Annex 1
List of Participants and Description of Work

Network title: Localisation by Nonlinearity and Spatial Discreteness, and Energy Transfer, in Crystals, Biomolecules and Josephson Arrays

Network short title: LOCNET

Part A - The Participants

The Principal Contractor and the Members listed below shall be jointly and severally liable in the execution of work defined in Part B of this Annex:

The Principal Contractor

The University of Warwick, established in the United Kingdom of Great Britain and Northern Ireland (Warwick).

The Members

Commissariat à l'Energie Atomique, Direction des Sciences de la Matière, established in France (Saclay)

Universität Erlangen-Nürnberg, established in Germany (Erlangen)

Universidad de Zaragoza, established in Spain (Zaragoza)

Technical University of Denmark, established in Denmark (Lyngby)

Foundation for Research and Technology - Hellas, established in Greece (Heraklion)

Istituto Nazionale per la Fisica della Materia, established in Italy (Firenze)

Centre National de la Recherche Scientifique, Délégation Ile-de-France Est, established in France (Thiais)

The Principal Contractor and the Members are referred to jointly as "the Participants". They are referred to individually by the short names given in parentheses above.

Part B - The Joint Programme of Work

1. Project Objectives

Classical Discrete Breathers: We will extend the existence theorems for optic breathers to general anharmonic systems with many degrees of freedom per unit cell, including acoustic phonons. We will also prove existence of discrete breathers associated with acoustic phonons. We shall numerically investigate bifurcations of breathers, to understand the ways they may lose stability or even existence, and to stimulate a general theory of such phenomena. Of particular interest are local modes of vibration on top of breathers, and we will develop theory to predict the number of such local modes. We shall develop theory of mobile breathers. Breather dynamics in the presence of external ac-fields will also be investigated, paying particular attention to the possibility of controlling energy transport and storage in discrete systems. (Tasks 1,4,5,6,7)

Quantum Discrete Breathers in Molecular Crystals: We will seek to apply the quantization of rotobreathers to the interpretation of experiments on 4-methyl pyridine, and similar approximate quantum treatments of anharmonic oscillators to an experiment on PtCl ethyldiamine chlorate. We shall develop new methods of data analysis for neutron scattering, to extract spatial correlation functions and provide direct experimental evidence for breathers. We shall put quantum discrete breathers onto a rigorous mathematical footing by proving persistence of spectral projections for networks of quantum units and deriving localisation properties. We shall explore technological implications (Tasks 2,3,15)

Vibrational energy distribution and flow: We shall explore the implications of spatially inhomogeneous time-periodic solutions which propagate energy. We shall extend to the case of "generalised multi-breathers" which are not exactly time-periodic. We shall understand the formation and annihilation of breathers in thermal equilibrium. We will investigate the role of breathers in detonation, heat conduction and glassy behaviour. We will examine the extent to which spectral hole burning and observations on absorption by interstellar carbonated dust can be explained in terms of breathers. (Tasks 5,6,7)

Polarons and Bipolarons: We wish to prove that the ground state of some 1D electron-phonon models are periodic or quasiperiodic structures, and that their transition by breaking of analyticity belongs to the same universality class as for Frenkel-Kontorova models. For 2D models we will investigate the coexistence of a metallic state with bipolarons and the effects of a magnetic field, temperature and addition of a Hubbard term. We will seek to prove existence of polarons in the SSH model of polyacetylene, and to formulate and study models for excitons in polyphenylenevinylene. (Task 8)

