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ORIGENS DO CENTRO INTERNACIONAL DE FÍSICA  
TEÓRICA (Trieste)

J. Tiomno

## THE INTERNATIONAL CENTRE FOR RESEARCH IN THEORETICAL PHYSICS

Report to the Director General by Messrs. Marshak,  
Tiomno and Van Hove

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## ORIGENS DO CENTRO INTERNACIONAL DE FÍSICA TEORICA (Trieste)

J. Tiomno

O documento seguinte, distribuído pelo Dr. Sigvard Eklund, Diretor Geral da Agencia Internacional de Energia Atomica, aos membros do Board of Directors a 21 de Maio de 1963 foi o documento base para as discussões do Board que levaram à criação do Instituto de Trieste. Por sua importância histórica, a atualidade e por envolver o Centro Brasileiro de Pesquisas Físicas na comissão que foi cognominada, jocosamente, dos "Three Wise Men" é reproduzida nesta série.

## THE INTERNATIONAL CENTRE FOR RESEARCH IN THEORETICAL PHYSICS

Note by the Director General [Dr. Sigvard Eklund]

1. The Board will recall that when last February it requested the Director General to study the offers of facilities, assistance and co-operation made to the Agency in connection with the establishment under its auspices of an international centre for research in theoretical physics, it suggested that in so doing he should secure the advice and help of up to three eminent theoretical physicists.<sup>1</sup> The Director General accordingly arranged for Dr. R.E. Marshak, Chairman of the Department of Physics and Astronomy at the University of Rochester, United States of America, Professor J. Tiomno of the Centro Brasileiro de Pesquisas Físicas at de Janeiro, and Dr. L. Van Hove of the Theoretical Physics Division, European Organization for Nuclear Research, Geneva, to come to Vienna from 3 to 5 April to study all the documentation on the centre that had been assembled up to that time.
2. As a result of their visit the three physicists provided the Director General with a report on their work, the text of which is reproduced overleaf for the information of the Board. In a letter transmitting their report, the physicists stated.

"In the course of our discussions we have come to see such great potentialities in the project of establishing an International Centre for Theoretical Physics that we feel this enterprise to deserve the greatest and most enthusiastic support. We therefore devoted very great attention to many aspects of the problem, especially all questions of principle, and we are glad to report that we have reached unanimous agreement on all the views and recommendations presented in the accompanying paper."

<sup>1</sup> GOV/DEC/30 (VI), decision number (22) (b).

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Texto da carta referida pelo Dr. Eklund

Vienna, 6 April 1963

Dear Dr. Eklund,

We send you enclosed the paper containing our views and our recommendations concerning the various questions which you have put in front of us regarding the establishment of an International Centre for Theoretical Physics.

We would like to say first how much we appreciate your invitation to discuss this matter with you and your staff. Also your hospitality and the kind collaboration we have found for carrying out our work have been for us a source of great pleasure.

In the course of our discussions we have come to see such great potentialities in the project of establishing an International Centre for Theoretical Physics that we feel this enterprise to deserve the greatest and most enthusiastic support. We therefore devoted very great attention to many aspects of the problem, especially all questions of principle, and we are glad to report that we have reached unanimous agreement on all the views and recommendations presented in the accompanying paper.

We have discussed in addition two further points which are of a more confidential nature and are therefore not touched upon in the document. The first one concerns a preliminary review of those theoretical physicists who in our opinion would on scientific grounds be possible choices for senior staff positions at the Centre. This review has been made in presence of staff members of your Agency who are thus informed of its content. We would like to stress, however, that it should be regarded as highly preliminary because we feel that such matters require not only greater attention but also consultation on a broader scale.

Dr. Sigvard Eklund  
Director General  
International Atomic Energy Agency  
Vienna I  
Austria

The second point is the question of possible candidates for the post of Director of the Centre. Our discussions here have been much more thorough and we have unanimously given first priority to four very highly qualified theoretical physicists. Although we have definite views on a possible priority order among these four candidates we prefer not to state it at this time and present the names in alphabetical order. They are: Professor H. H. Dalitz (Chicago), Professor A. Salam (London), Professor V. F. Weisskopf (CERN, Geneva) and Professor C. N. Yang (Princeton).

Thanking you again for your hospitality and for the opportunity you gave us to discuss these very interesting questions.

