

	NATIONAL FUND FOR SCIENCE AND TECHNOLOGY
RE	CHILE NARDA MORIN 551, PROVIDENCI
	3 0 NOV 2006
HOR	DATE
ORIO	A:

NATIONAL PROGRAM FOR ADVANCE RESEARCH CENTERS (FONDAP)

CONTINUITY PLAN EVALUATION REPORT

This form is intended to facilitate your work as a referee and standardize the evaluation reports. Each topic is expected to be evaluated with concepts ranging from outstanding to poor and detailed technical comments supporting your views on the proposal and the site visit. If the proposal or the site visit do not contain information on the given topic, please indicate so in your evaluation.

Your final overall comments and recommendations are an important part of the review process.

I. PROJECT INFORMATION

CENTER'S NAME: Center for Astrophysics

DIRECTOR: Guido Garay

II. EVALUATION PANEL				
REFEREE NAME	ORGANIZATION/ INSTITUTION	E - MAIL	SIGNATURE	
Dr. Danielle Alloin	CNRS and CEA / Saclay	danielle.alloin@cea.fr	L	
Dr. Alain Omont	IAP, Paris	omont@iap.fr	1	
Dr. Ronald Snell	Univ. Of Massachusetts	snell@astro.umass.edu	Kan	

III. PROPOSAL EVALUATION

1.- Goals and objectives for the next five-year period

i.- Comments

The overarching goal of the Center for Astrophysics is to transform Chilean astronomy from one of individual research efforts to one of a coordinated and collaborative endeavor in science and education. To accomplish this, the Center is promoting six research areas that relate to the origin and evolution of celestial objects and developing human resources within astronomy. The research areas have evolved since the original Center proposal, some new directions have been added and some of the continuing areas modified. Comments on the individual research projects are presented later in our evaluation. These six research areas make good use of observational facilities available to Chilean astronomers, build on the expertise present in the Center and will increase the international visibility of Chilean astronomy. The Center has also recognized the opportunities that will be afforded with the completion of ALMA, and have begun to consider how to incorporate this facility in these key research areas. The Center has chosen to focus on large surveys, which have in the past been effective in fostering both national and international collaborations. The Center has also been instrumental in promoting the growth of faculty positions within the three institutions.

The Center plans to continue to play an important role in education and training of the new generation of astronomers in Chile. During the past five years, the Center has been extremely successful in increasing the number of graduate students and postdoctoral fellows involved in Center research. FONDAP support for these students and postdocs are essential for their participation. The graduate programs at the three institutions have reached a mature size, and in the coming five years only modest increases in these numbers are planned. The Center is continuing the successful series of Advanced Schools and workshops that have been important for training students and postdoctoral fellows. The Center has started attracting students from abroad, particularly students from other Latin American countries. We believe these plans for developing human resources have been very successful over the past five years and are the correct directions for the Center in the coming five years. In addition, the Center has an active outreach program, which will help educate the public about the important contributions of Chilean astronomers as well as to excite and encourage young Chileans to consider studies in science and technological related fields.

The Center has also played a pivotal role in bringing together the researchers at the three participating institutions and in unifying the Chilean astronomical community. The plans for the Center will allow for continued cooperation within Chile, strengthen the existing ties to the international astronomical community and build connections to other Latin-American countries. The Center has plans to develop a National Data Center, which will be an important resource for all Chilean astronomers. Overall, we believe that the goals presented in the Center's continuity plan are well conceived and appropriate in the context of Chilean astronomy.

ii.- Evaluation

Outstanding

Very Good





Good

Poor

Outstanding

2.- Expected educational impact of the center in the short and long term. Please analyze the Center strategy to influence on human resources formation (PhD students and postdoctoral fellows).

i.- Comments

Each of the three institutions participating in the FONDAP Center has developed a training path in astrophysics for students (slightly different schemes in the three institutions). Researchers in the three institutions of the FONDAP Center are supervising PhD and Master students. Graduate student training will be strengthened by developing an independent astronomy doctoral program at the Universidad de Concepcion (astronomy graduate programs already exist at the other two institutions), broadening the teaching of astronomy into new disciplines (particularly in the area of theory), and by developing programs in radio astronomy instrumentation.

