

**MEMORANDUM OF UNDERSTANDING**

**between**

**The National Science Foundation (NSF) of the United States of America**

**and**

**the following European Organisations (hereinafter called "the European Organisations"):**

**The European Southern Observatory (ESO), Garching ,  
the Centre National de la Recherche Scientifique (CNRS), France,  
the Max-Planck Gesellschaft (MPG), Germany,  
the Netherlands Foundation for Research in Astronomy/Nederlandse  
Onderzoekschool Voor Astronomie (NIRA/NOVA),**

**and**

**the United Kingdom Particle Physics and Astronomy Research Council  
(PPARC),**

**- all hereinafter called "the Signatories" -**

**concerning the design and development phase of a large aperture mm/sub-mm  
array, to be known as the Atacama Large Millimeter Array (ALMA).**

*RAE*

## Recognising

- the potential of large interferometric arrays operating at millimeter and sub-millimeter wavelengths to contribute to the study of a wide range of astronomical problems;
- the interest of the astronomical communities of Europe and of the United States of America in developing such an array;
- the interest of other astronomical communities in participating in a large millimeter and sub-millimeter interferometric array project;
- the potential advantages of combining these aspirations in a single global project;
- the advantage of sharing the necessary design and development;
- the necessity to locate ALMA at a dry, high altitude site;
- the identification of a suitable site in a region of the Altiplano in northern Chile; known as Zona Chajnantor;
- the need to develop the site and design the technology to take greatest advantage of the site;

## and Noting

- the design and development work already underway in the United States on the Millimeter Array (MMA) and the preparatory work already in progress in Europe on the proposed Large Southern Array (LSA);
- the work already carried out in Europe, and specifically the Combined Report of April 1997 and the LSA/MMA Feasibility Study of April 1998 prepared by the working groups of the "LSA Consortium";
- the support given by the National Science Foundation to the US National Radio Astronomy Observatory (NRAO) to carry out a design and development phase for the MMA during the period June 1998 through June 2001;
- the Memorandum of Understanding (attached at Annex 1) between the European Organisations ("the European MOU") concerning the design and development phase of a large mm/sub-mm array;
- the Resolution between the NRAO and the European Southern Observatory (ESO) signed in June 1997, and affirming a common interest in conducting discussions exploring the possibility of a merged array project;

- the progress made by ESO and NRAO in negotiating with the Chilean authorities over the use of the identified site;
- the Resolutions of the ESO Council of September 15, 1998;
- the Resolution of the ECC and AUI of 20 January 1999;
- the Resolution of AUI, ECC, and National Astronomical Observatory of Japan (NAOJ) of 23 March 1999;

**the Signatories hereby resolve to:**

collaborate in the Design and Development phase (hereinafter referred to as "Phase 1") of a large millimeter/submillimeter array (to be known as the Atacama Large Millimeter Array, ALMA), presently intended to comprise 64 12-m antennas with instrumentation to be agreed, on the Zona de Chajnantor east of the village of San Pedro de Atacama in the Republic of Chile; and

use their best endeavours to obtain approval and all necessary funding for their collaborative participation in a single project for the Construction and Operation (hereinafter referred to as "Phase 2") of ALMA.

**The Signatories have therefore agreed as follows:**

#### **Article 1**

##### **Scope and Purpose**

- 1.1 This Memorandum of Understanding (MOU) shall provide for Phase 1 of ALMA with the intention of the Signatories, subject to availability of funds, the results of Phase 1 work and necessary authorisations, to proceed with Phase 2 of ALMA under the terms of an agreement ("the Phase 2 Agreement") which shall be concluded during the period of validity of this MOU.
- 1.2 The Signatories commit themselves to 'best efforts' in meeting the provisions of this MOU.
- 1.3 The European Organisations will co-ordinate their activities in Phase 1 and exercise their rights and obligations under this MOU through the ECC established under the terms of the European MOU (Annex 1).

#### **Article 2**

##### **Period of Applicability**

- 2.1 This MOU shall come into force on the date the last signatory signs and shall expire on 31 December 2001, or the date that the Phase 2 Agreement comes into force, whichever is the sooner, unless extended for a further defined period by the written agreement of all the Signatories.

- 2.2 Insofar as it affects the relations between Signatories, this MOU takes precedence over, but does not replace, any existing agreements or MOUs concerning the LSA, MMA, or ALMA to which the Signatories are party.

### **Article 3**

#### **Intellectual and Economic Benefits**

- 3.1 The Signatories will obtain intellectual and economic benefit from ALMA in proportion to the value of their contributions to ALMA and consistent with the timely and cost-effective execution of ALMA.