Yours sincerely,

R. E. Marchak  
J. Tiomno  
L. Van Hove

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## R E P O R T

## I. PURPOSES OF THE CENTRE

1. The principal purpose of the Centre should be to foster, through teaching and research, the advancement of theoretical physics in the newly developing countries. Theoretical physics is highly qualified to provide a firm basis for advancing on a broad front the science and technology of the developing countries. This potentially important role of theoretical physics derives from the fact that the rigorous mathematical techniques required in its performance, as well as the need to meet experimental tests, set the style and level for fruitful scientific work in many fields. In addition, theoretical physics has the advantage that the proper conditions for fruitful accomplishment can be established at relatively small cost. Indeed, the high potential return to developing countries, measured in terms of the investment of funds, makes theoretical physics the ideal starting discipline for a truly international institute where the capabilities of the developed countries can be pooled for the benefit of the developing world. Since it happens that the major advances of modern theoretical physics have relevance for the development of atomic energy, the Agency can justifiably support a broad spectrum of teaching and research activities in this field.

2. Additional purposes which would be served by the Centre are:

- (a) The Centre would help and encourage able theoretical physicists from newly developing countries to continue and expand their research work. The Centre would make it possible for very promising theoreticians from the developing countries to consolidate and refine their research training. As is well known, famous schools of theoretical physics have developed around great individuals, and therefore the encouragement which the International Centre would give to very capable scientists from the less-developed countries could help them establish the foundations for their home institutes. In addition, the Centre will enable theorists from developing countries to re-establish contact with the most recent developments in their fields of interest;
- (b) The Centre would serve as a pilot plant for future international research institutes. If successful, it would indeed stimulate the

desire for similar institutes in other disciplines. The experience gained would be very valuable in reaching decisions concerning the desirability and structure of future international centres;

- (c) The Centre would promote the cross-fertilization of the various fields of activity within its scope. The fact that concepts developed within one field of theoretical physics have often found applicability in other quite different fields would justify the establishment of a theoretical physics centre on a rather broad scientific basis covering more than one field of specialization; and
- (d) The Centre would make an important contribution to the furtherance of international contacts, between widely separated areas of the world and between countries at different stages of scientific and technological development.

## II. PROGRAMME

### Teaching and training functions

3. It is our opinion that the teaching and training functions of the Centre are to be given great emphasis if the Centre is to achieve its principal purpose. These functions should be carried out through the fellowship system.
4. The normal duration of stay of a fellow at the Centre could be taken to be two years. A fellow should be initially appointed for a one-year period and be granted a one-year extension unless his scientific interest or activity falls below reasonable standards. Extensions for a longer period - not to exceed one year - could be given when special conditions, like completion of a piece of research, require it.
5. As discussed again in paragraphs 29 and 30 below, we propose that a selection procedure be established which would ensure that each fellow arriving at the Centre would be able to follow advanced courses, lectures, and seminars on specialized topics within the fields of research of the Centre, and to undertake a research problem under the guidance of a senior staff member. Whenever possible, candidates for fellowships at the Centre, who have not yet reached the level necessary for successful participation in its activities, should be sent to properly selected universities in order to follow programmes of study



which would enable them to go to the Centre at a later date. The arrangements necessary for this purpose should be made by the Centre and the Selection Panel after careful consideration of each case, accompanied by a scientific interview with the candidate. We shall come back later to this question of "pre-training", which we consider to be of utmost significance not only to the Centre but also to the advancement of theoretical physics in the developing countries.

6. In connection with the selection of fellows, both for direct admission to the Centre and for admission after pre-training, we expect from the experience at the European Organization for Nuclear Research (CERN) laboratory in Geneva that the number of applications will quickly become much larger than the number of available fellowships and that, initially, the level of applicants will often be too low. Many rejections are therefore to be expected, but, as shown also by the experience of CERN, in many cases they turn out to be only postponements until a higher level in the applicant's training is reached.

7. To carry out the teaching and training functions of the Centre, the Director and senior staff will have to follow methods which are rather different from the usual practice at existing research institutes of theoretical physics. Although they should attach high priority to pure research, they should devote considerable attention to the organization of lectures and seminars at a level geared to the fellows rather than to themselves. They should watch the fellows closely in connection with their research problems and encourage the fellows to give lectures on the background material which they have learned in the course of their research activities. The senior staff should, with patience and devotion, create an atmosphere of informality and free discussion, especially during the lectures and seminars, so that the fellows will develop, as rapidly as possible, the habit of raising questions and asking for clarification whenever necessary for their own benefit. The creation of such a climate is not only important to the success of the Centre itself, but also to the preparation of the fellows for their future teaching and training tasks in their home countries.

