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Committee on the Peaceful Uses of Outer Space

Report on the Second United Nations/National Aeronautics and Space Administration Workshop on the International Heliophysical Year 2007 and Basic Space Science

(Bangalore, India, 27 November – 1 December 2006)

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I. Introduction

A. Background and objectives

1. The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), in particular through its resolution entitled "The Space Millennium: Vienna Declaration on Space and Human Development",[1] recommended that activities of the United Nations Programme on Space Applications should promote collaborative participation among Member States at both the regional and international levels by emphasizing the development of knowledge and skills in developing countries.

2. At its forty-eighth session, in 2005, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and conferences planned for 2006.[2] Subsequently, the General Assembly, in its resolution 60/99 of 8 December 2005, endorsed the United Nations Programme on Space Applications for 2006.

3. Pursuant to General Assembly resolution 60/99 and in accordance with the recommendations of UNISPACE III, the Second United Nations/National Aeronautics and Space Administration Workshop on the International Heliophysical Year 2007 and Basic Space Science was held in Bangalore, India, from 27 November to 1 December 2006. The Indian Institute of Astrophysics (IIA) hosted the Workshop on behalf of the Government of India.

4. Organized by the United Nations, the National Aeronautics and Space Administration (NASA) of the United States and the IIA, the Workshop was the second in a series of workshops on the International Heliophysical Year 2007 proposed by the Committee on the Peaceful Uses of Outer Space, based on discussion in its Scientific and Technical Subcommittee and reflected in the report of the Subcommittee (A/AC.105/848, paras. 181-192).

5. The main objective of the Workshop was to provide a forum to comprehensively review preparations for the International Heliophysical Year and related recent scientific and technical results in order to:

(a) Develop the basic science of heliophysics (the connections between the Earth, the Sun and interplanetary space) through cross-disciplinary studies of universal processes;

(b) Determine the response of terrestrial and planetary magnetospheres and atmospheres to external drivers;

(c) Promote research on the Sun-heliosphere system outward to the local interstellar medium;

(d) Foster present and future international scientific cooperation in the study of heliophysical phenomena;

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[1] *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (United Nations publication, Sales No. E.00.I.3), chap. I, resolution 1.

[2] *Official Records of the General Assembly, Sixtieth Session, Supplement No. 20* and corrigendum (A/60/20 and Corr.1), para. 94.

(e) Preserve the history and legacy of the International Geophysical Year on its fiftieth anniversary;

(f) Communicate unique results of the International Heliophysical Year to the scientific community and the general public.

6. The present report was prepared for submission to the Committee on the Peaceful Uses of Outer Space at its fiftieth session and to the Committee's Scientific and Technical Subcommittee at its forty-fourth session, both in 2007.

B. Programme

7. At the opening of the Workshop, statements were made by the Director of IIA, the Chairman of the Governing Council of IIA, the Director of the National Institute of Advanced Studies on behalf of the Government of India and by representatives of the International Heliophysical Year secretariat, NASA and the Office for Outer Space Affairs of the Secretariat. The Workshop was divided into plenary sessions, each focusing on a specific issue. Presentations by invited speakers, describing the status of their results in organization, research, education and outreach related to International Heliophysical Year, were followed by brief discussions. Eighty papers were presented by invited speakers from both developing and industrialized countries. Poster sessions and working groups provided an opportunity to focus on specific problems and projects in preparation for the International Heliophysical Year 2007 and basic space science.

8. The Workshop focused on the following topics: (a) the status of preparations for the International Heliophysical Year, including for the United Nations Basic Space Science initiative, at the national, regional and international levels; (b) solar surface phenomena; (c) dynamics of the chromosphere and transition region; (d) coronal studies; (e) corona and interplanetary medium; (f) terrestrial atmosphere; (g) non-extensive statistical mechanics; (h) International Heliophysical Year/United Nations Basic Space Science instrument donors; (i) International Heliophysical Year/United Nations Basic Space Science instrument hosts; (j) International Heliophysical Year science in developing nations; and (k) astrophysical data systems and virtual observatories.

