

**(NNH16ZDA001N)**  
**ASTROPHYSICS RESEARCH AND ANALYSIS**  
**(APRA16)**  
**PANEL EVALUATION**

**Proposal No.:** 16-APRA16-0051

**PI/Institution:** Walker, Christopher Kidd \ University of Arizona

**Proposal Title:** The Large Balloon Reflector (LBR): Science and Technology Test Flights

---

**Brief Summary of Research Objectives:**

The proposed investigation will construct a balloon-borne sub-mm observatory, with a spherical mirror (the aluminized half-surface of an inner balloon having an effective aperture of 2.5m) encased inside of a larger outer mylar balloon. This innovative design will yield a more stable mount for the reflector and detector, while not significantly attenuating the astronomical signals. The observatory will be optimized for observing the ground-state transition of water, as well as a nearby transition of the <sup>13</sup>C isotopologue of CO. The proposed work will enable the construction of this instrument, as well as two test flights over a three-year period, which will test this concept as well as make scientific observations of a number of star forming regions. This will be a major step toward realizing a larger aperture THz observatory than has previously been achieved with SOFIA or Herschel. The science goal of this proposal is to measure the abundance and distribution of water vapor in the Galaxy and solar system, specifically, to measure the 557 GHz line of water vapor.

**OVERALL RATING: G**

## **DETAILED FINDINGS**

### **Major Strengths:**

The proposal describes an innovative design for a large balloon reflector concept. The proposal includes a summary of prior work having been done to establish proof of concepts for the proposed design.

The PI and team are extremely qualified to undertake the proposed work, have an excellent track record in balloon-borne instrumentation, and have access to facilities and equipment necessary to achieve the stated objectives of this plan.

The ultimate science goal of measuring the distribution of water vapor is of high interest, and cannot be done from the earth's surface or even from SOFIA.

### **Major Weaknesses:**

The proposal's discussion of progress to date does not adequately show that the technological maturity has reached a level where flight testing is essential. Further hardware development is necessary to assure the stability of the LBR mounting inside the carrier balloon. The proposal does not adequately present a thorough analysis of how well the LBR holds its shape under the expected environment, including the mechanical loading by the receiver package and its support structure: deformation of the reflector due to instrument weight, changes in elevation through the mounting structure, and changing altitude, may significantly impact the LBR shape and focal length.

There is insufficient discussion of the procedure for measurement and corrections for changes in LBR optical properties.

The proposal provided insufficient information to demonstrate that the proposed methods (e.g., interior support curtains) for stabilizing the receiver position would succeed in a balloon environment.

### **Minor Strengths:**

The proposal made some assessment of risks, including the lack of pointing targets (proposed to be addressed by onboard AO system) and balloon stability/shape requirements, addressed by a unique polyhedral design that will minimize strain while maintaining sphericity.

The proposed work will contribute to training a substantial number of undergraduate and graduate students.

This proposal is relevant to the ROSES APRA D.3 solicitation.

The labor and procurements proposed here are reasonable to accomplish the goals of this proposal. The cost of the major components is well addressed.

Minor Weaknesses:

The proposal's description of the significance of the scientific methods and yield (maps of H<sub>2</sub>O) was not sufficiently compelling to consider a project of this magnitude.

**COMMENTS OR SUGGESTIONS FOR THE PROPOSER (Optional):**

Including a measurement of the <sup>18</sup>O isotope of water vapor would address the likely optical thickness of the main H<sub>2</sub>O line.