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Report on the Expert Meeting on preparation of the United Nations/Italy Workshop on the Open Universe Initiative

(Rome, Italy, 11 and 12 April 2017)

Note by the Secretariat

The present document contains the outcome summary of the Expert Meeting on preparation of the United Nations/Italy Workshop on the Open Universe Initiative, held in Rome, Italy, from 11 to 12 April 2017 and hosted by the Italian Space Agency.

I. Introduction

1. The United Nations has the mandate to promote international space cooperation and to assist its Member States with capacity-building in the use of space technology and its applications. For this purpose, the Programme on Space Applications (PSA), implemented by the Office for Outer Space Affairs (OOSA), was established in 1971.

2. The Programme of Space Applications soon recognized that space science-related activities and access to astronomical facilities and data could offer a cost-effective, entry-level path for capacity-building and science and technology education. To address this, the Basic Space Science Initiative (BSSI) was launched in 1991 (see A/AC.105/2013/CRP.11)

3. BSSI has been a long-term effort for the development of astronomy and space science through regional and international cooperation on a worldwide basis, particularly in developing nations. A series of workshops was held from 1991 to 2004, and astronomical telescope facilities and planetariums were established and inaugurated in several developing countries. From 2005 to 2008, BSSI focused on the preparations and follow-up of the International Heliophysical Year 2007. Since 2009 BSSI contributed with its activities to the International Space Weather Initiative.

4. BSSI has established ties with the Virtual Observatory (VO) community from their inception, as a way to promote access to space science and data. Various organizations have developed in the past decades a set of standards widely used in

space science, e.g., the International Virtual Observatory Alliance (IVOA), the International Planetary Data Alliance (IPDA), the International Astronomical Union (IAU) Flexible Image Transport System (FITS) Working Group, NASA's Planetary Data System (PDS) or the Virtual Solar Observatory (VSO), among others. Several new initiatives have picked up in recent years, and various derived services and products now provide interactive user-friendly access to astronomical data.

5. The Italian Space Agency (ASI) has a long-standing history of contribution to space science through national and international programmes. In line with the United Nations, ASI shares the vision of open data as a driver for knowledge and development. With its ASI Science Data Center (ASDC), ASI has responded to the increasing demand for more open space science data providing services for several satellites, some of which are implementing a completely open data policy.

6. In order to provide more comprehensive visibility of these and other services, improve transparency and facilitate the access to scientific data, the government of Italy proposed the "Open Universe" Initiative, under the auspices of the Committee on the Peaceful Uses of Outer Space (COPUOS) in its 2016 session (see A/AC.105/2016/CRP.6). COPUOS welcomed this proposal and agreed that the Initiative would be included in the preparations for UNISPACE+50 (see A/71/20 par. 299). UNISPACE+50 will be a dedicated segment of the 61st session of COPUOS, marking the 50th anniversary of the first UNISPACE conference. This Initiative is part of the seventh thematic priority of UNISPACE+50: "Capacity-building for the 21st Century".

7. The Open Universe Initiative has been devised to stimulate the pursuit of space science through application of the principles of unrestricted access to data and greatly expanded provision of software services. Its aims are to foster dialogue between data providers and networks of users and developers in order to extend the potential of scientific discovery for research, education and inspiration among all communities from professionals to citizens of all ages. These efforts intend to extend to the sector of space science the current widespread desire for transparency of goods produced with public money.

8. The Expert Meeting on preparation of the United Nations/Italy Workshop on the Open Universe Initiative was the first step in a series of activities to define the objectives and roadmap of the Initiative. The preparatory Expert Meeting was organized by OOSA in cooperation with ASI and the University of Sheffield. It will be followed by a United Nations/Italy Workshop on the Open Universe Initiative, to be held at the United Nations Office in Vienna from 20 to 22 November 2017, when the Initiative will be presented to the world at large. The present report provides a summary of the Expert Meeting, including outcomes and recommendations.

II. Organizational framework

9. The Expert Meeting was conducted as part of PSA activities in preparation of UNISPACE+50 and in support of its thematic priorities endorsed by COPUOS in its 59th session (see A/71/20 par. 296). The meeting was hosted by ASI at their headquarters in Rome, Italy.

