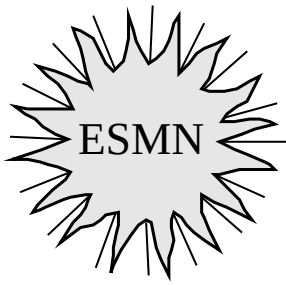


European
Solar Magnetism
Network

# First Periodic Progress Report

Network title: EUROPEAN SOLAR MAGNETISM NETWORK

Network short title: ESMN

Contract number: HPRN-CT-2002-00313

Commencement date of contract: November 1, 2002

Contract duration: 48 months

Period covered by this report: November 1, 2002 — October 31, 2003

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## Part A – Research results

### A.1 Scientific Highlights

Overview: the *European Solar Magnetism Network* fared very well in its first year. Seven Fellow openings were filled, while a suited candidate was identified for the remaining eighth opening (ESA). The Fellows were rapidly integrated into the Network activities. The first of the three projected ESMN schools, held at Oslo in June 2003, was highly successful. The development and exploitation of the various telescopes went very well, including spectacular first results from the Swedish Solar 1-m Telescope, the first DOT tomographic speckle imaging, a new management structure at THEMIS, on-schedule GREGOR progress, and continuing excellent performance of SOHO in space with unprecedented media attention in October 2003. Many multi-telescope campaigns were organised and delivered good data. Numerical simulations and polarization diagnostics were forcefully advanced.

Spectacular sunspot image sequences came from the Swedish Solar 1-m Telescope (SST) on La Palma, which is the very first solar telescope to combine 1-m class aperture with adaptive optics (37-actuator system developed in collaboration with industry). The KVA publication (Scharmer et al. 2002) in Nature in November 2002 led to front-page attention in many newspapers and magazines around the world. It addresses ESMN objective (a). The key result is that at 0.1 arcsec resolution the filamentary structures seen in sunspot penumbrae possess dark central cores. The present UiO Fellow is first author of a more detailed analysis published soon after the reporting period. The UiO, UU and IAC groups are involved in SST development. UiO is a formal partner in the SST, with considerable investment and much student involvement in SST observing concentrating on objectives (a) and (b), and exploits the UiO ESMN Fellow's expertise gained as graduate student at Stockholm while the SST was built. The UU team installed a new SST guider during the report year. The IAC collaborated in calibrating the SST Mueller matrix for characterising the telescope polarimetric capabilities. These technical collaborations are part of ESMN objectives (d) and (e). Another SST primeur was the high-resolution observation of intergranular magnetic elements close to the solar limb, a KVA–UiO collaboration with American colleagues from industry (Lockheed-Martin) presented at a US press conference in June 2003. The unexpected height of the observed elements is attributed to convective pile-up against the magnetic walls of upright fluxtubes (objectives (a) and (b)).

The development of the neighbouring Dutch Open Telescope (DOT) reached an important milestone in December 2002 by acquiring its first tomographic multi-wavelength image sequences (in the meantime analysed and in press). The DOT was increasingly exploited in ESMN observing campaigns during 2003. Its potential for large-volume speckle observation and processing is boosted dramatically (two orders of magnitude) by the award of a sophisticated hybrid computer cluster from the Dutch science foundation NWO (objective (d)), designed in consultation with an UiO expert. The DOT efforts on La Palma receive much assistance from the KVA team.

THEMIS, the French-Italian telescope on Tenerife saw changes in directorship and team constitution. These are likely to enhance THEMIS performance and accelerate the perfec-

tion of its unique suitability to high-precision polarimetry (teams OP and OAA, objective (d)). In the meantime, the sophisticated OAA IBIS (Interferometric BIdimensional Spectrometer) was completed and installed at the Dunn Solar Telescope at Sacramento Peak (USA) for extensive two-year testing before installation at THEMIS. At the American telescope IBIS is mounted at a laboratory-style optical bench already fed with adaptive optics, providing a suited testbed before realising the more complex (hanging and rotating) setup required at the larger THEMIS telescope (objective (d)). The instrument will be offered to the international community including ESMN partners from 2004 (objectives (a)–(e)) when the OAA ESMN Fellow has completed its full capability characterisation.

The GREGOR development is on schedule (AIP with other German institutes; AsU, IAC, UU; objective (d)). The primary mirror has been cast. It is made of advanced new-technology material (SiC, with carbon fiber matrix enforcement, which combines very large strength with light weight and excellent thermal conductivity). GREGOR is specifically designed for high-precision spectropolarimetry, also in the infrared. AIP is in charge for the mountings of two mirrors and a new polarimeter for the visible. The IAC is designing the spectrograph and will install an upgrade of its Tenerife Infrared Polarimeter (TIP) at GREGOR. An image derotator system is developed by AsU, with a structure of granite instead of steel to reduce weight. The GREGOR dome follows the DOT folding-clamshell design. Its construction, at Delft under UU supervision, is nearly complete.

The ESMN telescopes on the Canary Islands were exploited in many more collaborative campaigns than originally scheduled in the ESMN Joint Programme of Work, implying that their complementary science capabilities are combined even more frequently than anticipated. This intensive collaboration right at the start of the Network can for a significant part be attributed to heritage from the preceding *European Solar Magnetometry Network*[1].

