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ASTRONOMY IN BRAZIL

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Abstract. A historical background combined with political decisions along time explain the increasing importance of Brazil in the world's astronomical scenario. Professional astronomy was triggered in the late sixties and early seventies by the two main historical institutions then existing (ON and IAG/USP[1]), together with the creation of agencies for research and combined with individual actions. There are presently 670 astronomers working in the country, including permanent jobs and graduate students. A brief description of observational facilities and plans to increase access to other facilities is presented.

1. Historical Background

The discovery of Brazil by the Portuguese led by Pedro Álvares Cabral took place on April 22, 1500. For about 300 years the colonialist approach of the Portuguese consisted basically in the exploitation of the newly found land, especially by extracting gold, precious stones, wood, and whatever goods the country would produce, with very little concern for the education and development of its largely transient population. As a consequence, no higher learning institutions were founded, and even by the 19th century affluent "Brazilians" would have to take their studies in Europe. Therefore, practically no science was developed in the country, with some very few exceptions, in particular concerning the activities of the Jesuits of the

[1]See the list of abbreviations at the end of the paper.

Figure 1. The observatory on the roof of Count Nassau residence. (Watercolor by Zacharias Wagner – Courtesy Kupferstich-Kabinett, Staatl. Kunstsammlungen Dresden)

Companhia de Jesus, like Valentim Estancel, a professor at the Colégio da Bahia, whose observations of a comet of 1668 were referenced in Newton's *Principia Mathematica*.

One of these exceptions, which is particularly remarkable in an astronomical context, was the establishment of the first truly astronomical observatory in the southern hemisphere during the Dutch occupation of the Brazilian northeast (1630-1654). The observatory was built in 1639 in Recife, presently the capital of the state of Pernambuco, by the Colonial Governor at the head of the Brazilian colony of Nieuw Holland, Count Johan Maurits van Nassau-Siegen. The observatory was located at the top of the governor's house (Fig. 1), and, according to some sources, later on transferred to one of the towers of the newly built Freiburg palace. No traces of these observatories are left. The main responsible for the astronomical observations was the German naturalist, cartographer and astronomer Georg Markgraf (1610-1644). Markgraf is better known for the publication of the *Historia Naturalis Brasiliae* with the Dutch physician and naturalist Willem Pies (1611-1678) and edited by the geographer Johannes de Laet (1581-1649) (Leiden/Amsterdam, 1648), but for about four years between 1638 and 1643 performed detailed astronomical observations until his departure for Angola, Africa, and to his untimely death.

An important change in this situation which boosted the country as an autonomous nation was triggered by the invasion of Portugal by Napoleon in 1807. The Portuguese royal family and Court decided to flee to Brazil,

just one day before Napoleon troops reached the Portuguese capital, Lisbon. The court in exile was established in Rio de Janeiro, declared as the new capital of the Kingdom of Portugal, under the authority of Regent Prince Dom João VI. In 1816 Dom João VI was recognized as King of Portugal, but he continued to reside in Brazil, which he had raised to the status of a Kingdom on 16 December 1815.

An era of effervescence then started, triggered partly by the opening of ports to commerce in 1808 and in particular by the arrival of many European scientists and explorers, who for the first time had access to the largely unknown natural resources of the country, especially its flora and fauna. The presence of the royal court in Brazil greatly helped to bring a clear progress in the cultural and scientific activities. Dom João VI created the Royal Library, the National Museum, the Naval and Military Academies, and the Botanical Garden.

Dom João VI returned to Portugal in 1821. His elder son and heir, Pedro, declared Brazil independent from Portugal on 7 September 1822, and subsequently declared himself Emperor Pedro I. The independence was recognized by Portugal in 1825. Dom Pedro I created several institutions such as the Academy of Fine Arts, the Justice Supreme Court, the Post, and in particular, the Imperial Observatory, the latter created on October 15, 1827.

