker as PI.

The Large Balloon Reflector (LBR) project proposes to develop and demonstrate the technology required to realize a suborbital, 10 meter class telescope suitable for operation from radio to THz frequencies. The telescope consists of an inflatable, half-aluminized spherical reflector deployed within a much larger carrier stratospheric balloon. Besides serving as a launch vehicle, the carrier balloon provides a stable mount for the enclosed telescope. Looking up, the LBR will serve as a telescope. Looking down, the LBR can be used for remote sensing or telecommunication activities. By combining successful suborbital balloon and ground-based telescope technologies, the dream of a 10 meter class telescope free of 99% of the Earth's atmospheric absorption in the far-infrared can be realized. The same telescope can also be used to perform sensitive, high spectral and spatial resolution limb sounding studies of the Earth's atmosphere in greenhouse gases and serve as a high flying hub for any number of telecommunications and surveillance activities.

LBR is a multi-institution effort between the University of Arizona (the PI institution), SWRI, JPL, and APL. APL participation in this project/concept is to provide the service gondola: mechanical structure with avionics system, interface with telecommunication system, and power system; as well as the LBR guidance and control (GNC) system software and hardware: GNC computer, star cameras, Inertial measurement unit (IMU)

LBR was selected in 2013 by NASA Innovative Advanced Concepts (NIAC) program to proceed into the NIAC Step I Phase B of the program. This makes LBR eligible to propose to the 2014 Step II phase. Goal of NIAC Step II is to bring the new proposed concepts to a Technology Readiness Level of at least 2 in maturity, by addressing key unknowns, assumptions, risks, and paths forward remaining after the Step I completion.

Below is a figure of the entire LBR system concept as of end of Step I Phase B:



2. SCOPE

This work plan is for the generation of a design concept of the LBR systems components assigned to APL which are:

- LBR service gondola suspended from below the carrier balloon:
  - Mechanical structure
  - Avionics system (hardware and software)
  - Power System
  - Interface with LBR system on top of carrier balloon
  - Interface with CSBF (Columbia Scientific Balloon Facility) provided balloon control and telecommunication system
- LBR GNC package on top of carrier balloon
  - Pointing Control computer (hardware and software)
  - Star Cameras system
  - Inertial Measurement Unit system
  - LBR azimuth-elevation drive system (in collaboration with SWRI)
  - Interface with LBR azimuth-elevation drive system

This work will require coordination and working closely with other entities (University of Arizona, SWRI, and JPL) involved in the LBR project.

3. OBJECTIVES AND FUNCTIONAL DESCRIPTION OF THE WORK

The work is exclusively of hardware/software design and reporting in nature. No hardware is expected to be fabricated/purchased for this work. The level of maturity of the design at the end of performance should be sufficient to enable LBR to be proposed for a future opportunity to fabricate and fly a prototype system in a balloon test flight (about at a level of a PDR).

4. TASKS

1) Perform conceptual design of the LBR service gondola that meets the LBR requirements. This includes design of: Gondola mechanical structure; Avionics computer system (hardware and software); Power system; Interface with LBR system on top of carrier balloon; Interface with CSBF balloon control and telecommunication system.
2) Perform conceptual design of the LBR GNC package on top of carrier balloon. This includes design of: Star Cameras system; Inertial Measurement Unit, Interface with LBR azimuth-elevation drive system.
3) In close collaboration with SWRI perform conceptual design of the LBR azimuth-elevation drive system.
4) Participate in regular teleconferences with the rest of the team: University of Arizona, SWRI, JPL
5) Prepare and provide technical material to the PI institution to be included in presentations and posters that will be presented at the annual NIAC symposium.
6) Prepare and provide technical material to the PI institution to be included in the NIAC required end of Phase II report.
7) Prepare a final grant report to be submitted to NIAC at the end of performance.

5. PERIOD OF PERFORMANCE

The period of performance is of total duration of 1 year from time of the award. The expected date of award is August 1st, 2014. The projected end of performance is therefore July 31, 2015.

6. PERSONNEL ROLES AND RESPONSIBILITIES

Dr. Pietro Bernasconi will be APL's Institutional PI for the LBR program at APL. He will be responsible for the overall management and success of the APL part of the project. He will assure that the LBR systems design assigned to APL will allow achievement of the objectives stated in the main proposal submitted by Chris Walker (PI) of University of Arizona. Dr. Bernasconi is responsible for assembling the technical team and for allocating the resources in a reasonable and effective manner to successfully complete the tasks. He will actively participate in the design work for the LBR service gondola and GNC package. He will also participate in producing technical material for presentations, posters, and reports and integrate it in the Master presentations, posters and reports assembled by the PI institution.