The research environment for PhD preparation appears appropriate in the three institutions. The students we met gave positive feedback on the support they receive from the FONDAP Center in terms of travel grants for attending Schools or Workshop and for performing observing runs at the international observatories in Chile. They expressed the need for some specific training: how to write a research paper, an application for telescope time...

One feature of the FONDAP Center poses a difficulty for PhD students: the one-year limited support in PhD preparation does not match the five years of coursework and research necessary for the achievement of a PhD.

We noticed that only a few publications (in the list available at the time of the evaluation) include students in their author list. In times of high competition in the job market, this might penalize Chilean applicants. Therefore we recommend that students be encouraged to contribute to papers quite early in their research training and that their supervisors keep this in mind. We note that during our visit updated information was provided that suggests that student participation in publications is increasing.

Few postdocs are funded on FONDAP funds (the percentage of the personnel budget which goes to postdocs is guite low, 7.7%). Two reasons have been given for this situation: (a) postdoc positions in Chile are available through other channels (support-funds from the various international observatories in Chile, such as ESO, GEMINI, ALMA..., and inter-university agreements) and (b) the ceiling set by FONDAP for a postdoc support makes FONDAP postdocs unattractive. Attention should be paid to try to make postdoc salaries uniform within and across the Center institutions.

ii.- Evaluation

Outstanding	Very Good	Good	Poor

Very Good

Very Good

Good

Poor

3.- Initiatives that would be undertaken by the Center related to scientific and technological innovation and its applications to the development of the country. Please analyze the Center strategy to get involved with problems to the development of the country.

i.- Comments

One of the major new undertakings of the Center is the development of radioastronomical instrumentation. The Center will help create a millimeter wavelength laboratory at the Universidad de Chile and promote the growth of a radioastronomical instrumentation facility at the Universidad de Concepcion. Both of these projects are being carried out in conjunction with their respective engineering programs and both will provide excellent training for the coming generations of young astronomers and engineers in state-of-the-art instrumentation, and in particular microwave engineering. The technology behind the astronomical instrumentation has potential for many spin-offs. These programs will have an immediate impact by providing the much-needed trained engineering staff for the ALMA project. In the longer term, students trained in this area may help develop microwave communications innovation in Chile. This is a rapidly growing field, and one that has much potential.

In addition, Pontificia Universidad Catolica will be creating a National Data Center to handle the large amounts of data that will be generated by the large surveys being undertaken through the Center key projects. This will require the development of data base and data analysis products. This effort will be undertaken jointly with the engineering program. This program will provide good training for students in this very important area of information technology.

ii.- Evaluation



Outstanding

Very Good



Very Good

Good



Poor

4.- Main goal changes since the first proposal of the Center and their effects in the plan for the following period.

i.- Comments

The goals set forth in the continuity plan are very similar to the goals in the original Center proposal. Although the overall goals are similar, the Center has added several additional elements. The most significant new plans are to develop radioastronomical instrumentation and a National Data Center. We believe that the development of radioastronomical instrumentation has potential for future technology innovation and is well aligned with the needs of ALMA. Since the Center has placed an emphasis on science with large surveys, a Data Center is critical for dealing with the data generated. The Data Center will be an important resource for the Center and for Chilean astronomers at institutions across Chile. We believe that the goals set forth in the continuity plan are appropriate for the Center and the new elements worthwhile.

ii.- Evaluation











Very Good

Good

Poor

Too few changes to need an evaluation

5.- Research lines of the Center, including their feasibility and updating validity.

i.- Comments

The research program is organized around key projects that have teamed members from the three institutions with international partners. After the success of the first 5-year period, the proposed key projects have been slightly reorganized for the second phase in six research areas, with very balanced leadership between the three institutions (2 PI in each of them). One of the key projects, whose topic is new, is described in the next section.