2. From the Imperial Observatory to the National Observatory

The Imperial Observatory was later (1900) renamed as the National Observatory, and its main aims were the mapping of the territory, the measurements of longitudes, and the reference local time, services that continue presently with the now existing branches of Official Time Service, and Geomagnetism services of the National Observatory. After several years facing bureaucratic problems, the observatory was able to develop several research projects related to classical astronomy and to participate in several scientific expeditions, especially under the direction of Emmanuel Liais (1826-1900), a former director of the Paris Observatory, Louis Cruls (1848-1908), Henrique Morize (1860-1930) and Lelio Gama (1892-1981). Fig. 2 shows the historical building of the National Observatory.

3. Additional Milestones up to the First Half of the 20th century

Before the second half of the 20th century, some additional important facts worth mentioning regarding astronomy, can be summarized as follows:

- The School of Engineering in Porto Alegre inaugurated an Observatory in 1908, then called Instituto Astronômico e Meteorológico (IAM) with

Figure 2. Observatório Nacional in Rio de Janeiro. This building is now the Museum of Astronomy MAST/MCT. The staff of Observatório Nacional is located in buildings at the same site. (Courtesy MAST/ON/CNPq)

the aim of preparing engineers for work in geodesy and astronomy. The historical building in the center of Porto Alegre (Fig. 3) is a listed building considered of historic interest and has outreach activities, belonging now to the Universidade Federal do Rio Grande do Sul (UFRGS).

- In 1912 the Observatório de São Paulo was inaugurated as the seat of the Meteorological Service of the Geographic and Geological Commission, at Avenida Paulista 69 (now the location of the Museum of Art of São Paulo, MASP). The observatory was moved to Parque do Estado in 1932, then called Instituto Astronômico e Geofísico, as a complementary institute to the recently created Universidade de São Paulo (USP) in 1934. It was eventually incorporated to USP in 1946. Fig. 4 shows the historical building of IAG, built in 1932. This is presently part of the São Paulo state science park, as the astronomical institute moved to the main university campus in 2002.
- Eddington's expedition to measure the bending of light during the Solar Eclipse of May 29, 1919: the measurements obtained in Sobral, in the state of Ceará, together with those in the Principe Island, consisted in the first confirmation of the Einstein theory of relativity. In a visit to Rio de janeiro in 1925, Albert Einstein declared "The idea that my

Figure 3. Historical building of the Observatório Astronômico da Universidade Federal do Rio Grande do Sul (UFRGS). (Courtesy R.A. Frantz/UFRGS)

mind formulated, was confirmed in the bright skies of Brazil", a phrase reported by a local newspaper. Fig. 5 shows Albert Einstein at the National Observatory, in 1925.

4. Creation of the Universidade de São Paulo - USP

In 1932, the state of São Paulo started a revolution against the governing dictatorship in favour of the establishment of a constitution, called the "constitutionalist revolution". They were defeated after a few months. As a consequence, there has been a decision to carry out an intellectual and scientific revolution. One of the main actions was the creation of the Uni-

Figure 4. Instituto Astronômico e Geofísico (IAG/USP), building from 1932. The site is now a state outreach science Park and the IAG/USP staff was relocated at the University of São Paulo main campus. (Courtesy IAG/USP)

versidade de São Paulo, led by the appointed governor Armando Salles de Oliveira.

European professors, that became widely well-known later on, were hired to start groups in the new University in all scientific fields. In physics, Gleb Wathagin and Giuseppe Occhialini formed a group working in cosmic rays, which included experiments held in Bolivia. Important names in Brazilian physics were formed in that nucleus: Paulus Aulus Pompéia, Marcelo Damy de Souza, Cesar Lattes, Mario Schemberg. Results of the research on cosmic rays can be found, for example, in Pompéia *et al.* (1940), Wataghin *et al.* (1940a&b) and Souza Santos *et al.* (1941).

Cesar Lattes in particular missed a Nobel prize: he worked with Cecil Powell, and published the discovery of the meson pi in *Nature*, as first author (1947). Cecil Powell alone was awarded the Nobel Prize of Physics in 1950, and it was told that the policy at the time was that the head of a research group would be the one awarded.

Mario Schemberg was a foremost scientist, with two major contributions related to Astronomy: with George Gamow, they created the URCA process, a reaction that emits neutrinos, during the cooling of neutron stars – the name was an allusion to the casino URCA in Rio de Janeiro, to ex-

Figure 5. Visit of Albert Einstein to the Observatório Nacional in 1925. (Courtesy ON)

plain energy disappearing similarly to money disappearing in the casino (Gamow & Schoenberg 1940, & 1941). With Chandrasekhar, he published the Schemberg-Chandrasekhar limit (1942).

