NEVEC business plan

August 1, 1999 – August 1, 2005

This is an evolving document (version 01 September 2001)

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Management summary

This document is a business plan for NEVEC, but evolves to resemble the current status of NEVEC and than therefore also be regarded as a business plan.

It described the boundary conditions under which NEVEC operates (the financial limitations, the human resources, and the missions statement), and gives an overview on how the NEVEC activities are structured (through the definition of work packages).

It also gives a summary of the achievements of NEVEC, output produces (software, articles, talks etc)

This document is continuously evolving and always resembles the latest views on recent developments.

Contents

1 Introduction

The NOVA-ESO VLTI Expertise Centre (NEVEC) is a joint venture between the Netherlands Research School for Astronomy (NOVA) and the European Southern Observatory (ESO) concerning the Very Large Telescope Interferometer. NEVEC's headquarters (HQ) is located at Leiden Observatory in the Netherlands with an additional office at the University of Amsterdam. NEVEC is funded by NOVA and formulated in a Memorandum of Understanding (MoU) signed at the University of Amsterdam (UvA) on 31 May 1999. NEVEC inauguration took place on 26 May 2000.

This document describes the work executed under the umbrella of NEVEC in the period August 1, 1999 to August 1, 2005, and is based on information available in September 2001.
NOVA instrumentation program
The NOVA instrumentation program has a total budget of approximately 15 Mfl for the period August 1 1999 to August 1 2005 (NOVA-1). A second NOVA term (NOVA-2 during the period August 1, 2004 to August 1, 2009) is anticipated. Within NOVA-1 a number of programs are funded (see Table 1). For almost all the programs listed, NOVA participates in a consortium and only partly funds the final instrument to be developed.

Table 1: overview of the NOVA instrumentation program.

NOVA program	Description
ALMA mixers	Atacama Large Millimeter Array
SINFONI	Adaptive Optics for the VLT
DOT	Dutch Open Telescope, La Palma
SLA	Sackler Laboratory of Astrophysics, Leiden
MIDI	The Mid-Infrared Interferometric instrument for VLTI
NEVEC	NOVA-ESO VLTI Expertise Centre
OmegaCAM	Wide-Field Imager for the VST at Paranal
PuMa	Dutch Pulsar Machine

1.1 Commitment from NOVA to VLTI

NOVA's commitments related to ESO-VLTI instrumentation program (1999-2005) includes commitments to ESO and the Max Planck Institute for Astronomy (MPIA), the MIDI consortium, and a cash-contribution to the ESO-VLTI program. In total this amounts to kfl 4,420 for the period 1999 to 2005. It is anticipated that a second 5-year NOVA program on VLTI instrumentation will include NEVEC. This document only deals with the NEVEC commitments within NOVA-1.

VLTI-enhancement: (total budget 4,420 kfl)

VLTI-MIDI: (total budget 1,403 kfl)
- FTE postdoc (with Waters) (263 kfl);
- Hardware being built at NFRA (kfl 1,140, including 6.0 FTE + materials);
- 0.8 FTE of Waters (1998 to 2001).

VLTI-NEVEC: (total budget 2,791 kfl)
- 18.3 FTE (1999-2005) (2,395 kfl, bench and travel 396 kfl);
- Of which VLTI-NEVEC-task list: (10.0 FTE);
- Of which VLTI-NEVEC-MIDI (3.3 FTE);

- Of which VLTI-NEVEC-open research (5.0 FTE);
- And 5 FTE of academic staff from Leiden Observatory.

VLTI-ESO: (total budget 226 kfl)
- No allocated personnel;
- Cash contribution of DM 200,000 (kfl 226,000).

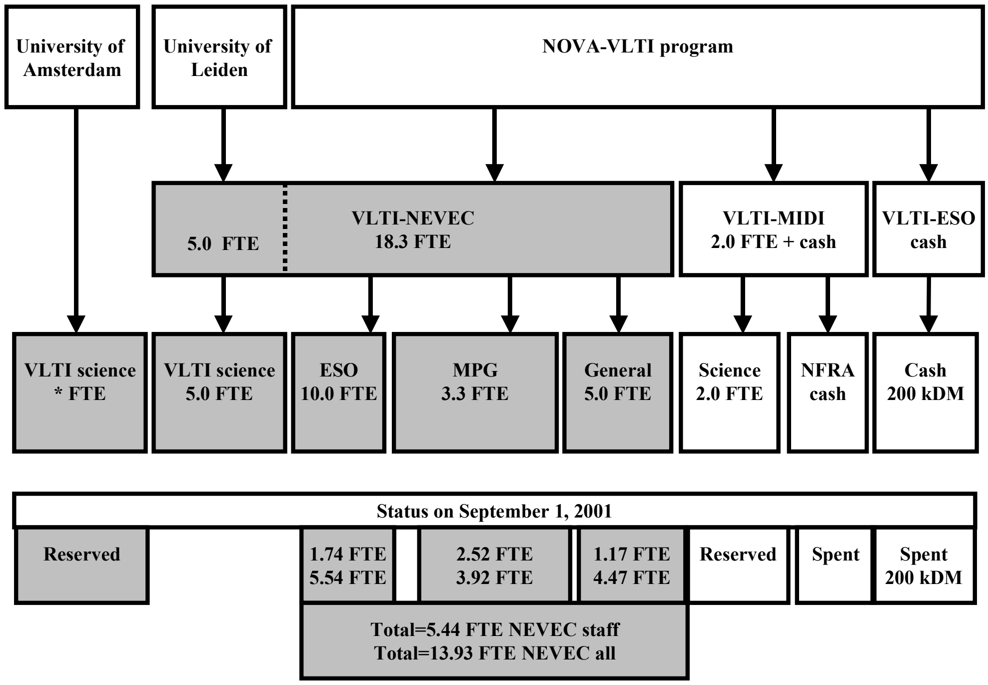


Figure 1: *presentation of NOVA obligations to the VLTI program and NEVEC's position and the work realised on September 1, 2001. The two numbers in the lower two rows represents efforts only by NEVEC staff (the upper number), and by NEVEC staff and NEVEC affiliates (lower number).*

1.2 Memorandum of understanding NOVA-ESO

The "Agreement between NOVA and ESO concerning the ENHANCEMENT of the VERY LARGE TELESCOPE INTERFEROMETER" has been signed by Prof. Tim de Zeeuw (Director of NOVA) and Prof. Riccardo Giacconi (Director General of ESO) on May 31, 1999. To clearly set the framework of NEVEC activities, Article 5 and Appendix D of this agreement are provided below.

1.2.1 Article 5: contribution schedule

This Agreement is based on the following funding schedule:

The Netherlands Research School for Astronomy (NOVA) will set up an Expertise Centre for VLTI in the Netherlands as a joint venture with ESO.

The goals of the NOVA-ESO Expertise Centre for VLTI (NEVEC) will be the following:
1. Development of instrument modelling, data reduction and calibration techniques for VLTI;

2. Accumulation of expertise relevant for a second-generation VLTI instrument;
3. Education in VLTI.

Besides providing an infrastructure for NEVEC, NOVA will fund a minimum of 18 person-years of scientists and software engineers to work at NEVEC during the period from 1999 to 2005.

At least 10 person-years will be devoted to carrying out a set of tasks to be defined jointly by NOVA and ESO within the bounds of the available manpower (cf. **Appendix D**). These tasks will be defined in detail not later than 6 months after signature of this Agreement taking into account both the goals of NEVEC and the needs of ESO and NOVA. The relevant work-packages and management structure for NEVEC will be developed in mutual agreement between NOVA and ESO. Selection of the staff for NEVEC will be carried out by representatives of both ESO and NOVA. For the purpose of this Agreement this contribution is accounted for at a value of DM 1,500,000.00.

As well as developing NEVEC as a joint NOVA - ESO venture, NOVA shall make a substantial additional funding available to ESO for the infrastructural needs of VLTI and as an initial payment shall transfer the sum of DM 200,000.00 to ESO during 1999. NOVA shall make every effort to ensure further funding to ESO for VLTI, with a target of DM 800,000.00 during the period 2000 to 2005.

1.2.2 Appendix D: NEVEC task list

A revised task list has been agreed upon in December 1999, and is better defined through the work package definitions as described later in this document.

1. Understanding the atmosphere for optimisation of PRIMA design, control, feed back and detection. Develop an atmospheric simulator for testing system designs;
2. Creation (together with ESO) of a delay model for entire system. (Astrometry-Metrology);
3. Calibration:
   - 3.1. Study of which instrument effects are astronomically calibratable;
   - 3.2. Development of astrometric, spectroscopic, and photometric calibrator database;
4. Pre-PRIMA survey around a set of PRIMA phase-reference sources to create a public catalogue of deep images + spectroscopy of astrophysically interesting objects;
5. Fringe detection and fringe estimation algorithms for MIDI and FSU. (Also relevant for VINCI and AMBER, as well as for future instruments). Develop source modelling and self-calibration algorithms, which take advantage of broad band capabilities of VLTI instruments;
6. FITS format for the VLTI: definition;
7. Study (at system level) of the next generation instruments or improvements to current instruments;
   - 7.1. Multi-baseline instruments;
   - 7.2. "Wide field" instruments;
   - 7.3. Planet finders;
   - 7.4. Polarisation measurements;
   - 7.5. Exploring new ways of reducing rms. atmospheric delay e.g. correlation between IR radiometry and delay.

1.2.2.1 High priority NEVEC tasks for the period 1/2000 to 6/2001

1. (URGENT) Develop a simulator of atmospheric wavefront distortions in a form that can serve as input to the ESO VLT(I) opto-mechanical models by April 2000;
2. (URGENT) Develop a well defined set of calibrators and targets for initial VINCI observations by July, 2000;

3. Deliver a working and appropriately documented version of the MIDI expert workbench system to ESO to support interpretation of VINCI data. If necessary (and possible) aid ESO in converting VINCI data formats to standard VLTI FITS binary table formats. (By end 2000);
4. Collaborate with ESO, under ESO leadership, in preparing an RFQ for PRIMA (by March 2000);
5. Collaborate with ESO in a study of optimising operation and fringe detection techniques with the preliminary fringe tracking system: FINITO (end 2000);
6. Develop operations and calibration plans for PRIMA (mid 2001);
7. Support for commissioning of VLTI delay lines;
8. Support for commissioning and initial astronomical use of VINCI and the siderostats.

1.3 Memorandum of understanding NOVA, NFRA, and MPIA

The "Memorandum of Understanding concerning the Netherlands involvement in the collaboration on MIDI" between Max-Planck Institute for Astronomy (MPIA), the Netherlands Research School for Astronomy (NOVA), and the Netherlands Foundation for Research in Astronomy (NFRA) has not been signed, but exists in draft. To clearly set the framework of NEVEC activities, article 3.2 and appendix B are provided below.
This MoU is part of a larger MoU between MPIA and ESO titled "Agreement on the Mid-Infrared Interferometric Instrument (MIDI) for the ESO VLTI", which has been signed on September 15, 2000 by Dr. Hans-Walter Rix (Managing Director MPIA), and Dr. Catherine Cesarsky (Director General ESO).

1.3.1 Article 3.2: NOVA

NOVA will provide a grant of 1,080 kfl to support the MIDI involvement at NFRA. This grant shows the following breakdown:
1. Manpower for optical, mechanical and electrical work at NFRA (6.0 man years);
2. Hardware up to 30,0000.00 hfl;
3. Travel funds (50,000.00 hfl);
4. Contingency (90,000.00 hfl).

In addition NOVA will provide 3 staff years at NEVEC for software development and procurement in relation to MIDI. NEVEC will deliver the tasks as specified in appendix B. It is anticipated that the intense interactions necessary during software development with ESO and the other software developing groups will necessitate travel expenses in the amount of 20,000.00 DM.

Through NOVA the University of Amsterdam will provide the Co-Principal Investigator for MIDI, Dr. Rens Waters (0.2 staff years per year for the period from 1 January 1998 until successful commissioning of the instrument, assumed to happen end of 2001). Dr. Waters will also be responsible for the overall co-ordination of the Dutch involvement in MIDI.

The important Dutch contribution during the concept and interface definition phase of the project are accounted as a total effort of 1.7 staff years. Following ESO rules, one staff year will be taken as equivalent to 150,000.00 DM.

1.3.2 Append B: software work packages

Appendix B has been signed on July 19, 2000 at Heidelberg and an overview is presented in Table 2.

Table 2: overview of contributions from different parties involved in MIDI software development.

	Description	Party responsible
1	Overall design, management and co-ordination between the three involved groups	Leiden
2	Computer system architecture	Heidelberg
3	Detector control software (DCS)	Heidelberg
4	Instrument control software (ICS)	Heidelberg
5	Infrastructure development for data reduction	Leiden
6	Data pre-processing and quality control (NRTS)	Leiden
7	Data preparation for archiving – general	Leiden
8	Data preparation for archiving – assembling the files	Heidelberg
9	Data reduction system (DRS) – structure development	Meudon
10	Data reduction system (DRS) – applications	Meudon Leiden
11	Developmental expert workbench system (EWS)	Leiden Meudon
12	Observation software (OS) – general	Heidelberg
13	Observation software (OS) – producing the translation tables	Leiden
14	Simulation tools	Leiden Meudon Heidelberg
15	Observation and calibration analysis	Leiden

Interfaces, detailed work breakdown and delivery dates as determined in mutual agreement during consortium meetings.
Documentation: each party for its respective work package

2 Human resources

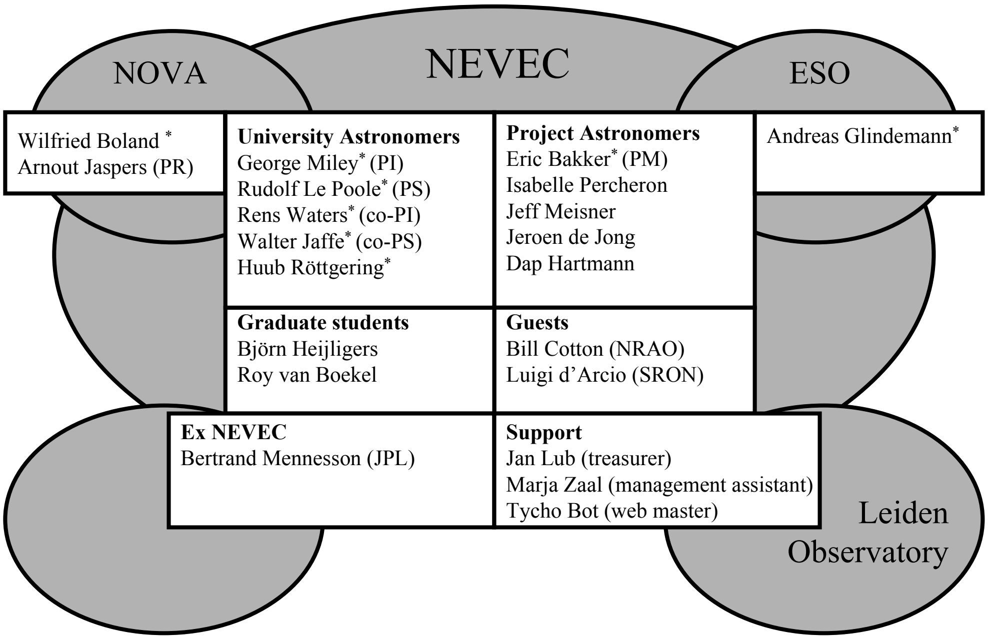
2.1 Management team

NEVEC management team consists of George Miley (principal investigator), Rudolf Le Poole (project scientist), Walter Jaffe (co-project scientist), Huub Röttgering (liaison space interferometry), Rens Waters (Dutch principal investigator MIDI, co-PI NEVEC), Eric Bakker (project manager), Wilfried Boland (NOVA), and Andreas Glindemann (ESO VLTI team).

