



ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ

**Α.ΔΙ.Π.**

ΑΡΧΗ ΔΙΑΣΦΑΛΙΣΗΣ ΠΟΙΟΤΗΤΑΣ

ΑΝΩΤΑΤΗΣ ΕΚΠΑΙΔΕΥΣΗΣ

HELLENIC REPUBLIC

**H.Q.A.A.**

HELLENIC QUALITY ASSURANCE AGENCY

FOR HIGHER EDUCATION

## **EXTERNAL EVALUATION REPORT**

UNIVERSITY OF CRETE

**DEPARTMENT OF PHYSICS**

November 2008

### **External Evaluation Committee**

The Committee responsible for the External Evaluation of the Department of Physics of the University of Crete consisted of the following five (5) expert evaluators, drawn from the Registry constituted by HQAA in accordance with Law 3374/2005:

1. Prof. Panos Razis, University of Cyprus, Cyprus (President)
2. Prof. Stavros Katsanevas, Prof. of Paris VII, IN2P3, France
3. Prof. Costas Kounnas, École Normale Supérieure, CNRS, France
4. Prof. Sokrates Pantelides, Vanderbilt University , USA
5. Prof. Emmanuel Paschos, Technical University of Dortmund, Germany

*The structure of the “Format” proposed for the External Evaluation Report is dictated by the requirements of Law 3374/2005 and corresponds generally to the structure of the Internal Evaluation Report submitted by the Department.*

## **Introduction**

- The Committee visited the Physics Department of the University of Crete between the 25<sup>th</sup> and the 26<sup>th</sup> of November 2008.
- In the morning of the 25<sup>th</sup>, we had an extensive presentation of the Department activities by its Chairman (G. Tsironis). During the interview a few key members of the Department as well as the Dean (N. Kilafis), a member of the Department himself, were present and participated in the discussion.
- Towards noon, the session was interrupted for half an hour by representatives of the University Student Association, wanting to express their opposition to the evaluation process in general. After an intense but rather civilised discussion and after stating their points, the students left and the Committee continued its deliberations.
- After lunch we met the Rector (Pallikaris) and the two Vice-Rectors (Kitsopoulos and Papamattheakis) of the University and had an hour’s discussion with them.
- We then had a brief Committee deliberation and immediately afterwards we had a rather extensive discussion with the former (I. Perakis) and present (N. Papanikolaou) Directors of the Committee on Undergraduate Studies.
- In the afternoon we had a meeting with a large group of graduate students.
- We then met with Prof E. Economou, one of the founding fathers of the Department and T. Tomaras, who gave us the point of view of the particle physics sector.
- After the day’s meeting, a few private discussions were held with various members of the Department.
- On the 26<sup>th</sup> of November, we started with a meeting with the administrative and technical staff and visited the teaching laboratories (electromagnetism, mechanics, optics) and the library.
- We then visited the FORTH (Foundation for Research and Technology-Hellas) research laboratories, connected with the Department and heard presentations by the Director of the Institute of Electronic Structure and Laser (K. Fotakis) and by Dr. I. Kominis. We had the opportunity to meet several students of the Department working in these laboratories. Before leaving FORTH, we visited the University Press Centre and had discussions with its members.
- On our return to the main Department buildings, we visited the microelectronics research laboratories, which were presented to us by their Director Prof. A. Georgakilas.

- We had again a short Committee deliberation and then met with Prof. G. Papamastorakis, who presented to us the activities of the astrophysics sector and the Skinakas Observatory and Prof. X. Zotos, who presented to us the activities of his group in the condensed matter sector.
- Finally, a meeting was arranged with undergraduate students, but given the opposition of the Student Association to the evaluation procedure, we unfortunately had the opportunity to talk with only one from them. His input was illuminating for the Committee, in particular with matters having to do with the concerns of students who would like to continue their careers in secondary education.
- We received the following documents:
  1. Internal Evaluation Report plus an annex concerning personnel and curriculum
  2. The report of the previous External Review Committee (Sep 99)
  3. The PowerPoint presentation by the chair of the Department
  4. Summary of education and research and publication record of the faculty members
  5. Statistics of the student evaluation reports of the courses offered by the Department
  6. The undergraduate prospectus and documents describing innovative methods of teaching that have been tried in the Department. We also received the report of the previous Committee on Undergraduate Studies, containing recommendations for curriculum changes
  7. Graphs concerning the age distribution of the faculty staff and the annual investment budget detailing the funding sources.
  8. A report on the history of the Plasma Physics Institute.
  9. A report on the current professional status of the Department alumni
  10. The voting report from the student union, declaring their opposition to the evaluation process
  11. Pamphlets of Skinakas Observatory and FORTH laboratories

General comments of the Committee for the methodology:

The Committee suggests that in future evaluations of this kind, the presentation of the activities of the Department should have a broader scope, including several speakers. It would be very useful if the chair of the Department starts with an overall presentation of the activities of the Department, and that this presentation is followed by the educational and research activities of each sector by one of its representatives. The presentation of the chair should have a certain number of statistical items that have to be covered (educational and research numbers, budgets, age distributions, planning elements). In this respect, the presentation of the Physics Department chair was satisfactory; some extra elements were asked and were provided immediately. The educational committees should make presentations. A presentation of the activities of the technical and administrative personnel should be also included, as well as the activities of outreach and knowledge transfer to industry and local society. Having the different sectors, committees and parts of the personnel make presentations enhances the self-awareness of the Department on its status and current planning. It also makes easier the task of the Committee, which does not have to reconstruct the image of the Department from scattered points of view. A meeting with the students and the overall institutional environment (Dean and Rector) is of course another important factor.