Josephson Junction Arrays: Using low temperature scanning laser microscopy, we will perform detailed experiments on Josephson junction ladders and larger arrays to excite and investigate localised dynamical states. Our objectives are to systematically study the stability and parameter range of the existence of the localised modes in ladders, investigate multi-cell localised states and interaction between individual rotobreathers, and attempt to study the effects of rotobreathers on transmission of plasmons and fluxons. In parallel, we shall develop the dissipative extension of the theory of breathers; in particular, we will have to investigate to what extent breather properties such as resonances, plane wave scattering and mobility, extend from the Hamiltonian case to these dissipative systems. An important step will be a uniform persistence of normally hyperbolic submanifolds result, to establish existence of generalised multibreathers in this context. We will also study aggregation of fluxons and flux interactions on stacked Josephson junctions under the influence of external fields. Finally, we shall investigate the possibility of observing quantum rotobreathers in the quantum regime of operation of Josephson-based devices. (Task 9)

Friction and Nonlinear Conductivity: We shall prove existence of a globally attracting sliding state for overdamped inertial dynamics of tilted Frenkel-Kontorova chains when there are no equilibria, and answer further questions for this model. Models of friction with contact and non-contact areas will also be studied. We shall carry out a critical examination of the applicability of elastic media models to CDW materials by comparing experimental data and theory, and explore alternative models of the Holstein type. (Task 10)

Breathers in Biomolecules: We propose to develop models for dynamical processes in biomolecules, like local openings in DNA, the active centre of enzymes, proton transfer along chains of hydrogen bonds, and biomotors (concentrating on the interaction of ATP synthase with myosin). We will perform STM studies on α-helices of polyalanine ordered under an electric field. (Tasks 11,12,13,14)

2. Research Method

Our research methods will comprise a combination of mathematical proof, numerical computation, physical insight, experiment and data analysis.

Mathematical proof: Mathematics plays an important role in our project, as it is a very useful tool for formulating physical problems and firmly establishing logical consequences. We will apply the implicit function theorem in suitable Banach spaces to deduce persistence results uniform in system size, and its Lyapunov-Schmidt version for the theory of generalised multi-breathers and a theory of travelling breathers. We will reduce the error estimates for the latter two by various techniques of exponentially small analysis. We will use functional analysis to deduce spatial localisation bounds. We will use preserved partial orders to deduce results about global attractors for tilted FK chains. We will use homology index theory to deduce survival of large numbers of critical points from tractable limits. We will use extensions of Levinson's theorem to understand the numbers of local modes on breathers. We will use concentration compactness to prove existence of acoustic breathers in FPU models.

Numerical computation: Computation is crucial for obtaining ideas on systems too complex to approach directly by experiment or mathematics. We will carry out simulations to discover and investigate phenomena, and design computations to find particular types of solution and their properties.

Physical insight: Physical intuition enables one to focus on the important phenomena, devise appropriate models, ask suitable questions and propose key experiments.

Experiment: Experiment plays a key role in our project to focus attention on real world problems and to test the applicability of theoretical results to real systems. The Josephson junction array experiments will be studied by low temperature scanning laser microscopy. The dynamics of molecular crystals will be investigated by vibrational spectroscopy and neutron scattering.

Data analysis: It is important to develop further data analysis techniques, in particular to extract spatial correlations of excitations in molecular crystals. We shall design new techniques using Bayesian inference.

3. Work Plan

The work is divided into 15 tasks below. Each task is broken down into pieces with start and end dates indicated in months from the beginning of the contract. The main nodes that will carry out each task are indicated (including Subcontractors and Associates in italics, where involved).

T1. Breather Existence Theorems :

Explicit estimates on breather continuation (0-12).
Extension of the existence theorems to anharmonic crystals with several degrees of freedom per unit cell and acoustic phonons (0-12),
and to acoustic breathers (0-12).
Theory of the number of localised modes on a breather (0-12).
Normally hyperbolic persistence theorems for generalised multibreathers in dissipative systems like Josephson arrays, proof (0-12),
and applications (6-18).
Life-time of quasiperiodic breathers (0-24).
Rigorous relation between modulational instability and discrete breathers (12-36).
Nodes: Saclay, Warwick, Zaragoza, *Nice*, *Milano*, *Dresden*.