Figure 2: NEVEC management team (photograph taken on February 9, 2001 at Leiden) From left to right: Le Poole, Miley, Bakker (front row), Boland, Glindemann (front row), Röttgering, Waters, and Jaffe.

2.2 NEVEC staff

Full-time NEVEC staff currently includes (technical) astronomers (Percheron, Mennesson (till August 2000), Bakker), physicist (Meisner), and software engineers (de Jong, Hartmanm, and Cotton). An overview is presented below.



PI: Principal investigator, PS: Project scientist, PM: Project manager, PR: public relations * :NEVEC management team

Figure 3: overview of the people involved in NEVEC.

A number of people are involved in NEVEC. Figure 3 shows an overview of those involved. For details see Table 3.

Table 3: names and dates of those involved in NEVEC.

Person	Function	From	Till
George Miley	Staff astronomer	01-aug-99	31-dec-04
Rudolf Le Poole	Staff astronomer	01-aug-99	31-dec-04
Walter Jaffe	Staff astronomer	01-aug-99	31-dec-04
Huub Röttgering	Staff astronomer	01-aug-99	31-dec-04
Rens Waters	Staff astronomer	01-aug-99	31-dec-04
Isabelle Percheron	Astronomer	01-sep-99	01-mrt-03
Jeff Meisner	Physicist	01-okt-99	01-mrt-03
Betrand Mennesson	Astronomer	17-jan-00	01-aug-00
Jeroen de Jong	Scientific programmer	21-feb-00	21-feb-03
Eric Bakker	Project manager/astronomer	01-jan-01	01-jan-05
Dap Hartmann	Scientific programmer	01-nov-00	01-jul-01
Tycho Bot	Web-master		
Luigi d'Arcio	Physicist	01-feb-00	x
Björn Heijligers	Graduate student	01-jan-00	31-dec-04
Bill Cotton	Scientific programmer	15-aug-99	05-jul-00
Roy van Boekel	Graduate student	01-mei-00	01-mei-04
Andreas Glindemann	ESO observer	01-aug-99	31-dec-04
Wilfried Boland	NOVA observer	01-aug-99	31-dec-04

2.3 Netherlands VLTI team

The Netherlands VLTI team acts as an advisory board for NEVEC. Members of the NL VLTI team are listed in Table 4.

Table 4: Dutch VLTI team.

Person	Institute
Jan-Willem Pel	University of Groningen
Marten van Kerkwijk	University of Utrecht
Rens Waters	University of Amsterdam
George Miley	University of Leiden
Jan Noordam	NFRA
Richard Schilizzi	JIVE
Thijs de Graauw	SRON
Rudolf Le Poole	NEVEC
Walter Jaffe	NEVEC
Huub Röttgering	NEVEC
Eric Bakker	NEVEC

2.4 NOVA Instrument steering committee

NEVEC management team is required to regularly present progress report to the NOVA Instrument Steering Committee (ISC). Members of the NOVA ISC are listed in Table 5.

Table 5: NOVA Instrument Steering Committee

Name	Affiliation
Michael Perryman	ESA Chair
Guy Monnet	ESO
Arnold van Ardenne	NFRA
Wilfried Boland	NOVA
Thijs de Graauw	SRON
Jan-Willem Pel	University of Groningen
Marijn Franx	University of Leiden
Michiel van der Klis	University of Amsterdam
Rob Rutten	University of Utrecht

2.5 Primary actuators

NEVEC is operating in an environment with a number of actuators. Figure 4 shows the primary actuators (those which have a strong impact on the operations of NEVEC).

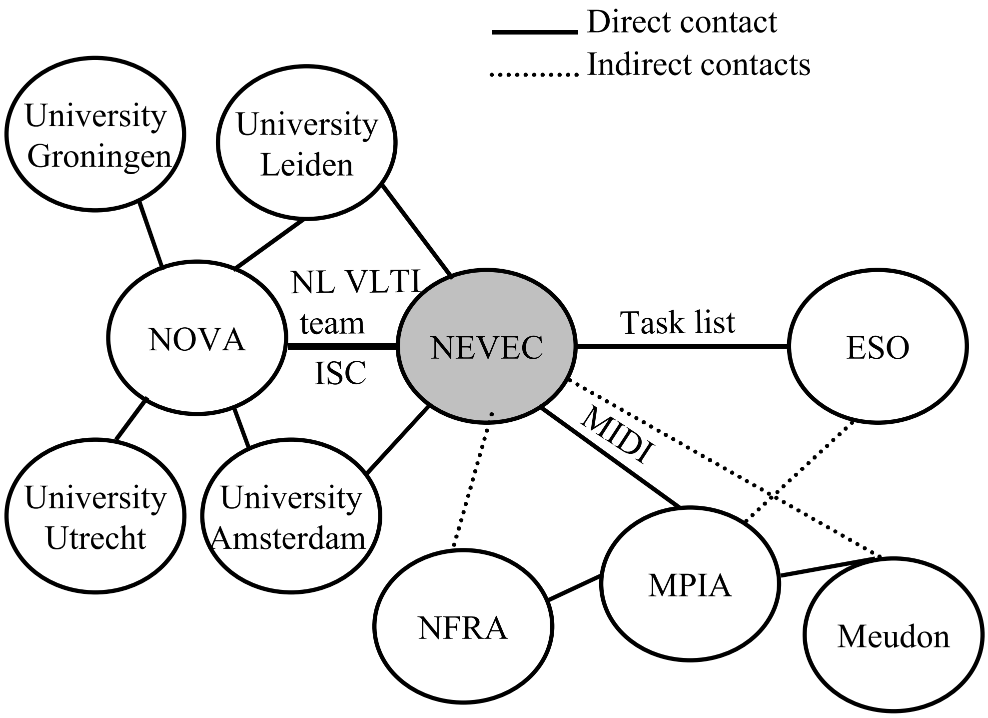


Figure 4: presentation of primary actuators of NEVEC.

2.6 Secondary actuators

Secondary actuators are those that can only influence NEVEC through collaborations and interfaces, but not through direct communications.

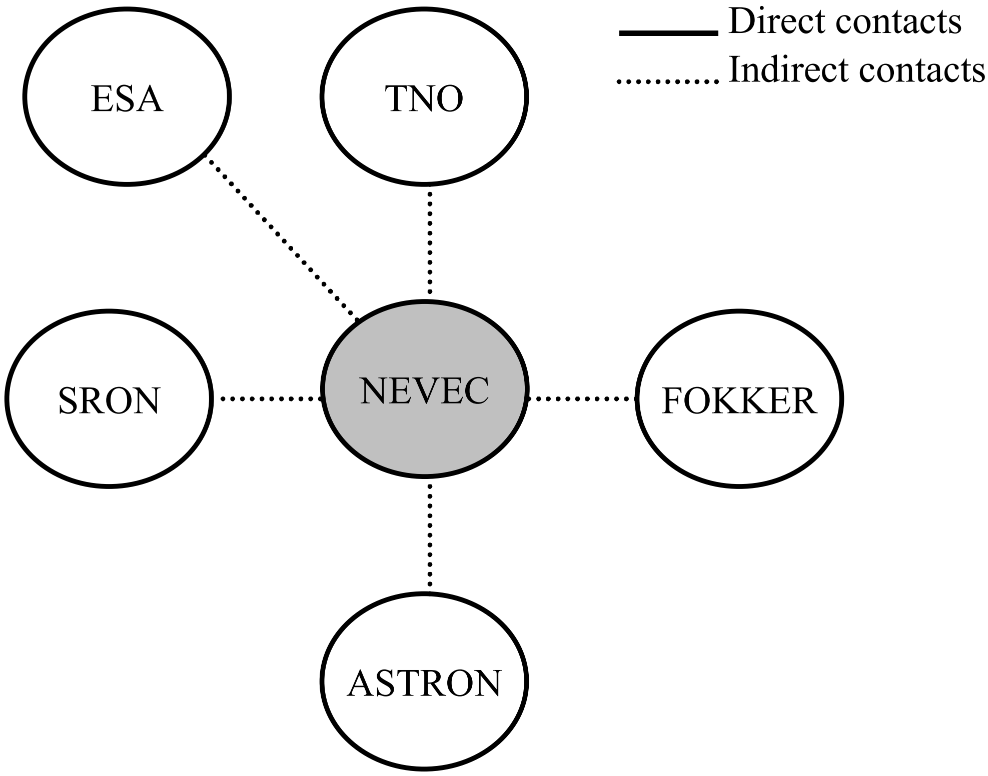


Figure 5: presentation of secondary actuators of NEVEC.

3 Financial resources

3.1 Spending profile

NOVA has assigned a budget of 2,815 kfl (equivalent to 18.3 FTE with bench and travel) for NEVEC over the period 1 August 1999 to 1 June 2005. The spending profile (expenses as function of time) is a free parameter that can be controlled by NEVEC MT. The spending profile is tabulated in Table 6.

- Case A is the based on current contract without any extension to these contracts (excluding 0.5 FTE for Hartmann).
- Case B, is also based on the current contracts, and assumes that all contracts will be extended till the end of NEVEC-1 (June 2005). (Excluding 0.5 FTE for Hartmann).
- Case C: proposed new spending profile, which assumes that 3 astronomer positions will be continued to the end of NEVEC-1, but that the scientific programmer position will not be. (Excluding 0.5 FTE for Hartmann).

Table 6: NEVEC spending profile (A: current contracts, B: continuing current profile, C: proposed new profile).

	1999	2000	2001	2002	2003	2004	2005	Total
A	0.67	3.26	3.50	3.50	1.42	1.00	0.00	13.35
B	0.67	3.26	3.50	3.50	3.50	3.50	1.46	19.39
C	0.67	3.26	3.50	3.58	3.07	3.00	1.50	18.50

NEVEC's case C spending profile is presented in Table 7.

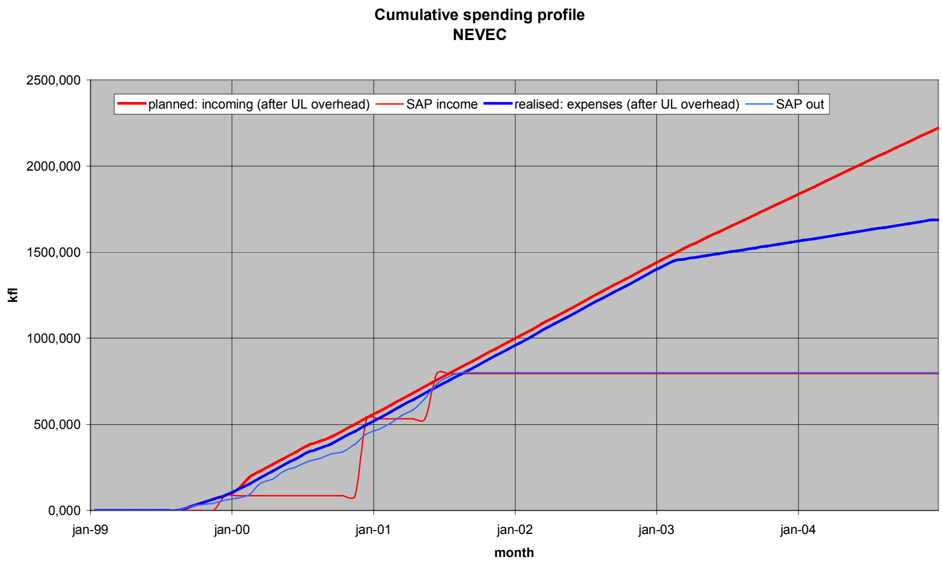


Figure 6: NEVEC's spending profile. The thick red line is the planned NEVEC spending profile, whereas the thick blue lines shows NEVEC commitments for spending (mostly salary). The thin red line is income in SAP, whereas the thin blue lines shows the expenses made so far according to SAP.

The thick red line is the planned spending profile during the period 1999 to 2005, whereas the thick blue line shows the current spending profile based on expenses made, and the yellow line included allocation of funding to cover salary for those already hired.

planned spending profile	Total kfl	1999	2000	2001	2002	2003	2004	2005
Sub-total personnel	2386	87	426	457	457	402	393	164
Sub-total material	503	20	85	90	90	90	90	38
Sub-total additional	40	0	40	0	0	0	0	0
planned: total NOVA (before UL overhead)	2929	107	551	547	547	492	483	201
planned: incoming (after UL overhead)	2367	87	451	439	439	398	391	163
SAP income	794	86	447	262	0	0	0	0
realised and reserved spending profile								
Sub-total personnel	1742	87	426	457	457	184	131	0
Sub-total material	355	20	85	90	90	40	30	0
Sub-total outsourcing	0	0	0	0	0	0	0	0
realised: total NOVA (before UL overhead)	2097	107	511	547	547	224	161	0
realised: expenses (after UL overhead)	1687	87	411	439	439	181	130	0
SAP out	800	61	382	356	0	0	0	0

Table 7: numbers for the "Case C" spending profiles on a yearly basis

4 NEVEC work break down structure

NEVEC work break down structure is presented in the following table.

Table 8: NEVEC work breakdown structure. (Le Poole as PS is involved in all work-packages).

Work package	Title	Responsible person	FTEs (NOVA)	FTEs (all)
00	management	Bakker	2.0	4.0
01	MIDI	Jaffe	5.0	7.0
02	PRIMA	Röttgering	2.0	3.0
03	next generation instruments	Bakker	2.0	4.0
04	instrument calibration	Percheron	2.0	2.0
05	instrument models	Jaffe	0.5	1.0
06	data formats	Jaffe	0.5	1.0
07	commissioning	Jaffe	1.0	2.0
08	education	Bakker	0.5	2.0
09	algorithms	Meisner	0.0	0.0
10	science	Miley	2.5	5.0
11	interfaces	Bakker	0.0	2.0
		Total	18.0	33.0

Table 9: NEVEC weighting factors per work-package.

Compiled on	NEVEC total				
03-sep-01	2000	ESO	MGP	NOVA	Total
2000.00	Management				
2000.00.01	Management team	0,43	0,13	0,43	1,00
2000.00.02	NEVEC project management	0,43	0,00	0,57	1,00
2000.01	MIDI				
2000.01.01	MIDI project management	0,00	1,00	0,00	1,00
2000.01.02A	Operating analysis: scientific procedures	0,00	1,00	0,00	1,00
2000.01.02B	Operating analysis: calibration	0,00	1,00	0,00	1,00
2000.01.02C	Operating analysis: startup/shutdown	0,00	1,00	0,00	1,00
2000.01.02D	Operating analysis: commissioning	0,00	1,00	0,00	1,00
2000.01.03A	EWS: FITS	0,00	1,00	0,00	1,00
2000.01.03B	EWS: tools	0,00	1,00	0,00	1,00
2000.01.03C	EWS: applications	0,00	1,00	0,00	1,00
2000.01.04A	NRTS: infrastructure design	0,00	1,00	0,00	1,00
2000.01.04B	NRTS: implementation	0,00	1,00	0,00	1,00
2000.01.04C	NRTS: applications	0,00	1,00	0,00	1,00
2000.01.05A	Hardware: detector	0,00	1,00	0,00	1,00
2000.01.06A	MIDI science	0,00	0,00	1,00	1,00
2000.02	PRIMA				
2000.02.01	Tender related	1,00	0,00	0,00	1,00
2000.02.02	Limiting magnitude	0,00	0,00	1,00	1,00
2000.02.03	Operating analysis	0,00	0,00	1,00	1,00
2000.03	Next generation instruments				
2000.03.01	STJ	0,00	0,00	1,00	1,00
2000.03.02	Nulling	0,00	0,00	1,00	1,00
2000.03.03	Imaging	0,00	0,00	1,00	1,00
2000.03.04	IRSI/DARWIN/SMART2	0,00	0,00	1,00	1,00
2000.04	Instrument calibration				
2000.04.01	VLTI calibrations plan	1,00	0,00	0,00	1,00
2000.04.02	VINCI calibrators	1,00	0,00	0,00	1,00
2000.04.03	MIDI calibrators	1,00	0,00	0,00	1,00
2000.04.04	PRIMA calibrators	1,00	0,00	0,00	1,00
2000.04.05	AMBER calibrators	1,00	0,00	0,00	1,00
2000.05	Instrument models				
2000.05.01	Atmospheric simulator	1,00	0,00	0,00	1,00
2000.05.02	Data simulators	1,00	0,00	0,00	1,00
2000.06	Data format				
2000.06.01	FITS documents	1,00	0,00	0,00	1,00
2000.06.02	FITS library	1,00	0,00	0,00	1,00
2000.06.03	VINCI FITS converts	0,00	0,00	1,00	1,00
2000.07	Commissioning				
2000.07.01	Commissioning: VINCI	1,00	0,00	0,00	1,00
2000.07.02	Commissioning: MIDI	0,00	1,00	0,00	1,00
2000.08	Education				
2000.08.01	Summer school	0,50	0,00	0,50	1,00
2000.08.02	Interacademial lectures	0,50	0,00	0,50	1,00
2000.08.03	WWW	0,50	0,00	0,50	1,00
2000.08.04	PR general	0,50	0,00	0,50	1,00
2000.09	Algorithms				
2000.09.01	Fringe tracking	0,50	0,00	0,50	1,00
2000.09.02	FINITO	0,50	0,00	0,50	1,00
2000.10	Science				
2000.10.01	Galactic	0,50	0,00	0,50	1,00
2000.10.02	Extra-galactic	0,50	0,00	0,50	1,00
2000.11	Interfaces				
2000.11.01	Interfaces	0,50	0,00	0,50	1,00
2000.11.02	Acquisition	0,50	0,00	0,50	1,00
2000.99	Not NEVEC related				
2000.99.01	Other activities	0,00	0,00	0,00	0,00
		0,00	0,00	0,00	0,00
	Total				15316,00

Since NEVEC has three accountable parties (ESO, MPG and NOVA), each work package is accounted towards these parties using a weighting table. This table is presented in Table 8.