On the interpretational side there is much concentration on Hanle-Zeeman diagnostics to derive the strength and geometry of solar magnetic fields (objectives (d) and (f), partners OP, AIP, IAC, OAA, AsU). For example, an IAC–OAA collaboration involving the IAC Fellow exploited such spectropolarimetry to address the field orientation in filaments. Numerical simulation (objective (f)) at UiO and KVA has expanded from hydrodynamics to magnetohydrodynamics, with full account of radiation in optically thick and thin circumstances. These codes become capable to address many issues in wave excitation, shock formation, mode conversion, and the dynamics of field topology. Their development represent an important breakthrough in interpretational solar physics by permitting analysis at the same level of complexity inherent in the observations.

The Sun itself played an astounding role at the end of the report period by flaring up in tremendous activity, quite unexpectedly since the solar activity cycle is already well into its declining phase. In just a few days the Sun turned from an almost spotless orb into a source of incredible fireworks. Over two weeks (the second just after the present reporting period) it featured three unusually large sunspot groups including the largest one of this solar cycle, a series of strong flares including the strongest ever recorded, and numerous halo (earth-directed) coronal mass ejections (CMEs) producing two significant proton storms which lasted for a combined five days. Satellites, power grids, radio communication and navigation systems were significantly affected. These events caused

[1]Henceforth ESMN-1. This TMR-programme network was funded by the EC under contract ERBFMRXCT980190 from May 1, 1998 until April 30, 2002. ESMN-1 was effectively the ESMN(-2)'s direct predecessor.

unprecedented attention from the media and the public. Images from SOHO appeared in most major newspapers and many TV news services in the USA and Europe (and probably elsewhere too). Many ESMN members were interviewed. The SOHO web traffic rose to a new records: more than 16 million hits and over 2.6 TB of image and movie downloads were logged for *http://soho.nascom.nasa.gov/* in the week of 27 October.

### A.2 Joint Publications and Patents

The list of pertinent ESMN publications from ESMN team members is given below in alphabetical order. All but one acknowledge the ESMN but for some this is the previous ESMN incarnation. This is appropriate since the ESMN-1 addressed similar science and tasks, and since some of the present ESMN's Fellows were already part, at another institute, of ESMN-1. The only paper without ESMN acknowledgement is the Nature paper by Scharmer et al. (2002) mentioned above, for which the work was done in the inter-ESMN gap but which is added here because its authors include the present UiO Fellow. ESMN-acknowledging single-institute papers are added for Associated State partners to show their ESMN affinity because they participate as minor partner without ESMN Fellow funding. The volume of ESMN Fellow papers acknowledging their EC support will obviously increase with time after their hiring.

There were no patent applications or awards.

Asensio Ramos, A., Trujillo Bueno, J., Carlsson, M., and Cernicharo, J.: 2003, "Nonequilibrium CO Chemistry in the Solar Atmosphere", *Astrophysical Journal Letters* **588**, L61–L64
- *Asensio Ramos: IAC; Trujillo Bueno: IAC; Carlsson: UiO*
- *Objectives (f)*
- *WWW: http://adsabs.harvard.edu*

Badalyan, O., Obridko, V., Rybak, J., and Sykora, J.: 2003, "N-S Asymmetry of Solar Activity and Quasi-biennial Oscillations", in *Solar Variability as an Input to the Earth's Environment*, Procs. of ISCS 2003 Symposium, ESA SP-535, ESA Publ. Div., ESTEC, Noordwijk, 63–66
- *Rybak, Sykora: AISAS*
- *Objective (c)*

Carroll, T., Muglach, K., Balthasar, H., and Collados, M.: 2002, "Application of artificial neural networks to solar infrared Stokes spectra", *Il Nuovo Cimento* **25C, N. 5-6**, 581–585
- *Muglach, Carroll, Balthasar: AIP; Collados: IAC*
- *Objectives (a), (d), (f)*

Dorotovic, I. and Rybak, J.: 2003, "Green Corona Versus Photospheric Magnetic Flux: Solar Cycle Dependence", in *Solar Variability as an Input to the Earth's Environment*, Procs. of ISCS 2003 Symposium, ESA SP-535, ESA Publ. Div., ESTEC, Noordwijk, 87–90
- *Rybak: AISAS*
- *Objective (c)*

Forgács-Dajka, E., Petrovay, K., and Erdélyi, R. (Eds.): 2003, *Contributions on Turbulence, Waves and Instabilities in the Solar Plasma*, Publications of the Astronomy

Department of Eötvös University, No. 13, Budapest
• *Petrovay, Forgács-Dajka: ELTE*
• *ESMN publication related to a NATO Advanced Research Workshop*

Mein, N., Tziotziou, K., and Mein, P.: 2003, "Some results from THEMIS/MSDP observations", in *THEMIS Workshop*, Procs. of THEMIS Workshop, Observatoire Midi Pyrénées, Toulouse, France, 233–236
• *Tziotziou: UU Fellow; Mein, Mein: OP*
• *Objectives (a), (b), (c), (f)*