T2. Breather Quantization :
Semiclassical EBK quantization of breathers (0-12).
Breather tunnelling (0-12).
Rigorous theory of quantum breathers as spectral projections (0-24).
Comparisons with experiments (0-36).
Nodes: Warwick, Saclay, Thiais, *Salerno*, *Montpellier*, *Dresden*, *Milano*.

T3. Rotobreathers :
Measurements of the full neutron scattering function on single crystals (0-24).
Development of semi-classical theory (0-24).
Analysis of experimental results (12-36).
Nodes: Thiais, Saclay, *Lyon*, *Cambridge*.

T4. Breather Mobility :
Tests of new concept of Peierls-Nabarro barrier (0-6).
Breather mobility in DNLS systems (0-12).
Analytical approaches (0-24).
Extensive numerical simulations (0-24).
Nodes: Heraklion, Lyngby, Warwick, Zaragoza, Saclay, Erlangen, *Lyon*, *Dresden*, *Edinburgh*, *Nice*, *Berlin*, *Milano*, *Sevilla*.

T5. Phonon-Breather interactions and Self-Localisation of Thermal Energy :
Analytical and numerical study of elastic and inelastic scattering of phonons from breathers, in 1,2 and 3D models (0-24).
Spontaneous breather growth and decay in systems at non-zero temperature (0-24).
Breather collisions (0-24).
Spectral hole-burning (12-36).
Interstellar carbon (12-36).
Detonation (24-36).
Nodes: Lyngby, Heraklion, Saclay, Firenze, Warwick, Erlangen, *Lyon*, *Berlin*, *Madrid*, *Dresden*.

T6. Spatial randomness and nonlinearity :
Interaction between Anderson and nonlinear localisation (0-24).
Application to DNA models (12-36).
Nodes: Warwick, Saclay, Firenze, Lyngby, *Sevilla*.

T7. Breather Induced Slow Relaxation :
Interpretation of experimental results on methyl pyridine (0-24).
Stretched exponential relaxation of breathers (0-24),
thermodynamic consequences (12-36),
dynamical response functions (12-36).
Nodes: Heraklion, Zaragoza, Saclay, Firenze, Thiais, *Lyon*, *Dresden*.

T8. Polarons and Bipolarons :
Formation of polarons and bipolarons in the 2D Holstein-Hubbard model (0-24),
investigation of conditions favouring superconductivity (12-24).
Theory for SSH polarons (12-36),
and PPV excitons (24-42).
Nodes: Warwick, Zaragoza, Lyngby, Saclay, *Edinburgh*, *Salerno*, *Milano*, *Cambridge*.

T9. Josephson Junction Arrays :
Breather stability and movability in Josephson junction ladders and forced-damped arrays of oscillators (0-24).
Interactions with fluxons (in JJ arrays) or discommensurations (oscillator arrays) and

linear waves (0-24).
Aggregation of breather-breather interactions on arrays and magnetic flux interactions on stacked Josephson junctions (0-24).
Experiments and their analysis (0-36).
Nodes: Zaragoza, Lyngby, Saclay, Erlangen, *Dresden*, *Salerno*, *Sevilla*.

T10. Solid Friction and Nonlinear Conductivity :
Extension of proof of globally attracting sliding states from gradient to overdamped inertial case (0-12).
Theory and numerics for one and two-dimensional generalized Frenkel-Kontorova models with tilt, inertia and damping (0-24).
Application to solid friction and nonlinear conductivity (but including an assessment of the applicability of the model to this problem) (12-30).
Energy dissipation and coupling with other degrees of freedom (24-36).
Study formation of breathers in underdamped case (24-42).
Nodes: Warwick, Zaragoza, Saclay, *Lyon*, *Edinburgh*.

T11. Proton transfer :
Experiments using inelastic neutron scattering technique that allows the quantum regime in proton transfer to be observed along pre-existing hydrogen bonds (0-36).
Collective proton transfer in infinite networks of hydrogen bonds, tunnelling transitions in polyglycines (0-36).
Nodes: Thiais, Heraklion, *Lyon*, *Montpellier*.

