



**SCAR Sub-Group**

SG

**AAA**

Under ExCom

Person  
Responsible:

Tony  
Travouillon

## **SCAR Delegates Report 2020**

# **Astronomy and Astrophysics from Antarctica**

## **2018-2020 Report**

### **Summary**

#### **Report Author(s)**

Tony Travouillon - Australian National University, AUS  
Adriana Maria Gulisano - Instituto Antártico Argentino, Argentina

#### **Summary of activities from 2018-20**

AAA is continuing its role as an independent SRP to promote collaborations in Antarctic sciences. In these three years, we have expanded our group to welcome sciences working in near-earth observations, grown our base of researchers and presented our plan to become a SCAR science group.

#### **Meetings/Workshops**

- SCAR OSC Davos, Switzerland, June 15-26, 2018 had SCAR AAA meeting, and which were well attended, with contributions from current and proposed astronomy and astrophysics research projects in the Arctic and Antarctic. The session was a forum to learn about the science potential of these regions, and techniques for conducting research in extreme environments including ground-based and balloon borne experiments. There were talks from early career scientists and nations who have recently joined SCAR and IASC as associate members, along with presentations from more established researchers to provide opportunities for mentoring and building collaborations to leverage the investment in scientific infrastructure in the Polar Regions. Talks involving polar research in Astronomy and Astrophysics were also presented.
- 5th AAA workshop Courmayeur, Italy, June 17-19, 2019 had 43 international participants along with key polar and funding agency representatives to discuss Antarctic astronomy/astrophysics research.
- SCAR OSC Virtual Meeting with a mini-symposia where Tony Travouillon presented the highlights of AAA research activities and sessions that incorporates all astronomical and near-earth observations and studies made from the Antarctic continent, spanning all wavelengths and methods.

## Outreach Activities

- IceCube/PolarTREC educator Jocelyn Argueta documented her trip to the South Pole with a series of ten bi-lingual short videos (<https://tinyurl.com/jebxu9yw>).
- SCAR AAA International Girls and Women in Science day posts promoted, celebrated and supported young women, encouraging them to join AAA efforts.
- Antarctica Astronomy booth at the IAU general assembly, Vienna 2018

## Research Activities

**IceCube** continued to operate with greater than 99.8%, producing a wide range of leading results on topics ranging from neutrino properties, tests of fundamental physics, cosmic ray spectrum and composition, and the first ever identification of the astronomical object that produced a high energy neutrino.

The IceCube Upgrade underway will add 7 more densely instrumented strings of optical sensors and calibration devices in the center of the existing array. The pandemic severely curtailed deployments in the 2020-21 season which will delay completion of the Upgrade. A conceptual design for IceCube-Gen2, a proposed expansion to the optical array along with a radio array, is under review by the Astro 2020 panel.

In Latin America, due to the Outreach activities of AAA steering committee members at regional level, new projects were started. A **new development of an Optical Robotic Observatory** at the Argentine Antarctic Station Belgrano II is undergoing, with the scientific objectives of: Search or tracking of exoplanets, search or tracking of smaller bodies with polar orbits, Tracking peculiar stars, monitoring of AGN's or GRB's, and provide Support for space missions. In this way AAA is getting the South American astronomical community more involved in the Antarctic Astronomy activities. The Antarctic Node of LAGO (Latin American Giant Observatory) was settled since March 2019 and is in continuous operation since then, even under the pandemic situation, while the LAMP group (Laboratorio Argentino de Meteorología del Espacio, Argentinian Space Weather Laboratory) is monitoring the functioning of the cosmic rays flux measurements. The LAGO collaboration is developing another Cherenkov detector for cosmic rays studies and expects to include an additional node, from Peruvian researches, in the Antarctic Peninsula when the pandemic situation allows it.

At the Dome A station, there was a traverse to Taishan Station with the 36<sup>th</sup> CHINARE during the 2019/2020 season. Supported by PLATO-A, the **new site testing instruments were able to operate through the 2019 polar nights at Dome A**. Data from KL-DIMM and KLAWS-2G have revealed superb night-time free-atmosphere (FA) seeing with a median value of 0.31 arcsec and there is a 49% chance to obtain FA seeing at the 14m height. Another major accomplishment in 2018-2020 has been the **release of the AST3-1 point source catalog**, which provides free public access to the data from the 0.5m optical AST3-1 telescope at Kunlun Station. In addition, we have published a series of three papers on Exoplanets in the Antarctic Sky, describing the main results of the AST3 exoplanet survey. Finally, we collaborated with atmospheric scientists at Kunlun Station to measure the near-surface ozone concentrations over a period of a year. There are about 30 papers published between 2018-2020 on Dome A astronomy related topics.

