Overview on Brazilian projects on Computational and Big-data Astronomy

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ASTRONOMY WORKSHOP 2016

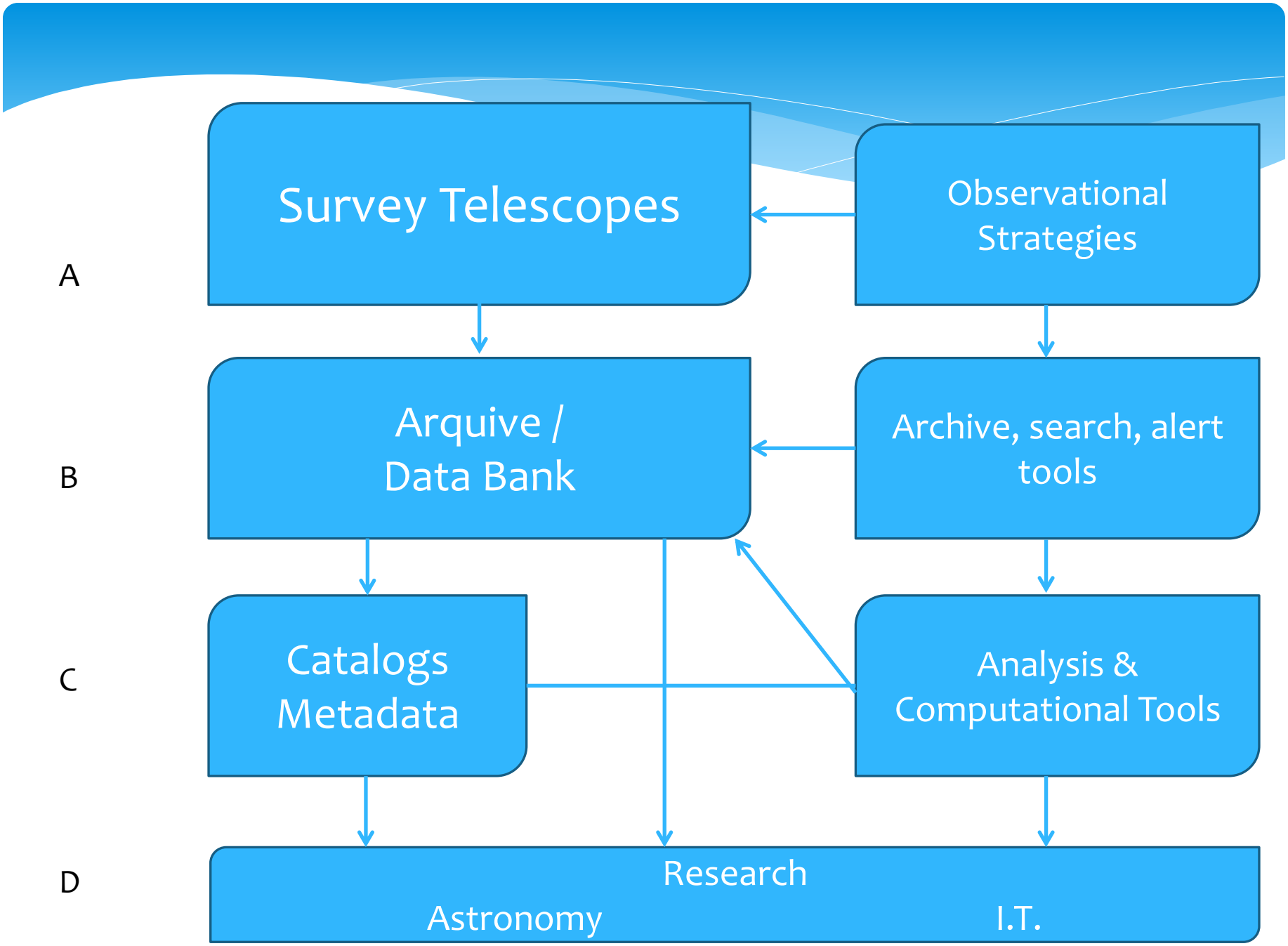
BRICS

ASTRONOMICAL DATA AND COMPUTATION

* In the last years Brazil has invested both at the local infrastructures and in international collaborations in the field of big data and computational astronomy. These investments are crucial to foster the general development of this extreme important field. The work of several Brazilian groups in the last decade either in computer infrastructure and software or in surveys are now consolidating a more national effort.

* We present the latest developments in the field.

* This presentation is based on my knowledge and research and is most probably not complete.