## ***A. Curriculum and Teaching***

### ***A1.1 Curriculum: Undergraduate***

#### APPROACH

The undergraduate curriculum is structured in accordance to other physics curricula adopted by well established universities in Europe and the USA, while at the same time taking into account national aspects. In particular, the need of the secondary education system of Greece to produce well trained physics teachers should be addressed.

The Physics curriculum, both in the past as well as the newly adopted one, is well structured and includes mandatory introductory courses, mandatory core courses, a series of elective courses to be taken from a set that covers the areas of the physics sectors of the Department and a small number of free electives chosen by the students.

The new curriculum that has been adopted by the Department, suggests that the mandatory elective physics courses are categorized in the following groups:

- i) High Energy Physics and Cosmology
- ii) Astrophysics and Space Physics
- iii) Condensed Matter Physics
- iv) Semiconductors Circuits and Electronics.
- v) Photonics,
- vi) Courses adapted to the needs of the secondary education

The Undergraduate Studies Committee, headed by its prior Director (Perakis), proposed a change in the curriculum that was not adopted by the Department, namely requiring students to adopt one of six focus areas, one of which is on the teaching of physics while the rest are research areas. In view of the fact that the curriculum is strongly focused on physics (as opposed to the US model that has a strong humanities component), the Evaluation Committee feels that the adoption of focus areas offers a major advantage: it forces the students to think more seriously about their future career. Perhaps 3-4 focus areas may be adequate. The requirements to be fulfilled in each focus area could be minimal, but the student will be able to state in his/her resume or applications for graduate students that they had a focus area. Teaching courses are not included in the second category of courses (elective); we suggested that they should include one.

All courses are well harmonized to the European standards and follow the ECTS credit system. The four years physics curriculum is credited with 240 ECTS, covering 144 ECTS for the mandatory courses, 42 ECTS for general physics directions and 54 ECTS for specialized elective courses in physics and other electives from other departments, outside physics. The new program recognizes the special needs of the majority of students, who are

inclined to careers towards secondary education, science communication and didactics (pedagogy), as well as for a more structured program in the main physics areas of the Department, thus facilitating access to the graduate program and the research directions.

The enrolments and other administrative actions related to the students files and engagement to the physics program is highly supported by an innovative electronic system provided by the Computer Center of the University. All the objectives of the undergraduate physics program were constantly being examined by the special Studies Committee of the Department for a series of years, in close collaboration with the students.

A novelty was introduced in the curriculum, “*Ennoiotriveia*”, supported by an electronic communications system. It entails an analytical presentation of necessary scientific concepts that are being discussed and scrutinized by the students, taking at the end quick and relevant decisions with electronic voting means.

Overall, the curriculum is consistent with the scientific objectives of the University and the general requirements of the society. It constitutes a dynamic process and could be revised at any point, according to the international developments and the special conditions/difficulties of the Greek society.

#### APPLICATION

We find the curriculum well organized. Although the Committee would prefer that the prerequisites are strictly enforced, we understand the student culture in Greece and consider very appropriate the effort to streamline the way courses are taken, i.e. requiring that a student can register for up to 8 courses, with mandatory registration in all the previous courses he failed.

There is a comprehensive and coherent pathway with a strong physics content, which is closer to the European continental system and slightly different from the general USA system or practice, which contains a higher percentage of elective courses (liberal arts approach).

The infrastructure of the Department is adequate, but in the Committee’s opinion needs further refurbishing to comply with international standards. One area that is lacking is demonstrations in the classrooms, which cannot be implemented, due to the lack of sufficient number of specialized technicians. The present situation, with only 2 technicians covering the needs of so many student groups in at least 5 educational laboratories, as well as other student support needs is not adequate. It should have a priority in any new recruitment policy of personnel, together with a possible solution providing stipends/fellowships to graduate students to help out with running the experimental courses.

#### RESULTS

The Committee understood that approximately 60% of the graduating students prefer to be employed in secondary education. In view of that, many of them choose some of their electives outside the Department, from the School of Humanities. This creates a problem, basically due to the geographical dispersion of the University of Crete. For example, they have to commute to Rethymnon to take classes.

The above problem can be adequately solved by recruiting at least one faculty member, in collaboration with other university departments operating in the Heraklion area, so that a critical mass is formed in the area of science education, especially at the secondary-school level.

The overall educational program of the Department contains the two most important components of any department in an internationally well respected university, the educational component and the research component. The latter component is further enhanced by the synergy with the neighbouring FORTH, as well as by the astronomical research performed at the neighbouring Skinakas Observatory. The already existing strong and fruitful collaboration with these high-caliber research centers should continue and be further enhanced. The whole faculty staff of the Physics Department is well aware of, and correctly utilizes the scientific impact arising from the above synergies.

The Committee is particularly pleased to learn that there are plans to create a new institute in “Theoretical and Computational Physics, EPI”, which will enhance the research and educational activities of the scientific community in the corresponding fields.

