MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES
MCTIC

Centro Brasileiro de Pesquisas Físicas

OPEN DATA IN SPACE SCIENCES: PERSPECTIVES AND OPPORTUNITIES FOR DEVELOPMENT

Ulisses Barres de Almeida

Brazilian Center for Research in Physics (CBPF)
Min. Science, Technology, Innovation & Comm.
ulisses@cbpf.br

BRAZIL, BACK IN THE 1950's...

Centro Brasileiro de Pesquisas Físicas

CBPF was found in 1949, as the first research institute in Brazil, following the wake from C. Lattes' discovery of the pion in Bristol and later laboratory production in Berkeley.

- Confluence of interests from several spheres of society led to the creation of other institutes and, within a decade, the **National Research Council (CNPq).**

- Pushed the development of experimental physics in Brazil, and the creation of the **first international collaboration: the Brazil-Japan Cosmic-ray Collaboration**, and an associated international lab in Chacaltaya, Bolivia.

- A concrete example of the impact of science and international collaboration in national development.

Cesar Lattes and Cecil Powell, in Bristol

Chacaltaya Cosmic-ray Lab

BRAZIL, BACK IN THE 1950's...

Centro Brasileiro de Pesquisas Físicas

CBPF was found in 1949, as the first research institute in Brazil, following the wake from Lattes' discovery of the pion in Bristol and laboratory production in Berkeley.

- Confluence of interests from several spheres of society led to the creation of other institutes and, within a decade, the **National Research Council (CNPq).**

- Pushed the development of experimental physics in Brazil, and the creation of the **first international collaboration: the Brazil-Japan Cosmic-ray Collaboration**, and an associated international lab in Chacaltaya, Bolivia.

- A concrete example of the impact of science and international collaboration in national development.

A motivating element, provided by Lattes' fundamental discoveries

Appropriate social-political context

The right entry-point: cosmic-ray physics was cheap to develop and sustainable!

SPACE, PROGRESS, DEVELOPMENT

Centro Brasileiro de Pesquisas Físicas

- **Space represents a frontier in many fields: scientific knowledge, innovation and technology, applications to modern global challenges such as climate change and disaster management, etc.**

- **And access to space and to the benefits of space exploration is a powerful tool for development — direct and indirect implications to the welfare of society and economic growth as well as international cooperation and integration, and ultimately peace.**

SPACE, PROGRESS, DEVELOPMENT

Centro Brasileiro de Pesquisas Físicas

- **Space represents a frontier in many fields: scientific knowledge, innovation and technology, applications to modern global challenges such as climate change and disaster management, etc.**

- **And access to space and to the benefits of space exploration is a powerful tool for development — direct and indirect implications to the welfare of society and economic growth as well as international cooperation, and ultimately peace.**

But a word of caution: Who is reaping the dividends of space exploration the most? Space, and the space age, can dangerously contribute to world inequality!

DEVELOPMENT OF SPACE & SPACE FOR DEVELOPMENT

Centro Brasileiro de Pesquisas Físicas

The first UNISPACE Conference in 1968

Opening Address by Pope Paul VI

http://w2.vatican.va/content/paul-vi/en/messages/pont-messages/documents/hf_p-vi_mess_19680806_conferenza-onu.html

"If the benefits of the use of outer space are put, in spite of justice, **to the service of only a small group of nations, in exclusion of others** […] who then would fail to realise that the recent and wonderful discoveries of science have turned themselves against man, and now work for its unhappiness, instead of contributing to the happiness of humanity?

Scientific and technological progress are usually **not matched by comparable progress in moral, legislation, and international cooperation, for the benefit of all peoples.** I think here particularly of those who, owing to their lower state of technological or cultural development, are kept in a state of unjust inferiority […] **To use the resources of space exploration for their benefit is to contribute to advance humanity to justice and peace."**

THE FOURS PILLARS OF SPACE

Centro Brasileiro de Pesquisas Físicas

The four pillars of Space 2030 : space economy, space society, space accessibility and space diplomacy.

Fundamental ingredient for developing countries, as a means to enable new actors to take their place, and benefit from, the future of space.

THE FOURS PILLARS OF SPACE

Centro Brasileiro de Pesquisas Físicas

The four pillars of Space 2030 : space economy, space society, space accessibility and space diplomacy.

Fundamental ingredient for developing countries, as a means to enable new actors to take their place, and benefit from, the future of space.