5 Work realised

In "Appendix A" an overview is given of the amount of person-days consumed by NEVEC personal during the period of this document relates to. The current status of affairs is as follows **

Table 10: NEVEC work breakdown structure.

Work package	Title	NS	all	NS	all
		1999-2000		2001	
00	Management	0.06	0.46		
01	MIDI	1.66	2.89		
02	PRIMA	0.00	0.19		
03	Next generation instruments	0.05	0.10		
04	Instrument calibration	0.00	0.00		
05	Instrument models	0.31	0.69		
06	Data formats	0.00	0.60		
07	Commissioning	0.00	0.00		
08	Education	0.30	0.91		
09	Algorithms	1.00	1.00		
10	Science	0.00	0.94		
11	Interfaces	0.00	0.29		
		3.71	9.60		

Some remarks:

- A person-year corresponds to 210 working days (1596 hours, 38 hours per week) per year.

6 NEVEC deliverables

In Table 11 an overview is presented of all NEVEC deliverables produced during the period this document relates to. In total 12 are related to the NEVEC task list, 25 to NEVEC MIDI activities, and 7 to NEVEC open. In total 44 deliverables are produced. Most of the deliverables are reports and papers, and a number of software packages.

Table 11: an overview of NEVEC deliverables.

Deliverable	NEVEC task list	NEVEC MIDI	NEVEC open research
3-sep-01			
2000.00: management			
NEVEC team, NEVEC business plan			X
E.J. Bakker, G. Miley, L.B.F.M. Waters, R. Le Poole, W. Jaffe, H. Röttgering, I. Percheron, J. Meisner, J. de Jong, D. Hartmann, B. Cotton, B Heijligers, R. van Boekel, A. Glindemann, L. d'Arcio, W. Boland, NEVEC: the NOVA ESO VLTI Expertise Centre, 2001, ESO workshop on "Next generation VLT/VLTI instruments"	X		
2000.01: MIDI			
Cotton W., Near Real Time System Design Report for FDR, 2000, VLT-TRE-MID-15824-0131		X	
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Cotton W., MIDI Demonstration Software, Draft version: December 8, 1999, VLTI-TRE-MID-15824-0133		X	
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7 Project management tools in place

Table 12: NEVEC meeting schedule.

Tool	Frequency	Goal	Reporting
MT	4 per year	Strategic issues	minutes distributed
PAP	monthly	Progress & planning	progress report distributed
TM	Two-weekly	technology	no reporting
Effort	weekly	effort registration	overview

- MT stands for Management team
- PAP stands or Planning and Progress
- TM stands for Technical Meeting
- Each week, each NEVEC member fills-out a form that keeps track on which work packages they have worked;
- NEVEC MT meetings four times a year;
- Two-weekly NEVEC technical meetings;
- Monthly NEVEC progress and planning meetings;

8 Signature

Approved by:

Date:	Date:
Dr. A. Glindemann Head ESO VLTI team	Prof. Dr. G. Miley PI NEVEC

9 Appendix A: Work package description

9.1 WP 00: management

9.1.1 Introduction
This document specifies the NEVEC work package referred to as "management" for a total of 2 person-years.

9.1.2 Objective
This work package describes NEVEC management activities required to operate a professional project environment. The activities executed in the framework of this work package are focussed on the management team and project management of NEVEC. The management team deals with strategic issues, project management with day-to-day operations of the project.

Management includes supervision on 18 FTE funded by NOVA (1999-2005) (of which 10 FTE for an ESO task list, 3 FTE MIDI software development, and 5 FTE open research). University staff and NEVEC guests provide additional person-power. In total management requires co-ordination of activities of 15 scientist involved, distributed over two locations (headquarter at Leiden observatory, second location at the University of Amsterdam), with a total person-power consumption for NEVEC of about 6 FTE/year.

The work package has a starting date of August 1, 1999 and a finish date of August 1, 2005. It is estimated that this work package will require 2 person-years of effort by NEVEC staff, over a period of 6 years.

Deliverables of this work package are organising meetings, compiling minutes, distributing yearly updates of the business plan.

9.1.3 Human resources

The NEVEC Management Team (MT), currently consisting of:
- G.K. Miley (principal investigator NEVEC, Chair)
- L.B.F.M. Waters (co-principal investigator NEVEC, Netherlands MIDI principal investigator)
- E.J. Bakker (project manager, deputy chair and executive secretary)
- R.S. Le Poole (project scientist)
- Glindemann (representative of ESO)
- W. Jaffe (co-project scientist, software advisor)
- H. Röttgering (link with ESA, SRON)
- W. Boland (representative NOVA)

NEVEC-NOVA staff are:
- E.J Bakker (50% PM, 50% astronomer)
- I. Percheron (100 % astronomer)
- J. Meisner (100 % physicist)
- J. de Jong (50 % software engineer)
- D. Hartmann (50 % software engineer through outsourcing contract)

- T. Bot (10 % WWW-master through outsourcing contract)
- M. Zaal (5 %, management assistant)

NEVEC-guests currently are:
- B. Cotton (NRAO)
- L. d'Arcio (SRON)

Ex-NEVEC staff is:
- B. Mennesson (currently at JPL)

9.1.4 Work package structure

The work package is planned to have kick-off (K.O.) on August 1, 1999.

Table 13: WP00: management: work package structure.

Work Package	Title	Person power month	Deliverable (dead-line)
0.1	Management team	2	
0.2	Project management	20	
	Total	25	

9.1.4.1 WP 0.1: management team

The management team is responsible for strategic issues concerning NEVEC.

The responsibilities of the MT include:
- The MT will meet about once per month, with the PI as Chair and the PM as Deputy Chair and Executive Secretary;
- Provide a general oversight of NEVEC activities;
- Provide advice on the set of tasks to be agreed on between NEVEC and ESO or other NEVEC clients;
- Monitor the progress and cost of the agreed work-packages, with particular attention to problem areas;
- Discuss matters related to the strategy on NEVEC;
- Discuss other matters deemed to be appropriate by the PI, PM or ESO representative;
- Decide on budgetary matters if they are larger than 10 kfl per occasions.

The responsibilities of the PI include:
- Responsibility for the overall direction of the project;
- Responsibility for the general strategy of NEVEC;
- Arbitration of (i) any disputes that may arise within the NEVEC MT and, (ii) any disputes that may arise between NEVEC and ESO (together with the Head of the VLTI group at ESO);
- Determination (together with the PM and Head of the VLTI Group at ESO) of a set of mutually agreeable tasks to be carried out by the NS for ESO that are (i) in accordance with the goals of NEVEC and (ii) the available manpower specified by the MOU. The final set of tasks will be selected from a set proposed by members of the MT and ESO;
- Chairing meetings of the MT;
- In carrying out these tasks the PI will consult with the PM, PS and the MT.

The responsibilities of the PM include:
- Organisation of the procedure whereby a task package is agreed between NEVEC and ESO and other NEVEC clients (e.g. MIDI);
- Management of the day to day operations within NEVEC, including priorities, schedules and manpower allocations of the NS;

- Responsibility for hiring staff, in consultation with the Principal Investigator (PI) and Project Scientist (PS) and the Head of the VLTI Group at ESO;
- Responsibility for the budget of NEVEC and expenditures in consultation with the PI and PS. The PM can decide on budgetary matters to the amount of 10 kfl per occasions;
- Organisation of regular meetings of the Management Team (MT) of NEVEC and the national VLTI team and to participate in these bodies;
- Production of regular (e.g. monthly) written reports both for the Management Team of NEVEC and for ESO;
- To be the main NEVEC contact for communications with ESO and ensure that the views of NEVEC are properly represented to ESO;
- Organisation of the procedures whereby long-term strategy is determined by the PI and MT;
- In carrying out these tasks the PM will consult regularly with the PI, PS, and representatives of ESO and the MT.

The responsibilities of the PS include:

- The tasks of the PS will include the following;
- To ensure (together with the PM) that a set of possible appropriate tasks are produced for discussion and selection by the MT;
- To advise whether tasks suggested by members of the MT and ESO fall within the goals of NEVEC as specified in the MoU;
- To work towards optimising the scientific effectiveness of the agreed tasks.
- To monitor the scientific effectiveness of NEVEC;
- In carrying out these tasks the PS will consult regularly with the PM, PI and MT.

Deliverables
Del1: monthly management team meetings, and minutes of meeting

Deadlines
Del1: monthly

9.1.4.2 WP 0.2: project management

Project management is responsible for day to day operations of NEVEC. The project manager has the direct supervision on the NEVEC-NOVA staff (NS) appointed jointly by NOVA and ESO. The project manager organised three types of meetings:

Table 14: NEVEC meeting schedule

Meeting	When	Goal
Monthly technical meeting	1st Friday of the month	Technical issues
Monthly management team meetings dealing with strategic issues	2nd Friday of the month	Strategic issues
Monthly science meetings	3rd Friday of the month	Science
Monthly planning and progress meetings	4th Friday of the month	Planning and progress

Any professional project environment must have some kind of effort registration in order to monitor progress and for planning purposes. Within NEVEC we have a very basic type of effort registration in place which is being used as a tool for progress and planning.

Deliverables
Del2: effort registration

Del3: yearly updates of business plan

Deadlines
Del2: monthly
Del3: January 1, 20XX

9.1.5 Conditions
None

9.1.6 Bibliography
None

9.2 WP 01: MIDI

9.2.1 Introduction
In the Memorandum of Understanding (MoU) between Max Planck Institute for Astronomy (MPIA), ASTRON, and NOVA, it has been agreed that NEVEC will devote 3 person-years of efforts to MIDI software development. This document specifies in some detail the NEVEC activities employed within the NEVEC obligations to MIDI.

9.2.2 Objective
In close collaboration with the Max Planck Institute for Astronomy at Heidelberg (MPIA), the Observatory of Paris Meudon, and ASTRON, NEVEC designs and develops procedures and software to operate the instrument and analyse data from MIDI.

The objective of this work package is to design and develop software for the first scientific instrument for the VLTI, the Mid-Infrared Interferometric Instrument MIDI. The main NEVEC efforts are directed towards two software modules, the Near real-time System (NRTS) allows quick look display, and the Expert Workbench Station (EWS), which both process the detector data to extract scientific information, and towards theoretical development and validation of the underlying fringe tracking algorithms. Additionally efforts are directed towards the operating analysis of MIDI, Template Signature Files (TSF), detector and overall MIDI sensitivity, MIDI commissioning, and overall MIDI software management.

The work package has a starting date of August 1, 1999 and a finish date of August 1, 2002. It is estimated that this work package will require 3 person-years of effort by NEVEC staff, over a period of 3 years.

Deliverables of this work package are a large number of documents and the corresponding software codes. The NEVEC contribution to the software (and hardware) is only a small fraction of those developed for MIDI with the whole consortium.

9.2.3 Human resources
The people identified at NEVEC to work on this work package are Dr Jaffe, Dr. Jong, Dr. Hartmann, Dr. Percheron, Dr. Meisner, Dr. Cotton, and Dr. Bakker. All available NEVEC staff could potentially make a contribution to this work package. Local supervision at Leiden will be the responsibility of Dr. Jaffe (PS NEVEC and also NEVEC Point of Contact for this work package), who is also responsible for the overall MIDI software management.

The person identified at MPG to be the Point of Contact (POC) for this work package is Dr. Leinert.

9.2.4 Work package structure

This work package is planned to have kick-off (K.O.) on August 1, 1999. This work package can be divided in eight work packages. Corresponding estimates of NEVEC efforts are listed. Note that the table only includes efforts by NEVEC staff. Additional efforts by Dr. Jaffe are not included. It is estimated that these efforts amount to at least 2 FTE for the whole work package.

Table 15: WP01: MIDI: work package structure.

Work Package	Title	Person power Month	Deliverable (dead-line)
1.0	Management	2	Progress reports (every two months)
1.1	Operating analysis	12	ESO documents (continuously)
1.2	NRTS	12	NRTS module (K.O. + 24 , August 1, 2002)
1.3	EWS	6	EWS module (K.O. + 24 , August 1, 2002)
1.4	Templates	6	Templates (K.O. + 24 , August 1, 2002)
1.5	Fringe tracking Algorithms	12	NEVEC report (K.O. + 24, August 1, 2001)
1.6	Detector sensitivity	4	Science paper (Munchen workshop)
1.7	Commissioning	9	Commissioning plan (K.O. + 30, February 1, 2002) (K.O. + 36, August 1, 2002)
	Total	63 (31) months	

9.2.4.1 WP 1.0: management

Overall management of MIDI software design and development is under the responsibility of Dr. Jaffe. Involvement of the NEVEC PM (Dr. Bakker) is limited to attending meetings and integration efforts related to this work package into NEVEC activities.

This work package is executed by Dr. Jaffe and Dr. Bakker.

Deliverables
Every two months a progress report is presented to NEVEC Project Manager and Principal Investigator of MIDI.

Deadlines
January 1, March 1, May 1, July 1, September 1, November 1.

9.2.4.2 WP 1.1: operating analysis

Studies need to be conducted to operate MIDI in the different modes. All the procedures (Observations procedures as well as test, calibrations and engineering procedures) have to be described first at a high level then at a very detailed level.
We are using our knowledge to run existing instruments to detail these procedures.

This has resulted in a number of ESO documents that describe the scientific operation of MIDI.

This work package is executed by Dr. Percheron in collaboration with the MIDI team.

Deliverables
Del1: number of ESO documents, which includes Final Design Review (FDR) documents.

Deadlines
Del1: continuously

9.2.4.3 WP 1.2: NRTS
The Near Real Time System (NRTS) is a quality control module, which is part of the MIDI instrument software. The NRTS computes quality of the detected fringes, gives an estimate of the visibility, and could be used for fringe tracking. The NRTS is designed to operate in real-time, when the detector read-out operates at 40 Hz. Implemented fringe tracking algorithms are obtained from work package 1.5 "fringe tracking algorithms".