Area 1: Birth and evolution of structures in the universe (PI: Dr. Leopoldo Infante)

A major achievement in this field in the first phase has been the MUSYC survey organized with the Yale group. It has produced important results on structure evolution at redshift of 3, and allowed a number of various projects, including active galactic nuclei physics, by the team members. The acquired experience allows the Chilean astronomy to be now an important player in the new generation of cosmological surveys.

Being the PI of a major survey with the new ESO/VST telescope allows the FONDAP team to lead with Princeton the search for the detection of the integrated Sachs-Wolfe cosmological effect and its implication for the equation of state of the Universe. It also provides the opportunity to tie collaborations with other international cosmological surveys for various purposes. Such surveys will generate a lot of important results and follow-up observation programs, which will feed an intense activity of the different members of the group (from the institutions), and give FONDAP a very good visibility in worldwide cosmological studies.

Other projects will build up on the results of the first phase with MUSYC and other surveys, for follow-up observations. Those on gravitational lensing by clusters of galaxies are particularly promising.

Area 2: Stellar Populations in the Local Universe (PI: Dr. Douglas Geissler)

This area is closely complementary of the previous one since the local universe keeps many traces of cosmological processes in the formation of its structures (galaxies, including the Milky Way, and clusters of galaxies). Indeed, both topics were parts of the same key project at the beginning of the Center. Considering the large number of people involved and the various projects, it was correctly decided to split this broad topic into two different key projects.

A major effort in Area 2, which was very successful in the first 5-year phase, is devoted to studying globular clusters in early-type galaxies in nearby groups and clusters of galaxies. Their dynamics and stellar populations directly trace the distribution of dark matter in the halos and provide information about the processes of formation of these structures in the young Universe.

Other projects similarly test the formation mechanisms of the Milky Way and other nearest galaxies, including the Magellanic Clouds, through the dynamics of dwarf satellites of the Milky Way, and various studies of stellar populations and element abundances. A group at the Center is in particular leading the international team of the future public infrared survey with VISTA, VVV, which will observe the entire Galactic bulge and central disk.

The Center group is making important contributions in this field, and the prospects are extremely promising for the new 5-year phase.

Area 3: Extragalactic Distance Scale (PI: Dr. Wolfgang Gieren)

This topic was a great success during the first phase, in particular the *Araucaria Project*, which was a ESO *Large Programme*. The first 5 years were mainly devoted to devising and structuring the project, collecting a huge database, developing accurate pipelines for data reduction and analysis, making important discoveries of distance indicator populations in the target galaxies, and optimizing several of the techniques for distance determination.

The obvious high priority work during the second phase is to capitalize on the data and the results of the first phase to fully realize the initial science goals, and in particular to precisely calibrate the metallicity dependence of the most important stellar distance indicators and comparing them, including Cepheids, RR Lyrae stars, blue supergiants, and red clump stars. The various steps, including an improved fiducial Period-Luminosity relation for LMC Cepheids, will lead to a re-determination of the distances to the Cepheid host galaxies from the *HST Key Project* by Freedman et al., and finally to a new determination of the Hubble constant.

This group is clearly now leading the continuation of the work on this essential topic of precision cosmology, combining forefront observations with detailed modelling.

Area 4: Star formation (PI: Dr. Guido Garay)

The main prospect in this field is the arrival of ALMA by 2012, which will revolutionize the capabilities in sensitivity and angular resolution for probing the different stages of star formation. The main goal in the present phase is to prepare for ALMA large programs on star formation with the available instruments. In particular, the program will focus on the formation of massive stars with the ASTE and APEX telescopes.