It should be noted that Schemberg signed the papers with a modified spelling of his own name: instead of Schemberg, he adapted it to "Schoenberg" or "Schönberg", so that he is often not identified as a Brazilian in some studies.

These beginnings in research related to Astrophysics did not have immediate follow-up with these scientists. Despite this, Cesar Lattes formed and inspired many students.

The University of São Paulo is to this day a leading university, with over 5000 professors, 70 000 undergraduate students, and 22 000 graduate students. It produces 25% of refereed papers in the country, and forms over 2000 PhDs/year.

It is interesting to note that the State of São Paulo research universities, institutes and centers, are among the 20 most productive regions in the world, according to the report "Knowledge, networks and nations – Global scientific collaborations in the 21st century" issued by the Royal Society (UK), in March 2011.

5. The Creation of the National Agencies CNPq and CAPES

A most important step taken by the Brazilian government in 1951, was the creation of the national research council CNPq (nowadays Conselho Nacional de Desenvolvimento Científico e Tecnológico), and CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior), the latter within the Ministry of Education. Both institutions have graduate studies and development of research as their main focus. Presently the country has reached a rate of 11,000 PhDs per year.

6. Creation of FAPESP and FINEP

In 1962 FAPESP (Fundação de Amparo Pesquisa do Estado de São Paulo) was created. The Foundation was already planned in the state constitution of 1947, according to which its budget would be based on a transfer of 0.5% from the state taxes. In 1989, it was increased to 1% of state taxes, and this steady transfer of resources has been the fundamental basis of the success of FAPESP. Since then other state foundations were created, and in particular among those that provide presently a support to their communities, we mention FAPERJ (Rio de Janeiro), FAPEMIG (Minas Gerais), FAPESB (Bahia), and FAPRN (Rio Grande do Norte).

FINEP (Financiadora de Estudos e Projetos) was created in 1967, with the aim of promoting and financing applied scientific and technological research and innovation in industries, universities, centers of research, government and the so-called third sector. These state institutions, CNPq, CAPES, FINEP, and FAPESP were, and still are, the main mechanisms for funding research in the country.

7. First Steps in Building Professional Astronomy

Professional astronomy only started in the 1960's, due to government as well as individual initiatives: In 1961 the first Law of Guidelines and Bases (Lei das Diretrizes e Bases – LDO), concerning the educational system, proposed a restructuring of universities, leading to university teaching connected with research and graduate studies.

Also in 1961, the physicist and mathematician Abrahão de Moraes working on celestial mechanics, Director of the Instituto de Astronomia e Geofísica da Universidade de São Paulo (IAG-USP), proposed and obtained the affiliation of Brazil to the International Astronomical Union (IAU), approved in the General Assembly in Berkeley in 1961. Abrahão de Moraes also articulated and promoted the formation of Brazilian PhDs in Astronomy abroad, funded by FAPESP and CNPq fellowships.

8. The Beginning of Graduate Astronomy Courses

In the late 1960s and early 1970s, the first PhD astronomers formed abroad returned to the country: Sylvio Ferraz Mello, Paulo Benevides, and José Antonio de Freitas Pacheco came to São Paulo, along with a few astronomers then working in France, and Licio da Silva, in Rio de Janeiro. These astronomers have had a fundamental role in nucleating astronomical centers in the country, by forming groups of students, and fostering their graduation and obtention of PhDs both abroad and in the country. Since then the process has continued sucessfully, as a snowball.

It is difficult to make science without adequate equipment, but it is impossible for science to develop without people. Probably the main reason for the impressive growth of astronomical research in the country was the successful creation of graduate astronomy courses in the late sixties and beginning seventies. The first courses were implemented at the well known aeronautics engineering school ITA, the Instituto Tecnológico de Aeronáutica, located in São José dos Campos, state of São Paulo, boosted by the construction of an observatory featuring a 60cm reflecting telescope (Fig. 6). Graduate courses at IAG/USP and Mackenzie University followed, and later on the decade ON, UFRGS and UFMG started their own courses. Nowadays, about 20 institutions offer graduate MSc courses, and many also PhD courses. These institutions produce in average about 50 new MSc/PhD graduates per year.