C. Attendance

9. Researchers and educators from developing and industrialized nations from all economic regions were invited by the United Nations, NASA and IIA to participate in the Workshop. Participants held positions at universities, research institutions, observatories, national space agencies, planetariums and international organizations and were involved in all the preparations for the International Heliophysical Year 2007 and all the aspects of basic space science covered by the Workshop. Participants were selected on the basis of their scientific background and their experience in programmes and projects in which the International Heliophysical Year 2007 and basic space science played a leading role. The overall preparations for the Workshop were carried out by an international scientific organizing committee, a national advisory committee and a local organizing committee.

10. Funds provided by the United Nations, NASA and IIA were used to cover the travel, living and other costs of participants from developing countries. Funds for the holding of the Workshop were also provided by the Indian Space Research Organization, the Indian Institute of Geomagnetism, the Indian National Centre for Radio Astrophysics of the Tata Institute of Fundamental Research, the Indian Inter-University Centre for Astronomy and Astrophysics and the Indo-US Science and Technology Forum. A total of 150 specialists on the International Heliophysical Year and in basic space science attended the Workshop.

11. The following 30 Member States were represented at the Workshop: Algeria, Austria, Bangladesh, Brazil, Bulgaria, Cameroon, Canada, China, Egypt, Ethiopia, France, Germany, India, Indonesia, Iraq, Japan, Kenya, Malaysia, Mexico, Nigeria, Peru, Republic of Korea, Russian Federation, South Africa, Sri Lanka, Switzerland, Syrian Arab Republic, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland and United States of America.

II. Observations and recommendations

12. The Workshop took note with appreciation that the Third United Nations/European Space Agency/National Aeronautics and Space Administration Workshop on the International Heliophysical Year 2007 and Basic Space Science would be hosted by the Japanese National Astronomical Observatory on behalf of the Government of Japan in Tokyo from 11 to 15 June 2007.

13. The Workshop introduced the database project as part of the International Heliophysical Year "Tripod" triple-element concept to promote basic space science in developing nations. There was consensus that the database project would be a focus topic during the following workshop, in Japan. The database project would modify the International Heliophysical Year Tripod concept by replacing the instrument and observation elements by database and analysis tools.

14. The Workshop identified a need to ensure that the science background sessions scheduled for future workshops were of maximum benefit to participants, in particular International Heliophysical Year/United Nations Basic Space Science instrument hosts and instrument donors.

15. The Workshop recommended that International Heliophysical Year schools be organized at the same venue as the workshops in order to facilitate workshop participants' attendance, thereby contributing to the capacity-building effort. Host countries could also consider offering certain participants longer stays in order to enable them to gain hands-on experience at various institutes. Each year, the host country could provide information on opportunities available before the deadline for workshop applications.

16. The Workshop noted with appreciation the offer of the representative of the Republic of Korea to host the workshop in 2009 and the expression of interest of the Bulgarian Academy of Sciences in hosting the workshop in 2008.

17. The Workshop suggested that virtual observatories could enhance International Heliophysical Year investigations and recommended that International Heliophysical Year/United Nations Basic Space Science investigators make use of them to augment their data sources.

18. The Workshop emphasized that data gathered through International Heliophysical Year/United Nations Basic Space Science instruments (and other data that would become part of the International Heliophysical Year database) should have proper documentation to enhance their utility.

19. The Workshop emphasized that, in addition to instruments and data sets, numerical models could also become part of the International Heliophysical Year/United Nations Basic Space Science programme. Modelling could also assist the development of space science in developing nations.

20. It was suggested that in nations such as India, it could be beneficial to establish a separate fund that could be used for International Heliophysical Year-related activities.

21. The Workshop agreed that it would be necessary to establish an international working group on the use of the GNU data language (GDL). GDL was expected to become part of the International Heliophysical Year legacy and to be used worldwide for scientific computation free of cost.

22. The Workshop observed that the Smithsonian/NASA Astrophysics Data System (ADS) Abstract Service had become an important part of the infrastructure necessary for conducting efficient science investigations during the International Heliophysical Year and beyond. ADS provided a search system for the literature in astronomy, physics and geosciences, free access to a large part of the astronomical literature and an extensive system of links to other online resources.

23. The Workshop recommended the establishment of a worldwide system of ADS mirror sites under the auspices of the International Heliophysical Year in order to support International Heliophysical Year science investigations by improving access to this resource by developing nations.

24. The Workshop noted that significant advances had been made through the use of virtual observatories, especially in the area of solar physics, and recommended that scientists from developing nations made full use of that emerging tool to support their participation in the International Heliophysical Year.

