Teaching and Research @ IAG

Laerte Sodré Jr.

IAG – USP

INFIERI 2016
4th Summer School on INtelligent signal processing for FrontIEr Research and Industry

January 23rd to February 3rd, 2017
Departments:

- Astronomy
- Geophysics
- Atmospheric Sciences

Faculty: 69 (+7)
UNDERGRADUATES: 345
GRADUATES: 236
POSTDOCS: 66
Good CAPES grades!

ASTRONOMY
FACULTY: 31 (+4)
UNDERGRADUATES: 67
GRADUATES: 71+29
POSTDOCS: 40
CAPES GRADE: 7

GEOPHYSICS
FACULTY: 20 (+2)
UNDERGRADUATES: 171
GRADUATES: 50
POSTDOCS: 12
CAPES GRADE: 6

ATMOSPHERIC SCIENCES
FACULTY: 18 (+1)
UNDERGRADUATES: 107
GRADUATES: 86
POSTDOCS: 14
CAPES GRADE: 7

Administrative/technical staff: 129
Undergraduate courses:
- Astronomy (2009) – 20/yr
- Meteorology (1977) – 30/yr

Graduate courses:
- Astronomy (1973)
- MSc in Teaching of Astronomy (2013)
- Geophysics (1974)
- Meteorology (1975)

>1000 PhD and MSc!
Astronomy @ IAG

Solar System
Exoplanets, Astrochemistry & Astrobiology
Stellar Structure and Evolution
Stellar Populations
Milky Way
Formation and Evolution of Galaxies
Physics of Black Holes and compact objects
Cosmology
Geophysics @ IAG

Structure and Dynamics of the Earth: relation between deep and surface processes

Brazil crustal thickness from seismological tomography

Interaction Geophysics – Biology – Atmosphere in the primitive Earth: transition from the PreCambrian to Cambrian and the origin of the Oxygen in Earth

Density of South America up to depths of 800km
Atmospheric Sciences @ IAG

- Physical Processes in the Atmosphere
- Atmospheric Pollution
- Micrometeorology
- Atmosphere – Biosphere Interaction
- Climate and Global Warming
IAG infrastructure for research

HPC
- Several clusters!
- Laboratório de Astroinformática:
  - 2304 cores (192 Opteron processors)
  - +distributed processing
  - +GPUs

RESEARCH LABs:
- Meteorological stations
- Seismology
- Paleomagnetism
- SOAR remote observation room
- Air pollution
Development of instruments:
- Workshops: optics, mechanics, electronics

Inauguration Feb 2017
Brazilian Optical Astronomy Landscape

- Observatório do Pico dos Dias - LNA
- Gemini Observatory (6.5%)
- SOAR Telescope (34%)
- GMT (4%, SP)
- ESO? pending ratification by the Congress
- J-PAS, T80-S
Instrumentation for optical telescopes

- **SOAR:** SIFIS, BTFI, STELES
- **J-PAS (JPcam, T80Cam), South-Pol**
- **Subaru:** PFS
- **ESO:** CUBES (VLT), Mosaic (ELT-MOS)
- **GMT:** GCLEF ...
- ...

**SIFIS- SOAR Integral Field Unit Spectrograph**
PI: B. Barbuy, J. Lépine, C. Gneiding (LNA)

**BTFI- Brazilian Tunable Filter Imager**
PI: Cláudia Mendes de Oliveira

two modes:
iBTF (tunable filter)
- Low resolution mode: $5 < R < 4,000$
- High resolution mode: $600 < R < 35,000$

**STELES- SOAR Telescope Echelle Spectrograph**
PI: Bruno Castilho (LNA)

- Two channel, VPH cross dispersed echelle spectrograph
- White pupil configuration
- Bench mounted
- Nasmyth focus, slit fed
- Resolving power - 50,000 (3 - 2.5 pixel resolution) with a 0.8" slit. Higher resolution can be achieved with narrow slits.
- Wavelength range - 3000 - 8900 Å (blue arm 3000-5500 Å, red arm 5300-8900 Å)