"The difference between developed and developing countries is amplified by the circle that connects lack of infrastructure to poverty and poverty to the lack of capability to improve infrastructure. This can only be broken by the use of space technology […] which is essential to developing countries lacking of alternative means […]"

G.Genta & M. Rycoft, *Space, the final frontier?* (CUP, 2003)
quoted by J. Montserrat Filho, *Direto e Política na Era Espacial* (2007)

THE FOURS PILLARS OF SPACE

Centro Brasileiro de Pesquisas Físicas

The four pillars of Space 2030 : space economy, space society, space accessibility and space diplomacy.

Fundamental ingredient for the developing countries as a means to enable new actors to take their place, and benefit from, the future of space.

THE PILLARS OF SPACE AND FOR SPACE 2030

Centro Brasileiro de Pesquisas Físicas

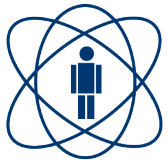
The four pillars of Space 2030 : space economy, space society, space accessibility and space diplomacy.

Fundamental ingredient for the developing countries as a means to enable new actors to take their place, and benefit from, the future of space.

Data is the key element of our times:

- Technological barriers for data access, two-way data exchange, data storage and processing are drastically reduced
- Data is generated beyond our capacity to convert it into knowledge
- **Data is cheap and sustainable: a gateway to space for the developing world**

THE SUSTAINABLE COST OF DATA FOR SPACE ACCESSIBILITY



Centro Brasileiro de Pesquisas Físicas

- Gathering the full force of existing infrastructure and data services : fundamental technologies and services (e.g., IVOA) are already in place and must have their full potential extracted through new use concepts.

- Push for PI-quality, high-level data provision : attainable with only small modification of agencies' cost-to-implementation models

- Achieve global coordination and cooperation : can actually reduce costs by avoiding duplication of efforts by organising the collaboration between data centres and data providers

- Develop new technological paradigms and innovative tools : can bring a revolution in the software level to boost data and space accessibility at low-cost, with impact in education, capacity building and citizen science.

SPACE DATA FOR DEVELOPMENT

Centro Brasileiro de Pesquisas Físicas

THEMATIC PRIORITIES

UNISPACE+50

- Global partnership in space exploration and innovation
- Legal regime of outer space and global governance
- Enhanced information exchange on space objects and events
- International framework for space weather services
- Strengthened space cooperation for global health
- International co-operation towards low emission and resilient societies
- Capacity-building for the 21st Century

SPACE DATA FOR DEVELOPMENT

Centro Brasileiro de Pesquisas Físicas

THEMATIC PRIORITIES

UNISPACE+50

- Global partnership in space exploration and innovation
- Legal regime of outer space and global governance
- Enhanced information exchange on space objects and events
- International framework for space weather services
- Strengthened space cooperation for global health
- International co-operation towards low emission and resilient societies
- Capacity-building for the 21st Century

[science] Data as the gateway to space for development

"The developing countries rapidly need to build national capacity to face specific local problems at the best cost-benefit. [For this] it is important to secure the development of human resources, producing young scientists and technicians to whom they can entrust the application of space technology in national tasks"

Prof. U.R. Rao, ex-chair of COPUOS (2000)

SUSTAINABLE DEVELOPMENT GOALS

Centro Brasileiro de Pesquisas Físicas

SUSTAINABLE DEVELOPMENT GOALS

Centro Brasileiro de Pesquisas Físicas

Open Data can directly impact in education and capacity building in developing nations, **provided that high-level, truly accessible and usable data is available.** [Transparent Data]

