

(a) A description of the nature of the research project being conducted.

ABSTRACT

Citizen Explorer is a program created to educate students of all ages about space, science, and technology. This program, created by the Colorado Space Grant Consortium (CSGC), will be realized through a series of Earth-orbiting satellites designed to take measurements of the Earth's environment. The first satellite in the series is Citizen Explorer I (CX-I), a small satellite that will measure atmospheric ozone and solar ultraviolet radiation. CX-I embodies the objectives of the Citizen Explorer Program—environmental and space education for K-12 students, significant experimentation for the scientific community, and real-world experience for undergraduate and graduate student engineers and scientists.

Introduction

Students at the Colorado Space Grant Consortium (CSGC) at the University of Colorado in Boulder, are currently designing and prototyping Citizen Explorer I (CX-I) -- a simple, low-cost, robust small satellite designed to measure total column ozone and solar ultraviolet radiation. CX-I is the first of a series of small satellites planned as part of the Citizen Explorer Program. This program, started by CSGC in the fall of 1996, was created to increase general environmental awareness and to transform math, science and technology education from classroom theory into exciting reality. Each satellite in the series will focus on a different aspect of the environment (i.e. the ozone layer, weather patterns, greenhouse gases, pollutants, land surveys and resource surveys). The program enables K-12 students to become actively involved in real and useful measurements of the environment by directly receiving data from the satellite and by assisting in ground-based measurements. In addition, the program enables undergraduate and graduate students, with mentors from academia, industry and government, to design, build, test, and operate a real satellite.

Educational and Scientific Mission

The Citizen Explorer Program was created to enable students of all ages to: participate in the space program, gain a better understanding of the environment, become familiar with the latest technologies, and work as part of an exploration team. This program will allow team educators, government officials, students, professional engineers and scientists to bring the space frontier into the K-12 classroom.

Educational Objectives

The main goal of the Citizen Explorer Program is environment, technology, and space education. The following CX-I mission objectives highlight this focus:

- CX-I will motivate K-12 students to pursue new experiences in Earth science and space technology by:
 - providing a better understanding of the Earth's environment;
 - increasing K-12 literacy in science and technology;
 - using space age technologies to inspire students; and

- enabling students to make informed decisions in environmental, scientific, and technical areas;
- CX-I will boost education in technology and science by:
 - involving student explorers in *real* and *significant* measurements of the environment;
 - exposing these explorers to a range of scientific and technical disciplines;
 - complementing other related educational programs; and
 - linking pre-college and college-age students.

Educational Significance

Citizen Explorer creates a powerful virtual community to encourage learning by uniting K-12 schools with university students and faculty, parents, industry, government labs, government agencies, and non-profit organizations in collaborative research projects and student/mentor partnerships.

Through the National Space Grant Program, college students in Colorado and across the nation will assist in training K-12 students and teachers in the use of the CX-I satellite to measure aspects of the Earth and its atmosphere from space. This training will be accomplished through workshops where classroom resources and lesson plans will be developed. The benefits of this interaction are far-reaching: teachers will receive science, advisory, and technology support; K-12 students will be exposed to relationships with university students, industry and government experts; and an extended team will enable teachers to meet educational standards in fun, interactive, and dynamic ways. In addition, students will:

- have the unique experience of participating in designing, developing, and operating a spacecraft, understanding its orbit, and evaluating its measurements;
- acquire a knowledge of space technology and how it functions – including the process by which space technology is developed, reviewed, tested, and launched;
- gain a unique global perspective of planet Earth from space;
- have near real-time data made available to them in a way conducive to the student explorer's research and analysis needs; and
- develop a sense of "ownership" and connection with the satellite mission.

Educational Standards

Throughout the program, educators from across Colorado have provided advice on how the underlying concepts of CX-I will respond to the Colorado Model Content Standards for Science (published 11/9/95). Support of these standards will make the CX-I mission applicable to existing state science curriculum, support the national standards, and contribute to the development of new, exciting curricula.