Such projects will build on the experience of the group in massive dense cores and in CO and dust studies of the Magellanic Clouds. A key to this program for the present period will be a large survey of the dust continuum emission at 850 microns in the Galactic disk. Center members play an important role in the ATLASGAL team led by MPG astronomers to survey the whole Galactic plane using the LABOCA camera on APEX.

The programs in this field will reach their full promise with the availability of ALMA. The present period is essential for their preparation, and the group should be in good position to play an important role. However, such a preparation should be more focussed, including the definition of other organized programs with APEX and ASTE, in particular on the Magellanic Clouds, and training with current mm/submm interferometers such as IRAM, CARMA and SMA, and the coordinated use of space results from *Spitzer* and *Herschel*. This is an area with enormous potential, but the group needs to carefully define the surveys that they wish to undertake with ALMA. Additional collaboration with international groups might be beneficial for the program.

Area 5: Brown dwarfs and planetary system studies. (PI: Dr. Dante Minniti)

During the first 5-year phase of the Center, the "Extrasolar Planets" group took momentum while Center members were organizing the First Advanced School on Astrophysics, which allowed them to make key contacts. An ambitious legacy project to search and characterize Hot Jupiters was soon started. The

culmination is the recently approved ESO Large Programme to search and characterize the OGLE transiting planetary candidates, in collaboration with the Swiss group.

The full exploitation of this large programme is now the main goal for the second phase. It is expected to produce a considerable number of newly discovered objects for which the main physical parameters will be accurately determined. This will allow the group to test specific planetary models of atmospheres, of internal structure, and of evolution, and will generate various follow-up projects., in particular with perfecting new techniques to measure exo-planetary atmospheres and proto-planetary disks.

Another major initiative is the VISTA Variables in the Via Lactea (VVV) infrared ESO public Survey. The newly discovered variable sources in the inner bulge and disk of the Milky Way, will include transiting planets, as well as high proper motion sources, like faint, nearby Brown Dwarfs. Much activity and follow up observations with major facilities in Chile will be needed to validate exo-planet candidates.

It is clear that this FONDAP group is gaining through the new survey a very good international visibility and will play an important role in this booming and highly competitive field.

ii.- Evaluation



Overall the research program is outstanding, however some areas are better defined and stronger than others.

6.- When applicable, new lines of research that aroused during this period and how they were considered in the present proposal.

i.- Comments

Within the rapid evolution of contemporary astrophysics and the very fast growth of the Chilean astronomy and the FONDAP Center, it is normal that after five years that there are some changes in the priority topics of the key projects, while staying within the general scientific goals of the Center. In Section 5, we already mentioned the splitting of the original key project on "birth and evolution of structures in the universe" into two new key projects on this topic in the high-z universe and the local universe, respectively; on the other hand, the research area "Quasars and Active Nuclei" has been merged with the first one (Area 1); and we also recognize the successful changes in the main methods for identifying and confirming new exo-planets.

In addition, a new key project has been initiated in "Area 6: Supernovae and dark energy (PI: Dr. José Maza)". This is an area closely connected to Areas 1, 2 and 3 about the formation and evolution of structures in the Universe and its distance scale. Solving the mystery of dark energy is maybe the most important problem in cosmology today. The decision of the Center to create such a new research area which will deal with this fundamental problem, is certainly timely and sound for various reasons including: the complementarity with Areas 1, 2 and 3 which are the main core of the Center expertise; the expertise of several Center members in supernovae observations; the current availability of a rich variety of adequate observational facilities; the importance of Chilean telescopes for providing massive follow up observations of the thousands of new supernovae to be discovered by the various major experiments currently underway or planned; and also the prospects of new major dedicated facilities planned in Chile for this purpose, especially LSST.