8. We have paid great attention to the problem created by the possible absence of an experimental physics laboratory near the Centre. It is indeed absolutely essential that staff and fellows be put in regular contact with the experimental advances in the field of physics in which they work. As is shown by the existence of very lively and productive theoretical groups in elementary

particle physics at locations far away from the great laboratories where experimental particle physics is being carried on, it is possible to maintain the necessary type of contact between experiment and theory despite geographical separation. To further this objective, the Centre should arrange for invitations to experimental physicists extending over periods of sufficient length (whenever possible several weeks or a few months). The experimentalists should deliver lecture series describing in sufficient detail the status of experimental work in the various fields of interest of the Centre.

9. One can hope that when experimental physicists have established in this way sufficiently close contact with some of the staff members and fellows at the Centre, they will raise theoretical problems connected with their work which may be the source of research activity inside the Centre! Under such conditions, the Centre could sustain contacts with experimental physics over longer periods of time which would greatly contribute to its success.

10. Regarding summer schools, we believe that the Centre could play a very useful role in their organization. Summer schools could undoubtedly be set up under auspices of the Centre, also in the developing areas, in which case one should endeavour to adjust their level to the real demands of the area concerned. One could imagine, for example, that a summer school in a developing country would bring together for a number of weeks a few senior scientists and some fully trained junior ones, the latter following lecture courses given by the former, while both senior and junior participants give more elementary lectures adapted to the level and interest of the local physicists.

#### Fields of research

11. We have put considerable stress in the previous sub-heading on the teaching and training functions of the Centre, because they imply a significant difference compared to theoretical institutes now in existence. In agreement with the policy of such institutions, however, we believe that original research should be the main task of the Centre, both for senior staff and for fellows.

12. We do not feel that comments are necessary on the proper methods for carrying out this aim, except for the statement that the research should be of the highest quality and that the senior staff should give paramount attention to bringing the fellows up to a high level of performance.

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13. As indicated earlier, we think that the Centre would greatly profit from having more than one field of theoretical physics on its programme because of the remarkable effective phenomenon of cross fertilization which has been repeatedly observed in theoretical physics. The two other considerations which have played a role in our selection of fields of research are the fact that top quality people are unavoidably attracted to topics of fundamental significance and that a genuine relation should exist between the programme of the Centre and the fields of nuclear physics and atomic energy which are of immediate concern to the Agency. We propose that the three chief fields of research be:

Low energy nuclear physics;

Solid state physics; and

Elementary particle physics.

14. The first two subjects have obvious connections with the basic research aspects of the broad field of atomic energy. The third topic is, in our view, of utmost importance because of its fundamental significance in present day theoretical physics (thereby tending to attract the most talented people), and also because of its role for cross fertilization with the other two subjects. One need only recall that meson theory, and therefore the whole field of modern elementary particle theory, grew out of the desire to understand nuclear forces. On the other hand, concepts developed in the theory of elementary particles have found important applications both in nuclear physics and in solid state physics.

15. In addition to the three main fields mentioned above, connected subjects like neutron physics, reactor theory, many-body theory, plasma physics and astrophysics, should also be considered as relevant topics. In view of their somewhat more specialized character, however, it should not be expected that these related subjects would necessarily be under continuous study at the Centre. Rather, they could be occasionally included in the programme, upon request from a sufficient number of Member States, in the form of special lecture series and training courses of a duration up to one year.

### III. STAFF AND ORGANIZATION

#### Staff

16. In estimating staff figures, we have been guided by the following general considerations:

- (a) A reasonable estimate for the ratio between numbers of senior scientific staff and fellows would be in our opinion 1:3. In establishing this ratio we propose to consider under senior scientific staff both the theorists who have a long-term contract at senior level (duration of three years or more) and those senior visiting scientists who are visiting the Centre for no less than one year and are paid by it (only then can the visitors be expected to accept fully the task of "tutoring" fellows); and
- (b) The Centre should start from a small nucleus and grow at a rather rapid rate to a size of about 50 to 60 scientists (including fellows and visitors). This number is large enough to allow for each of the three chief fields of theoretical physics to be covered by more than one senior staff member (to avoid scientific isolation of senior staff members). On the other hand, appealing to the experience of the Theory Division of CERN, we feel that this number is small enough to ensure lively and direct contacts between all the scientists involved, thereby achieving conditions favourable to cross fertilization between the different fields.