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**STELES Image:**

**SIFIS Image:**
PFS/SuMIRe
Prime Focus Spectrograph for the Subaru
Measurement of Images and Redshifts survey

• PI: Hitoshi Murayama  Kavli IPMU (U. Tokyo)
• Survey epoch: 2019-2023
• Spectrograph for the Subaru Telescope: 2400 optical fibers within a FOV of 1.3 deg diameter
• Spectral coverage: 0.38 – 1.3 microns, R ~ 3000 – 5000
• Brazil (USP+LNA): optical fiber subsystem
PFS/SuMIRe
Prime Focus Spectrograph for the Subaru Measurement of Images and Redshifts survey

- **Science:**
- Baryon Accoustic Oscillations (BAO) \(0.8 < z < 2.4\) \((9.3 \, h^3 \, \text{Gpc}^3)\)
- Cosmological distances with accuracy of 3%; structure growth with 6%
- Local Cosmology: Milky Way & Andromeda history through the observation of \(~10^6\) stars
- Chemo-dynamical evolution and dark matter in Local Group dwarf galaxies
- Galaxy populations and structures \(1<z<2\)
- "Lyman break" & "Lyman alpha" galaxies \(3<z<7\): glimpses on reionization

Takada et al., 2014  arXiv:1206.0737
http://sumire.ipmu.jp/en/2652
https://www.youtube.com/watch?v=5mW3v2k8Ofo
J-PAS, J-PLUS, S-PLUS

- J-PAS: Javalambre Physics of the Accelerating Universe Astrophysical Survey
- J-PLUS: Javalambre Photometric Local Universe Survey
- S-PLUS: Southern Photometric Local Universe Survey
J-PAS
J-PLUS
S-PLUS

mosaic of 14 10kx10k CCDs

Javalambre Astrophysical Observatory

two survey telescopes @JAO:
2.5m (FOV 3 deg diam) & 80cm (FOV 2 deg diam)

JAO T250 telescope

T80-N,S telescope

JPCam
mosaic of 14 10kx10k CCDs
(2\textsuperscript{nd} largest astronomical camera!)

SI Camera for the T80
(e2v 9k x 9k pix CCD)
Collaboration between Brazil and Spain
Photometric survey of ~8500 sq. deg. to $i \sim 22$
Photometric system with 59 filters
(54 narrow band, 5 broad band)

Main driver: the nature of Dark Energy through measurement of the BAO scale up to $z \sim 1$
Large scope of science: from asteroids to cosmology...

J-PAS photometry ~ low resolution spectrum ($R \sim 40-60$) for each pixel in the sky up to 23 mag arcsec$^{-2}$!
distribution of stellar population properties within galaxies
J-PLUS (T80-N)

J-PLUS: Survey with T80-N (@JAO)
PI: Javier Cenarro (CEFCA)

Motivation:
- Photometric calibration for J-PAS
- Test of J-PAS scientific and technical management systems

- 12 filters: SDSS griz + 8 narrow/intermediate band filters
- Survey area: 5000 sq. deg.
- ~3 years, started Nov 2015

Science: from asteroids to distant quasars
Principal Investigator: Claudia Mendes de Oliveira (IAG)
Project Scientist: R. Overzier (ON)

S-PLUS (T80-S)

starts TODAY!

M83

Full field

zoom

SOUTHPOL - polarimetric survey with T80-South
New Large Astronomical Projects @ IAG

**GMT: Giant Magellan Telescope (4%, SP) - 2023**

- @ Las Campanas Observatory (Chile)
- FOV of 20', resolution ~0.020” at 2.2 µm (10x better than HST)
- seven 8.4m mirrors (equivalent to a single 24.5m mirror)
- PI: João Steiner
New Large Astronomical Projects @ IAG

LLAMA: Large Latin American Millimiter Array - 2018

- @ NE Argentina (4820m)
- 12m diameter antenna (similar to those used by ALMA)
- Angular resolution of 8" at 900 GHz to 3' at 35 GHz
- PI: Jacques Lepine

- Antenna & detectors ~ ALMA
- Operation as a single dish or part of a VLBI network:
  increase x10 the resolution of the ALMA interferometers
New Large Astronomical Projects @ IAG

**ASTRI Mini Array (CTA precursor)**
- Collaboration with INAF (Italy) and North-West University of South Africa
- @ Chile
- operational by 2019
- PI: Elisabete de Gouveia Dal Pino

- nine 4.3m Cherenkov telescopes for ultra-high energy γ-ray observations (up to ~ 100 TeV)
- FoV = 9.6 deg, resolution ~arcmin, energy resolution 10-15%
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Enjoy the School!