Mein, P. and Tziotziou, K.: 2003, "2D THEMIS/MSDP spectropolarimetry: results, constrains and prospects", in *THEMIS Workshop*, Procs. of THEMIS Workshop, Observatoire Midi Pyrénées, Toulouse, France, 49–56
• *Tziotziou: UU Fellow; Mein: OP*
• *Objectives (a), (b), (c), (d), (f)*

Mocak, M. and Rybak, J.: 2003, "On Evolution of the Photospheric Magnetic Fields on the Sun: Separation of Active/Dissipative/Background Fields by Optimum Thresholds", in *Solar Variability as an Input to the Earth's Environment*, Procs. of ISCS 2003 Symposium, ESA SP-535, ESA Publ. Div., ESTEC, Noordwijk, 137–140
• *Rybak, Mocak: AISAS*
• *Objective (a)*

Ozguc, A., Atac, T., and Rybak, J.: 2003, "Short-term Periodicities in the Flare Index Between the Years 1966-2001", in *Solar Variability as an Input to the Earth's Environment*, Procs. of ISCS 2003 Symposium, ESA SP-535, ESA Publ. Div., ESTEC, Noordwijk, 141–144
• *Rybak: AISAS*
• *Objective (b)*

Rouppe van der Voort, L. H. M., Rutten, R. J., Sütterlin, P., Sloover, P. J., and Krijger, J. M.: 2003, "La Palma observations of umbral flashes", *Astronomy & Astrophysics* **403**, 277–285
• *Rouppe van der Voort (UiO Fellow): KVA; Rutten: UU, UiO; Sütterlin, Sloover, Krijger: UU*
• *Objectives (b), (e)*
• *WWW: http://adsabs.harvard.edu*

Rybak, J. and Karlovsky, V.: 2003, "Mutual Relations of the Intermediate Periodicities of the Wolf Sunspot Number", in *Solar Variability as an Input to the Earth's Environment*, Procs. of ISCS 2003 Symposium, ESA SP-535, ESA Publ. Div., ESTEC, Noordwijk, 145–148
• *Rybak: AISAS*
• *Objective (a)*

Scharmer, G. B., Gudiksen, B. V., Kiselman, D., Löfdahl, M. G., and Rouppe van der Voort, L. H. M.: 2002, "Dark cores in sunspot penumbral filaments", *Nature* **420**, 151–153
• *Rouppe van der Voort (UiO Fellow)*
• *Objective (a)*
• *WWW: http://adsabs.harvard.edu*

Schmieder, B., Tziotziou, K., and Heinzel, P.: 2003, "Spectroscopic diagnostics of an H$\alpha$ and EUV filament observed with THEMIS and SOHO", *Astronomy and Astrophysics* **401**, 361–375
- *Tziotziou: UU Fellow; Schmieder: OP, UiO; Heinzel: AsU*
- *Objectives (f)*
- *WWW: http://adsabs.harvard.edu*

Schmieder, B., Tziotziou, K., Heinzel, P., Malherbe, J.-M., and Curdt, W.: 2002, "Filament absorption study using THEMIS and SOHO/CDS-SUMER observations", *Il Nuovo Cimento* **25C, N.5-6**, 775–782
- *Tziotziou: UU Fellow; Schmieder: OP, UiO; Malherbe: OP; Heinzel: AsU*
- *Objectives (f)*

Temmer, M., Veronig, A., Rybak, J., and Hanslmeier, A.: 2003, "On Rotational Patterns of the Solar Magnetic Field", in *Solar Variability as an Input to the Earth's Environment*, Procs. of ISCS 2003 Symposium, ESA SP-535, ESA Publ. Div., ESTEC, Noordwijk, 157–160
- *Rybak: AISAS*
- *Objective (a)*

Tziotziou, K. and Mein, P.: 2003, "Line profile inversions developed for MSDP data", in *THEMIS Workshop*, Procs. of THEMIS Workshop, Observatoire Midi Pyrénées, Toulouse, France, 161–166
- *Tziotziou: UU Fellow; Mein: OP*
- *Objectives (f)*

Tziotziou, K. and Tsiropoula, G.: 2002, "The role of chromospheric mottles in the mass balance and heating of the solar atmosphere", in *Solar Variability: From Core to Outer Frontiers*, Procs. of 10th European Solar Physisc Meeting, ESA SP-506, ESA Publ. Div., ESTEC, Noordwijk, 787–790
- *Tziotziou: UU Fellow*
- *Objectives (a), (c), (f)*

Tziotziou, K., Tsiropoula, G., and Mein, P.: 2003, "On the nature of the chromospheric fine structure. I. Dynamics of dark mottles and grains", *Astronomy and Astrophysics* **402**, 361–372
- *Tziotziou: UU Fellow; Mein: OP*
- *Objectives (a), (b), (f)*
- *WWW: http://adsabs.harvard.edu*

## Part B – Comparison with the Joint Programme of Work

### B.1 Research Objectives

The ESMN research objectives remain as defined in Section B.1 of Annex I of the contract. They remain relevant and achievable.

### B.2 Research Method

There is no change in the ESMN research methods as defined in Section B.2 of Annex I of the contract. The Canary Island telescopes, SOHO, polarimetric diagnostics, and nu-

merical modelling together remain the methodological ESMN backbone. Only the GCT (German Gregory Coudé Telescope on Tenerife) has been taken out of service, being rebuilt into GREGOR – as planned and on schedule.