Scientific Objectives

The scientific objectives of CX-1 are to:

- provide unprecedented geographical coverage with its combination of aerosol, UV, and ozone measurements acquired with a large network of schools;

- provide extensive coverage to study large scale, global phenomena and localized trends such as El Nino and the distribution of cloud cover;
- provide scientists and students with a unique opportunity to explore localized atmospheric trends vs. global scale variability, and to explore rural vs. urban atmospheric variations;
- observe the effects of sudden stratospheric warming events and episodes of solar activity ;
- study the effects of these phenomena on global tropospheric chemistry and the biosphere on a geographically broad scale.

Scientific Significance

The Citizen Explorer Program is an excellent example of how space technology can benefit life on Earth. Students will get hands-on experience in using real data and igniting their enthusiasm for science while providing a genuine service to the public. The importance of measuring ozone is well known:

- Ozone is responsible for shielding the Earth from excessive levels of ultraviolet radiation;
- Global ozone has been declining for many years;
- Ozone distribution is highly variable due to seasonal changes and atmospheric circulation;
- Regional polar ozone depletion is expanding in the Southern Hemisphere and has been observed at unprecedented levels in the Northern Hemisphere.

In addition, CX-1 will provide a unique network of monitoring sites with unprecedented spatial coverage that complements the TOMS UV data product. These measurements are important because:

- UV is a driving force in photochemical oxidant formation and in photochemical formation of Aitken nuclei (sub-micron aerosols);
- UV plays a key role in the photodegradation of paints and polymers;
- UV is linked to skin carcinoma and melanoma, cataracts, plant damage, and net oceanic bioproductivity;
- Surface level UV radiation is difficult to accurately model due to aerosol variability.

CX-I will complement other NASA missions that measure atmospheric ozone from the space perspective only. The satellite will also complement EOS-AM MODIS data and assist in modeling surface level UV flux with measurements of aerosol optical depth. With resources such as the National Oceanic and Atmospheric Association (NOAA), CU, the National Center for Atmospheric Research (NCAR), Ball Aerospace, and Lockheed-Martin, Colorado has the unparalleled scientific and technical infrastructure to support the CX-I mission. CX-I will leverage these resources to improve the education of all citizens and to further the understanding of ozone, one of today's most significant Earth science issues.

Scientific Implementation

Ozone measurements onboard the satellite will be conducted by a single, nadir-looking spectrophotometer. A suite of coarse and fine sun sensors, also used for spacecraft attitude determination, will acquire solar ultraviolet radiation measurements. The utility of the satellite measurements will be extended through ground-based observations made by students using their own hand-held instruments. The UV sensitive multichannel photometer, costing about \$100, will enable students to determine the amount of ozone in the atmosphere directly above their site. Atmospheric ozone can be determined by differencing the satellite measurement of solar radiation from space with the student measurement of solar radiation from the ground.

(b) A showing that the communications facilities requested are necessary for the research project involved.

This FCC application is for the transmission station aboard the satellite Citizen Explorer I. The authorization for transmitting is necessary in order to complete the objectives of the experiment. Without this authorization, we cannot downlink ozone data to the schools involved or to university groundstations for engineering and health monitoring.

(c) A showing that the existing communications facilities are inadequate.

The Colorado Space Grant Consortium does not own or operate any satellites. Therefore; without this authorization, the experimentation and educational mission of Citizen Explorer I cannot go forward.

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001



Reply to Attn of: M-7

APR 9 1997

Ms. Elaine R. Hansen
Director, Colorado Space Grant Consortium
Campus Box 520
University of Colorado at Boulder
Boulder, CO 80309-0520

Dear Ms. Hansen:

NASA has manifested the Citizen Explorer satellite as a secondary payload with the Earth Observer-1/Satellite de Aplicaciones Cientificas-A (EO-1/SAC-C) mission, currently scheduled for launch in May 1999. NASA will provide for the integration and launch of Citizen Explorer in return for sharing of any data obtained. Details of the agreement would be established in a memorandum of understanding. Please contact Mr. Kevin Niewoehner at (202) 358-0751; to discuss terms of the exchange.

Secondary payloads are launched on a non-interference basis with primary payload requirements. This manifest assignment is subject to change in the event the primary missions requirements reduce or eliminate the currently identified secondary payload opportunity.