9. The Brazilian Astronomical Society (SAB)

In 1974, the Sociedade Astronômica Brasileira (SAB) was founded, and its foundation document was signed by 48 astronomers, many still students at the time. It has now over 500 members, with a very important role in the conduction of the astronomical community. Since its foundation, it has distinguished itself in the organization of annual meetings and supporting other scientific events in the country, so that Brazilian astronomers, including students, could have an opportunity to present and discuss their own research in a friendly environment. Frequently well known foreign astronomers are invited to participate in these meetings, which frequently opens the opportunity of new collaboration work.

10. The Itapetinga Radiotelescope

Since 1960, a group of students and amateur astronomers, led by Pierre Kaufmann, started efforts to build a radiotelescope, and an agreement with Mackenzie University was concluded. A larger agreement between Mackenzie, UFRN (Universidade Federal do Rio Grande do Norte), and the North-

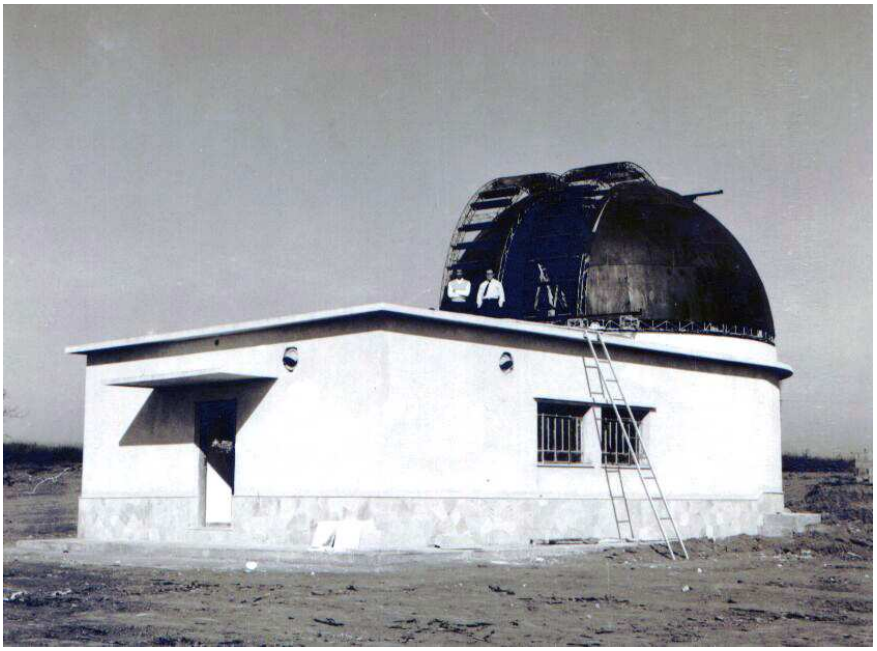

Figure 6. Construction of the ITA Observatory, São José dos Campos, state of São Paulo. (Courtesy ITA/CTA)

American Air Force Geophysics Laboratory (AFGL), led to the building in 1971, of the Itapetinga millimeter radiotelescope, with a diameter of 13.7m (Fig. 7). This radiotelescope was able to measure frequencies in the range 7 GHz to 94 GHz, and was built with resources from BNDES (Banco Nacional de Desenvolvimento), CNPq, and Mackenzie University. Several Nature papers were produced with the Itapetinga Radiotelescope, and a graduate course focussing on Radioastronomy was launched. Research concentrated mainly in solar physics and galactic and extragalactic astronomy, in particular with the observations of several water and SiO maser sources, as well as studies on the variability of quasars and radiosources.