### **Article 4**

#### **Implementation of Phase 1**

- 4.1 Immediately after this MOU comes into effect, the Signatories shall establish an ALMA Co-ordination Committee (ACC) to be responsible to them for the oversight of all activities carried out under the provisions of this MOU.
- 4.2 The ACC will comprise 6 representatives designated by the NSF and 6 representatives designated by the European Organisations. The Signatories may change their appointees at any time by notifying the change in writing to the Secretary of the ACC.
- 4.3 The composition of the ACC is set out in Annex 2 and its Terms of Reference in Annex 3.
- 4.4 The Chair shall be selected by the ACC from among its members and will serve for a period not exceeding one year, after which the ACC shall select a new Chair. The Chair shall be held alternately by the US and by the European Organisations.
- 4.5 The ACC Chair shall arrange for the appointment of a Secretary to ensure the proper running and recording of its activities.
- 4.6 Within 90 days of this MOU coming into force, the ACC shall establish, by the unanimous agreement of its members, its Rules for Procedure, including those for the selection of the Chair. The Rules for Procedure shall be attached as Annex 4 to this MOU.
- 4.7 The ACC shall meet not less than twice per year.

### **Article 5**

#### **Project Management in Phase 1 of ALMA**

- 5.1 The MMA Project Director (appointed by NRAO under the authority of the NSF) and the European Project Manager for Phase 1 of the LSA (appointed under the authority of the European MOU) shall, under the direction of the ACC, jointly develop a Management Plan and Work Programme for Phase 1

of the ALMA project for approval by the ACC within 120 days of the MOU coming into force.

- 5.2 The agreed Phase 1 Management Plan and Work Programme will be set out in Annex 5 and shall be periodically reviewed and revised as necessary by the ACC.
- 5.3 The aforementioned MMA Project Director and the European Project Manager shall jointly maintain detailed records of work done, and shall submit joint quarterly progress reports to the ACC, detailing work done against the agreed Phase 1 Work Programme, resource utilisation and contributions, in cash or in kind, made by the Signatories.
- 5.4 The ACC shall report on all activities, progress and resource utilisation at regular intervals, and not less than semi-annually, to the Signatories.

#### **Article 6**

##### **Work Programme in Phase 1 of ALMA**

- 6.1 The objective of Phase 1 is to completely define the work to be carried out in Phase 2 and its cost and to negotiate the Agreement for its implementation. The definition shall include scientific and technical requirements, proposed technical and management approaches, a Work Breakdown Structure (WBS) and the cost estimate and schedule for Phase 2, as derived from this WBS.
- 6.2 The project shall show in Phase 1 both the feasibility of the proposed technical approach to meet the requirements, and the reliability of the cost estimate and schedule, by performance measurements on prototype components, and subsystems, such as prototype antenna(s).

#### **Article 7**

##### **Resource Contributions to Phase 1 of ALMA**

- 7.1 The Signatories shall contribute specified resources in cash and in kind to enable the Work Programme of Phase 1 to be carried out.
- 7.2 These resources shall be agreed by the Signatories and set out in Annex 6, subject to confirmation by each contributing Signatory, and shall be periodically reviewed.
- 7.3 The equipment supplied under this MOU shall be used to enable the execution of the Work Programme. The contributing Signatory or its designee shall remain the owner of this equipment, unless otherwise agreed by the Signatories. In general, major purchases shall be the subject of competitive tendering on terms that are not selectively or unreasonably to the disadvantage of contractors based in any of the Signatory countries. The procedures for such tendering shall be approved by the ACC.

- 7.4 The ACC may propose that the Signatories modify the Resource Contributions and hence Annex 6. Any changes will only become effective when agreed to by the Signatories.

#### **Article 8**

##### **Resource Contributions to Phase 2 of ALMA**

- 8.1 It is the intention of the Signatories that the resources contributed by the NSF and the European Organisations collectively to the total value of Phase 1 and Phase 2 of the project should be approximately equal.
- 8.2 It is expected that most contributions will be made without exchange of funds, and that benefits will accrue in proportion to the value of contributions.

#### **Article 9**

##### **Relations with the Host State**

- 9.1 The Signatories confirm their intent to provide Chilean Astronomy with a proportion of ALMA's observing time, in recognition of Chile's status as Host State and subject to negotiation in the context of the Phase 2 Agreement (see Annex 7).

#### **Article 10**

##### **Intellectual Property Rights**

- 10.1 The Signatories shall notify each other of any inventions or copyright work emanating from their contributions to Phase 1.
- 10.2 For intellectual property created during Phase 1 activities designated in the Work Programme, as defined under Article 5.1 as joint design and development, the Signatories shall have rights and interests on the basis of their relative contributions. For any Phase 1 design and development activities that are not designated as joint activities, rights will fall to the Signatory responsible for this activity.
- 10.3 Each Signatory shall ensure that the other Signatories are granted non-exclusive, royalty free licenses for the use of such intellectual property within the framework of this MOU.