17. We think that it is not unrealistic to expect that the period of growth to such a size would last about five years. This will enable the Agency to review the status and the future of the Centre four years after it starts to function. Our estimate of a growth period of five years is made on the assumption that the Centre will be able to attract, at the very beginning of its operation, a sufficient number of senior staff (at least three in addition to the director). We realize that this assumption may be too optimistic, in which case we would propose to count as starting date the time when three senior scientists have taken up their duties at the Centre (in addition to the director). What will happen after the size of 50 to 60 scientists has been reached is, of course, a crucial question. Our proposal is that, if the Centre has successfully achieved its aims, further growth of its activities should be oriented toward the creation of new centres of a similar nature.<sup>1/</sup>

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<sup>1/</sup> See also paragraphs 45 to 48 below on the question of geographical distribution.

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18. Taking into account these points, we consider as reasonable the following numbers of scientific staff posts at the end of the second and fourth year of operation of the Centre:

Posts	Number	
	End of second year	End of fourth year
Director	1	1
Professors	3 - 6	6
Visiting scientists (junior and senior)	4 - 6	6
Guest scientists (junior and senior: only travel expenses paid by Centre)	8 - 12	12 - 15
Fellows	20	35
TOTAL	36 - 45	60 - 63

19. In this table, we have used the title of "Professors" for the senior scientific staff under contract for at least three years. By this title we wish to emphasize that such scientists are expected to take very seriously their obligations towards the teaching and training of fellows.

20. By "Visiting scientists" we mean those scientists who are appointed for at most one year and are fully paid by the Centre. Some of them would be senior, some of them less advanced (junior), but all should be capable of carrying out independent original research. We have called "Guest scientists" persons of the same category as the visiting scientists except for the fact that the Centre will only pay their travel expenses (their salaries will be taken care of by their home countries or other agencies and foundations). We propose to include also in the category of guest scientists theoretical physicists from the developing countries who have spent some time at the Centre before, for example as fellows. They can be invited to come back for a few months at a time, at regular intervals, in order to maintain their contacts with recent developments, the Centre taking care of their travel expenses.

21. To the most active among these regular visitors, one could award the title of "Corresponding member" of the Centre, and this would be a title of honour.

22. We think that it will be advisable to consider two grades for the follows, with a salary differential, to be distinguished on the basis of scientific qualifications and experience.

23. It is our strong conviction that the regulations of the Centre should be such as to enable the whole scientific staff to be treated like university scientists, with a comparable amount of academic freedom and with a summer vacation period of three months in which they would be free to travel or work in other institutions.

24. Our estimate of the necessary technical and administrative staff is the following:

Posts	Number	
	End of second year	End of fourth year
Administrator	1	1
Secretaries and typists	4	6
Housing officer, also assistant to administrator	1	1
Librarian	1	1
Computer, programmer	1	2
TOTAL	8	11

Among the secretaries, some should have the competence required to assist the Librarian.

25. We have not entered into any detailed discussions regarding contracts and would like to mention only the following points. In our view, the Director should be appointed for five years. The professors should be initially appointed for three to five years, after which period they could be considered for permanent appointments. Salaries will be found in Appendix I devoted to budget estimates. They have been proposed by the staff of the Agency, and we consider them to be reasonable. We emphasize the necessity of having a salary scale with a sufficient diversity of steps to allow the flexibility needed for senior staff appointments.

### Scientific Council and Selection Panel

26. A Scientific Council should be established to assist the Director of the Centre in all important problems regarding programme, staff and budget. It should be composed of theoretical physicists of high reputation selected in such a way as to give proper representation to the various areas of the world. Each member should be appointed for a limited number of years.

27. In addition to this Council, we propose the creation of a Selection Panel which would have the duty of advising the Centre on the selection of fellows. It should be an international body of recognized theoretical physicists. Each member could possibly represent a definite region and would have the responsibility of advising on all applications originating from his region and of helping with the "pre-training" arrangements for the fellowship applicants requiring them.<sup>2/</sup> Clearly, each member of the Selection Panel should have close liaison with the various scientific institutions and universities within his region and he may wish to avail himself of his own advisory committee.

28. Both the Scientific Council and the Selection Panel should not be too large. The number of members should probably not exceed a dozen for each group. The Selection Panel will probably convene once each year at the Centre whereas the Scientific Council can be expected to convene more frequently, at least in the early years.

### Selection criteria for staff members and fellows

29. The senior staff positions (Director and professors) should be reserved for theoretical physicists of established reputation who have given ample proof of their creative ability in at least one of the fields of research of the Centre and who have demonstrated their willingness and ability to "tutor" younger research scientists.

