



Observacione <u>s:</u>	ESTADO FINAL RESOLUCION DEL CONSEJO	FECHA	1. APROBADO 2. PENDIENTE 3. RECHAZADO 4. A FISCALIA

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EVALUATION REPORT CENTERS FOR ADVANCED RESEARCH

I. PROJECT INFORMATION
CENTER'S NAME
Center for Astrophysics
DIRECTOR
Professor Guido Garay

II. EVALUATION PANEL			
NAME	ORGANIZATION/ INSTITUTION	E-MAIL	SIGNATURE
REIVEWER 1			

III. PROGRAMS EVALUATION (please fill up as many forms as programs exist within the Center)

PROGRAM'S NAME Birth and evolution of structure in the universe PRINCIPAL INVESTIGATOR Leopoldo Infante

ITEM	Total/	Partial/	Insufficient/	Internal
	Good	Regular	Deficient	use
Degree of adoption of suggestions from the last				
report *				
Accomplishment of objectives and goals of the				
reported program	Х			
Quantity of the results reached regarding the				
objectives and goals	Х			
Quality of reached outcomes related to proposal				
objectives and goals	Х			
Degree of integration with other ongoing programs of				
the Center		Х		
Diffusion of the results				
	Х			

Comments: This is a highly visible and very productive program within the Center. The program has a number of diverse surveys either planned or underway. The program has wisely expanded into millimeter/submillimeter wavelengths, initiating surveys for galaxy clusters using the S-Z effect as well as for submilleter galaxies. Such studies should position the group well for future ALMA investigations. The ALHAMBRA survey is also an extremely important survey and provides a wealth of information on the properties and star formation histories of galaxies. A major achievement for the program has been the MUSYC survey and its extension into the near-infrared. This survey has elevated Chilean astronomy to be an important player in cosmological survey studies. I believe the addition of a theory component is also a good direction. For studies of the formation and evolution of galaxies, observation and theory go hand in hand. This research program has been extremely productive with over 40 papers in refereed journals for this past year.

PROGRAM'S NAME				
Stellar populations in the local universe				
PRINCIPAL INVESTIGATOR	PRINCIPAL INVESTIGATOR			
Doug Geisler				
ITEM	Total/	Partial/	Insufficient/	Internal
	Good	Regular	Deficient	use
Degree of adoption of suggestions from the last				
report *				
Accomplishment of objectives and goals of the				
reported program	Х			
Quantity of reached outcomes related to proposal				
objectives and goals	Х			
Quality of reached outcomes related to proposal				
objectives and goals	Х			
Degree of integration with other ongoing programs of				
the Center	Х			
Diffusion of the results				
	Х			

• If there had been none, please disregard this question

Comments: Center members from all three institution contribute to this research program. This program is complementary to research area 1, since the stellar populations in the Milky Way and in local galaxies, reflect the processes involved in their formation. Indeed, both topics share data obtained from one of the four FONDAP key projects. An important focus of this program has been on the globular cluster systems of the Milky Way and nearby galaxies, studying their dynamics and ages, including interesting work on multiple populations. This program has also been extremely productive, with nearly 40 publications in refereed journals during this past year.

PROGRAM'S NAME				
The extragalactic distance scale				
PRINCIPAL INVESTIGATOR				
Wolfgang Gieren				
ITEM	Total/	Partial/	Insufficient/	Internal
	Good	Regular	Deficient	use
Degree of adoption of suggestions from the last				
report *				
Accomplishment of objectives and goals of the				
reported program	Х			
Quantity of reached outcomes related to proposal				
objectives and goals	Х			
Quality of reached outcomes related to proposal				
objectives and goals	Х			
Degree of integration with other ongoing programs of				
the Center	Х			
Diffusion of the results				
	Х			

Comments: The Araucaria Project, a FONDAP key project (also has ESO Large Program status), is the primary activity of this research program. This program is providing improved distance calibration for the Cepheid and RR Lyrae variable stars, as well as the calibration of other methods of distance determination. The group is now applying these methods to supernova-containing galaxies – this will help calibrate the supernovae as standard candles that ties in well with the studies of research program 6. A relatively new approach is the use of eclipsing binaries for distance determination, and this has the exciting prospect of deriving distances to the LMC and SMC to an accuracy of 1%. The is a focused program undertaking fundamental studies that are essential for anchoring the distance scale of the universe.