The EO-1/SAC-C mission is scheduled for launch from Vandenberg Air Force Base (VAFB) in California on a Boeing Delta 7320-10 vehicle. The EO-1 spacecraft will be placed in a 705 km sun-synchronous orbit. Subsequent to separation of EO-1, the Delta will perform a maneuver to change the local mean time (LMT) of the orbit node to the value required by SAC-C. SAC-C will then be separated in a 705 km circular orbit with an inclination of 98.2 degrees and a descending node LMT of 10:15 a.m. Citizen Explorer would separate in approximately this same orbit shortly after the separation of SAC-C.

A copy of the Delta Launch Vehicle Payload Planner's Guide for Secondary Payloads is enclosed. Please review it and advise as soon as possible of any incompatibility of Citizen Explorer with the mission or launch vehicle requirements. Based on information which you have provided previously, mass and dimensions of Citizen Explorer can be accommodated. Please verify that Citizen Explorer can withstand the vehicle environments defined in the enclosure and can comply with safety and contamination

restrictions required to protect the primary payloads. Planning should assume that the interface will be the standard Delta separating payload interface described in the enclosure.

Please contact Mr. Ron Mueller (202-358-4621) with any additional questions. For technical support, please contact Don Kraft at Goddard Space Flight Center, 301-286-0435, fax 301-286-1696, e-mail don.kraft@gsfc.nasa.gov.

Sincerely,



Karen Poniatowski
Director, Expendable Launch Vehicle Requirements
Office of Space Flight

Enclosure

bc:

M/J. Rothenberg
S. Oswald
SD/K. Ledbetter
Y/M. Mann
YF/M. Luther
K. Niewoehner
GSFC/170/R. Price
470/B. Clark
P. Frustace
D. Kraft
KSC/BR/B. Bruckner
R. Lugo
VAFB/L. Kruse

Return-Path: andersod@ucsu.Colorado.EDU

Received: from ucsu.Colorado.EDU (ucsu.Colorado.EDU [128.138.129.83])

by refuge.Colorado.EDU (8.8.8/8.8.7/UnixOps/Hesiod/(SDM)) with ESMTP id MAA13006
for <forman@refuge.colorado.edu>; Thu, 21 May 1998 12:35:26 -0600 (MDT)

Received: from localhost (andersod@localhost)

by ucsu.Colorado.EDU (8.8.5/8.8.4/CNS-4.1p) with SMTP

id MAA03517 for <forman@ucsu.Colorado.EDU>; Thu, 21 May 1998 12:35:24 -0600 (MDT)

Date: Thu, 21 May 1998 12:35:24 -0600 (MDT)

From: ANDERSON DAVID JAMES <andersod@ucsu.Colorado.EDU>

To: FORMAN MICHAEL ALAN <forman@ucsu.Colorado.EDU>

Subject: Re: Citizen Explorer (fwd)

Message-ID: <Pine.GSO.3.96.980521123513.2293A-100000@ucsu.Colorado.EDU>

MIME-Version: 1.0

Content-Type: TEXT/PLAIN; charset=US-ASCII

----- Forwarded message -----

Date: Sat, 25 Apr 1998 03:29:31 +0000

From: Graham Ratcliff <gratclif@senet.com.au>

To: ANDERSON DAVID JAMES <andersod@ucsu.Colorado.EDU>

Subject: Re: Citizen Explorer

Hi David,

At 14:59 20/04/98 -0600, you wrote:

>1 uplink in the 2 meter band; 144-148 MHz

You may or may not be aware that the allocation for the Amateur Satellite Service is only from 145.8 to 146.0 MHz so as you could well imagine this 200 Khz segment is severely overcrowded. This means that all frequencies are shared with other satellites and/or satellite users.