The Committee members feel that the whole educational program offered by the Physics Department is highly successful. However, the Committee expresses its disappointment in not being able to discuss and exchange ideas with the undergraduate student community as a whole. During this visit, the Committee met with only one undergraduate student, due to the decision of the student association of the Department to boycott the evaluation process.

#### IMPROVEMENT

A plan for recruitment of new, young faculty members should be followed by the Department. The plan should guarantee the continuity of a well functioning educational program, taking into account the retiring of a large number of faculty members and the dynamic scientific developments of our times. In addition, the Department urgently needs new positions at the level of technical assistants to cover the educational laboratory activities in physics and computing.

A significant upgrade of the infrastructure of the teaching laboratories is necessary, both in terms of computing facilities, networking, experimental equipment, as well as refurbishing the rooms themselves. After many discussions with representatives of the faculty, the Evaluation Committee is convinced that the faculty members are well aware of the need for the proposed improvements mentioned above.

Concerning the curriculum, the Committee encourages a dynamic approach, to continuously modernise the program of study according to the international scientific developments, as well as the local needs.

## ***A1.2 Curriculum: Master and Doctoral level***

### APPROACH

The University of Crete organized the first postgraduate program of Physics in Greece, in 1984. The program has been adapted according to the European standards of Bachelor, Master and Doctorate degrees. All courses are credited according to the ECTS scheme.

There are 2 Master programs, the first of 12 months duration (60 ECTS), in the area of Advanced Physics, and the second one of 18 months duration (90 ECTS), in the area of Photonics and Nanoelectronics. The programs include 5 and 8 courses, respectively, plus a Master's Thesis. Both programs offer 8 scholarships in total, with the financing originating from research projects of the faculty and/or the FORTH Institute.

The contents of the Master programs are harmonized according to the research interests of the faculty and the projects carried out in FORTH. They are of high quality, comparable to the level of Master programs offered by leading universities in the world.

The presence of FORTH, Skinakas Observatory and the other research activities in the vicinity of the Department provide a natural framework, within which the curriculum is developed. Since some of the topics are of applied nature, it automatically serves the needs of the general society, by providing technological knowledge and methods for solving several current problems of interest.

The content of all the graduate programs are continuously reviewed by the Graduate Studies Committee and is accordingly modified to fulfill the needs. The Master students are naturally entering into it through the undergraduate program and are examined with oral and written exams.

### APPLICATION AND RESULTS

The Committee discussed the graduate program with members of the faculty and 7 out of the 9 presently enrolled graduate students. All of them were happy and satisfied with the quality and structure of the program. This is also supported by the fact that 3 of the students transferred to the University of Crete from American universities (Berkeley, Delaware, Stony Brook) and one ERASMUS student from the Humboldt University in Berlin. It was delightful for the Committee members to hear that one student was informed about the quality of the graduate program through other students participating in the Summer School of the Department.

The students emphasized that the program is good but very intense and requires many hours of study. It became evident that financial support for master students is very limited and both faculty and students emphasized the need for a scholarship system. Rents, restaurants, and traveling expenses are quite high in the Heraklion area. Furthermore, it seems that Master students automatically lose their rights for free access to the University canteen. Scholarships for graduate students are a very common practice in major Universities around the world. For the University of Crete this will have the additional effect of attracting a larger number of excellent graduate students to geographically dispersed universities like Crete.

## IMPROVEMENT

A major problem in the Master program is the lack of fellowships and scholarships to support the students while attending the program offered by the Department. The Department should have the freedom that funds allocated to it be rechanneled from one category to another and accommodate the needs.

In addition, the members of the Committee noticed a considerable need for improving and upgrading the infrastructure of the Department, particularly in scientific areas where the facilities and structure of FORTH cannot cover them.

Another measure that will improve the situation would be to establish start-up funds for new faculty members in experimental physics. Such funds are available to new faculty at major universities in the US and Europe. The Department in Crete cannot hope to fulfill all its promise if it continues to be handicapped by the lack of start-up funds.

The introduction of a new laboratory at the graduate level in the curriculum would significantly help the training of young students and facilitate their decision for joining one of the experimental groups.

## ***A2.1 Teaching: Undergraduate***

### APPROACH

With respect to teaching, the members of the Physics Department use the internationally established methodology, which is a blending of lectures, problem solving sessions and practical exercises. The process is successfully supported by electronic means and by posting the educational material on the web pages of the Department.

As far as the bibliography used, the University of Crete has the privilege to have access to one of the best University Press, efficiently utilizing the translated versions of the most reputable textbooks existing in the international bibliography. All courses and laboratories are offered by members of the faculty.

Innovative approaches in teaching, such as “*Ennioitriveia*”, explained above, was recently introduced with great success.

The teaching staff-student ratio is approximately 1:20, something that needs further improvement, considering that it is at the lower part of the spectrum accepted internationally.

The collaboration between the faculty members and the students seems to be very good. Each student has an advisor w.r.t. his/her studies, although we have learned that this tool is rarely used by the students. Despite the small number of administrative staff in the Department, the distribution of all the required books is done relatively quickly. However this can be further accelerated by simplifying the procedures at the Ministry level and by adding administrative personnel.