At Dome C, since 2019, ASTEP in Concordia has been focused on the **follow-up of transiting planet candidates from the TESS NASA mission** and obtaining a great

number of detections. **SuperDARN radar Dome C North (DCN) was successfully installed at Concordia** during 2018-2019 campaign (PI: Marcucci-INAF). Its aim is to study the Earth-Sun relation and to investigate the Space Weather. Interactions with the solar wind makes the environment relevant for astronomy (as well as for the society).

**New facilities are being conducted for Dome C:**

**ESCAPE-AntarctiCor** (Sun Coronagraph, Dome C, PI Fineschi). Its aim is to conduct polarimetric observations of the solar broadband K-corona (585-595nm) and of the the coronal emission line FeXIV line (530.3nm). It can demonstrate Concordia quality field test of the space coronagraph ASPIICS

**COSMO:** COSmological Monopole Observer (PI: Masi-Sapienza). COSMO is an instrument to measure the distortions of the Cosmic Microwave Background (CMB) frequency spectrum. Site and instrument are being constructed. CMB spectral distortion is a unique way to look in the past and to monitor the origin of the universe. This allows us to set the thermal history of the Universe. COSMO is being constructed in the labs of Sapienza University.

**Summary Budget 2019 to 2022**

	2019	2020	2021	2022
	Spent	Allocated	Request	Request
(US\$)	3,369	6,631	6,989	7,000

## Progress to date

Between the 20-21 of August 2018, AAA operated a booth at the general assembly and of the International Astronomical Union. Its goal was to promote the astronomical activities taking place in Antarctica and generate interest in collaborations with astronomers not familiar with the facilities available on the Antarctic continent. During this meeting, we also advertised the scientific purpose of the SCAR organization.

AAA organized its 5th workshop between the 17-19 of June 2019 in The Aosta Valley (Italy). The conference was the first hybrid conference attended by 50 astronomers in person and many more in video form. Most of our SCAR budget for that year was spent to help attendance from ECR and participants with limited budget.

In 2020, our activities were very limited due to our incapacity to travel and focus was relegated to the scientific activities. We however presented the scientific highlights of our group at the SCAR online open conference

## Future plans

### Planned activities in 2020 to 2022

The events of 2020 dramatically changed the plan of AAA. Our goal to organize a semi-yearly conference dedicated to astronomy in Antarctica means that the 2021 planned workshop will instead be organized in an online format. In 2022, our involvement in the International Astronomical Union remains the same as we hope normal travel will be restored and will be able to represent AAA with a booth presence.

We also continue to provide our endorsement and support to other related scientific workshop such as the 2021 Girls and Women in science day and the Icecube science workshop taking place in January 2021. We will be particularly focused on the support of collaborations with emerging countries with no logistical means to access the Antarctic continent.

### Planned use of funds for 2020 to 2022

Year (YYYY)	Purpose/Activity	Amount (in USD)	Contact Name	Contact Email
2021	Virtual conference	6,000	Tony Travouillon	tony.travouillon@anu.edu.au
2022	IAU educational booth	5,000	Tony Travouillon	tony.travouillon@anu.edu.au
2022	Travel support for ECR to SCAR open science conference	2,000	Tony Travouillon	tony.travouillon@anu.edu.au
<b>Total</b>		<b>13,000</b>		

### Any additional detail on funds usage and desired results/outcomes

Our budget is regularly divided in three main purpose:

- 1) Support ECR scientists to attend the SCAR open conference

- 2) Promote Antarctic astronomy at the International Astronomical Union (IAU)
- 3) Organize a semi-yearly AAA workshop.

### Percentage of the budget to be used for support of early-career researchers

2020: N/A (no funds were spent in 2020 due to Covid)

2021: 30% (virtual conference will be offered free to all participants of which we expect 30% to be ECR based on past meetings.