11. The First Professional Optical Observatory – OAB

Since 1962, the geophysicist Luís Muniz Barreto, Director of Observatório Nacional (ON) (formerly Imperial Observatory), together with Abrahão de Moraes, Director of IAG/USP, started to plan the implementation of an optical Observatory, that should have a national amplitude. Led by these two scientists, the two main institutions at that time, ON and IAG/USP, prepared a plan for the creation of the Observatório Astrofísico Brasileiro (OAB), consisting in a first step, of the choice of best site for astronomi-

Figure 7. The Itapetinga 13.7m radiotelescope. (Courtesy ROI/DAS/INPE)

cal observations. The immediate consequence of this plan was the visit of the French astronomers Jean Rösch, from the University of Paris VI and Director of the Pic du Midi Observatory; Jean Delhaye, Director of the Observatory of Besançon, and Roger Cayrel, Head of Astrophysics at the Observatory of Paris. Jean Rösch had already been part of the team that chose the La Silla site in Chile for the European Southern Observatory.

In 1963 CNPq created the Comissão Brasileira de Astronomia (CBA), composed by: Abrahão de Morais (IAG); Lélio I. Gama and Luís Muniz Barreto (ON), and Fernando de Mendonça (Comissão Nacional de Atividades Espaciais – CNAE, nowadays Institute Nacional de Pesquisas Espaciais, INPE), in order to work on the project of a national observatory.

In 1972, the agency FINEP approved the project of installation of an

Figure 8. Observatory at Pico dos Dias, of the Laboratório Nacional de Astrofísica linked to the Ministry of Science & Technology, near Brasópolis, Minas Gerais. (Courtesy C.D. Gneiding/LNA)

Astrophysical Observatory in the site chosen previously, which was near Brasópolis, in the state of Minas Gerais. On April 22, 1980 a reflecting cassegrain-coudé telescope, with mirror of 1.60m started operations. In February 1981, Muniz Barreto, Director of ON, officially inaugurated the installations of the Observatório Astrofísico Brasileiro (OAB). On March 13, 1985, OAB was split from ON, giving place to a new institution, the Laboratório Nacional de Astrofísica (LNA), a truly national facility. Fig. 8 shows the Observatory of Pico dos Dias of LNA, and Fig. 9 shows the 1.6 Perkin-Elmer reflecting telescope.

Together with the main action towards the building of OAB, smaller 60cm telescopes were installed at Piedade Observatory (Minas Gerais), Valinhos (São Paulo) and Porto Alegre (Rio Grande do Sul).

12. The Gemini and SOAR Consortia

In 1993 Brazil joined the Gemini consortium, a two 8-m telescope facility in Chile and Hawaii, with a fraction of 2.5% of the observing time. In 1995, we joined another consortium for the building of a 4m telescope SOAR,

Figure 9. The 1.6m Perkin-Elmer reflecting telescope of the Laboratório Nacional de Astrofísica (LNA). (Courtesy LNA)

with a fraction of 34% of the observing time. These facilities were useful in the sense of allowing Brazilian astronomers to participate in international committees, and instrumentation programs. In particular, in the last 10 years, we were able to build 3 spectrographs for the SOAR telescope: SIFS, BTFi and STELES, that should be operative in 2012. Figs. 10 and 11 show, respectively, the SOAR telescope in Chile, and the SIFS spectrograph built by LNA/MCT and IAG/USP.

In the last 3 years Brazilian astronomers also rented 10 nights/year at the CFHT telescope, providing access to a wide field, and high resolution spectroscopy in a 4m telescope.

13. The General Assembly of the International Astronomical Union in Rio de Janeiro

In the last century, the only General Assembly of the International Astronomical Union (IAU) in South America was held in 1991, in Buenos Aires, Argentina. In 2000, the Brazilian representative at the IAU Walter Maciel, sent a first letter of intent to host the General Assembly in Brazil. In 2003, an official invitation was sent, and approved in the Executive Committee (EC) session during the General Assembly in Sydney. The organization of

Figure 10. The 4m SOAR telescope at Cerro Pachón, Chile. Brazil has a share of 34% of the observing time. (Courtesy SOAR Telescope Consortium)