Having carefully reviewed the current situation the best frequency within that segment that I could suggest/recommend is 145.860 MHz. - *uplink (N/A to this application, included for reference)*

On that frequency you would be sharing it with stations uplinking to:

AMSAT-OSCAR-10's analogue Mode-B transponder downlink - CW or LSB (lower single side band) signals (N.B. this would be the case for any frequency between 145.825 and 145.975 MHz)

RS-10's analogue Mode-A transponder uplink - CW or USB (upper single side band) signals (N.B. this would be the case for any frequency between 145.860 and 145.900 MHz)

LUSAT-OSCAR-19 digital PACSAT uplink - 1200 baud AFSK FM (one of 4 uplinks)

RS-13 CW Beacon

RS-15's analogue Mode-A transponder uplink or Mode-K transponder downlink - CW or USB (upper single side band) signals (N.B. this would be the case for any frequency between 145.860 and 145.900 MHz)

Proposed Phase-3D's analogue transponders have both uplink and downlink - CW or USB (upper single side band) signals or LSB. (N.B. this would be the case for any frequency between 145.800 and 145.990 MHz)

Proposed Cessar-1 (AMSAT-Chile) digital PACSAT uplink - 1200 baud AFSK FM (one of 4 uplinks).

As you can see the 2M satellite segment is quite crowded and I think that 145.860 MHz is about as good as you will get in that segment. In an earlier submission there was a suggestion that a 1.2 GHz uplink maybe and alternative option - you may still want to consider that possibility....

>1 downlink in the 70 cm band; 434-438 MHz

The Amateur Satellite Service segment is from 435 to 438 MHz and there is a little more room to move in this segment. However, I am trying to keep all the digital downlink signals separated from the voice/analogue transponder outputs.

Having carefully reviewed the current situation the best frequency within this segment that I could suggest/recommend is 436.750 MHz. However, if you were to consider using a 1.2 GHz uplink instead of 2M then I would suggest using 437.850 MHz. *- downlink*

Can you please feedback to me if you have any problems with the above suggestions for frequencies - if you are happy with my suggestions then I will email all members of Amsat-International for comment prior to making any final recommendation.

>Hours of Operation: Uplink and downlink operation from 9 AM to 11 PM
>intermittent operation when overhead participating ground stations.

As an aside - are you saying by the above statement that the downlink is not going to be transmitting full time???

73 Graham VK5AGR



U. S. TREASURY DEPARTMENT
INTERNAL REVENUE SERVICE

DISTRICT DIRECTOR
DENVER, COLORADO 80202

SEP - 5 1967

IN REPLY REFER TO
Form L-178

AR:DJH:dg
DEN:EO:67-153

The University Foundation, Inc.
334 University Memorial Center
Boulder, Colorado 80302

| | |
|--|--|
| PURPOSE Educational | |
| ADDRESS INQUIRIES & FILE RETURNS WITH DISTRICT DIRECTOR OF INTERNAL REVENUE Denver, Colorado | |
| FORM 990-A RE- QUIRED | ACCOUNTING PERIOD ENDING June 30 |
| <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO | |

Gentlemen:

On the basis of your stated purposes and the understanding that your operations will continue as evidenced to date or will conform to those proposed in your ruling application, we have concluded that you are exempt from Federal income tax as an organization described in section 501(c)(3) of the Internal Revenue Code. Any changes in operation from those described, or in your character or purposes, must be reported immediately to your District Director for consideration of their effect upon your exempt status. You must also report any change in your name or address.

You are not required to file Federal income tax returns so long as you retain an exempt status, unless you are subject to the tax on unrelated business income imposed by section 511 of the Code, in which event you are required to file Form 990-T. Our determination as to your liability for filing the annual information return, Form 990-A, is set forth above. That return, if required, must be filed on or before the 15th day of the fifth month after the close of your annual accounting period indicated above.

Contributions made to you are deductible by donors as provided in section 170 of the Code. Bequests, legacies, devises, transfers or gifts to or for your use are deductible for Federal estate and gift tax purposes under the provisions of section 2055, 2106 and 2522 of the Code.

You are not liable for the taxes imposed under the Federal Insurance Contributions Act (social security taxes) unless you file a waiver of exemption certificate as provided in such act. You are not liable for the tax imposed under the Federal Unemployment Tax Act. Inquiries about the waiver of exemption certificate for social security taxes should be addressed to this office, as should any questions concerning excise, employment or other Federal taxes.

This is a determination letter.

Sincerely yours,

Arthur A. Kennedy
Arthur A. Kennedy
District Director

Copies sent to Gene Wilson, John Holloway, Jim Bayer (2) copies,
Jim Counter and Ed King on September 8, 1967, per DVR