25. The Workshop took note of the following criteria for the establishment of ADS mirror sites: to be eligible, a participating country should have a university with a physics or astronomy department equipped with a permanent Internet connection and an appropriate computer system. Eligible universities interested in establishing an ADS mirror site should contact the International Heliophysical Year secretariat, which will initiate the connection between ADS and the given physics/astronomy department. Once a suitable computer system is available at the participating department, ADS will configure the mirror site and transfer the data to the new system. ADS will remain responsible for keeping the mirror site up to date. The participating university will be responsible for ensuring that the computer system remains operational and for continuing the Internet connection.

III. Overview of the status of preparations for International Heliophysical Year 2007

A. Background

26. On 4 October 1957, only 54 years after the first flight, the launch of Sputnik I marked the beginning of the space age, when humankind took the first steps to leaving the protected environment of the Earth's atmosphere. The discovery of the radiation belts, the solar wind and the nature of Earth's magnetosphere prepared the way for the inevitable human exploration to follow. Before long, cosmonauts and astronauts were orbiting the Earth and then, in 1969, astronauts landed on the Moon. Today a similar story is unfolding: the spacecraft Voyager has crossed the termination shock and will soon leave the heliosphere. For the first time, humankind will begin to explore the local interstellar medium. During the next 50 years, exploration of the solar system, including the Moon, Mars and the outer planets, will be the focus of space programmes and, just as 50 years ago, unmanned probes will lead the way, followed by human exploration.

27. The International Geophysical Year of 1957, one of the most successful international science programmes of all time, broke new ground in the development of new space science. Fifty years later, International Heliophysical Year 2007 continues this tradition. The tradition of international science years began almost 125 years ago, when the first international scientific studies of global processes of the Earth's poles took place from 1882 to 1883. A second International Polar Year was organized in 1932, but a worldwide economic depression curtailed many of the planned activities. The International Heliophysical Year will continue the legacy of these previous events, extending global synoptic study to the heliosphere.

B. Universal processes

28. The large-scale structure of objects within the universe is determined mainly by two forces: gravitation and magnetism. Gravity is responsible for the structuring of planets, planetary systems, stars, galaxies and clusters of galaxies; and gravitation has been the dominant force controlling the evolution of the universe since the big bang. Magnetism, a second long-range force, is dominant in the rarefied, ionized matter. Magnetic forces at work within the plasma environment of the solar system are responsible for the storage and subsequent release of large quantities of energy in solar flares, coronal mass ejections, magnetic storms and other transient phenomena within the solar system. In addition, the magnetic field of planets such as Earth, Jupiter, Saturn and even the Sun dominate and define the structure of the space environment surrounding them.

29. It is now widely recognized that the large-scale evolution of the solar system plasma proceeds through a set of magnetic-field-dominated universal processes such as reconnection, particle acceleration, plasma-wave generation and propagation. New scientific insights can be gained by studying these universal processes in diverse environments and in a comparative way.

30. This is perhaps best understood by citing some examples. Shocks are observed in situ in the interplanetary medium; they are believed to play a role in the

acceleration of particles in the solar corona and standing bow shocks and termination shocks separate the major regions of the heliosphere. Shock formation and particle acceleration are universal processes. Auroras are observed on Earth, Saturn and Jupiter and Jovian auroral "footprints" have been observed on Io, Ganymede and Europa. The formation of auroras is observed to be the universal response of a magnetized body in the solar wind. The cross-disciplinary study of these processes will provide new insights that will lead to a better understanding of the universal processes in the solar system that affect the interplanetary and planetary environments.

C. Goals and objectives

31. The International Heliophysical Year has three primary objectives: (a) to advance understanding of the fundamental heliophysical processes that govern the Sun, Earth and heliosphere, (b) to continue the tradition of international research and advance the legacy of the International Geophysical Year on its fiftieth anniversary and (c) to demonstrate the beauty, relevance and significance of space and Earth science to the world.