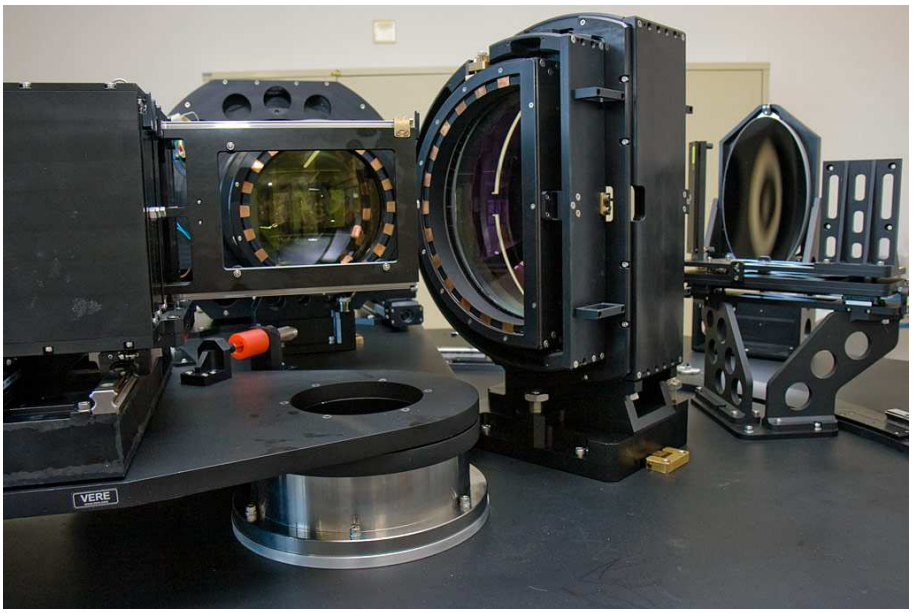

Figure 11. The SIFS – SOAR Integral Field Unit Spectrograph, the first spectrograph built by Brazilian astronomers. (© B. Barbuy)

TABLE 1. Distribution per institution

Institution	**Staff**	**Postdocs**	**Graduate students**	**Total**
IAG-USP	35	26	57	118
ON/MCT	28	12	33	73
INPE/MCT	27	7	26	60
Obs.Valongo/UFRJ	16	1	13	30
UFRGS	13	3	18	34
UFMG	11		8	19
UFRN	10	4	20	34
UNIVAP	10		10	20

TABLE 2. Distribution per state or region

State	**Staff**	**Postdocs**	**Graduate students**	**Total**
São Paulo	116	41	140	297
Rio de Janeiro	53	15	61	129
Minas Gerais	29	3	45	77
Rio Grande do Sul	28	3	24	55
Rio Grande do Norte	15	6	20	41
Bahia	14		5	19
SC + PR[a]	15	2	7	24
DF + G + MT[b]	9		4	13
PB + PE + RR +S [c]	12		4	16

[a] Santa Catarina + Paraná

[b] Distrito Federal + Goiás + Mato Grosso

[c] Paraíba + Pernambuco + Roraima + Sergipe

the GA had as chairpersons Daniela Lazzaro (ON) and Beatriz Barbuy (IAU Vice-President, USP). In that same year, the EC, and at the General Assembly approved the idea of proposing to UNESCO and UN the year of 2009 as the Year of Astronomy, in commemoration of 400 years of the first telescope observations by Galileo Galilei. A successful General Assembly took place in Rio de Janeiro in 2009, assembling about 2800 participants.

TABLE 3. Number of women astronomers

	Women astronomers	**Total of astronomers**	**Percentage of women**
permanent staff	69	311	22.2%
post-doctoral fellows	20	74	27%
PhD students	40	154	26%
MSc students	35	132	26.5%

14. Present Status of Brazilian Astronomy

Since the beginning of the astronomy graduate courses in the late 1960's, an impressive growth has occurred, and nowadays about 20 courses are in operation, providing MSc degrees and in half of them also PhD degrees. This has expanded considerably the scope of the astronomical research in the country, encompassing previously areas that did not have enough attention, such as the study of gravitational waves and X-ray astronomy, along with more traditional approach in the optical, infrared and radio domains.