SUSTAINABLE DEVELOPMENT GOALS

Centro Brasileiro de Pesquisas Físicas

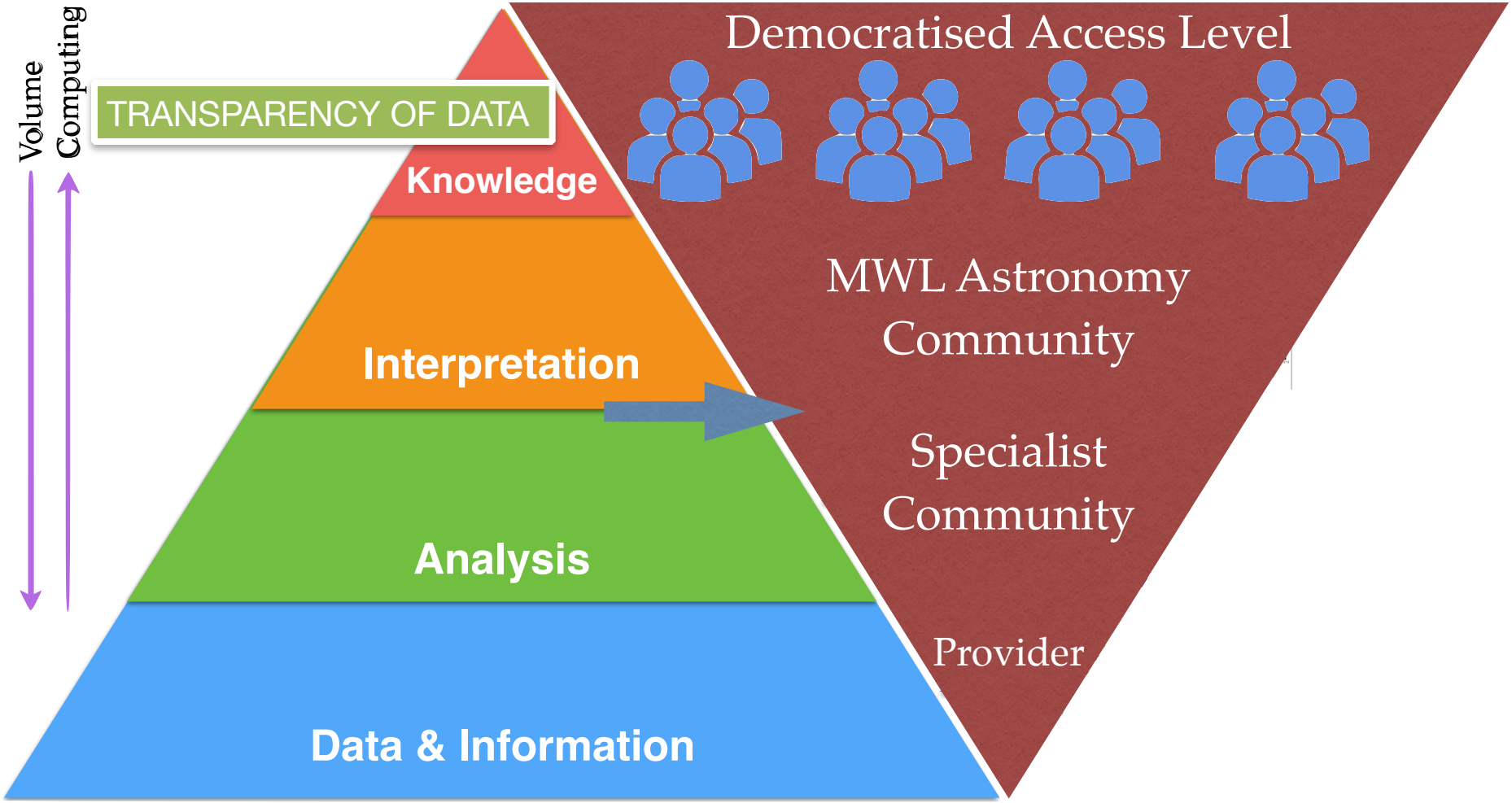
Open Data can directly impact in education and capacity building in developing nations, **provided that high-level, truly accessible and usable data is available.** **[Transparent Data]**

Citizen Science is expected to have great impact in future societies.

NOV/18 Report from NAS
"Learning through citizen science"
https://www.nap.edu/download/25183

SUSTAINABLE DEVELOPMENT GOALS

Centro Brasileiro de Pesquisas Físicas



SUSTAINABLE DEVELOPMENT GOALS

Centro Brasileiro de Pesquisas Físicas

Open Data can directly impact in education and capacity building in developing nations, **provided that high-level, truly accessible and usable data is available.** **[Transparent Data]**

Transparent data can also be a tool for horizontal collaboration between developing and emerging countries, improving local action.

“SOUTH-SOUTH” COOPERATION FOR DEVELOPMENT

Centro Brasileiro de Pesquisas Físicas

The **BRICS countries** form a particular bloc of emerging countries. Heterogeneous in many senses, they have a similar development context, and can can mostly benefit from capacity building to access space technology and the derived benefits.

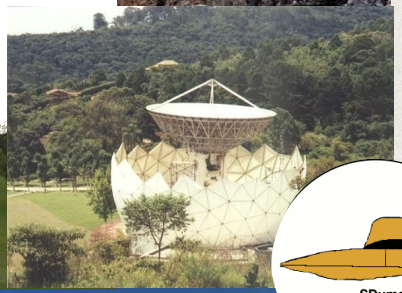
— E.g., see the BRICS Astronomy Working Group directory : www.bricsastronomy.org/

- A good number of medium / small astronomical facilities across different fields
- Insertion in large international projects, either abroad or as host
- Varying degree of direct space accessibility and capabilities
- Generally poor dissemination of advanced knowledge, and lack of human resources.