30. Also for fellows, the primary principle of selection must be scientific ability, although of course at a much more modest level. In picking the fellows, however, it will be necessary to seek a wide and just geographical distribution. The selection of fellows should be made by the permanent staff members of the Centre after consultation with the Selection Panel. No applicant should be accepted unless he can reasonably be expected to be able to tackle,

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<sup>2/</sup> See para. 30 below.

under guidance, an original research problem and to follow, with success, the specialized lectures and seminars given at the Centre. Applicants, whose scientific preparation has not yet reached the minimum level for admission, could be helped by the pre-training system mentioned earlier. Through the intervention of the Centre and with the assistance of its Selection Panel, it could be determined whether a reasonably short stay at a good university (one or two years), with the requirement to follow prescribed courses, could bring the candidate up to the necessary level. If this is the case, the Centre would make the necessary arrangements for acceptance by a suitable university. Although the Centre could not be expected to carry the cost of this pre-training, it would accept the responsibility to admit the candidate as a fellow if the pre-training, which it has arranged, has been successful. Particular attention should be given in the pre-training programme to those countries which have not been able to appoint candidates to the level of "fellow".

#### IV. FACILITIES

##### General

31. We have made rough estimates of the facilities required by the Centre. They are based on personal experience in our home institutions. Especially for two items, however, we strongly advise that more detailed estimates be obtained from experts. We refer to library space and budget, as well as to the reproduction department for scientific information.

32. We would like to stress that all decisions on facilities will have to be made jointly by the local authorities offering the site and by the authorities of the Centre, in particular its Director. The latter, we feel, should be granted full authority for all detailed decisions.

33. The minimum space requirements for offices, lecture rooms, library, etc., but not including housing facilities, is estimated to be about 3000 - 4000 m<sup>2</sup> for staff estimates as described above (end of fourth year). Details on this question are found in Appendix II prepared by the Agency's staff.

34. It would be desirable to have some open space, for example, lawns or recreation grounds, available on site.

35. Ordinary office equipment, including typewriters suitable for scientific publications, as well as desk computers (from two at the beginning to about four in the fifth year) should be provided.



Special facilities(a) Library

36. We would like to stress strongly that it is, in our opinion, absolutely essential to have a well-equipped physical science library on the site of the Centre from the very beginning of its activities. During the first year, library needs could be met by having the office space of the Centre very near to an existing library. By the end of the second year, however, the Centre should have built up its own library so that dependence upon external libraries is reduced to a minimum.

37. The library of the Centre should be a well-equipped physical science library which provides, in the very great majority of cases, the material required by theorists working in the chief and connected fields of research mentioned earlier. One should aim at acquiring what might be called a 99 per cent library, by which we mean that in no more than one per cent of cases should loans from outside libraries be necessary. All important physics journals should be available for a sufficient number of back years. The library should possess a good supply of books covering in detail the main fields of theoretical research and, in satisfactory fashion, the rest of physics, certain aspects of mathematics, and astrophysics. In view of the important teaching task of the Centre, a proper number of advanced textbooks should be available on all relevant subjects. We believe that the financial requirements for the library would comprise an initial investment of about \$100 000 and a yearly budget of about \$15 000. These figures should be checked by an expert although they are probably not off by more than 50 per cent.

(b) Computing facilities

38. The question of computing facilities was discussed at great length. We again leaned heavily on the experience of the Theory Division of CERN, which counts at present between 50 and 60 scientists and has, as part of its research programme, a few problems which require rather extensive computations.

39. We feel that the most natural solution for the computing needs of the Centre would be to have access to a large and fast electronic machine available near the site or at least in the same city. We estimate that, as the Centre grows to a staff of about 60 scientists, it might be reasonable to count on computing needs

amounting to 20 to 30 hours per week for a computer similar in size and speed to the IBM 709. Taking into account that research institutes of the type of the Centre can usually count on rates more favourable than commercial rates, our rough expectation is that the equivalent cost would rise to about \$100 000 per year at the end of the first five years. We would propose to budget \$20 000 yearly for computing during the first year with a linear growth to the amount just mentioned. It is not our opinion that the Centre would be bound to buy or even rent a computer of its own, at least during the first five years of its life.

(c) Reproduction facilities

40. Reproduction equipment, such as mimeographing machines, photostat machines, etc., should be available at the Centre for providing some 1000 to 3000 pages per year during the initial period. The number of copies would strongly depend on the distribution scheme of the Agency. One could expect that, in addition to the Agency's distribution obligations, up to 1000 or more copies of scientific preprints and lecture notes will be needed for scientific institutes and individual research physicists all over the world.