A
Survey Telescopes
Observational Strategies
B
Arquive / Data Bank
Archive, search, alert tools
C
Catalogs Metadata
Analysis & Computational Tools
D
Research
Astronomy
I.T.

Telescopes / Data

* International Partnerships
* SLOAN III, IV (USA, …, Linea / National Observatory)
* DES, DESI (USA, …, Linea / National Observatory)
* JPAS (Spain, National Obs. / Univ. São Paulo, ...)
* LSST (USA, …, Brazil (Linea, LNA, RNP, ANSP))
* ABRAS (Brasil, Argentina)

* Brazilian Initiative
* JPAS-south (Univ. São Paulo, Nat. Obs., …)
* S-Plus (T80) (Univ. São Paulo, Nat. Obs., …)

Participation by Individuals

* Differently from Traditional telescopes were we usually have partnerships divided by number of nights in the surveys we have usually the participation by a certain number of researchers.

* Brasil collaborates with SLOAN III, SLOAN IV, DES, DESI, LSST using this modality.

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Dark Energy Spectroscopic Instrument

The Dark Energy Spectroscopic Instrument (DESI) is a dedicated survey the spectroscopic observations of tens of millions of objects for the study of dark energy. Observations will be made for five years with the Mayall telescope 4m Kitt Peak National Observatory (see Figure 1) and must start in 2019

Dark Energy Survey

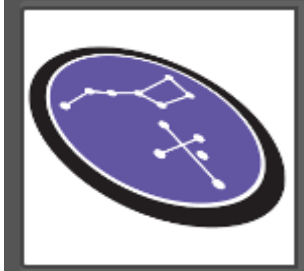
The survey Dark Energy Survey (DES) is to study the nature of dark energy, a recently discovered component, which represents around 70% of the Universe content, and this energy the alleged responsible for the acceleration of its expansion. The project seeks to determine the abundance of dark energy and

Large Synoptic Survey Telescope

The Large Synoptic Survey Telescope (LSST) is a telescope being built in Cerro Pachón in Chile. Expected to come into operation at the beginning of the next decade, the LSST will map into six bands, almost half of the sky for a period of 10 years. The telescope having a diameter of 8.4 square

Sloan Digital Sky Survey - III

The project Sloan Digital Sky Survey - III (SDSS-III) is an international collaboration that produced several spectroscopic surveys of large regions of the sky, creating unprecedented statistical samples for studies in different areas. The observations were closed in 2014, but scientific analyzes are still



Sloan Digital Sky Survey - IV

The project Sloan Digital Sky Survey - IV (SDSS-IV) is a continuation of the work done in SDSS-III. In particular, two of the surveys (eBOSS and APOGEE-2) are natural extensions of surveys in SDSS-III. The project also includes a new survey (MANGO) 10,000 nearby galaxies using optical fiber packages

* LSST (2022) USA + France, Brasil, China(?) etc...

* Brazil now:
  * 10 Groups (each of 1 Pi + 4 postdocs / PhDs) (RNP, ANSP, Linea, LNA)
    * National call for proposals Open now

* Future -> possible participation as country member with open access to the data and a local data server

* https://www.lsstcorporation.org/become-international-contributor

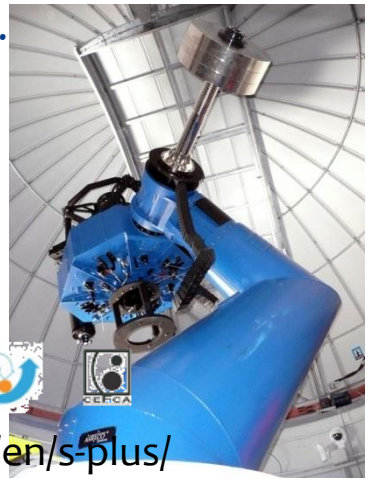
ABRAS

* ABRAS (Argentina-Brazil Astronomical Center) is a bi-national project to build a 1m robotic telescope, operating on the near infrared band. This telescope, that should have wide field of view, is located on the site of Cerro Macón, in the province of Salta, at an altitude of 4600m. On the argentine side, the project is been led by IATE.
* IATE, Univ. São Paulo (IAG/USP)