The means available to cover the teaching program are adequate, but the Committee believes that the available hardware needs further refurbishing. An area where improvement is needed is that of demonstrations in the classrooms, which cannot be sufficiently provided, due to the lack of sufficient number of technicians. The present situation, with only 2 technicians covering so many laboratories is clearly inadequate. Recruitment of new personnel is needed, together with a possible fellowship/stipend scheme for graduate students.

With respect to the examination system, the Department uses a combination of continuous assessment, including midterms, problem solving questions, oral and written examinations and practical exercises.

### IMPLEMENTATION

The Physics Department has 31 faculty members, 2 under hiring and 4 “emeriti” professors, a number which is considered to be sufficient for the actual educational program of the Department, both at the undergraduate and graduate levels. The number of technicians (only 2) is considered totally insufficient. The electronic environment (web, network, software), supporting the teaching activities, needs much improvement as far as the connection of the

students to the internet is concerned.

The textbooks adopted for each course (4-5 different books proposed in every course) are of excellent choice and favorably compared or at the same level as other international institutions. The material covered is up to date, including recent scientific developments.

The overall educational program is in complete agreement and linked to research and teaching. This linking is enhanced by the presence in the neighbourhood of the Foundation of Technology and Research (FORTH) and Skinakas Observatory. The already existing strong and fruitful collaboration with these high caliber research centers should continue and be further enhanced.

There is a need to encourage and motivate the academic staff and especially the students, to participate in European exchange programs, such as Erasmus, in order to enhance further mobility inside the European Area of Higher Education.

The system evaluating the teaching personnel by the students is very well organized; however, like the situation in many other institutions, this does not necessarily lead to the enforcement of drastic actions, for reasons that are beyond the scope of this evaluation.

## RESULTS

In overall, the teaching methodology and procedures practiced by the Department of Physics are considered to be efficient.

Although the intake of the Department is approximately 120 students per year, only around 85 enroll in the undergraduate program, out of which about 50 graduate per year. This first phenomenon is highly connected to the nature of the entrance criteria imposed by the national examinations system, which obliges the students to sometimes select a field outside their main preferences. The second phenomenon is due to the quality of the enrolled students and the financial restrictions, considering the fact that Crete is a geographically remote university, far away from the birthplace of most students, which strongly favours Athens and Thessaloniki.

The average duration of their studies is about 6 years. Only 8% of the enrolled students succeed to graduate within 4 years. Approximately, 18% of the graduating students continue with graduate studies at the University of Crete or elsewhere.

There seem to be no discrepancies in the success/failure percentage rate in the various courses, whether introductory or advanced. Many differences in the duration for the completion of studies and the grade of the degrees are mainly justified for social reasons.

## IMPROVEMENTS

The Physics Department is actively pursuing a program of actions, aimed to promote the visibility of the Department at the national level, something which the members of the Committee find very important and complementary to the research reputation of the faculty members and the nearby research centers (FORTH, Skinakas Observatory). Such actions include advertisements across Greece for the quality of the program and the quality of the international summer schools hosted by the Department of Physics at the University of Crete.

The Evaluation Committee believes that the number of enrolled students has to remain at the same level, but the Department has to find a mechanism to improve the quality of the students. One way to achieve this is to introduce a system of fellowships for the excellent candidates. At the same time, every effort should be made to complement the existing entrance examination system at the national level, with suitable measures to attract more good students in the regional universities, as well as to do a better matching to the candidates preferences w.r.t. the available scientific fields.

## ***A2.2 Teaching: Master and Doctoral studies***

### **APPROACH**

The entrance requirements follow international practices. They consist of a transcript of grades, a curriculum vitae and letters of recommendations. The Department reviews the application and invites the good candidates to visit the campus in order to have a first hand experience with the faculty and the teaching facilities. Once they are admitted, they follow the graduate curriculum of the Department, where master and doctoral courses are integrated.

The courses follow the five scientific fields of study already mentioned in the undergraduate section of this report, but now at a more advanced level competitive with international standards. An advantage at the University of Crete is the possibility to join one of the laboratories at the institutes (FORTH, Skinakas Observatory, etc.) and start doing their independent research.

The Doctoral program is closer to the American one, by including courses and a thesis. The graduate students mature naturally in the research group of a professor, where they also try to make their own original contributions.

### **IMPLEMENTATION**

For each course there are examinations, which are either written or oral, as is described in the bulletin for graduate studies. The bulletin describes rules to be followed and the content of the course. Some of the material is available in the Internet. The courses also include problem sets and term papers. They are finally crowned by the Masters and Doctors thesis, which contain original work. This system presents the advantage of a closer collaboration between the student and the supervising professor.

For the doctoral program there is a committee consisting of 7 faculty members who follow closely the progress of the candidate and the selection of the topic for the thesis. After the completion of the work for the doctoral thesis, the students presents his research in an open seminar, in front of a committee, which subsequently examines him orally on the methodology and outcome of his research. All the doctoral theses should lead to a publication in an international refereed journal.

### **RESULTS**

The students who complete the graduate programs are of high quality. This is supported by the reputation of their corresponding supervising professors. An indicator of the good graduate work is the high quality of students they attract and excellent positions they secure after graduation. The graduates achieved permanent positions at universities, research centers and the private sector in Greece and abroad. In the Department of Physics graduated already 73 PhDs and 205 MScs.