#### **Article 11**

##### **The Phase 2 Agreement**

- 11.1 The Signatories will aim to complete the draft of the Phase 2 Agreement by no later than May 2000 and the final text of the Phase 2 Agreement by no later than December 31, 2000. An outline of items to be included in the Phase 2 Agreement is attached at Annex 7.

## Article 12

### New Signatories

- 12.1 Other organisations may join the MOU at any time by application to the ACC and subject to the unanimous agreement of all existing Signatories. Their rights and obligations, including participation in the ACC, shall be made clear in an amendment to this MOU.

## Article 13

### Amendments

- 13.1 This MOU may be amended at any time with the agreement of all Signatories. Any amendment must be in writing, signed and dated by all Signatories, and becomes an integral part of the MOU on the date that the last Signatory signs.

## Article 14

### Withdrawal

- 14.1 A Signatory may withdraw from this MOU subject to not less than one year's written notice and to agreement between the Signatories, including the withdrawing Signatory, of the terms of withdrawal.
- 14.2 In the event that a Signatory withdraws, the MOU will be amended to reflect the new circumstances under which it will continue.

## Article 15

### Default

- 15.1 A Signatory determined by the ACC to be in default of its obligations under this MOU will immediately be served notice of its default in writing by the Chair of the ACC, acting on behalf of the other Signatories.
- 15.2 If the defaulting Signatory has not rectified its default to the satisfaction of the ACC within 30 days of the serving of notice, it shall be deemed to have sought withdrawal and must negotiate in good faith with the other Signatories to reach an equitable settlement for its withdrawal under Article 14.

## Article 16

### Disputes

- 16.1 Any disputes between Signatories on the interpretation or implementation of the provisions of this MOU shall be resolved by negotiation between the Signatories.

Article 17

Disclaimer

17.1 This MOU is not intended to create legally binding obligations between the Signatories.

For the National Science Foundation

Robert A. Eisenstein June 10, 1999

For the European Southern Observatory

Ruedo 10/6/99

For the Centre National de la Recherche Scientifique

[Signature] 21/6/99

For the Max-Planck-Gesellschaft

[Signature] 10-June - 1999

AGP DAF



**MEMORANDUM OF UNDERSTANDING**  
**CONCERNING THE DESIGN AND DEVELOPMENT**  
**PHASE OF A LARGE MM/SUB-MM ARRAY**

The European Southern Observatory (ESO) Garching

and

The following Organisations in its member states

Centre National de la Recherche Scientifique,

Max-Planck-Gesellschaft,

the Netherlands' Foundation for Research in Astronomy and  
Nederlandse Onderzoekschool Voor Astronomie

and

The United Kingdom Particle Physics and Astronomy Research Council  
(PPARC) Swindon

- hereinafter called "Signatories" -

**Recognising**

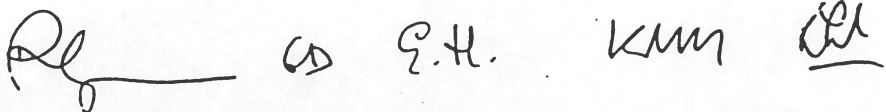
the potential of large interferometric arrays operating at millimetre and sub-millimetre wavelengths to contribute to the study of a wide range of astronomical problems;

the interest of the European astronomical community in developing such an array (LSA) to be constructed in Chile;

the interest of the astronomical community of the United States of America in developing an array (MMA) to be constructed in Chile;

the interest of other astronomical communities in participating in a large millimetre and sub-millimetre interferometric array project;

the potential advantages of combining these aspirations in a single global project;



**and Noting**

the work already carried out in Europe, in particular the instruments already developed the Combined Report of April 1997 and the LSAMMA Feasibility Study of April 1998 prepared by the working groups of the "LSA Consortium" including ESO, IRAM, NFRA and OSO;

the support given by the National Science Foundation to the US National Radio Astronomy Observatory (NRAO) to carry out a design and development phase over the period 1998-2001;

the Agreement between the European Southern Observatory (ESO) and NRAO signed in June 1997;

the progress made by ESO and NRAO in negotiating with the Chilean authorities over the use of a site on the Plateau of Chajnantor;

the Resolutions of the ESO Council of September 15, 1998;

**the Signatories to this Memorandum of Understanding have Resolved**

to pursue, over the period until 2001, a co-ordinated design and development programme, hereinafter referred to as "Phase 1", in conjunction to that being pursued by NRAO, drawing on the expertise and experience of a range of institutes and industries in Europe;

to negotiate collectively with NSF, NRAO, and other interested parties on the development of an international millimetre and sub-millimetre interferometric array project;

**in pursuance of which they will**

establish the structures and mechanisms necessary for European co-ordination in the implementation of the provisions of this MOU;

negotiate with NSF and others on the contents of an MOU formalising a global project.