Mr. Harry Eaton of APL will be the LBR systems engineer and pointing system lead engineer. He will oversee the overall design of the LBR service gondola and GNC package. In particular he will lead the effort of designing the GNC package. He will also participate in producing technical material for presentations, meetings, and reports.

An APL mechanical engineer will be responsible to conduct design and mechanical analysis of the service gondola and GNC package mechanical components. He will also participate in producing technical material for presentations, meetings, and reports.

CURRICULUM VITAE

PIETRO N. BERNASCONI INSTITUTIONAL PI

Current Position

The Johns Hopkins University / Applied Physics Laboratory
Senior Scientist
Space Department, Space Science Group, Solar Physics Section

Education

1992 Diploma (Physics) (equivalent to American Master's Thesis), Swiss Federal Institute of Technology Zürich (ETH-Z)
1997 Ph.D. (Natural Science), Swiss Federal Institute of Technology Zürich (ETH-Z)

Relevant experience

2014 Gondola Lead Engineer and Mission Manager for Balloon Observation Platform for Planetary Science (BOPPS)
2013 Gondola Lead Engineer and Mission Manager for Balloon Rapid Response for ISON (BRRISON)
2008 - present: Payload PI, Stratospheric TeraHertz Observatory balloon program.
2007 - present: PI, Solar Bolometric Imager balloon/space program.
2001-2007: Project Scientist, Solar Bolometric Imager balloon program.
1997-2004: Project Scientist, Flare Genesis Experiment balloon program.
1992-1997: Research Fellow, Institute for Astronomy of the Swiss Federal Institute of Technology Zürich, Solar Physics Group.

Professional Societies

Member American Astronomical Society, Solar Physics Division (SPD)
Member American Geophysical Union (AGU)
Member Society of Photo-Optical Instrumentation Engineers (SPIE)

Relevant Publications

Bernasconi P.N., Rust D.M., Eaton H.A.C., Murphy G.A., A Balloon-borne Telescope for high resolution solar imaging and polarimetry, in Airborne Telescope Systems, eds. R.K. Melugin, H.P. Röser, Proc. of SPIE Vol. 4014, 214 (2000)

Bernasconi P.N., Rust D.M., Eaton H.A.C., High resolution vector magnetograms with the Flare Genesis vector polarimeter, in Advanced Solar Polarimetry - Theory, Observation, and Instrumentation, M. Sigwarth (Ed.), Astron. Soc. Pacific Conf. Series Vol. 236, 399-406 (2001)

Bernasconi P. N., Rust D. M., Georgoulis M. K., LaBonte B. J. 2002, Moving Dipolar Features in an Emerging Flux Region, Sol. Phys. 209, 119-139 (2002)

Bernasconi P.N., Eaton H.A.C., Foukal, P., Rust D.M., The Solar Bolometic Imager, in Advances in Space Research Vol. 33 1746 (2004)

Foukal, P., Bernasconi, P. N., Eaton, H. A. C., and Rust, D. M., Broad-band Measurements of Facular Photometric Contrast with the Solar Bolometric Imager, Astrophysical Journal 611, L57, (2004)

C. Walker, C. Kulesa, P. Bernasconi, et al., 2010, The Stratospheric THz Observatory (STO), in Ground-based and Airborne Telescopes III, eds. Larry M. Stepp, Roberto Gilmozzi, Helen J. Hall, Proc. of SPIE Vol. 7733, 77330N (2010)

STATEMENS OF COMMITMENT

JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

May 12, 2014

Prof. Christopher K. Walker
Steward Observatory
933 N. Cherry St.
Tucson, AZ 85721

Dear Chris,

I acknowledge that I am identified by name as a Co-Investigator to the investigation, entitled **10 meter Sub-Orbital Large Balloon Reflector (LBR)**, that is submitted by Prof. Christopher Walker to the NASA Research Announcement, NNH14ZOA001N -14NIAC-A2, and that I intend to carry out all responsibilities identified for me in this proposal. I understand that the extent and justification of my participation as stated in this proposal will be considered during peer review in determining in part the merits of this proposal. I have read the entire proposal, including the management plan and budget, and I agree that the proposal correctly describes my commitment to the proposed investigation. For the purposes of conducting work for this investigation, my participating organization is the JHU/Applied Physics Laboratory.