## IMPROVEMENT

The Department strives and must be further supported to find scholarships for the students, especially for the Masters programs. The money could come from government and other sources, like private sector and research contracts of the professors or from the institutes. This is happening to an extent and should be further encouraged. One improvement would be, as mentioned elsewhere, to grant the Department greater freedom to allocate funds internally, according to the needs.

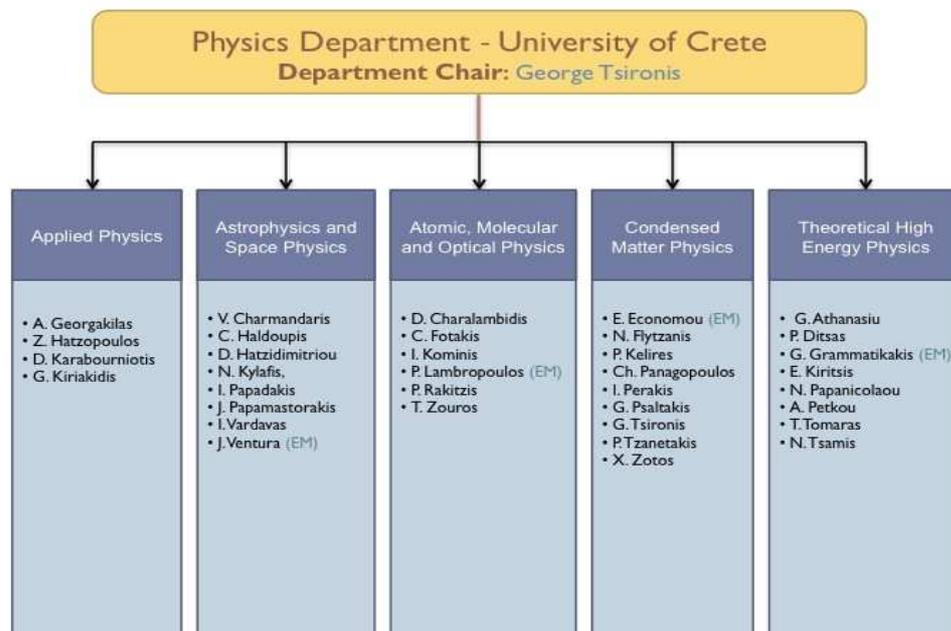
The Committee recommends the introduction of a graduate experimental course(s), where technical personnel are also needed.

## B. Research

### APPROACH

It was noted by the members of the Committee that the Physics Department of the University of Crete has the lowest number of professors who got their PhD at the same institution.

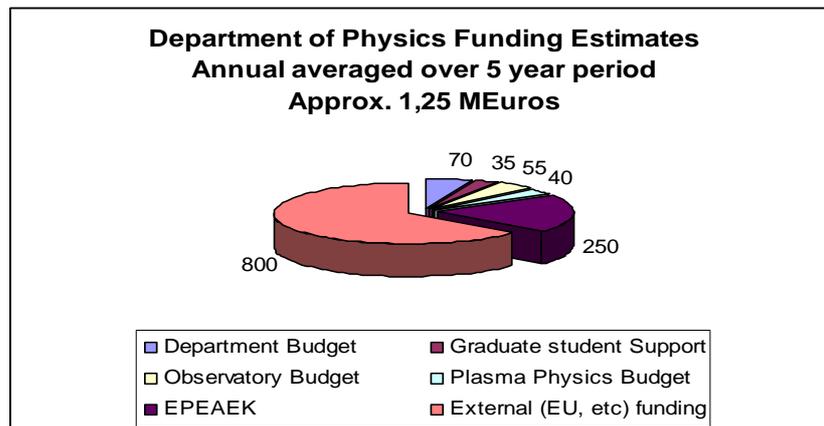
- The Department strives for excellence in research, by concentrating in a few selected and state of the art themes within 5 general directions:
  1. Astrophysics and Space Physics (7 staff members from 1999 to 2008)
  2. Atomic, Molecular and Optical Physics (5 staff members, from 1999 to 2008)
  3. Applied Physics (5 staff members from 1999 to 2008)
  4. Theoretical High Energy Physics (7 members from 1999 to 2008)
  5. Condensed Matter Physics (7 members, they were 6 in 1999)
- The structure of research is shown below:



- The Department promotes research by hiring the best scientists available in the world market. They frequently come from the best Universities and Institutions.
- They avoid “inbreeding”. Only 1 person of the faculty studied in Crete. They have the

best position in this respect among the Greek universities.

- They strive to concentrate on a few specific well defined topics and avoid dispersion in areas where they do not have the critical mass.
- They are very effective in securing research funds from competitive external grants. The following graph shows that 84% of their budget comes from competitive grants, out of which  $\frac{3}{4}$  are international.



