

American Astronomical Society Small Research Grant Proposal

Title: The VSA Phase 2: Front-end Electronics for Array2k Prototype
Applicant: H. Paul Shuch, Ph.D. (email paul@setileague.org)
Affiliation: Executive Director and Chief Scientist, The SETI League, Inc.
433 Liberty Street, PO Box 555
Little Ferry NJ 07643 USA

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. Funding awarded was sufficient to complete the physical structures, but not the accompanying front-end electronics; thus, the project is on hold, pending further financial support.

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 complete the physical dishes, mounts, and conduit 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 current annual revenues of \$150,000 supporting one full-time and one part-time employee. Its membership base of 1335 members in 63 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 \$50,000. 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: All eight VSA antennas and mounts are currently in place, funded in part by prior grants from the AAS and the ARRL Foundation, 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.

American Astronomical Society Small Research Grant Proposal

It is optimistically hoped that the prototype array can be operational within six months after initial testing commences.

Use of Funds: Funds received from the American Astronomical Society in conjunction with this grant application will be used to continue previously funded research, which has already drawn heavily on SETI League cash reserves. All further grant funds will be 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: A prior AAS grant in the amount of \$2000 was issued on 8 February 2002, and helped facilitate completion of Phase 1 of the VSA project within its \$10,000 budget. Total direct expenses associated with Phase 2 of the VSA project are estimated at just over \$10,000 US, as indicated below. The present grant application respectfully requests \$7,000 US in funding, to be used toward acquisition of required electronic hardware, estimated below. Any additional required funding will be secured through grants or gifts-in-kind, as delineated in the following Section.

<u>Item</u>	<u>Qty</u>	<u>Unit Price</u>	<u>Total</u>
Matched Low -Noise Amplifiers	16	\$ 155.00	\$ 2,480.00
Quadrature Hybrids	14	\$ 200.00	\$ 2,800.00
LNA Cable Assemblies	16	\$ 34.00	\$ 544.00
Combiner Cable Assemblies	16	\$ 44.00	\$ 704.00
Elevation rotors	8	\$ 280.00	\$ 2,240.00
Type N right angle adapters	32	\$ 3.00	\$ 96.00
Type N female bulkhead adapters	20	\$ 5.00	\$ 100.00
Type N male-male adapters	32	\$ 5.00	\$ 160.00
Type N male connectors	16	\$ 5.00	\$ 80.00
Type N female connectors	16	\$ 4.00	\$ 64.00
Feedhorn sheetmetal	8	\$ 50.00	\$ 400.00
Elevation rotor controller	1	\$ 250.00	\$ 250.00
Contract labor - hourly	12	\$ 15.00	<u>\$ 180.00</u>
			\$ 10,098.00

Other Funding Sources:

1. The Principal Investigator's salary and benefits are being paid out of a grant from the Second Foundation.
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: VSA progress to date is documented at <<http://www.setileague.org/vsa>>.

Respectfully Submitted:

Approved By:

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

Richard C. Factor
President, The SETI League, Inc.
10 October 2002