NRTS will be integrated in the MIDI instrument software structure. This requires close collaboration between NEVEC and MPG and Meudon to facilitate integration in the final phase of the development.

NRTS is written in ANSI C, and is designed conform the ESO software standards.

This work package is executed by Dr. de Jong in collaboration with the MIDI team.

Deliverables
Del2: NRTS module

Deadlines
Del2: K.O. + 24.

9.2.4.4 WP 1.3: EWS
The expert workbench system (EWS) is an off-line data reduction system, which allows the astronomer to interactively reduce MIDI data and compute the visibility. Implemented fringe tracking algorithms are obtained from work package 1.5 "fringe tracking algorithms". The EWS code developed by NEVEC is designed to be integrated with codes developed at the Observatory of Paris-Meudon. This requires close collaboration between NEVEC and Meudon to facilitate integration in the final phase of the development.

The EWS is written in IDL, and is not designed conform ESO standards.

This work package is executed by Dr. Hartmann.

Deliverables
Del3: EWS code.

Deadlines
Del3: K.O. + 24.

9.2.4.5 WP 1.4: templates signature files
Design and development of the MIDI templates required for input to P2PP and BOB, and as such for MIDI OS. These templates allow the astronomer to prepare an observing run

and will include engineering mode templates to perform test measurements. Templates are written according to ESO standards using ESO software, and built on the experience from VINCI.

The different template signature files (*.tsf), extended template signature files (*.tsfx) and sequencer files (*.seq) will be designed and developed.

This work package is executed by Dr. Bakker in collaboration with the MIDI team.

Deliverables
Del4: template files

Deadlines
Del4: K.O. + 24.

9.2.4.6 WP 1.5: fringe tracking algorithms

Fringe tracking algorithms are developed in order to be implemented in MIDI's NRTS and EWS. These fringe tracking algorithms will be described in a NEVEC report and are the basis for off-line documentation for NRTS and EWS fringe tracking algorithms.

This work package is executed by Dr. Meisner.

Deliverables
Del5: NEVEC report description of algorithms

Deadlines
Del5: K.O. + 24.

9.2.4.7 WP 1.6: detector sensitivity

A study on the limiting signal-to-noise ratio for MIDI will be conducted and a number of experiments will be executed in order to characterise the detector sensitivity and to improve the detector performance.

This work package is executed by Dr. Meisner.

Deliverables
Del6: paper on MIDI sensitivity, participate in detector characterisation experiments in collaboration with the MIDI team.

Deadlines
Del6: K.O. + 24.

9.2.4.8 WP 1.7: commissioning

During commissioning of MIDI all required NEVEC staff will be allocated either at Paranal or at Leiden. The commissioning is planned for approximately July 2002 and will last approximately 6 months. During this whole period there will always be at least one NEVEC staff member at Paranal, at the same time other NEVEC staff members will provide support from Leiden.

This work package is executed by Dr. Jaffe.

Deliverables
Del7: MIDI commissioning plan
Del8: participate in commissioning

Deadlines
Del8: K.O. + 30.
Del9: K.O. + 36.

9.2.5 Conditions
The execution of the work package requires close collaboration between NEVEC and MPG and will require regular visits of NEVEC staff to MPG.

9.2.6 Bibliography
None

9.3 WP 02: PRIMA

9.3.1 Introduction
In the Memorandum of Understanding (MoU) between ESO and NOVA, it has been agreed that NEVEC will devote 10 person-years of efforts to a mutually agreed task list. This document specifies a NEVEC work package referred to as the "Pre-PRIMA Survey" for a total of 2 person-years.

9.3.2 Objective
The objective of this work package is to find interesting science objects within the isoplanetic patch of a bright reference object.

For adaptive optics and phase referencing for interferometry to work at their best, a bright point source as reference object is required within the isoplanetic patch of the science object. Given the small size of the isoplanetic patch, the number of reference objects for PRIMA around a science object is somewhat restricted. This work package follow the following approach: instead of first selecting a science object and then a reference object, one could first select a reference object, and look for science objects within the isoplanetic patch.

The work package has a starting date of August 1, 2001 and a finish date of August 1, 2005. It is estimated that this work package will require 2 person-years of effort by NEVEC staff, over a period of 4 years.

Deliverables of this work package are a list of science objects around at least 25 reference objects (goal 100 reference objects) accessible from Paranal, NEVEC/ESO report(s), and scientific paper(s) in refereed journals describing the reference and science objects resulting from this work package.

9.3.3 Human resources
The people identified at NEVEC to work on this work package is Dr Percheron (at least 20% of the required efforts). The NEVEC staff person to realise the remainder of the efforts has not yet been identified. All available NEVEC staff could potentially make a contribution to this work package. Local supervision at Leiden will be the responsibility of Dr. Röttgering.

The person identified at ESO to be the Point Of Contact (POC) for this work package is Dr. Richichi.

Dr. Röttgering is involved in a project with MPE, ESO, Köln, and Leiden astronomers (PI of observing proposal is M. Lehnert from MPE) with the objective of imaging fields around carefully selected bright reference objects using the NTT with SOFI and SUSI2 instruments. Their intention is to identify objects for galaxy evolution studies for CONICA and SINFONI on the VLT. It is foreseen that the two projects could partly overlap and as a result information could be shared between the two projects. This is being regarded as a positive element of the presented work package. Regarding human resources this means that more scientists could be involved as a result of the collaboration.

However this Pre-PRIMA work package is broader in scope and is not limited to extra galactic science objects, but rather to any science object. The work package is primarily intended to optimise the scientific output of PRIMA by working towards a set of selected reference stars which can be used as soon as PRIMA enters its operational life time.

9.3.4 Work package structure

The work package is planned to have kick-off (K.O.) on August 1, 2001. This work package can be divided in five work packages. The work packages WP1-WP2-WP3 are closely related and will partly run in parallel. Corresponding estimates of NEVEC efforts are listed. Estimates of efforts required (third column), and span time (fourth column) are presented.

Table 16: WPO2: PRIMA: work package structure.

Work package	Title	Person power	Deliverable
2.0	Management	1	
2.1	Selection of candidate reference objects	7	Reference object list and observing proposals (K.O. + 12, August 1, 2002)
2.2	Data reduction and science object extraction	7	Reduced data (K.O. + 24 , August 1, 2003)
2.3	Characterising science objects	7	Follow up observation proposals (K.O. + 24, August 1, 2003) Science object characteristics (K.O. + 36, August 1, 2004)
2.4	Publication	2	Scientific paper (Submitted: K.O. + 48, August 1, 2005)
	Total	24 month	

9.3.4.1 WP 2.0: management

Which includes reporting and attending meetings. ESO will be informed every two months on planning and progress of this work package (a progress report in written form not exceeding one page).

Deliverables
Every two month a progress reports to ESO and NEVEC PM.

Deadlines
January 1, March 1, May 1, July 1, September 1, November 1.

9.3.4.2 WP 2.1: selection of candidate objects

In order to obtain an interesting list of astrophysical objects (25 at least, goal is 100) to be observed with a first or second generation VLTI instrument using a phase reference facility we propose the next steps.

1. Definition of the criteria required for the reference objects (to be used with FINITO and PRIMA);
2. Selection of reference objects: A first list of objects will be obtained by investigating the 2MASS database. This list will be refined to be a list of suitable reference targets for FINITO/PRIMA by cross correlating it with other databases;
3. Pre-selection of scientific objects nearby a reference object (preliminary list of reference objects) using: a number of catalogues, such catalogues could include NVSS, FIRST, WENSS, 2MASS, DENIS, POSS II survey, the IRAS survey and the Rosat all sky survey : *preliminary list of science targets*;
4. A number of scientifically "interesting" pairs (reference/science objects) will be selected based on specific criteria : *list of selected objects*;
5. Archive data (HST, ESO, La Palma) will be searched for these selected objects.

Observing proposals will be written to obtain information on the scientific objects

- A proposal could be written to use a small (1 m class) telescope to do an extensive survey of our preliminary list for a large number of sky snap shots. The advantage to this approach is the amount of time available on small telescopes.;
- A proposal could be written to obtain moderately deep multicolour images of the selected fields, preferably using ADONIS on the ESO 3.6 meter telescope (the option of using a coronograph could be considered);

These 2 observing proposals are complementary and could be done in parallel or one after the other.

Deliverables

Del1:

1. a preliminary list (from catalogues and archive data) of scientific objects around bright objects,
2. List of 25 selected reference objects (goal is 100 reference objects),
3. observing proposal(s) to obtain fundamental parameters of the scientific objects.

Deadlines

Del1: K.O. + 12.

9.3.4.3 WP 2.2: data reduction and science object extraction

The raw data will be reduced and science objects around the reference objects will be extracted to the limiting magnitude of the observations. Standard astronomical software (MIDAS, IRAF, etc.) will be used to carry out these tasks.

Deliverables

Del2: Reduced images and list of scientific targets obtained in the course of the research.

Deadlines

Del2: K.O. + 24.

9.3.4.4 WP 2.3: characterising science objects

The science objects will be characterised. If the nature of a science object cannot be established, additional observations will be required on other ESO telescopes, possible including spectroscopy.

Deliverables
Detailed characterisation of the astronomical science objects identified in the images which includes:

- Accurate relative position to the reference object
- Estimation of object type
- Estimation of magnitude
- Estimation of angular diameter, if available.

Del3: Follow-up observation proposals aimed at identifying science objects near reference object.
Del4: a NEVEC/ESO report containing information on the nature of the science objects.

Deadlines
Del3: K.O. + 24.
Del4: K.O. + 36.

9.3.4.5 WP 2.4: publication

The results of the studies executed in the framework of this work package will be published in scientific paper(s) in a refereed journal (preferably in A&A).

The knowledge gained during the study will be transferred to ESO. The most appropriate mean to transfer this knowledge depends on the outcome of the study. It could be by means of a software model, NEVEC internal report, ESO report, discussion etc. The goal is to transfer the knowledge gained during this study, as efficiently as possible to ESO personnel.

Deliverables
Del5: Scientific paper(s) in refereed journal (preferable A&A).

Deadlines
Del5: K.O. + 48.

9.3.4.6 WP 2.5: PRIMA tender

Input to ESO, by the person of Le Poole, has been provided regarding the invitation to tender on PRIMA.

Deliverables
Del6: This has resulted in a number (as of today 5) of tender papers.

Deadlines
Del6: KO + 0.

9.3.5 Conditions

The execution of the work package requires close collaboration between NEVEC and ESO and will require regular visits of NEVEC staff to ESO.

Additionally to obtain observing time on the 3.6 meter is required to execute this work package. If the proposal is not awarded time to execute for this work package, then it might be considered to request telescope time outside the normal competitive allocations.

9.3.6 Bibliography

None

9.4 WP 03: next generation instruments

9.4.1 Introduction

In the Memorandum of Understanding (MoU) between ESO and NOVA, it has been agreed that NEVEC will devote 10 person-years of efforts to a mutually agreed task list. This proposal aims at defining part of the efforts for the task list through the definition of a work package "Next generation instruments".

The current VLTI is able to combine light from two telescopes coherently (in April 2001, from two siderostats), to be extended to three beams when AMBER is commissioned. This does not make use of the full capabilities of the VLTI, as the interferometer is designed to coherently combine the light from up to eight telescopes. In order to combine the light coherently of up to eight telescopes a number of beam combination techniques can be applied among which closure phase and homothetic mapping. To fully access the potential of homothetic mapping we propose to make a theoretical study aiming at improving our understanding of this technique and developing tools to make a conceptual study of a homothetic mapper for the VLTI.

The experimental experience required for proper modelling will be acquired through interaction with the University of Delft, and ESO.

9.4.2 Objective

This document specifies a NEVEC work package referred to as "Next generation instruments" for a total of 2 person-years within a period of 4 years. The work package has a starting date of July 1, 2001 and a finish date of July 1, 2005.

The objective of this work package is to study concepts for the next generation VLTI instruments involving a beam combiner that uses the homothetic mapping principle.

Deliverables of this work packages are software models, NEVEC/ESO reports, and scientific paper(s) in refereed journals.

9.4.3 Human resources

The person identified at NEVEC as Point of Contact (POC) towards ESO is Dr. Bakker. Given the current staffing of NEVEC, Dr. Bakker will realise at least 25% of the efforts for this work package. The NEVEC staff person(s) to realise the remainder of the efforts of this work package has not yet been identified. All available NEVEC staff could potentially make a contribution to this work package. Local supervision of this work package at Leiden will be the responsibility of Le Poole and Dr. Jaffe (project scientists NEVEC).

The person identified at ESO to be the Point Of Contact for this work package is Dr. Schöller.

9.4.4 Work package structure

The work package is planned to have kick-off (K.O.) on July 1, 2001. This work package can be divided in six work packages. Corresponding estimates of NEVEC efforts are listed. (Not just by Dr. Bakker, Le Poole, and Dr. Jaffe, but all other NEVEC staff involved).

Table 17: WP03: next generation instruments: work package structure.

Work package	Title	Person power month	Deliverable (dead-line)
3.0	Management	1	Bimonthly reports

3.1	Definition phase	2	NEVEC/ESO report (K.O. + 6, January 1, 2002)
3.2	Software simulator	6	software simulator (beta version at K.O. + 12, July 1, 2002) (final version at K.O. + 36, July 1, 2004)
3.3	Error budget and piston retrieval	6	ESO/NEVEC report (draft version at K.O. + 24, July 1, 2003) (final version at K.O. + 36, July 1, 2004)
3.4	Conceptual design	6	ESO/NEVEC report (draft version K.O. + 28, January 1, 2003) (final version at K.O. + 36, July 1, 2004)
3.5	Publication	3	Scientific article (Submitted at K.O. + 48, July 1, 2005)
	Total	24 month	

9.4.4.1 WP 3.0: management

Which includes reporting to ESO and attending meetings. ESO will be informed every two months on planning and progress of this work package (a progress report in written form, not exceeding one page). The progress report will be send to ESO POC and NEVEC PM.

Deliverables
Every two months progress reports to ESO and NEVEC PM.

Deadlines
January 1, March 1, May 1, July 1, September 1, November 1.

9.4.4.2 WP 3.1: definition phase

A literature study will be conducted on homothetic mapping which will focus on previously presented homothetic mapper concepts and the in the literature presented opportunities of homothetic mapping.

Based on this literature study, a preliminary conceptual design of a homothetic mapper will be developed. This design will be used for the software simulator and will include details on all optical components, which are critical for understanding the performance of a homothetic mapper, but exclude others which are not (see Table 18).

To give the reader a feeling about how such a preliminary design could look like, a flow diagram is presented in Figure 7.

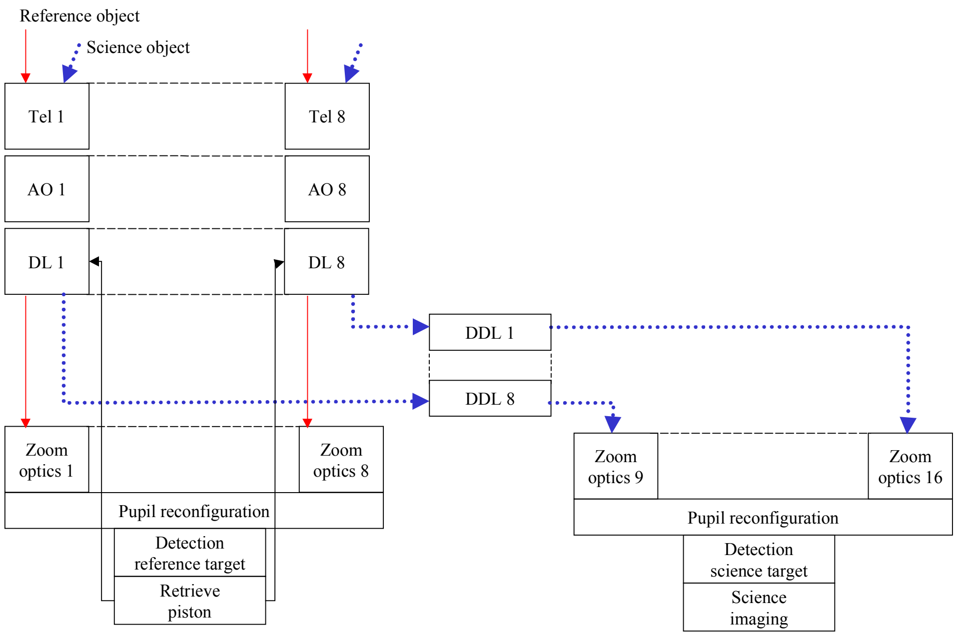

Figure 7: possible preliminary design with the reference channel on the left and the science channel on the right.