- The research is supported by 25 postdoctoral fellows and 31 graduate students who also carry a large fraction of the research. The ratio of post-docs to faculty is 1:1 as well as this of graduate students. These are healthy ratios by international standards. It is also worth noting that this ratio has grown by a factor of two since the 1999 evaluation.
- The Department benefits from the vicinity of and close links to FORTH, which provides the facilities and technical personnel for at least 2 directions of research among the five pursued in the Department (Atomic and Applied Physics) and there are plans for the larger involvement of a third direction (Condensed Matter).
- The Committee wonders whether the clearly inadequate numbers of technical personnel at the University may have encouraged the emphasis in theoretical directions of the other two fields (Particle Physics and Astrophysics). It also acknowledges that efforts have been and are being made to improve the situation.
- The two sectors of research not benefiting as much, up to now, from the proximity with FORTH were operating and obtaining limited operational funds for a) the Skinakas Observatory (Astrophysics) and b) the Institute of Plasma Physics (Nuclear and Particle Physics).
- It is worth noting that Skinakas, being a small telescope, concentrates on niche of observations, where one profits from the full time availability of the telescope (space-ground and gamma ray burst follow-ups).
- These two centers have made proposals, which are in an advanced stage, to establish two new institutes: a) an Institute of Theoretical and Computational Physics, which would replace the Institute of Plasma Physics and could profit from the computational aspects developed in FORTH and in other departments of the University of Crete and b) an Institute of Space and Earth Astrophysics (IDEA), inside FORTH, to develop

space technology and profit from the recent entry of Greece in ESA and the synergy with the research at FORTH.

- The Committee did not have enough material to properly evaluate the plans for these institutes, but generally commends the efforts to further associate the experimental aspects of the research in astrophysics and particle physics in the local environment (FORTH, computing and informatics) and also in international activities (ESA, grid and intensive computing etc.)

#### IMPLEMENTATION

- From preliminary data available to the Committee we arrive at the following numbers:
  1. The members of the Department published 680 articles in refereed journals in the last 6 years, corresponding to 3,4 articles per year and faculty member. This number has remained constant with respect to the figures of the Evaluation Committee of 1999.
  2. The number of citations per year for the total number of publications of the Department approaches 1000.
  3. This number places this Department among the most frequently cited physics departments in Greece.
- A more complete bibliometric picture will emerge when ADIP makes its review of the other physics departments in Greece.
- Research projects and research collaborations.
  1. Astrophysics
    - a. Atmospheric and Ionospheric Physics
    - b. High Energy Astrophysics and Multiwavelegth Studies
  2. Particle and Astroparticle Physics
    - a. Strings Branes and Conformal Field Theory
    - b. Cosmology , Gravity and Cosmic Ray Physics
  3. Atomic and Molecular Physics
    - a. Photonics, Attosecond Pulses, Theory
    - b. Ultrasensitive Quantum Measurements, CP violation, Atomic Physics with Accelerators
  4. Condensed Matter Physics
    - a. Theory: Quantum and classical transport properties in magnetic and quasi-1d systems, Bose-Einstein condensation, magnetic systems, non-linear phenomena and applications to biology, quantum Hall effects,

computational material science.

- b. Experiment: High temperature superconductivity, complex electronic materials, MEMS/ NEMS.

## 5. Applied Physics

- a. Growth and properties of new materials through epitaxy, photonic materials  
b. Plasma physics applications

Selected recent programs with international funding (above 100 K€) are presented below:

<b>Πρόσφατη Χρηματοδότηση Ερευνητικών Προγραμμάτων Μελών ΔΕΠ - Τμήμα Φυσικής - Πανεπιστήμιο Κρήτης</b>					
PI	Grant	ΦΟΡΕΑΣ	ΕΤΟΣ ΕΝΑΡΞΗΣ	ΔΙΑΡΚΕΙΑ (έτη)	BUDGET
Π. Ρακιντζής	TRICEPS: "Time-resolved Ring-Cavity-Enhanced Polarisation Spectroscopy"	ERC SP2-IDEAS	2008	5	910 000 €
Χ. Παναγόπουλος	Electroncomplexity: "Emergent complexity in electronically frustrated correlated electron systems"	Marie Curie Excellence Grant 2006	2007	5	1 390 000 €
Χ. Παναγόπουλος	Electroncomplexity: "Emergent complexity in electronically frustrated correlated electron systems"	European Young Investigator Award 2006	2007	5	1 080 000 €
Ν. Κυλάφης	ASTROCENTER: Development of an Astrophysics Center in Crete	Marie Curie Transfer of Knowledge	2006	4	740 000 €
Ν. Κυλάφης	ASTROSPACE: Development of Space Astrophysics in Crete	EU: REGPOT-2007-1	2008	3	1 200 000 €
Η. Κυρίτσης	CRETEHEPCOSMO: Crete Center for High-Energy Physics & Cosmology	EU: REGPOT-2008-1	2008	3	1 120 000 €
				<b>Σύνολο:</b>	<b>6 440 000 €</b>
<b>Ενδεικτική Παλαιότερη Χρηματοδότηση Ερευνητικών Προγραμμάτων Μελών ΔΕΠ - Τμήμα Φυσικής - Πανεπιστήμιο Κρήτης</b>					
PI	Grant	ΦΟΡΕΑΣ	ΕΤΟΣ ΕΝΑΡΞΗΣ	ΔΙΑΡΚΕΙΑ (έτη)	ΣΥΝΟΛΙΚΟ ΠΟΣΟ
Ξ. Ζώτος	Transdyn	International Reintegration Grant	2004	2	80 000 €
Ξ. Ζώτος	NovMag	STREP (Information Society Technologies -	2006	4	154 000 €
Β. Χορμονδόρης	Support to Development of a Standard Product Generation Pipeline for Hershell	European Space Agency	2007	3	271 000 €
Ι. Κομίνης	Quantum Measurements	International Reintegration Grant	2005	2	80 000 €
				<b>Σύνολο:</b>	<b>585 000 €</b>

- The international contacts and collaborations are satisfactory.