**Article 1**

**Scope and Purpose**

1.1 This MOU comprises the main Articles together with Annexes, which are an integral part of the MOU. The Signatories commit themselves to 'best efforts' in meeting its provisions.

1.2 This MOU has as objective and establishes the commitment of the Signatories:

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*Re*

*GD*

*E.H*

*KMM*

1.2.1 to pursue, over the period until 2001, a co-ordinated design and development programme, in conjunction to that being pursued by NRAO, drawing on the expertise and experience of a range of organisations, institutes and industries in Europe;

1.2.2 to negotiate collectively with NSF, NRAO, and other interested parties on the development of an international millimetre and sub-millimetre interferometric array project, to be formalised in a Memorandum of Understanding on a global project to be submitted to the Signatories;

1.2.3 to establish the structures and mechanisms necessary for European co-ordination in the implementation of the provisions of this MOU.

## Article 2

### Period of Validity

2.1 This MOU shall be deemed to enter into force on 1 January 1999 and to remain in force until either 31 December 2001 or the end of Phase 1, whichever is the sooner, unless extended.

2.2 The MOU shall not confer rights and obligations upon any Signatory until such time as they have signed the MOU.

## Article 3

### European Co-ordination Committee

3.1 Immediately after this MOU comes into effect, the Signatories shall establish a European Co-ordination Committee (ECC) to be responsible to them for the oversight of all activities carried out under the provisions of this MOU.

3.2 The ECC will comprise representatives of the Signatories in numbers in broad proportion to their intended contributions to the array project. The Signatories may change their appointees at any time by notifying the change in writing to the ECC.

3.3 The composition of the ECC is set out in Annex 1 and its Terms of Reference in Annex 2. New members may join the ECC as and when they become Signatories to this MOU under the terms of Article 11.

3.4 The Chair shall be selected by the ECC from among its members and will serve for a period not exceeding two years, after which the ECC shall select a new Chair.

3.5 The ECC shall establish its Rules of Procedure, including those for the selection of the Chair.

3.6 The ECC shall meet not less than three times per year.

## Article 4

### Project Management in Phase 1

4.1 The ECC shall appoint a European Project Manager (EPM), who will act as Project Leader, and a European Project Scientist within 31 days of this MOU coming into force.

4.2 The EPM shall set up a European Project Team, drawing on resources offered by the Signatories, and within 60 days of appointment shall submit a Project Phase 1 Management Plan including the composition of the Project Team and Work Programme to the ECC for approval.

## Article 5

### Work Programme in Phase 1

5.1 The objective of Phase 1 is to completely define a joint project to construct and operate an international millimetre and sub-millimetre interferometric array (hereinafter called "Phase 2") and to negotiate an agreement for the implementation of Phase 2. The definition shall include Level 1 scientific and technical requirements, proposed technical and management approaches, and the estimated cost and schedule for Phase 2. The Phase 1 Work Programme shall demonstrate both the feasibility of the proposed technical approach to meet the Level 1 requirements and the reliability of the estimated cost and schedule. Demonstration of these characteristics by measured performance on prototype components and subsystems, including a European prototype antenna, is part of the objectives of Phase 1.

5.2 A preliminary Work Programme is attached for reference.

*RF*      *GD*      *S.H.*      *KMM*      *BS*

## Article 6

### Resource Contributions to Phase 1

- 6.1 The Signatories agree to contribute specified resources in cash and in kind to enable the Work Programme of Phase 1 to be carried out.
- 6.2 These resources shall be agreed by the ECC and set out in Annex 3, subject to confirmation by the contributing Signatory, and shall be periodically reviewed. The in-cash resources shall be administered on behalf of the Signatories by ESO, which will report to the ECC on its use.
- 6.3 The equipment supplied under this MOU shall be used to enable the execution of the Work Programme. The contributing Signatory shall remain the owner of this equipment, unless otherwise agreed by the Signatories. The rules and regulations of each Signatory shall apply for procurement of this equipment.
- 6.4 The ECC may propose that the Signatories modify the Resource Contributions and hence Annex 3. Any changes will only become effective when agreed by the relevant Signatories.

## Article 7

### Reporting and Accounting

- 7.1 The EPM shall maintain detailed records of work done, and shall submit quarterly progress reports to the ECC, detailing work done against the agreed Work Programme, resource utilisation and contributions, in cash or in kind, made by the Signatories.
- 7.2 The ECC shall report on all activities, progress and resource utilisation at regular intervals, and not less than annually, to the Signatories.