### B.3 Work Plan

The ESMN *task definition* remains as specified in Section B.3 of Annex I of the contract, also the task breakdown in the table given there.

The *schedule and milestone delivery* are very well on track. An overview of the status of the complete list of milestones defined for the mid-term review, as a preview of where we should stand by then:

- *young researchers hired*: seven of the eight Fellow openings were filled; a highly suited candidate has been identified for the remaining slot at ESA.
- *gender aspects positive*: three ESMN Fellows are female.
- *initial results in hand and joint publications on science objectives (a) – (c) in print or in press, including international presentations*: yes indeed, and many more coming.
- *demonstrated progress in implementation objectives (d) – (f)*: good advances at all telescopes.
- *effective multi-telescope campaign coordination*: see campaigns list below.
- *multi-telescope campaigns completed and successful*: many more than planned at the time of Contract conclusion, see campaigns list below.
- *summer/winter schools completed and successful*: the first ESMN School was an outstanding success (see below). The second is well on its way (see below).
- *technological, observing and analysis training given*: most ESMN Fellows participate in all three activities.
- *industrial training started*: not formally, but there are industrial contacts at multiple partners.
- *effective networking between partners*: see selected travel lists and the networking activity matrix below. Many more than ESMN-funded contacts take place – for example, the ESMN coordinator (UU) became part-time professor at UiO during the report year while the OP scientist-in-charge continues her UiO part-time professorship as well.
- *presentation training successful*: all Oslo School students presented their own work. ESMN Fellows presented their work at various occasions (see their travel lists below), and participate frequently in public outreach.
- *public outreach effectuated*: the ESMN outreach website was started (specified below). Numerous popular lectures were given, in particular in connection with Sun–Earth Day (March 18 2003). The tremendous solar activity at the close of the report period generated much media attention.

The *research effort of the participants* is detailed in the team tables below. In continuation of the reporting practice developed in consultation with the program officer during the first ESMN, these tables give maximum information by splitting the effort over individual researchers identified by name and including specification of the source of their funding.

**UU (Utrecht)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Felix Bettonvil | Scientist/Engineer | NWO/ASTRON | 9 |
| Rob Hammerschlag | Scientist/Engineer | UU | 9 |
| Jorrit Leenaarts | PhD Student | UU | 1 |
| Rob Rutten | Senior Scientist | UU | 6 |
| Pit Sütterlin | Post Doc | NWO | 10 |
| Kostas Tziotziou | Post Doc | ESMN | 8 |
| Alfred de Wijn | PhD Student | UU | 7 |
| 7 | | | 48 |

NWO = Nederlandse Organisatie voor Wetenschappelijk Onderzoek
ASTRON = The Netherlands Foundation for Research in Astronomy

**IAC (La Laguna)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Andrés Asensio Ramos | PhD Student | IAC | 6 |
| Jose Antonio Bonet | Research Scientist | IAC | 3 |
| Manolo Collados Vera | Profesor Titular | ULL | 6 |
| Rafael Manso Sainz | Post Doc | IAC | 6 |
| Valentin Martínez Pillet | Research Scientist | IAC | 3 |
| Laura Merenda | Pre Doc | ESMN | 8 |
| Ines Rodriguez Hidalgo | Associate Profesor | ULL | 3 |
| Basilio Ruiz Cobo | Profesor Titular | ULL | 3 |
| Jorge Sánchez Almeida | Research Scientist | IAC | 6 |
| Javier Trujillo Bueno | Científico Titular | CSIC | 6 |
| 10 | | | 50 |

CSIC = Consejo Superior de Investigaciones Científicas
ULL = University of La Laguna

**OAA (Florence)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Gianna Cauzzi | Research Astronomer | OAA/MIUR | 5 |
| Fabio Cavallini | Associate Astronomer | OAA/MIUR | 8 |
| Ambretta Falchi | Associate Astronomer | OAA/MIUR | 4 |
| Katja Janssen | Postdoc | ESMN | 2 |
| Egidio Landi degl'Innocenti | Professor | UF/MIUR | 8 |
| Marco Landolfi | Astronomer | OAA | 6 |
| Rafael Manso Sainz | Postdoc | MIUR | 2 |
| Kevin Reardon | Graduate Researcher | OAA | 8 |
| 8 | | | 43 |

UF = University of Florence
MIUR = Ministero Istruzione Universitá e Ricerca

**UiO (Oslo)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Mats Carlsson | Professor | UiO | 8 |
| Oddbjørn Engvold | Professor | UiO | 1 |
| Astrid Fossum | PhD Student | NFR | 12 |
| Viggo Hansteen | Professor | UiO | 6 |
| Andrew McMurry | Post Doc | NSF | 11 |
| Michiel van Noort | Post Doc | NFR | 12 |
| Luc Rouppe van der Voort | Post Doc | ESMN | 8 |
| Saadatnejad Bard | PhD Student | UiO/NFR | 12 |
| 8 | | | 70 |

NFR = Norsk Forskningsråd
NSF = National Science Foundation

**KVA (Stockholm)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Peter Dettori | Science Engineer | KVA | 10 |
| Boris Gudiksen | PhD student | KVA | 10 |
| Dan Kiselman | Research Associate | KVA | 6 |
| Kai Langhans | Post Doc | ESMN | 5 |
| Mats Löfdahl | Research Associate | KVA | 5 |
| Göran Scharmer | Professor | KVA | 8 |
| 6 | | | 44 |

**AIP (Potsdam)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Horst Balthassar | Scientist | AIP | 8 |
| Axel Hofmann | Scientist | AIP | 7 |
| Jürgen Rendtel | Scient. Assistant | AIP | 4 |
| Monica Sánchez Cuberes | Post Doc | ESMN | 6 |
| Jürgen Staude | Professor | AIP | 3 |
| 5 | | | 28 |

**OP (Paris)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Guillaume Aulanier | Scientist | OP | 5 |
| Arkadiusz Berlicki | Post doc | ESMN | 9 |
| Veronique Bommier | Scientist | CNRS | 3 |
| Pascal Démoulin | Scientist | OP | 3 |
| Jean Claude Hénoux | Senior Scientist | CNRS (retired) | 3 |
| Jean Marie Malherbe | Senior Scientist | OP | 6 |
| Nicole Mein | Senior Scientist | Paris VII | 5 |
| Pierre Mein | Senior scientist | OP (retired) | 5 |
| Etienne Pariat | PhD student | EN Lyon | 2 |
| Brigitte Schmieder | Senior Scientist | OP | 10 |
| Lidia van Driel-Gesztelyi | Senior Scientist | UCL | 1 |
| Nicole Vilmer | Senior scientist | CNRS | 4 |
| 12 | | | 56 |

CNRS: Centre National de la Recherche Scientifique
Paris VII: Université Paris VII
EN Lyon: Ecole Normale supérieure de Lyon
UCL: University College London

**ESA (Noordwijk/Greenbelt)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Danielle Bewsher | ESA Research Fellow | ESA | 9 |
| Paal Brekke | Scientist | ESA | 2 |
| George Dimitoglou | Computer Scientist | ESA | 2 |
| Bernhard Fleck | Scientist | ESA | 3 |
| Bernard Foing | Scientist | ESA | 1 |
| Stein Haugan | Scientist | ESA | 4 |
| Scott McIntosh | ESA Research Fellow | ESA | 4 |
| Luis Sanchez | Scientist | ESA | 2 |
| 8 | | | 27 |

Most of the ESA team resides at the SOHO Experimenters Operations Facility at the Goddard Space Flight Center.

**AsU (Ondřejov)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Pavel Ambrož | Senior Scientist | AsU | 5 |
| Petr Heinzel | Senior Scientist | AsU | 4.5 |
| Jan Jurčák | PhD Student | AsU | 3 |
| Marian Karlický | Senior Scientist | AsU | 2 |
| Jana Kašparová | PhD Student | AsU | 3 |
| Miroslav Klvaňa | Senior Scientist | AsU | 5 |
| Pavel Kotrč | Senior Scientist | AsU | 5 |
| Michal Sobotka | Senior Scientist | AsU | 5 |
| 8 | | | 32.5 |

**AISAS (Tatranská Lomnica)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Katarína Brčeková | PhD Student | AISAS | 8 |
| Peter Gömöry | PhD Student | AISAS | 6 |
| Július Koza | PhD Student | AISAS | 8 |
| Aleš Kučera | Senior Scientist | AISAS | 4 |
| Ján Rybák | Senior Scientist | AISAS | 4 |
| Július Sýkora | Senior Scientist | AISAS | 3 |
| František Tomasz | PhD Student | AISAS | 6 |
| 7 | | | 39 |

The planned ESMN participation of Dr. Anna Antalová has regrettably been canceled for medical reasons.

**ELTE (Budapest)**

| Name | Position | Funding | Months |
|---|---|---|---|
| Balazs Major | PhD Student | ELTE | 6 |
| Kristof Petrovay | Associate professor | ELTE | 5 |
| Emese Forgacs-Dajka | PhD Student | ELTE | 6 |
| Daniel Marik | PhD student | ELTE | 5 |
| 4 | | | 22 |

## B.4 Organisation and Management

The ESMN *organisation and management* adheres to the practices specified in Section B.4 of Annex I of the contract. The administration and reporting are web-based, the selection and hiring of Fellows went fully by email, and Ing. Pieter Thijssen of the UU Finance Department controls the financial administration. Most planning meetings take place during international conference and observing campaigns.

The *result dissemination* is primarily through the major refereed international journals and conference proceedings, as evident from the ESMN publication list above and to come in future reports. The travel lists below show at which meetings Fellows and Associated-State members have represented and presented the ESMN.

As to *non-EU travel*, no ESMN fellow has so far traveled to ESA's experimenters facility at the Goddard Space Flight Center, USA, which is deemed approved in the Contract. Nor has prior approval been sought to fund other outside-EU travel. It is the ESMN's policy that non-ESMN funding is used for all such travel.

*ESMN websites:*
main site: *http://esmn.astro.uu.nl*
outreach site: *http://www.astro.uio.no/∼rouppe/esmn/*

### *ESMN Schools*

1. The first ESMN school *"Radiative Transfer and Numerical Magneto-Hydrodynamics"* was held at Oslo during June 2–13, 2003. It was a highly successful in-depth school on radiative transfer and magneto-hydrodynamics, adding elaborate numerical exercises to high-level lectures during two very intensive weeks. It brought 30 students from 15

countries to Oslo. Most students were well below 35 years of age, with an excellent spread over field of interest, background, nationality, and gender. Three of the four teachers and half the students came from ESMN partners. All students presented their own research. More detail is given at *http://www.astro.uio.no/school-03*, including the full programme, photographs of all students and links to lecture notes constituting permanent "Virtual School" follow-up.

2. The second ESMN school is integrated into the XVth Canary Island Winter School, making it part of this prestigious sequence just as was the case for the second school of the ESMN-1 network. The school title is *"Mission and Payload Definition in Space Sciences"* and it takes place on Tenerife while this report is being written. For more detail including the full programme see *http://www.iac.es/winschool2003.*

***Collaborative ESMN observing campaigns***

1. "Transverse magnetic field and second solar spectrum", THEMIS, December 2–8, 2002, partners OP, OAA
2. "Wave propagation through the solar atmosphere", May 25 – June 7, 2003, combining SST, SOHO and TRACE, partners UiO, KVA, ESA
3. "Ca II H diagnostics of the solar chromosphere", June 5 – 6, 2003, combining SST and DOT, partners UiO, KVA, UU
4. "The structure of filaments and filament barbs", June 5–12 2003, combining VTT and DOT, partners UU, AsU
5. "The evolution of active regions", July 7–15, combining VTT and DOT, partners UU, IAC/OP
6. "Active region structure and dynamics", August 8, 2003, combining SST, DOT and VTT, partners KVA, UU
7. "H-alpha observations of filaments in quiet and active regions", August 15 – 28, 2003, SST, partners UiO, KVA
8. "The magnetic field of sunspots at different heights in the solar atmosphere", August 27 - September 6, 2003, VTT, partners AIP, IAC
9. "The magnetic field of solar coronal filaments", September 6 – 14, 2003., VVT, partners IAC, OAA
10. "Onset of flare activity and CMEs", October 30 – November 7, 2003, combining THEMIS, DOT, and SOHO, partners OP, UU, ESA
11. "The magnetic structure of sunspots", October 22 - November 3, 2003, VTT, partners AIP, IAC
12. "Sunspot oscillations and magnetism", October 30 – November 7, THEMIS + DOT, partners UU, OP.

***ESMN meetings***

1. Workshop "Emergence and evolution of solar active regions", Rome, November 11–13, 2002, partners UU, OAA, OP
2. Workshop "Science with the Swedish 1-m Solar Telescope", Stockholm, April 3–4, 2003, partners UU, IAC, UiO, KVA

***ESMN planning meetings***

1. at the First ESMN School, Oslo, June 2003, partners UU, IAC, UiO, KVA, AIP, OP, AsU, AISAS, ELTE
2. at the Workshop "Science with the Swedish 1-m Solar Telescope", Stockholm, April 3–4, 2003, partners UU, IAC, UiO, KVA
3. at the XXVth General Assembly of the International Astronomical Union, Sydney, July 13–26, 2003, partners UU, IAC, UiO, KVA, ESA
4. during SST observing campaign, La Palma, July 30 – August 13, 2003, partners UU, KVA
5. at the Summer School & Workshop "Solar Magnetic Phenomena", Kanzelhöhe Solar Observatory, 25 August – 5 September 2003, partners UiO, IAC, ESA
6. at the Fall Meeting of the Astronomische Gesellschaft, "The Sun and Planetary Systems - Paradigms for the Universe" Freiburg, September 15 – 20, 2003, partners: UU, OAA, AIP
7. at the SOHO 13 Workshop: "Waves, Oscillations and Small Scale Transient Events in the Solar Atmosphere", Palma de Mallorca, September 29 – October 3, 2003, partners UiO, AISAS, ESA, ELTE

***ESMN travels***

The following lists, ordered per partner per person, specify travels of ESMN nature. It is impractical to tabulate all pertinent travels of all ESMN team members, and that would represent unjust overclaim of the ESMN's role for the many travels not funded by ESMN. For example, both the UU scientist-in-charge (and ESMN coordinator) and the OP scientist-in-charge travel frequently to Oslo to fulfill their professorial obligations there, on UiO cost. While there, they mostly work on ESMN science and also discuss organisational ESMN matters, but such travels cannot be listed as ESMN-supported nor claimed as ESMN "product" in this report. Likewise, the IAC serves as another hub in the ESMN because many ESMN participants visit there prior or after observing with a Canary Island telescope, or meet at these telescopes themselves. Also elsewhere, ESMN team members frequently visit other ESMN teams on non-ESMN funding. The lists below are therefore restricted to, firstly, the ESMN Fellows (but then include also their travels on other funding, for the sake of completeness in demonstrating their integration in European solar physics) and, secondly, to ESMN-funded travels of other researchers at the EU partners, and, thirdly, to ESMN-funded as well as non-ESMN-funded but ESMN-related travels of Associated-State team members (where all ESMN funding goes to such travel, without ESMN Fellow hiring).

Note that the activity matrix at the end of this section summarizes all ESMN traffic irrespective of its source of funding.

*Kostas Tziotziou (ESMN Fellow at UU since March 2003)*

- Collaborative visit to OP, Meudon, France, March 29 – April 5, 2003
- ESMN summer school: "Radiative Transfer and Numerical Magnetohydrodynamics", Oslo, Norway, June 2–13, 2003

- XXV General Assembly International Astronomical Union, Sydney, Australia, July 13–26, 2003
- Collaborative visit to National Observatory of Athens, Athens, Greece, September 1–14, 2003
- 6th Hellenic Astronomical conference, Athens, Greece, September 15–17, 2003
- Collaborative visit to IAC, La Laguna, Tenerife, Spain, October 24–29, 2003
- Observing campaign at THEMIS, Teide Observatory, Tenerife, Spain, October 30 – November 7, 2003

*Laura Merenda (ESMN Fellow at IAC since March 2003)*

- Collaborative visit to IRSOL, Locarno, Switzerland, July 29 – August 2, 2003
- Observing campaign at VTT, Teide Observatory, Tenerife, Spain, September 6–14, 2003

*Katja Janssen (ESMN Fellow at OAA since September 2003)*

- Fall Meeting Astronomischen Gesellschaft, “The Sun and Planetary Systems - Paradigms for the Universe”, Freiburg, Germany, September 15–20, 2003

*Luc Rouppe van der Voort (ESMN Fellow at UiO since March 2003)*

- Workshop: “Science with the Swedish 1-m Solar Telescope”, Stockholm, April 3–4, 2003
- Observing campaign at SST, Observatorio del Roque de los Muchachos, La Palma, Spain, May 25 – June 7, 2003
- Observing campaign at SST, Observatorio del Roque de los Muchachos, La Palma, Spain, August 20–27, 2003

*Michiel van Noort (NFR Postdoc at UiO)*

- Advisorship DOT speckle processor architecture, Utrecht, November 25–30, 2003

*Kai Langhans (ESMN Fellow at KVA since June 2003)*

- Workshop: “Science with the Swedish 1-m Solar Telescope”, Stockholm, April 3–4, 2003
- Observing campaign at SST, Observatorio del Roque de los Muchachos, La Palma, Spain, July 30 – August 13, 2003
- Collaborative visit Kiepenheuer Institut für Sonnenphysik, Freiburg, Germany, July 28, 2003

*Boris Gudiksen (ESMN-1 PhD student at KVA)*

- ESMN summer school: “Radiative Transfer and Numerical Magnetohydrodynamics”, Oslo, Norway, June 2–13, 2003

*Monica Sánchez Cuberes (ESMN Fellow at AIP since May 2003)*

- ESMN summer school: “Radiative Transfer and Numerical Magnetohydrodynamics”, Oslo, Norway, June 2–13, 2003
- Collaborative visit to OAA while still at Göttingen, July 15–16, 2003
- Observing campaign at VTT, Teide observatory, Tenerife, with partner IAC, August 27 – September 6, 2003
- Collaborative visit to IAC, September 7–14, 2003
- Fall Meeting of the Astronomische Gesellschaft, Freiburg, September 15–20, 2003
- Observing campaign at VTT, Teide observatory, Tenerife, October 27 – November 3, 2003

*Arkadiusz Berlicki (ESMN Fellow at OP since February 2003)*

- ESMN summer school: “Radiative Transfer and Numerical Magnetohydrodynamics”, Oslo, Norway, June 2–13, 2003
- Collaborative visit to the Astronomical Observatory of Wroclaw, Poland, April 1–14, 2003
- Observing campaign at THEMIS, Teide Observatory, Tenerife, Spain, October 19–30, 2003
- Collaborative visit to the Astronomical Observatory of Wroclaw, Poland, November 1–9, 2003

*Petr Heinzel (AsU staff)*

- Collaborative visit to OP, Meudon, France, March 29 – April 5, 2003

*Jana Kašparová (AsU PhD student)*

- ESMN summer school: “Radiative Transfer and Numerical Magnetohydrodynamics”, Oslo, Norway, June 2–13, 2003

*Michal Sobotka (AsU staff)*

- Observing campaign at SST, Observatorio del Roque de los Muchachos, La Palma, Spain, September 10–21, 2003
- Collaborative visit to IAC, La Laguna, September 22 - October 10, 2003.

*Peter Gömöry (AISAS PhD student)*

- ESMN summer school: “Radiative Transfer and Numerical Magnetohydrodynamics”, Oslo, Norway, June 2–13, 2003
- SOHO 13 Workshop: “Waves, Oscillations and Small Scale Transient Events in the Solar Atmosphere”, Palma de Mallorca, Spain, September 29, 2003 – October 3, 2003

*Július Koza (AISAS PhD student)*

- ESMN summer school: “Radiative Transfer and Numerical Magnetohydrodynamics”, Oslo, Norway, June 2–13, 2003

*František Tomasz (AISAS PhD student)*

- ESMN summer school: “Radiative Transfer and Numerical Magnetohydrodynamics”, Oslo, Norway, June 2–13, 2003
- SOHO 13 Workshop: “Waves, Oscillations and Small Scale Transient Events in the Solar Atmosphere”, Palma de Mallorca, Spain, September 29, 2003 – October 3, 2003