## RESULTS

- We commend the fact that the Department was built by hiring the best scientists abroad and recruited only if they meet a certain high standard.
- The result is therefore a highly visible research in a few selected areas, like string theory, atmospheric and high energy astrophysics, state of the art laser physics, theoretical condensed matter studies and studies of properties of new materials
- The work has been recognized by 2 Awards of Marie Curie (Rakintzis, Panagopoulos) and an ESF Young Investigator award.
- The atomic and molecular physics activity in FORTH has obtained of the order of a dozen patents

## IMPROVEMENT

- As improvements that were identified, we could mention the creation of 2 new institutes, in replacement of the previous activity (Institute of Plasma Physics, Skinakas Observatory): The Institute of Theoretical and Computational Physics and the Institute of Space and Earth Astrophysics.
- Recruitment policy: the Particle Physics sector also wishes to extend its activities towards experimental astroparticle physics, which would exploit synergy with high energy astrophysics. The wish to move towards instrumental know-how is expressed also by Astrophysics and Solid State groups.
- Collaborations. They also realize that they have to intensify their collaborations with teams in other Greek Universities and research institutes. The Committee corroborates this statement and actually strongly recommends more efforts in this direction, which is an endemic weakness of all Universities in Greece.
- Graduate student policy. The Department is concerned that a number of graduate students, mostly Master's, decreased significantly in recent years and began revising their curriculum. The new curriculum is in effect starting the current semester and they hope that it will be more attractive to graduate students. They also feel that scholarships to Master's students and other financial incentives will attract more students to their University.

## ***C. All Other Services***

### APPROACH

- There is a real effort to modernize the administrative services. The administrative services seem quite effective, adequate and recently modernized (student web subscription, grading by professors on the web and recently also management of electronic book distribution). The personnel seemed happy with the arrangements.
- The technical support for teaching and supervising at the laboratories is, on the contrary, overstrained and evidently insufficient to cover the needs of the curriculum. The existing personnel is currently filling the gaps with a lot of self-sacrifice and extra non-remunerated hours, but obviously this is not something that can last for long. One of the 2 technicians that support the laboratories will retire soon.

### IMPLEMENTATION

- The administrative infrastructure seems well organized.
- The Library is very pleasant and sufficiently modernized. There are computing labs with sufficient number of PC's for student education and the Department has WIFI internet access.
- Above all the Computing Center, not belonging directly in the Department, but including technical personnel from the Department seems very efficient and well equipped with knowledgeable engineers. A few faculty members stressed their appreciation of the services rendered.

### RESULTS

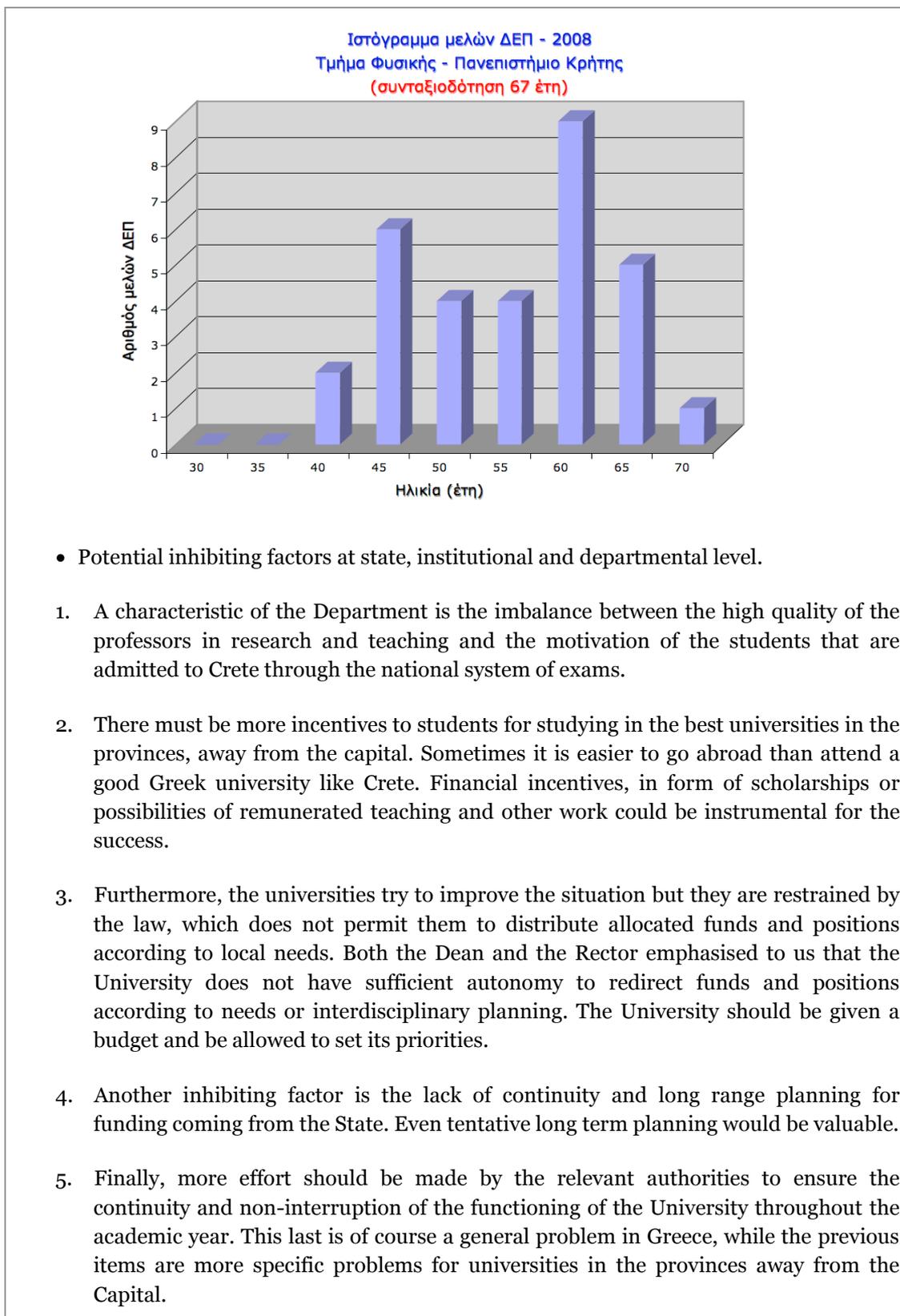
- The Department appreciates the administration and computing center services and is ware of the clear inadequacy of the number of the technical personnel.