## Article 8

### The European Negotiating Team

- 8.1 Immediately after this MOU comes into effect, the Signatories shall establish a European Negotiating Team, which will be responsible for all formal negotiations with NSF/NRAO and other agencies or institutions (with the exception of Chile - Article 10) which are not Signatories to this MOU. The European Negotiating Team shall consist of representatives of the Signatories in numbers in broad proportion to their intended contributions to the array project. The Signatories may change their appointees at any time, by notification in writing to the ECC and all other Signatories.

8.2 The European Negotiating Team shall consult the Signatories as necessary and report regularly to the ECC.

## Article 9

### Liaison with NRAO/NSF

9.1 All formal liaison on the technical level with NRAO shall be carried out by the European Project Manager and the Project Team under his control.

9.2 All formal liaison with NSF shall be carried out by the European Negotiating Team.

## Article 10

### Liaison with Chile

10. All formal liaison with the relevant bodies in Chile on behalf of the Signatories and the ECC will be carried out by ESO, which will consult the Signatories where necessary and report regularly to the European Co-ordination Committee.

## Article 11

### New Signatories

11. New Signatories, in particular research organisations or national funding agencies, may join the MOU at any time by application to the ECC and subject to the unanimous agreement of all existing Signatories. Their rights and obligations shall be made clear in an amendment to this MOU.

## Article 12

### Amendments

12. This MOU may be amended at any time with the agreement of all Signatories. Any amendment must be in writing, signed and dated by all Signatories, and becomes an integral part of the MOU on the date that the last Signatory signs.

*Ref* *GO* *P.H.* *KMM* *Ref*

## Article 13

### Withdrawal

13.1 A Signatory may withdraw from this MOU subject to one year's written notice of termination and to a consultation between the Signatories with a view to reaching an equitable settlement.

13.2 In the event that a Signatory withdraws, the MOU will be amended to reflect the new circumstances under which it will continue.

## Article 14

### Default

14.1 A Signatory in default of its obligations under this MOU will be served notice of its default in writing by the Chair of the ECC, acting on behalf of the other Signatories.

14.2 If the defaulting Signatory has not rectified its default to the satisfaction of the ECC within 31 days of the serving of notice, it shall be deemed to have sought withdrawal and must negotiate in good faith with the other Signatories to reach an equitable settlement for its withdrawal under Article 13.

## Article 15

### Disputes

15. Any disputes between Signatories on the meaning or implementation of the provisions of this MOU shall be resolved by negotiation between the Signatories.

## Article 16

### Intellectual Property Rights

16.1 The Signatories shall notify each other of any inventions or copyright work emanating from their contributions to Phase 1.

16.2 For intellectual property created during research and development activities designated by the Signatories as joint research and development, the Signatories shall obtain rights and interests by mutual agreement, on the basis of their relative contributions. If research and development activities are not designated as joint research, rights will be obtained in accordance with the policy of the signatory responsible for this research.

16.3 Each Signatory shall assure that the other Signatories are granted non-exclusive, royalty free licenses for the use of such intellectual property within the framework of this array project.

Date: November 6, 1998

For the European Southern Observatory



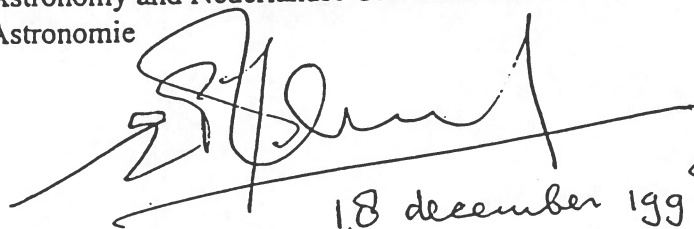
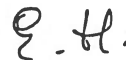
For Centre National de la Recherche Scientifique



For the Max-Planck-Gesellschaft



For the Netherlands' Foundation for Research in  
Astronomy and Nederlandse Onderzoekschool Voor  
Astronomie



18 december 1998

For the United Kingdom Particle Physics and  
Astronomy Research Council

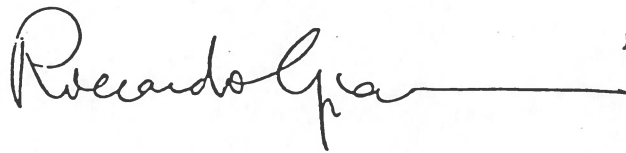




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Date: November 6, 1998

For the European Southern Observatory



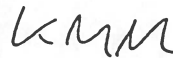
Dec 17, 1998

For Centre National de la Recherche Scientifique



Jean-François MINSTER

For the Max-Planck-Gesellschaft

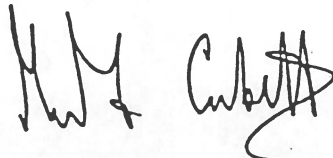


Dec. 17, 1998

For the Netherlands' Foundation for Research in Astronomy and Nederlandse Onderzoekschool Voor Astronomie

S.H.