Deliverables
Del1: NEVEC/ESO report describing the results of this work package.

Deadlines
Del1: K.O. + 6.

9.4.4.3 WP 3.2: software simulator

A model will be developed which simulates a homothetic mapper for the VLTI based on the preliminary design. The model will include the functions listed in Table 18.

The software simulator will be developed to study the error budget and piston retrieval from the computed point spread function for a reference object and on the integrated image of a science object. The simulator will allow the user to vary design parameters e.g.:

- Aperture densification (to be defined for each telescope);
- Pupil reconfiguration (magnification for array, geometry etc.);
- Alignment errors of critical optical components;
- Detector characteristics (e.g. noise parameters, integration time, wavelength and band pass).

And computes or adopted parameters for those that cannot be varied in the design e.g.:

- Intervening atmosphere (coherence time, amplitude and phase fluctuations of wavefront distortions);
- VLTI infrastructure constraints (telescope stations, telescope size etc.);
- Photon shot noise.

The simulator will assume a point source as reference object (later to be extended to larger objects), and the science object will be the solar system seen from a large distance (later to be extended to an arbitrary input image).

The design and development of the software will have the following specifications:

- The model will be written in a later to be specified language (possible IDL, JAVA, or C);
- The code will have inline documentation to allow others to continue the development of the code;
- A user manual will be written;
- The code will not be written conform ESO standards.

The software developed for these studied will be released to ESO and the scientific community and will be developed in order to run on a regular window or LINUX based PC.

Table 18: preliminary design of software package.

Module name	Function
Homo_panel	GUI to set input parameters
Homo_init	Define variables: • Refsource.angularsize • Refsource.magnitude • Refource.spectralindex • Refsource.wavelength • Source.fitsimage • Atmosphere.friedparameter • Atmosphere.coherencetime • Atmosphere.temperature • AO.tiptilt • Telescopes.XYZ • Telescopes.radius • Telescopes.efficiency • Telescopes.phaseerror • Telescopes.number • Delayline.OPD • Instrument.FOV • Instrument.IFOV • Instrument.wavelength • Instrument.bandpas • Instrument.densification • Instrument.reconfiguration • Detector.xsize • Detector.ysize • Detector.readoutnoise • Detector.darkcurrent • Detector.quantumefficiency • Detector.DIT • Detector.NDIT
Homo_default	Defines default parameters: • Use of 8 ATs • Point source as reference object • Solar system as science object • 10 Micron • 25 X 25 micron pixels
Compute_inputimage	Obtain the input image of both reference object and science objector by either

	• Computing the image from the source parameters • Acquire the image from an externally provided FITS file
Wavefront_infinity	Computes the unperturbed wavefront from the source at infinity
Atmospheric_distortion	Computes the atmospheric distortion of the wavefront
Wavefront_pupilplane	Computes wavefront (complex) at input pupil of interferometer
Instrumental_distortion	Computes the distortions of the wavefront to the instrument
Aperture_densification	Applies aperture densification. Includes details on: • Estimation of field of view properties • Field invariance of PSF
Pupil_reconfiguration	Applies pupil reconfiguration. Includes details on: • Homothetic mapping • Scaling factors
Compute_PSF	Computes PSF from wavefront applying • Probability theory of arriving of photons • Spectral characteristics • Quality of PSF expressed in Strehl ratio
Compute_detectorimage	Given the detector characteristics, compute the detector image for • Reference channel • Science channel
MOP_image	Determines the Measure Of Performance (quality) of detected image • Fully filled aperture versus sparsely filled aperture • Coherent combination versus incoherent combination of light
Display_PSF	Display computed PSF with MOP
Retrieve_piston	Retrieves the piston error for the individual telescopes from the detector signal of the reference channel

Deliverables
Del2: The software simulator developed for this study. Including documentation, both in the code, and an offline user manual.

Deadline
Del2: beta version at K.O. + 12 and final version at K.O. + 36.

9.4.4.4 WP 3.3: error budget and piston retrieval

Given the input parameters the theoretical error budget of a homothetic mapped VLTI will be described. Deviations from ideal pupil reconfiguration (homothetic mapper) by assuming errors in the tip and tilt of the wavefront, piston errors of the wavefront, wavefront errors present after adaptive optics (MACAO), errors due to aperture densification and pupil reconfiguration, and detector characteristics.

Different methods will be developed and applied to retrieve the piston of the individual telescopes from the simulated detector signal.

Deliverables
Del3: NEVEC/ESO report describing the performance of a homothetically mapped beam combiner. Including error budget and piston retrieval.

Deadline

Del3: draft version at K.O. + 24, final version at K.O. + 36.

9.4.4.5 WP 3.4: conceptual design

The instrumental constraints derived from the modelling will be translated to required hardware components. Homothetic mapping will be realised by the use of delay lines (or possibly alternatives using fibres and integrated optics). The aperture densification will be realised through a proposal of a hardware zooming system (also possibly by means of fibres and integrated optics). The required detector characteristics will be elaborated on in term on constraints posed by current generation photo-counting detectors like the SuperTunnel Junction (STJ) and Bolometers.

The first key question to address is the decrease in required observing time for a scientific observation using pair wise combination of telescopes, versus combining of all telescopes simultaneously on one detector by means of homothetic mapping. This will be investigated for the reference and science channel. The second key question to address is the scientific driver for a homothetic beamcombiner.

Deliverables
Del4: The results of the studies executed in the framework of this work package will be published in a NEVEC/ESO report.

Deadline
Del4: draft version at K.O. + 28, final version at K.O. + 36.

9.4.4.6 WP 3.5: publication

The results of the studies executed in the framework of this work package will be published in a scientific paper(s) in a refereed journal (preferably in A&A or J. of Applied Optics).

The knowledge gained during the study will be transferred to ESO. The most appropriate mean to transfer this knowledge depends on the outcome of the study. It could be by means of a software model, NEVEC internal report, ESO report, discussion etc. The goal is to transfer the knowledge gained during this study, as efficiently as possible to ESO personnel.

Deliverables
Del5: submitted scientific paper(s) to a refereed journal (preferably A&A or J. of Applied Optics).

Deadline
Del5: K.O. + 48 for submission of paper to a refereed journal.

9.4.5 Conditions

The execution of the work package requires close collaboration between Dr. Bakker and Dr. Schöller. Regular visits of Dr. Bakker to ESO are therefore anticipated.

This work package would benefit from close collaboration between the University of Delft and NEVEC in order to increase the understanding of hardware related issues in the modelling and conceptual design phase (by making use of the Dutch Testbed Interferometer). Within this work package Dr. Bakker will regularly interact with University of Delft. The interaction between NOVA and the optics group (Prof. Braat) of the University of Delft will be defined in due time.

NEVEC assumes that ESO will provide it with all documentation and information on the design and performance of the actual hardware configuration relevant for this study (e.g.

MACAO) as soon as these are known, except when restricted by confidentiality concerns with respect to industrial contractors.

9.4.6 Bibliography

None

9.5 WP 04: VLTI data base and instrument calibrators

9.5.1 Introduction

In the Memorandum of Understanding (MoU) between ESO and NOVA, it has been agreed that NEVEC will devote 10 person-years of efforts to a mutually agreed task list. This document specifies a NEVEC work package referred to as "instrument calibration" for a total of 2 person-years.

9.5.2 Objective

This document is a proposal to provide a VLTI database and a list of calibrators for the VLTI instruments, extending the work already done at ESO for the siderostats, to the phase in which UT and AT will be available.

The aim is to provide a catalogue with a sufficient number of sources either unresolved or having a known angular diameter, either from direct measurements from the VLTI or other interferometers or from indirect estimates. These compiled data can be used to calibrate the instrumental visibility factor both in the near-IR and the mid-IR ranges (AMBER and MIDI).

Involvement of the different VLTI instrument teams is desirable and recommended, mainly to provide requirements parameters which could be instrument dependent and will define which data to include in the catalogue. ESO will actively collaborate, and co-ordinate the work package.

ESO has developed a strategy to supply calibrators and verification sources for VINCI/SID. This is a subsection of the full VLTI catalogue (VLTI database), described in [2]. In summary, ESO has developed and provides:

- A compilation of sources with a measured or estimated angular diameter, some of them to be used as calibrators;
- A database platform to sort and filter the compilation;
- Tools to estimate angular diameters and visibilities, in connection with the VLTI [1].

In parallel, the MIDI Science Group has produced a list of stars, which could serve as calibrators for mid-infrared interferometry [4].

We propose to use the same database structure and tools used by ESO for the VLTI catalogue project [2], to include therein also the compilation produced by MIDI, and to extend the list of sources as needed by the various VLTI/instrument configurations.

Since the ATs and the UTs will extend the limiting magnitude of the calibrators to about K=8 and K=12 respectively, it will be necessary to make use of near-IR surveys such as DENIS and IRSA/2MASS. Additionally, these databases will have to be correlated with other surveys such as GSC and Hipparcos. For this, we can make use of tools developed by ESO and by the Simbad centre in Strasbourg.

We shall also consider the need for spectroscopic calibrators, adequate to the performance of the AMBER and MIDI instruments.

The aim is to provide an initial list of sources, which could be used as calibrators. It remains understood that in order to achieve the ultimate accuracy permitted by the VLTI and its instruments, it will be necessary to develop a full VLTI-specific database from actual observations. Therefore, our working plan is as follows:

The complete list of parameters to be included in the database will be defined in association with the scientific team of the different VLTI instruments.

9.5.3 Human resources

The people identified at NEVEC to work on this work package is Dr Percheron. All available NEVEC staff could potentially make a contribution to this work package. Local supervision at Leiden will be the responsibility of Dr. Waters (co-PI NEVEC).

The person identified at ESO to be the Point Of Contact (POC) for this work package is Dr. Richichi.

9.5.4 Work package structure

The starting date (Kick Off) for this proposal is estimated to by March 15 2001. The time allocation is an estimate of NEVEC involvement (mostly I. Percheron). ESO (mostly Dr. Richichi) and the VLTI instrument teams (for example R. Waters, B. Stecklum for MIDI) will be actively involved.

Table 19: WP04: instrument calibration: work package structure.

Work Package	Title	Person power month	Deliverable (dead-line)
4.0	Management	0.5	
4.1	Work proposal	1.0	February, 10 2001
4.2	List of calibrators for VINCI	4.0	March 2001
4.3	List of calibrators for MIDI and AMBER	5.0	Kick off + 1 year
4.4	Final database	1.0	From kick off + 10 months
4.5	Transfer to ESO		Kick off + 20 months
	Total	12	

9.5.4.1 WP 4.0: management

Which includes reporting and attending meetings. ESO will be informed every two months on planning and progress of this work package (a progress report in written form not exceeding one page).

Deliverables
Every two month a progress reports to ESO and NEVEC PM.

Deadlines
January 1, March 1, May 1, July 1, September 1, November 1.

9.5.4.2 WP 4.1: work proposal
Prepare this document

Deliverables
Del1: this document

Deadlines
Del1: K.O. + 1

9.5.4.3 WP 4.2: VLTI catalogue and list of calibrators for VINCI

The VLTI catalogue already developed by ESO will be extended to compile all the known measurements from direct interferometry (Long Baseline Interferometry, and Aperture Masking on large telescopes)

The initial database will be including:
- The first compilation of sources used for VINCI on the Siderostats obtained from the VLTI catalogue (see [2]),
- Sources from database such as IRSA/2MASS, these sources will be chosen using an estimation of the precision and sensitivity of the different VLTI instruments (see [3] for VINCI),
- Sources from initial lists made by the different instrument teams, if available to NEVEC (see [4]).

For the initial database, tools will be provided to convert the angular diameter and associated error into an expected visibility and error at the given wavelength and VLTI array configuration.

VINCI/SID data on selected calibrators will be accumulated and processed during commissioning and instrumental effects will be derived from them. Once the instrumental effects are better understood and quantified, the initial VLTI catalogue and the database on calibrators will be updated.

The data stored on the calibrators (accuracy of the measurement for example) will be re-validated for each of the different instruments and configuration of the VLTI.

The total manpower for the update of the preliminary database, and its extension is estimated to 6 man-months over a period of 12 months. This does not include observing time.

NEVEC, ESO and the VLTI instrument teams will be participating in WP3. The estimated time allocation of NEVEC is 80 days

Deliverables
Del2: list of calibrators for VINCI, VLTI catalogue

Deadlines
Del2: K.O. + 2

9.5.4.4 WP 4.3: list of calibrators for VLTI Instruments
The instrumental visibility factor will have to be derived from multiple observations of calibrators, in order to reduce the error. This will be done first with the processing of the VINCI/SID data obtained on the calibrators.

Some of the pre-existing calibrators could be rejected; some added or measured with a better accuracy. At this stage the data on the calibrators observed with VINCI/SID will be more accurate.

Parallel to the update of the list of calibrator, the VLTI catalogue will be updated to include all the sources observed with VLTI.

The list of calibrators will be further extended to accommodate the other instruments and configurations of the VLTI. The measurements obtained with the VLTI instruments will then be correlated to the previous list.

Deliverables
Del3: list of calibrators for MIDI and AMBER, VLTI catalogue updated with VLTI observations

Deadlines
Del3: K.O. + 24.

9.5.4.5 WP 4.4: final database

It is desirable that a knowledge database of calibrators actually observed by the VLTI is accumulated.

Some observations with ESO (for example TIMMI2) or non-ESO (South African Astronomical Observatory instrument SAAO) instruments to obtain near –IR photometry and spectroscopy could also be planned.

This database will increase in volume with time, and it is hoped that within 1-2 years it can replace the initial collection and serve as the actual calibration tool.

The goal is to continue our effort until this latter version of the database is achieved.

Deliverables
Del4: final database

Deadlines
Del4: yet undetermined

9.5.4.6 WP 4.5: transfer to ESO

The work package will be transferred to ESO for further maintenance and update of the database.

Deliverables
Del5: A set of documents will be written by NEVEC.

Deadlines
Del6: K.O.+20

9.5.5 Conditions

The execution of the work package requires close collaboration between NEVEC and ESO and will require regular visits of NEVEC staff to ESO.

Additionally to obtain observing time on the 3.6 meter is required to execute this work package. If the proposal is not awarded time to execute this work package, then it might be considered to request telescope time outside the normal competitive allocations.

9.5.6 Bibliography

[1] VISITOOLS: A collection of tools for the estimation of visibilities of stellar sources, A. Richichi, VLT-TRE-ESO-15000-xxxx
[2] The Main VLTI catalogue, A. Richichi, VLT-TRE-ESO-15000-2416
[3] LdV Precision and Sensitivity, P. Kervella, VLT-TRE-ESO-15810-2177.
[4] Calibration stars for the MIDI VLT Interferometrer, V. Geers, July 2000

9.6 WP 05: instrument models

9.6.1 Introduction

In the Memorandum of Understanding (MoU) between ESO and NOVA, it has been agreed that NEVEC will devote 10 person-years of efforts to a mutually agreed task list. This document specifies a NEVEC work package referred to as "instrument models" for a total of 1 person-years.