T12. Discrete polarobreathers :
Polarobreathers in hydrogen-bonded networks, Holstein and Fröhlich-type models (0-12).
Energy localisation in biological systems due to discreteness and nonlinearity (12-36), collapse studies (12-36).
Nodes: Heraklion, Lyngby, Saclay, Zaragoza, *Montpellier*, *Lyon*.

T13. DNA and globular protein dynamics :
Statistical mechanics of models for DNA and their dynamics near the denaturation transition, focussing on the role of discrete breathers (0-24).
The DNA model will be extended to include the elastic field associated to the twist and its coupling with DNA openings (12-24).
Application of extended DNA model to study bending induced by RNA polymerase, coupling of bending and local unwinding (12-36).
Molten globular protein states (12-36).
Nodes: Lyngby, *Lyon*, *Athens*, *Salerno*, *Cambridge*.

T14. Biological Motors :
Extension of molecular motor model for motion of proteins in biopolymers to include nonlinear aspects of the biopolymeric substrate (0-12),
stochastic simulations and analytical work targeting the role of nonlinear localised modes and collective motor function (12-24).
Interpretation of experiments at Saclay and Lyon (12-42).
Nodes: Heraklion, Zaragoza, Saclay, Lyngby, Firenze, *Salerno*, *Lyon*, *Barcelona*, *Cambridge*.

T15. Design of Breather-based Materials :
Based on the experience gained, put together ideas for potential ways that breathers could be used in technology (32-48).
Nodes: Heraklion, Erlangen, Thiais, Saclay, Zaragoza, Lyngby, Firenze, *Montpellier*, *Lyon*.

Schedule and Milestones

The schedule for the tasks has been indicated in the previous section. The milestones by which progress can be assessed are given in Table 1.

Major Milestones		
Month	*Milestones*	*Tasks*
6	Proofs of existence of acoustic breather in FPU models,	1
	optic breathers in general models with acoustic phonons,	1
	and globally attracting sliding state for overdamped tilted FK models	10
12	Development of data analysis techniques for neutron scattering experiments.	2,3
	Understand number of local modes on a breather.	1
	Proof and properties of generalised multibreathers in dissipative oscillator networks,	1
	and observation in Josephson arrays.	9
18	In depth assessment of role of breathers in interstellar carbon, spectral hole burning, 4-methyl pyridine, DNA and some biomotors.	2,3,5,7,13,14
	Rigorous theory of quantum breathers as spectral projections.	2
24	Theory of breather mobility.	4
	Mid-term review	
30	Understanding of heat conduction.	5,7
	Proof of existence of SSH bipolarons.	8
	Understanding of role of polarobreathers in hydrogen-bonded systems.	12
36	Understanding of solid friction and CDW conductivity.	10
	Understanding of proton transfer problems.	11
	Assessment of effect of genetic code on DNA breathers.	13
	Theory of relaxation of thermal energy in molecular crystals.	7
42	Theory for PPV excitons.	8
	Conceptual design of breather-based materials	15
	Feasibility study of Josephson qubits based on breather states in arrays.	9
	Extension of biomolecule work to other biomotors	14
48	Assessment of status.	
	Final report.	

Table 1: Major milestones for the project and their relation to the tasks.

Research Effort of the Participants

The research effort is given in Table 2. As indicated, some of the research and training will be subcontracted, and some of the work will be carried out in collaboration with Associates. Associates are groups which will be involved in the research and in some cases in the training.