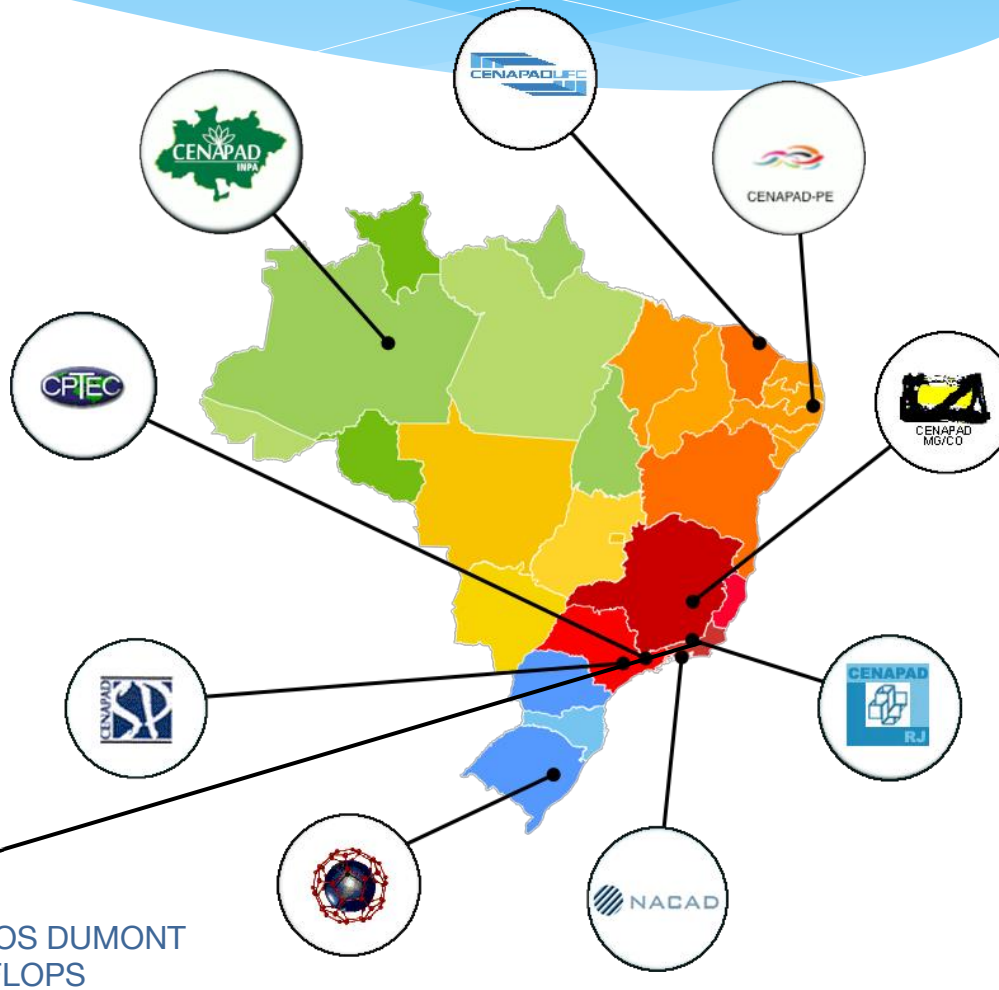
A SNAPSHOT OF ASTRONOMICAL DATA IN BRAZIL

Centro Brasileiro de Pesquisas Físicas

OBSERVATORIES



SANTOS DUMONT
1,1 PFLOPS



DATA PROCESSING CAPABILITY

Centro Brasileiro de Pesquisas Físicas

Brazil - BRICS Collaboration

Clarivate Analytics | Research in Brazil

Country	Papers	Citation impact	Institutions
USA	30,467	1.85	881
UK	11,668	2.66	187
France	10,615	2.43	279
Spain	10,105	2.39	266
Germany	9,957	2.54	185
Italy	7,826	2.73	225
Canada	6,884	2.77	87
Portugal	6,394	1.8	71
Australia	5,371	3.44	79
Netherlands	4,781	3.32	45
Argentina	4,763	2.03	45
Switzerland	4,339	3.53	44
China	4,260	3.68	315
Colombia	3,444	2.7	28
Mexico	3,324	2.97	67
Russia	3,257	3.93	132
Chile	3,143	2.34	52
Japan	3,076	3.92	225
India	3,065	4.36	212
Belgium	3,036	3.26	32

Figure 9 Top 20 countries that collaborate with Brazil 2011 – 2016 by number of papers.