2022: 30% (100% of our travel support for SCAR 2022)

### Percentage of the budget to be used for support of scientists from countries with developing Antarctic programmes

2020: N/A (no funds were spent in 2020 due to Covid)

2021: 10-30% (In person meetings usually attract 10% of scientists from developing nations however we expect an increase of this percentage for the virtual meeting since there are no travelling costs involved.

2022: <20%. Partial travel costs support is usually insufficient to enable the participation of developing nations (they would rely on a full support which we cannot afford under this budget). Exact numbers will depend on the location of the 2022 meeting. Significant improvement could be made in this area with a larger yearly budget.

## Membership

### Leadership

Role	First Name	Last Name	Affiliation	Country	Email	Date Started	Date Term is to End
Chief Officer	Tony	Tony Travouillon	ANU	Australia	Tony.Travouillon@anu.edu.au	2021	2024
Steering Committee Member	Jenny	Adams	UC	New Zealand	jenni.adams@canterbury.ac.nz	2021	2024
Steering Committee Member	Michael	Ashley	University of New South Wales	Australia	m.ashley@unsw.edu.au	2021	2024
Steering Committee Member	Elia	Battistelli	Sapienza Università di Roma	Italy	elia.battistelli@roma1.infn.it	2021	2024
Steering Committee Member	Adriana	Gulisano	Instituto Antártico Argentino	Argentina	adrianagulisano@gmail.com	2021	2024
Steering Committee Member	Nicholas	Crouzet	ASTEP	Canada/France	Nicolas.Crouzet@esa.int	2021	2024
Steering Committee Member	*Jennifer	Cooper	APECS	USA	jrc323@cornell.edu	2021	2024
Steering	XueFei	Gong	NIAOT	China	xfgong@niaot.a	2021	2024

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<b>Committee Member</b>					c.cn		
<b>Steering Committee Member</b>	James	Madsen	UW-River Falls&Ice Cube	USA	jim.madsen@icecube.wisc.edu	2021	2024
<b>Steering Committee Member</b>	Naomasa	Nakai	kwansei Gakuin University	Japan	nakai@physics.px.tsukuba.ac.jp	2021	2024
<b>Steering Committee Member</b>	Zhaohui	Shang	Tianjin Normal University	China	zshang@gmail.com	2021	2024
<b>Steering Committee Member</b>	Peng	Jiang	Polar Research Institute of China	China	jiangpeng@pric.org.cn	2021	2024
<b>Steering Committee Member</b>	Waraporn	NUNTIYAK UL	Chiang Mai University	Thailand	waraporn.n@cmu.ac.th	2021	2024

Please identify early-career researchers with \* in first column

**Other members**

First Name	Last Name	Affiliation	Country	Email
<b>Silvia</b>	Masi	University of Rome "La Sapienza"	Italy	silvia.masi@roma1.infn.it
<b>Charling</b>	Tao	CPPM/IN2P3/CNRS	China/France	tao@cppm.in2p3.fr
<b>Andrea</b>	Richichi	NARIT	Italy	andrea4work@gmail.com
<b>Takashi</b>	Ichikawa	Tohoku University Astronomical Institute	Japan	ichikawa@astr.tohoku.ac.jp
<b>Albrecht</b>	Karle	ICECUBE	USA	albrecht.karle@icecube.wisc.edu
<b>Xiangqun</b>	Cui	Nanjing Institute Astronomy Optics-Technology Chinese Academy of Sciences	China	xcui@niaot.ac.cn
<b>Lyu</b>	Abe	Lab JL Lagrange	France	Lyu.Abe@unice.fr
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<b>Michael</b>	Burton	UNSW	Australia	m.burton@unsw.edu.au
<b>Nemanja</b>	Jovanovic	Caltech	USA	nem@naoj.org
<b>Zak</b>	Staniszewski	Caltech	USA	zks@caltech.edu
<b>Peter</b>	Tuhill	Sydney Institute for Astronomy	Australia	p.tuhill@physics.usyd.edu.au
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<b>Anna</b>	Moore	ANU	Australia	anna.moore@anu.edu.au

Please identify early-career researchers with \* in first column

## Additional information (optional)

*Please add any more detail here that you wish, on your subgroup activities, papers published, etc.*

### Notable Papers

1. "Night-time measurements of astronomical seeing at Dome A in Antarctica", Ma, B., Shang, Z., Hu, Y. et al. 2020, Nature, 583, 771

This work provides information from measurements of seeing at Dome A

2. "Astronomy from Dome A in Antarctica", Shang, Z. 2020, Research in Astronomy and Astrophysics, 20, 168

In this paper the Astronomical activities at Dome A are detailed.