A. Background and objectives

10. A series of high level fora on preparation for UNISPACE+50 has identified four key pillars to address the broader perspective of space activities: space economy, space society, space accessibility and space diplomacy. The "Space Accessibility" pillar refers to all user communities and decision makers being able, on an equal basis, to benefit from and use space technologies and space-based data. Against this backdrop, the participants of the first High Level Forum in 2016 stressed the importance of full and open access to space-derived data (see Dubai

Declaration par. 8). By promoting access to open space data and aiming to expand the end-user base, the Open Universe Initiative directly contributes to this purpose.

11. The promotion of access and use of science-data is as well part of the continuous capacity-building efforts of OOSA, in line with the seventh UNISPACE+50 Thematic Priority: "Capacity-building for the 21st Century." Ties are also established with the Sustainable Development Goal 4 on "Quality Education" by further advancing knowledge and increasing the level of sharing of scientific discoveries among user communities, and with new participants in all parts of the world. In addition, the open-source philosophy and the proposed collaborative approach in the development of the platform are aligned with Thematic Priority 1: "Global Partnership on Space Exploration and Innovation". Finally, the access to planetary science data, including solar activity, could tentatively support Thematic Priority 4: "International Framework on Space Weather Services", with possible projects such as citizen-science distributed reporting on location and intensity of auroras.

12. In this context, the objectives of the preparatory Expert Meeting included bringing together experts and leading providers of open data in astronomy and space science to:

(a) Review recent developments in archive services, efforts for transparency and openness of data and future plans.

(b) Serve as a forum to discuss the use of space science in capacity-building and outreach.

(c) Lay the ground for the follow-up United Nations/Italy Workshop on the Open Universe Initiative.

(d) Draft recommendations for the Open Universe Initiative to be further refined in the United Nations/Italy Workshop and subsequently fed into the UNISPACE+50 process and the Space2030 agenda.

B. Attendance

13. The preparatory Expert Meeting was attended by 54 experts and professionals from the following Member States: Armenia, Australia, Brazil, Canada, China, France, Germany, Italy, Japan, Russian Federation, Spain, Switzerland, United Kingdom, and United States of America. Altogether, participants represented 35 national, regional and international organizations, including agencies and organizations of the United Nations system, the space community, academic institutions, private companies and non-government organizations.

C. Programme of activities

14. The programme of the Expert Meeting was developed by a committee from OOSA, ASI and the University of Sheffield who extended invitations to potential participants around the world among current data providers in astronomy and space science and others engaged in related work. The programme included opening remarks by representatives of OOSA and ASI, keynote presentations by the original proponents of Open Universe from ASI and the University of Sheffield, three technical sessions, a plenary discussion, a final round-table to discuss the way forward, and closing remarks.

15. The ASI keynote speaker explored possible responses of space science to modern technological conditions of essentially limitless computer resources. Opportunities now exist to expand software services in order to make both open and transparent all past, current and future science data obtained with public funds by coordinating increasingly sophisticated services for the transformation from raw data through science-ready to web-ready material. Such a collective visionary effort

stimulated through the Open Universe Initiative would require only a small fraction of the annual space science expenditure of about €15 billion and would lead to a significant cultural shift involving scientific participation of many new social and economic communities.

16. The University of Sheffield keynote speaker discussed possible technical definitions of the consolidated service obligations that an Open Universe Initiative would imply for current data providers, curators of historical material and those planning future missions. The collective design of these obligations would be driven by maximising scientific return through the elimination of inefficiency and duplication and the development of new client-centred aggregate services concentrating on visualisation, on mobile devices in particular, within the context of a unified complete observational model of the Universe.

D. Current Status and Perspectives

17. This session presented the current status of science data generation, archiving, distribution and utilisation by representatives of major space agencies and data providers, as well as their perspectives on the future of astronomy and science data.

18. The Acting Chief Scientist of NASA introduced the data publication policy changes of the Office of Science and Technology Policy, and discussed the associated implementation challenges to be addressed, including budget, software and other technical considerations and the balance between open data policy and acceptable “proprietary periods” to ensure a proper scientific return for Principal Investigators (PI). NASA provides a variety of tools for open space science, including a “one-stop shop” and the PubSpace portal for open science data.