High Impact Research in collaboration with BRICS countries

Source: CAPES InCites Report 2017

https://www.capes.gov.br/images/stories/download/diversos/17012018-CAPES-InCitesReport-Final.pdf

Centro Brasileiro de Pesquisas Físicas

Brazil - BRICS Collaboration

Clarivate Analytics | Research in Brazil

Country	Papers	Citation impact	Institutions
USA	30,467	1.85	881
UK	1		
France	1		
Spain	1		
Germany	9		
Italy	7		
Canada	6,[illegible]		
Portugal	6,394	1.8	71
Australia	5,371	3.44	79
Netherlands	4,781	3.32	45
Argentina	4,763	2.03	45
Switzerland	4,339	3.53	44
China	4,260	3.68	315
Colombia	3,444	2.7	28
Mexico	3,324	2.97	67
Russia	3,257	3.93	132
Chile	3,143	2.34	52
Japan	3,076	3.92	225
India	3,065	4.36	212
Belgium	3,036	3.26	32

> "[…] a strategy of expanding strategic collaborations with the BRICS countries would yield greater dividends than collaboration […]"
>
> CAPES InCites Report 2017

High Impact Research in collaboration with BRICS countries.

Figure 9 Top 20 countries that collaborate with Brazil 2011 – 2016 by number of papers.

Source: CAPES InCites Report 2017

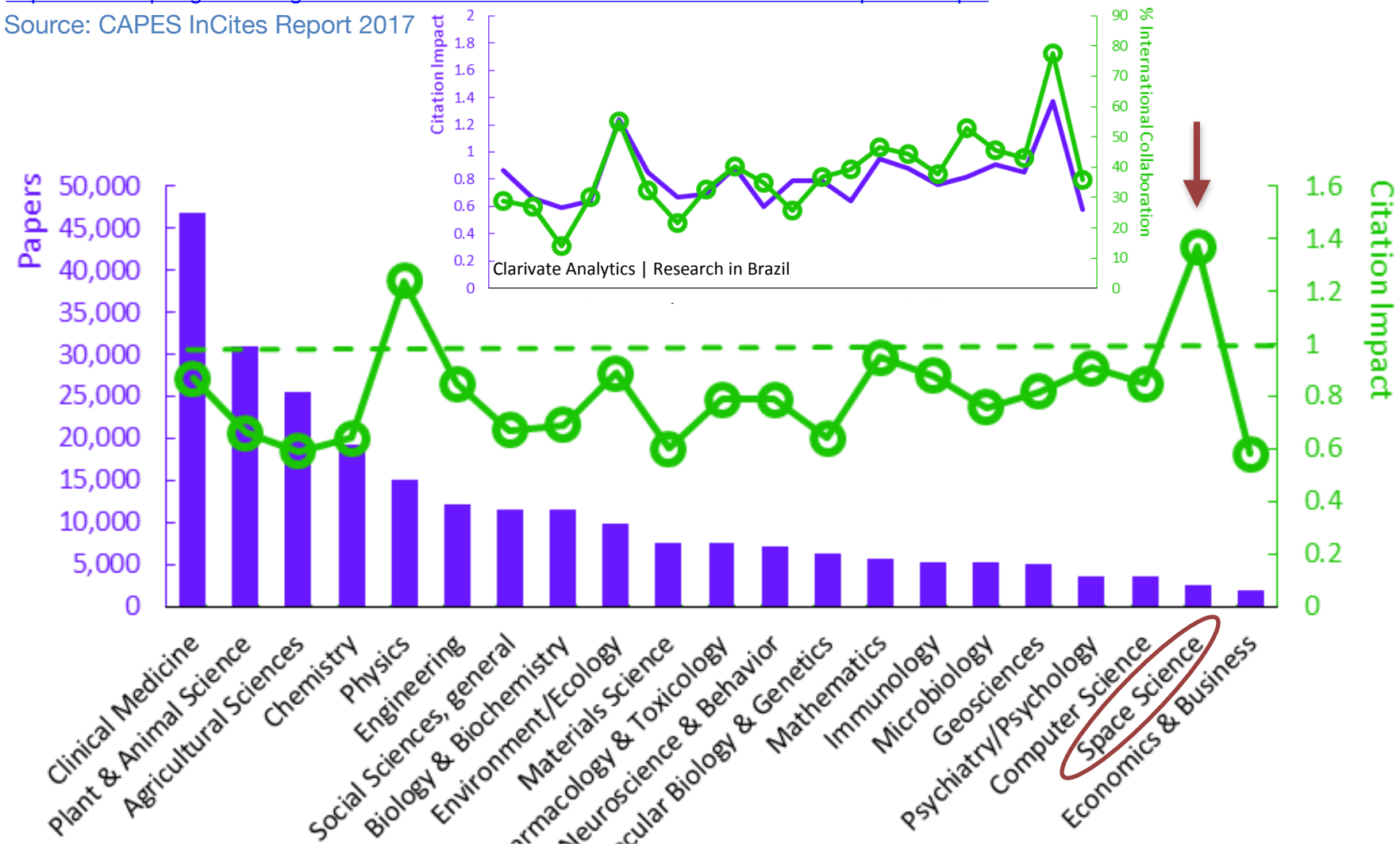
https://www.capes.gov.br/images/stories/download/diversos/17012018-CAPES-InCitesReport-Final.pdf