The choice of studying local supernovae as a first step activity for the Center in this field appears perfectly sound. The improvement of the calibration of nearby supernovae is mandatory for any progress in the field of high redshift supernovae. There is a deficit in surveying southern galaxies for new local supernovae. Such a program may start immediately with available telescopes. It is well within the expertise and the strengths of the Center. Developing such an expertise should allow Center members to take an important participation in future major dark energy studies. Of course, it is much too early to judge of the eventual impact of such a program on making progress in understanding dark energy, and even to probe its importance with respect to other programs on the precise calibration of nearby supernovae.

ii.- Evaluation



This addresses a fundamental problem in astrophysics and will be a very valuable contribution.

7.- Synergies and interactions between the members of the Center and their purpose in the Continuity Plan (not only based on publications or thesis, but also, for example, on emerging new research lines (areas) in the nearest future). Remember that the whole should be greater than the sum of work of individual researchers.

i.- Comments

Interactions between the members of the FONDAP Center during the past five years have been extremely effective at building among them a "sense of community", beyond their host-institutions.

On a larger scale, this has contributed in turn, to the emergence of a "Chilean astronomical community" and played a significant role in the onset of the Chilean astronomical society, SOCHIAS.

The frequent meetings organized in the framework of the FONDAP Center have resulted in exchanges of ideas, of points of views, and altogether in a better mutual understanding. Such a new spirit has enabled *synergies* to play an increasing role in the development of projects within the FONDAP Center and has boosted their effectiveness and results. This can be traced through various signs, all showing a positive trend from 2002 to 2006:

(a) research publications from the FONDAP Center: especially for the year 2006, there is an increasing number of collaborative papers with authors belonging to at least two (of the three) different institutions taking part in the FONDAP Center.

(b) FONDAP Schools and Workshop tend to be more often organized by a team involving FONDAP researchers from different institutions.

(c) with respect to astronomy teaching: courses proposed at one institution can be attended by students from another institution (this is of course easier to implement between the two institutions in Santiago). It brings not only a synergy in teaching but also an excellent opportunity for students to get to know each other.

(d) for outreach activities: interactions among the members of the FONDAP Center have resulted in a distribution of activities, and also some joint-ventures such as the publication (PUC Ediciones) of a series of popular astronomy books targeted at high-school students and written by authors from the three institutions.

(e) regarding the development of instrumental projects or data-related projects: discussions within the FONDAP Center have resulted in a coordination of efforts and investments in the three institutions. Complementary developments in instrumentation for radio astronomy are planned at two institutions (mm APEX-related VLBI at one and mm ALMA-related experiment at the other), while the optical/infrared window is considered/planned at the third one. A data center (data reduction, storage and mining) is being developed as a FONDAP joint facility at one of the institutions, avoiding the duplication of efforts, and will moreover be accessible to the entire Chilean astronomical community. Without the FONDAP Center, such a coordination and synergy might not have taken place so rapidly.

(f) a striking result of the interactions brought by the FONDAP center can be seen in the key-projects proposed for the second period of the FONDAP Center, 2007-2011. All of them gather FONDAP researchers from at least two different institutions and most of them from the three institutions: thanks to the FONDAP Center institutional boundaries tend to vanish away, while expertise complement each other. As a net result, the projects are strengthened, they are mostly in the top quartile of the competition, and have gained a higher visibility on the international scene. The set of key-projects proposed for the second period of the FONDAP Center reflects this evolution: they address some of the hottest topics in astrophysics today (in the fields of cosmology and extrasolar planets studies) or some of the fundamental problems of astrophysics (distance scale in the Universe, galaxy evolution, star

formation). It is also to be noticed that most of the key-projects for the new period of the FONDAP Center are presented in the framework of an international collaboration involving forefront teams in the topics.

So, interactions among the FONDAP Center members have enabled synergies to take place and raised the level of astrophysical research at the three institutions taking part in the Center, making them more attractive for young researchers, on a world-wide basis. Beyond the FONDAP Center, this is beneficial to the entire Chilean astronomical community and contributes to the quality and fame of the science performed at the International Observatories in Chile (of which the Chilean community receives 10% of the available observing time).

ii.- Evaluation



Outstanding





Very Good

Good

Poor

Outstanding

8.- Center organization net including its nearest links (companies, associated institution, other units within the same institution, etc), and international and national collaboration.

i.- Comments

The Center organization net was evaluated from documents, from the visits to two (Santiago) of the three sites (unfortunately, the visit to Concepcion could not be organized) and through the discussions with all research-contributors to the FONDAP Center (founding members, associate researchers, postdocs, PhD and Masters students).