3. "Contributions of the LAGO Collaboration to the 36 th ICRC". International Cosmic Ray Conference 2019. Alberto, A.; Alvarez, W.; Ancari, L.; Uzieda, M. Andrade; Arceo, R.; Areso, O.; Arnaldi, L. H.; Asorey, H.; Audelo, M.; Berazaín, E.; Bertou, X.; Bonilla-Rosales, M. J.; Caballero-Mora, K. S.; Calderón-Ardila, R.; Calle García, C. A.; Campelo, J.; Campos-Fauth, A.; Cando, J.; Carramiñana, A.; Carrasco-Licea, E. Carrera, E.; Castromonte-Flores, C.; Cazar, D.; Cogollo, D.; Conde-Sanchez, R.; Cotzomi, J.; Dasso, S.; De-Castro, A.; Echiburú, M.; García, L. G.; Garibay-Orellana, A.; González, M.; Grisales-Casadiegos, J.; Guachalla, N.; **Gulisano, A. M.**; Guzmán, R.; Gómez Berisso, M.; Helo, J. C.; Hueyotl-Zahuantitla, F.; Hurtado, J. S.; Jaimes-Motta, A.; López, J.; Manriquez, D.; Martínez Bravo, Oscar; Martínez-Méndez, A.; Masías Meza, J. J.; Mayo-García, R.; Mijangos, L. G.; Miranda, P. P.; Montes, E.; Morales, I. R.; Morales-Olivares, O. G.; Moreno, E.; Muñoz, P.; Navarro, F.; Nina, C.; Núñez, L. A.; Otiniano-Ormachea, L.; Paye, P.; Pereira, M.; Perez, H.; Peña-Rodríguez, J.; Pinillos, L. P.; Pisco-Guabave, J.; Ponce-Lancho, E.; Pérez-Sánchez, L. R.; Rajjevic Ergueta, M. S.; Ramelli, M.; Rivera Bretel, H. M.; Rosero, C.; Rubio-Montero, A. J.; Sacahui, J. R.; Salazar, H.; Samanés-Cárdenas, J.; Santos, E.; Sarmiento-Cano, C.; Sidelnik, I.; Sofo Haro, M.; Subieta Vasquez, M. A.; Suárez-Durán, M.; Ticona, M.; Ticona Ordoñez, R. R.; Ticona Peralta, R. D.; Vega, A.; Vega, P.; Vega-Martínez, J.; Vesga-Ramírez, A.; Vitoretì, D.; Vásquez, N.; Vásquez-Ramírez, A.; Zepeda, A.; de León H, Hugo; Alvarez, C. 2019arXiv190910039A

This work provides the state of the Art of the development of the Latin American Giant Observatory, that includes an Antarctic Node in the Antarctic Peninsula.

4. "Space weather service activities and initiatives at LAMP (Argentinean Space Weather Laboratory group)"V.Lanabere, S.Dasso, **AM.Gulisano**, V.E.López, A.E.Niemelä-Celeda. Advances in Space Research, Volume 65, Issue 9, 1 May 2020, Pages 2223-2234.

This work provides the activities regarding Space Weather services Research to operations and operations to research of the LAMP group, that includes the measurements of cosmic rays fluxes at the Antarctic node of LAGO.