(d) Drafting facilities

41. The scientists of the Centre should be able to use the services of draftsmen working on, or near the site, for example in adjoining scientific or technical institutions. This need is connected with the preparation of figures and diagrams for scientific publications and reports.

## V. BUDGETARY ESTIMATES

42. Concerning the budget, we would like to make the following general remarks. If the Centre is in any way successful, it will go through a steady and rapid rate of growth during its first five-year period. As was the case in the past for many similar projects, it will then unavoidably require a rapidly increasing budget containing a number of unforeseen items. We feel that this expectation is worth mentioning explicitly although there may be some frightening aspects to it. In our opinion, success should not be regarded as being a source of serious future difficulties because an encouraging start of the Centre should rapidly open up new possibilities of finding financial support. Our very strong conviction in this respect is based on previous projects where this has happened, including research projects of an experimental nature which have much heavier

financial implications. If, on the contrary, the new Centre has no more than a very slow rate of growth during its early years, this would clearly be a very unhealthy sign requiring a careful re-evaluation, whereas at the same time there would, of course, be no problem of a rapidly increasing budget. We cannot foresee how failure can be associated with a large budget since the money at this Centre is being invested primarily in people.

43. As a consequence, we came, after much discussion, to the optimistic conclusion that even rather large budget estimates for the first five years should not be regarded as an essential difficulty. In his very first years of activity, the Director could probably be extremely helpful in finding additional support of the kind provided by foundations and other organizations on the basis of the scientific prestige of the staff. The Members of the Agency may also discover novel ways of providing financial support for the Centre.

44. In Appendix I, budget estimates are presented as they have been calculated by the staff of the Agency. Although we have not studied them in detail, we have the impression that they are quite realistic. We proposed a contingency of ten per cent because of the importance we attach to unforeseen elements of activity in a healthy scientific institution.

## VI. GENERAL PRINCIPLES FOR SELECTION OF SITE

45. Since, as stated earlier, the principal purpose of the Centre is to foster the advancement of theoretical physics in the newly developing countries, there is in our mind no doubt that the ideal location for a fully equipped and fully operating centre of the type under discussion would be in one of the developing areas.

46. On the other hand, in the very first years of its existence, the Centre is bound to be quite small and its very few senior scientists will have to struggle with many organizational problems, such as, for example, starting successfully the fellowship system for the benefit of the developing countries. In those critical years of childhood of the Centre, it is essential that its first scientists work right away in a fully active and stimulating atmosphere of theoretical physics research. Otherwise, personal creative work would become too difficult for them and these scientists are in danger of losing the very

qualifications which made them eligible for appointment. In our opinion, the Centre has therefore to be started in a place where an excellent scientific environment exists in the field of theoretical physics, in the form of an existing highly qualified research group, regular lectures and seminars on advanced topics, and of course also the library and computing facilities discussed above in paragraphs 38. to 41.

47. In view of the paramount importance which we attach to the latter considerations - we consider them to be by far the most essential conditions for the successful establishment of a new centre - we recommend that the Centre be started on a site where it would be fully embedded in the scientific life and atmosphere of an existing theoretical physics institute of the highest calibre. On such a site the Centre would have very favourable possibilities to grow during its first five years of existence to the size of 50 to 60 scientists discussed in paragraphs 16 to 25 above, discharging its responsibilities to the developing countries through the fellowship system, the guest and visiting scientist programme and the pre-training scheme.

48. As the size of 50 scientists is reached near the end of the first five-year period, and under the assumption that the first centre has proved to be successful, the next development of the project may be the establishment of a second centre of similar nature in one of the developing areas. This new centre could be carefully planned and prepared by the staff and former fellows of the first centre so that it would then have a very good chance of starting successful operation even in a location where theoretical physics has not reached yet a high level of development. By establishing in this way one or more new centres in the developing countries one could envisage a situation where eventually the chief purpose of this whole enterprise, that of advancing theoretical physics in the developing world, would be achieved right in the middle of the areas which need it most. Although such an achievement could certainly not be reached before a number of years, it would be, in our opinion, of such great importance for the advancement of science and technology in the developing world that it deserves the closest attention and the most careful planning already at this early stage.