Professional Research Effort on the Network Project					
Participant	*YVR*	*R*	*N*	*Subcontractors (YVR months, cost in Euro)*	*Associates*
1. Warwick	50	134	17	Edinburgh (15, 8000)	Cambridge
2. Saclay	42	216	12	Lyon (20, 25600)	Nice
3. Erlangen	44	163	11	Dresden (8, 10000)	Berlin
4. Zaragoza	40	360	16	Barcelona (12, 16000), Madrid (12, 16000)	Sevilla
5. Lyngby	35	300	11		
6. Heraklion	38	150	10	Athens (10, 7600)	
7. Firenze	58	110	10		Salerno, Milano
8. Thiais	22	150	12		Montpellier (8)
TOTALS	329	1583	99	(85, 83200)	

Table 2: Size of professional research effort by participant in person-months, including the indicated dependent subcontractors and associates, differentiating between young visiting researchers (YVR) financed by the network and researchers (R) financed from other sources (including the group leaders), and indicating the total number of researchers likely to contribute to the project (N). After each subcontractor is indicated in parentheses the numbers of YVR months to be seconded to them (also for Associate Montpellier) and the subcontract costs. The legal names of the subcontractor and associate organisations are – Edinburgh: Heriot-Watt University; Cambridge: University of Cambridge; Lyon: Ecole Normale Superieure - Lyon; Nice: Institut Non-Linéaire de Nice-Sophia (CNRS); Dresden: Max Planck Institut für Physik Komplexer Systeme; Berlin: Freie Universität Berlin; Barcelona: Universitat de Barcelona; Madrid: Universidad Complutense; Sevilla: Universidad de Sevilla; Athens: National Hellenic Research Foundation; Salerno: Istituto Nazionale per la Fisica della Materia - Salerno; Milano: Università degli Studi di Milano; Montpellier: Université Montpellier 2.

4. Organisation and Management

The network will be managed hierarchically as indicated in Table 3. There are four levels of unit: Coordinator, Members, Subcontractors and Associates. We refer to them collectively as Nodes. The first three levels are official Research Training Network categories, the Coordinator and Members together forming the Participants. The Associates are groups with whom one or more of us have an active research collaboration on the theme of the project and whose participation in the research will be beneficial to the project and who will in some cases play a role in the training. They will be invited to join in relevant network meetings, and their permissible expenses paid from their parent Participant's networking budget.

The tasks will be carried out by the nodes indicated in the Work Plan. For each task, the nodes responsible will elect one person to coordinate the work and to report on progress to the Coordinator.

The contributions of each node to research and training will be monitored by the Coordinator and assessed more formally on the basis of annual reports. Reporting will be hierarchical with strict deadlines for collation of information. We will seek to resolve any perceived problems by discussion together. In case of inability of a node to carry out its commitments, a redistribution of the budget will be drafted for approval at the mid-term review.

Communication will be primarily by e-mail. There will also be a network of webpages to display the function, activities, work and appointment opportunities in the network, with a central website at Warwick.

An initial node leaders meeting is planned for month 2 to establish personal links and common terminology, confirm goals, elect task coordinators, make plans and throw ideas around.

The results of the project will be disseminated by publication in standard refereed journals and by presentations at international conferences. Many papers will also be made available on web servers. In addition, it is likely that we will produce conference proceedings from some of our network meetings.

Coordinator	Members	Subcontractors	Associates
		Edinburgh (4,8,10)	
Warwick (1,2,4,5,6,8,10)			
			Cambridge (3,8,13,14)
		Lyon (3,4,5,7,10,11,12,13,14,15)	
	Saclay (1,2,3,4,5,6,7,8,9,10,12,14,15)		
			Nice (1,4)
		Dresden (1,2,4,5,7,9)	
	Erlangen (4,5,9,15)		
			Berlin (4,5)
		Barcelona (14)	
	Zaragoza (1,4,7,8,9,10,12,14,15)	Madrid (5)	
			Sevilla (4,6,9)
	Lyngby (4,5,6,8,9,12,13,14,15)		
	Heraklion (4,5,7,11,12,14,15)	Athens (13)	
			Salerno (2,8,9,13,14)
	Firenze (5,6,7,14,15)		
			Milano (1,2,4,8)
	Thiais (2,3,7,11,15)		Montpellier (2,11,12,15)

Table 3: Organisational Chart for the Nodes of the network, also indicating their tasks. The Coordinator and Members form the Participants. The Subcontractors will subcontract from the indicated Participants. The Associates will be dependent on the indicated Participants. For each task, one researcher will be elected task coordinator, to whom the responsible Nodes will report. The task coordinators will report to the network coordinator on the progress of the tasks.