32. More specifically, six goals for the International Heliophysical Year have been identified, each corresponding to a unique opportunity afforded by the International Heliophysical Year:

(a) To develop the basic science of heliophysics through cross-disciplinary studies of universal processes;

(b) To determine the response of terrestrial and planetary magnetospheres and atmospheres to external drivers;

(c) To promote research on the Sun-heliosphere system outward to the local interstellar medium, the new frontier;

(d) To foster present and future international scientific cooperation in the study of heliophysical phenomena;

(e) To preserve the history and legacy of the International Geophysical Year on its fiftieth anniversary;

(f) To communicate unique International Heliophysical Year results to the scientific community and the general public.

33. International Heliophysical Year is an integrated programme of many diverse activities working on an international level to achieve all of the above goals and objectives.

D. Plans for the International Heliophysical Year

34. The International Heliophysical Year programme has four main components (see figure I):

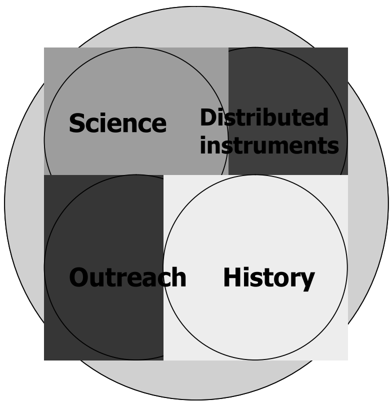
(a) Science activities, consisting primarily of coordinated investigation programmes dedicated to the study of the extended heliophysical system and the universal processes common to all of heliophysics (see paras. 35-37);

(b) The United Nations Basic Space Science distributed instrument observatory development programme, dedicated to the establishment of observatories and instrument arrays for the purpose of expanding knowledge of global heliophysical processes, while increasing the viability of space science research and education in developing nations and regions that have not yet been active in space research (see paras. 38-45);

(c) Education and public outreach, promoting public awareness of heliophysics and educational activities for students of all ages (see paras. 46 and 47);

(d) The International Geophysical Year Gold History Initiative, preserving the history and legacy of International Geophysical Year 1957 by identifying and recognizing planners of and participants in the first International Geophysical Year, preserving and making available items of historical significance from the International Geophysical Year and organizing commemorative activities and events (see para. 48).

Figure I
The objectives and goals of the International Heliophysical Year are met by the implementation of four interlinking thrusts, encompassing scientific research, the development of distributed instrument observatories, history and outreach efforts