In the last few years the system of universities has been largely expanded, in particular the federal universities, as well as private universities and new state universities. The result of all this is that, presently, there are over 60 institutions where there is at least one astronomer. In total there are 311 professional astronomers with permanent jobs, including 291 PhDs, and 20 Masters, 59 postdocs, and 290 graduate students, amounting to a total of 660 astronomers in activity in the country. A recent census is available online[2]. The distribution of staff members, postdocs and PhD plus Master students is given in Tables 1 & 2. In a few cases, there are staff members with a Master degree. The largest institutions, with more than 10 staff PhD members are listed in Table 1, as well as the distribution of astronomers per State or region in Table 2.

15. Women Astronomers

The proportion of women astronomers in Brazil is presently around 25%. This fraction is higher than in most countries, but still not satisfactory. The current estimates are shown in Table 3.

[2]http://www.sab-astro.org.br/levantamento_2011.htm

16. Scientific Profile – Papers in ISI (2010)

A consultation on the Institute for Scientific Information – ISI data base shows that, in the year of 2010, in the field of Astronomy, there are 550 papers from Brazilian authors. More than half of these are from physicists, in journals such as Physical Review.

By selecting the papers that can be identified with astronomy (mostly from being published in the main astronomy journals), 210 papers remain. Among these, the distribution of fields of research can be subdivided in:
• Optical/IR/mid-IR: stellar – 63 (30%) (4 of these with COROT data);
• Optical/IR/mid-IR: extragalactic – 43 (including 3 multiwavelength studies) (20.5%);
• Optical/IR/mid-IR: HII regions, Planetary Nebulae, Interstellar Medium – 11 (5.24%);
• Solar system – 20 (9.52%);
• Sun – 3 (1.43%);
• Astrobiology – 7 (3.33%);
• X-rays – 6 (2.86%);
• Gravitational waves – 6 (2.86%);
• Exoplanets – 13 (6.2%) (11 of these with COROT data);
• Theoretical: dense objects, magnetic fields, turbulence, jets, galaxies, bulges, black holes, general relativity: 26 (12.4%);
• Theoretical: cosmology – 14 (6.7%).

These numbers deserve a few comments:
a) it is clear that astronomy with optical-IR-mid-IR telescopes represents the main profile of Brazilian astronomy, with 62% of publications;
b) it has to be said that many more theoretical papers in cosmology are produced, if physicists would be gathered all together;
c) radioastronomy is employed in one paper that uses multiwavelength data, and in another on solar physics; COROT participation has brought a strong interest from our community and strengthened the exoplanet field.

It is also important to mention that Brazil joined the Journal Astronomy & Astrophysics, as a member, in 2006, together with Chile and Argentina.

17. Joining the European Southern Observatory (ESO)

A historical step in Brazilian astronomy has been the signing of access agreement to become a Member of the European Southern Observatory, signed between the Minister of Science and Technology Sergio Rezende, and the Director of ESO Tim de Zeeuw, on December 29, 2010. It is clear from the numbers in the previous section that optical/ir/mid-ir astronomy is the area where we need more facilities, which would be largely provided

by ESO; on the other hand, the weak activity in radioastronomy also shows that we will greatly benefit from joining ALMA, through ESO.

The final decision on joining ESO still depends on confirmation by the Brazilian Congress. It will represent a clear change in category for Brazilian astronomy, and its science and technology in general.

18. Conclusions

Brazilian astronomy has been growing steadily since the late 1960s, and has now a solid community, apart from a strong attractive power over students and researchers from several latin american countries. Fig. 12 shows the 25 States and 1 territory that compose the Brazilian Federation, and overplotted are the numbers of astronomers per State. The south-east (São Paulo, Rio de Janeiro, Minas Gerais) is the strongest region in all fields, such as Economy, Science, Education, and this is also reflected in number of astronomers.

We need however to take big steps to keep the pace of international astronomy. Joining ESO is a great step in this sense. With this, we should greatly improve our interactions with the industry, forming engineers in astroengineering, and as well getting into space astronomy.