PROGRAM'S NAME				
Star Formation				
PRINCIPAL INVESTIGATOR				
Guido Garay				
ITEM	Total/ Good	Partial/ Regular	Insufficient/ Deficient	Internal use
Degree of adoption of suggestions from the last report *				
Accomplishment of objectives and goals of the reported program	Х			
Quantity of reached outcomes related to proposal objectives and goals	Х			
Quality of reached outcomes related to proposal objectives and goals	Х			
Degree of integration with other ongoing programs of the Center		X		
Diffusion of the results	Х			

Comments: This program is led by researchers at the Universidad de Chile. ATLASGAL survey on APEX is a dust continuum survey of the galactic plane at 870 microns being carried out by this group in collaboration with MGP and ESO. ATLASGAL is also one of the four FONDAP key projects. The focus of much the research for this program has been the study of massive star formation in the Milky Way, however the report could provide more specifics on the aspects of star formation they are trying to address. A summary of the important questions in this field would be valuable. The future excitement for this field is the arrival of ALMA by around 2012, which will revolutionize the capabilities in sensitivity and angular resolution to probe star forming regions in the galaxy. The group anticipates using ALMA to follow-up on ATLASGAL. This research program has the most to be gained from ALMA, and the group should now be crafting the questions concerning massive star formation that they want to address and then defining the surveys to be undertaken with ALMA. The group was productive this past year, producing ~15 publications in refereed journals.

PROGRAM'S NAME				
Extrasolar Planets and Brown Dwarfs				
PRINCIPAL INVESTIGATOR				
Dante Minniti				
ITEM	Total/	Partial/	Insufficient/	Internal
	Good	Regular	Deficient	use
Degree of adoption of suggestions from the last				
report *				
Accomplishment of objectives and goals of the				
reported program	Х			
Quantity of reached outcomes related to proposal				
objectives and goals	Х			
Quality of reached outcomes related to proposal				
objectives and goals	Х			
Degree of integration with other ongoing programs of				
the Center		Х		
Diffusion of the results				
	Х			

Comments: This research area has made much progress in recent years. The group is pursuing a variety of techniques, including radial velocity studies (Magellan Planet Search Program), transit time monitoring, and microlensing, to study exoplanets and brown dwarf stars. The group had a productive year, with of ~15 publications in refereed journals. The group is also involved with the installation of the HAT-South station in Chile, part of network of telescopes to monitor transit events. The report summarizes many discoveries and measurements made by this group, however I had a difficult time understanding what the "big picture" is for this research area. With numerous exoplanets and brown dwarf stars now detected, it would seem that we are past the discovery mode. It would have be useful for the group to summarize what the important questions are in this field and how the research they are doing addresses these important questions.

PROGRAM'S NAME Supernova and dark energy				
PRINCIPAL INVESTIGATOR				
José Maza				
ITEM	Total/	Partial/	Insufficient/	Internal
	Good	Regular	Deficient	use
Degree of adoption of suggestions from the last report *				
Accomplishment of objectives and goals of the				
reported program	Х			
Quantity of reached outcomes related to proposal				
objectives and goals	Х			
Quality of reached outcomes related to proposal				
objectives and goals	Х			
Degree of integration with other ongoing programs of				
the Center	Х			
Diffusion of the results				
	Х			

Comments: This is the newest of the Center's research programs and one that has close ties to program 2. The program is focusing on the detection and characterization of local supernovae. Using the PROMPT robotic telescope the group detected 36 nearby supernovae this past year and obtained, in collaboration with the Carnegie Supernova Program, follow-up photometry and spectroscopy of most of these newly discovered supernovae. These results will be used to refine the calibration of supernovae for distance determinations. I assume that the group is working closely with area 2 researchers, however this was not mentioned. The group is also modeling the physics of supernovae using hydrodynamic simulations. This relatively new program had a productive year with ~14 papers in refereed journals.