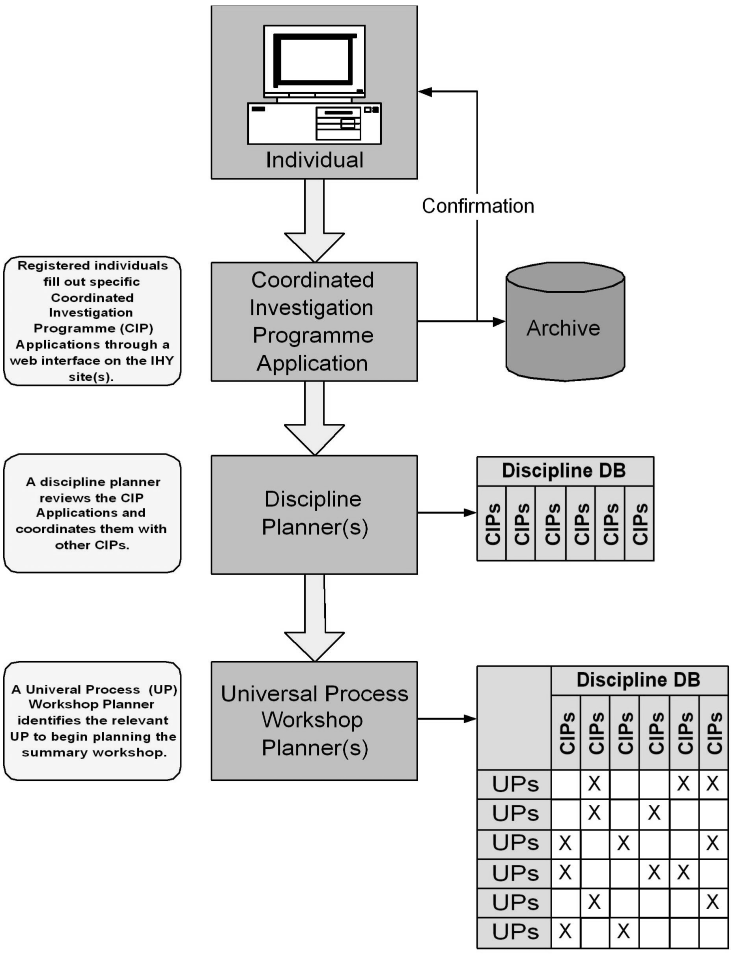


E. Science activities

35. During the International Heliophysical Year, coordinated investigation programmes utilizing space- and ground-based observatories will be organized to study universal processes at work throughout the solar system (see figure II). Maximum use will be made of the Internet and World Wide Web infrastructure to facilitate communication and organization. These research campaigns will operate in a similar way to the Solar and Heliospheric Observatory's Joint Observing Projects. The resulting data sets will be processed and assembled in order to make them readily available to the global science community. Coordinated data analysis will be performed during a series of workshops and the results will be published and made available to the science community.

36. Individuals within the research community may participate in coordinated investigation programmes (see figure II). Discipline coordinators will review all suggestions and organize similar coordinated investigation programmes into observing programmes that can be implemented. Observatory coordinators representing each of the instruments participating in the International Heliophysical Year will assist in this process. Later, the observing programmes will be organized into cross-disciplinary topical universal process workshops to discuss and communicate the scientific results of the International Heliophysical Year campaigns.

Figure II
Coordinated investigation programmes will be initiated by individual scientists and later organized into universal process workshops for the purpose of summarizing and publishing the scientific results



Note: CIP coordinated investigation programme
UP universal process

37. Conducting joint campaigns with organizations having overlapping goals minimizes the resources required for the International Heliophysical Year. The International Heliophysical Year will seek to identify areas where it can support programmes such as Climate and Weather of the Sun-Earth System, International Polar Year, Electronic Geophysical Year and the International Year of Astronomy 2009 by, for example, providing the Web-based campaign-planning database software developed to support International Heliophysical Year to these international groups. Detailed discussions on areas of support were carried out during 2005 and led to detailed cooperation and coordination in 2006. International Heliophysical Year workshops and coordination meetings will be held in conjunction with Solar, Heliospheric and Interplanetary Environment; Geospace Environment Modeling; and Coupling, Energetics and Dynamics of Atmospheric Regions and, whenever possible, in conjunction with meetings of major societies such as the American Geophysical Union and the European Geosciences Union.

F. United Nations Basic Space Science distributed instrument observatory development programme

38. Through a cooperative programme with the United Nations Basic Space Science initiative for 2005-2009, the International Heliophysical Year will facilitate the deployment of a number of arrays of small instruments to take global measurements of space physics-related phenomena (see table 1 and A/AC.105/856). These may range from a new network of radio dishes to observe interplanetary coronal mass ejections to extending existing arrays of Global Positioning System receivers to observe the ionosphere. These instrument concepts are mature, developed and ready to be deployed. A coordination meeting was held among International Heliophysical Year and United Nations Basic Space Science representatives at Greenbelt, Maryland, United States in October 2004. As a result of that meeting, the United Nations Basic Space Science initiative has dedicated its activities up to 2009 to providing the International Heliophysical Year with a link into developing nations. The initiative has provided more than 2,000 scientist contacts in 192 nations, many of whom are eager to participate in international space science activities.

Table 1
Updated list of International Heliophysical Year/United Nations Basic Space Science projects (see also A/AC.105/856)

	Instrument	*Contact*	*Status*
1.	Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory (CALLISTO)	C. Monstein (Switzerland)	Two instruments deployed in India, one in Siberia and one in Switzerland. Installation in Costa Rica in progress; others planned.
2.	Magnetic Data Acquisition System (MAGDAS)	K. Yumoto (Japan)	Deployed in Côte d'Ivoire, Ethiopia, Malaysia and Nigeria. Others planned.