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List of Abbreviatons

BNDES	Banco Nacional de Desenvolvimento
BTFi	Brazilian Tunable Filter
CAPES	Coordenação de Aperfeiçoamento de Pessoal de Nível Superior
CNPq	Conselho Nacional de Desenvolvimento Científico e Tecnológico

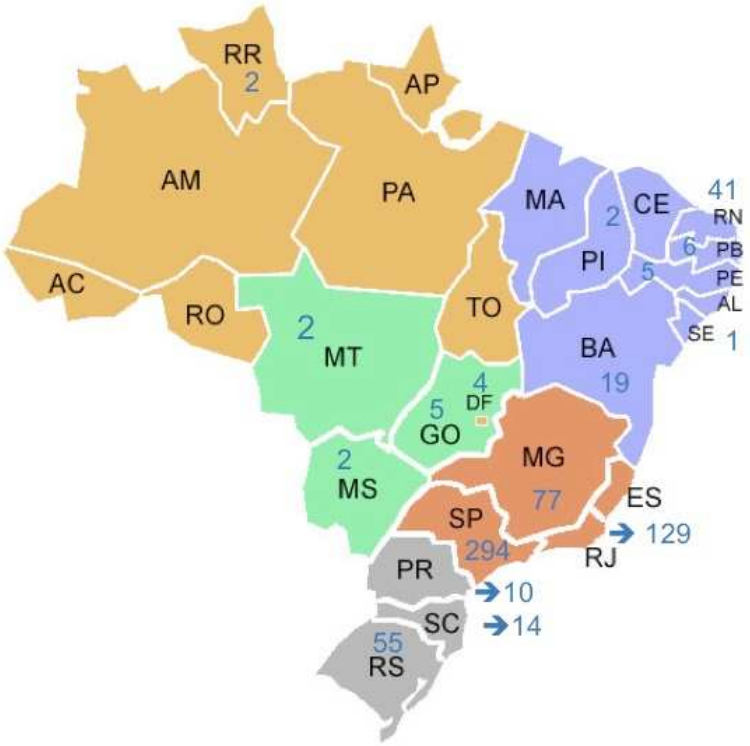

Figure 12. Brasil is a Federation with 25 States and one territory. In the figure the number of astronomers per State are overplotted. Abbreviations can be decoded as follows: AC = Acre (territory), AL = Alagoas, AM = Amazonas, AP = Amapá, BA = Bahia, CE = Ceará, DF = Distrito Federal, ES = Espírito Santo, GO = Goiás, MA = Maranhão, MG = Minas Gerais, MS = Mato Grosso do Sul, MT = Mato Grosso, PA = Pará, PB = Paraíba, PE = Pernambuco, PI = Piauí, PR = Paraná, RJ = Rio de Janeiro, RN = Rio Grande do Norte, RO = Rondônia, RR = Roraima, RS = Rio Grande do Sul, SC = Santa Catarina, SE = Sergipe, SP = São Paulo, and TO = Tocantins

COROT	COnvection, ROtation & planetary Transits satellite
ESO	European Southern Observatory
FAPEMIG	Fundação de Amparo Pesquisa do Estado de Minas Gerais
FAPERJ	Fundação de Amparo Pesquisa do Estado do Rio de Janeiro
FAPESB	Fundação de Amparo Pesquisa do Estado da Bahia
FAPESP	Fundação de Amparo Pesquisa do Estado de São Paulo
FAPRN	Fundação de Amparo Pesquisa do Estado do Rio Grande do Norte
FINEP	Financiadora de Estudos e Projetos

IAG	Instituto de Astronomia, Geofísica e Ciências Atmosféricas
IAU	International Astronomical Union
INPE	Instituto Nacional de Pesquisas Espaciais
IR	Infrared
ISI	Institute for Scientific Information
LNA	Laboratório Nacional de Astrofísica
MCT	Ministério de Ciência e Tecnologia
OAB	Observatório Astrofísico Brasileiro
Obs. Valongo	Observatório do Valongo
ON	Observatório Nacional
SAB	Sociedade Astronômica Brasileira
SIFS	SOAR integral field spectrograph
SOAR	SOuthern Astrophysics Research telescope
STELES	SOAR Telescope echelle spectrograph
UFMG	Universidade Federal de Minas Gerais
UFRGS	Universidade Federal do Rio Grande do Sul
UFRJ	Universidade Federal do Rio de Janeiro
UFRN	Universidade Federal do Rio Grande do Norte
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIVAP	Universidade do Vale do Paraíba
USP	Universidade de São Paulo

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