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Committee on the Peaceful Uses of Outer Space

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

(Tokyo, 18-22 June 2007)

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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”, 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, in a variety of space science and technology activities, by emphasizing the development and transfer of knowledge and skills and countries with economies in transition.[1]

2. At its forty-ninth session, in 2006, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and conferences planned for 2007.[2] Subsequently, the General Assembly, in its resolution 61/111 of 14 December 2006, endorsed the activities of the Office for Outer Space Affairs of the Secretariat for 2007.

3. Pursuant to Assembly resolution 61/111 and in accordance with the recommendations of UNISPACE III, the United Nations/European Space Agency/National Aeronautics and Space Administration Workshop on the International Heliophysical Year 2007 and Basic Space Science was held in Tokyo from 18 to 22 June 2007. The National Astronomical Observatory of Japan (NAOJ) hosted the Workshop on behalf of the Government of Japan.

4. Organized by the United Nations, the European Space Agency (ESA), the National Aeronautics and Space Administration (NASA) of the United States of America and NAOJ, the Workshop was the third in a series of workshops on basic space science and the International Heliophysical Year 2007 proposed by the Committee on the Peaceful Uses of Outer Space, on the basis of discussions in its Scientific and Technical Subcommittee, as reflected in the report of the Subcommittee (A/AC.105/848, paras. 181-192). The two previous workshops in the series were hosted by the Governments of the United Arab Emirates, in 2005, and of India, in 2006 (A/AC.105/856 and A/AC.105/489). Those workshops were a continuation of the series of workshops on basic space science that were held between 1991 and 2004 and that were hosted by the Governments of India (A/AC.105/489), Costa Rica (A/AC.105/530) and Colombia (A/AC.105/530), Nigeria (A/AC.105/560/Add.1), Egypt (A/AC.105/580), Sri Lanka (A/AC.105/640), Germany (A/AC.105/657), Honduras (A/AC.105/682), Jordan (A/AC.105/723), France (A/AC.105/742), Mauritius (A/AC.105/766), Argentina (A/AC.105/784) and China (A/AC.105/829).

5. The main objective of the Workshop was to provide a forum in which participants could comprehensively review achievements and plans for basic space science and the International Heliophysical Year and assess recent scientific and

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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, sect. I, para. 1 (e)(ii), and chap. II, para. 409 (d)(i).

[2] *Official Records of the General Assembly, Sixty-first Session, Supplement No. 20* (A/61/20), para. 87.

technical results, with a view to reporting on the status of implementation of follow-up projects for the promotion of basic space science (A/AC.105/766) and the International Heliophysical Year (A/AC.105/882).

B. Programme

6. At the opening of the Workshop, statements were made by the Director General of NAOJ on behalf of the Government of Japan and by representatives of the International Heliophysical Year secretariat, NASA and the Office for Outer Space Affairs. The Workshop was divided into plenary sessions, each focusing on a specific issue. Presentations by invited speakers, describing their achievements with regard to organizing events, and carrying out research, education and outreach activities related to basic space science and the International Heliophysical Year, were followed by brief discussions. Eighty papers and posters were presented by the invited speakers, some of whom came from developing countries and others from developed countries. Poster presentation sessions and working groups provided participants with an opportunity to focus on specific problems and projects related to basic space science and the International Heliophysical Year.

7. The Workshop focused on the following topics: (a) the development of telescopes, observing programmes and teaching materials to be used as part of the "Tripod" concept for the promotion of basic space science in developing countries; (b) the space programme of Japan; (c) the development of instruments, data analysis software and teaching materials to be used as part of the "Tripod" concept for the promotion of the International Heliophysical Year in developing countries; (d) data systems; (e) virtual observatories; and (f) statistical mechanics and astrophysics.

8. In a ceremony, as part of the Workshop, organizers and participants of the workshops expressed their appreciation for the long-term, substantive contributions made to basic space science, particularly for the benefit of developing countries, by the following distinguished scientists: M. Kitamura of NAOJ, T. Kogure of Kyoto University in Japan, Y. Kozai of the Gunma Astronomical Observatory in Japan, N. Kaifu of the National Astronomical Observatory of Japan, C. Tsallis of the Centro Brasileiro de Pesquisas Físicas in Brazil, P. Okeke of the Centre for Basic Space Science in Nigeria, H.M.K. Al-Naimiy of the College of Arts Sciences at Sharjah University and of the Arab Union for Astronomy and Space Sciences in the United Arab Emirates and A. M. Mathai of the Centre for Mathematical Sciences, at Pala Campus in India.

9. In 2004, the International Geophysical Year Gold Club was established to commemorate the achievements of those who participated in the International Geophysical Year. The first recipient, Alan Shapley, was presented with the award at the International Heliophysical Year Workshop held in Boulder, Colorado, in the United States, 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, persons must (a) have participated in commemorating the International Geophysical Year in some way and (b) provide some historical materials (such as copies of letters or books) to the history committee of the International Heliophysical Year. Those materials should provide a legacy of the International

Geophysical Year for generations to come. The collection of historical materials is a cooperative effort of the International Heliophysical Year secretariat, the history committee of the American Geophysical Union and the history committee of the International Association of Geomagnetism and Aeronomy.

10. In a ceremony, as part of the workshop, representatives of the International Heliophysical Year secretariat awarded International Geophysical Year Gold Club certificates to Masami Wada and Keizo Nishi, two distinguished senior scientists from Japan.