5. Training

Appointment of Young Researchers

The minimum overall total of young researchers whose employment will be financed by the contract will be 329 person-months, broken down as in Table 4.

The vacancies will be advertised via the CORDIS vacancies webpages, a central webpage for this network at Warwick, the host laboratory's webpage, electronic newsletters such as UK Nonlinear News, advertisements sent to laboratories likely to have appropriate candidates, advertisements in newspapers or magazines if appropriate, and e-mail to all group leaders in the network. We expect that a significant fraction of the appointments will be made via exchange between the nodes. The duration of the appointments will vary from 2-36 months. Although positions of less than one year may not sound attractive, our experience with previous network grants is that there are many PhD students for whom this provides an excellent first employment prior to obtaining a more stable position somewhere, and that institutions are often able to extend the appointments by combining other funding sources. The salaries will be the standard ones for appointments at the given level in the given institution. All the node leaders will take active measures to attract suitable candidates, not only to their own institutions but also with other nodes in mind. In the event that some participant has difficulty in hiring candidates of sufficient calibre and promise, despite concerted effort of all the node leaders to attract them, we would at the end of the second year seek permission to redeploy the funds to hire additional young researchers at some of the nodes in the other countries.

We have requested employments costs for predocs at only one node (Erlangen), though most of the nodes will also train alternatively funded predocs in the research area of the network project. In the event that the predoc(s) appointed on this contract do not complete their study for PhD in the period of their appointment, the node responsible will ensure their continued finance to completion.

Young Researchers to be financed by the contract

Participant	*Predocs*	*Postdocs*	*Total*	*Specialities*
1. Warwick, UK	0	50	50	M-05, M-14, P-16
2. Saclay, FR	0	42	42	P-16, P-09, P-10, L-01, P-07, P-15
3. Erlangen, DE	36	8	44	P-10, P-16
4. Zaragoza, ES	0	40	40	P-09, P-16
5. Lyngby, DK	0	35	35	M-05, P-09, P-10, P-16, L-01
6. Heraklion, GR	0	38	38	P-09, P-16
7. Firenze, IT	0	58	58	P-09, P-16
8. Thiais, FR	0	22	22	P-10, P-11, P-14, P-16, C-05
TOTALS	36	293	329	

Table 4: Numbers of young researchers to be financed by the network (in person-months) and the scientific specialities of the training to be provided. Appointments will be made just at these participant institutions but some of the postdocs will be seconded to subcontractors or associates, as was indicated in table 2.

All eight Participant institutions are committed to equal opportunity (within the constraints of age, nationality etc. imposed by the IHP programme, and the necessity to train at least the given number of person-months within the budget), in particular with regards to sex. Male and female researchers are treated on an equal basis in our network; it is the science that counts.

Training Programme

The training objectives of the project are to give experience to promising young researchers in first-rate research at the cutting edge in other EU countries than their own, in general introducing them to problems and methods and disciplines that are new to them.

We will provide training schools, detailed below, to which young researchers on this contract and others involved in the project shall be invited; some of these will also be open to PhD students from outside the network. Also, two of the nodes run Master's level courses in areas relevant to the proposal, indicated below, which will be available to young researchers (both pre and postdocs) at these and other institutions in the network by exchange agreements like SOCRATES and Marie Curie Training Sites.