19. The lead of ESA Science Archives and ESA VO Team presented the science data activities in archives and accessibility from legacy data through operational missions to those still in development, emphasizing the need for archives to be prepared well in advance. The ESAC Science Data Centre acts as a digital library of all astronomy, planetary and heliophysics data obtained from ESA missions. There are associated technological challenges with long term preservation of these archives, and interfacing with science operations, which involve PIs and the community. PIs have a proprietary period of one year. ESA’s collaboration with international associations and initiatives such as IPDA and IVOA were highlighted, and the ESASky tool, in collaboration with Strasbourg astronomical Data Center (CDS) through its Aladin visualization software, was presented.

20. JAXA gave an overview of their efforts on open space science data, including challenges in archiving and the use of data for educational activities. DARTS is JAXA’s Data Archives and Transmission System for all scientific data, including solar system exploration missions and ISS’s Kibo module, but it is tailored for scientific professionals and it is not suitable for educational purposes. An example of the use of scientific data for educational purposes, which provides access to data from JAXA’s remote sensing mission to the Moon, Kaguya, was provided. The project promotes imagination and an early initiation of children into science.

21. The science and technical director of ASI provided a review of the agency’s involvement in space science since its establishment in 1988 as an evolution of existing facilities, including what is now known as the “Broglio Space Center” in Malindi, Kenya, where many of the early space science satellites where launched. ASI supports archiving efforts since the 1990’s through the ASDC following as much as possible open science data policies. Having been the initiator of Open Universe, ASI strongly supports this initiative in tight cooperation with OOSA.

22. Following up on previous presentations, the University of Leicester described the major challenges faced by open data provision, based on their experience with

high-energy astrophysics, and the management of raw and processed datasets, including publishing of sources catalogues. Leicester University has been involved in space science since the very beginning, contributing to many high-energy astronomy missions from ARIEL in the 1970's to EXOSAT, GINGA, ASCA, XMM and Swift. Examples of the relevant experience of the UK Swift Science Data Centre were provided.

23. A short overview of the activities and policy on open data and outreach of the European organisation for Astronomical Research in the Southern Hemisphere (ESO) was provided, with a description of ESO's mission, current capabilities and data policy. ESO encourages public access, after the mandatory proprietary periods, with a focus on specialized users. The representative of ESO discussed as well ESO's vision on the Open Universe Initiative, and their public outreach activities: production of material, videos for planetariums and other.

24. Past experience and current efforts of the Canadian Astronomy Data Centre (CADC), with over 30 years of history supporting science and astronomy, were presented. The CADC was originally started to support the Hubble space telescope, and it was later extended to several other space and ground-based observatories. CADC follows VO standards and provides a range of services and data sets. The new widely used cloud-based distributed storage and processing platform CANFAR (Canadian Advanced Network for Astronomical Research) was introduced and its capabilities discussed.

25. The scientific director of the National Institute of Astrophysics of Italy (INAF) discussed the new required approach, policies and additional efforts in preparation, preservation and diffusion of science-ready data sets in this era of Big Observatories and Big Data. The relation between raw data and processed science-ready data, as well as availability and long-term storage policies was analysed with the help of an analogy to fishing. INAF is taking part on most collaborative efforts in the field, at least at the European level.

26. The chair of IVOA Executive Committee, and representative of the Harvard-Smithsonian Center for Astrophysics, defined the VO concept and objectives, and presented the work and organization of IVOA, discussing their efforts in standardization for astronomy data access, interoperability, good data practices and outreach and education applications. Numerous organizations, space agencies and data providers worldwide follow IVOA standards, data formats, and derived interfaces, integrated in an evolving ecosystem of projects.

27. A representative of the Observatory of Strasbourg and vice-chair of IVOA Executive Committee gave a presentation on the experience of the Strasbourg astronomy Data Centre (CDS), their always evolving work, their compliancy with the standards promoted by IVOA, their catalogue services, their portal, and their interactive visualisation tool Aladin Sky Atlas. The presentation highlighted the practical approach of standardization and fostering collaborations between data centres, observatories and space agencies.