C. Attendance

11. Researchers and educators from developing and developed countries from all economic regions were invited by the United Nations, ESA, NASA and NAOJ to participate in the Workshop. The participants, who held positions at universities, research institutions, observatories, national space agencies, planetariums and international organizations, were involved in implementing activities in the framework of the International Heliophysical Year 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 basic space science and the International Heliophysical Year played a leading role. The preparations for the Workshop were carried out by an international scientific organizing committee, a national advisory committee and a local organizing committee.

12. Funds provided by the United Nations, ESA, NASA and NAOJ were used to cover the travel, accommodation and other costs of participants from developing countries. A total of 75 specialists in basic space science and the International Heliophysical Year attended the Workshop.

13. The following 28 Member States were represented at the Workshop: Algeria, Austria, Brazil, Bulgaria, China, Egypt, India, Indonesia, Japan, Kenya, Malaysia, Mongolia, Morocco, Nigeria, Paraguay, Peru, Republic of Korea, Russian Federation, Spain, Sri Lanka, Syrian Arab Republic, Thailand, Netherlands, Philippines, Ukraine, United Arab Emirates, United States, and Uzbekistan.

II. Observations and conclusions

14. Workshop participants considered the opportunities associated with basic space science and the International Heliophysical Year important for enabling countries, particularly developing countries, to participate in activities recommended by the Committee on the Peaceful Uses of Outer Space and its subsidiary bodies and stressed the importance of preparing for such a participation in good time.

15. Workshop participants noted with appreciation the offers made by the Governments of Bulgaria, the Republic of Korea, and Nigeria to host workshops on basic space science and the International Heliophysical Year in 2008, 2009 and 2010 respectively.

16. Workshop participants recommended examining the feasibility of creating an independent source of funding, supported by interested parties, to facilitate the execution of global and regional studies and projects on basic space science and the International Heliophysical Year. By making available small grants, the fund could actively stimulate multinational and interregional education, application and research initiatives.

17. Workshop participants observed with satisfaction that international and interregional initiatives had developed further, using astronomical telescopes and planetariums established over the previous 25 years. They also noted that it would be helpful to formalize networks and working groups with common goals to further coordinate research work and thus promote greater participation in such initiatives.

18. In particular, workshop participants noted with satisfaction the ongoing collaboration among observatories in Indonesia, Malaysia and Paraguay, a collaboration that had resulted in the supply of important continuous observing capability, essential for understanding objects such as variable stars. Extending such collaboration to other observatories at different longitudes would contribute significantly to worldwide coverage of such phenomena.

19. Workshop participants observed with satisfaction the successful establishment and operation of low-cost, ground-based, worldwide instrument arrays for achieving the goals of the International Heliophysical Year.

20. Workshop participants commended the NASA Astrophysical Data System (ADS) for successfully enabling the laying out and implementation of road maps that improved access for all scientists and engineers to relevant literature and expressed their hope that ADS would continue to be supported in the future. ADS was extremely important for the worldwide scientific and technical community. The continued support of ADS mirror sites and of similar databases was important and should be seriously considered in all countries where scientists and engineers experienced difficulties in accessing networks due to obstacles caused by international boundaries.

21. Workshop participants emphasized that the initiatives of various virtual observatories in a number of countries could contribute significantly to accelerating the development of basic space science and to the International Heliophysical Year. The ongoing exchange of information on standards, for example, which is one of the activities of the International Virtual Observatory Alliance, would greatly enhance the value of the initiatives of individual virtual observatories.

22. Workshop participants observed with satisfaction that the regional centres for space science and technology education, affiliated to the United Nations were operational. The centres are located in Brazil and Mexico for Latin America and the Caribbean, in India for Asia and the Pacific, and in Morocco and Nigeria for Africa. The participants emphasized that it would be beneficial to establish a regional centre in West Asia.

23. Workshop participants took note of the establishment of the International Committee on Global Navigation Satellite Systems under the umbrella of the United Nations and expressed the opinion that the International Committee might be able to support the development of GNSS technology for low-cost, ground-based,

worldwide instrument arrays for achieving the goals of the International Heliophysical Year.

III. Summary of deliberations

A. Basic space science

24. The deliberations of Workshop participants gave rise to the sharing of information about past and future activities in basic space science, about plans that had been developed over long periods in different countries and regions and about the results that had emerged in different developing and developed countries. The results that were addressed in the Workshop were achievements of a truly international nature for all those involved in previous workshops. Over time, the mutual support that workshop participants offered each other helped them significantly to implement recommendations made at the workshops. Workshop participants came from all economic regions of the world, specifically from Africa, Asia and the Pacific, Europe, Latin America and the Caribbean and West Asia, which allowed them to recognize the importance of a regional and, at times, global approach to basic space science for the benefit of developing and developed countries worldwide. The topic "astronomical telescopes and planetariums" for sessions of the Workshop was selected because of the long-standing success of the donation of telescopes and planetariums to developing countries by the Government of Japan.

25. At the workshops, participants developed a concept, known as the "Tripod", that comprises three elements. The first element is the provision of the means to carry out basic research appropriate for developing countries, such as astronomical telescope facilities. The second element is the implementation of original research programmes in basic space science appropriate for the state of existing facilities and of scientific development, in a given country, for example the implementation of variable star observing programmes supplemented by information from the areas of computer science, mathematics, physics and astronomy. The third element is the development and provision of teaching material to allow the introduction of basic space science into the established physics and mathematics curricula of universities in countries that implement the "Tripod" concept. Access to scientific literature, such as that provided by ADS, and to databases, such as those of the virtual observatories, represent an essential supplementary component of "Tripod".