For the United Kingdom Particle Physics and Astronomy Research Council



17/12/98

## ANNEX 1

**COMPOSITION OF THE EUROPEAN  
CO-ORDINATION COMMITTEE (ECC)**

The ECC shall be comprised of four members representing the European Southern Observatory (ESO), one member representing the Particle Physics and Astronomy Research Council of the United Kingdom (PPARC), and one member representing the Centre National de la Recherche Scientifique of France (CNRS). Each member can, at their discretion, be accompanied by an expert.

The members as of 1 January 1999 are:

ESO            Prof. R. Giacconi  
                  Dr. J. Bezemer  
                  Dr. A. Freytag  
                  Prof. F. Pacini

PPARC        Dr. I. F. Corbett

CNRS         Prof. J-F. Minster

## ANNEX 2

**TERMS OF REFERENCE OF THE EUROPEAN  
CO-ORDINATION COMMITTEE (ECC)**

1. The ECC shall be responsible to the Signatories for the co-ordination and oversight of all activities carried out under the provisions of the MOU. (MOU Article 3.1)
2. The ECC shall establish its Rules of Procedure, including those for the selection of the Chair. (MOU Article 3.5)
3. The ECC shall select its Chair according to the Rules of Procedure. The Chair shall serve for a period not exceeding two years, after which the ECC shall select a new Chair. (MOU Article 3.4)
4. The ECC shall meet not less than three times per year. (MOU Article 3.6)
5. The ECC shall appoint a European Project Manager (EPM) and a European Project Scientist (EPS) within 31 days of the MOU coming into effect. (MOU Article 4.1)
6. The ECC shall review and approve the Project Phase 1 Management Plan, including the composition of the Project Team, and Work Programme that will be prepared by the EPM within 60 days of his/her appointment. The ECC may modify these plans. (MOU Article 4.2)
7. The ECC may propose to the Signatories to modify the Resource Contributions and Annex 3 of the MOU. (MOU Article 6.4)
8. The ECC shall report on all activities, progress and resource utilization at regular intervals to the Signatories. (MOU Article 7.2)
9. Any Signatory in default of its obligations under the MOU will be notified in writing of its default by the Chair of the ECC, acting on behalf of the other Signatories. The ECC will monitor the rectification of this default. (MOU Article 14.1)
10. The ECC will serve for the duration of the MOU.
11. The ECC shall be the primary forum for interactions and decisions between the Signatories.
12. The ECC shall establish and control policy for Phase 1 of the program.
13. The ECC shall receive and comment on reports from the Signatories on negotiations with non-Signatories wishing to join the Phase 1 program.

14. The ECC shall review and approve the Scientific and Technical Requirements.
15. The ECC shall define and appoint such subcommittees as the ECC deems necessary.

## ANNEX 3

## PHASE 1 RESOURCE CONTRIBUTIONS

Preliminary projections of Phase 1 resource contributions in kind and in cash were given by the Signatories at the 6 November 1998 meeting and are listed below. These projections are for planning purposes only and are subject to confirmation by the Signatories.

|           | <b>In-kind Contribution</b> | <b>In-cash Contribution</b> |
|-----------|-----------------------------|-----------------------------|
| ESO       | 3.6 MDM                     | 7.2 MDM                     |
| PPARC     | 1 M£                        | 1 M£                        |
| CNRS      | 6 FTE's                     | 2 MDM                       |
| MPG       | 5-6 FTE's                   | 2 MDM                       |
| NFRA/NOVA | 7,7 FTE's<br>320 KDM        |                             |

## ANNEX 4

### COMPOSITION OF THE EUROPEAN NEGOTIATING TEAM (ENT)

The ENT shall be comprised of four members representing the European Southern Observatory (ESO), one member representing the Particle Physics and Astronomy Research Council of the United Kingdom (PPARC), and one member representing the Centre National de la Recherche Scientifique of France (CNRS).

The members as of 1 January 1999 are:

|     |  |
|-----|--|
| ESO | Mr. H. Grage<br>Prof. R. Giacconi<br>Dr. A. Freytag<br>Prof. F. Pacini |
|-----|--|

|       |                   |
|-------|-------------------|
| PPARC | Dr. I. F. Corbett |
|-------|-------------------|

|      |                    |
|------|--------------------|
| CNRS | Prof. J-F. Minster |
|------|--------------------|

## ANNEX 2

### COMPOSITION OF THE ALMA CO-ORDINATION COMMITTEE (ACC)

The ACC shall be comprised of six members representing the European Organisations and six members designated by the NSF.