www.iag.usp.br/labcosmos/en/abras/

S-PLUS

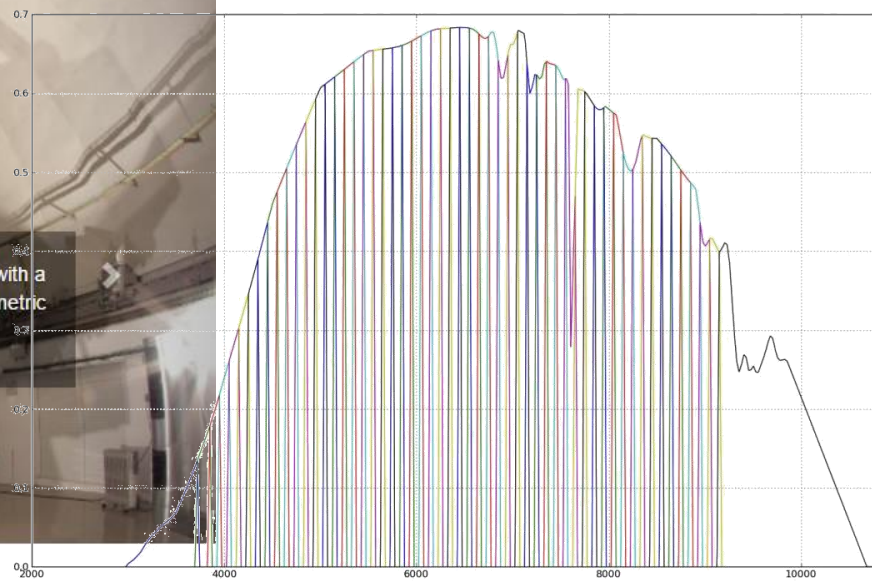
* S-PLUS (Southern Photometric Local Universe Survey) is an astronomical facility in Chile (Cerro Pachón), dedicated to mapping the observable Universe in 8 narrow-band filters and 5 broad-band (Sloan-like, *ugriz*) filters in the optical region.
* The 0.87m mirror of the T80-South telescope, combined with a field of view of 1.5 square will produce high-quality images and a unique spectral resolution for millions of objects over several thousand square degrees. = T80-North survey.



www.iag.usp.br/labcosmos/en/s-plus/

J-PAS

Javalambre Physics of the Accelerating Universe Astrophysical Survey



Javalambre Physics of the Accelerating Universe Astrophysical Survey, J-PAS, is a photometric sky survey of 8500 deg^2 in 59 colors, using a set of broad, intermed. and narrow band filters.

J-PAS will discover an unprecedented number of stars, galaxies, supernovas, quasars and solar system objects, which will be mapped with exquisite accuracy. The innovative designs of the J-PAS camera and filter system will allow, for the first time, to map not only the positions of hundreds of millions of galaxies in the sky, but their individual distances to us as well, providing a 3D map. (Centro de Estudios de Física del Cosmos de Aragón, Univ. de São Paulo, Observatorio Nacional, Instituto de Astrofísica de Andalucía)

Portals for Data and Analysis Tools

* See talks of the Brazilian participants

BRAZILIAN VIRTUAL OBSERVATORY

BRAVO

http://bravo.iag.usp.br/

Why VO ?

Because Astronomy is awash with data, observed and simulated, and thousands of discoveries are lost in a heap of underexploited data!
The Virtual Observatory is a way to paint a new scenery!

The main goals of the Brazilian Virtual Observatory (BRAVO) are

-To promote the discussion about within our astronomical community.
- To inform the about the VO status worldwide.
- To support the Brazilian astronomical community in a new paradigm of astronomical databases.

The VO worldwide effort

The Virtual Observatory is the vision that astronomical datasets distributed worldwide and related resources should work as a seamless whole.


Astro Grid
ArVO
Armenian Virtual Observatory
Aus-VO
BrAVO
China-VO
CVO
VObs.it
esa
VAO
VIRTUAL ASTRONOMICAL OBSERVATORY
France
IVOA
vo-i
EURO VO
UKR VO
GERMAN ASTROPHYSICAL
GAVO
VIRTUAL OBSERVATORY
HVO
Hungarian Virtual Observatory
JVO
NOVA
RVO
SVO
Spanish Virtual Observatory