SPACE SCIENCE:
A STRONG DRIVER FOR DEVELOPMENT

Centro Brasileiro de Pesquisas Físicas

https://www.capes.gov.br/images/stories/download/diversos/17012018-CAPES-InCitesReport-Final.pdf

Source: CAPES InCites Report 2017



A WAY FORWARD: OPEN UNIVERSE INITIATIVE

Open Universe
Space science data for everyone

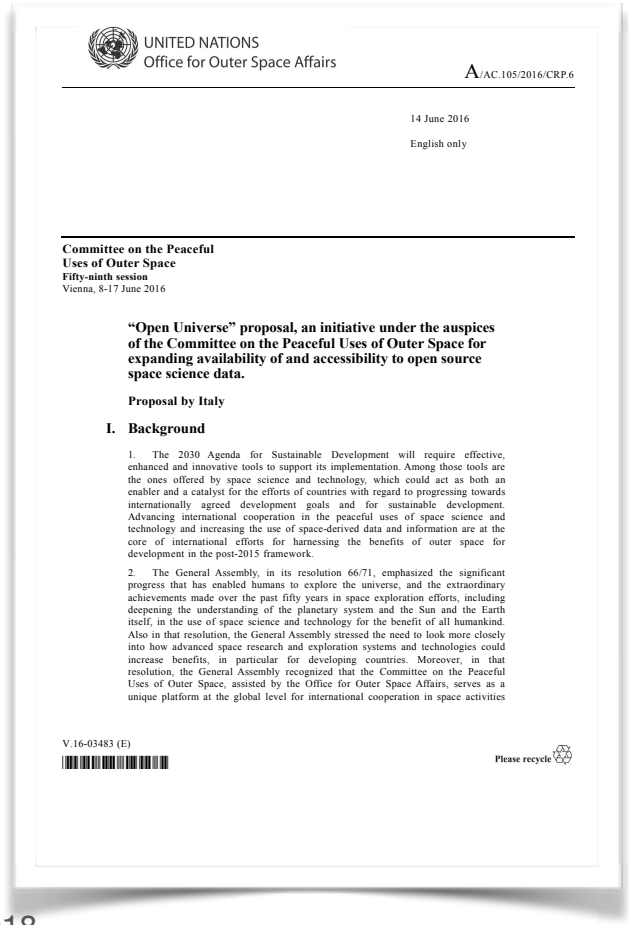
The Open Universe Initiative was proposed by the Govt. Italy and ASI to COPUOS in 2016, as an answer to the United Nations SDGs and the 2030 Agenda. A/AC.105/2016/CRP.6

- Developed in preparation for UNISPACE+50
- Formally supported by Brazil

Experts Meeting at ASI, Feb 2017
http://www.openuniverse.asi.it/documents/ou_documents.php

United Nations Workshop, Nov 2017
http://www.unoosa.org/oosa/en/ourwork/psa/schedule/2017/workshop_italy_openuniverse.html

UNOOSA Report on Open Universe found at:
http://www.unoosa.org/oosa/oosadoc/data/documents/2018/aac.105/aac.1051175_0.html



UNITED NATIONS
Office for Outer Space Affairs

A/AC.105/2016/CRP.6

14 June 2016

English only

Committee on the Peaceful Uses of Outer Space
Fifty-ninth session
Vienna, 8-17 June 2016

"Open Universe" proposal, an initiative under the auspices of the Committee on the Peaceful Uses of Outer Space for expanding availability of and accessibility to open source space science data.

