

**on the establishment of a
Brazilian Science Data Center
(BSDC)**

General Guidelines

1 Introduction

Since the entrance of Brazil in ICRANet a variety of projects have been started to be developed a) in the theoretical field of Relativistic Astrophysics (see Volumes 2 and 3 of this Report), b) in possible future joint space missions between ICRANet Member States and Brazil (see report on page 353) and c) in the development of a Brazilian Science Data Center (BSDC) in close contact with the Italian Space Agency (ASI) and the National Institute for Space Research (INPE).

This document has been prepared thanks to the collaboration of Prof. Carlo Luciano Bianco (ICRANet), Prof. João Braga (Vice President of INPE), Prof. Paolo Giommi (Director of the ASI Science Data Centre, ASDC), Prof. Mario Novello (CBPF) and Prof. Remo Ruffini (Director of ICRANet). The BSDC will largely capitalize on the scientific knowledge and infrastructures of the ASDC and the scientific research and teaching activities at ICRANet.

A comprehensive high-level description of the ASDC, including the space missions that it supports, the data hosted in its electronic archives, the services that it provides to the astronomical community, and its infrastructure, is given in the document "The ASI Science Data Center", ASDC TN2011-2, here attached. The scientific main research and teaching activities of ICRANet are enclosed in the three volumes of this report by the Director. It is assumed that, after the establishment of BSDC within ICRANet, ASDC will foster its cooperation in terms of public data and software exchange and at the level of scientific activities.

The objective of the BSDC is to provide the data of all international ongoing space missions in the X and gamma rays wavelength for all galactic and extragalactic sources in the Universe in the Rio ICRANet Center. Possible additions of data from International missions in other wavelength are currently being considered. BSDC will be open to all Research Centers and Universities in Brazil and guarantee the collaboration and preparation of the ongoing and future scientific space missions of INPE. The existence of the BSDC is an essential step to guarantee the possibility of the advanced theoretical research of ICRANet and Research Centers in South America. Particular attention will be given to reach full compliance with the standards defined by the Virtual Observatory (VO). In addition of these scientific activities the BSDC will foster program of outreach to explain and illustrate to students and to the public at large the conquest of Science in the understanding of the Universe.

The main purpose of this document is to:

- a) set the general guidelines for the implementation of the BSDC,
- b) identify the technical support and hardware necessary to build the BSDC,
- c) to provide an estimate of the costs for the set up and first years of operation of the Centre.

A detailed project will be formulated after the presentation to the Scientific Committee and receiving the feed back of the Members.

In the following we briefly first describe a possible initial configuration of the BSDC, the archives, the high-level hardware and man-power requirements.

2 Astronomical data archives hosted at ASDC that could be replicated at BSDC

The BSDC will host a copy of a subset or of the entire amount of the data sets and services available at ASDC of the following missions :

Archives of active missions

AGILE (~0.5 TB),

Swift (~5 TB),

Fermi (~0.5TB),

Chandra (1.4 TB) – Subject to the negotiation of an agreement with Harvard CfA

Herschel (1.0TB)-

There are additional missions supported at ADSC that will be operational in the near future

e.g.

NuSTAR

GAIA

We stress that the size of these archives refer to the date of December 2011. Based on current rates we estimate that the total volume of these archives will grow at a rate of approximately 1.5 TB/year

Past missions

All the historical archives of:

BeppoSAX (1.3TB)

EXOSAT (< 1 GB)

Einstein, (< 1 GB)

ROSAT (< 1 GB)

ASCA (< 1 GB)

Astronomical Catalogs

The ASDC hosts a copy of hundreds of astronomical public catalogs. Most of these are small in size, but some are of considerable volume (e.g. WISE, SDSS, etc..).

Other catalogs have either been produced at ASDC or the ASDC is the prime publication site, e.g. BeppoSAX, catalogs, Swift XRT serendipitous sources catalogs, AGILE catalog of gamma-ray sources, ROXA survey, Sedentary Survey, Roma-BZcat, some Fermi catalogs, Planck AGN catalog, etc.

The total size of these datasets is approximately 2 TB.

Web Services and software tools

These include web-based software like:

- the ASDC multi-mission interactive archive
- the SED builder
- the Data explorer
- ASDC interactive catalogs interface
- on-line data visualization and analysis tools.