	Instrument	*Contact*	*Status*
3.	Global Positioning System (GPS) Scintillation	C. Amory-Mazaudier (France) and T. Fuller-Rowell (USA)	More than 25 new installations across Africa in progress.
4.	Scintillation Network Decision Aid (SCINDA) GPS	K. Groves (USA)	Deployed in Cape Verde and Nigeria. Others in progress.
5.	Coherent Ionospheric Doppler Receiver (CIDR)	T. Garner (USA)	Four-instrument chain planned for Egypt.
6.	Atmospheric Weather Educational System for Observation and Modeling of Effects (AWESOME) Very Low Frequency (VLF) Radio	U. Inan (USA)	Deployed in Algeria, Morocco and Tunisia. Others planned for Egypt and the Libyan Arab Jamahiriya.
7.	Remote Equatorial Nighttime Observatory for Ionospheric Regions (RENOIR)	J. Makela (USA)	Instrument funding obtained, instrument development in progress.
8.	Space Environmental Viewing and Analysis Network (SEVAN) Particle Detector	A. Chillingarian (Armenia)	Instrument for Bulgaria in process of construction.
9.	African Meridian B-field Education and Research (AMBER) (International Heliophysical Year magnetometer)	I. Mann (Canada) and E. Yizengaw (USA)	Instrument deployment in progress.
10.	South Atlantic Very Low Frequency Network (SAVNET)	J.-P. Raulin (Brazil)	Instrument funding obtained.
11.	Low-cost Ionosonde	J. Bradford (UK)	Seeking instrument funding.
12.	Low-frequency radio array	J. Kasper (USA)	Instrument deployment in progress.
13.	Muon Detector Network	K. Munakata (Japan)	Collaborating with SEVAN.

39. The purpose of the observatory development programmatic thrust of the International Heliophysical Year is to develop activities and facilitate partnerships that stimulate space and Earth science activities, such as the establishment of ground-based instrument arrays and research programmes, throughout the economic regions of the world. This includes the deployment of small, inexpensive instruments such as magnetometers, radio antennas, Global Positioning System receivers, all-sky cameras, and so forth around the world to provide global measurements of ionospheric and heliospheric phenomena. Although nearly all of the proposed instruments require global coverage to be effective, there are notable (and scientifically important) geographical gaps where coverage is minimal. The region of Africa is one of these gap regions. The International Heliophysical Year

observatory development programme will attempt to address this by facilitating instrument deployment in these sparsely covered regions of the world.

40. The basic observatory development concept is summarized as follows:

(a) The lead scientist or principal investigator will provide instrumentation (or plans for the construction of instruments) for the instruments in the array;

(b) The host nation will provide the workforce, facilities and operational support to obtain data with the instrument, typically at a local university;

(c) The instrument host scientists will become part of the principal investigator team;

(d) All data and data analysis activities will be shared with all members of the group;

(e) Publications and meetings will involve the participation of all team members whenever possible.

41. The observatory development programme facilitates partnerships between instrument providers and instrument host institutions. The Tripod approach, with the three legs of the Tripod consisting of instrumentation, education and observation, leads to scientific cooperation, which produces excellent science and improves the viability of space science around the world, providing an important link between scientific outreach and first-class science research.

42. This joint programme, a collaboration between the International Heliophysical Year and the United Nations Basic Space Science initiative, centres around a series of annual workshops hosted in varying international locations, including the 2005 Workshop held in the United Arab Emirates (A/AC.105/856) and the 2006 Workshop in India discussed in the present report. Both workshops brought together instrument providers and those interested in providing an instrument to discuss facilities and requirements for each of the planned arrays. Each Workshop included 20 instrument providers and 30 potential instrument hosts selected from over 150 applicants.

43. The first instrument deployments in the United Nations Basic Space Science distributed instrument observatory development programme have already been completed. Numerous instruments are operating in Africa and many additional installations are planned. This has been one of the most successful campaigns of the International Heliophysical Year. In total, at the present time, over 30 new observatories are planned for Africa and new observatories are added to the list every month.

44. In addition to updating the status of previously identified instruments, four new instrument concepts were presented during the 2006 Workshop. These are summarized in table 2. The International Heliophysical Year secretariat will work during 2007 to identify host institutes for these instruments.

Table 2
Four new International Heliophysical Year/United Nations Basic Space Science programme instrument concepts presented at the Workshop

	Instrument	*Contact*	*Status*
1.	H-alpha Telescope	K. Shibata, S. Ueno (Japan)	Deployed in Chile. Other deployments in progress.
2.	Liulin	T. Dachev (Bulgaria)	Instruments available, seeking sites for deployment.
3.	South Atlantic Magnetic Anomaly (SAMA)	J. H. Fernandez (Brazil)	Seeking instrument funding.
4.	Very Low Frequency (VLF) Direction Finding	A. Hughes (South Africa)	Deployment at the planning stage.