Proposal by Italy

I. Background

1. The 2030 Agenda for Sustainable Development will require effective, enhanced and innovative tools to support its implementation. Among those tools are the ones offered by space science and technology, which could act as both an enabler and a catalyst for the efforts of countries with regard to progressing towards internationally agreed development goals and for sustainable development. Advancing international cooperation in the peaceful uses of space science and technology and increasing the use of space-derived data and information are at the core of international efforts for harnessing the benefits of outer space for development in the post-2015 framework.

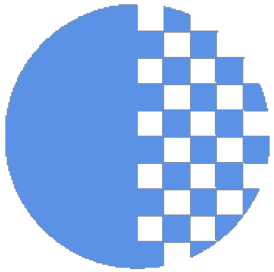
2. The General Assembly, in its resolution 66/71, emphasized the significant progress that has enabled humans to explore the universe, and the extraordinary achievements made over the past fifty years in space exploration efforts, including deepening the understanding of the planetary system and the Sun and the Earth itself, in the use of space science and technology for the benefit of all humankind. Also in that resolution, the General Assembly stressed the need to look more closely into how advanced space research and exploration systems and technologies could increase benefits, in particular for developing countries. Moreover, in that resolution, the General Assembly recognized that the Committee on the Peaceful Uses of Outer Space, assisted by the Office for Outer Space Affairs, serves as a unique platform at the global level for international cooperation in space activities

V.16-03483 (E)

Please recycle

PILLARS OF THE OPEN UNIVERSE INITIATIVE

Open Universe
Space science data for everyone



INCREASE TRANSPARENCY of already accessible resources: including promoting FAIR (Findable, Accessible, Interoperable, Reusable) guiding principles, promoting the adoption of widely-used standards, processing from raw data to web-ready products, enhanced data-mining and integration solutions, interfacing and facilitating cooperation between data providers and data centres and archives…

RESURFACE DATA and other hidden or otherwise hardly accessible resources: by identifying inaccessible data and working with national and regional entities to solve the challenges to make them public, including legacy data, as well as bringing new main players and actors in the international space science arena into the Initiative and in contact with other public data access solutions.