Sincerely,

Dr. Pietro Bernasconi

BUDGET JUSTIFICATION

SUMMARY OF PERSONNEL AND WORK EFFORTS

Personnel	**Role**	**Effort in Man Months**
Pietro N. Bernasconi	APL Institutional PI	1.5
Harry Eaton	Systems Engineer & Pointing System Lead	1
Mechanical Engineer	Mechanical systems design	1

TOTAL BUDGET

TA : FG4HZ
AD-45406

BUDGET SUMMARY

FG4HZ - 10 METER SUB-ORBITAL LARGE BALLOON REFLECTOR (LBR) JHU/APL CO-I

1. Direct Labor

First Year

	Staff Months	$/Staff Months
Principal Professional Staff	2.50	11,772.49
Senior Professional Staff S1	0.93	8,153.93
Associate Professional Staff A1	0.06	5,733.52

2. Other Direct Costs

N/A

3. Facilities and Administrative (F&A) Costs:

The terms "Facilities and Administrative (F&A) Costs" are not applicable at the Johns Hopkins University Applied Physics Laboratory (JHU/APL). JHU/APL submitted an updated forward pricing rate (FPR) proposal to the Defense Contract Management Agency (DCMA) on 22 April, 2014. The forward pricing rates were revised effective with the new submittal and are reflected in rate memo BSB-FIN-14-L004 as Rate Table ID 078 effective 22 April, 2014. The rates used in this proposal are consistent with this FPR proposal.

Department Overhead on Direct Labor. Per disclosed practices, the Laboratory employs departmental burden rates that are applied as required. Departmental overhead is applied to the sum of JHU/APL direct labor and RSE direct labor. Details of the rates and calculations by department by fiscal year are provided in the proposal documentation.

Procurement Burden. Procurement burden is proposed as part of the JHU/APL Forward Pricing submittal and, in accordance with disclosed practices, is applied to the sum of Material and Subcontract costs. Details of the rates and calculations by fiscal year are provided in the proposal documentation.

Administrative and Research Burden. In accordance with JHU/APL disclosed practices, Administrative and Research Burden is applied to the sum of Direct Labor Costs, Procurement Burden, and Other Direct Costs. Details of the rates and calculations by fiscal year are provided in the proposal documentation.

Please be advised that Johns Hopkins University Applied Physics Laboratory (JHU/APL) is governed by the commercial cost principles contained in Federal Acquisition Regulation (FAR) Part 31.2. Accordingly, the work to be performed by JHU/APL under any resulting grant award shall be in accordance with the provisions FAR 31.2.

THE JOHNS HOPKINS UNIVERSITY-APPLIED PHYSICS LABORATORY

TA: FG4HZ
AD-45406

BUDGET SUMMARY

FG4HZ - 10 METER SUB-ORBITAL LARGE BALLOON REFLECTOR (LBR) JHU/APL CO-I

Includes optional Education/Public Outreach Proposal: ____ **YES** **X** **NO**

Total Period of Performance **From (M/Y/D)** **Aug-2014** **to** **Jul-2015**

			NASA USE ONLY	
1.	Direct Labor (salaries, wages, and fringe benefits)	54,838		
2.	Other Direct Costs:			
	a. Subcontracts			
	b. Consultants			
	c. Equipment			
	d. Supplies			
	e. Travel			
	f. Other			
3.	Facilities and Administrative Costs	25,142		
4.	Other Applicable Costs:			
5.	SUBTOTAL - Estimated Costs	79,980		
6.	Less Proposed Cost Sharing (if any)			
7.	Carryover Funds (if any)			
	a. Anticipated amount:			
	b. Amount used to reduce budget			
8.	Total Estimated Costs	79,980		XXXXXXXX
9.	APPROVED BUDGET	XXXXXXXX	XXXXXXXX	

THE JOHNS HOPKINS UNIVERSITY - APPLIED PHYSICS LABORATORY
COST SUMMARY REPORT
Project Summary by Year - Project Period of Performance = Aug 2014 to Jul 2015
(for all WBS IDs and all Departments)

Project ID: AD45406 **Proposal ID: AD-45406** **Task ID: FG4HZ** **Cost Model: M8**

Proposal Title: 10 METER SUB-ORBITAL LARGE BALLOON REFLECTOR (LBR) JHU/APL CO-I

	Total Project: AD45406		
	Staff Hours	Staff Months	Cost
Direct Labor Cost			
Principal	376.8	2.5	29,427
Senior I	139.4	0.9	7,542
Associate I	8.9	0.1	344
Total Direct APL Labor	525	3.5	37,313
Employee Fringe			17,526
Direct LW Labor			
Dept. Ovhd on Dir. Labor			15,505
Sub-Total	525	3.5	70,343
Direct Procurement Cost			
Material			
Subcontract			
Sub-Total			
Procurement Burden			
Procurement Burden			
Other Direct Cost			
LW Non-Salary			
LW ODC			
Travel			
Consulting			
Special Test Equipment			
Miscellaneous Other Direct Cost			
Sub-Total			
Total Direct Labor + Procurement Burden + ODC			70,343
Admin & Research Burden			9,637
Total Estimated Cost			79,980
Cost of Money			
Total Estimated Cost + COM			79,980
Fee			
Total Est. Cost, Fee, COM	**525**	**3.5**	**79,980**

* Totals and sub-totals may not add due to rounding.