45. A new initiative discussed and begun during the 2006 Workshop was to involve developing nations in the analysis of data obtained from space missions (see table 3). These data are routinely available on the Internet or on digital video disc (DVD) for use by the scientific community. During the Workshop, several experimenters agreed to identify data analysis projects that would use their data sets to enable researchers from developing nations to participate in a large-scale data analysis project. A project to make free data analysis software available (GDL) is already under way and ADS will be made available to mirror sites as necessary to ensure that researchers have access to the scientific literature needed.

Table 3
Five new data analysis concepts identified at the 2006 Workshop

	Instrument	*Contact*	*Status*
1.	Solar Anomalous and Magnetospheric Particle Explorer (SAMPEX) magnetometers	S. Kanekal (USA)	Further definition at 2007 Workshop in Japan.
2.	GNU data language (GDL) software development	R. Schwartz (USA)	Development-level software being tested in India.
3.	Astrophysics Data System (ADS) reference sites	G. Eichhorn (USA)	Identifying appropriate sites.
4.	Solar Ultraviolet Measurements of Emitted Radiation (SUMER) database	C. Wilhelm (Germany)	Further definition at 2007 Workshop in Japan.
5.	Large Angle Spectrometric Coronagraph (LASCO) Coronal Mass Ejection (CME) database	N. Gopalswamy (USA)	Further definition at 2007 Workshop in Japan.

G. Education and public outreach

46. One of the primary objectives of the International Heliophysical Year/United Nations Basic Space Science initiative is to encourage the study of space science in developing nations, providing the opportunity to participate in space science research, while at the same time developing the curriculum and facilities to demonstrate and teach space science in the university environment. The International Heliophysical Year fully supports these objectives and will be preparing printed material describing a space science curriculum for each of the deployed instrument arrays. Scientists at participating institutions will be able to use these curricula as guides in teaching and to fully participate in the analysis of the data from the array and in the scientific discoveries that result.

47. The International Heliophysical Year will organize a series of two-week schools, in India, China, Malaysia, Europe, the United States and Latin America to teach heliophysics at the graduate-student level. These schools will be open to students and faculty in the area and provide heliophysics instruction at a very reasonable cost. The schools will provide both an outreach component and the opportunity for additional training of the instrument hosts.

H. International Geophysical Year Gold History Initiative

48. In 2004, the International Geophysical Year Gold Club was established to commemorate the achievements of International Geophysical Year participants. The first recipient, Dr. Alan Shapley, was presented with the award at the International Heliophysical Year Workshop held in Boulder, Colorado, in February 2005. The Gold Club award consists of a certificate and a pin with the International Geophysical Year logo embossed on it. To be eligible for membership, one must (a) have participated in the International Geophysical Year in some way and (b) provide some historical materials (such as copies of letters or books) to the International Heliophysical Year history committee. These materials will provide a lasting legacy of the International Geophysical Year for generations to come. This is a cooperative effort among the International Heliophysical Year, the history committee of the American Geophysical Union and the history committee of the International Association of Geomagnetism and Aeronomy.

I. International Heliophysical Year schedule of preparations and activities

49. Planning for the International Heliophysical Year has been organized into seven regions as follows: Africa, Asia and the Pacific, Eastern Europe and Central Asia, Europe, Latin America and the Caribbean, North America and Western Asia. Each of these regions has formed a regional planning committee to coordinate regional International Heliophysical Year participation. Representatives from each region met in Toulouse, France, in July 2005 to begin the joint international planning process. International planning will continue in regional and international organizing meetings. Additional information on meeting plans and regional organizations is available at the International Heliophysical Year website (http://ihy2007.org).

50. Hundreds of national, regional and international planning conferences and meetings have taken place for all aspects of the International Heliophysical Year programme. Teams continue to form, implementing International Heliophysical Year activities in all the regions of the globe. The four main programmatic thrusts of International Heliophysical Year (science, distributed instruments, outreach and history (see figure I)) are necessary to enable the individual organizations and institutions to develop unique International Heliophysical Year programmes that suit their own goals and challenges. It is the activities and programmes developed by these individual organizations and institutions that form the "building blocks" of the International Heliophysical Year. Therefore, the International Heliophysical Year's international planning activities have focused on the establishment of the four main components of International Heliophysical Year and on enabling the individual International Heliophysical Year regions and nations to commence with their planning activities.