5. "Development of a web monitor for the water Cherenkov detectors array of the LAGO project" Luis Otiniano, Iván Sidelnik, Lago Collaboration(Alberto, A.; Alvarez, W.; Ancari, L.; Uzieda, M. Andrade; Arceo, R.; Areso, O.; Arnaldi, L. H.; Asorey, H.; Audelo, M.; Berazaín, E.; Bertou, X.; Bonilla-Rosales, M. J.; Caballero-Mora, K. S.;

Calderón-Ardila, R.; Calle García, C. A.; Campelo, J.; Campos-Fauth, A.; Cando, J.; Carramiñana, A.; Carrasco-Licea, E. Carrera, E.; Castromonte-Flores, C.; Cazar, D.; Cogollo, D.; Conde-Sanchez, R.; Cotzomi, J.; Dasso, S.; De-Castro, A.; Echiburú, M.; García, L. G.; Garibay-Orellana, A.; González, M.; Grisales-Casadiegos, J.; Guachalla, N.; **Gulisano, A. M.**; Guzmán, R.; Gómez Berisso, M.; Helo, J. C.; Hueyotl-Zahuantitla, F.; Hurtado, J. S.; Jaimes-Motta, A.; López, J.; Manriquez, D.; Martínez Bravo, Oscar; Martínez-Méndez, A.; Masías Meza, J. J.; Mayo-García, R.; Mijangos, L. G.; Miranda, P. P.; Montes, E.; Morales, I. R.; Morales-Olivares, O. G.; Moreno, E.; Muñoz, P.; Navarro, F.; Nina, C.; Núñez, L. A.; Otiniano-Ormachea, L.; Paye, P.; Pereira, M.; Perez, H.; Peña-Rodríguez, J.; Pinillos, L. P.; Pisco-Guabave, J.; Ponce-Lancho, E.; Pérez-Sánchez, L. R.; Rajjevic Ergueta, M. S.; Ramelli, M.; Rivera Bretel, H. M.; Rosero, C.; Rubio-Montero, A. J.; Sacahui, J. R.; Salazar, H.; Samanés-Cárdenas, J.; Santos, E.; Sarmiento-Cano, C.; Sidelnik, I.; Sofo Haro, M.; Subieta Vasquez, M. A.; Suárez-Durán, M.; Ticona, M.; Ticona Ordoñez, R. R.; Ticona Peralta, R. D.; Vega, A.; Vega, P.; Vega-Martínez, J.; Vesga-Ramírez, A.; Vitoreti, D.; Vásquez, N.; Vásquez-Ramírez, A.; Zepeda, A.; de León H, Hugo; Alvarez). Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment. Volume 952, 1 February 2020, 161908

In this paper the development of a monitor web for the Latin American Giant Observatory, that includes an Antarctic Node in the Antarctic Peninsula is detailed.

6. “IceCube-Gen2: The Window to the Extreme Universe”, IceCube-Gen2 Collaboration: M. G. Aartsen et al. Submitted to the Journal of Physics G; e-print archive arXiv:2008.04323 [astro-ph.HE], 10 August 2020

The vision for the next generation of IceCube which would increase the instrumented volume of ice by nearly a factor of 10 and introduce a radio array to significantly enhance the sensitivity to the extremely high energy cosmogenic neutrinos is described.

7. “Multimessenger observations of a flaring blazar coincident with high-energy neutrino IceCube-170922A The IceCube, Fermi-LAT, MAGIC, AGILE, ASAS-SN, HAWC, H.E.S.S, INTEGRAL, Kanata, Kiso, Kapteyn, Liverpool telescope, Subaru, Swift/NuSTAR, VERITAS, and VLA/17B-403 teams Science 361, eaat1378 (2018); DOI:10.1126/science.aat1378

8. “Neutrino emission from the direction of the blazar TXS 0506+056 prior to the IceCube-170922A alert”, IceCube Collaboration: M.G. Aartsen et al. Science 361, 147-151 (2018). DOI:10.1126/science.aat2890

The first paper describes the first ever identification of a high energy cosmic ray source by a multimessenger campaign of observatories initiated by a real-time alert of a high energy neutrino detection by IceCube. The second paper adds further evidence to the claim based on an archival search of IceCube that found an earlier burst of neutrinos from the same direction.

9. “Exoplanets in the Antarctic Sky. II. 116 Transiting Exoplanet Candidates Found by AST3-II (CHESPA) within the Southern CVZ of TESS”, Zhang, H., Yu, Z., Liang, E., Yang, M., Ashley, M. C. B., et al., 2019, ApJS, 240, 17

Details of the exoplanet survey found by AST3-II



10. *Evidence for an additional planet in the  $\beta$  Pictoris system*. Lagrange, A.-M., et al., *Nature Astronomy* 3, 1135-1142 (2019).