26. State-of-the-art observing facilities on the ground and in space are producing large quantities of high-quality data that are being stored in science archives with the goal of exploiting them in the best way possible. The next logical step is to link those archives so that users can retrieve the data in a simple and uniform way and so that the scientific use of those expensive resources can be maximized. It would also be useful to supply a suite of science visualization and analysis tools in order to facilitate further the handling of the data. Virtual observatory concepts are being developed in a number of countries. To avoid redundancy, care is being taken to coordinate efforts. Such concepts are being developed through the International Virtual Observatory Alliance, which also facilitates coordination with other virtual observatory activities worldwide.

27. Basic space science data systems are available in many countries. One of the most prominent is ADS, a NASA-funded project that provides free Internet abstract search services. ADS has references in databases on the following topics: (a) astronomy and planetary sciences; (b) physics and geophysics; (c) space instrumentation; and (d) astronomy preprints. Each database contains abstracts from hundreds of journals, publications, colloquiums, symposiums, workshops, expert meetings, training courses, proceedings, doctoral theses and NASA reports. ADS has 11 mirror sites in Argentina, Brazil, Chile, China, France, Germany, India, Japan, the Republic of Korea, the Russian Federation and the United Kingdom of Great Britain and Northern Ireland, which help to improve global access to ADS.

B. International Heliophysical Year

28. It was noted that the International Geophysical Year, one of the most successful international science programmes of all time, had broken new ground in the development of new space science and technology and that, 50 years later, the International Heliophysical Year continued that tradition.

29. It was also noted that the International Heliophysical Year had three primary objectives: (a) to advance understanding of the fundamental heliophysical processes governing the Sun, the Earth and the heliosphere; (b) to continue the tradition of international research and add to 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.

30. It was noted that one of the main components of the International Heliophysical Year was the United Nations Basic Space Science Initiative, which is dedicated to the establishment of observatories and instrument arrays for expanding the knowledge of space science and the viability of space science research, engineering and education in developing countries and regions not yet active in space research.

31. Through a cooperative programme with the United Nations Basic Space Science Initiative for the period 2005-2009, the International Heliophysical Year would provide a framework for facilitating the deployment of a number of arrays of small instruments to take global measurements of space physics-related phenomena (see annex I and A/AC.105/856). Such efforts could include developing a new network of radio dishes to observe interplanetary coronal mass ejections and extending existing arrays of Global Positioning System receivers to observe the ionosphere. The concepts behind such efforts were mature, developed and ready to be implemented. A coordination meeting had been held among representatives of the International Heliophysical Year secretariat and the United Nations Basic Space Science Initiative at Greenbelt, Maryland, in the United States, in October 2004. As a result of that meeting, the United Nations Basic Space Science Initiative had made a commitment to focus its activities up to 2009 to providing the International Heliophysical Year organization with a link to developing countries. The Initiative had made available the contact details of more than 2,000 scientists in 192 countries, many of whom were eager to participate in international space science activities.

32. A new initiative discussed and begun during the 2006 Workshop involved developing countries in the analysis of data obtained from space missions (see annex II). The data are routinely made 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 countries to participate in a large-scale data analysis project. A project to make data analysis software (GNU Data Language) available free of charge is already under way. Moreover, ADS will be made available to mirror sites to ensure that researchers have access to the scientific literature they need.

C. Aiding basic space science in developing nations: the official development assistance programme of Japan

33. It was noted that, to date, the number of science and engineering students in developing countries was rapidly increasing. In order to promote science education and research in developing countries, the Government of Japan had been providing such students with high-grade equipment in the framework of the Cultural Grant Aid, a programme of Official Development Assistance (ODA) that started in 1982. Annex III and IV list 27 institutions in 22 developing countries that have received astronomical equipment donated by the Government of Japan over the past 25 years. Among the equipment were seven professional reflecting telescopes that came with a scientific instrument, such as the ST-7 or ST-8 charge-coupled device (CCD) camera and that could be used for the photometric and spectroscopic observations of celestial objects. In addition, 20 planetarium systems had been installed at universities and space museums in developing countries.

34. It was also noted that the Government of Japan had started its ODA programme (http://www.mofa.go.jp/policy/oda/) in 1954. The official objectives of the ODA programme of Japan were to contribute to peace and to the development of the international community and thereby to increase the security and prosperity of Japan. Most of the ODA provided by Japan was devoted to economic and social infrastructure development, human resource development and institution-building.

35. It was also noted that the Cultural Grant Aid (http://www.mofa.go.jp/policy/oda/category/cultural/index.html) had been established in 1975 as part of the ODA programme to provide material support for a wide variety of cultural and educational projects. As part of that scheme, funds had been granted to install equipment and to construct and restore facilities used for various cultural and higher education activities and to preserve cultural heritage. Countries eligible to receive assistance from the Cultural Grant Aid programme are listed in groups I-IV of the World Bank lending standards. Up to 50 million yen for equipment supply and up to 300 million yen for the construction of facilities have been provided to the Government agencies of recipient developing countries.

36. In 2000, another scheme, the Grant Aid for Cultural Grassroots Projects, had been launched to support small-scale projects. That scheme had provided up to 10 million yen per project to local public bodies, non-governmental organizations and others in developing countries. Then, the Grant Aid for Cultural Heritage, which aimed to support larger projects dealing with cultural heritage, had been introduced.