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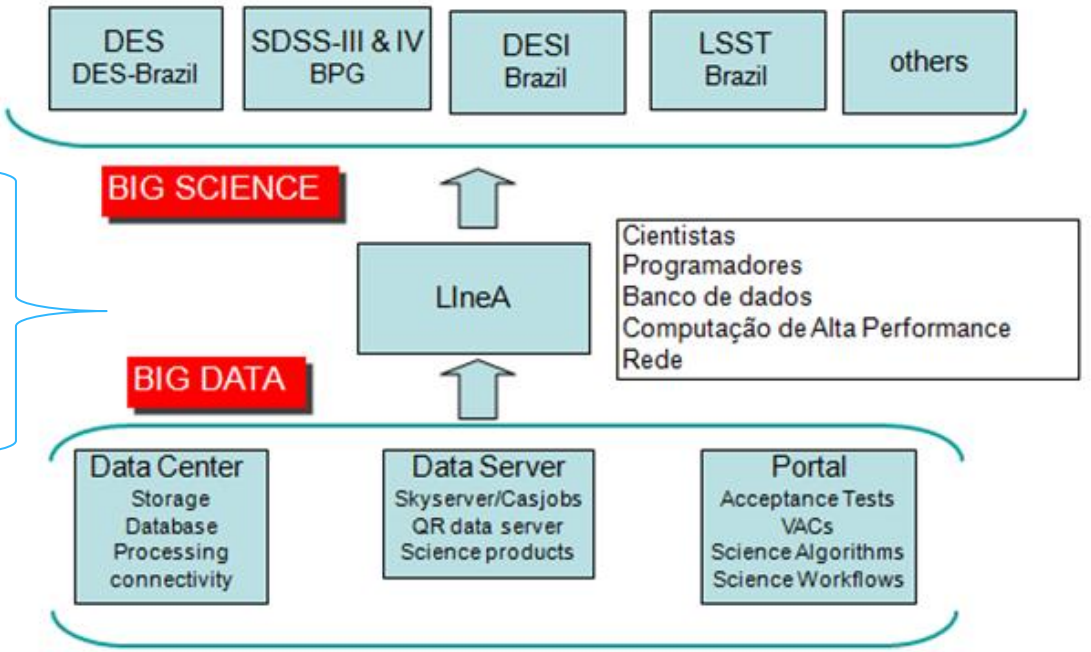
www.linea.gov.br

Hardware and software infrastructure to support the participation of Brazilian teams, on projects generating large volumes of data.

www.rnp.br/ RNP REDE NACIONAL DE ENSINO E PESQUISA

www.on.br/ Observatório Nacional

www.lncc.br/ Laboratório Nacional de Computação Científica



Data Archiving and Computation

* Several Universities and institutes have its own (sometimes open accesses) computing facilities.
  * Linea (LNCC+RNP based machines)
  * Laboratory of Astroinformatics (IAG/USP, NAT/Unicsul)
  * LAC (INPE)
  * CBPF (Braz Cent. For Theoret Phys), etc...
    * See talks of the Brazilian participants

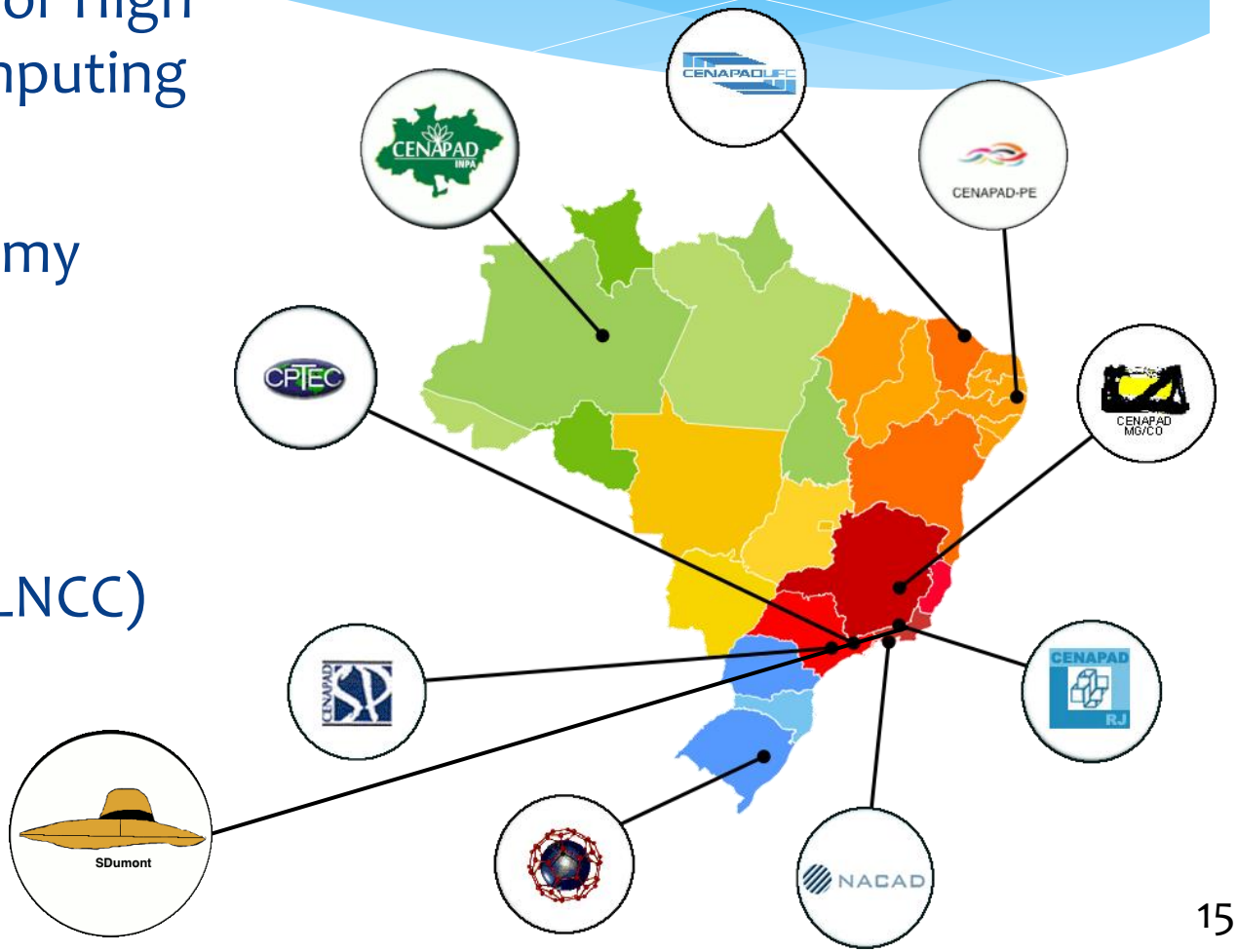
* But with the new planned big-data projects investments are being made to create national facilities, both for storage and for computing.