Two internal committees, the technical committee and the research committee, assist the Director in decision-making and in operation of the Center. This seems to be adequate as it results in a smooth operation. No major problems were brought to our attention during the interviews. Regular plenary meetings of the members of the FONDAP Center are held, between two and four times a year, and this looks satisfactory.

Research brain-storming meetings, in relation with the key-projects, are also felt to be frequent enough. Researchers at all levels (senior, associates, postdocs and students) contribute to these meetings and are encouraged to give progress reports on their work and to share ideas. This is obviously a key-tool to organize research activities in each key-project, to monitor their progress, to unveil possible difficulties and find solutions, to evaluate scientific results and to plan short-term and mid-term actions.

The wish for some long-term prospect in astrophysics was expressed and would indeed be very useful to prepare the follow-up of the FONDAP Center after its first decade. An international advisory committee with three scientists has also been setup as an external insight on the Center, and could take part in the long-term prospective.

In the three institutions of the FONDAP Center, relations and even joint ventures, with other departments have been mentioned: with physics departments, with engineering departments and with computational center/departments. In order to progress rapidly enough, the planned instrumental projects (radio astronomy) and data center require that such interactions be set on to join together the necessary and existing expertise.

At a national level, the FONDAP Center, through the quality of the research it conducts, pulls Chilean astronomy in full light on the international scene and therefore acts as a catalysis in the development of astronomy groups at other institutions. This is why the future of the FONDAP Center, after its first decade, must be thought about with great care. Beyond 2011, international observatories will still be in operation in Chile and the Chilean astronomical community will receive, for free, 10% of the available observing time on first-class astronomical facilities. Such a favorable situation cannot be ignored and instead, all efforts should be made to exploit it at best for the benefit of Chilean research. The FONDAP Center, because of its privileged position within the astronomical community in Chile, also has the responsibility to encourage and support the efforts made at other institutions. The planned open access to the data center, for the entire Chilean community, goes in this direction and will probably trigger collaborations between the FONDAP Center researchers and astronomers from other institutions in Chile. Indeed, such collaborations already appear in the second generation of key-projects. The impact of the FONDAP Center at a national level is most probably on an exponential track.

The framework of international collaborations for the FONDAP Center research activities is a very

natural output of several factors:

(a) the presence of international observatories on Chilean grounds since the end of the sixties has exposed very early the Chilean astronomical community to international "science",

(b) the participation of Chilean astronomers in the various boards related with the international observatories have familiarized them with the international community,

(c) funding supports from these international observatories or from other bodies such as Fundacion Andes, the European Community, the Japanese research observatories, also channel international collaborations,

(c) a few generations of Chilean astronomers have prepared their PhDs abroad, resulting in close and lasting links with astronomy groups in universities outside Chile,

(d) the setup of inter-university agreements with major universities abroad for students training has been a further step in the collaborations,

(e) the world-wide evolution of research being performed within international teams,

(f) and finally, the choice of key-projects for the FONDAP research activities matches at best the large amount of telescope time made available to the Chilean community. This leads to the setup of international collaborations bringing together all the necessary know-how in data collection, interpretation, modeling and theoretical approach.

The key-projects of the FONDAP Center presented for the second period all involve international collaborations and have attracted collaborators from prestigious groups all over the world.

Special mention should be made about collaborations with astronomy groups in South America: it is primarily through the training of students and young researchers (organization of Schools and Workshop) that the FONDAP Center establishes links with close by countries in South America. The development of astronomy groups in institutions in Chile which are not part of the FONDAP Center, relies in part on astronomers from these countries and some of them are already collaborators in the FONDAP key-projects. So, the impact of the FONDAP Center should in the future also show up in this direction.