In 2005, the Grant Aid for Cultural Heritage was merged into the Cultural Grant Aid, which, since then, had provided support not only for large-scale projects dealing with cultural heritage but also for large-scale projects promoting higher education and culture in general.

37. It was noted that, the first astronomy-related support given in the framework of the ODA programme of the Government of Japan had been granted to Myanmar in 1982. A planetarium made by Goto Inc. of Japan had been installed at the Pagoda Cultural Centre in Yangon in 1986. The Government of Japan recognized that planetariums could be valuable for nations wishing to enhance their astronomy education and outreach activities and that they were an efficient way of teaching basic astronomy to a large number of students. With the modern planetarium systems donated by Japan through its ODA programme, teachers in developing countries could communicate more effectively with students and the public than they could by using astronomical telescopes.

38. There was no doubt that a scientific-grade astronomical telescope would play an essential role in teaching basic astronomy. In 1987, a 40-centimeter reflector telescope had been donated to the Singapore Science Centre (http://www.science.edu.sg/ssc/index.jsp). The telescope was still in use and was one of the main attractions of the Centre. Following that donation, two 45-centimeter reflector telescopes had been donated: to the Bosscha Observatory of the Institute of Technology in Bandung, Indonesia, in 1988 and to Chulalongkorn University in Bangkok in 1989. In 1990, Japan had provided three telescopes and four planetariums to developing countries through its ODA programme.

39. It was noted that the Government of Japan and the Office for Outer Space Affairs had not made any coordinated effort with regard to the worldwide development and promotion of basic space science until the development of the "Tripod" concept by the Office for Outer Space Affairs, in cooperation with ESA and the Government of Japan, to introduce the research and education of basic space science at universities in developing countries. Since 1991, the Office for Outer Space Affairs and ESA had organized annual workshops with the aim of developing basic space science. The present Workshop was the fifteenth workshop in the series. The workshop series was a vehicle to create suitable plans for meeting the astronomy education requirements of developing countries. At the present Workshop, scientists and educators from developing countries met with Japanese astronomers to discuss and plan applications for the ODA programme of Japan. To date, a total of seven telescopes (see annex III) and 20 planetarium equipments (see annex IV) have been installed by taking advantage of the ODA scheme. The latest of those was the planetarium system at Tin Marín Children's Museum in San Salvador.

40. In order to make sure that the donated instruments were used effectively, the Government of Japan also provided follow-up assistance programmes through the Japan International Cooperation Agency. Japanese astronomers and engineers spent time in countries that had received telescopes and planetariums to provide necessary technical training to the staff of institutions receiving the equipment or facility. Furthermore, with the support of some public observatories in Japan (in particular the Bisei, Nishi-harima and Gunma observatories), six-month astronomy research and observation training courses had been provided to the staff of institutions receiving a telescope with a CCD camera.

D. Aiding the establishment and operation of instrument arrays in developing countries for achieving the goals of the International Heliophysical Year: the magnetic data acquisition system of Japan

41. The Space Environment Research Center (SERC) at Kyushu University in Japan was installing the Magnetic Data Acquisition System (MAGDAS) at 50 stations in the Circum-pan Pacific Magnetometer Network (CPMN) region and several frequency-modulated, continuous-wave (FMCW) radars along the 210 degree magnetic meridian. (For the station list of the MAGDAS project see annex V.) The MAGDAS project was contributing to the International Heliophysical Year by supporting a ground-based magnetometer array for worldwide studies. Nearly 20 MAGDAS units had been installed as a result of the collaboration of 30 organizations around the world, along the 210 degree magnetic meridian in 2005 and along the magnetic dip equator in 2006. In 2007, 20 additional MAGDAS units would be deployed to locations in India, Italy, Mexico, the Russian Federation (Siberia), South Africa, the United States (Alaska), as well as Antarctica. The goal of MAGDAS was to become the most comprehensive ground-based monitoring system of the Earth's magnetic field. It already supplemented space-based observations but, to properly study solar-terrestrial events, data from both ground and space were required.

42. It was noted that MAGDAS and CPMN had been divided into two portions. The MAGDAS-A system was a new magnetometer system installed at CPMN stations, while the MAGDAS-B was a data acquisition and monitoring system installed at SERC. The new magnetometer system consisted of tri-axial ring-core sensors, tilt meters and a thermometer in a sensor unit, a fluxgate-type magnetometer, data logging and transferring units, and a power unit. The total weight of the MAGDAS-A system was less than 15 kg. The data transferring unit transferred the l-sec averaged data (H+ δ H, D+ δ D, Z+ δ Z, F+ δ F) in real time from the overseas stations to SERC in Japan by Internet, telephone or satellite.

43. By analysing MAGDAS data, a real-time monitoring and modelling of the current global three-dimensional system and the ambient plasma mass density for understanding the electromagnetic and plasma environment changes in geospace during helio-magnetospheric storms was performed:

(a) To understand couplings of the solar wind-magnetosphere-ionosphere-atmosphere system, long-term spectrum packs of solar wind parameters, geomagnetic indices and MAGDAS data was compared. Subtracted H component data (H(DAV)-Dst) near the equatorial Davao station had shown 7.5 and 14.5 day periods, which were not involved in any long-term spectrum components of the geomagnetic indices and solar wind parameters. The spectrum peaks meant that there was a strong neutral wind-plasma interaction in the atmosphere-ionosphere;