### IMPROVEMENTS

- A clear priority of the Department is the recruitment of new technical personnel.
- The computing services, although quite good, will need upgrading in the context of the new Institute of Theoretical and Computational Physics.
- The administration strives to ameliorate the delays for the delivery of the educational material (books), which is not very bad currently (mid-November), but could be further improved.

### ***D. Strategic planning, perspectives for improvement and potential inhibiting factors***

- Short-, medium- and long-term goals.
1. The organisation of the curriculum seems to be well planned. A tendency to experiment and continually improve it is evident. It should be supplemented with a strong effort to recruit one Professor of high academic standards, specialising in pedagogical and didactical techniques, since the majority of the students will choose secondary education as their career.
  2. The Administration staff seems to have the electronic tools to adequately plan and expand the services offered in support of the students and the researchers.
  3. The number of technical personnel is obviously inadequate. The few (2-3) technical personnel actually perform herculean tasks to provide the proper support for the education of the students. The system cannot be based on the continuous spirit of self-sacrifice of a few people. It must be organised in a better way in the future.
  4. Some efforts of outreach with local schools have been attempted. Nevertheless a careful planning of the outreach and a better link with the local schools and community has to become more prominent in the program of the Department.
  5. The research programs look promising and growing. The two new Institutes (Astrophysics and Theory and Computation) will increase the interdisciplinary links between the different teams. These links will be also helped by the very good interpersonal relationships that seem to prevail in the department.
  6. Nevertheless, as the age-graph below shows, the first generation that has built the laboratory 30 years ago will be at the age of retirement in 10 years time. Half of the staff of the laboratory is currently above 55. The Department will be coming in the next 10 years to a crossroad. This is an opportunity for the Department to think its future in depth and see whether more focusing is needed or whether new directions of research must be created.



## ***E. Conclusions:***

- Conclusions of the E.E.C. and recommendations on:
  - (a) The development of the Department to this date.
    - The Department has clearly developed to a level of excellence in research
    - In its short history of 30 years practically all of its members have remained active
    - Its graduates have obtained positions in leading universities and institutes across the world.
    - It benefited from its proximity to FORTH and has reasonable plans for the future directions of research (e.g. new Institutes)
    - It has made significant efforts both in graduate and undergraduate studies to close the gap between the excellence in research and the effectiveness in training and producing good students. The remaining deficiencies are to be attributed more to the general institutional structure of the Greek universities and the peculiarities of the admission system.
  - (b) Department's quality assurance.
    - The Department follows closely the application of the syllabus with two specialised committees (undergraduate and graduate)
    - There should be more frequent planning and deliberating exchanges of the faculty staff.
- The Committee believes that in order of priority the urgent recommendations are:
  1. Increase of the number of technical personnel supporting the undergraduate laboratories to an adequate level.
  2. Find ways to minimally finance Master and PhD students, so that Greek and foreign students can profit from the high-level courses and career opportunities offered at the Department.
  3. Support with investments and personnel the creation of the 2 new institutes (Theoretical and Computational Physics and IDEA). In the context of the planning of the 2 new Institutes assess the needs of a new computing cluster and high level instrumentation.
  4. Refurbish the training laboratories and some teaching facilities
  5. Draft carefully a plan for the hiring of new faculty members in view of the upcoming retirements. In this context, special attention must be given to the hiring of a faculty member with didactic training and positions in experimental particle astrophysics, as well as more experimentally oriented staff.

## The Members of the Committee

Name and Surname	Signature
1. Prof. Panos Razis, University of Cyprus, Cyprus (President)	
2. Prof. Stavros Katsanevas, Prof. of Paris VII, IN2P3, France	
3. Prof. Costas Kounnas, École Normale Supérieure, CNRS, France	
4. Prof. Sokrates Pantelides, Vanderbilt University , USA	
5. Prof. Emmanuel Paschos, Technical University of Dortmund, Germany	