

American Astronomical Society Small Research Grant Proposal

Title: The VSA: a Proof-of-Concept Prototype for Array2k
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Statement of Purpose:

To test the engineering concepts proposed by The SETI League, Inc., for arraying multiple small satellite TV dishes into a sensitive radio telescope.

Summary of Research:

The SETI League, Inc., pioneers in the use of backyard satellite TV dishes for radio astronomy and SETI research, has for two years been working on a new kind of radio telescope -- *Array2k* -- which combines a large quantity of standard satellite TV antennas into a single powerful radio telescope, at a fraction of the cost of a single giant dish such as those at Green Bank and Jodrell Bank.

Array2k will be used to support the individual efforts of The SETI League's 1280+ members worldwide as a follow-up detection device to help confirm their observations. It will also be used for direct astronomical research, and serve as a test-bed for SETI League engineers to develop the technologies which will someday allow them to unite thousands of members' small, backyard telescopes into a huge, planetary array.

Budgeted at \$160,000 US, *Array2k* is clearly beyond the scope of projects funded by the AAS Small Research Grant Program. The present proposal seeks to facilitate construction of a modest prototype for this project, dubbed the Very Small Array (VSA), which will test the circuitry and software concepts proposed for Array2k, and also serve as a research-grade radio telescope of moderate sensitivity.

Importance and Relevance:

NASA HRMS (High Resolution Microwave Survey), a modestly funded SETI observation program launched in 1992, was terminated by Congress in 1993. The SETI League and other non-profit organizations have endeavored to privatize that research. The proposed array is a prototype for a much larger and more ambitious radio telescope array, which will fulfill part of the mission of the late NASA HRMS. In a climate of increasing privatization of scientific projects, we hope to demonstrate that radio astronomy and SETI need not require the kinds of facilities which only governments can afford. Additionally, numerous other projects worldwide (the Ohio State Argus Telescope, the SETI Institute's Paul Allen Telescope, the Square Kilometer Array, etc.) are exploring the arraying of many small radio telescopes. The experience gained in developing the VSA will be shared with these other groups.

Institutional Endowment:

The SETI League, Inc. is an international, membership-supported nonprofit [501(c)(3)] educational and scientific organization, with a current annual budget of \$180,000 supporting two full-time employees. Its membership base of 1282 members in 60 countries provides less than 20% of that operating budget. The balance comes from small corporate gifts, foundation grants, and research grants such as this one. Total assets of the Corporation are on the order of \$140,000. Thus, The SETI League, Inc. qualifies as a smaller, less endowed institution, and respectfully requests we be given priority in consideration of this application.

Timeframe:

Site preparation, surveying and design work for the planned array facility have in fact already begun, funded out of SETI League unrestricted cash reserves. Initial testing will commence six months after receipt of funds requested herein. It is expected that the prototype array will be operational within six months after initial testing commences.

Use of Funds:

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All funds received from the American Astronomical Society in conjunction with this grant application will be used to replenish SETI League unrestricted discretionary funds currently being expended solely for the purpose stated herein. A full accounting will be provided to the AAS within eight months of receipt of funds.

Preliminary Budget:

Total direct expenses associated with this project are expected to exceed \$12,000 US. This grant application respectfully requests \$5,000 US to defray part of the costs of required hardware, labor, equipment rental, and freight, which are estimated as follows:

Coaxial Adapters, various	\$1650
Low Noise Amplifiers, 16 pcs @ \$145ea.	\$2320
Feedhorn components, 8 sets @ \$40 ea.	\$ 320
Antenna masts, 8 @ \$46 ea.	\$ 368
Concrete (est.)	\$ 500
Quadrature hybrids, 14 pcs @ \$200 ea.	\$2800
Coaxial cable, 500 feet @ 0.59/ft	\$ 295
Elevation rotors, 8 pcs @ \$280 ea.	\$2144
Equipment rental (back hoe and auger)	\$ 600
Professional Installation contract labor, 40 hours @ \$20/hr.	\$ 800
Freight, dishes, masts, rotors, cable (est.)	<u>\$1000</u>
	\$12,797

All additional required funding has already been secured through grants or gifts-in-kind, as delineated in the following Section.

Other Funding Sources:

1. The Principal Investigator's salary and benefits are being paid by grants from the Second Foundation and the Scott Randell Charitable Trust.
2. Office space is being donated by Eventide, Inc.
3. Secretarial support is funded by The SETI League, Inc. through membership dues.
4. The array site is being contributed by the Principal Investigator.
5. Site surveying services are being provided by Civil Engineering students from the Pennsylvania College of Technology, on a volunteer basis.
6. The required parabolic dish antennas and polar mounts have been contributed by JCM Computers LLC and Micro Technology.
7. Expenses not covered by this Grant will be paid out of SETI League unrestricted cash reserves.

Project Details:

Further technical information about the Array2k project, and this VSA prototype, appears on The SETI League's website, at <<http://www.setileague.org/array2k/update.htm>>. This section includes project development photos, system block diagrams, and schematic diagrams of the required correlator and combiner circuitry. Letters of support from Prof. Govind Swarup and Sir Arthur C. Clarke may be found there.

Prior Experience:

Just over one year ago, this PI received on behalf of The SETI League, Inc. an AAS Small Research Grant for construction of a Lunar Reflective Calibration Beacon for Radio Astronomy and SETI. That project was completed on schedule and within budget, and has exceeded expectations.

Respectfully Submitted:

H. Paul Shuch, Ph.D.
Principal Investigator, *Array2k* and VSA
Executive Director, The SETI League, Inc.

Approved By:

Richard C. Factor
President, The SETI League, Inc.
1 November 2001