9.- Outreach strategy.

i.- Comments

The Center has an ambitious plan for outreach that has participation by many of the Center researchers. All three institutions have observatories that provide regular programs for the public. At Cerro Calan, a 45-cm telescope has been modified so it can be remotely operated via the internet, and this facility will be an important laboratory for schools throughout Chile to teach astronomy and physics. The Center has also developed astronomy web pages for children. Besides the continuation of the outreach programs now in place, the Center has proposed several new activities. The first is a series of modern astronomy books that will be directed to high school students. These books will be an excellent accompaniment to the laboratory provided by the internet-controlled telescope. The other new outreach activity is the plan to hire a young journalist, with experience in science writing, to create news releases that will publicize the results of Chilean astronomers and to create outreach activities for the general public. This idea has merit, as an experienced journalist will be able to convey the excitement of Chilean astronomy in non-technical terms.

Outreach is important, and astronomy is extremely well suited to get people excited about science. We believe the Center's outreach plans are well conceived and will be effective at reaching both the public and more importantly to school-age children. The books are an excellent example of the cooperation that has been achieved by the Center. It will be important for the Center to coordinate outreach activities developed within the Center (such at exhibits and power-point presentations) with researchers at all institutions.











Outstanding

Very Good

Good

Poor

10.- Economic feasibility: coherence between needs, operational costs, new positions, major equipment, traveling and per diem, among others, and proposed activities (1US \approx 550 Chilean pesos).

i.- Comments

This is an area which would require a detailed understanding of the financial structure of Chilean universities and CONICYT to review in detail, which we do not have. However, astronomy may be unique amongst the FONDAP Centers as having the major research equipment (telescope facilities) provided by the international observatories located in Chile. Therefore, the FONDAP budget can be primarily devoted to salaries of the personnel associated with the Center. The budget proposed allow continued support of the founding members, new researchers, graduate students and postdoctoral fellows, which we believe all to be important.

We recognize that there are many rules and constraints within the FONDAP program that we do not fully understand, so the following suggestions may or may not be viable. The following comments should not be considered criticism of the proposed budget, but should be considered, particularly if the Center is extended after 10 years. First we believe that the salary support provided by FONDAP should reflect the researchers contribution to the activities and life of the Center. Periodic evaluations of the contributions of researchers would then allow those individuals making the more significant contributions to receive the largest FONDAP support. We also recommend that the Center attempts to make the salaries paid to Center graduate students and postdoctoral fellows be as uniform as possible.

The following comments are directed to CONICYT/FONDAP. We heard from many researchers that the salary provided by FONDAP for postdoctoral fellows is insufficient to attract the most talented candidates. We strongly urge that the salary levels be brought to an appropriate level that would allow the Center to compete at the international level. We also believe that at least a cost-of-living increase be built into the funding of the multi-year Center grants, so the Centers do not have to chose between maintaining reasonable salaries and reducing the number of personnel that can be funded.



11.- Economic feasibility for Institutional commitment: coherence between needs, operational costs, new positions, major equipment, traveling and per diem, infrastructure, among others, and proposed activities (1US\$ \approx 550 Chilean pesos). Resources coming from other sources considering that other funds make the Center activities more consistent.

i.- Comments

During the first five years of the Center, the institutions have provided substantial infrastructure support to expand office and laboratory space at all three of the institutions connected to the Center. We visited the new facilities at the Universidad de Chile and the Universidad Catolica de Chile and were impressed. The institutions provide salary support for the investigators, new researchers and additional graduate students and postdoctoral fellows. Similar levels of support have been committed by the institutions for the coming five years. We believe that the institutions are providing excellent matching support for the Center.

ii.- Evaluation



Outstanding









Poor

Very Good

Good

Very Good

12.- Final overall comments and recommendations.

i.-Comments

The Center for Astrophysics has been extremely successful in its first five 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. The plan for the next five years continues to expand on these accomplishments. Past reviewers have made a number of recommendations, and we are pleased to see that the continuity plan has incorporated many of these suggestions. For instance, it was suggested that the Center expand into astronomical instrumentation, and coming five year plan includes the development of instrumentation at both Universidad de Chile and Universidad de Concepcion.