IV. CENTER EVALUATION

ITEM	Total/	Partial/	Insufficient/	Uso
	Good	Regular	Deficient	Interno
Degree of adoption of suggestions from the last				
report *	Х			
Accomplishment of objectives and goals of the Center				
	Х			
Quantity of reached outcomes related to proposal				
objectives and goals	Х			
Quality of reached outcomes related to proposal				
objectives and goals	Х			
Degree of integration between the programs of the				
Center		Х		
Creation and reinforcement of international networks				
	Х			
Outreach				
	Х			
Diffusion of results				
	Х			
Establishment and tasks of the Advisory Committee				
	Х			



EVALUATION CONCEPTS ANNUAL REPORT

1. **Approve:** The reviewer recommends to accept the report in its present form since he/she considers objectives and goals fully accomplished and all relevant issues covered by the report.

2. Approval with suggestions or minor observations

2.1 *Minor observations*: The reviewer recommends the approval of the report despite the justified incompleteness of some aspects that does not constitute an obstacle for the continuity of the Center activities.

2.2 *Suggestions*: The reviewer recommends minor changes in order to improve the future performance of the Center.

3. Additional information: The reviewer requires additional documentation or specific explanations to fully evaluate the report.

4. **Pending:** The reviewer makes significant observations to the report and conditions its approval to the accomplishment of specific demands.

5. Reject: The reviewer has strong objections to the contents of the report.

EVALUATION COMMENTS:

The FONDAP Centro de Astrofisica has been extremely successful in its first eight years in expanding the number of researchers, increasing the international visibility and reputation of Chilean astronomy, educating and training the next generations of astronomers, strengthening public outreach and creating career opportunities for Chilean astronomers. Past reviewers have made a number of recommendations, and I am pleased to see that the report now addresses these recommendations. I am also pleased to see that the Center has followed most of these recommendations.

The Center has completed another very successful and productive year. The Center continues to produce substantial and important publications in the world's leading astronomical journals. The 132 publications this year is a significant accomplishment and exceed past years. The key projects have been an important part of this success and important in building collaborative science between the three institutions that are part of the Center.

The Center has continued to play an important role in developing human resources in Chile. The number of researchers that are part of the Center has steadily grown, surpassing earlier goals. The Center has grown to include 34 researchers, including two outstanding new additions. Even more impressive gains have been made in student training. Chile's three institutions with active graduate training now have 40 Ph.D. students. The annual report noted that most of these students have benefited from the Center for by enabling funding for observing trips or to attend international meeting. Also many of the students are directly involved in the Key Projects. International collaborations continue to expand and I am pleased to see a continuation of workshops sponsored by the Center. Three workshops were held last year, with activities related to research programs 1, 4 and 5.

The technology initiative appears to be off to a good start with funding under CATA. I believe that the directions selected by the Center are well chosen. Building ALMA Band 1 receivers will expand the frequency coverage and capabilities of ALMA and are a great opportunity for student training in both astronomy and electrical engineering in Chile. Band 1 is at relatively low frequency, and thus has direct applications to commercial communications. Band 5 receivers are more complicated, and would be prudent to start with Band 1 receivers before embarking on Band 5. It would be desirable to receive a report on the progress of these technology directions. High performance computing has become an essential element not only in astronomy but in most other sciences. I think this is an important direction for the Center and has potential for synergy with other sciences and in the development of computational infrastructure in Chile. Again an update of the progress in this area would be useful.

The importance of an external Advisory Committee cannot be overstated. I am glad to see that the Advisory Committee met and I found it useful to have their recommendations included in the report. One recommendation of the Advisory Committee that I want to echo is that concerning plans for ALMA. Although the Center is developing a plan for the ALMA-era, I agree with the Advisory Committee that this needs a more concentrated effort. The Center should also take the Advisory Committee's recommendation for developing a regional ALMA center seriously. This is a good way ensure that Chilean astronomers get the most from this major international project. I have suggested in the past that training on current millimeter/submillimeter interferometers would be an ideal way to get prepared for the ALMA era.