(b) By using the equatorial Pi 2 pulsations observed at stations located worldwide and recorded near the dip equator at ILR (dip latitude = -2.95, mean longitude = 76.80), AAB (0.56, 110.47), CEB (2.73, 195.06), ANC (0.72, 354.33), EUS (-7.00, 34.21), the following wave characteristics had been discovered:

(i) Pi 2 pulsations observed near the dip equator showed an amplitude enhancement at about 1000-1300 hours local time;

(ii) The closer the observation site was to the dip equator, the larger the Pi 2 amplitudes tended to become;

(iii) The Pi 2 amplitudes tended to become larger as the ambient total field intensity at the stations became lower;

(c) Analysis of SC-associated electric fields observed by the FMCW radar at Sasaguri had showed that the intensity of the ionospheric electric field was stronger during the night than during the day. That result could be explained by the superimposed effect of the polar electric field and the westward electric field of compressional hydromagnetic waves, which had been caused simultaneously by the interplanetary shock.

E. Selected satellite missions of Japan

44. It was noted that the QSAT satellite would perform polar plasma observations. The QSAT project, which had begun in 2006 as an initiative by graduate students at Kyushu University in Japan, contributed to the International Heliophysical Year by showing the world the beauty, importance and relevance of space science. The primary objectives of the QSAT mission were to investigate plasma physics in the Earth's aurora zone in order to better understand spacecraft charging and to compare observations made in orbit of field-aligned currents with those made from the ground. The secondary objectives of the QSAT mission were: (a) to offer educational and research opportunities to students through their participation in an activity combining space science and satellite engineering; (b) to validate a spacecraft charging analysis software called the Multi-Utility Spacecraft Charging Analysis Tool (MUSCAT) being developed at the Kyushu Institute of Technology; (c) to carry out in-flight verifications of a satellite bus system built by commercial off-the-shelf (COTS) products; and (d) to promote cooperation among Kyushu University, Kyushu Institute of Technology, Fukuoka Institute of Technology and local industries with the aim of developing valuable satellite design expertise. The QSAT satellite had been designed to be launched in a piggyback fashion with the Japanese launch vehicle H-IIA. The spacecraft bus was being developed at the Department of Aeronautics and Astronautics of Kyushu University in collaboration with the Fukuoka Institute of Technology. Regarding the payload instruments, SERC was developing the magnetometers, whereas the Laboratory of Spacecraft Environment Interaction Engineering of the Kyushu Institute of Technology was developing the plasma probes. The QSAT project was currently at the C or design phase; the critical design review was scheduled for 31 May 2008. Japan was aiming to launch the QSAT satellite in mid-2008 together with the Greenhouse Gases Observing Satellite (GOSAT).

45. It was noted that Akari was the first Japanese satellite dedicated to infrared astronomy. It was a project of JAXA that was being carried out with the participation of ESA. Launched on 22 February 2006, Akari had been designed to carry out an all-sky survey at six photometric bands in the mid-to-far infrared region (9-160 micron), thus improving on the 24-year-old survey that had been carried out by the Infrared Astronomical Satellite (IRAS), and to start observations for deep imaging and spectroscopy. Akari had two scientific instruments on board, the

far-infrared surveyor and the infrared camera. Both instruments had been working well and were providing significant data useful to various fields of astronomy.

46. Hinode satellite was an orbital solar observatory with three exceptionally good telescopes providing extremely high-quality data. Hence, special data analysis methods and computer resources were needed for interpreting Hinode data. Prior to the launch of Hinode, NAOJ and the Institute of Space and Astronautical Science of JAXA had developed a data search and provision system and facilitated the use of the data analysis environment by the public.

47. The Japanese spacecraft Hayabusa, launched in May 2003, had arrived at its destination on the near-Earth asteroid Itokawa in September 2005. The tiny asteroid (measuring approximately 500m in diameter) looked quite different from what had been expected. It was the first time that that type of asteroid had been was observed.

Annex I

Updated list of International Heliophysical Year/United Nations Basic Space Science Initiative projects

	Instrument	Contact			Status
		Name	Country	E-mail	
1.	Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory (CALLISTO)	A. Benz	Switzerland	benz@astro.phys.ethz.ch	Two instruments deployed in India, one in the Russian Federation (Siberia) and one in Switzerland; installation in Costa Rica in progress
		C. Monstein	Switzerland	monstein@astro.phys.ethz.ch	
2.	Magnetic Data Acquisition System (MAGDAS)	K. Yumoto	Japan	yumoto@serc.kyushu-u.ac.jp	Deployed in Côte d'Ivoire, Ethiopia, Malaysia and Nigeria
		G. Maeda	Japan	maeda@serc.kyushu-u.ac.jp	
3.	Global Positioning System (GPS) Scintillation	Amory-Mazaudier	France	Christine.amory@cetp.ipsl.fr	More than 25 new installations across Africa in progress
		T. Fuller-Rowell	United States	..	
4.	Scintillation Network Decision Aid (SCINDA) GPS	K. Groves	United States	Keith.groves@hansom.af.mil	Deployed in Cape Verde and Nigeria
5.	Coherent Ionospheric Doppler Receiver (CIDR)	T. Garner	United States	garner@arlut.utexas.edu	Four-instrument chain planned for Egypt
6.	Atmospheric Weather Educational System for Observation and Modelling of Effects (AWESOME) very low frequency radio	U. Inan	United States	inan@stanford.edu	Deployed in Algeria, Morocco and Tunisia
7.	Remote Equatorial Nighttime Observatory for Ionospheric Regions (RENOIR)	J. Makela	United States	jmakela@uiuc.edu	Instrument development in progress
8.	Space Environmental Viewing and Analysis Network (SEVAN) particle detector	A. Chillingarian	Armenia	chili@aragats.am	Instrument for Bulgaria in process of construction
9.	African Meridian B-field Education and Research (AMBER) (International Heliophysical Year magnetometer)	I. Mann	Canada	imann@phys.ualberta.ca	Instrument deployment in progress
		E. Yizengaw	United States	ekassie@igpp.ucla.edu	
10.	South America Very Low-Frequency Network (SAVNET)	J. P. Raulin	Brazil	raulin@craam.mackenzie.br	Instrument funding obtained