As of June 10, 1999, these members are:

#### NSF:

|                          |   |
|--------------------------|---|
| Dr. Robert A. Eisenstein | Assistant Director for Mathematical and Physical Sciences   |
| Dr. Hugh M. Van Horn     | Director, NSF Division of Astronomical Sciences   |
| Dr. Robert L. Dickman    | Co-ordinator, NSF Radio Astronomy Facilities Unit   |
| Dr. Martha Haynes        | President, Associated Universities, Inc.  |
| Dr. Paul A. Vanden Bout  | Director, National Radio Astronomy Observatory  |
| (To be named)            | Representative of the North American astronomical community,<br>nominated by the President of AUI subject to NSF approval |

#### European Organisations:

|                         |                             |
|-------------------------|-----------------------------|
| Prof. Riccardo Giacconi | ESO Director General        |
| Dr. J. Bezemer          | Delegate to the ESO Council |
| Dr. I. F. Corbett       | Director of Science, PPARC  |
| Dr. A. Freytag          | Delegate to the ESO Council |
| Prof. J-F. Minster      | Director of INSU (CNRS)     |
| Prof. F. Pacini         | Delegate to the ESO Council |

### ANNEX 3

#### TERMS OF REFERENCE OF THE ALMA CO-ORDINATION COMMITTEE (ACC)

The ACC shall

- ◆ Maintain oversight of the merged Phase 1 ALMA project defined in this MOU;
- ◆ Establish the organization of Phase 1 of the ALMA project;
- ◆ Be responsible for defining the scope of work for Phase 1 of the ALMA project;
- ◆ Establish the mechanisms for, and control the implementation of, Phase 1 of the ALMA project; and
- ◆ Establish the Final Agreement to merge the U.S. and European construction projects into the construction phase of the ALMA project.

Specifically,

1. The ACC shall be responsible to the Signatories for the co-ordination and oversight of all activities carried out under the provisions of the MOU (MOU Article 4.1).
2. The ACC shall establish its Rules of Procedure (MOU Article 4.6; Annex 4).
3. The Chair shall be selected by the ACC from among its members and will serve for a period not exceeding one year, after which the ACC shall select a new Chair. The Chair shall be held alternately by the U.S. and by the European Organisations (MOU Article 4.4).
4. The ACC shall meet not less than twice per year (MOU Article 4.7).
5. The ACC Chair shall arrange for the appointment of a Secretary (MOU Article 4.5).
6. The ACC shall define and appoint such subcommittees as it deems necessary.
7. The ACC shall review and approve the Management Plan and Work Program for Phase 1 of the ALMA Project within 120 days of the MOU coming into force. The ACC will review and revise these documents as necessary (MOU Articles 5.1, 5.2).
8. The ACC may propose to the Signatories to modify the Resource Contributions and Annex 6 of the MOU (MOU Article 7.4). Any changes only become effective when agreed to in writing by the Signatories.
9. The ACC shall report on all activities, progress and resource utilization at regular intervals, and not less than semi-annually, to the Signatories (MOU Article 5.4).



10. Any Signatory determined by the ACC to be in default of its obligations under the MOU will be notified in writing of its default by the Chair of the ACC, acting on behalf of the other Signatories. The ACC will monitor the rectification of this default (MOU Articles 15.1, 15.2).
11. The ACC will serve for the duration of the MOU. Appointees to the ACC may be changed at any time by providing the Signatories with written notification of the change via the Secretary of the ACC (MOU Article 4.2).
12. The ACC shall be the primary forum for interactions and decisions between the Signatories.
13. The ACC shall approve tendering procedures for major purchases (MOU Article 7.3).
14. The ACC shall receive and comment on reports from the Signatories on negotiations with non-Signatories wishing to join the Phase 1 program. Applications to join this MOU shall be addressed to the Chair of the ACC and require the unanimous agreement in writing of the Signatories through the ACC (MOU Article 12.1).
15. The ACC shall review and approve the scientific and technical requirements proposed for the ALMA.