Communication is important and has been stressed in past reviews. I glad to see that there are regular research area meetings and that the Center organizes bi-annual meeting attended by everyone, including students. The annual report clarifies the role of the Research Committee and Graduate Studies Committee, and it is very good to see that they meet several times each year.

I am also encouraged to see that the Center is in the process of discussing new Key Projects for the next decade. The four key projects have been extremely successful in bringing together Chilean astronomers, in building collaborations with European and US astronomers and in making more effective use of the observing resources available in Chile. Future Key Projects can build stronger connections between the various research areas and Center members and also utilize many of the new facilities available in Chile. With ALMA operations only years away, some of these key projects must be focussed on ALMA science. ALMA provides enormous opportunities to all of the research areas, but is particularly important for research programs 1 and 4.

The Center has also been active in outreach. Improvements of the Center's website includes an update of the site for children and the addition of astronomy information in Spanish. Although most of the researchers would prefer learning about events by email, having a webpage helps advertise these events to those outside of the Center. I also urge that the website be maintained in both Spanish and English, the English version is important to advertise the Center's activities to the international astronomical community. Center members have also prepared and published astronomy books suitable for both high school students and for the general public – this is an important contribution to education. Finally the Center has continued with public talks and was active in the International Year of Astronomy.

An area that needs some attention by the Center is the lack of graduate student authorship on publications. I previously noted how important it is to encourage student participation in research early in their graduate training. Although last year there was an increase in student authorship, this year graduate students are authors on only 21 of the 132 publications. The fraction of student authorship has gone down. I hope one of the Center's goals is to increase the graduate student participation in refereed publications. It is extremely rare for papers from European or US groups not to have graduate students involved. Hopefully, in future years we will see the participation of graduate students rise in Center publications.

Overall, I am extremely pleased to see the advances in so many areas of the Center over the past year. Many of the minor concerns raised in past reviews have been addressed. I believe that the Center for Astrophysics is a force in transforming Chilean Astronomy. The Center has achieved all of the goals that it originally set out and more. The development of human resources over the eight years has been stunning. The Center has now added technology endeavors that will will both enhance the Center and the general technological development of Chile. The Center has been extremely successful, and I hope that it can continue as a FONDAP Center for a second decade.





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EVALUATION REPORT CENTERS FOR ADVANCED RESEARCH

I. PROJECT INF	TORMATION
CENTER'S NAM	E Center for Astrophysics
DIRECTOR	Guido Garay

II. EVALUATION PANEL			
NAME	ORGANIZATION/ INSTITUTION	E-MAIL	SIGNATURE
REVIEWER 2			

III. PROGRAMS EVALUATION (please fill up as many forms as programs exist within the Center)

PROGRAM'S NAME Area 1. Birth and evolution of structures in the universe

PRINCIPAL INVESTIGATOR Leopoldo Infante

ITEM	Total/ Good	Partial/ Regular	Insufficient/ Deficient	Internal use
Degree of adoption of suggestions from the last report *				
Accomplishment of objectives and goals of the reported program	X			
Quantity of the results reached regarding the objectives and goals	X			
Quality of reached outcomes related to proposal objectives and goals	X			
Degree of integration with other ongoing programs of the Center		x		
Diffusion of the results	X			

Comments: This is the most important part of the Center both for the number of researchers and of students. It is very productive in publications and it is engaged in many important international collaborations and projects. The field of surveys is especially strong and contributes much to the visibility of Chilean astronomy. It includes one of the FONDAP key projects. The major new developments are the first results from the ALHAMBRA survey and a strong involvement in ACT and lensed submillimeter galaxies. This is a promising field in the prospects of key projects with ALMA. A better link with Herschel southern surveys could be useful for this purpose. There are lively regular internal meetings in this area. One of the last international workshops organized by members of the Center was in this area.