	Instrument	Contact			Status
		Name	Country	E-mail	
11.	Low-cost ionosonde	J. Bradford	United Kingdom	..	Seeking instrument funding
12.	Low-frequency radio array	J. Kasper	United States	jck@mit.edu	Instrument deployment in progress
13.	Muon Detector Network	K. Munakata	Japan	Kmuna00@gipac.shinshu-u.ac.jp	Collaborating with SEVAN
14.	H-alpha telescope	K. Shibata	Japan	..	Deployed in Chile
		S. Ueno	Japan	..	
15.	Liulin spectrometer	T. Dachev	Bulgaria	..	Instruments available, seeking sites for deployment
16.	South Atlantic Magnetic Anomaly (SAMA)	J. H. Fernandez	Brazil	..	Seeking instrument funding
17.	Very Low Frequency (VLF) Direction Finding	A. Hughes	South Africa	..	Deployment at the planning stage

Source: “Report on the United Nations/European Space Agency/National Aeronautics and Space Administration of the United States of America Workshop on the International Heliophysical Year 2007” (A/AC.105/856); and “Report on the Second United Nations/National Aeronautics and Space Administration Workshop on the International Heliophysical Year 2007 and Basic Space Science” (A/AC.105/882).

Annex II

Five new data analysis concepts identified at the Second United Nations/National Aeronautics and Space Administration Workshop on the International Heliophysical Year 2007 and Basic Space Science

	Instrument	*Contact*			*Status*
		Name	*Country*	*E-mail*	
1.	Solar Anomalous and Magnetospheric Particle Explorer (SAMPEX) magnetometers	S. Kanekal	United States	..	At planning stage
2	GNU Data Language (GDL) software development.	R. Schwartz	United States	..	Development-level software tested in India
3.	Astrophysics Data System (ADS) reference sites	G. Eichhorn	United States	Guenther.eichhorn@springer.com	Identifying appropriate sites
4.	Solar Ultraviolet Measurements of Emitted Radiation (SUMER) database	C. Wilhelm	Germany	..	At planning stage
5.	Large Angle Spectrometric Coronagraph (LASCO) Coronal Mass Ejection (CME) database	N. Gopalswamy	United States	gopals@ssedmail.gsfc.nasa.gov	At planning stage

Source: "Report on the Second United Nations/National Aeronautics and Space Administration Workshop on the International Heliophysical Year 2007 and Basic Space Science, (Banglore, India, 27 November-1 December 2006)" (A/AC.105/882).

Annex III

Astronomical telescopes donated to developing countries through the Official Development Assistance programme of Japan

	Receiving Institution	*Location*	*Model*	*Option*	*Country*	*Year*
1.	Science Centre	Singapore	40-cm Reflector	..	Singapore	1987
2.	Bosscha Observatory Institute of Technology	Bandung, Lembang, 40391 Java, Indonesia	45-cm Cassegrain	Photoelectric photometer, spectrograph	Indonesia	1988
3.	Chulalongkorn University	Physics Department Faculty of Science Bangkok 10330, Thailand	45-cm Cassegrain	Photoelectric photometer, spectrograph	Thailand	1989
4.	Arthur C. Clark Center for Modern Technologies	Colombo, Katubedda Moratuwa, Sri Lanka	45-cm Cassegrain	Photoelectric photometer, spectrograph	Sri Lanka	1995
5.	Facultad Politecnica Asuncion University	Campus Universitario, Observatorio, Astronomico, San Lorenzo Asunción, Paraguay	45-cm Cassegrain	Photoelectric photometer, charge-coupled device	Paraguay	1999
6.	Philippine Atmoshperic, Geophysical and Astronomical Services Administration	1424 ATB Bldg., Quezon Avenue, 1104 Quezon City, Philippines	45-cm Cassegrain	Photoelectric photometer, spectrograph	Philippines	2000
7.	Cerro Calan Astronomical Observatory Universidad de Chile Departamento de Astronomia	Casilla 36-D, Santiago, Chile	45-cm Cassegrain	Charge-coupled device	Chile	2001

Annex IV

Planetarium equipment donated to developing countries through the Official Development Assistance programme of Japan