ASDC - BSDC Virtual Observatory software and tools

The ASDC and BSDC will be strongly committed to reach full compliance with the standards defined by the Virtual Observatory (VO). To this end the already now ASDC is devoting significant internal resources to VO software development and is actively cooperating with other international data centers.

The VO software that has already been developed at ASDC and could be shared with BSDC includes:

- Software suitable for the access of data stored in remote archives according to the standards defined by the IVOA (International Virtual Observatory Alliance), in particular a set of java functions to allow the remote access to astronomical catalogs using the Table Access Protocol (TAP).
- Software tools suitable for the analysis of multi-frequency data with VO-compliant functionalities (output in VOTable format, interoperability with other VO tools).
- Software for the communication between web-based interactive catalogs and VO tools.

BSDC public data that will be made available to ASDC

In exchange for the data sets, software and infrastructure that ASDC will mirror at BSDC, the Brazilian data center will provide ASDC with a copy of all the public data that will be stored at BSDC as part of local activities, e.g. public data sets from Brazilian astronomical missions and ground based observatories, etc.

The list of public BSDC data sets that will be available to ASDC will be given in the detailed proposal for the implementation of the BSDC.

3 BSDC staff

Based on the ASDC experience ICRA Net will appoint a BSDC staff composed of:

1 a BSDC Director, with full responsibility of the center.

2 senior scientists in charge of coordinating scientific activities and of guaranteeing the scientific quality of the data hosted.

1 secretary with general duties

1 secretary with administration duties

1 senior system manager

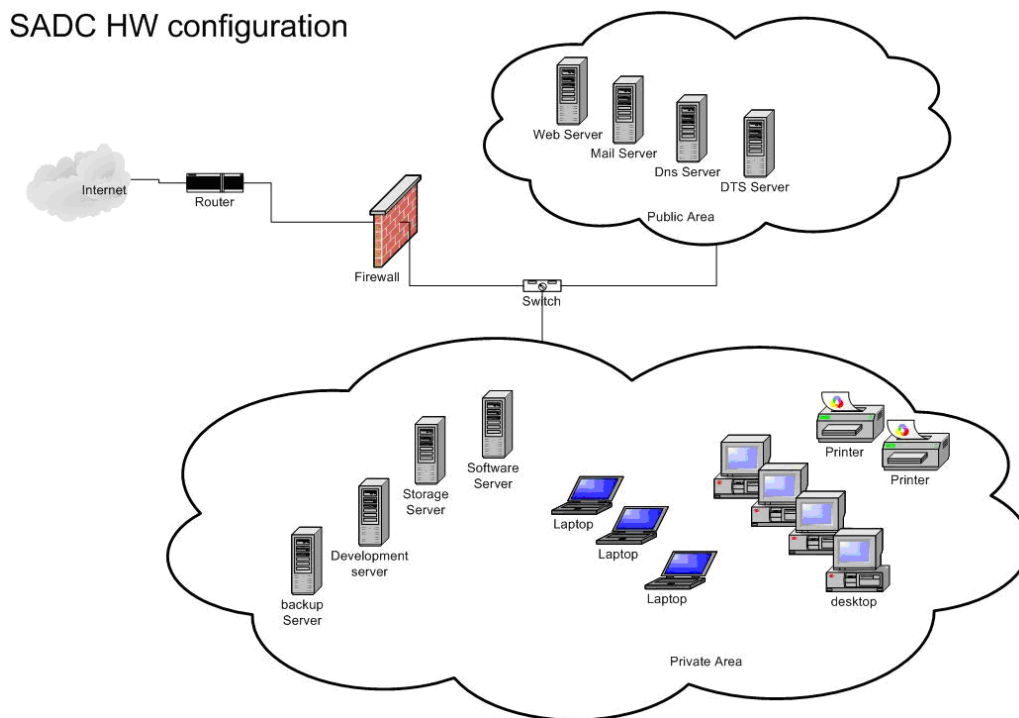
1 junior system manager

Part-time ASDC staff visiting the BSDC regularly and remotely working from Italy. This staff will help implementing the site and will ensure alignment with ASDC software and data sets (~1 FTE equivalent).

In Addition ICRA Net will interface the BSDC activities with its Faculty, two senior scientists and five postdoctoral fellows and the Graduate Students from the IRAP PhD program in order to develop the scientific research associated to the flow of Data from the BSDC .