Previous reviews have suggested that the Center build a theory program and we believe that the investigators recognize this need and are attempting to build such a program. Another area of past concern was communications, and early in the Center's history frequent meetings of Centers members were an important aspect of establishing connections between investigators, students and postdocs at the three institutions. Today things are very different. The formation of the Society of Chilean Astronomers (SOCHIAS) provides an avenue for the entire community of Chilean astronomers to meet. Although there are still Center meetings several times per year, there are many regular meetings of Center members (including students and postdocs) focused on the different research topics. Unlike in the past, there is now the concern that there may be too many meetings.

The set of key-projects proposed for the second period of the FONDAP Center address some of the hottest topics in astrophysics today (in the fields of cosmology and extrasolar planets studies) or some of the fundamental problems of astrophysics (distance scale in the Universe, galaxy evolution, star formation). We note that most of the key-projects for the new period of the FONDAP Center are collaborations of researchers at two or more of the participating institutions and include collaboration with forefront international teams.

The Center has been important in promoting the growth of graduate education in astronomy. PhD programs are now in place at all three institutions, and there has been an enormous growth in the number and quality of student during the first period of the Center.

ii.-Recommendations:

- The development of millimeter/submillimeter astronomy instrumentation is an important new direction for the Center. It is essential that new researchers, with the proper background, are hired to lead this effort into the future. Such hires should take top priority.
- Although the Center has recognized the importance of ALMA in future science, we wish to reiterate that it is mandatory to prepare for observations with this facility well in advance of its completion. The Center needs to begin planning now for ALMA key projects to insure they have the properly trained researchers and have connections to large international collaborations.

- An Advisory committee can be extremely beneficial in providing the Center with an unbiased view of their progress and in helping prioritize their research directions. This committee appears to have only met once. The Center should hold annual advisory committee meetings and they should ensure that the committee is composed of leading researchers in similar research areas as represented by their main scientific projects. It would probably be desirable to expand the committee to 4 or 5 members to get better representation from the different subfields in astronomy.
- The Center should expand their program of visiting scientists to bring in the still missing expertise in modeling and theory.
- Improve the coordination of the PhD programs by developing shared short-courses in specialized topics, organized in joint sessions of one or two weeks.
- The Center should initiate regular brainstorming sessions to address use of new facilities that are planned for the future, such as the extremely large telescopes and the LSST.
- Although improvements have been made in the Center's web pages, more is needed. The web
 pages should be made as appealing as possible and provide information for the public and for
 other astronomers. Since the web pages provide the window of Center activities to the
 international astronomical community, these pages should be in both Spanish and English. The
 web site should provide either content or links to events and activities at each of the institutions
 (such as seminars, schools, workshops, research meetings ...).

ii.- Evaluation

Outstanding	Very Good	Good	Poor

The overall evaluation of the continuation proposal is Outstanding

AMMEB//MECR 21.11.2006

Comments for CONICyT/ FONDAP:

Given all the previous comments, we very strongly recommend the continuation of the Center for Astrophysics for the second five year period.

We believe it is important for FONDAP to decide soon on the future of these Centers. We strongly urge FONDAP to consider allowing the most successful Centers to continue beyond the 10-year limit. Independent of the decision, the Centers should know soon the outcome of this decision so they can either begin to plan for possible continuation or for the future without FONDAP support.

A minor point - it would be useful in future progress reports to require the Director of each Center to address the comments and recommendations that were made by the previous reviewers.