## VII. FINAL RECOMMENDATIONS

49. We would like to make the following chief recommendations which, in our judgement, will help to achieve the purposes spelled out in paragraphs 1 and 2 above:

- (a) Regarding the programme of the Centre, great weight should be given to its basic teaching and training functions. While the main activity of the Centre would be original research work in certain fields of theoretical physics, it would have as an essential function to train young scientists from the developing countries and have them carry out original research under competent and devoted supervision by the senior scientific staff. Lectures and seminars on advanced topics, given by senior scientists as well as by young fellows, would form an essential part of the Centre's activity. The Centre should also accept responsibility for the organization of summer schools;
- (b) As major fields of research, we propose:
- Low energy nuclear physics;
  - Solid state physics; and
  - Elementary particle physics.

In addition, the scientific programme of the Centre could encompass connected subjects like neutron physics, reactor theory, many-body theory, plasma physics, astrophysics. In view of their more specialized character, however, these related topics should not be necessarily under continuous study at the Centre;

- (c) The fellowship programme of the Centre should be adjusted to the needs of the developing countries as well as to the necessity of maintaining the Centre at the high scientific level required for carrying out fundamental research. To solve this difficult problem, we propose a pre-training system under which, through arrangements made by the Centre, sufficiently promising candidates for fellowships who have not yet reached the level necessary for admission would be sent (whenever possible) to existing universities for a period of intensive instruction, at the end of which time they would be expected to reach the competence required for successful work at the Centre. To carry out

this task, the Centre would be assisted by a Selection Panel, advising it on all matters relating to fellowship selection and pre-training. Also the visiting and guest scientists' programme of the Centre should pay great attention to the needs of developing countries and help their highly competent theoretical physicists to avoid the dangers of scientific isolation;

- (d) In addition to the Selection Panel for fellowships, a Scientific Council of highly qualified and experienced theoretical physicists should be established to assist the Director in all problems relating to scientific programme, staff and budget. We believe that each of these committees should have no more than twelve members;
- (e) As to the selection of site, we have discussed at great length the two conflicting requirements that, on the one hand, the Centre could only start successful operation if it can profit in its initial years from the scientific life and atmosphere of an existing theoretical physics institute of the highest quality, while, on the other hand, location in the midst of a developing area would be the most natural way of fostering theoretical physics in the new countries. Our general conclusion is that the Centre has to start and grow to a size of about 50 scientists in the immediate neighbourhood of an existing institute of the highest quality, whereas the future growth of the project should occur through the establishment of one or more similar centres in developing areas by the staff and former fellows of the first centre. We expect that the growth period of the original centre will be about five years, so that a full evaluation of the project could take place at the end of the fourth year to decide on its measure of success and future prospects. Starting from these general considerations, and after careful discussion with the Agency of the offers made up to now, we have come to the following more specific recommendation for the selection of the site where the first centre should be established:

Specific recommendation concerning site

Subject to the qualification that no substantial changes are made in the present offers and that there are no new comparable offers by the deadline date, we would recommend that a choice be made

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between Copenhagen and Trieste. In deciding between these two offers, we believe that weight should be given both to the external theoretical environment and to the financial support. On the basis of these criteria, Copenhagen would be a more favourable location than Trieste from the point of view of existing theoretical environment whereas Trieste would be favoured on the basis of financial commitment. It is true that Trieste has announced the creation of two full professorial chairs and four assistant professorial chairs in theoretical physics at the University, but we do not feel that a clear-cut recommendation can be given without knowledge of the occupants of these chairs. If outstanding theoretical physicists can be found to occupy these chairs, we feel that the University of Trieste might be able to provide the appropriate scientific climate for the Centre.