We shall organise a series of workshops, detailed below, to share results and ideas, which will have a significant training aspect, because the young researchers will learn how to present results, how to benefit from informal discussions, and will pick up invaluable advice, feedback and second opinions about their research projects. The most promising young researchers will also be sent to major international conferences to present their work and benefit from feedback and pick up new ideas.

Some network postdocs will be seconded by the Thiais team and their Associate at Montpellier (in addition to postdocs employed at Thiais) for periods of a few months to gain experience in Raman and neutron scattering experiments. It is planned, for example, to obtain beamtime to use the MARI instrument at ISIS, Rutherford Appleton Lab, and some network postdocs would be invited to take part in these experiments. Some network postdocs seconded to Edinburgh or Madrid (and possible short-term secondments to Cambridge) will be trained in the use of high performance computing facilities for the investigation of the tasks here. Other network postdocs may spend some of their time visiting another network node in order gain training in some specific area and to collaborate on research.

There will be contact with industry on specific projects, particularly with reference to task 15, e.g. Cambridge Display Technology (UK), Hewlett-Packard Bristol (UK), Novo Nordisk (DK), Spanish Army (ES), Rhone-Poulenc (FR), and Lucent/Bell(US). These might involve short-term training of young researchers in the industrial lab.

To enhance its teaching and training possibilities, the network will experiment with *virtual training mobility* for the interaction between partners and in particular the trainees. We plan to use public domain software, such as CUSEEME (Cornell University See Me) in order to have real-time audio-video exchanges among the partners. This means of intercommunication and interaction will be developed by the Multimedia Lab at Heraklion. Several other nodes have suitable facilities for video-conferencing.

The ratio between individual and group training is difficult to quantify, but in terms of recipient contact hours we would expect a roughly even split.

(a) Schools and Workshops planned

Risø/Lyngby Annual Nonlinear Science Festival, organized by the Graduate School in Nonlinear Science, Danish Research Academy, each December, principally for PhD students, including themes of the network; likely young researcher candidates are invited to this.

Edinburgh There will be a Dynamical Systems 2000 workshop, 10-14 July 2000 at ICMS, Edinburgh, which will include topics and young researchers from this network.

Les Treilles A small workshop involving selected people from within and outside the network is being planned for Les Treilles, France in 2001.

Firenze proposes to host a 1-week workshop in June or Autumn of 2001 (or else 2003), probably at ISI in Torino.

Dresden A large scale seminar will be held at MPIPKS, to be part-funded locally, on 'Nonlinear Lattice Structure and Dynamics', Sept-Oct 2001. It will consist of an international seminar with about 20 participants over 2 months, including one larger scale 1-week conference (50-100 participants), and either one smaller workshop or school (30-50 participants). Topics will include nonlinear materials science (defects, morphology, growth, deformation, nonequilibrium processes, aging), optical lattices, transport in discrete systems, and breathers in hard, soft and biological matter.

Spain The Spanish group propose to host a summer school at El Escorial in June or Sept 2002.

Warwick It is likely that Warwick will run a 1-year Symposium on the topic of the network Sept 2002 – July 03, to combine expertise from outside the EU. This will include an introductory school and several workshops on specific subtopics.

Heraklion proposes to hold a school and workshop during the period of the contract. There is a possibility that Heraklion will host the international annual conference Dynamics Days one year.

Les Houches Saclay and Lyon will apply to organise a Les Houches school or workshop during the period of the contract.

Trieste An application may be submitted to ICTP to run a school and workshop, if not all the above materialise.

(b) Relevant Master's Level courses run by the nodes

Lyon The Diplome d'Etudes Approfondies on Statistical physics and nonlinear phenomena at ENS Lyon provides education at the Master's level in many of the topics of this proposal.

Warwick The 1-year MSc degree in Mathematical Interdisciplinary Research will include a component on the topics of this proposal from Oct 2000, in addition to a range of courses in mathematics, physics, engineering, computer science and other domains.