*Jan Rybák (AISAS staff)*

- SOHO 13 Workshop: “Waves, Oscillations and Small Scale Transient Events in the Solar Atmosphere”, Palma de Mallorca, Spain, September 29, 2003 – October 3, 2003

*Balazs Major (ELTE PhD student)*

- ESMN summer school: “Radiative Transfer and Numerical Magnetohydrodynamics”, Oslo, Norway, June 2003

*Daniel Marik (ELTE PhD student)*

- SOHO 13 Workshop: “Waves, Oscillations and Small Scale Transient Events in the Solar Atmosphere”, Palma de Mallorca, Spain, September 29, 2003 – October 3, 2003
- Collaborative visit to ETH-Zentrum Zürich, Switzerland, April 2003

*Kristof Petrovay (ELTE staff)*

- SOHO 13 Workshop: “Waves, Oscillations and Small Scale Transient Events in the Solar Atmosphere”, Palma de Mallorca, Spain, September 29, 2003 – October 3, 2003
- ISSI ”Solar Turbulence” collaborative project, Bern, Switzerland, June – July 2003

***ESMN networking matrix***

The *networking table* below displays the intensity matrix of interactions between ESMN partners during the report year, with as scale 0 = no collaboration, 1 = some collaboration, 2 = much collaboration, 3 = intense collaboration. The estimates include both ESMN-funded travel (primarily by ESMN Fellows and young Associated-State team members)

and networking funded from other sources.

| Team | UU | IAC | OAA | UiO | KVA | AIP | OP | ESA | AsU | AISAS | ELTE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UU | – | 1 | 0 | 3 | 3 | 1 | 2 | 1 | 2 | 0 | 0 |
| IAC | 1 | – | 3 | 1 | 3 | 2 | 2 | 1 | 1 | 1 | 0 |
| OAA | 0 | 3 | – | 0 | 0 | 1 | 3 | 1 | 1 | 0 | 0 |
| UiO | 3 | 1 | 0 | – | 3 | 0 | 3 | 3 | 0 | 0 | 0 |
| KVA | 3 | 3 | 0 | 3 | – | 1 | 0 | 1 | 1 | 0 | 0 |
| AIP | 1 | 2 | 1 | 0 | 1 | – | 1 | 1 | 2 | 2 | 1 |
| OP | 2 | 2 | 3 | 3 | 0 | 1 | – | 3 | 3 | 1 | 2 |
| ESA | 1 | 1 | 1 | 3 | 1 | 1 | 3 | – | 2 | 0 | 2 |
| AsU | 2 | 1 | 1 | 0 | 1 | 2 | 3 | 2 | – | 3 | 1 |
| AISAS | 0 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | 3 | – | 1 |
| ELTE | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 1 | 1 | – |

## B.5 Training

The ESMN vacancies were announced in international electronic newsletters, the most important being SolarNews, on the ESMN website, at other job-market sites including the EU's, through email to colleagues at other institutes, and through emails to likely candidates. As anticipated, SolarNews advertisements were most useful. Most non-pertinent applications came from Asia.

The recruitment table is given on the next page. The change from post-doc to pre-doc at partner IAC was explained in a letter to the Project Officer on March 27, 2003. The change at UiO is conform the original ESMN proposal; the subsequent 6/24 split was entered in the contract to accommodate a specific candidate, but eventually turned out unnecessary. As mentioned above, in the meantime also the ESA partner has identified a suited candidate, with the hiring procedure initiated. Thus, the ESMN's Fellow recruiting is nearly complete.

The *training programme* follows the element list given in Section B.5 of Appendix I to the contract. Most ESMN Fellows take part in observing with the Canary Island telescopes but none has worked so far at the SOHO EOF at Goddard. They all gain experience in observing strategies, data reduction, and analysis techniques, and they all participate in seminars and in international meetings. The detailed lists in Section B.4 above specify all their travels since becoming Fellow.

| Participant | Contract deliverable of Young Researchers to be financed by the contract (person-months) | | | Young Researchers ("Fellows") financed by the contract so far (person-months) | | |
|---|---|---|---|---|---|---|
| | Pre-doc (a) | Post-doc (b) | Total (a + b) | Pre-doc (c) | Post-doc (d) | Total (c + d) |
| 1. UU | – | 30 | 30 | 0 | 8 | 8 |
| 2. IAC | – | 30 | 30 | 8 | 0 | 8 |
| 3. OAA | – | 30 | 30 | 0 | 2 | 2 |
| 4. UiO | 6 | 24 | 30 | 0 | 8 | 8 |
| 5. KVA | – | 30 | 30 | 0 | 5 | 5 |
| 6. AIP | – | 30 | 30 | 0 | 6 | 6 |
| 7. OP | – | 30 | 30 | 0 | 9 | 9 |
| 8. ESA | – | 30 | 30 | 0 | 0 | 0 |
| 9. AsU | – | – | – | – | – | – |
| 10. AISAS | – | – | – | – | – | – |
| 11. ELTE | – | – | – | – | – | – |
| TOTAL | 6 | 234 | 240 | 8 | 38 | 46 |

### B.6 Difficulties

None, fortunately.