28. The ISDC Data Centre for Astrophysics put forward the importance of archiving and the long term maintenance and sustainability of these archives given the power of legacy data sets for generating new discoveries. They proposed the promotion of visibility of space science worldwide, including for educational purposes and the general public, and the development of more user-friendly interfaces. ISDC is developing an interface to provide access to data analysis, HEAVENS, one step closer to a possible future interface in data interpretation.

29. A representative of the Institute of Astronomy of the Russian Academy of Sciences (INASAN) and the Russian Virtual Observatory (RVO) presented the recent challenges in astronomical data maintenance, distribution and processing at the RVO. A brief review of some past, current and future activities and projects performed in the field of both ground-based and space-based astronomical data in the Russian Federation was also presented.

30. The ASTRONET Coordinator and member of the French National Center for Scientific Research presented the work of the ASTRONET Consortium, which strives to enable the self-sustainable coordination of European astronomy efforts, and to provide a coherent strategy in that discipline. The activities range from the support of a sustainable European VO, to education and public outreach efforts. An overview of the new ASTRONET agreement outside of the umbrella of the European Commission, their strategy and accession process was provided. ASTRONET is aware that in the future the community of users may include researchers from other fields such as biology or chemistry, and this needs to be taken into account.

31. The Director of ICRANet presented the astronomical implications of Gamma-ray bursts from binary systems, and the high precision tests of bursts and their flares arrival date. The importance of correct analysis and processing was highlighted, as well as the fascinating power of astronomy in these high-energy processes.

32. A representative of the National Institute of Astrophysics (INAF) in Italy, and member of the International Planetary Data Alliance (IPDA) presented the work of IPDA in developing and promoting standards for inter-operability. The mission, structure, current membership, affiliation procedure and core projects of IPDA were presented. IPDA provides, inter alia, a multi-agency search service for international archives, and a repository or registry for planetary science tools.

E. Plenary Discussion: Archiving State of the Art

33. Building on the inputs from the first technical session presentations, this plenary discussion focused on the current practices in provision of space science data, the strengths and possible weaknesses in these practices, the needs and requirements of current data consumer communities, and on ways to raise awareness of the need to increase demand for transparency including data accessibility, usability and robustness.

34. Some participants presented the various definitions of the concept of transparency, which varies between disciplines, countries, and depending as well on the end-users, both in terms of quantitative and qualitative attributes. It is necessary to agree on a clear definition of transparency of space science data in the context of the Open Universe Initiative, and to identify the components that contribute to transparency (e.g., accessibility, usability, timeliness, presentation, traceability…).

35. In this context, some participants campaigned for the promotion of FAIR guiding principles for scientific data: that all data is findable, accessible, interoperable and reusable. Some participants expressed their view that education is a pre-requisite for transparency if the target is the general public. Some participants highlighted as well the potential of new technologies, smart phones and other devices to enhance transparency.

36. Participants expressed concern that the final end-user for the Open Universe Initiative was not clearly defined: the Initiative may have different applications and objectives if the end-users are the scientific community, amateur citizen scientists or a wider public. A two-way communication between the growing communities of providers and end-users should be promoted.

37. All participants highlighted the importance of the promotion of existing standards and best practices, widely used among most members of the research community.

38. The view that transparency was already largely achieved among the scientific community was contested. It may be needed to have the data management plan up-front for most scientific missions. Developing countries with no current data strategic plan would benefit from an initiative that provides a framework for this,

as, for example, accessing and using data from certain ground observatories in developing and emerging countries may not be straightforward in some cases.

39. Some participants argued for a growing self-regulating community that implements existing standards (e.g. IVOA, IPDA, FITS, etc.), best practices, services and top-layer platforms, and assesses those by testing how difficult they are to implement, follow and use. No obligation of compliancy is built in the system and mayor players lead by example. The implementations by the Canadian and Strasbourg groups were put forward as prime examples of good practices.

40. Other participants argued that some of these practices may not be applicable for less developed countries or when funds are not available. It was highlighted that the potential of astronomy for education is one key point to foster additional development in the scientific community.

F. Social and Economic Benefits: Open access as an enabler of education, capacity-building and knowledge-based economic development

41. This technical session focused on space economy and the potential social and economic impacts of scientific activity, in particular astronomy and space science. Open access to space science data was tackled as an enabler of the advancement of knowledge, education at all levels and the engagement of young generations in STEM subjects. Open access is a driver of innovation and in the middle term a decisive factor of economic development.

