

American Astronomical Society Small Research Grant Proposal

Title: The VSA Phase 2: Front-end Electronics for Array2k Prototype
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Statement of Purpose:

To continue testing the engineering concepts proposed by The SETI League, Inc., for arraying multiple small satellite TV dishes into a sensitive radio telescope, and to complete work begun under a prior AAS Small Research Grant, for which far less funding was awarded than was required for the present project.

Summary of Research:

The SETI League, Inc., pioneers in the use of backyard satellite TV dishes for radio astronomy and SETI research, has for three years now 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 1300+ 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.

Now budgeted at \$250,000 US, *Array2k* is clearly beyond the scope of projects funded by the AAS Small Research Grant Program. A prior AAS Small Research Grant Application in the amount of \$5000 sought to facilitate construction of a modest prototype for this project, dubbed the Very Small Array (VSA), to test the circuitry and software concepts proposed for Array2k, and also serve as a research-grade radio telescope of moderate sensitivity. An award of \$2000 in that grant cycle allowed us to plant the physical dishes for the array. The present grant request will fund front-end electronics to continue bringing this facility closer to realization.

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 one full-time and one part-time employee. Its membership base of 1300 members in 62 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 currently on the order of \$90,000. 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:

Antenna placement is well underway, funded in part by a prior AAS grant and partly out of SETI League unrestricted cash reserves. Initial testing of front-end electronics will commence six months after receipt of funds requested herein. It is optimistically hoped that the prototype array can be operational within six months after initial testing commences.

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Use of Funds:

All funds received from the American Astronomical Society in conjunction with this grant application will be used to continue previously under-funded research which has already drawn heavily on SETI League unrestricted discretionary funds expended solely for the purpose stated herein. A full accounting will be provided to the AAS within eight months of receipt of any further funds.

Preliminary Budget:

The VSA is a \$12,000 project. Total direct expenses associated with this phase of the VSA project are expected to exceed \$9,000 US, as indicated below. A prior grant in the amount of \$2000 was issued on 8 February 2002, and fully expended on the present project within less than two months thereafter. A shortfall in funds received under that grant resulted in a corresponding shortfall in anticipated matching funds, thus the project remains incomplete. The present grant application respectfully requests an additional \$5,000 US to defray part of the costs of required electronic hardware, estimated as follows:

Coaxial Adapters, various	\$ 1650
Low Noise Amplifiers, 16 pcs @ \$145ea.	\$2320
Feedhorn components, 8 sets @ \$40 ea.	\$ 320
Quadrature hybrids, 14 pcs @ \$200 ea.	\$2800
Coaxial cable, 500 feet @ 0.59/ft	\$ 295
Elevation rotors, 8 pcs @ \$280 ea.	\$2144
Freight on rotors, cable (est.)	<u>\$ 200</u>
	\$ 9,729

Any additional required funding will be 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 has been contributed by the Principal Investigator.
5. Site surveying services were 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:

Photos of progress to date with this VSA prototype appear on The SETI League's website, at <http://www.setileague.org/vsa>.

Prior Experience:

This PI has received on behalf of The SETI League, Inc. two prior AAS Small Research Grants. The first was for a project that was completed on schedule and within budget, and has exceeded expectations. The second resulted in an award of funding sufficient to begin, but not to complete, the present project.

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.
10 April 2002