PROGRAM'S NAME Area 2 Stellar Populations in the Local Universe

PRINCIPAL INVESTIGATOR Doug Geisler

ITEM	Total/	Partial/	Insufficient/	Internal
	Good	Regular	Deficient	use
Degree of adoption of suggestions from the last report *				
Accomplishment of objectives and goals of the reported program	X			
Quantity of the results reached regarding the objectives and goals	X			
Quality of reached outcomes related to proposal objectives and goals	X			
Degree of integration with other ongoing programs of the Center		X		
Diffusion of the results	X			

Comments: This is a field very successful and very productive in publication number. The three fields of globular clusters, nearby galaxies and stellar populations in the Milky Way are strong. It would be important to think of a strong link with GAIA and its ground follow-up. The relative lack of graduate students is probably due to local conditions.

PROGRAM'S NAME Area 3 The Extragalactic Distance Scale.

PRINCIPAL INVESTIGATOR Wolfgang Gieren

ITEM	Total/ Good	Partial/ Regular	Insufficient/ Deficient	Internal use
Degree of adoption of suggestions from the last report *				
Accomplishment of objectives and goals of the reported program	X			
Quantity of the results reached regarding the objectives and goals	X			
Quality of reached outcomes related to proposal objectives and goals	X			
Degree of integration with other ongoing programs of the Center		x		
Diffusion of the results	X			

Comments: This is a very focused and well organized field, which allows this very active team to have a good international leadership. They are very successfully developing the FONDAP key project Araucaria, for improving the distance scale with stellar distance indicators in nearby galaxies.

PROGRAM'S NAME Area 4: Star Formation

PRINCIPAL INVESTIGATOR Guido Garay

ITEM	Total/ Good	Partial/ Regular	Insufficient/ Deficient	Internal use
Degree of adoption of suggestions from the last report *				
Accomplishment of objectives and goals of the reported program	X			
Quantity of the results reached regarding the objectives and goals	X			
Quality of reached outcomes related to proposal objectives and goals	X			
Degree of integration with other ongoing programs of the Center		x		
Diffusion of the results	X			

Comments: This field has again displayed a good activity in the last year. It is well implied in APEX and especially in its sub-millimeter survey of the Galactic disk, ATLASGAL and its follow-up. ATLASGAL is also a FONDAP key project tied to an ESO large program. The field of star formation will be blooming with ALMA. Chilean astronomy should have the ambition to lead key projects there. The workshop organized on "Star Formation: the pre-ALMA stage" goes in this direction. This move should be amplified, building on the breakthrough brought by Herschel in this field.

PROGRAM'S NAME Area 5: Extrasolar Planets and Brown Dwarfs

PRINCIPAL INVESTIGATOR Dante Minniti

ITEM	Total/ Good	Partial/ Regular	Insufficient/ Deficient	Internal use
Degree of adoption of suggestions from the last report *				
Accomplishment of objectives and goals of the reported program	X			
Quantity of the results reached regarding the objectives and goals	X			
Quality of reached outcomes related to proposal objectives and goals	X			
Degree of integration with other ongoing programs of the Center	X			
Diffusion of the results	X			

Comments: This still young field has reached an important rate of publications. It seems especially attractive for students. Members are participating in various international projects successful in discovering and analyzing new exo-planets. It also benefits from a FONDAP key project (ESO Large Programme). A workshop was organized by this group on astrobiology.

PROGRAM'S NAME Area 6: Supernova and dark energy

PRINCIPAL INVESTIGATOR Jose Maza

ITEM	Total/ Good	Partial/ Regular	Insufficient/ Deficient	Internal use
Degree of adoption of suggestions from the last report *				
Accomplishment of objectives and goals of the reported program	X			
Quantity of the results reached regarding the objectives and goals	X			
Quality of reached outcomes related to proposal objectives and goals	X			
Degree of integration with other ongoing programs of the Center	X			
Diffusion of the results	X			

Comments: This is the last established area. Although it is very productive in publications, it seems to still lack PhD students. It develops a considerable activity in international projects with telescopes in Chili, for discovering supernovae and obtaining follow-up data about them. This work is interestingly extended to detailed theoretical analysis and modeling of exotic or outstanding objects, including hypernovae.