42. The Organization for Economic Co-operation and Development (OECD) shared their views on the use of open science and space science data. The presentation put emphasis in the access to data at marginal costs and with short embargo times, thanks to online dissemination in this ICT society, and the challenges at the organization and policy level. Examples of the revolution in open data on other fields such as genomics were used to illustrate these benefits.

43. The National Research Council of Italy discussed the application of the field of research of Economic Complexity (EC) to scientific production. EC extracts testable hypothesis and predictions based on correlations from a number of variables using the scientific method. The method was illustrated with an example based on the amount of trade and the number of patents and publications, and applied it to the topic of astronomy and planetary sciences. Initiatives such as Open Universe promoting open data and the building of coherent integrated databases would result in an increase of scientific production and technology development with important spill over effects on the national manufacture industry.

44. The New York University at Abu Dhabi discussed the use of open data and its benefits for education at university level. In all activities of the university, including liberal courses, research and outreach activities, they use publicly available astronomy data. Abu Dhabi places great emphasis in space development and education and the university strives to use space science data at all levels from undergraduate to PhD. A framework to ease the accessibility of data for educators would be highly recommended, together with outreach events such as hackathons.

45. The legal aspects of freedom of access to scientific data were introduced and discussed in detail by a representative of the University Sapienza in Rome. The principle of free access to space data is already rooted in the Outer Space Treaty, which celebrates in 2017 its 50th anniversary. New commercial applications of space activities, including space mining and mega-constellations, pose challenges. However, astronomy and space science usually has not those limitations and is as such a great access point for developing countries to technology and development. From the perspective of space law, including national and international legislation, various legal instruments and guidelines recognize access to space data.

46. ESA presented their views on the challenges and opportunities of open big data and innovation for the European space sector, with a focus on Earth observation. Services using seamless data and information and smartphone applications enable new forms of science and possibly commercial applications. The disruptive trends include hardware and software engineering on-the-fly. Transparency in data is a key concept in this process, in this shift from data to information for end-users. The presentation also put forward the engagement of citizen scientists, the need to build communities based on trust around the services and tools, and the new role traditional leaders such as agencies should take.

G. New Initiatives and Roadmap for Future Success

47. The technical session concentrated in new and innovative solutions devised to address the current challenges in data provision, archiving and dissemination, and proposed initiatives to ensure the long-term sustainability and transparency of open space science data.

48. The International Astronomical Union (IAU) General Secretary presented the work of the Office of Astronomy for Development (OAD), and their strategic plan from 2010 to 2020. For an effective implementation, the local culture and language needed to be taken into account, which led to the founding of a network of 9 regional nodes (ROADs), which could take a central role in the Open Universe Initiative. The OAD concentrates on three levels: universities and research, schools, and the general public. Examples of projects across the globe of how astronomy can contribute to capacity-building and sustainable development were provided. The main challenges are the follow-up after the initial introduction to science, and the background education and science awareness required. Recommendations for the initiative in line with this were provided.

49. A representative of the Brazilian Center for Research in Physics discussed the potential and challenges of “big data”. Its Brazilian Science Data Center (BSDC) aims to provide greater access to data for scientific and educational use, in cooperation with ICRANet and the Brazilian Space Agency. The BSDC is built to be compliant with VO standards, transparent from the level of implementation, and is supportive of Open Universe. The integration with existing global platforms and infrastructures is paramount for developing and emerging countries. The data and derived services need to be put into context to increase its usefulness in this era of a data revolution.

50. Drawing parallelisms between the Earth remote sensing and the astronomy and space science data communities, a member of National Research Centre (CNR) of Italy and the Group on Earth Observations (GEO) discussed the lessons learned by the GEO System of Systems (GEOSS) in brokering data from multiple sources. There are similarities in the way they target a diverse group of end-users, including the general public, and support an even more diverse number of sources of data and providers. The landscape of the system of systems and stream of information from providers to end-users was discussed. Some lessons are applicable, but the tier system of GEOSS may not be applicable to the problems Open Universe intends to address.