ANNEX 6 (revised)

**PHASE 1 RESOURCE CONTRIBUTIONS**

Preliminary projections of Phase 1 resource contributions in kind and in cash were given by the Signatories and are listed below. These projections are for planning purposes only.

|                     | <b>In-kind Contribution</b> | <b>In-cash Contribution</b> |
|---------------------|-----------------------------|-----------------------------|
| <b>ESO</b>          | 4.5 MDM                     | 7.2 MDM                     |
| <b>PPARC</b>        | 1 M£                        | 1 M£                        |
| <b>CNRS</b>         | 19.3 staff-years            | 2 MDM                       |
| <b>MPG</b>          | 15.8 staff-years            | 2 MDM                       |
| <b>NFRA/NOVA</b>    | 7.7 staff-years<br>320 KDM  |                             |
| <b>NFR</b>          | 28 FTE's<br>2.8 MSEK        | 1 MDM                       |
| <b>NSF<br/>NRAO</b> | 5-7 staff-years             | \$26M <sup>1</sup>          |

Annex 5 - missing

Annex 4 missing

<sup>1</sup> Final U.S. contribution in FY 2000 is subject to approval of funding by the U.S. Congress.

## ANNEX 6

### PHASE 1 RESOURCE CONTRIBUTIONS

Preliminary projections of Phase 1 resource contributions in kind and in cash were given by the Signatories at the June 10, 1999 meeting and are listed below. These projections are for planning purposes only and are subject to confirmation by the Signatories.

|           | In-kind Contribution | In-cash Contribution |
|-----------|----------------------|----------------------|
| ESO       | 3.6 MDM              | 7.2 MDM              |
| PPARC     | 1 M£                 | 1 M£                 |
| CNRS      | 6 person-years       | 2 MDM                |
| MPG       | 5-6 person-years     | 2 MDM                |
| NFRA/NOVA | 7.7 person-years     | 320 KDM              |
| NSF       |                      | \$26M <sup>1</sup>   |
| NRAO      | 5-7 person years     |                      |

<sup>1</sup> Final U.S. contribution in FY 2000 is subject to approval of funding by the U.S. Congress.

## EXAMPLES OF ITEMS TO BE INCLUDED IN THE PHASE 2 AGREEMENT

The Phase 2 Agreement will, *inter alia*, specify:

- the baseline ALMA instrument, including the number of antennas to be built, their diameter, receivers, etc.;
- the cost, schedule, and milestones for delivery of this instrument;
- a common methodology for the valuation of in-kind contributions;
- the nature, quantity and value of the Signatories' contributions to ALMA;
- the composition, remit and authority of the ALMA Board;
- the relations with the host state;
- the mechanism by which, when agreed to be necessary, purchases may be made, and costs may be paid, centrally on behalf of all Signatories;
- the tendering procedures to be adopted;
- the ownership of the ALMA and its various components;
- the organizational details of ALMA;
- the procedures for the allocation, execution and monitoring of in-kind contributions;
- the procedures for the allocation of the observing time;
- the procedures for the archiving and distribution of data collected by ALMA;
- the procedures for the allocation and protection of intellectual property rights; and
- the mechanisms for dealing with withdrawals, defaults and disputes.

**AMENDMENT NO. 1 TO THE  
MEMORANDUM OF UNDERSTANDING  
CONCERNING THE DESIGN AND DEVELOPMENT  
PHASE OF A LARGE MM/SUB-MM ARRAY,  
TO BE KNOWN AS THE ATACAMA LARGE MILIMETER ARRAY (ALMA)**

signed on June 10 and 21 and July 1, 1999, by its Signatories:

The National Science Foundation (NSF) of the United States of America,  
The European Southern Observatory (ESO), Garching,  
The Centre National de la Recherche Scientifique (CNRS), France,  
The Max-Planck-Gesellschaft (MPG), Germany  
The Netherlands' Foundation for Research in Astronomy/  
Nederlandse Onderzoekschool Voor Astronomie (NFRA/NOVA),  
and  
The United Kingdom Particle Physics and Astronomy Research Council .  
(PPARC).

Article 1

The Memorandum of Understanding shall be amended in accordance with its Articles 12 and 13 to include the Swedish Natural Science Research Council (NFR) as new Signatory.

Article 2

NFR shall have the rights and obligations of a Signatory as set out in the Memorandum of Understanding.

Article 3

Annex 6 to the Memorandum of Understanding setting out the resource contributions of the Signatories to Phase 1 shall be amended and will include the contribution of NFR. The revised version of this Annex 6 is part of this amendment and annexed to it.

Done on the date and at the place indicated in a single copy. This copy shall be kept in the custody of the Chair of the ECC who shall transmit a certified copy thereof to all Signatories.

For the National Science Foundation

For the European Southern Observatory:

Garching, January 11, 2000

For the Swedish Natural Science Research Council:

For the Centre National de la Recherche Scientifique:

For the Max-Planck-Gesellschaft:

For the Netherlands' Foundation for Research in Astronomy  
and Nederlandse Onderzoekschool Voor Astronomie:

For the United Kingdom Particle Physics and  
Astronomy Research Council: