ANNEX I

LIST OF PARTICIPANTS AND DESCRIPTION OF WORK

Network Title: EUROPEAN SOLAR MAGNETISM NETWORK

Network Short Title: ESMN

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

1	Universiteit Utrecht [UU]	established in The Netherlands

The Members

2	Instituto de Astrofísica de Canarias [IAC]	established in Spain
3	Istituto Nazionale di Astrofisica [OAA]	established in Italy
4	Universitet i Oslo [UiO]	established in Norway
5	Kungliga Vetenskapsakademien [KVA]	established in Sweden
6	Astrophysikalisches Institut Potsdam [AIP]	established in Germany
7	Observatoire de Paris [OP]	established in France
8	European Space Agency [ESA]	established internationally, with headquarters in France
9	Astronomický ústav Akademie věd České republiky [AsU]	established in the Czech Republic
10	Astronomický ústav Slovenskej akadémie vied [AISAS]	established in Slovakia
11	Eötvös Loránd Tudományegyetem [ELTE]	established in Hungary

The Principal Contractor and the Members are referred jointly as “the Participants”.

Part B – The Joint Programme of Work

B.1 Project Objectives

The Network science goal is to gain basic insight in the roots of solar magnetism by establishing the structure and dynamics, patterns and coupling of magnetic fields throughout the solar atmosphere. The Network science objectives are:

(a) structure and dynamics of solar surface fields: study magnetic field patterns of flux tubes, network and plage, search for internetwork fields, elucidate dynamics of sunspots, prominences and eruptions;

(b) topology and evolution of solar active regions: study precursor geometry to eruptive activity, combine magnetometry with dynamo modelling to understand emergence and disappearance of active regions and activity nests;

(c) magnetic coupling between the solar interior, photosphere, and outer atmosphere: map time-dependent flux tube topology, analyse flux tube dynamics, magnetic canopy linkage and wave mode conversion, and the connection between flux tubes and coronal loops.

The Participants will combine efforts on the implementation objectives:

(d) perfection of magnetometry instrumentation and methodology: improving and applying image restoration techniques, developing filter magnetometry, perfection of the Canary Island spectropolarimeters and their calibration;

(e) solar magnetometry through multi-telescope observing campaigns: campaign organisation and coordination, execution of multi-telescope campaigns, data dissemination;

(f) interpretation through numerical inversions and simulations: development of data analysis software, of polarimetric inversion techniques, and of numerical simulation of actual data.

The training objectives are:

(g) training in magnetometry techniques through working with the Canary Island telescopes and the SOHO mission;

(h) advanced schooling in solar astrophysics and space weather physics through Network schools and advanced seminars;

(i) gain of international experience through Fellow exchange, training at industry, participation in Network meetings, and presentations at international conferences.

B.2 Research Method

The Network will exploit European excellence in four areas:

– Canary Island telescopes, in order of aperture:
• DOT (Dutch Open Telescope), La Palma, aperture 45 cm, operational since 1999. Suited to high-resolution proxy magnetometry. A large-volume five-wavelength speckle pipeline system is being installed.

• GCT (German Gregory Coudé Telescope), Tenerife, aperture 45 cm. Vacuum reflector which will be rebuilt into the open 1.5 m GREGOR reflector during the project period.
• VTT (German Vacuum Tower Telescope), Tenerife, aperture 70 cm. General-purpose solar telescope with extensive post-focus equipment for imaging and spectrometry.
• THEMIS (French-Italian Télescope Héliographique pour l'Etude du Magnétisme et des Instabilités Solaires), Tenerife, aperture 90 cm, operational since 1999. Specifically designed for high-resolution magnetometry.
• NSST (New Swedish Solar Telescope), La Palma, aperture 96 cm. Recently completed vacuum refractor providing breakthrough resolution (0.1 arcsec) to optical solar physics.

– State of the art Stokes magnetometry: *e.g.*, with the IAC's TIP (Tenerife Infrared Polarimeter) mounted at the German VTT telescope, and with other spectropolarimeters built and operated by Network partners. In addition, Stokes data inversion methodology will be developed further, including the application of neural networks.

– The use of solar telescopes in space: in particular SOHO (Solar and Heliospheric Observatory) which is ESA's first Cornerstone mission and remains the solar physics flagship in space, and to a lesser extent the US TRACE mission and from 2005 the international Solar-B mission.

– Numerical modelling: direct confrontation of observations with concerted numerical modelling, using actual data as simulation input in order to enable direct comparison with diverse observational diagnostics.

B.3 Work Plan

The science and implementation objectives (a)–(f) define the following specific tasks:

(a) *Structure and dynamics of surface fields.*
(a1) flux tube topology in network and plages
(a2) search for weak fields
(a3) sunspot dynamics
(a4) prominence physics
(a5) eruption studies

(b) *Topology and evolution of active regions.*
(b1) eruption-precursor geometry
(b2) emergence and disappearance

(c) *Magnetic coupling between interior, photosphere, and outer atmosphere.*
(c1) interior–surface: dynamo to activity
(c2) photosphere–chromosphere: flux tube and canopy dynamics
(c3) chromosphere–corona: tube-loop connections

(d1) *Image restoration.* Speckle imaging at the DOT and adaptive optics at the NSST and THEMIS. These tasks are contingent on the continuation of additional outside funding.

(d2) *Filter magnetometry.* At the DOT, NSST, and THEMIS, with expertise being provided by the IAC team.

(d3) *Spectropolarimetry.* Perfection of the IAC and AIP spectropolarimeters at the German telescopes on Tenerife, of THEMIS spectropolarimetry, and installation of new spectropolarimeters at the German telescopes and the NSST. These tasks are partially contingent on obtaining additional outside funding.

(e1) *Campaign coordination.* Implementation of mechanisms to streamline joint observing programmes by email serving and WWW targetting.

(e2) *Joint multi-telescope campaigns.* Network-wide observing campaigns during the good-seeing season, of duration 1–3 weeks.

(e3) *Data dissemination.* Contribution of efforts toward a "Virtual Solar Observatory" and national and transnational data archives.

(f1) *Data analysis.* Joint development of analysis software including public software packages.

(f2) *Data inversions.* Polarimetric inversion modelling, especially with respect to chromospheric structures and prominences.

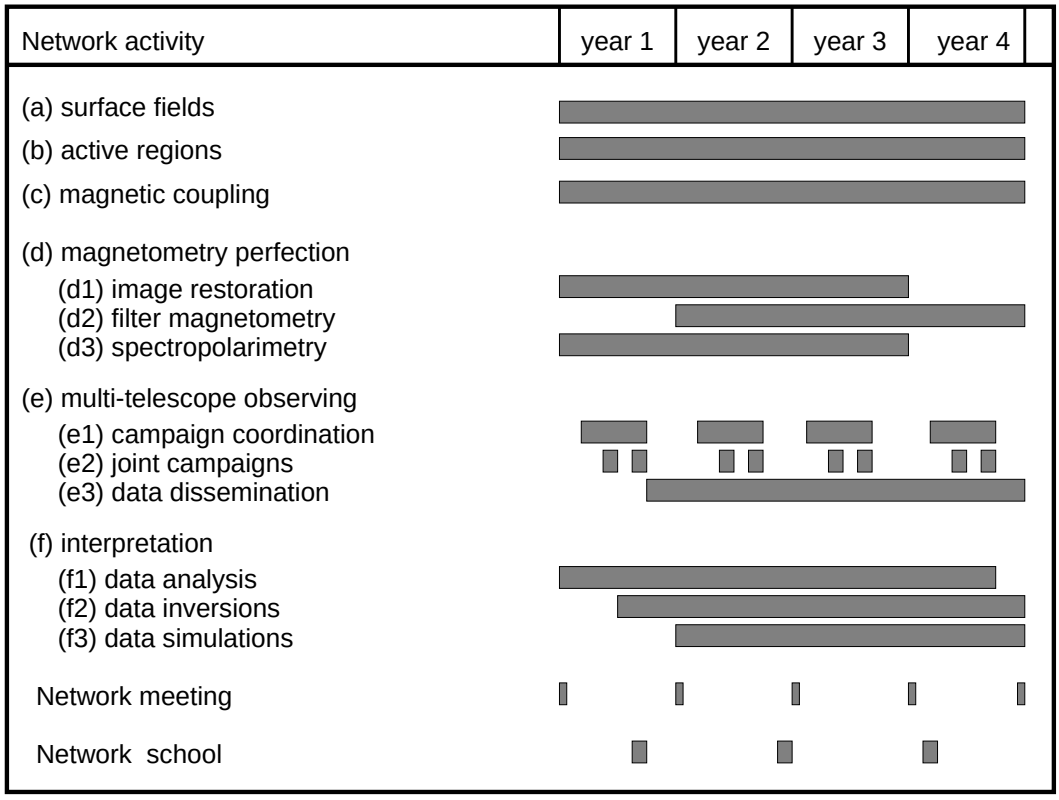
(f3) *Data simulations.* Numerical simulation of actual data, including MHD wave modes and different field regimes, in particular sunspots.

The table below specifies the task distribution in the joint programme of work over the Participants.

Science Objective	Task	Teams (leader first)
(a) Surface Fields	(a1) flux tubes	UU+KVA+OAA+AISAS
	(a2) weak fields	IAC+OAA+OP
	(a3) sunspots	all teams
	(a4) prominences	OP+AsU+OAA+UiO+AISAS
	(a5) eruptions	OP+AsU+OAA
(b) Active Regions	(b1) topology	AISAS+ELTE+OP+ESA+AsU+KVA
	(b2) evolution	ELTE+AsU+OP+ESA+AISAS+KVA
(c) Magnetic Coupling	(c1) interior–surface	ELTE+AsU+IAC
	(c2) photosphere–chromosphere	UU+KVA+UiO+ESA+IAC+AIP
	(c3) chromosphere–corona	ESA+UU+UiO+AsU+AISAS+AIP
Implementation Objective	Task	Teams (leader first)
(d) Magnetometry Perfection	(d1) image restoration	UU+KVA+OP+OAA
	(d2) filter magnetometry	UU+OAA+IAC+KVA
	(d3) spectropolarimetry	IAC+OP+OAA+AIP+KVA
(e) Multi-Telescope Observing	(e1) campaign coordination	ESA+OP+others
	(e2) joint campaigns	all teams except ELTE
	(e3) data dissemination	all teams except ELTE
(f) Interpretation	(f1) data analysis	all teams except ELTE
	(f2) data inversions	IAC+OP+OAA+AIP
	(f3) data simulations	UiO+ELTE+AIP

- **Schedule and milestones**

The chart below specifies the Network planning schedule. The multi-telescope campaigns will mostly take place in the May–October good-seeing season at the Canary Islands.



The following milestones will be assessed at the mid-term review and refined as necessary until the end of the project:

- young researchers hired;
- gender aspects positive;
- initial results in hand and joint publications on science objectives (a) – (c) in print or in press, including international presentations;
- demonstrated progress in implementation objectives (d) – (f);
- effective multi-telescope campaign coordination;
- multi-telescope campaigns completed and successful;
- summer/winter schools completed and successful;
- technological, observing and analysis training given;
- industrial training started;
- effective networking between partners;
- presentation training successful;
- public outreach effectuated.

Overall milestones at final reporting:

- successful completion of the full training programme;
- effective integration of the Associate State teams;
- successful implementations (tasks (d) – (f));

– breakthrough results on solar magnetism (tasks (a) – (c));
– high-visibility public outreach.

- **Research Effort of the Participants**

Participant	Professional research effort on the Network project (person-months)		Number of researchers likely to contribute to the Network project (number of individuals)
	by young researchers to be financed by the contract (a)	by researchers to be financed from other sources (b)	(c)
1. UU	30	154	6[a]
2. IAC	30	158	8[b]
3. OAA	30	152	7[c]
4. UiO	30	130	7[d]
5. KVA	30	115	6
6. AIP	30	146	6[e]
7. OP	30	141	8[f]
8. ESA	30	63	6[g]
9. AsU	0	130	6
10. AISAS	0	146	6
11. ELTE	0	96	3
Totals	240	1431	69

a including employees of the Netherlands Organisation for Research NWO.
b including employees of the Consejo Superior de Investigaciones Cientificas CSIC and of the University of La Laguna.
c including employees of the University of Firenze.
d including employees of the Norwegian Research Council NFR.
e including employees of the German Science Foundation DFG and Space Agency DARA.
f including employees of the Centre National de la Récherche Scientifique CNRS and of Université Paris VII.
g including ESA Postdoctoral Research Fellows. The ESA team is partially (including the Network Scientist in Charge) located at ESA's Experimenters Operations Facility for the SOHO Mission in the Goddard Space Flight Center, Greenbelt, USA.

B.4 Organisation and Management

The major Network management tools are:

– *web-based administration,* with permanent access by all participants to general administration directories and files, and confidential information protected by selective username/password shielding;
– *email application processing,* without any paper processing whatsoever. Applications and letters (emails) of reference will be accessible only to the Participant coordinators;

- *professional financial administration,* by the Finance Department of the Faculty of Physics and Astronomy harbouring Partner UU, with personal involvement of its head;
- *Network progress monitoring,* on a regular basis by the combined Network Coordinator and local Scientists in Charge and with special attention to the integration of the Network Fellows into the Network activities;
- *personal meetings,* exploiting frequent Network member encounters at international meetings (including the near-yearly Euroconferences in solar physics);
- *Network meetings,* campaign planning meetings, regular Network meetings, Network schools. The Network will strive to combine the mid-term review with a general European solar physics conference to gain visibility;
- *Network business meetings,* at regular Network meetings but also whenever multiple Participant researchers meet at conferences and workshops;
- *promotion of East-West linkages,* through organising the third Network School in Slovakia and scheduling other meetings at the Associated-State institutes as well;
- *international travel.* Part of the networking costs concerns the organisation of three advanced Network schools (IAC, UiO, UU+AISAS). In order to give these the highest-possible quality and international visibility, the Network is entitled to fund travel and subsistence per Network school not only for teachers and students from EU and Associated States, but also for up to two teachers and four students from countries outside the EU and Associated States.

  Another part of the networking costs concerns training at ESA's Experimenters Operations Facility of the SOHO Mission at the Goddard Space Flight Center (effectively European soil and the daily base of the ESA team including its Scientist in Charge), in connection with SOHO observing in Network context. A Network-wide maximum of four field trips to Goddard, each involving up to two Network Fellows or young researchers from Associated State partners for a maximum of four weeks, is deemed to be approved when part of the Network training programme;
- *scientific result dissemination,* through publications in the mainstream refereed journals (in particular the principal ones: *Astronomy and Astrophysics*, *Solar Physics*, and *Astrophysical Journal*) and in solar physics conference proceedings (in particular those published in well-established series by ESA, Wolters-Kluwer, and the Astronomical Society of the Pacific);
- *popular-science result dissemination,* through public outreach programs including web-based information spreading, popular-science articles, and public popular-science lectures.

B.5 Training

- **Appointment of Young Researchers**

  A minimum overall total of 240 person-months will be provided by young researchers whose employment will be financed by the contract.

Participant	Young researchers to be financed by the contract (person-months)			Scientific specialities in which training will be provided
	Pre-doctoral researchers (a)	Post-doctoral researchers (b)	Total (a + b)	
1. UU	–	30	30	P-08 (astrophysics), P-04 (optics)
2. IAC	–	30	30	P-08 (astrophysics), P-04 (optics)
3. OAA	–	30	30	P-08 (astrophysics)
4. UiO	6	24	30	P-08 (astrophysics)
5. KVA	–	30	30	P-08 (astrophysics), P-04 (optics)
6. AIP	–	30	30	P-08 (astrophysics), P-04 (optics)
7. OP	–	30	30	P-08 (astrophysics), P-04 (optics)
8. ESA	–	30	30	P-08 (astrophysics)
9. AsU	–	–	–	P-08 (astrophysics)
10. AISAS	–	–	–	P-08 (astrophysics), P-04 (optics)
11. ELTE	–	–	–	P-08 (astrophysics)
TOTAL	6	234	**Overall total** 240	

The Network will mainly advertise its vacancies electronically, including direct email to colleagues across the EU and Associated States. In particular the widely spread SolarNews electronic newsletter will be utilized, as will all pertinent web-based job-posting sites (including the EC's).