9.6.2 Objective

The objective of this work package is to develop software modules for the VLTI end-to-end model developed by ESO. The VLTI end-to-end model is a modular toolbox for a dynamic simulation of the VLTI. It generates models of the optical wave at any point in the instrument. The end-to-end model has been developed by ESO within the scope of the VLTI but could also be used for dynamic simulation of astronomical telescopes.
The entire toolbox is currently being maintained at ESO, NEVEC is involved in maintaining and improving the atmospheric simulator.
The work package has a starting date of August 1, 1999 and a finish date of January 1, 2001. It is estimated that this work package will require 1 person-years of effort by NEVEC staff, over a period of 4 years.

Deliverables of this work package are the corresponding software codes.

9.6.3 Human resources

The person identified at NEVEC to work on this work package is Dr. Percheron. But all available NEVEC staff could potentially make a contribution to this work package. Local supervision at Leiden will be the responsibility of Dr. Jaffe (PS NEVEC). The NEVEC Point of Contact for this work package is Dr. Percheron.

The person identified at ESO to be the Point Of Contact (POC) for this work package is Dr. Wilhelm.

9.6.4 Work package structure

The work package is planned to have kick-off (K.O.) on August 1, 1999. This work package can be divided in two work packages. Corresponding estimates of NEVEC efforts are listed. Note that the table only includes efforts by NEVEC staff.

Table 20: WP05: instrument models: work package structure.

Work Package	Title	Person power Month	Deliverable (dead-line)

5.0	Management	1	Progress reports (every two months)
5.1	Atmospheric simulator	5	Update code (continuously)
5.2	End-to-end model	0	
	Total	6 months	

9.6.4.1 WP 5.0: management
Management is limited to attending meetings.

Deliverables
None

Deadlines
None

9.6.4.2 WP 5.1: atmospheric simulator
A software model has been developed (based on existing codes) which computes the atmospheric effects on a passing wavefront. This codes will be included in the ESO end-to-end model to simulate the performance of the VLTI.

Deliverables
Del1: updated software code and documentation

Deadlines
Del1: code with documentation has been delivered to ESO.

9.6.4.3 WP 5.2: end-to-end model
Not yet specified

Deliverables
Del1: updated software code and documentation

Deadlines
Del1: K.O. + ?

9.6.5 Conditions
The execution of the work package requires close collaboration between NEVEC and ESO and will require regular visits of NEVEC staff to ESO.

9.6.6 Bibliography
None

9.7 WP 06: data format

9.7.1 Introduction
This document specifies a NEVEC work package referred to as “data format” for a total of 0.5 person-years.

9.7.2 Objective

The objective of this work package is to define extended FITS format to be used by the VLTI. The FITS table format is suited to handle interferometric data from the VLTI.

Deliverables of this work package are description of extended FITS format for optical/infrared interferometric data.

9.7.3 Human resources

The persons identified to work on this work package is Dr. Jaffe.

9.7.4 Work package structure

The work package is planned to have kick-off (K.O.) on August 1, 1999.

Table 21: WP06: data formats: work package structure.

Work Package	Title	Person power month	Deliverable (dead-line)
6.0	Management team	1	
6.1	FITS tables	5	
	Total	6	

9.7.4.1 WP 6.0: management

Deliverables
Del1:

Deadlines
Del1:

9.7.4.2 WP 6.1: FITS tables

Deliverables
Del2: NEVEC report describing extended FITS format
Del3: IDL routines for FITS table format

Deadlines
Del2: delivered to ESO
Del3: delivered to ESO

9.7.5 Conditions

None

9.7.6 Bibliography

None

9.8 WP 07: commissioning

9.8.1 Introduction

In the Memorandum of Understanding (MoU) between ESO and NOVA, it has been agreed that NEVEC will devote 10 person-years of efforts to a mutually agreed task list. This document specifies a NEVEC work package referred to as "commissioning" for a total of 1 person-years.

9.8.2 Objective

The objective of this work package is to support ESO in commissioning the VLTI with VINCI.

The first VLTI instrument to coherently combine light from up to two telescopes is VINCI. NEVEC provides support to ESO in the first phase of the VLTI commissioning with VINCI, develops software for VINCI data reduction system (DRS) , quick look and data analysis, and analyses scientific and technical VINCI procedures and in order to improve the performance of the VLTI . It is also anticipated that NEVEC will participate to the commissioning of some of the other instruments.

The work package has a starting date of March 2001 and a finish date of March 1, 2003. It is estimated that this work package will require 1 person-years of effort by NEVEC staff, over a period of 2 years.

Deliverables of this work package are participating in VLTI/VINCI commissioning, parts of VINCI DRS, and analysis of VINCI data.

9.8.3 Human resources

The people identified at NEVEC to work on this work package are Dr. Jaffe (also NEVEC Point of Contact for this work package). Significant contributions are made by Dr. Percheron, Dr. Cotton and Dr. Meisner. All available NEVEC staff could potentially make a contribution to this work package. Local supervision at Leiden will be the responsibility of Dr. Jaffe (Project Scientist NEVEC).

The person identified at ESO to be the Point Of Contact (POC) for this work package is Dr. Schöller.

9.8.4 Work package structure

The work package is planned to have kick-off (K.O.) on March 1, 2001. This work package can be divided in five work packages.

Table 22: WP07: commissioning: work package structure.

Work Package	Title	Person power Month	Deliverable (dead-line)
7.0	Management	1	
7.1	Participate in commissioning	5	Be at Paranal
7.2	VINCI data reduction and analysis software	1	IDL code
7.3	Analysis of VINCI data	5	
7.4	Publication	0	
	Total	12 month	

9.8.4.1 WP 7.0: management

Which includes reporting and attending meetings. ESO will be informed twice a monthly on planning and progress of this work package (a progress report in written form not exceeding one page).

Deliverables

Every two months progress reports to ESO Point of Contact and NEVEC project manager.

Deadlines

January 1, March 1, May 1, July 1, September 1, November 1.

9.8.4.2 WP 7.1: participate in commissioning

To participate in commissioning of VINCI both at Paranal and at Leiden. People involved are Dr. Percheron (1 month), Dr. Jaffe (1 month), Dr. Cotton (2 months), Le Poole (1 month), Dr. Bakker (1 month) and Dr. Meisner (at Leiden). Actually work to be executed at Paranal is being decided by Dr. Schöller.

Deliverables

Del1: participation in commissioning

Deadlines

Del1: K.O. + 12.

9.8.4.3 WP 7.2: VINCI data reduction and analysis software

A data reduction and analysis toolbox, and software system, is being developed in order to support VLTI commissioning with VINCI. This toolbox will be written in IDL and will not be designed according to ESO standards. Many of the functionality's present in the LabView data reduction and analysis system from the Observatory of Meudon for VINCI (and FLUOR) will be incorporated into the VINCI DRS.

Deliverables

Del2: VINCI data reduction and analysis software.

Deadlines

Del2: K.O. + 24.

9.8.4.4 WP 7.3: analysis of VINCI data

An interferometer using spectrally dispersed detection is capable, with sufficiently bright sources, of delivering data, which permits the solution of the random atmospheric OPD. Using that as a phase reference, it is possible to coherently integrate the data in order to obtain the visibility magnitude and phase as a function of optical frequency. While this powerful technique is directly applicable to systems using spectrally-dispersed detection, the majority of modern interferometers (including VINCI), especially in the near infrared, are designed using delay-scanning in order to reduce the effect of detector readout noise.

It has been suggested that coherent processing of interferograms from a delay-scanned interferometer may be possible. This would involve finding, with a reasonable degree of confidence, the central fringe in each scan; scans in which the central fringe remained ambiguous might be dealt with by removing them from the data stream. For faster scan rates (not too much longer than the atmospheric coherence time), the scan-to-scan correlation of OPD may be of use in identifying the central fringe. Within each scan, small changes in the atmospheric OPD can be tracked to a certain precision. That determination can be used to warp the time axes of the data to better reflect the true OPD affecting each data point.

Following such processing, the data from a series of scans can be combined coherently. Using the Fourier transform, a result, averaged over many scans, can be obtained as a function of optical frequency. That visibility function can be divided by the instrumental visibility function obtained from a calibrator star to produce a calibrated curve of correlated power over optical frequency. Normalised visibility can be obtained by further dividing by the spectral brightness of the incoming starlight. Through coherent processing, this method retains not only the magnitude, but also the phase of the visibility curve. Such curves of complex visibility over non-negligible bandpasses, may be used directly for parameter estimation based on simple models of the object which might be assumed. Measurements at additional baselines can be used for consistency checks, and also to view a source collapsed at different position angles.

A by-product of such processing is a graph of atmospheric OPD variations during the "on-fringe" portion of each scan, with gaps in between the scans. Despite the gaps, useful (but incomplete) power spectra of the atmospheric OPD could be obtained.

The work would involve:
1. Refining the mathematical basis for this approach;
2. Development of algorithms which will be tested on simulated data;
3. Analysis of data from VINCI using this technique;
4. Interpretation of the results, both regarding instrumental effects, and actual source structure.

Deliverables
Del3: results of analyses by means of NEVEC technical reports

Deadlines
Del3: continuously

9.8.4.5 WP 7.4: publication

Result, both technical and scientifically, could be published in a scientific paper or ESO or NEVEC report as it proofs to be of interest.

Deliverables
Del5: Reports or scientific paper(s) in refereed journal (preferable A&A).

Deadlines
Del5: K.O. + 48.

9.8.5 Conditions

The execution of the work package requires close collaboration between NEVEC and ESO and will require regular visits of NEVEC staff to ESO, and an extensive stay at Paranal.

9.8.6 Bibliography

None

9.9 WP 08: education

9.9.1 Introduction
In the Memorandum of Understanding (MoU) between ESO and NOVA, it has been agreed that NEVEC will devote 10 person-years of efforts to a mutually agreed task list. This document specifies a NEVEC work package referred to as "education" for 1 FTE.

9.9.2 Objective
The objective of this work package is to involved NEVEC staff in developing education on Interferometry and its techniques in the Netherlands. NEVEC in collaboration with other associations (for example ESO, ESA) will organised lectures and seminars on interferometry.

The work package has a starting date of December 1999 and a finish date of August 1, 2005. It is estimated that this work package will require 2 person-years of effort by NEVEC staff, over a period of 4 years.

9.9.3 Human resources
The people identified at NEVEC to work on this work package is Dr Percheron, Dr. Bakker, and Le Poole. All available NEVEC staff could potentially make a contribution to this work package.

The person identified at ESO to be the Point Of Contact (POC) for this work package is Dr. Glindemann.

9.9.4 Work package structure
The work package is planned to have kick-off (K.O.) on December 1999. This work package can be divided in five work packages.

Table 23: WP08: education: work package structure.

Work Package	Title	Person power month	Deliverable (dead-line)
8.0	Management	1	
8.1	Summer school 2000	3	
8.2	Workshop 2001	2	
8.3	Summer school 2003	3	
8.4	University course	3	
	Total	12 months	

9.9.4.1 WP 8.0: management
Which includes reporting and attending meetings. ESO will be informed every two months on planning and progress of this work package (a progress report in written form not exceeding one page).

Deliverables
Every two months a progress reports to ESO and NEVEC PM.

Deadlines
January 1, March 1, May 1, July 1, September 1, November 1.

9.9.4.2 WP 8.1: summer school 2000

In the context of NEVEC's mission to provide education VLTI, a NOVA/LEIDEN/NEVEC/ESO/ESA summer school has been organised from 18 to 22 September 2000 at Leiden on "Space and Ground based Optical and Infrared interferometry".

Invited speakers were R. Waters (University of Amsterdam), F. Paresce (ESO), G. Lund (Alcatel Space Industries), W. Cotton (NRAO), A. Glindemann (ESO), A. Léger (IAS), C. Haniff (MRAO), A. Quirrenbach (University of California at San Diego), P. Léna (Observatoire de Paris), R. le Poole (Leiden Observatory), and C. Leinert (MPIA Heidelberg).

A total of 75 scientist participated from all over the world. A proceeding is made available for the summer school and a set of handouts will be made available to all participants and other interested.

Deliverables
Del1: summer school 2000
Del2: proceedings

Deadlines
Del1: K.O. + 12.
Del2: K.O. + 18.

9.9.4.3 WP 8.2: work shop 2001

This workshop aim at discussions among scientists and engineers on the technological and scientific challenges related to the imaging capabilities of the Very Large Telescope Interferometer (VLTI). The topics discussed are also highly relevant for space-based interferometers like DARWIN and TPF, and build on current Dutch involvement in the VLTI.

All speakers are active in the field or work on related problems. The workshop is open for all interested but the presentations are assuming in depth knowledge in the field.

The sequence of talks will follow the path of a photon. Starting with the emission of a photon by a science target, passage through the turbulent atmosphere, through the VLTI infrastructure, with detailed discussion on some of the key instruments (adaptive optics, delay lines, metrology) towards the science instrument, and finally data reduction and analysis leading to the science result. The talks will be connected with each other through the overall theme of the day "Imaging with the VLTI". This is currently not a capability of the VLTI, however it is anticipated that this capability will be implemented within 5 years. As a result this offers quite some opportunities for Netherlands based scientists and engineers to participate in enhancement of the VLTI in order to reach this result. Awareness of each other's interests and capabilities is vital for the future of Dutch involvement in optical/infrared interferometry for astronomical instruments and is the main driver for organising this workshop.

The speakers invited will be a representation of the Netherlands based scientists and engineers involved in optical/infrared interferometry related astronomical instrumentation projects.

Deliverables
Del3: work shop 2001
Del4: proceedings

Deadlines
Del3: October 11, 2001
Del4: October 11, 2001+ 3 months

9.9.4.4 WP 8.3: summer school 2003
Organisation of summer school on "optical/infrared interferometry"

Deliverables
Del5: summer school 2003
Del6: proceedings.

Deadlines
Del5: K.O. + 48
Del6: K.O. + 48

9.9.4.5 WP 8.4: university course
Organisation of lecture series on "optical/infrared interferometry"

Deliverables
Del7: lecture series
Del8: lecture notes

Deadlines
Del7: K.O. + ?
Del8: K.O. + ?.

9.9.5 Conditions
The execution of the work package requires close collaboration between NEVEC and ESO and will require regular visits of NEVEC staff to ESO.

9.9.6 Bibliography
None

9.10 WP 09: algorithms

9.10.1 Introduction
In the Memorandum of Understanding between ESO and NOVA, it has been agreed that NEVEC will devote 10 man-years of efforts to a mutually agreed task list. This proposal aims at defining part of the efforts for the task list through the definition of a work package "algorithms" for a total of 1.25 person-years over a period of 2 years.

9.10.2 Objective
The objective of this work package is to develop and analyse algorithms for phase tracking/delay estimation and group delay tracking. This analysis would be applied to the current VLTI hardware and also to the VLTI infrastructure feeding a superior fringe tracker utilising a photon-counting NIR detector (such as the STJ). The goal would be to enable fringe tracking (and thus coherent integration) using the faintest possible reference star. To reach this objective, a study will be conducted described as analysis, development, and testing (using simulated data) of fringe tracking algorithms for interferometric instruments using spectrally dispersed detection.

The work package has a starting date of July 1, 2001 and a finish date of July 1, 2003. It is estimated that this work package will require 1.25 person-years of effort by NEVEC staff, over a period of 2 years. Deliverables of this work package are software, reports, and scientific papers in refereed journals.

9.10.3 Human resources

The person identified at NEVEC to lead this work package is Dr. Meisner, but all available NEVEC staff could potentially make a contribution to this work package. Local supervision of Dr. Meisner at Leiden will be the responsibility of Dr. Jaffe (co-project scientist NEVEC) and Le Poole (project scientist NEVEC).

The person identified at ESO to be the point of contact for this work package is Dr. Menardi.