## Budget estimates (in United States dollars)

Item of expenditure	First year No.	First year Cost	Second year No.	Second year Cost	Third year No.	Third year Cost	Fourth year No.	Fourth year Cost	Fifth year No.	Fifth year Cost
<b>STAFF</b>										
<u>Scientific</u>										
Director (D-2) <sup>b/</sup>	1	20 630	1	21 330	1	22 040	1	22 040	1	22 040
Professors (D-1) <sup>c/</sup>	2	34 310	4	69 410	5	88 060	6	106 970	6	106 220
Visiting scientists (senior) (D-1) <sup>d/</sup>	2	34 310	2	34 310	3	51 470	3	51 470	3	51 470
Visiting scientists (junior) (P-4) <sup>e/</sup>	1	12 680	2	25 360	2	25 360	3	38 040	3	38 040
Guest scientists (travel only)	8	8 000	11	11 000	13	13 000	15	15 000	15	15 000
Fellows (stipends and travel) <sup>f/</sup>	15	5 000	20	76 000	25	95 000	30	114 000	35	133 000
Sub-total	29	166 930	40	237 410	49	294 930	58	347 520	63	365 770
<u>Technical</u>										
Librarian (P-2)	1	8 700	1	8 960	1	9 230	1	9 500	1	9 770
Computer, Programmer (P-3)	1	10 590	1	10 890	2	21 780	2	22 380	2	23 280
<u>Administrative</u>										
Senior officer (P-3)	1	10 590	1	10 890	1	11 190	1	11 490	1	11 790
Assistant (housing etc.) (G-7)	1	4 230	1	4 370	1	4 510	1	4 650	1	4 790
Secretaries, typists (G-4...G-6)	3	8 950	4	12 100	5	15 450	6	18 500	6	19 500
Maintenance & Operative	4	10 000	4	10 000	5	12 500	6	15 000	6	15 000
TOTAL <sup>g/</sup>	40	220 000	52	295 000	64	370 000	75	429 000	80	450 000
<b>TECHNICAL SERVICES</b>										
Library <sup>h/</sup>		15 000		15 000		15 000		15 000		15 000
Computing services		20 000		40 000		60 000		80 000		100 000
Reproduction and drafting services and facilities		4 000		5 000		6 000		7 000		7 000
TOTAL		39 000		60 000		81 000		102 000		122 000
<b>MISCELLANEOUS</b>										
Travel of scientific staff		10 000		20 000		25 000		30 000		30 000
Scientific Council and Selection Panel		20 000		20 000		20 000		20 000		20 000
Conferences, Summer schools, etc.		20 000		20 000		25 000		30 000		30 000
General costs		10 000		20 000		25 000		35 000		35 000
TOTAL		60 000		80 000		95 000		115 000		115 000
CONFINGENCY		25 000		25 000		25 000		25 000		25 000
GRAND TOTAL		344 000		460 000		571 000		671 000		712 000



## Appendix 1

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- a/ It has been assumed that the Director would have the emoluments of a member of the Agency's Secretariat at the D-2 level and a five years' appointment. The corresponding base salary is \$14 530 per annum.
- b/ It has been assumed that professors would have the emoluments of the D-1 grade and appointments of three to five years. A four years' appointment was therefore taken as an average basis for calculation. The base salary of the D-1 grade is \$12 080 per annum.
- c/ It has been assumed that senior visiting scientists would also have the emoluments of the D-1 grade, whereas junior visiting scientists would have the emoluments of the P-4 grade. In both cases the appointments would be of one year average. The base salary of the P-4 grade is \$8 930 per annum.
- d/ It has been assumed that stipends for the fellows could be under the United Nations Expanded Programme of Technical Assistance and an average between the present rates for Italy and Denmark was taken as a basis. Two grades for the fellows with a salary differential of about 10% have been taken into account.
- e/ The base salaries of the P-3 and P-2 grades are \$7 460 per annum and \$6 130 per annum respectively.
- f/ Rounded out to the nearest thousand dollars.
- g/ Including an initial investment of \$100 000.

Basis for Estimate of Space Requirements  
(Not including housing facilities)

The capacity of the centre at the end of the 5th year is considered. Units of 12 m<sup>2</sup> are taken as a basis. It is felt that for fellows and secretarial staff a surface of 2 units for 3 persons might be sufficient.

<u>Scientific staff:</u>	No.	units	m <sup>2</sup>
Director	1	3	36
Professors	6	12	144
Visiting scientists	6	6	72
Guest scientists	15	15	180
Fellows	35	24 - 35	288-420
Sub-totals:	63	60 - 71	720-852

Administrative and technical staff:

Administrator	1	2	24
Secretaries, typists	6	4 - 6	48 -72
Housing (Assistant)Off.	1	1	12
Librarian	1	1	12
Computer, programmer	2	2	24
Sub-totals:	11	10 - 12	120-144

m<sup>2</sup>

Total staff: 74 . 70 - 83 (840-996)

i.e. 1000 approx.

Facilities:

Library (for 10.000 books, including bound periodicals)	400
Storage room for scientific documents	200
Lecture rooms: one big (150 m <sup>2</sup> ), two small (50m <sup>2</sup> each)	250
Conference room for Council, panels, etc; for about 20 participants plus secretariat; including simultaneous interpretation (?)	150
Recreation rooms	200
Reproduction rooms (1 - 2)	50
Maintenance rooms (2 - 3)	50
Circulation space, showers, toilets, etc. (representing about 1/3 of working area)	700

Grand total: 3000

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Total minimum recommended space requirements: 3000 m<sup>2</sup>