The indicative length per appointment is 30 months per postdoc researcher except at UiO.

Based on past experience, no recruiting difficulties are foreseen. The Network will strive to appoint postdoc researchers as tabulated, but fulfilment of the deliverable person-month total by hiring predoc researchers will be considered in consultation with the Commission, if required.

The Network will strive to improve the gender balance in European solar physics and hopes to receive appropriate applications. Their probability will be promoted through specific announcements as well as through utilisation of the high visibility of the two female Scientists in Charge in the Network.

- **Training Programme**

  The Network training is designed to meet the following training needs:

  – *Space weather:* the increasing global importance of the influence of explosive events in the solar atmosphere on the Earth's magnetosphere and of solar activity on the terrestrial climate increases the need for young researchers that are trained in gathering, analysing and interpreting solar magnetism data.

  – *Utilisation of European facilities:* the Canary Island telescopes and the SOHO mission are large investments that have brought Europe to the forefront in the field. This position must be exploited and strengthened, the more so since solar magnetism and space weather will constitute a field of intense world-wide endeavour also after the project duration.

  – *Job perspectives:* the Network will school young researchers in techniques that are highly valuable also outside solar physics or space weather applications, gaining much experience in high-speed data acquisition, large-volume data handling, sophisticated analysis techniques, and more generally in complex problem solving including numerical simulations at the forefront of computational physics. Such researchers are an asset to Europe's high-technology economy.

  The Network training programme encompassses extensive Fellow training in solar physics research at each partner. It additionally contains the following specific elements to meet the training objectives (g)–(i) specified in Section B.1:

  – *Optical observing technology:* optical solar telescopes, secondary optics including adaptive optics, polarimetry technology, fast-readout CCD technology, and large-volume data acquisition.

  – *Observing strategies:* through sharing in the joint observing campaigns including the pre- and post-campaign planning and evaluation.

  – *SOHO operation:* daily planning, spacecraft commanding and data acquisition at ESA's SOHO Experiment Operations Facility.

  – *Data reduction and analysis techniques:* training in sophisticated computer methods to handle large amounts of data, often involving large-volume electronic transfer.

  – *Network schools.* Three postdoctoral schools are planned, respectively on radiation hydrodynamics (UiO), spectropolarimetry (IAC), and solar magnetism and space weather (UU). The Network will strive to let the third school take place in Slovakia in order to enhance Associated State partnership visibility.

  – *Advanced seminars.* Postdocs located at the university partners will take part in the advanced seminars run at these institutions.

  – *Postdoc exchanges.* The Network will establish frequent Fellow exchange between partners, and also between partner telescopes.

  – *International meetings.* The Network will strive to make all Fellows attend Network meetings at least once a year, and make them participate in other meetings of interest such as solar physics Euroconferences.

  – *Presentation training.* All Network Fellows will be required to represent the Network and to present their own work frequently at international meetings, and to describe their work in Network context including formal EC reporting and reviewing.

– *Multidisciplinarity.* Most Network Fellows will receive extensive training in advanced computing and computer system management, in particular in handling large data rates and data volumes.
– *Training at industry.* The Network will strive to exploit its linkages to industry in Fellow training, in particular the strong ties of KVA with the HP/Compaq Systems Research Center and of KVA and UU with the Solar and Astrophysics Laboratory of the Lockheed–Martin company. Funding from other sources will be sought to achieve Fellow training at these industries.

The training task distribution over the Network partners is specified in the table below.

Training Objective	Task	Teams
Magnetometry Techniques	optical observing technology	UU, IAC, KVA, AIP, OP, AISAS, OAA
	observing strategies	all teams except ELTE
	SOHO	ESA
	data reduction & analysis	all teams except ELTE
Post-Doctoral Schooling	Network schools	UiO, IAC, UU + AISAS
	advanced seminars	all university teams
Exchange	young-researcher exchange	all teams
	training at industry	KVA, UU, possibly others
	Network meetings	UU + all teams
	presentation training	all teams