4 BSDC Hardware infrastructure

Based on the ASDC experience a possible BSDC hardware configuration is sketched in the following Figure

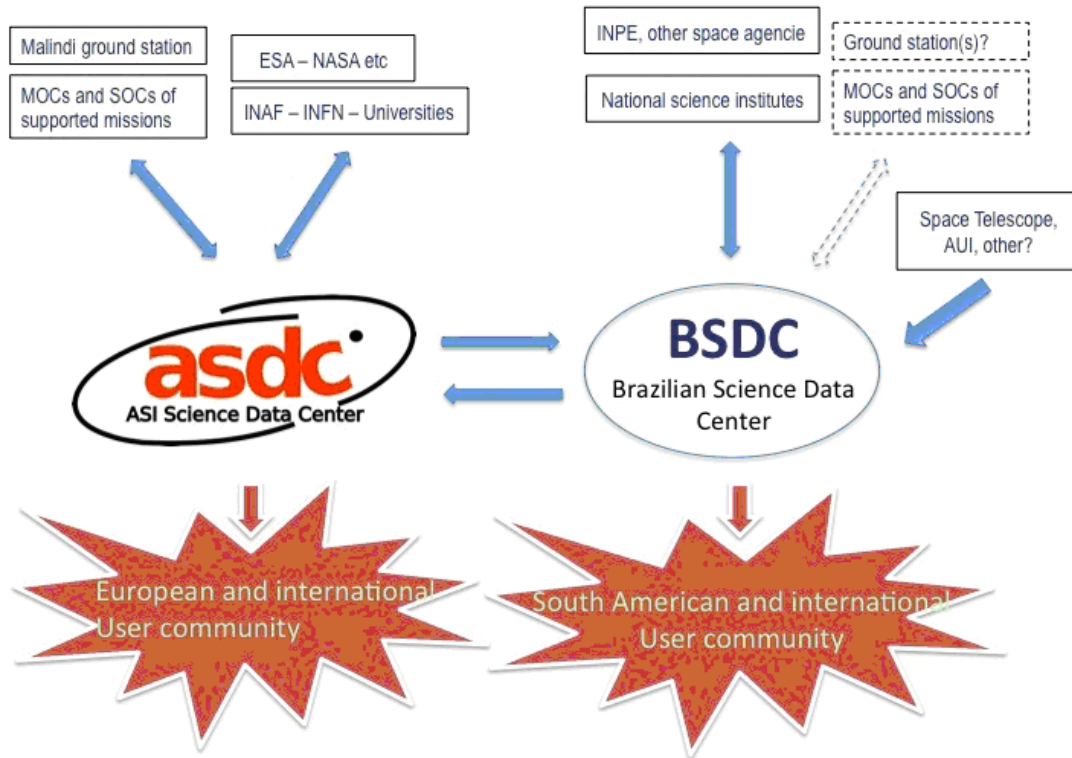


A preliminary list of BSDC hardware necessary to implement the proposed configuration is given below (see also attached specifications):

- 2 storage units, 20 TB each (this enables a complete back up of all data stored on site)
- 2 servers for archive handling
- 1 web server
- 1 mail/DNS/DHCP/DTS server
- 15 work platforms for local users and guests
- 1 firewall
- 1 high performance machine dedicated to science applications
- various material including switches, router, printers, etc...

5 ASDC-BSDC interactions

A high-level sketch of how the BSDC could operate and interact with the ASDC and other external institutions is shown below.



The ASDC is based in Frascati, Italy, it is funded by the Italian Space Agency (ASI) and it is mostly devoted to serve the national, European and the international scientific community; it operates on the basis of agreements with Italian institutions, NASA, ESA and other agencies, and benefits of agreements with the National Institute for Astrophysics (INAF), and the National Institute of Nuclear Physics (INFN), it has direct interconnections with the Italian Ground Station of Malindi (Kenya), and with the Mission Operation Centers (MOCs) and Science Operation Centers (SOC) of a number of space astronomy missions.

In a first stage BSDC will be located in the ICRANet Center at CBPF (see attached figures). After it will move to the ICRANet Center at the Casino de Urca (see Enclosure 8 and attached figure). Its services will be mostly directed towards the Brazilian, the South American, and the international scientific community; it will have agreements with the National and international agencies in support to its activities.

The two centers will be interconnected with secure communication channels (e.g. internet and dedicated lines) to ensure that the data hosted will be properly kept up to date.