ASTEP detection of an additional planet in the  $\beta$  Pictoris system.

11. "Measurements of the E-Mode Polarization and Temperature-E-Mode Correlation of the CMB from SPT-3G 2018 Data", Dutcher et al., submitted, arXiv:2101.01684 (2021)

First science result from the SPT-3G camera on the 10-m South Pole Telescope (SPT), using the first half-season of observations from a six-year 1500 square degree survey which began in 2018. With its 16,000 superconducting detectors, SPT-3G is the most sensitive cosmic microwave background camera ever deployed. In this result, the SPT team presents new measurements of the CMB polarization anisotropy at 95, 150, and 220 GHz, to place constraints on cosmological parameters, testing consistency with CMB measurements from the all-sky Planck satellite, and improving CMB-based constraints on a six-dimensional LCDM cosmological model by a factor of 1.5.

### **Direct support from outside organisations received for your activities**

1. 2018 AAA workshop in Courmayeur was sponsored by the *Regione Autonoma Valle D'Aosta* at a level of \$10,000
2. Our Booth at the IAU general meeting was in part financed by the Australian National University (~\$3,000)

### **Major collaborations your Science Group has with other SCAR groups and with organisations/groups beyond SCAR**

(Numbered list of substantive collaborations)

#### **Within SCAR and Outside SCAR**

##### Within SCAR:

Astronomy community within SCAR is in constant collaboration usually around scientific programs such as Icecube or the South Pole Telescope or by location.

A Dome A, collaborations with various Chinese astronomical and Antarctic institutes for optical/infrared/THz astronomy at Kunlun Station. For including Purple Mountain Observatory, the Nanjing Institute for Astronomical Optics and Technology, the Polar Research Institute of China, the National Astronomical Observatories, Tianjin Normal University, Nanjing University, Beijing Normal University, University of Chinese Academy of Sciences. This consortium of Chinese research institution is also collaborating with Australia for over 10 years with the support of the Australian Astronomy Limited (AAL) and the Australian Antarctic Division (AAD)

At Dome C, projects such as ASTEP to generate young researchers to be involved in Astronomy from Antarctica from several institutions across Europe...

##### Outside SCAR:

Short examples:

1. Infrared astronomy: Collaborations with Mansi Kasliwal and Roger Smith at Caltech for development of technologies for a future Antarctic infrared survey telescope.

2. Exoplanets: Collaborations between the Laboratoire Lagrange, the University of Birmingham, the ESA and the LESIA
3. Latitude Survey: Collaboration with NARITE and CMU
4. Paul Hickson, UBC, collaboration on data analysis and instrumentation for Dome A.
5. Collaborations with cosmologists Prof. Aniello Mennella: Milano Statale University Dr. Mario Zannoni: Milano Bibocca University Prof. Phil Mauskopf: Arizona State University

### **Outreach, communication and capacity-building activities**

*Brief highlights of any activities undertaken since the SCAR Delegates meeting in 2018.*

The LAGO collaboration has generated a series of on-line working groups within the collaboration to perform cosmic rays simulations and machine learning techniques to analyze data, among the nodes (including the Antarctic one) to develop a latin american community of researchers in high energy Astronomy and cosmic rays studies.

### **SCAR fellowship reviewers**

*As part of SCAR's Capacity Building efforts, such as the Fellowships and Visiting Scholar Awards, we are looking for people from all the SCAR groups to form a 'review panel' so if applications in your field are submitted we have people to contact to help assess relevant applications. Please list one or more people (name and email address) from your group who would be willing to serve as reviewers for the next few years, along with 1-3 keywords on their principal expertise.*

First Name	Last Name	Email	Principal Expertise
Adriana Maria	Gulisano	adrianagulisano@gmail.com	Space Weather, Sun-Earth relationship, cosmic rays, MHD
Zhaohui	Shang	zshang@gmail.com	Exoplanets, Dome A astronomy
Nicolas	Crouzet	Nicolas.Crouzet@esa.int	Exoplanets detection, photometry, spectroscopy
Tony	Travouillon	tony.travouillon@anu.edu.au	Astronomical and space instrumentation
Elia	Battistelli	elia.battistelli@roma1.infn.it	Cosmology, radio a long wavelength astronomy