51. A representative of the National Institute on Nuclear Physics (INFN) of Italy gave their perspective of the challenges posed by open data in particles and astro-particle physics. In the astro-particle physics field, there are space, ground, under-ground and undersea observatories. Data sharing, management and exploitation are as well key issues, given the amount of data, non-standard formats and outputs, and the number of users and collaborations. The requirements vary greatly from scientists to educational and outreach users. Open access repositories and similar efforts are critical for science, and used in tools such as INDIGO.

52. Presenting contributions from the industry, Kayser Italia introduced their activities in research and operations and their proposal for a flexible catalogue

system for scientific publications, ISPARC. The ISPARC web application is currently applied for International Space Station research but with applications to a wider catalogue of scientific results from other fields, such as astronomy and space science in general. They propose a Flexible Scientific Publication Archive in the context of Open Universe.

53. The chair of the Scientific Commission E of the Committee on Space Research (COSPAR) provided insights of the experience of COSPAR in the field of open space science data, including dissemination among the general public. The objectives of COSPAR include the promotion of the exchange of results, information and opinions, mostly targeting the scientific community, and the generation of roadmaps.

H. Final Round-table and Discussion: Towards a roadmap and UNISPACE+50

54. Following up on discussions regarding requirements for improving transparency and completeness of data, the potential benefits of universal open data for sustainable social and economic benefits, and the promotion of global cooperation, agreed standards and the adoption of new technologies, a final round-table was held moderated by the Director of the United Nations Office for Outer Space Affairs.

55. The round-table discussed recommendations on shaping the Open Universe Initiative and the role of OOSA at leveraging the Initiative to better fulfil the 17 Sustainable Development Goals. After interventions by ASI, ICRANet, IAU, INFN and the University of Sheffield, the floor was open for a lively and productive discussion.

56. The participants of the expert meeting expressed different opinions on the data types that the Open Universe Initiative should focus on. The following domains were mentioned: astronomical data, planetary data, heliophysical data, and astro-particle data, from both space-based and ground-based observatories. This data of high scientific value is in general non-proprietary after the stipulated periods reserved for principal investigators, non-sensitive, and with limited direct commercial applications at present. The main objective of the Initiative should be to promote visibility and usability of these types of data among all communities of end-users.

57. A series of players and target groups for the Initiative were identified, with different requirements, interests and needs. A tentative list of target groups would include (i) the research community and specialised experts, (ii) universities and higher education institutions, including some amateur and citizen scientists, (iii) high schools and secondary education institutions, museums and planetariums open to the public, as well as the larger base of citizen scientists (iv) other curious citizens and the wider public,

58. For the researcher group –i– the Open Universe Initiative should work towards: (a) disseminating and promoting existing standards and best practices, (b) identifying any non-accessible or non-transparent data and resources, (c) joining efforts with the research community to help resurface this unavailable data and integrate it with existing data sets, (d) promoting the availability of legacy data, raw data, and the sustainable maintenance of data sets, (e) providing visibility to existing platforms and available data.

59. For the higher education group –ii– the Initiative should work with data centres and providers in order to: (a) provide guided navigation and initiation to existing tools, (b) ensure compliance with standards of any derived products or services, (c) provide visibility to science-ready data sets and associated tools for educational use, (d) promote the development by data centres of a layer of specialised software on the server side to distribute processed data and products.

The Initiative should as well team up with existing educational platforms such as the Regional Centres for Space Science and Technology Education, affiliated to the United Nations.

60. For the secondary education group –iii–, interested in a smaller subset of the available data, the Initiative should focus on (a) encouraging providers and higher-education groups to develop tools and citizen-science applications at top level, which would allow transparent seamless access to the subset of interest, and (b) working with existing organizations, such as the OAD and its network of regional nodes (ROADs), to promote education in astronomy and other STEM subjects, in particular in the developing world and for women.

61. For the general public –iv– the Initiative should focus on awareness and outreach efforts.

62. For the November UN/Italy Workshop on the Open Universe Initiative, the participants of the Expert Meeting agreed on the need to include the end-user community, from target groups ii to iv, to better incorporate their requirements and needs in a possible roadmap for the Initiative. It was proposed to have dedicated sessions for software demonstrations of existing platforms and tools, as well as citizen science projects and applications.

63. Some participants suggested as well the creation of an Open Data charter under the auspices of the United Nations, or the provision of certification or quality labels.