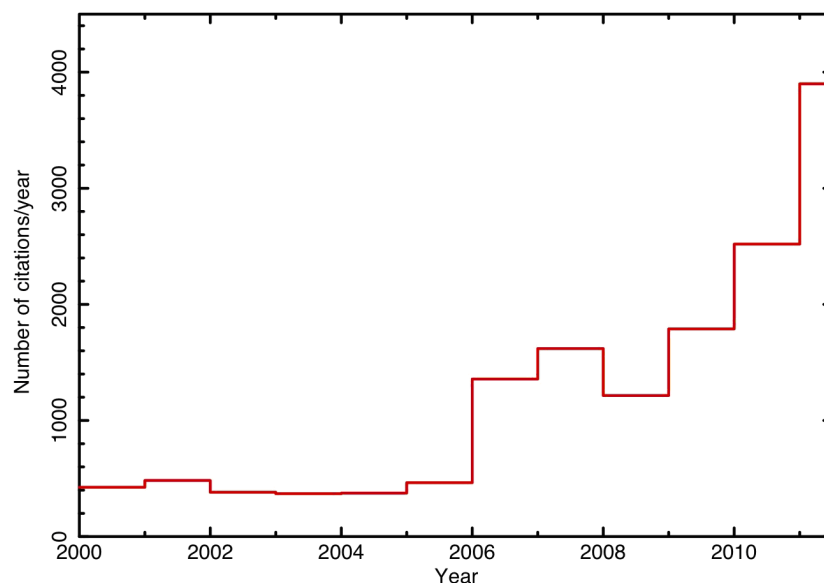
6 Scientific cooperation between ICRANet, INPE, ASI, ASDC and BSDC.

In view of the development of the BSDC and the other collaboration in Space missions between Italy and Brazil (see report on page 353) a specific collaboration Agreement between ICRANet and INPE is currently being drafted and its signature is expected at any time. A similar agreement between ICRANet and ASI has been also proposed. On the light of all these activities it will be appropriate that there will be an update of the collaboration agreement between ASI and the Brazilian Space Agency (AEB).

The main goal is to promote a strong interaction between the scientists in ICRANet and the Data acquisition and elaboration in ASDC and BSDC. This will also foster the scientific research activities of the staff resident at ASDC deeply involved in research activities related to the missions supported and to the data stored in its electronic archives. It will lead to a better use of the data archives hosted in the two institutions and, in turn, will result in better services to the general users' community.

7 Successes of the ASDC with the missions BeppoSAX, Swift, and Fermi

Among all possible scientific activities certainly Space Observatories have been among the most prolific in generating a vast amount of publications and fundamental scientific progress. The ASDC has participated crucially in this process by proceeding to the data analysis of all these missions and consequently sharing the co-authorship in all the publications of each specific space mission. It is so that the presence of Members of the ADSC in the scientific publications has grown coherently with the number of the missions, see the figure below. In particular, significant changes are present after the launch of Swift (Nov 2004), of AGILE (Apr 2007) and of Fermi (Jun 2008).



But the participation of the ADSC has been so significant, not just in Data Analysis but more generally in promoting the scientific success of each mission, that three successive AAS "Bruno Rossi" prizes were awarded to ASDC staff members: in 1998 as part of the BeppoSAX team, in 2007 as part of the Swift team, and in 2011 as part of the Fermi team.

Costs

An estimate cost of the BSDC costs for the set up and for the first year of operation are summarized below. It is particularly important that the Seat agreement of ICRANet in Brazil be done at the earliest convenience so that the tax system appropriate to ICRANet personnel as an international organization be guarantee and correspondingly reduce the total expenditures . The salaries have been estimated on current United Nation level P1-P5.

Personnel	Number	Cost (kEuro) ^a
BSDC Director P4	1	100
Secretaries P1	2	40 kEuro each = 80
System managers* P1	2	40 kEuro + 50 kEuro = 90
Travel costs		50 (first year)
Hardware and software		150
ASDC staff help for the set up		100
TOTAL		570

^a Estimate based on current (2011) costs in Italy

* 1 senior system manager and 1 junior system manager

All these activities have to be carried out within the framework of the ICRANet program for the Brazilian Center, which has been outlined in the letter to the Deputy Minister for Science and Technology L.A.R. Elias here attached. The total amount of request for the voluntary Brazilian contribution for ICRANet activities in Brazil are therefore:

Brazilian Faculty and Staff:	€ 590,000.00
Cesare Lattes Program:	€ 406,000.00
BSDC:	€ 570,000.00
Total:	€ 1,566,000.00