SINAPAD

Sistema Nacional de Processamento de Alto Desempenho

www.lncc.br/sinapad

* National System for High Performance Computing
* Open for Astronomy Projects
* Santos Dumont (LNCC)
  * 2016
  * 1,1 PFlops



CENAPAD	Equipamento (#cores)	Desempenho teórico (TFlops)	Memória RAM (TBytes)	Capacidade de disco (TBytes)
COPPE	SGI Altix 450 (64 CPU Cores)	0,384	0,128	3
	SGI Altix ICE 8200/8400LX/UV100 (672 CPU Cores + 896 GPU Cores)	8,33	1,3	72
	SGI ICE-X (6240 CPU Cores)	200	16	550
INPA	SGI Altix ICE 8400 (324 CPU Cores)	3,45	1,3	36
LNCC	Sun Blade X6250 (576 CPU Cores)	6,5	1,2	47
	SGI Altix XE 340 (360 CPU Cores + 8960 GPU Cores)[1]	13,79	0,63	136
	SGI Altix ICE 8400 (300 CPU Cores)[2]	3,2	1,2	16
	Bull bullx (1776 CPU Cores + 3584 GPU Cores)[3]	28,12	6	39
	Bull bullx + MESCA2 (18384 CPU Cores + 1140480 GPU Cores)[4]	1100	54	1100
SINAPAD	NetApp FAS 3240 - Servidores Distribuídos	---	---	832
	NetApp FAS 3140 - Servidor de Backup	---	---	302
UFC	Bull bullx (576 CPU Cores + 7488 GPU Cores)	14,2	1,44	27
UFMG	Bull NovaScale (878 CPU Cores)	9	1,7	45
UFPE	Bull NovaScale (576 CPU Cores)	6	1,1	11
UFRGS	SGI Altix ICE 8400LX (1536 CPU Cores)	15,97	4	174
	Sun Fire X2200M2/X4240/X4600M2 (454 CPU Cores + 1920 GPU Cores)	12,94	1,2	60
UNICAMP	SGI Altix 1350 (70 CPU Cores)	0,42	0,274	7
	SGI Altix 450/ICE 8400LX (560 CPU Cores)	5,96	1,496	36
	IBM P750 (1280 CPU Cores + 5376 GPU Cores)	43,18	5,12	224
Total	34626 CPU Cores + 1168704 GPU Cores	1471,444	98,088	3717
		Tflops	Tbytes	TBytes

Brasil x Astro bigdata Conclusions

* Some groups with knowledge and trained personal
* New international partnerships
* New investments on computing/archive hardware
* Need to increase young researchers training
  * Are working on it
* Need to foster the astrodata culture

End