	Receiving Institution	*Location*	*Model*	*Dome diameter (metres)*	*Seats*	*Country*	*Year*
1.	Pagoda Cultural Center	Yangon, Myanmar	GX	12	..	Myanmar	1986
2.	Haya Cultural Centre for Child Development	Post. B. 35022, Amman, Jordan	GEII-T	6.5	..	Jordan	1989
3.	National Planetarium Space Science Education Center	53 Jalan Perdana, 50480 Kuala Lumpur, Malaysia	Minolta Infinium β	20	213	Malaysia	1989
4.	Planetarium	Padre Burgos St., Ermita, Rizal Park, 2801 Manila, Philippines	GM-15s auxiliary projectors	16	310	Philippines	1990
5.	Meghnand Saha Planetarium	University of Burdwan, Golapbag Burdwan-713104, West Bengal, India	GS-AT	8.5	90	India	1993
6.	Planetario de la Ciudad de Buenos Aires “Galileo Galilei”	Av. Sarmiento y Belisario Roldán, s/n C1425FHA, Buenos Aires, Argentina	Auxiliary projectors	..	345	Argentina	1993
7.	Planetario de la Ciudad	Intendencia Municipal de Montevideo, Rivera 3245, 11600 Montevideo, Uruguay	Auxiliary projectors	..	..	Uruguay	1994
8.	Ho-Chi Minh Memorial Culture Hall Vinh City Planetarium	Vinh University, No. 6 Le Mao Street, Vinh City, Nghee An Province, Viet Nam	GS	8.5	80	Viet Nam	1998
9.	Planetarium	Science Center for Education, 928 Sukhumvit Road, Klong toey, Bangkok, 10110 Thailand	Auxiliary projectors	..	..	Thailand	1998
10.	Planetarium	Ministry of Science and Technology, 255 Stanley Wijesundara, Mawatha, Colombo 7, Sri Lanka	Auxiliary projectors	..	..	Sri Lanka	1998
11.	Tamilnadu Science and Technology Centre Anna Science Centre Planetarium	Pudukkottai National Highway, Near Tiruchirappalli Airport, Tiruchirappalli 620 007, India	GS	8.5	90	India	1998
12.	Planetarium	City Park, ul. Chamzy 6, Tashkent, Uzbekistan	..	..	..	Uzbekistan	2000
13.	Planetario Padre Buenaventura Suárez S.J.	Oliva No. 479, Asunción, Paraguay	EX-3	5	23	Paraguay	2001
14.	Planetario Municipal	Florencia Astudillo y Alfonso Cordero, Parque de la Madre, Cuenca, Ecuador	..	..	70	Equador	2002
15.	El Pequeño Sula, Museo para la Infancia of the City Hall of San Pedro Sula	Bulevar del Sur, Contiguo al Gimnasio Municipal, San Pedro Sula, Honduras C.A.	GS-T	8.5	..	Honduras	2003

	Receiving Institution	*Location*	*Model*	*Dome diameter (metres)*	*Seats*	*Country*	*Year*
16.	National Costa Rica University	San José, Costa Rica	GS-S	8.5	40	Costa Rica	2003
17.	Laboratorio Central del Instituto Geofisico	Calle Badajoz 169-171, IV Etapa Mayorazgo, ATE, Lima 03, Perú	GS-T	7.5	..	Perú	Scheduled for 2007
18.	National Astronomical Observatory of Tarija	Loc. Santa Ana Tarija, P.O. Box 346, Bolivia	GS-S	8.5	..	Bolivia	Scheduled for 2008
19.	National History Museum	Havana, Cuba	..	..	..	Cuba	Scheduled for 2007
20.	Tin Marín Children's Museum	Sexta Decima Calle Poniente, Centro Gimnacio Nacional y Parque Cuscatlan, San Salvador, El Salvador	GE-II	6.5	..	El Salvador	2007

Annex V

Station list of the Magnetic Data Acquisition System (MAGDAS) project

Observation Point	*Code*	*Person Of Highest Authority*	*General Administrator*
Paratunka	PTK	Boris M. Shevtsov, Director, Institute of Cosmophysical Researches and Radio Wave Propagation (IKIR), Far Eastern Branch of the Russian Academy of Sciences (FEBRAS), Russian Federation	Ilkhambek Babakhanov, Leader, "Paratunka" Geomagnetic Group, Russian Federation
Magadan	MGC		Poddelskiy Igor Nikolaevich, Head, Laboratory at Stekolniy, Russian Federation
Cape Schmidt	CST		Basalaev Mikhail Leonidovich, Head, Geophysical site at Cape Schmidt, Russian Federation
Ashibetsu	ASB	Tohru Adachi, Seisa University, Ashibetsu Campus, Japan	Ken Nishinaga, Seisa University, Ashibetsu Campus, Japan
Onagawa	ONW	Shoichi Okano, Planetary Plasma and Atmospheric Research Center, Tohoku University, Japan	Tadayoshi Tamura, Tohoku University Onagawa Observatory, Japan
Kuju	KUJ	Takafumi Gotoh, Faculty of Agriculture, Kyushu University, Japan	
Amamioshima	AMA	Kenichi Isamu, President, Isamu Construction Co., Ltd., Japan	M. Haruta, Isamu Construction Co., Ltd., Japan
Hualien	HLN	Jann-Yenq Liu, Ionospheric Physics Laboratory, National Central University, Institute of Space Science, Taiwan	S. W. Chen, National Central University, Institute of Space Science, Taiwan
Tuguegarao	TGG	Diosdado B. Dimalanta, Dean of College of Engineering, Cagayan State University, Philippines	Jackie Lou Liban, Representative of CSU Network Cagayan State University, Philippines
Muntinlupa	MUT	Commodore Rodolfo M. Agaton, Director, Coast and Geodetic Survey Department National Mapping and Resource Information Authority, Philippines	Alex A. Algaba, Officer in charge, Magnetic Observatory, Manila, Philippines
Cebu	CEB	Roland Emerito S. Otadoy, Department of Physics, San Carlos University, Philippines	Erwin A. Orosco, Department of Physics, San Carlos University, Philippines
Davao	DAV	Daniel McNamara, Director, Manila Observatory, Bldg. at Ateneo de Manila University Campus, Philippines	Efren S. Morales, Davao station of Manila Observatory, Philippines
Langkawi	LKW	Mazlan Othman, Director General, National Space Agency, Ministry of Science, Technology and Innovation, Malaysia	Mhd Fairos Asillam, Science Officer, Ministry of Science, Technology and Innovation, Malaysia
YAP	YAP	David Aranug, Director, National Weather Service Office, Yap State, Federated States of Micronesia	J. Kentun, National Weather Service Office, Yap State, Federated States of Micronesia
Manado	MND	Muhammad Husni, Geophysics Instrumentation and Calibration Division, Meteorological and Geophysical Agency, Indonesia	Subardjo, Head of Manado Geophysical Station, Coordinator of the Meterological and Geophysical Agency, Manado Office, Indonesia
Pare Pare	PRP	Mamat Ruhimat, National Institute of Aeronautics and Space, Space Science Application Center, Indonesia	La Ode Muhammad Musafar, National Institute of Aeronautics and Space, Space Science Application Center, Indonesia
Kupang	KPG	Muhammad Husni, Geophysics Instrumentation and Calibration Division, Meteorological and Geophysical Agency, Indonesia	Rivai Marulak, Head, Meteorological and Geophysical Agency at Kupang, Indonesia