9.10.4 Work package structure

The work package is planned to have kick-off (K.O.) on July 1, 2001 and will run for two years. This work package can be divided in five work packages. Corresponding estimates of NEVEC efforts are listed (not just from Dr. Meisner and Dr. Jaffe, but from other NEVEC staff who may become involved).

Table 24: WP09: algorithms: work package structure.

Work Package	Title	Person power (months)	Deliverable (dead-line)
9.0	Management	1	
9.1	Analysis and development of phase and group delay tracking/estimation techniques	6	Demonstration software, including source code. (K.O. + 16, November 1, 2002)
9.2	Publish results of above research	4	2 Papers submitted for publication. Also provided as ESO/NEVEC technical reports. (K.O. + 20, March 1, 2003)
9.3	Apply analysis to current PRIMA fringe sensor system	2	ESO/NEVEC technical report. (K.O. + 24, July 1, 2003)
9.4	Apply analysis to proposed STJ fringe sensor unit	2	ESO/NEVEC technical report. (K.O. + 12, July 1, 2002)
	Total	15 months	

9.10.4.1 WP 9.0: management

ESO will be informed every two months on planning and progress of this work package (through progress reports in written form, generally no longer than one page). Additional efforts in relation to the work package management are almost nil.

Deliverables
Bimonthly progress reports to ESO and NEVEC PM.

Deadlines
January 1, March 1, May 1, July 1, September 1, November 1.

9.10.4.2 WP 9.1: analysis and development of phase and group delay tracking/estimation techniques

The research will concentrate on modelling and analysis of delay estimation/tracking using data from a stellar interferometer in which spectral dispersion of the interfered light is employed. This analysis would encompass, as a special case, the model of an interferometer in which light over a somewhat narrow band (such as the H or K band) is detected *undispersed*, in other words, as the spectral dispersion is reduced to a single channel. However the further analysis of a *delay-scanning* interferometer using this type of detection (such as the FINITO instrument) will not be attempted; rather we will concentrate on models applicable to the current design of the PRIMA FSU in which a broadband channel is used for phase tracking while some interfered light is diverted into a spectrometer in order to verify/insure phase tracking on the central fringe. Work on the FINITO instrument could be defined through another NEVEC work package.

The analysis will identify the performance obtainable using idealised hardware, in particular, an ideal photon-counting detector. That result will be extended to apply to the use of available detectors and design trade-offs that are then involved. Performance will therefore be determined as a function of:

1. Detector characteristics:
   - 1.1. Dark current;
   - 1.2. Readout noise;
   - 1.3. Quantum efficiency;
2. Design parameters:
   - 2.1. Number of spectral channels;
   - 2.2. Exposure time;
   - 2.3. Induced OPD modulation (if any);
   - 2.4. Dispersion (intentional or inadvertent);
3. Source:
   - 3.1. Brightness;
   - 3.2. Visibility;
   - 3.3. Atmospheric (and instrumental) OPD noise.

The analysis will encompass both “Phase tracking” and so-called “Group-Delay tracking” techniques, and the commonalties and distinctions between these approaches will be explored. Attention will also be paid to the distinction between real-time (which would be used to stabilise the OPD in hardware) and off-line methods (capable of producing an estimate using data both before and after the time point of the estimation). This research is expected to extend current work in this area in which Bayesian methods are used to produce not only an estimate of atmospheric OPD, but a detailed statistical model of the results, their errors, and confidences, as depicted in Figure 8.

Analytical results will be verified with simulation software, which would therefore include a simulator for producing raw interferometer data to be reduced by the algorithms. Results from simulations and analysis will be compared and reconciled. User-friendly demonstration software will be supplied to illustrate the results.

The algorithms will also, of course, be tested on real interferometer data produced with spectral dispersion, such as data from the MIDI instrument, which is expected to be commissioned during the period of this work. However interpretation of specific results from real instruments is not within the scope of the present proposal, but is anticipated to be included in another NEVEC work package.

Deliverables

Del1: Self-contained software package. This will include an executable that runs under Microsoft Windows, and the source code written in ANSI-standard C. There will be no attempt to write this code in accordance with ESO standards, however the substantive source code for the algorithms developed will be written with inline documentation and be easily adapted to a different compiler or platform. The executable will include a demonstration mode, which could be operated by a person having no prior familiarity with the software or the concepts it is designed to illustrate.

Deadline
Del1: K.O. + 16.

9.10.4.3 WP 9.2: publication

The results of the studies executed in the framework of this work package will be published in scientific papers in a refereed journal (preferably in A&A).

Deliverables
Del2, Del3: Two separate papers will be written and submitted to a refereed journal to describe the results of this research. One would probably concern Group-Delay tracking which is used for "coherencing." The other would address true phase tracking, that is, estimation or stabilisation of the OPD within a fraction of a wavelength in order to enable coherent integration on a faint scientific target (i.e. PRIMA).

Deadline
Del2: K.O. + 20.
Del3: K.O. + 20.
The goal is to submit at least one article within K.O. + 12.

9.10.4.4 WP 9.3: application of research to current PRIMA design

The above research will be applied to the hardware proposed for the PRIMA fringe sensor unit.

Deliverables
Del4: An ESO/NEVEC technical report.

Deadline
Del4: K.O. +24.

9.10.4.5 WP 9.4: application of research to a fringe sensor employing a superior detector

The above research will be applied to an alternative hardware design employing a photon-counting detector, such as the Superconducting Tunneling Junction detector, according to characteristics obtained from scientists developing these technologies. Results obtainable with such hardware will be compared with those expected from the current PRIMA FSU in order to assess the improvement that could result from the employment of such a detector.

Deliverables
Del5: An ESO/NEVEC technical report.

Deadline
Del5: K.O. +12.

9.10.5 Conditions

The execution of the work package requires close collaboration between Dr. Menardi (ESO) and Dr. Meisner (NEVEC). Occasional visits of Dr. Meisner to ESO are therefore anticipated.

Execution of work package regarding STJ requires information obtainable from ESA (ESTEC). Dr. Meisner and Le Poole from NEVEC have contacts with Dr. Peacock from ESA regarding this issue. During the time of writing this proposal, it seems that current contacts are sufficient to execute the proposal work.

NEVEC assumes that ESO will provide it with all documentation and information on the design and performance of the actual hardware configuration (PRIMA, FINITO) as soon as these are known, except when restricted by confidentiality concerns with respect to industrial contractors.

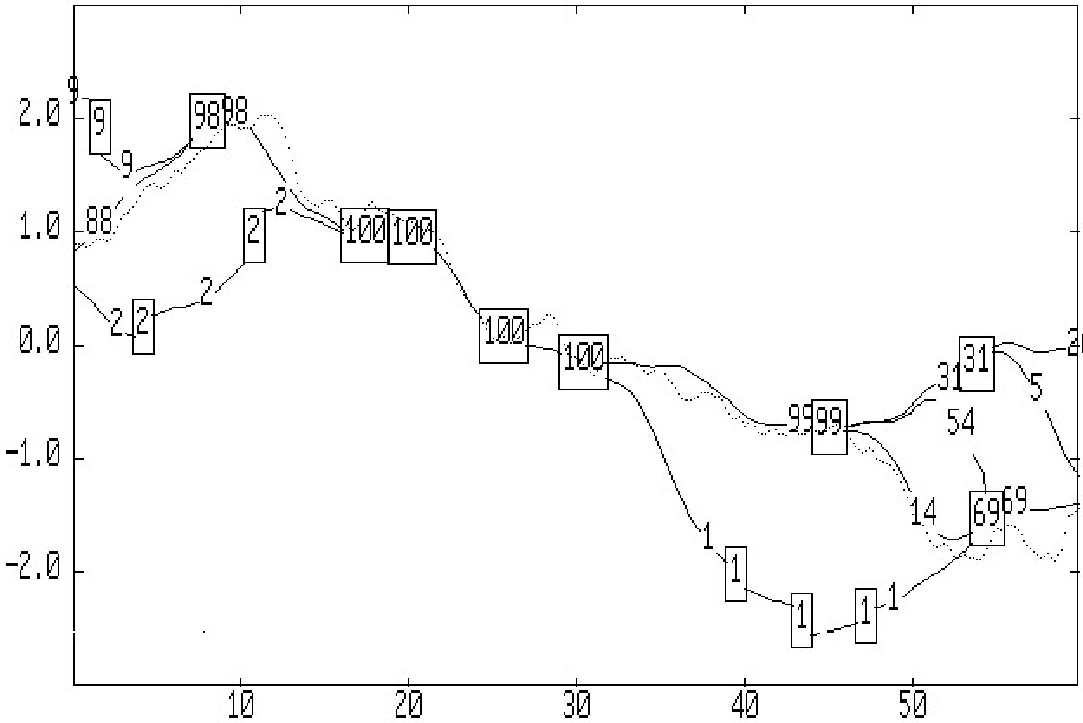

Figure 8: "Multi-path" delay estimation solution of random atmospheric OPD process from simulated data at a low signal to noise ratio; underlying atmospheric delay process plotted with dotted line. Vertical axes is delay in femtoseconds; horizontal axes is time in milliseconds. Numbers plotted at points represent the a posteriori probability of these solutions in percent, based on a Bayesian analysis and assuming Kolomogorov atmospheric delay statistics. A photon-counting stellar interferometer operating at visible wavelengths with spectral dispersion (.4 to 1 micron) is modelled, operating on a dim object near the threshold for phase tracking (the "intrinsic SNR" is 2.4): only 54 photons were detected over this period of 60 milliseconds from an unresolved object (visibility = 1) observed using ideal hardware. At SNR's twice this level, most ambiguities in the function would disappear; at much lower SNR's a usable solution would be impossible. See Optical Engineering v35. #7, July 1996, pp 1927-1935 for a more complete explanation.

9.10.6 Bibliography

None

9.10.7 Explanatory notes

The following note is an exchange of thoughts on this work package in order to clarify the goals of this work package in relation to the needs of ESO.

1. NEVEC states that this WP is intended to benefit to VLTI in general, and not to a specific instrument as it is the case for other NEVEC WPs dedicated exclusively to MIDI.

Bakker: The goal of the work package is to conduct studies which have an impact on the decision making process in the development and operations of PRIMA. Work directly related to the development of MIDI will not, and cannot be accounted towards this work package, but will be accommodated within another NEVEC work package referred to as "MIDI". The work package uses experience acquired with MIDI, as dispersed instrument, to reach conclusions on the optimal performance of PRIMA, possible in combination with operating MIDI.

Meisner: The analysis will be very general and thus applicable to MIDI, PRIMA, and OPD estimation/tracking on any interferometer.

2. ESO is primarily interested in phase and group delay algorithms applicable to the PRIMA Fringe Sensor Unit (FSU), operating in K band (or H and K bands simultaneously). Therefore ESO expresses the wish that this work addresses the case of Readout Noise limited fringe detection.

Bakker: the baseline for the discussion is an ABCD OPD sampling of the fringe of the reference source using two wavelength bands (either H and K, or two bands within K). This has a number of implications, among which that we deal with the detector read out limited regime, and that longitudinal dispersion needs to be taken into account.

Meisner: Two variants of the analysis will be developed:

1) Using a photon-counting detector in which individual photon events are recorded (some of which may be dark counts)
2) 2) Using an analogue detector, which produces an output proportional to the flux on the detector plus Gaussian noise. In the latter case, the source of the noise could either be from the detector or fundamental quantum noise entering the interferometer due to either the source or background radiation.

3. ESO is also very interested in a study that would specify how to use optimally PRIMA FSU in combination with MIDI, with the aim to optimise MIDI performance on faint sources.

Bakker: This study will be limited to the imaging mode of PRIMA. This includes a study on which parameters from PRIMA needs to be send to MIDI to improve MIDI operations, or the other way around. For example PRIMA requires information on the preferred path band filter, whereas MIDI requires information on the high frequency errors induced by PRIMA due to OPD modulations with the MIDI integration time.

Meisner: This goes beyond the issue of "fringe-tracking" per se. However I have previously addressed the application of OPD estimation to effect coherent integration of fringe visibility, and would be willing to restate my understanding in specific relationship to MIDI. This is something that I would be working on anyway due to my work with MIDI data reduction.

4. Another "hot topic" is the optimal number of spectral channels to be implemented in PRIMA FSU for group delay measurement, from the sensitivity point of view, given its detector characteristics (the current baseline for PRIMA FSU is to have 2 channels only).

Meisner: I intend to develop analyses and tools that could be applied to determine the performance expected of the PRIMA FSU as a function of design parameters, which would include the beam combiner phases, the spectral dispersion, and the exposure time(s). I cannot commit myself to solving for the optimum design parameters, however I will certainly be addressing these issues and expect to gain further insight into these questions.

5. For the detailed phase of this study, ESO suggests to use simulated interferometric data generated by MIDI and/or AMBER data simulation software, which most probably cover the needs of the study.

Bakker: it was agreed that at this stage theoretical (and perfect data) from Meisner's simulator could be used. At a later stage it would be advisable to use data from the MIDI and AMBER simulator, which includes instrumental artefacts.

Meisner: The data from my simulations is not "perfect" in any sense, but reflects the model that it described. That model is continually augmented to include effects that the analysis software needs to address. If there are other simulators generating data, that data could also be fed into my algorithms for analysis. In all cases discrepancies could be traced to shortcomings in the analysis algorithms or in the simulator used. I will try to work with anyone else writing simulators so that our data formats are compatible, enabling such comparisons.

6. A close collaboration with ESO will be necessary, especially at the beginning of the study, to give inputs to NEVEC on the VLTI and FSU designs and define the questions to be answered by the study. Emmanuel di Folco (PhD student at ESO) is interested in participating to this work (about 30% of his time).

Bakker: NEVEC is very much in favour of close interaction between NEVEC and ESO in relation to this work package.

Meisner: My analysis first needs to be developed in a more general way and can later be applied to specific designs or to answer specific questions. I will listen to any particular questions that ESO might pose, but those concerns would not (and could not!) determine the course of that general analysis. I had agreed to regularly report on my progress to ESO, and any input or questions from ESO could be sent to me at any time.

9.11 WP 10: science

9.11.1 Introduction

This document specifies a NEVEC work package referred to as “science” for a total of 5 FTE. The work executed within the work package is for internal NEVEC and mainly contains the 20 % of free research each NEVEC staff member (not the scientific programmers) can devote to personal research. Of the 18 FTE funded by NOVA, this amounts to 3.6 FTE, and additional 1.4 FTE is reserved for science.

9.11.2 Objective
The objective of this work package is to facilitate, initiate, and execute the scientific exploitation of VLTI data by mobilising the scientific community. There is a focus on the following three main themes for scientific exploitation of VLTI data:

- Active Galactic Nuclei
- Circumstellar disks
- Evolved stars

The required data will be obtained through:

- VLTI Science Demonstration Time
  A total of 30 nights on UT's for the four parties: ESO, NOVA, CNRS, and MPG, to demonstrate the potential of the VLTI;
- MIDI guaranteed time
  A total of 300 hours (approximately 30 nights) with UTs, and 260 nights with ATs, for the MIDI consortium;
- VINCI call for ideas.
- Observing proposals for AMBER and MIDI;

These opportunities to obtain scientific data include UT, AT, and siderostats time and are to be consumed over many years to come.

The work package has a starting date of August 1, 2001 and a finish date of August 1, 2005. It is estimated that this work package will require 5 person-years of effort by NEVEC staff, over a period of 5 years.

Deliverables of this work package are scientific papers.

9.11.3 Human resources
The people identified at NEVEC to work on this work package are all NEVEC staff members and others affiliated with NEVEC. They will work in close collaboration with Astrophysicists from Leiden Observatory and other institutions

The person identified at ESO to be the Point Of Contact (POC) for this work package is Dr Miley.

9.11.4 Work package structure
The work package is planned to have kick-off (K.O.) on August 1, 2001. This work package can be divided in four work packages.