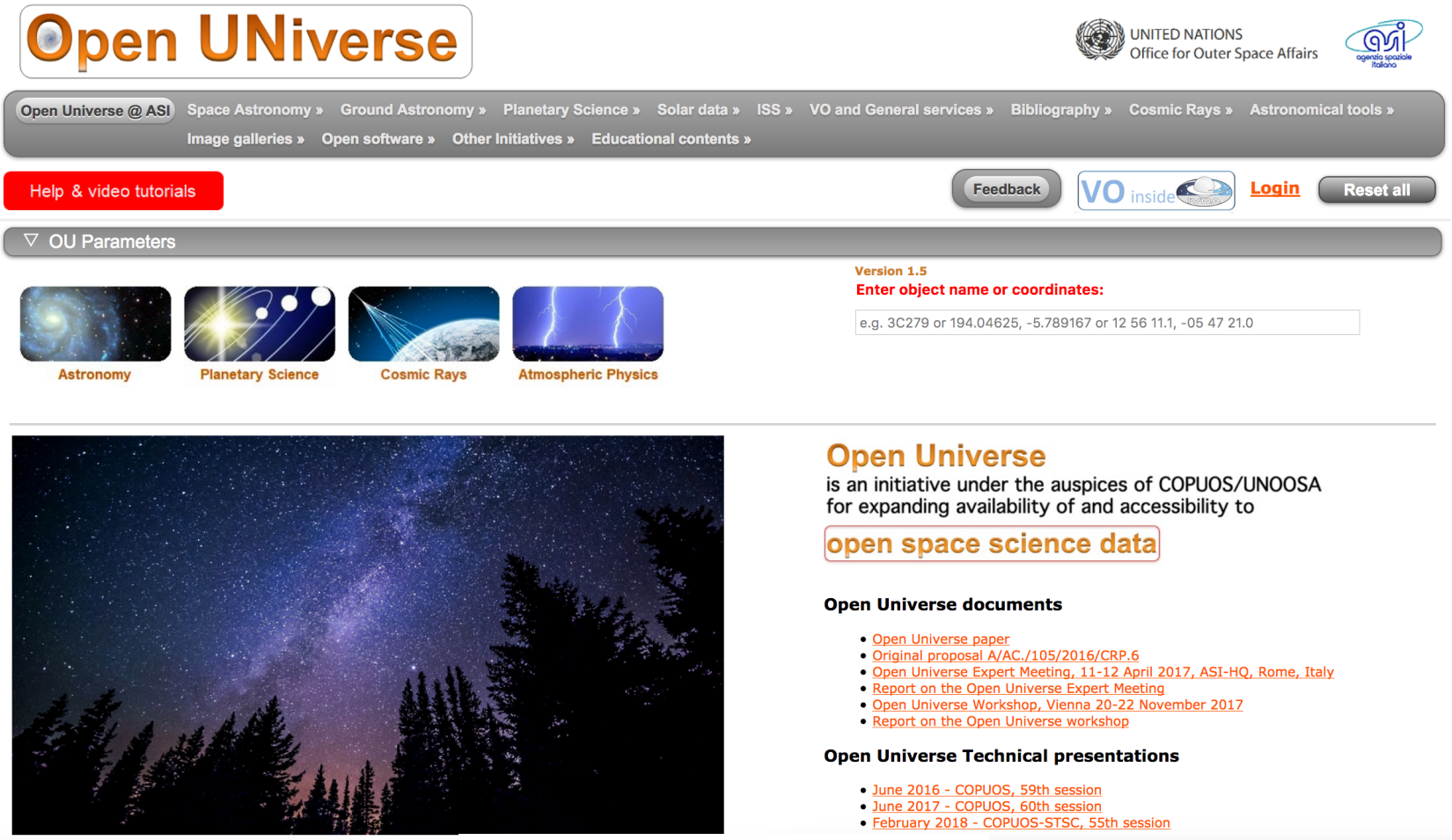
BROADEN THE USER-BASE of astronomy and space science data: to include as well the rapidly growing community of citizen scientists, by providing the necessary tools to use astronomy and space science data for a range of target groups, including educators and students, planetariums, amateur scientists or other potential end-users; and by promoting STEM education, particularly among women and youth in developing countries.

Summary from the UN Workshop on the Open Universe Initiative, November 2017

PILLARS OF THE OPEN UNIVERSE INITIATIVE

Open Universe

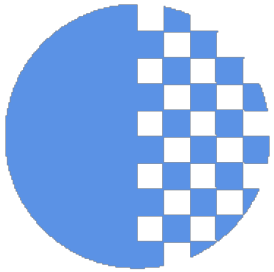
Space science data for everyone



www.openuniverse.asi.it

PILLARS OF THE OPEN UNIVERSE INITIATIVE

Open Universe
Space science data for everyone



INCREASE TRANSPARENCY of already accessible resources: including promoting FAIR (Findable, Accessible, Interoperable, Reusable) guiding principles, promoting the adoption of widely-used standards, processing from raw data to web-ready products, enhanced data-mining and integration solutions, interfacing and facilitating cooperation between data providers and data centres and archives…

RESURFACE DATA and other hidden or otherwise hardly accessible resources: by identifying inaccessible data and working with national and regional entities to solve the challenges to make them public, including legacy data, as well as bringing new main players and actors in the international space science arena into the Initiative and in contact with other public data access solutions.

BROADEN THE USER-BASE of astronomy and space science data: to include as well the rapidly growing community of citizen scientists, by providing the necessary tools to use astronomy and space science data for a range of target groups, including educators and students, planetariums, amateur scientists or other potential end-users; and by promoting STEM education, particularly among women and youth in developing countries.

Summary from the UN Workshop on the Open Universe Initiative, November 2017

PILLARS OF THE OPEN UNIVERSE INITIATIVE

Open Universe
Space science data for everyone

Examples of Actions under development:

OPEN UNIVERSE KIT

Accessibility tool for data publication.

CAPACITY BUILDING & TRAINING INITIATIVES

Enabling independent local actions.

PILLARS OF THE OPEN UNIVERSE INITIATIVE

Open Universe
Space science data for everyone

Examples of Actions under development:

OPEN UNIVERSE KIT

Accessibility tool for data publication.

CAPACITY BUILDING & TRAINING INITIATIVES

Enabling independent local actions.

Focal point within the UN OOSA is the right way to take it forward.

THANK YOU!

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES
MCTIC

Centro Brasileiro de Pesquisas Físicas

Ulisses Barres de Almeida
ulisses@cbpf.br