IV. CENTER EVALUATION

ITEM	Total/	Partial/	Insufficient/	Uso
	Good	Regular	Deficient	Interno
Degree of adoption of suggestions from the last report *				
Accomplishment of objectives and goals of the Center	X			
Quantity of reached outcomes related to proposal	х			
objectives and goals				
Quality of reached outcomes related to proposal	Х			
objectives and goals				
Degree of integration between the programs of the		Х		
Center				
Creation and reinforcement of international networks	X			
Outreach	v			
	А			
Diffusion of results	X			
Establishment and tasks of the Advisory Committee		x		



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2.2 *Suggestions*: The reviewer recommends minor changes in order to improve the future performance of the Center.

3. Additional information: The reviewer requires additional documentation or specific explanations to fully evaluate the report.

4. **Pending:** The reviewer makes significant observations to the report and conditions its approval to the accomplishment of specific demands.

5. Reject: The reviewer has strong objections to the contents of the report.

EVALUATION COMMENTS:

Altogether the Center continues to be an outstanding success, keeping more and more Chilean astronomy as an important actor in the world astronomy. The number of researchers has steadily increased since its foundation. With 34 researchers it can actively pursue research in six major areas including exo-planets, star formation, stellar populations, galaxies and observational cosmology. The number of (ISI) papers has significantly increased last year with 132 papers instead of 112-113 the two previous years.

The Center is more and more succeeding in its basic objective of bringing scientists from the three Chilean institutions to work together, particularly in large collaborative projects. It is good to have detailed information in the annual report about the level of communication inside the Center and various meetings bringing together members of the different institutes. However, it is normal that much effort should be continued for the purpose of increasing these interactions. Some effort should be extended to all other centers of Chilean astronomy, since it is clear that the large support given by CONICYT to the Center should be the core of the development of the whole Chilean astronomy.

For this purpose, the Center is especially successful with the formation of graduate students for the whole Chilean astronomy. Their number has amazingly increased since its foundation, to reach 40 PhD students in 2009. However, despite the effects expected from such a steep gradient, the distribution of students among the different areas could be improved, and it is surprising that only four students obtained their Ph.D. degree during 2009.

Four FONDAP Key Projects have been implemented to foster multi-institutional collaborations within the country and abroad. They have been granted considerable amounts of observing time in several telescopes at the International Observatories in Chile. These programs seem pretty successful. However it was not the topic of the annual report to give a detailed account of their results. It is rightly said that the definition and the success of new key projects for the next decade will be essential for the future of the Center. It will be important that the next annual report give details about their choice both for the quoted ALMA science and the other topics.

It is absolutely normal that such key projects are based on the outstanding strength of ground astronomy in Chilean Observatories. However, a significant added value could be gained by a stronger connection with unique space observatories such as Chandra, XMM, Herschel, GAIA, JWST, and the future space missions for dark energy and exoplanets, etc. Such space data are obviously central in many of the areas of the Center. The Chilean astronomers should be in good position for exploiting these data in the

frame of joint projects for ground follow-up.

I fully share the detailed appraisal by Mitchell Begelman in his last year evaluation report and the very positive opinion of the International Advisory Committee (IAC) about the rapid development of key technology areas under CATA, that IAC quotes as *'the most noteworthy accomplishment during 2009'*. However, these 2009 achievements could have been more detailed in the present report itself.

I also subscribe to IAC's recommendation 'that a more concentrated effort should be made on preparations for ALMA. In particular the opening of a Chilean ALMA Regional Center for support of ALMA project preparations and data analysis should be seriously considered'.

As quoted in previous reports, the research part of the web site should be improved. I have been unable to find a Spanish version fully updated since 2007 and any English version. This should be an essential tool for the international visibility of Chilean astronomy and of the very large support granted by CONICYT.

I have appreciated the information provided about the meetings of the Research Committee and the Graduate Studies Committee. However, it would still be better to append the proceedings of these meetings to the report or make them available on the web, since this could be a precious source of information about the real life of the Center.

I have also much appreciated the two pages describing the numerous outreach activities, especially in the frame of the International Year of Astronomy in 2009.