Table 25: WP10: science: work package structure.

Work Package	Title	Person power month	Deliverable (dead-line)
10.0	Management	2	
10.1	Scientific exploitation of VINCI	10	
10.2	Scientific exploitation of MIDI	12	
10.3	Scientific exploitation of PRIMA	12	
10.4	Scientific exploitation of AMBER	12	
10.5	Science with interferometry	12	
	Total	60 month	

9.11.4.1 WP 10.0: management
Facilitating the exploitation of scientific data from VLTI Science Demonstration Time, VINCI commissioning time, and MIDI guaranteed time.

Deliverables
None

Deadlines
None

9.11.4.2 WP 10.1: scientific exploitation of VINCI

Deliverables
Scientific papers

Deadlines
None

9.11.4.3 WP 10.2: scientific exploitation of MIDI

Deliverables
Scientific papers

Deadlines
None

9.11.4.4 WP 10.3: scientific exploitation of PRIMA

Deliverables
Scientific papers

Deadlines
None

9.11.4.5 WP 10.4: scientific exploitation of AMBER

Deliverables
Scientific papers

Deadlines
None

9.11.4.6 WP 10.5: scientific with optical/infrared interferometric data

An observation run at IOTA was successfully completed by Mennesson and resulted in a SPIE paper. Two graduate students (Heijligers in Leiden, and van Boekel in Amsterdam and at ESO) work on VLTI modelling of extra-galactic and galactic sources respectively.

Deliverables
Scientific papers

Deadlines
None

9.11.5 Conditions
None

9.11.6 Bibliography
None

9.12 WP 11: interfaces

9.12.1 Introduction
This document specifies a NEVEC work package referred to as "interfaces" for a total of 1 FTE.

9.12.2 Objective
The objective of this work package is to support the Dutch involvement in interferometry through providing an interface between ESO and ESA, and the non-for-profit organisations and industries within the Netherlands.

9.12.3 Human resources
The people identified at NEVEC to work on this work package is R.S. Le Poole and H. Röttgering.

9.12.4 Work package structure
The work package is planned to have kick-off (K.O.) on August 1, 2001. This work package can be divided in three work packages.

Table 26: WP11: interfaces: work package structure.

Work Package	Title	Person power month	Deliverable (dead-line)
11.0	Management	1	
11.1	Interfaces	5	
11.2	Acquisition	6	
	Total	12 month	

9.12.4.1 WP 11.0: management

Deliverables
None

Deadlines
None

9.12.4.2 WP 11.1: interfaces
Efforts have been devoted to other parties to promote NEVEC and to increase interest in ground-based and space born interferometry activities in Europe. Current interfaces in place are with SRON, TNO, ESA, TUD, and FOKKER.

NEVEC people active in this work package are Le Poole and Röttgering.

Deliverables

None

Deadlines
None

9.12.4.3 WP 11.2: acquisition
Not yet defined

Deliverables
None

Deadlines
None

9.12.5 Conditions
None

9.12.6 Bibliography
None

10 Appendix B: Allocation of NEVEC staff

Table 27: allocation of NEVEC staff.

03-sep-01	FTE	IP	JM	JJ	EB	DH	BC	X
WP 00: management	1,00				1,00			
WP 02: PRIMA	2,00	0,30			0,40			1,30
WP 03: next generation VLTI instruments	2,00				1,00			1,00
WP 04: instrument calibration	1,00	1,00						
WP 05: Instrument models	1,00	0,20						0,20
WP 06: data formats	0,60							0,60
WP 07: commissioning	1,00	0,20	0,50		0,10		0,20	
WP 08: education	1,00	0,30						0,70
WP 09: algorithms	0,40		0,40					
Sub-total	10,00							
WP 01: MIDI	5,00	1,20	1,00	1,30	0,50	0,50		0,50
Sub-total	5,00							
WP 00: management	1,00				1,00			
WP 10: science	3,00	0,30	1,10	0,20				1,40
WP 11: interfaces	0,10							0,10
Total	18,50	3,50	3,00	1,50	4,00	0,50	0,20	5,80
Granted	18,50	3,50	3,50	1,50	4,00	0,50	0,20	5,30

11 Appendix C: manpower consumption

Numbers are expressed in man-years (210 working days, 38 hours per week). First table is for the years 1999 and 2000, the second for the first two months of the year 2001. Accounting of efforts is split into two categories. The first category (NOVA) does only contain efforts by NEVEC staff, and which have been committed to ESO through the MoU. The second column (NOVA+UL+UvA) also includes efforts by University staff astronomers.

Table 28: person-power consumption over the period 1999+2000

Compiled on	NEVEC total	NOVA				NOVA + UL + UvA			
12-Sep-01		ESO	MGP	NOVA	Total	ESO	MGP	NOVA	Total
2000.00	Management	0.03	0.00	0.04	0.06	0.20	0.03	0.23	0.46
2000.00.01	Management team	0.00	0.00	0.00	0.00	0.10	0.03	0.10	0.22
2000.00.02	NEVEC project management	0.03	0.00	0.04	0.06	0.10	0.00	0.13	0.23
2000.01	MIDI	0.00	1.66	0.00	1.66	0.00	2.89	0.00	2.89
2000.01.01	MIDI project management	0.00	0.06	0.00	0.06	0.00	0.66	0.00	0.66
2000.01.02A	Operating analysis: scientific procedures	0.00	0.56	0.00	0.56	0.00	0.99	0.00	0.99
2000.01.02B	Operating analysis: calibration	0.00	0.51	0.00	0.51	0.00	0.57	0.00	0.57
2000.01.02C	Operating analysis: startup/shutdown	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.01.02D	Operating analysis: commissioning	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.01.03A	EWS: FITS	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.06
2000.01.03B	EWS: tools	0.00	0.06	0.00	0.06	0.00	0.09	0.00	0.09
2000.01.03C	EWS: applications	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.01.04A	NRTS: infrastructure design	0.00	0.43	0.00	0.43	0.00	0.48	0.00	0.48
2000.01.04B	NRTS: implementation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.01.04C	NRTS: applications	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.01.05A	Hardware: detector	0.00	0.04	0.00	0.04	0.00	0.04	0.00	0.04
2000.01.06A	MIDI science	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.02	PRIMA	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.19
2000.02.01	Tender related	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.19
2000.02.02	Limiting magnitude	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.02.03	Operating analysis	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.03	Next generation instruments	0.00	0.00	0.05	0.05	0.00	0.00	0.10	0.10
2000.03.01	STJ	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
2000.03.02	Nulling	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
2000.03.03	Imaging	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
2000.03.04	IRSI/DARWIN/SMART2	0.00	0.00	0.05	0.05	0.00	0.00	0.06	0.06
2000.04	Instrument calibration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.04.01	VLTI calibrations plan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.04.02	VINCI calibrators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.04.03	MIDI calibrators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.04.04	PRIMA calibrators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.04.05	AMBER calibrators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.05	Instrument models	0.31	0.00	0.00	0.31	0.69	0.00	0.00	0.69
2000.05.01	Atmospheric simulator	0.31	0.00	0.00	0.31	0.69	0.00	0.00	0.69
2000.05.02	Data simulators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.06	Data format	0.00	0.00	0.00	0.00	0.53	0.00	0.08	0.60
2000.06.01	FITS documents	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.26
2000.06.02	FITS library	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.26
2000.06.03	VINCI FITS converts	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
2000.07	Commissioning	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.07.01	Commissioning: VINCI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.07.02	Commissioning: MIDI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.08	Education	0.15	0.00	0.15	0.30	0.45	0.00	0.45	0.91
2000.08.01	Summer school	0.15	0.00	0.15	0.30	0.45	0.00	0.45	0.91
2000.08.02	Interacademial lectures	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.08.03	WWW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.08.04	PR general	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.09	Algorithms	0.50	0.00	0.50	1.00	0.50	0.00	0.50	1.00
2000.09.01	Fringe tracking	0.50	0.00	0.50	1.00	0.50	0.00	0.50	1.00
2000.09.02	FINITO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.10	Science	0.11	0.00	0.11	0.21	1.23	0.00	1.23	2.47
2000.10.01	Galactic	0.11	0.00	0.11	0.21	0.76	0.00	0.76	1.53
2000.10.02	Extra-galactic	0.00	0.00	0.00	0.00	0.47	0.00	0.47	0.94
2000.11	Interfaces	0.00	0.00	0.00	0.00	0.15	0.00	0.15	0.29
2000.11.01	Interfaces	0.00	0.00	0.00	0.00	0.10	0.00	0.10	0.21
2000.11.02	Acquisition	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.09
2000.99	Not NEVEC related	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000.99.01	Other activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	1.10	1.66	0.84	3.61	3.94	2.92	2.74	9.60

Table 29: person power consumption over the year 2001.

Compiled on	NEVEC total	NOVA				NOVA + UL + UvA			
12-Sep-01		ESO	MGP	NOVA	Total	ESO	MGP	NOVA	Total
2001.00	Management	0.11	0.00	0.14	0.26	0.19	0.02	0.23	0.45
2001.00.01	Management team	0.01	0.00	0.01	0.03	0.07	0.02	0.07	0.16
2001.00.02	NEVEC project management	0.10	0.00	0.13	0.23	0.12	0.00	0.16	0.28
2001.01	MIDI	0.00	1.00	0.00	1.00	0.00	1.20	0.03	1.23
2001.01.01	MIDI project management	0.00	0.03	0.00	0.03	0.00	0.15	0.00	0.15
2001.01.02A	Operating analysis: scientific procedures	0.00	0.16	0.00	0.16	0.00	0.18	0.00	0.18
2001.01.02B	Operating analysis: calibration	0.00	0.17	0.00	0.17	0.00	0.17	0.00	0.17
2001.01.02C	Operating analysis: startup/shutdown	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.01.02D	Operating analysis: commissioning	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.01.03A	EWS: FITS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.01.03B	EWS: tools	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
2001.01.03C	EWS: applications	0.00	0.17	0.00	0.17	0.00	0.23	0.00	0.23
2001.01.04A	NRTS: infrastructure design	0.00	0.05	0.00	0.05	0.00	0.05	0.00	0.05
2001.01.04B	NRTS: implementation	0.00	0.25	0.00	0.25	0.00	0.25	0.00	0.25
2001.01.04C	NRTS: applications	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01
2001.01.05A	Hardware: detector	0.00	0.15	0.00	0.15	0.00	0.15	0.00	0.15
2001.01.06A	MIDI science	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
2001.02	PRIMA	0.00	0.00	0.03	0.03	0.01	0.00	0.04	0.05
2001.02.01	Tender related	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
2001.02.02	Limiting magnitude	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
2001.02.03	Operating analysis	0.00	0.00	0.03	0.03	0.00	0.00	0.03	0.03
2001.03	Next generation instruments	0.00	0.00	0.09	0.09	0.00	0.00	1.02	1.02
2001.03.01	STJ	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
2001.03.02	Nulling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.03.03	Imaging	0.00	0.00	0.09	0.09	0.00	0.00	0.13	0.13
2001.03.04	IRSI/DARWIN/SMART2	0.00	0.00	0.00	0.00	0.00	0.00	0.87	0.87
2001.04	Instrument calibration	0.23	0.00	0.00	0.23	0.24	0.00	0.00	0.24
2001.04.01	VLTI calibrations plan	0.17	0.00	0.00	0.17	0.17	0.00	0.00	0.17
2001.04.02	VINCI calibrators	0.05	0.00	0.00	0.05	0.06	0.00	0.00	0.06
2001.04.03	MIDI calibrators	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01
2001.04.04	PRIMA calibrators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.04.05	AMBER calibrators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.05	Instrument models	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01
2001.05.01	Atmospheric simulator	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01
2001.05.02	Data simulators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.06	Data format	0.01	0.00	0.00	0.02	0.03	0.00	0.00	0.04
2001.06.01	FITS documents	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02
2001.06.02	FITS library	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01
2001.06.03	VINCI FITS converts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.07	Commissioning	0.43	0.01	0.00	0.44	0.78	0.01	0.00	0.79
2001.07.01	Commissioning: VINCI	0.43	0.00	0.00	0.43	0.78	0.00	0.00	0.78
2001.07.02	Commissioning: MIDI	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01
2001.08	Education	0.03	0.00	0.03	0.07	0.05	0.00	0.05	0.10
2001.08.01	Summer school	0.03	0.00	0.03	0.06	0.03	0.00	0.03	0.06
2001.08.02	Lectures	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.08.03	WWW	0.00	0.00	0.00	0.01	0.02	0.00	0.02	0.04
2001.08.04	PR general	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.09	Algorithms	0.09	0.00	0.09	0.18	0.11	0.00	0.11	0.22
2001.09.01	Fringe tracking	0.09	0.00	0.09	0.18	0.11	0.00	0.11	0.22
2001.09.02	FINITO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.10	Science	0.06	0.00	0.06	0.12	0.72	0.00	0.72	1.44
2001.10.01	Galactic	0.06	0.00	0.06	0.11	0.27	0.00	0.27	0.54
2001.10.02	Extra-galactic	0.00	0.00	0.00	0.01	0.45	0.00	0.45	0.90
2001.11	Development of collaborations	0.01	0.00	0.01	0.01	0.04	0.00	0.04	0.07
2001.11.01	Interfaces	0.01	0.00	0.01	0.01	0.03	0.00	0.03	0.07
2001.11.02	Acquisition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.99	Not NEVEC related	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001.99.01	Other activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	0.99	1.01	0.46	2.46	2.18	1.23	2.24	5.65

12 Appendix D: Abbreviations

Table 30: list of abbreviations.

Abbreviations	Meaning
AMBER	
ASTRON	Stichting Astronomisch Onderzoek in Nederland (NFRA)
AT	Auxiliary Telescope
BOB	
CVS	http://www.cyclic.com/cvs/support
DCS	Detector Control Software
DG	Director General
DJAST	Dutch Joint Aperture Synthesis Team
DRS	
ESA	European Space Agency
ESO	European Southern Observatory
ESTEC	European Space Research and Technology Centre
EWS	Expert Workbench Station
FDR	Final Design Report
FINITO	
FTE	Full Time Equivalent
ICS	Instrument Control Software
ISAC	Interferometry Science Advisory Committee
ISC	Instrument Steering Committee
KO	Kick Off
LOC	Local Organization Committee
MACAO	
MIDI	Mid-Infrared Interferometric Instrument for the VLTI
MoU	Memorandum of Understanding
MPIA	Max-Planck Institute of Astronomy (Heidelberg, Germany)
MT	Management Team
NEVEC	NOVA ESO VLTI Expertise Centre
NIC	NOVA Information Centre
NIVR	
NFRA	Netherlands Foundation for Research in Astronomy (ASTRON)
NOVA	Nederlandse Onderzoekschool Voor Astronomie Netherlands Research School for Astronomy
NRAO	National Radio Astronomy Observatory
NRTS	Near Real-Time System
OLT	Overwhelmingly Large Telescope
OPD	Optical Path Difference
OS	Observation Software
P2PP	
PAP	Planning and Progress
PI	Principal Investigator
POC	Point Of Contact
PRIMA	Phase-Referenced Imaging and Micro-arcsecond Astronometry Facility
PM	Project Manager

PS	Project Scientist
SCUBA	
SOC	Science Organization Committee
SP	Scientific Programmer
SRON	Stichting Ruimteonderzoek Nederland
STJ	Super Tunnel Junction
TAGI	Tactical Advisory Group for Interferometry
TM	Technical Meeting
TNO	Netherlands Organization for Applied Scientific Research
TNO-FEL	TNO Physics and Electronics Laboratory
TNO-TPD	TNO Applied Physics
	MIDI Diagram and Documentation System
TUD	Technical University Delft
UvA	University of Amsterdam
UT	Unit Telescope
VINCI	
VLT	Very Large Telescope
VLTI	Very Large Telescope Interferometry
WP	Work Package

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