51. The numerous national and regional planning activities have consisted primarily of International Heliophysical Year team meetings and special sessions held during scientific meetings. International Heliophysical Year team meetings have been held in each of the International Heliophysical Year's seven regions and each national planning team is continuing to develop and implement elements of its programme in coordination with the international effort. Numerous special sessions on International Heliophysical Year have been held at a wide range of scientific meetings, addressing all four of the International Heliophysical Year programmatic thrusts. These special sessions have provided a venue for members of the scientific community to learn about International Heliophysical Year activities and to begin to contribute to the International Heliophysical Year effort.

52. As one would expect, the number of International Heliophysical Year events has increased exponentially in the past several years. The "Events" section of the International Heliophysical Year website (http://ihy2007.org/events/events.shtml) lists a representative number of these activities, especially those pertaining to the aspects of the programme dealing with science and observatory development.

53. In preparation for the official launch of International Heliophysical Year activities in 2007, many precursor activities took place in 2005 and 2006. For the science component of International Heliophysical Year, the regional coordinators have established a list of several hundred observatories that are planning to participate in International Heliophysical Year science activities and members of the international scientific community have begun proposing their coordinated investigation programmes for implementation during the International Heliophysical Year. Sessions on International Heliophysical Year science activities, held during various scientific meetings, have focused on bringing discussions of International Heliophysical Year science to the forefront and identifying campaigns to be implemented as coordinated investigation programmes. The observatory development component has been the focus of intensive activities in concert with the United Nations Basic Space Science initiative. In particular, the deployment of individual instruments at remote sites has already begun as an essential step towards the establishment of global arrays by 2007. New instrument programmes and new host sites for these activities continue to be identified. The science component has already launched several activities worldwide, emphasizing the linkage to individual

local programmes, while the International Geophysical Year Gold History Initiative was implemented in 2004, with plans to continue through 2009.

54. A general description of the schedule of preparations for and follow-up to International Heliophysical Year is given below:

2001-2003	Establishment of International Heliophysical Year secretariat; establishment of main elements of the International Heliophysical Year programme; initialization of planning activities in all regions.
2004	Start of national and regional coordination meetings; definition of four essential components of International Heliophysical Year; synergy/coordination discussions with professional organizations; establishment of coordinated investigation programme structure; launch of International Heliophysical Year/ United Nations Basic Space Science and International Geophysical Year Gold History Initiative.
2005	Continuation of national and regional coordination meetings; synthesis and coordination from regional to international level; continuation of precursor activities for each of four main components; start of instrument deployment; formation of fabric of International Heliophysical Year science campaigns as coordinated investigation programmes proposed by individual community members begin.
2006	Focus on implementation of four main International Heliophysical Year components and on integration of national and local activities into International Heliophysical Year community; prototyping year, particularly for numerous coordinated investigation programmes and outreach activities serving as trailblazers or test beds, or both.
2007-2008	Launch of International Heliophysical Year as integrated international programme. Holding of science, observatory development, outreach and history activities worldwide and impact of efforts of each individual component and region multiplied by coordination with worldwide effort.
2008-2009	Continuation of International Heliophysical Year activities. Analysis of results of International Heliophysical Year coordinated investigation programmes and science campaigns in diverse workshops and analysis activities; continuation of observatory development through International Heliophysical Year/United Nations Basic Space Science legacy programmes; incorporation of major scientific results and breakthroughs in outreach activities.

J. Organization of International Heliophysical Year

55. The organization of planning for International Heliophysical Year is shown in figure III. The International Heliophysical Year is planned and directed by the International Heliophysical Year secretariat in coordination with the Steering Committee.

56. The International Heliophysical Year secretariat consists of four individuals, three of whom, Joseph M. Davila (Chairperson, International Steering Committee), Nat Gopalswamy (International Coordinator) and Barbara J. Thompson (Operations Coordinator), are located at Goddard Space Flight Center, Maryland, United States, and the fourth, Cristina Maria Rabello-Soares (Education and Outreach Coordinator) at Stanford University, Stanford, United States. The secretariat also coordinates International Heliophysical Year activities with cooperating organizations.

Figure III
Organizational chart of the worldwide implementation of International Heliophysical Year