Observation Point	*Code*	*Person Of Highest Authority*	*General Administrator*
Darwin	DAW	Tony Hertog, Commonwealth Scientific and Industrial Research Organization, Wildlife and Ecology, Tropical Ecosystems Research Centre, Darwin, Australia	Austin Brandis, Commonwealth Scientific and Industrial Research Organization, Wildlife and Ecology, Tropical Ecosystems Research Centre, Darwin, Australia
Townsville	TWV	IPS	John Webster, Australia
Cooktown	CKT	Doug Quadrio, Principal, Cooktown State School, Australia	Layton Nowlan, System administrator and teacher of mathematics, Cooktown State School, Australia
Rockhampton	ROC	Faculty of Sciences, Engineering and Health, Central Queensland University, Australia	Elizabeth Taylor, Executive Dean, Faculty of Sciences, Engineering and Health, Central Queensland University, Australia
Culgoora	CGR	IPS	Nigel Prestage, IPS Radio and Space Services, Australia
Camden	CMD	IPS	Richard Marshall, IPS Radio and Space Services, Australia
Hobart	HOB	IPS	George Goldstone but should contact Richard Marshall, IPS Radio and Space Services, Australia
MacQuarie Island	MCQ	Andrew Lewis, Geophysicist, Geoscience Australia, Space Geodesy and Geomagnetism Minerals and Geohazards, Australia	Lloyd Symons, S.A.S Support Engineer, Science Technical Support Group, Australian Antarctic Division, Australia
Addis Ababa	AAB	Baylie Damtie, National Coordinator in Ethiopia for the International Heliophysical Year, Deptartment of Physics, Bahir Dar University Ethiopia	Gizawa Mengistu, Coordinator for the International Heliophysical Year at Addis Ababa University, Department of Physics, Faculty of Science, Ethiopia
Ilorin	ILR	A. Babatunde Rabiu, National Coordinator for the International Heliophysical Year, Federal University of Technology, Department of Physics, Nigeria	Isaac Abiodun Adimula, Acting Head, Physics Department, University of Ilorin, Nigeria
Abidjan	ABJ	Doumouya Vafi, Laboratoire de Physique de l'Atmosphére, University of Cocody, Côte d'Ivoire	Olivier Obrou, Laboratoire de Physique de l'Atmosphére, University of Cocody, Côte d'Ivoire
Eusebio	EUS	Severino L. G. Dutra, Division of Space Geophysics, Brazilian National Space Research Institute, Brazil	
Santa Maria	SMA	Nelson Jorge Schuch, Director, Southern Regional Center of Space Research, Brazilian National Space Research Institute, Brazil	Marcelo B. Padua, Division of Space Geophysics, Brazilian National Space Research Institute, Brazil
Ancon	ANC	Ronald Woodman Pollitt, Presidente Ejecutivo, Instituto Geofisico del Peru, Ate Lima, Peru	Jose Ishitsuka, Instituto Geofisico del Peru, Ate Lima, Peru
Crib Point	MLB	Peter L. Dyson, Department of Physics, La Trobe University, Australia	Michael Waters, Professional Officer (Engineering), Space Based Observations - Satellite Engineering, Bureau of Meteorology, Australia
Glyndon	GLY	Linda Winkler, Department of Physics and Astronomy, Minnesota State University, United States	Peter Chi, Institute of Geophysics and Planetary Physics, University of California, Los Angeles, United States
Wadena	WAD	David Milling, Space Physics Group, Department of Physics, University of Alberta, Canada	Ian R. Mann, Canada Research Chair in Space, Physics Department of Physics, University of Alberta, Canada
IPS		Phil Wilkinson, Acting Director, IPS Radio and Space Services, Australia	Richard Marshall, IPS Radio and Space Services, Australia
Hermanus	HER	Peter R. Sutcliffe, Hermanus Magnetic Observatory, South Africa	Errol J. J. Julies, Hermanus Magnetic Observatory, South Africa
Tirunelveli	TRV	Archana Bhattacharyya, Director, Indian Institute of Geomagnetism, India	Sobhana Alex, Professor, Indian Institute of Geomagnetism, India