64. The main observations of the round-table and discussions are captured in the following section.

III. Outcomes and recommendations

65. The preparatory Expert Meeting allowed OOSA, its partners and participants to address on-going efforts related to the use of space-science data, discuss the objectives of the Open Universe Initiative and to draft recommendations to be fed into the UNISPACE+50 process. These recommendations are to be further refined in the United Nations/Italy Workshop on Open Universe to be held in November 2017 at the United Nations Offices in Vienna. Once consolidated, they may be elevated to COPUOS during its 61st session and the UNISPACE+50 segment for further consideration.

A. Outcomes

66. The preparatory expert meeting allowed participants to become aware of the current status and on-going efforts and advances related to astronomy and space science data management and dissemination.

67. In the context of the Open Universe Initiative, this expert meeting has allowed OOSA and its partners:

(a) To seek support for the Initiative and review the on-going efforts of space agencies, data providers and international organizations;

(b) To receive feedback and inputs on the objectives of the Initiative and the role of the United Nations.

68. The expert meeting contributed to:

(a) The compilation of the recent advances in the implementation of open space science data platform and services; and

(b) The compilation of preliminary recommendations for further consolidation regarding the needs to maintain the current data archives and the efforts to continue promoting transparency and accessibility in

space-science data, as well as the widening of the user base for this data.

B. Preliminary Recommendations[h]

69. Several recommendations were proposed in the plenary discussions held during the expert meeting. The draft recommendations summarised here are a compendium of the opinions expressed during these discussions, and the feedback received after the meeting through constructive email exchanges between participants. They may not reflect the view of all contributors, and will require further refinement at the UN/Italy Workshop in November and follow-up events.

70. The Open Universe Initiative should engage with a wide user base, including the various target groups identified, ranging from the research community, higher and secondary education, citizen and amateur scientists and other potential end users.

71. In the context of the Open Universe Initiative, the participants recommend that the Office for Outer Space Affairs should:

(a) promote among data providers the adoption of the FAIR (Findable, Accessible, Interoperable, Reusable) guiding principles for scientific data management, and of transparency on data production mechanisms and data access rules;

(b) recognize the existing standards defined by the organizations active in the field, and disseminate and promote their adoption by data providers and producers of data exploitation applications;

(c) foster partnerships among the research community in the development, extension and provision of visibility for the above-mentioned data, services, applications and standards for a wider user base;

(d) facilitate collaboration and coordination among Data Centres for the provision, besides data, of an amount of computing power and server-side tools appropriate to fulfil the users requirements; and

(e) work with partners to promote education in astronomy, space science and other STEM subjects, particularly in the developing world and for women.

C. The way forward

72. This report will be before delegations at the 60th session of COPUOS in June 2017 for consideration.

73. OOSA will continue working with its partners on the Open Universe Initiative to refine and consolidate the recommendations that have been outlined during this preparatory Expert Meeting, taking into account as well the discussion outcomes as outlined in sections II.E and II.H of this paper. The Initiative may be presented and further discussed in appropriate fora, such as the second High Level Forum to be held in Dubai from 6 to 9 November 2017.

74. OOSA and the Government of Italy will organize a follow-up Workshop on the Open Universe Initiative from 20 to 22 November 2017 in Vienna, Austria, with the participation of experts, data providers and current and potential end-users of astronomy and planetary data, including the growing community of citizen scientists. The recommendations in this report will serve as a base to build upon during the workshop. The Expert Meeting and follow-up Workshop are part of the preparatory activities for UNISPACE+50 related to TP7: “Capacity-building for the 21st century”.

75. OOSA will work with relevant potential partners to understand the needs of the various communities and present a preliminary plan of action in time for the Workshop.

76. The consolidated set of recommendation and plan of action stemming from this process will be before delegations at the Scientific and Technical Subcommittee of COPUOS in February 2018 for endorsement and inclusion in the UNISPACE+50 deliberations and ultimately the Space2030 Agenda.

77. The Initiative intends to contribute to the overall capacity-building strategy of the Office, the UNISPACE+50 Thematic Priorities and the Sustainable Development Goals.

78. Member States and other organizations interested in supporting activities under the Open Universe Initiative are requested to contact the Office for Outer Space Affairs.